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THE STUDY

ON

THE DISASTER REVALIDATION AND RESTORATION PROJECT

IN

SERRA DO MAR COUBATÃO REGION, STATE OF SÃO PAULO

FINAL REPORT

SUMMARY

[redacted]

FEDERATIVE REPUBLIC OF BRAZIL

THE STUDY
ON
THE DISASTER PREVENTION AND RESTORATION PROJECT
IN
SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO

FINAL REPORT

SUPPORTING

JANUARY 1991

JAPAN INTERNATIONAL COOPERATION AGENCY

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1. INTRODUCTION

The socio-economic study has the following three main objectives: (1) clarification of the historical background and present conditions concerning the socio-economic features, characteristics and structure in the study area under the national and state level framework, (2) projection of the future socio-economic trend in the study area in order to identify the project planning conditions and to contribute fundamental information for project evaluation, and (3) supply of basic information to assess the socio-economic impacts which would be influenced by the implementation of the proposed project in the study area.

The socio-economic study was basically made on the basis of socio-economic data and materials collected and presented from the agencies concerned, and through census reports. The socio-economic data, which are indispensable and relevant to the study but are not available, are extrapolated from data available, with due consideration and assumptions in and around the study area.

This annex, which fundamentally provides socio-economy related information to formulate Feasibility Study (F/S) in depth, following Master Plan, is composed of three sections. Section two details the present social and economic conditions including administration, social profile, economic performance, land use and infrastructures. Section three deals with the socio-economic development framework in the future, which are projected on the basis of the several due assumptions set out by the agencies concerned.

2. PROJECT BACKGROUND

2.1 Administration

2.1.1 Administrative organization

Brazil, officially called Federative Republic of Brazil, has been administer by a civilian government through 1980s. With presidential election held in early March 1990, a new package of comprehensive policies called the "Collor Plan" was inaugurated on March 16. In this

plan, the administrative organization of the federal government was drastically reduced in size to 12 ministries from former 23 ministries.

The organization of the state government of São Paulo has been unchanged so far, with seven (7) ministries even under the severe administrative reform policies in federal government. Meanwhile, Cubatão city is being organized with six(6) departments, with assistance from advisory organ.

2.1.2. Administrative division

Brazil has a national territory of 8,511,996 km2, administratively consisting of 24 states, two federal territories and the federal district of Brasilia. It is divided into five Grand Regions; Norte (North) with five states and two federal territories, Nordeste (Northeast) with nine states, Sudeste (Southeast) with four states, Sul (South) with three states, and Centro-oeste (Central West) with three states and the federal district of Brasilia.

The state of São Paulo is included in Sudeste Grand Region, having a state area of 248,256 km^2. Administratively, the state consists of 12 regions; Metropolitan region (Greater São Paulo) and other 11 regions, comprising totally 572 municipalities, 922 districts, 97 sub-districts, and 227 counties.

The study area is located in the southeast of the state of São Paulo and on the costal zone of the Atlantic Ocean. Its area covers 252 km^2, lying across the two regions; Metropolitan and Santos regions. The study area is laid across four administrative municipalities; Cubatão (99.7 km2) in the central part, São Vicente (36.3km^2) to the southwest, São Bernardo do Campo (103.5km^2)to the West, and Santo André (12.5 km2)to the north. Among four municipalities, São Bernardo do Campo and Santo André belong to the Metropolitan region, whereas Cubatão and São Vicente are included in Santos region. The general outline and the administrative division of the study is presented in Table A.1 and on Fig. A.1, respectively.

2.1.3 Authorities concerned

In the former federal governmental organization, the implementing

agency in charge of disaster prevention was previously Departmento Nacional de Obras e Saneamento. However, with an innauguration of the new government, the implementing agency in the federal level has been uncertain because of unsettled responsibilities of each ministry. A responsible executing agency will be nominated to perform disaster prevention works from the national viewpoint, in the near future.

With regard to the disaster prevention in the state level, the Secretaria do Meio Ambiente (SMA), the Secretaria do Energia e Saneamento (Energy and Sanitation), and the Secretaria do Ciencia e Technologia (Science and Technology) are the responsible organs. In particular, the state government has established disaster prevention plans organized by state authorities concerned for such areas with high potential of disaster. These plans aim at prompt information distribution for respective agencies and implementation of urgent countermeasures. So far, the state has formulated comprehensive disaster prevention plans for such municipalities as São Sebastião, Ilha Bela, Caraguatatuba and Ubatuba, which have been under high probable risks of disasters.

As for the region of the Serra do Mar, the state government established a Special Commission in June 1985 under the decree No. 23,457 (June 11, 1985) immediately after the destructive disaster in February 1985. The main objectives of the Commission is to restore the Serra do Mar in order to protect industrial establishments and local residents in Cubatão municipality. The Commission is organized by 17 authorities including state administrations and municipal counsels. Among the authorities concerned, Companhia de Technologia de Saneamento Ambiental (CETESB), Departmento de Aguas e Energia Electrica (DAEE), Instituto de Pesquisas Technologicas do Estado de São Paulo S.A. (IPT) and Instituto de Botanica (IBt) have been the significant institutions under the auspice of SMA.

Moreover, the Cubatão Municipal Civil Defense Commission (COMDEC) was inaugurated in Cubatão cityhall in November 1988. The primary purpose of COMDEC is to implement disaster prevention countermeasures as well as civil defense plan under the cooperation with CETESB, DAEE, IPT and Prefeitura Municipal de Cubatão (PMC).

2.2 Social Profile

2.2.1 Population

According to the 1980 census, Brazil had a population of 119 million. This population is estimated to reach 150 million in 1990 with population density of 17.6 persons/km^2, as shown in Table A.2.

The nation's population in 1990 doubles in the last 30 years from 70 million in 1960. The annual growth rate has gradually slowed down to 2.37 persons/km^2 in 1980s from 2.89 persons/km^2 in 60s and 2.48 persons/km^2 in 70s. The urban population increased 3.6 times to 113 million from 31 million in 1960, with average annual growth rate of 5.22% in 60s, 4.44% in 70s and 3.43% in 80s. Meanwhile, the rural population has stayed at around 37-39 million level except 41 million in 1970. The negative average annual growth rate was recorded at minus(-) 0.63% in 70s and minus(-) 0.25% in 80s.

The population in São Paulo was recorded at 25 million in 1980, accounting for 21.0% of the national population. This population is estimated to be approximately 31 million in 1987 with the average annual population growth of 3.16% in 80s, somewhat greater than that of the nation. The state population density is around 125.4 persons/km^2 in 1987. The urban population is projected at 28 million in 1987, which accounts for 90.6% of the state total population. That population increased by 20 million in 30 years, between 1960 and 1987, whereas the rural population decreased by 1.9 million in the same period.

The population in Cubatão municipality was estimated at 79,162 in 1980, which is assumed to represent the total population in the study area since the rest of the area except in Cubatão in the study area has been covered with dense forest, shrub and bushes with almost no inhabitants. The municipal population is estimated at 105,547 in 1990. The average annual growth rate has been greater than that of the state as well as the nation; 4.49% in 70s and 2.92% in 1980s. In particular, owing to rapid industrialization during 1960s, the population of 25,166 in 1960 almost doubled to 51,009 in 1970, recording the average annual growth rate of 7.32%.

The population in the study area is estimated at 97,543 in 1990,

distributing as follows: 97,039 in Cubatão, 504 in São Bernardo do Campo, and no inhabitants in both São Vicente and Santo Andre.

The population density of Cubatão in 1980 was 345.6 persons/km^2 and 713.1 persons/km^2 in 1990. The urban population occupied 73.0% in 1970, and that population has accounted for the whole municipal population since 1980. The population density in the study area is estimated at about 387 persons/km^2 on average. The density in the urban area, is 2,813 persons/km^2, and the density in the rural area is 387 persons/km^2. In Cubatão, the population density in urban area is 2,813 persons/km^2, and the average density is 973 persons/km^2.

2.2.2 Labor force

The economically active population in Brazil (defined as persons aged 10 years and over) increased 1.8 times to 87.7 million in 1980 from 48.7 million in 1960, with an average annual growth rate of 3.03% in 60s and 2.93% in 70s. This population is projected to have reached 104.3 million in 1987 as shown in Table A.2. The proportion of the economically active population to the total population has gradually increased from 69.9% in 1960, 70.5% in 1970 and 73.7% in 1980, respectively.

On the other hand, Brazil's labor force grew from 22.8 million in 1960 to 59.5 million in 1987. Labor force participation rate, defined as the rate of the labor force to the economically active population had stayed at less than 50% level till 1980. It registered at 57.1% in 1987.

As far as the labor force by industrial group is concerned, the agricultural sector absorbed 12.4 million or 54.5% of the total labor force in 1960, followed by services sector; 33.1%, and industrial sector, 12.4%. With rapid economic expansion and industrialization, the structure of the labor force in Brazil has drastically changed into that of the developed economics. The labor force in the agricultural sector inched up by 1.7 million to 14.1 million in 1987, whereas the percentage distribution sharply dropped to 23.7% in the same year, as shown in Table A.3.

The industrial sector employed 2.8 million or 12.4% of the labor force in 1960. This sector has increased to absorb a large share of the

labor force; 5.3 million in 1970 and 10.8 million in 1980, with an average annual growth rate of 6.54% in 60s and 7.36% in 70s. In 1987, this sector registered at 13.7 million, almost equivalent to the agricultural sector.

The services sector, which has been the largest single employer of the labor force, absorbed 7.5 million in 1960, 11.0 million in 1970, 18.8 million in 1980 and 29.6 million in 1987. The percentage distribution of this sector increased to around 50% in 1987 from 33.1% in 1960. The average annual growth recorded at 3.81% in 60s, 5.57% in 70s and 6.68% between 1980 and 1987.

In São Paulo, the economically active population recorded at 9.3 million in 1960, which has increased 2.6 times to 24.4 million in 1987. The proportion of the economically active population to the state total registered at 72.2% in 1960, 75,0% in 1970, 77.2% in 1980 and 77.9% in 1987, somewhat larger than that of the nation.

The state labor force in 1960 recorded at 4.5 million with labor participation rate of 48.5%. This labor force has increased to 6.4 million in 1970, 10.4 million in 1980 and 14.2 million in 1987. The average annual growth rate recorded 3.50% in 60s, 5.03% in 70s and 4.58% between 1980 and 1987, more than 1% higher than the federal figures. The labor participation rate in São Paulo has been around 2% higher than the nation; 48.5% in 1960, 47.8% in 1990, 53.9% in 1980 and 58.8% in 1987.

With regard to the labor force by industrial group, the structure of the state is markedly different from that of the nation. The agricultural sector registered at 1.4 million in 1960, or 31.8% of the labor force. An absolute labor force in this sector decreased to 1.2 million in 1987, with sharp decline to the share of 8.5% in the same year, as shown in Table A.4.

The industrial sector absorbed 1.0 million, or 23.3% in 1960. The labor force in this sector increased 2.0 million in 1970, 4.0 million in 1980 and 4.9 million in 1987. This sector, in 1987, occupied around one-thirds of the state labor force and approximately the same percentage share (35.5%) of the nation's labor force engaged in the industrial sector.

The services sector, which has been the largest employer of the labor force in the state, registering 2.0 million (44.0%) in 1960, 3.1 million (48.1%) in 1970, 5.1 million (48.6%) and 7.5 million (52.9%) in 1987. In 1987, the labor force in this sector approximately accounted for one-fourth (25.5%) of the same sector in Brazil.

The demographic structure in Cubatão has been almost similar to that of the nation. The proportion of the economically active population to the municipal total posted at 69.8% in 1970, 74.8% in 1980 and 72.1% in 1987. The labor force doubled to 31,576 in 1980 from 15,822 in 1970, with labor participation rate of 44.5% and 53.4%, respectively. However, this labor force has not been revealed in recent years.

2.3 Economic Performance

2.3.1 Gross domestic product

Gross Domestic Product (GDP) in 1988 was Cr$ 91,952 million (US$ 279.5 billion), as shown in Table A.5. GDP in 1989 would be approximately estimated at Cr$ 1,366 billion (US$ 303.5 billion). With chronic inflation in the economy, GDP at current prices increased astronomically in the last two decades. In real terms, GDP grew rapidly in 1970s, Cr$ 5,419 million in 1970, Cr$ 8,756 million in 1975, and Cr$ 12,402 million in 1980 at 1980 constant prices. In particular, the annual growth rate in early 1970s recorded more than 10% as a result of rapid industrialization; 11.3% in 1971, 11.9% in 1972, 14.0% in 1973.

During the recession in 1981-83 when the national economy was afflicted by a foreign debt crisis, the GDP growth rate was minus(-) 4.4% in 1981, 0.7% in 1982, and minus(-) 3.4% in 1983, respectively. Afterwards, in the last half of 1980s, the economy has recovered from the recession except in 1988 in which no real growth was recorded in real terms.

Per capita GDP would be provisionally Cr$ 9,270, equivalent to US$ 2,059 in 1989. In real terms, it grew at 1.5% over the previous year in which the real per capita GDP was recorded at minus(-) 2.0%. Per capita GDP has almost kept pace with GDP growth, some 2% less than the growth rate of GDP.

With regard to GDP by industrial origin, the agricultural sector accounted for only 11.6% in 1970, which gradually decreased to 10.2% in 1980 and 7.6% in 1986, as shown in Table A.6. The industrial sector expanded to 40% share in 1975 from 35.8% in 1970 owing to rapid industrialization. This sectoral share diminished slightly to 38.7% in 1985 and continued in the same level of 37.9% in 1988. The services sector has contributed significantly to the national economy as the backbone before industrialization era in 1970s. This sector has accounted for more than 50% of GDP in every period except for 48.8% in 1975 and 49.2% in 1980 since rapid expansion in the industrial sector caused to decrease its relative share.

2.3.2 Gross regional domestic product

Gross Regional Domestic Product (GRDP) in the state of São Paulo was Cr$ 5,280 thousand in 1980, Cr$ 574 million in 1985 and Cr$ 42.2 billion in 1988, respectively, as shown in Table A.7. In real terms, GRDP was Cr$ 5,280 thousand, Cr$ 5,629 thousand and Cr$ 6,268 thousand at 1980 constant prices, respectively. The real growth rate was 7.0% in the last half of 1970s supported by active regional economy, and 2.2% between 1980 and 1988.

Regarding GRDP by industrial origin, the agricultural sector has been quite low; 5.7% in 1970, 5.0% in 1975, and 3.8% in 1980 as shown in Table A.8. On the other hand, the industrial sector and the services sector has significantly contributed to the regional economy. The share of the industrial sector rose up to 48.2% in 1980 from 43.9% in 1970, with an average annual growth rate of 10.03% in 1970-75 and 9.03% in 1975-80. The share of the services sector declined slightly to 48.0% in 1980 from 50.4% in 1970. The average annual growth rate was high similar to that of the industry; 10.19% in 1970-75 and 6.03% in 1975-80.

Per capita GRDP was Cr$ 0.179 in 1975, Cr$ 0.207 in 1980 and Cr$ 0.198 in 1988 at 1980 constant prices. Thus, comparing with the national per capita, the regional per capita has been remarkably high; 2.21 times of the per capita GDP in 1975, 2.03 times in 1980 and 1.96 times in 1988. Meanwhile, GRDP has accounted for more than approximately 40% of GDP; 42.9% in 1975, 42.6% in 1980 and 45.9% in 1988.

2.3.3 Economic performance in study area

The nation's largest industrial complex, which has been established mostly since 1950, is located in the north along arterial roads in Cubatão municipality, as depicted in Fig. A.2. Its main products are petroleum and petrochemical products, iron steel, chemical and mixed fetilizers, cement and so on.

Volume and value of production by major industrial establishments since 1971 are enumerated in Table A.9 and A.10, respectively. Volume of production almost quadrupled to 17.9 million tons in 1988 from 4.5 million in 1971. Value of production, which amounted to Cr$ 2,883 in 1971, increased to Cr$ 700 million in 1988. In comparing with the state, production value from 131 manufacturing establishments in Cubatão stood at Cr$ 15,625 in 1975, which accounted for 3.6% of the state total production value, as shown in Table A.9. Its share climbed to 5.9% in 1980, valuing at Cr$ 298 thousand. By industrial sector, production value in chemistry produced around two-thirds of the total in Cubatão, 65.1% in 1975 and 64.2% in 1980. Its contribution of chemical sub-sector to the state output posted 15.6% in 1975 and 21.1% in 1980, respectively.

With regard to type of establishment, industrial establishments totalled 152, commercial and services, 1,473; and others, 201 in 1988, respectively, as shown in Table A.12. According to the municipal information, there were 752 commercial establishments, distributed in 50 retail and 702 wholesale, and 520 services establishments in 1986, as shown in Table A.13. On the other hand, residential housing has been growing steadily in parallel with population growth. In 1988, housing units numbered 17,476.

2.3.4 Prices

The whole country has been suffering from rampant inflation over the last decades, as shown in Table A.14. The annual inflation rate has been accelerating since 1980 except in 1986, when the so-called "Cruzado Plan" was introduced in February 1986 to eliminate internal inflationary pressure, posting 77.2% over the previous year. Recent inflation has been a serious aspect of the national economy, recording 395% in 1987, and 934% in 1988.

In January 1989, "New Cruzado" was denominated as a new currency in hoping for staving off chronic hyper-inflation. Even with new monetary measures, the Consumer Price Index jumped 1765% in 1989. This phenomenon continued until promulgation of new stringent economic measures named "Collor Plan" announced in March 1990. With this new economic package, the country's currency was denominated as "Cruzeiro" on a one-to-one basis with the old currency. Since then the inflation seems to have been moderated under the severe price control on foodstuff in particular; 84.3% in March, 44.8% in April, 7.9% in May, 9.6% in June, and 12.6% in July.

In the state of São Paulo, the Consumer Price has risen by 380% in 1987, 922% in 1988 and 1,785% in 1989. It continued to grow at 74.5% in January, 70.2% in February, 79.1% in March, 20.2% in April this year. This gain in Consumer Price Index seems to be tapered off afterward, posting 8.9% in May, 11.7% in June and 11.3% in July.

Table A.14 also shows GDP implicit deflator, index of real GDP and foreign exchange rate between local currency and US dollar since 1970. GDP implicit deflator has jumped around 90,310 times by the end of 1989 over the last 10 years since 1980, in parallel with hyperinflation nationwide. Real GDP, however, has climed 22.1% with an average annual growth rate of 2.02% in the same period, although real GDP between 1981 and 84 was deteriorated below 1980 level.

The foreign exchange rate of Cr$ 0.000064 to US dollar in 1980 was drastically devaluated around 176,600 times standing at Cr$ 11.302 at the end of 1989. This rate again jumped from Cr$ 17.643 in January to Cr$ 60.735 in June 1990 at the official rate basis. Since January 1989, a dual exchange rate was introduced in the monetary market: one being the official rate and the other called the tourist rate which is applicable only to tourists.

2.4 Land Use in Study Area

2.4.1 Present land use

No land use maps for any of the municipalities in the study area. Therefore, in this study, a land use map of the study area was compiled

on the basis of topographic maps (1 : 5,000), and aerial and infrared photographs taken by the study team in 1989, which are shown in Fig. 3.

The land use is primarily classified into four categories: (1) Built-up area of urban activities, (2) Industrial area, (3) Grassland, and (4) Forest and bush.

From the above classification, the total land of 252 sq.km in the study area is currently categorized as follows: (1) 34.5 sq.km (13.7%) of the total land is used for built-up area, (2) 22.9 sq.km (9.1%) is for industrial area, (3) 18.3 sq.km (7.2%) is for grassland; and (4) 176.3 sq.km (70.0%) is for forest and bush. By municipality, the total area of 99.7 sq.km in Cubatão is used as follows: 34.5 sq.km (34.6%) is built-up area, (2) 22.9 sq.km (23.0%) is industrial area, (3) 11.8 sq.km (11.8%) is grassland, and (4) 30.5 sq.km (30.6%) is forest and bush. In São Vicente, the whole area of 36.3 sq.km is classified into forest and bush. On the other hand, the total lands in São Bernardo do Campo and Santo André are used only for grassland, and forest and bush: 5.0 sq.km (4.8%) for grassland, and 98.5 sq.km (95.2%) for forest and bush in São Bernardo do Campo; and 1.5 sq.km (12.0%) for grassland, and 11.0 sq.km (12.0%) for forest and bush in Santo André.

2.4.2 Urbanization

The population in Cubatão municipality grew to 51,009 in 1970 from 25,166 in 1960 with an average annual rate of 7.32%, more than twice as much as the state average of 3.33% in the same period. A large number of people seeme to have settled in rural areas in 1960s, although no detailed records have distinguished the urban and rural classification.

According to the municipal information, the urban and rural population was 37,255 (73.0%) and 13,754 (27.0%) in 1970, respectively, as shown in Table A.2. The population in the municipality increased from 28,153 to 79,162 in 1980. On the other hand, urban population jumped 41,314 to 78,569, almost 1.5 times of the population increase. This means that the increase in population had been completely absorbed in the urban areas and that a large part of the rural population had migrated into the urban areas, as observed. This is confirmed partly by the fact that most of the rural residents who have settled illegally on

steep hillside have been resettled in new residential areas provided by the municipality. In 1990, municipal data shows that all the population inhabits the urban areas, although some rural squatters still reside on mountain sides subject to landslide risks.

2.4.3 Industrialization

Brazil's industrialization, which started in the 19th century, accelerated in the 1920s and 30s and continued in the following decades. In the 1950s, various manufacturing establisments began operation in rapid succession. They varied production from durable consumer goods, capital goods to intermediate products such as steel, petro-chemical products, rubler, paper and so forth.

In accordance with rapid industrialization nationwide, industrial development in Santos region began in two stages since the 1940s. In the first stage, food processing industries aiming at consumption only in Santos arose, followed by intermediate product producing industries such as paper, grass, and fertilizer for other regions. During this era, arterial transportation system linking Santos and other major cities, in particular, São Paulo was developed.

The second stage started in the early 1950s, when intermediate products came into full production for consumer industries as well as public facilities such as transportation and power stations. Supported by the federal policy aiming at self-sufficiency in domestic oil consumption, large scale petroleum refinery plants were constructed in Cubatão in the close vicinity of Santos which had large port facilities. In addition to the above reason, such key facilities as power stations, roads and railroads for industrial operation are already fully developed in Cubatão. Furthermore, Cubatão is topographically located at a strategic point as a center of industrial evolution between São Paulo as a consumption market, and Santos for import and export of materials, commodities and products. For these reasons, major heavy manufacturing industries which produce petroleum, petro-chemical products, steel, fertilizers etc. have been set up since the middle of the 1950s. Thus an agglomeration of manufacturing establishments constituting an industrial complex has been created.

2.5 Infrastructure

2.5.1 Economic infrastructure

In the study area, there are four arterial highways maintained by the state government, SP-150 or Anchieta runs through the west of the center in Cubatão, interconnecting São Paulo to the North via São Bernardo do Campo and Santos to the South. SP-160 or Imigrantes, which is located in the west in almost parallel with the Anchieta, also runs North and South, connecting São Paulo and São Vicente to the South. SP-140 or Piaçaguera runs East and West, connecting with the Anchieta at an interchange in the North of the municipal center. SP-148 or Caminho do Mar runs north and south connecting São Paulo and Cubatão.

The traffic volume via Anchieta was recorded at 4.3 million in 1972, divided into 3.3 million of passenger cars, 1.0 million of trucks and buses. In 1989, it decreased to approximately 3.8 million due to opening of Imigrantes highway in 1974; 2.9 million or 76% for passenger cars and 0.9 million or 24% for trucks and buses.

The traffic volume through Imigrantes was recorded at 2.3 million in 1974, distributed 1.9 million of passenger cars and 0.4 million of trucks and buses. In 1989, the volume increased to 6.1 million as distributing: 5.2 million of passenger cars and 0.9 million of trucks and buses. The traffic volume through Piacaguera was recorded at 4.2 million in 1972; 2.5 million of passenger cars and 1.7 million of trucks and buses. In 1989, the volume was 6.8 million, distributing as follows: 3.6 million of passenger cars and 3.2 million of trucks and buses.

The total road length in Cubatão municipality was around 83 km in 1988, including municipal roads of 24.6 km and industrial use. Of the municipal roads, 6,950 m or 28.3% are covered with asphalt paving, 6,500 m or 26.4% are mixed roads paved with cobblestones or flagstones, and 11,150 m or 45.3% still remains unpaved.

Other infrastructures in Cubatão are provided and maintained by their respective agencies. All residences are supplied with municipal water by SABESP, whereas the sewerage system covers only 1% of the total. In 1988, around 75% of the residences are covered by the electric

supply by ELETROPAULO. Meanwhile, only 15% of the residences subscribed to a telephone system in 1986.

2.5.2 Social infrastructure

According to the municipal information, there are 78 educational facilities in Cubatão, distributed as follows: 11 nursery schools/kindergartens, 20 first and secondary grade schools, 3 universities/colleges, and 44 miscellaneous schools. Regarding medical facilities, 3 hospitals and 11 clinics are situated. Cubatão municipality has 82 churches and 64 public facilities including a city hall and an assembly hall. These facilities are enumerated in Table A.17.

No social infrastructures exist in the other three municipalities in the study area: São Vicente, São Bernardo do Campo and Santo Andrę since these three municipalities are covered with deep forest, bush and grassland.

3. PROJECTION OF FUTURE DEVELOPMENT FRAMEWORK

3.1 Target of Projection

The primary objective of the study is to formulate Feasibility Study up to the middle of 1990s for the priority project selected among the Master Plan, in which disaster prevention measures for the study area will be materialized in line with the viable regional framework. The direct tangible benefits from the project will be considered to be economic effects being accrued from the reduction of the disaster damages in the study area.

The study area, in particular, Cubatão municipality, has been still developing rapidly in recent years, and will be more urbanized and industrialized in years to come than in the past. This economic growth in the municipality, which will contribute to the regional economy more significantly, will enhance an increase of various economic and industrial assets as well as social welfare. At the same time, this enchancement will also increase the damageable assets which are subject to the future possible disasters.

With due consideration of the above in this study, the project benefits are estimated under the socio-economic projection in the future regional framework, based on the present conditions explained in the previous section. The future regional development framework is assumed from three components: (1) current development plan, (2) socio-economic projection, and (3) land use plan in the study area. Of the above, the future socio-economic framework is projected up to the year 2020 and assumed to be constant for the period over the year 2020 owing to data availability and uncertainty in the far future.

3.2 Development Plan

The nation's economic development has been led by the so-called "New Cruzado Plan", promulgated in June 1987, directed by the former government. This plan aimed at staving off rampant hyperinflation nationwide as well as enhancing economic growth of around 7% per annum in early 1990s. However, with initial failure in undertaking this plan, the national economy was depressed with no real growth in 1988 and provisional 3.6 % in 1989.

The new government innaugurated in the middle of March 1990 introduced the new economic plan called the "Collor Plan". This Plan primarily focuses on eradicating inflation by introducing shrinkage in financial accounts, a wage and price freeze and new taxes. It also aims at reshaping domestic economy by privatization of the country's state enterprises and undertaking administrative reforms. However, a definite development plan under the new administration has not worked out yet.

In the state level, the state government has not established a concrete development plan in the territory of the state. In the study area, Cubatão municipality has envisage future zoning plans which intend to lead to desirable municipal land use. These plans are mainly based on the present land use and will show the future direction of urbanization and industrialization. However, the implementation schedule and shemes, which may include resettlement of some inhabitants in planed zones, have not set out so far.

3.3 Socio-economic Projection

3.3.1 Population and labor force

Brazil's future population is projected by IBGE up to the year 2000 by state as shown in Table A.18. The country's population beyond the year 2000 is estimated with the annual growth rate of 1.5% between 2000 and 2010, and 1.2% between 2010 and 2020. Similarly, the population in the state of São Paulo is projected with the annual growth of 1.7% during 2000-2010, and 1.5% during 2010-2020. The municipal population in Cubatão is estimated at 135,100 in 2000, 164,700 in 2010, and 194,900 in 2020, based on the population of 105,547 in 1990.

The economically active population in Brazil is assumed to account for 75% of the total population beyond the year 2000, from the percentage share of 74.7% in 1990. Meanwhile, the economically active population in São Paulo is projected in proportion of 80% to the state population based on the share of 80.7% in 1987. This population in the municipality of Cubatão is similarly assumed at 75% over the projected period up to the year 2020.

The labor force participation is assumed at 62.5% in year 2000, 65.0% in 2010, and 67.5% in 2020 for Brazil, the state of São Paulo and Cubatão municipality.

3.3.2 Economic growth

With the onset of the new economic plan introduced in March 1990, it is hard to project the prospective future economic growth of the country. However, the stringent economic policies imposed by this plan are expected to undermine the economic growth at least in the short run. According to the projection by CNPq, the country's economic growth in real terms is estimated at 2% for 1990-92, 5% for 1993-2000, and 7% for 2000-2010. In this study, however, the real economic growth of GDP is conservatively projected at 3.0% over the period between 1990 and 2000, and 2.0% beyond the year 2000. With this assumption, the future GDP is estimated at Cr$ 1,877 billion in 2000, Cr$ 2,288 billion in 2010, and Cr$ 2,789 billion in 2010, as shown in Table A.19, based on the 1989 constant prices.

The GRDP of the state of São Paulo is projected to account for 42.0% of the nation's GDP at 1989 constant prices, based on the percentage share of 42.6% in 1980. The GRDP is estimated as follows: Cr$ 573.9 billion in 1989, Cr$ 788.2 billion in 2000, Cr$ 960.9 billion in 2010, and Cr$ 1,171.3 billion in 2020.

3.4 Land Use Plan

Population and regional economy in the study area is expected to increase at comparatively high speed as explained in section 3.3, although its pace is assumed to be lower in the future than in the past. To cope with the population increase and spacial constraint, in particular the residential area, the municipality envisages a future land use plan dividing each area for specific purposes.

Regarding the built-up area in the Cubatão municipality, Vila Natal to the West of the municipal center and Casqueiro to the South along the Anchieta highway are planned to be used for exclusively residential use. The municipality is also planning to use the mangrove area lying to the South along the coastal line as a resettlement residential zone for those specifically who are residing in dangerous mountain area and Vila Nova area.

Along the resettlement program in Vila Nova area where urban squatters are settling today, the municipally is planning this area for industrial use, in particular for maintenance and services for industrial establishments. The municipality is also projecting a low elevation zone lying in the opposite side of COSIPA for the metal processing industry.

These future land use plan envisaged by the municipality an shown in Table A.4. The municipality, in general, is planning the North and East areas for industrial use, the South for exclusively residential use, and the central zone for business, commerce and services, as well as for administrative use as today.

LIST OF REFERENCES AND DATA COLLECTED

No.	TITLE	ISSUED ON	ISSUED BY
A01	ESTATÍSTICAS HISTÓRICAS DO BRASIL	1550-1988	IBGE
A02	ANUÁRIO ESTATÍSTICO DO BRASIL	1989	IBGE
A03	BRASIL PROGRAMA ECONÔMICO	1990	Banco Central do Brasil
A04	BOLETIM MENSAL	ABRIL/90	Banco Central do Brasil
A05	RELATÓRIO	1989	Banco Central do Brasil
A06	CENSO INDUSTRIAL - BRASIL	1960	IBGE
A07	CENSO INDUSTRIAL - BRASIL	1970	IBGE
A08	CENSO INDUSTRIAL - BRASIL	1980	IBGE
A09	CENSO DEMOGRÁFICO - BRASIL	1960	IBGE
A10	CENSO DEMOGRÁFICO - BRASIL	1970	IBGE
A11	CENSO DEMOGRÁFICO - BRASIL	1980	IBGE
A12	CENSOS DOS SERVIÇOS - BRASIL	1960	IBGE
A13	CENSOS DOS SERVIÇOS - BRASIL	1970	IBGE
A14	CENSOS DOS SERVIÇOS - BRASIL	1980	IBGE
A15	CONJUNTURA		FGV
A16	ANUÁRIO ESTATÍSTICO DO BRASIL	1989	IBGE
A17	ANUÁRIO ESTATÍSTICO DO ESTADO DE SÃO PAULO	1988	SEADE
A18	PESQUISA NACIONAL POR AMOSTRA DE DOMICÍLIOS	1980	IBGE
A19	PESQUISA NACIONAL POR AMOSTRA DE DOMICÍLIOS	1985	IBGE
A20	PESQUISA NACIONAL POR AMOSTRA DE DOMICÍLIOS	1987	IBGE
A21	CENSO INDUSTRIAL - SÃO PAULO	1960	IBGE
A22	CENSO INDUSTRIAL - SÃO PAULO	1970	IBGE
A23	CENSO INDUSTRIAL - SÃO PAULO	1980	IBGE
A24	CENSOS ECONÔMICOS - CENSO INDUSTRIAL SÃO PAULO	1975	IBGE
A25	CENSO DEMOGRÁFICO - SÃO PAULO	1960	IBGE
A26	CENSO DEMOGRÁFICO - SÃO PAULO	1970	IBGE
A27	CENSO DEMOGRÁFICO - SÃO PAULO	1980	IBGE

(to be continued)

(Continuation)

A28	CENSO DOS SERVIÇOS - SÃO PAULO	1960	IBGE
A29	CENSO DOS SERVIÇOS - SÃO PAULO	1970	IBGE
A30	CENSO DOS SERVIÇOS - SÃO PAULO	1980	IBGE
A31	CENSO COMERCIAL - SÃO PAULO	1960	IBGE
A32	CENSO COMERCIAL - SÃO PAULO	1970	IBGE
A33	CENSO COMERCIAL - SÃO PAULO	1980	IBGE
A34	INDICADORES DO DESEMPENHO ECONÔMICO DAS REGIÕES DE GOVERNO E DOS MUNICÍPIOS	1987	SINERG
A35	INDICADORES DA EVOLUÇÃO SÓCIO ECONÔMICO DO ESTADO DE SÃO PAULO	1985	SINERG
A36	SÃO PAULO	1990	SEADE

TABLES

TABLE A.1 GENERAL OUTLINE OF STUDY AREA

Item	Municipality				Total
	Cubatao	San Vicente	Sao Bernardo do Campo	Santo Andre	
1. Administrative Area(sq.km)					
- Urban Area	34.5	-	-	-	34.5
- Rural Area	65.2	36.3	103.5	12.5	217.5
Total	99.7	36.3	103.5	12.5	252.0
2. Population (1980) *1					
- Urban Population	72,237	-	n.a	-	72,237
- Rural Population	545	-	"	-	545
Total	72,782	-	"	-	72,782
3. Population (1990)					
- Urban Population	97,039	-	-	-	97,039
- Rural Population	-	-	504	-	504
Total	97,039	-	504	-	97,543
4. Population Growth Rate (%)					
- Urban Population	3.0	-	-	-	3.00
- Rural Population	-	-	-	-	-0.79
5. Population Density (1990) *2 (persons/sq.km)					
- Urban Area	2,812.7	-	-	-	2,812.7
- Rural Area	-	-	4.9	-	2.3
Total	973.3	-	4.9	-	387.1
6. Number of Establishments *3					
- Agriculture	-	-	55	-	55
- Industry	152	-	20	-	172
- Commerce $ Services	1,473	-	30	-	1,503
- Others	201	-	20	-	221
Total	1,826	-	125	-	1,951

Source : Boletim Informativo,1988: PMC
Boletim Informativo,1989: PMC

Remarks : *1 Estimated on the basis of the annual growth rate and municipal population.
*2 Population density is estimated on the basis of the built-up area.
*3 Representing total establishments in the Cubatao in 1988 and estimated on the basis of aerial photos in Sao Bernardo do Campo.

TABLE A.2 POPULATION GROWTH AND LABOR FORCE

Item	Population				Average Annual Growth Rate (%)		
	1960	1970	1980	1990(87)	'60-'70	'70-'80	'80-90(87)
(1) BRAZIL							
1. Population	70,070,457	93,139,037	119,002,706	150,367,841	2.89	2.48	2.37
2. Male	35,055,457	46,331,343	59,123,361	74,992,111	2.83	2.47	2.41
3. Female	35,015,000	46,807,694	59,879,345	75,375,730	2.95	2.49	2.33
4. Urban	31,303,034	52,084,984	80,436,409	112,743,732	5.22	4.44	3.43
5. Rural	38,767,423	41,054,053	38,566,297	37,624,109	0.57	-0.63	-0.25
6. Economically Active	48,740,564	65,683,745	87,677,224	(104,311,844)	3.03	2.93	2.51
7. Labor Force	22,750,100	29,557,224	43,235,712	(59,542,958)	2.65	3.88	4.68
8. Labor Force Participation(%)	46.7	45.0	49.3	57.1	-0.37	0.92	2.12
(2) Sao Paulo							
1. Population	12,809,231	17,771,948	25,040,772	(31,124,350)	3.33	3.49	3.16
2. Male	6,480,421	8,931,360	12,519,890	(15,416,521)	3.26	3.49	3.02
3. Female	6,328,810	8,840,588	12,520,882	(15,707,829)	3.40	3.54	3.29
4. Urban	8,019,743	14,276,239	22,196,378	(28,202,067)	5.94	4.51	3.48
5. Rural	4,789,488	3,495,709	2,844,334	(2,922,283)	-3.20	-2.08	0.27
6. Economically Active	9,308,538	13,334,701	19,327,707	(24,231,757)	3.66	3.78	3.28
7. Labor Force	4,517,600	6,372,842	10,411,726	(14,249,629)	3.50	5.03	4.58
8. Labor Force Participation(%)	48.5	47.8	53.9	58.8	-0.15	1.21	1.25
(3) Cubatao							
1. Population	25,166	51,009	79,162	105,547	7.32	4.49	2.92
2. Male	-	27,342	43,208	58,950	-	4.68	3.16
3. Female	-	23,667	35,954	46,597	-	4.27	2.63
4. Urban	-	37,255	78,569	105,547	-	7.75	3.00
5. Rural	-	13,754	593	0	-	-37.0	-
6. Economically Active	-	35,598	59,177	(76,571)	-	5.21	3.75
7. Labor Force	-	15,822	31,576	-	-	7.15	-
8. Labor Force Participation(%)	-	44.5	53.4	-	-	1.86	-

Source : Anuario Estatistico do Brasil 1989: IBGE
Estatisticas Historicas do Brasil 1988: IBGE
Anuario Estatistico do Estado de Sao Paulo 1988: IBGE
Boletim Informativo de Cubatao: P.M.C
Secretaria de Ciencia, Tecnologia e Desenvolvimento Economico

Remark : *1 Quated in 1990 are projected population.
*2 Figures in parentheses are projected data in 1987.
*3 Economically active population is defined as persons aged 10 years and over.
*4 (7)/(6)

TABLE A.3 LABOR FORCE BY INDUSTRIAL GROUP IN BRAZIL

Industrial Group	Number of Persons				Percentage Distribution (%)				Average Annual Growth Rate (%)		
	1960	1970	1980	1987	1960	1970	1980	1987	'60-'70	'70-'80	'80-'87
Agriculture	12,408,299	13,090,358	12,661,017	14,116,115	54.5	44.3	29.3	23.7	0.54	-0.33	1.57
Industry	2,809,317	5,295,427	10,772,463	13,674,775	12.4	17.9	24.9	23.0	6.54	7.36	3.47
- Manufacturing	-	-	6,939,421	9,005,076	-	-	16.1	15.1	-	-	3.79
- Construction	-	-	3,171,046	3,813,384	-	-	7.3	6.4	-	-	2.67
- Others	-	-	661,996	856,315	-	-	1.5	1.5	-	-	3.75
Services	7,532,412	10,952,684	18,838,046	29,619,085	33.1	37.1	43.6	49.7	3.81	5.57	6.68
- Commerce	1,486,797	2,263,539	4,037,917	6,655,291	6.5	7.7	9.3	11.2	4.29	5.96	7.40
- Transportation & Communication	1,056,227	1,244,395	1,800,243	2,161,421	4.6	4.2	4.2	3.6	1.65	3.76	2.65
- Other Services	4,989,388	7,444,750	12,999,886	20,802,373	21.9	25.2	30.1	34.9	4.08	5.73	6.95
Not specified	-	218,755	964,186	2,132,983	-	0.7	2.2	3.6	-	15.99	12.01
Total	22,750,028	29,557,224	43,235,712	59,542,958	100.0	100.0	100.0	100.0	2.65	3.88	4.68

Sources : Anuario Estatistico do Brasil, 1989: IBGE
Estatisticos Historicos do Brasil, 1988: IBGE

TABLE A.4 LABOR FORCE BY INDUSTRIAL GROUP IN STATE OF SÃO PAULO

Industrial Group	Number of Persons				Percentage Distribution (%)				Average Annual Growth Rate			% Share to Brazil in 1987 (%)
	1960	1970	1980	1987	1960	1970	1980	1987	'60-'70	'70-'80	'80-'87	
Agriculture	1,436,537	1,277,335	1,175,002	1,211,842	31.8	20.0	11.3	8.5	-1.18	-0.84	0.44	8.6
Industry	1,053,310	1,998,924	3,998,442	4,858,716	23.3	31.4	38.4	34.1	6.62	7.18	2.82	35.5
- Manufacturing		1,476,422	3,068,936	3,828,443	-	23.2	29.5	26.9	-	7.59	3.21	42.5
- Construction		460,346	795,313	903,402	-	7.2	7.6	6.3	-	5.62	1.84	23.7
- Others		62,156	134,193	126,871	-	1.0	1.3	0.9	-	8.00	-0.80	14.8
Services	1,988,489	3,062,354	5,062,567	7,538,824	44.0	48.1	48.6	52.9	4.41	5.16	5.85	25.5
- Commerce	405,714	627,175	1,102,525	1,733,880	9.0	9.9	10.6	12.2	4.45	5.80	6.68	26.1
- Transportation & Communication	280,932	351,040	486,319	598,180	6.2	5.5	4.7	4.2	2.25	3.31	3.00	27.7
- Other Services	1,301,843	2,084,139	3,473,723	5,206,764	28.8	32.7	33.3	36.5	4.82	5.24	5.95	25.0
Not specified	39,264	34,229	175,715	640,247	0.9	0.5	1.7	4.5	-1.38	17.77	20.29	30.0
Total	4,517,600	6,372,842	10,411,726	14,249,629	100.0	100.0	100.0	100.0	3.50	5.03	4.58	23.9

Sources : Senso Demografico, 1960: IBGE
Senso Demografico, 1970: IBGE
Senso Demografico, 1980: IBGE
Pesquisa Nacional por Amostra de Domicilio, 1987: IBGE

TABLE A.5 GROSS DOMESTIC PRODUCT

Year	Gross domestic Product				Gross Domestic Product per Capita			
	Current Price (Cr$ 1,000)	Constant Price at 1980(Cr$1,000)	Annual Growth Rate (%)	Current Price (US$ million)	Current Price (Cr$)	Constant Price at 1980(Cr$)	Annual Growth Rate (%)	Current Price (US$)
1970	194	5,419	-	34,034	0.002	0.057	-	355.18
1971	258	6,037	11.3	39,529	0.003	0.061	8.7	402.43
1972	347	6,754	11.9	45,704	0.003	0.067	9.3	454.21
1973	512	7,698	14.0	55,329	0.005	0.074	11.3	536.91
1974	745	8,326	8.2	66,403	0.007	0.079	5.7	629.32
1975	1,050	8,756	5.2	76,219	0.01	0.081	2.7	705.52
1976	1,634	9,654	10.3	88,896	0.01	0.087	7.6	803.78
1977	2,493	10,130	4.9	99,342	0.02	0.089	2.5	877.53
1978	3,617	10,634	5.0	112,205	0.03	0.092	2.5	968.46
1979	5,961	11,352	6.8	133,338	0.05	0.096	4.3	1,124.71
1980	12,402	12,402	9.2	165,264	0.10	0.102	6.8	1,362.60
1981	24,654	11,859	-4.4	174,334	0.20	0.096	-6.6	1,405.15
1982	51,025	11,939	0.7	186,311	0.40	0.094	-1.6	1,468.35
1983	118,927	11,531	-3.4	185,737	0,92	0.089	-5.6	1,431.32
1984	393,647	12,111	5.0	203,505	2.97	0.091	2.8	1,534.05
1985	1,413,312	13,111	8.3	228,137	10.43	0.097	6.0	1,682.87
1986	3,708,949	14,099	7.5	250,123	26.78	0.102	5.3	1,806.03
1987	11,899,911	14,611	3.6	268,663	84.13	0.103	1.5	1,899.32
1988	91,952,490	14,613	0.0	279,492	636.67	0.101	-2.0	1,935.16
1989*	1,366,421,000	15,139	3.6	303,452	9,270.00	0.103	1.5	2,058.64

Source: Anuario Estatistico do Brazil, 1989 : IBGE
Relatorio, 1989: Banco Central do Brasil
Remarhs: * Provisional estimate by IBGE

TABLE A.6 GROSS DOMESTIC PRODUCT BY INDUSTRIAL ORIGIN AT CURRENT PRICES

(Unit: Cr$ 1,000)

Economic Sector	1970		1975		1980		1985		1988	
Agriculture	20	(11.6)	107	(10.8)	1,232	(10.2)	130,740	(9.0)	7,296,786	(2.6)
Industry	62	(35.8)	403	(40.4)	4,902	(40.6)	562,314	(38.7)	36,405,711	(37.9)
Mining	1		8		125		51,554		1,606,925	
Manufacturing	48		313		3,746		402,703		25,944,331	
Construction	9		62		813		78,257		6,625,206	
Public Utilites	4		20		218		29,800		2,229,249	
Services	92	(52.6)	488	(48.8)	5,945	(49.2)	759,004	(52.3)	52,295,027	(54.5)
Commercial	29		145		1,328		135,417		8,183,071	
Transportation	6		32		462		53,411		3,362,501	
Communication	1		8		111		13,578		923,416	
Financial	11		65		956		160,060		12,163,666	
Government	16		75		781		95,975		6,585,485	
Real Estate	16		67		825		120,818		9,094,833	
Others	13		96		1,482		179,745		11,982,055	
Subtotal	174	(100.0)	999	(100.0)	12,079	(100.0)	1,452,058	(100.0)	95,997,524	(100.0)
Imputed Interest of Financial Services	-11		-67		-893		-163,133		-12.285.520	
GDP at Factor Costs	163		932		11,186		1,288,925		83,739,004	
Net Indirect Tax	31		118		1,214		124,387		8,213,486	
GDP at Market Prices	194		1,050		12,402		1,413,312		91,952,490	

Source: Anuario Estatistico do Brasil, 1979: IBGE

Remarks: Figures in Parenthesis Indicate Percentage Distribution By Industrial Sector

TABLE A.7 GROSS REGIONAL DOMESTIC PRODUCT IN STATE OF SÃO PAULO

Year	Gross Regional Domestic Product(GRDP)				Gross Regional Domestic Product per Capita				Percentage Share of GRDP to GDP (%)
	Current Price (Cr$ 1,000)	Constant Price at 1980(Cr$1,000)	Annual Growth Rate (%)	Current Price (US$ million)	Current Price (Cr$)	Constant Price at 1980(Cr$)	Annual Growth Rate (%)	Current Price (US$)	
1975	450	3,760	3.80	32,665	0.02	0.179	-	1,550.81	42.9
1976	680	4,130	9.84	36,995	0.03	0.189	5.71	1,690.26	41.6
1977	1,020	4,300	4.12	40,645	0.04	0.189	0.20	1,787.18	40.9
1978	1,570	4,700	9.30	48,704	0.07	0.199	5.19	2,060.93	43.4
1979	2,560	4,970	5.74	57,263	0.10	0.202	1.76	2,331.94	42.9
1980	5,280	5,280	6.24	70,359	0.21	0.207	2.22	2,756.89	42.6
1981	10,220	4,910	-7.01	72,268	0.39	0.187	-9.79	2,746.95	41.5
1982	21,120	5,050	2.85	77,117	0.78	0.186	-0.18	2,844.91	41.4
1983	49,580	4,930	-2.38	77,433	1.78	0.177	-5.20	2,773.94	41.7
1984	161,150	5,189	5.27	83,310	5.61	0.181	2.29	2,900.08	40.91
1985	574,030	5,629	8.48	92,660	19.43	0.191	5.49	3,136.56	40.6
1986	1,456,360	6,100	8.35	98,214	48.16	0.202	5.85	3,247.99	39.3
1987	5,142,230	6,339	3.93	116,096	166.19	0.205	1.56	3,751.97	43.2
1988	42,177,540	6,268	-1.13	128,200	1,332.56	0.198	-3.34	4,050.35	45.9
1989	-	-	-	-	-	-	-	-	-

Source: Anuario Estatistico do Brazil, 1989 : IBGE
Relatorio, 1989: Banco Central do Brasil

TABLE A.8 GROSS REGIONAL DOMESTIC PRODUCT IN STATE OF SÃO PAULO BY INDUSTRIAL ORIGIN AT CURRENT PRICES

(Unit: Cr$)

Economic Sector	GRDP at Market Prices						GRDP at 1980 Constant Price *1			Average Annual Growth Rate (%)	
	1970		1975		1980		1970	1975	1980	'70-'75	'75-'80
Agriculture	3,628	(5.7)	16,953	(5.0)	175,571	(3.8)	115,166	161,753	175,571	7.03	1.65
Industry	27,798	(43.9)	151,039	(44.3)	2,220,040	(48.2)	882,411	1,441,103	2,220,040	10.03	9.03
Services	31,963	(50.4)	172,721	(50.7)	2,208,968	(48.0)	1,014,624	1,647,977	2,208,968	10.19	6.03
- Commerce	10,584	(16.7)	55,846	(16.4)	669,493	(14.5)	335,975	532,841	669,493	9.66	4.67
- Transportation & Communication	2,369	(3.7)	12,567	(3.7)	169,764	(3.7)	75,201	119,905	169,763	9.78	7.20
- Finance	3,967	(6.3)	25,289	(7.5)	337,889	(7.3)	125,927	241,289	337,889	13.89	6.97
- Government	4,152	(6.6)	19,941	(5.9)	188,154	(4.1)	131,800	190,262	188,154	7.62	-0.22
- Real Estate	5,969	(9.4)	24,878	(7.3)	295,527	(6.4)	189,478	237,368	295,527	4.61	4.48
- Others	4,922	(7.8)	34,200	(10.0)	548,140	(11.9)	156,242	326,311	548,140	15.87	10.93
Total	63,389	(100.0)	340,713	(100.0)	4,604,579	(100.0)	2,012,201	3,250,833	4,604,579	10.07	7.21

Source : Estatisticas Historicas do Brasil, 1987: IBGE

Remarks : *1 Estimated on the basis of GDP implicit deflator in Table A.8
*2 Figures in parentheses indicate percentage distribution
*3 Difference of GRDP in Table A.7 is attributable to data source, from which raw data was extracted.

TABLE A.9 VOLUME OF PRODUCTION BY MAJOR INDUSTRIAL ESTABLISHMENTS IN CUBATÃO (1/2)

(Unit:ton)

Establishment	Major Products	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Adubos Trevo	Fertilizer	-	-	-	-	-	-	113,582	148,902	192,442	-
Alba Quimica	Chemical Products	41,499	46,030	59,531	-	27,904	85,698	79,210	69,207	86,975	-
Carbocloro	"	-	136,652	178,644	-	149,685	226,161	214,837	270,337	280,169	-
Cimento Santa Rita	Cement	202,273	208,427	216,518	-	220,689	224,521	203,466	248,511	402,110	-
Cosipa	Iron & Steel	589,400	763,600	725,700	-	948,010	1,595,543	2,675,369	2,054,295	2,624,582	-
Copebras	Chemical Products	191,329	252,483	291,112	-	401,396	929,526	1,046,110	1,022,575	1,154,812	-
Engebasa	Metal Products	-	-	11	-	144	360	480	400	600	-
Engeclor	Chemical Products	807	2,814	4,237	-	6,676	5,278	5,735	6,945	7,936	-
Estireno	"	19,252	31,626	45,774	-	58,044	66,132	67,214	79,344	69,670	-
Gespa	Plaster	-	-	-	-	-	21,242	113,638	171,190	209,061	-
Indag	Chemical Products	-	-	-	-	-	112,714	229,436	357,392	691,664	-
Liquid Carbonic	"	8,820	11,748	16,922	-	18,493	10,931	18,399	21,700	22,400	-
Liquid Quimica	"	-	-	-	-	-	-	-	-	-	-
Manah	Fertilizer	-	-	-	-	-	8,155	48,206	500,200	652,600	-
Petrobras	Chemical Products	3,268,330	3,245,321	3,449,186	-	7,925,765	7,733,255	6,970,593	7,375,824	7,480,885	-
Petrocoque	"	-	-	-	-	34,289	61,817	97,375	86,839	122,809	-
Rhodia	"	-	-	-	-	17,071	46,811	56,173	42,487	45,571	-
Santista de Papel	Paper	31,045	33,375	37,105	-	40,718	43,046	49,628	51,643	58,153	-
Solorrico	Chemical Products	-	-	-	-	-	-	-	-	-	-
Titanor	"	-	-	-	-	-	-	-	-	-	-
Ultrafertil	"	196,145	248,524	337,876	-	448,362	1,005,102	1,962,247	2,092,022	2,126,837	-
Union Carbide	"	-	-	62,305	-	76,336	90,783	100,020	99,089	96,860	-
Total		4,548,900	4,980,600	5,424,921	0	10,373,582	12,267,075	14,051,718	14,698,902	16,326,136	0

Source: Boletim Informativo, 1974: PMC
" , 1976
" , 1981
" , 1988

Remarks: - Denotes no data available

TABLE A.9 VOLUME OF PRODUCTION BY MAJOR INDUSTRIAL ESTABLISHMENTS IN CUBATÃO (2/2)

(Unit:ton)

Establishment	Major Products	1981	1982	1983	1984	1985	1986	1987	1988	1989
Adubos Trevo	Fertilizer	-	284,188	176,623	215,649	110,981	114,239	134,575	255,136	271,029
Alba Quimica	Chemical Products	-	87,933	86,054	96,996	89,980	96,263	91,510	82,110	72,567
Carbocloro	"	-	347,728	428,717	687,882	515,816	665,661	640,072	652,461	656,832
Cimento Santa Rita	Cement	-	408,005	427,818	343,059	348,268	349,649	317,580	302,195	306,511
Cosipa	Iron & Steel	-	2,012,000	2,418,000	2,443,000	2,439,622	2,525,991	2,285,529	5,218,498	-
Copebras	Chemical Products	-	1,044,522	1,223,541	1,388,074	1,421,121	1,480,281	958,171	1,566,339	1,681,049
Engebasa	Metal Products	-	-	-	-	-	-	-	-	-
Engeclor	Chemical Products	-	9,360	5,992	7,141	5,476	8,025	6,526	5,901	5,928
Estireno	"	-	73,447	74,217	81,888	165,597	165,934	163,492	170,376	188,902
Gespa	Plaster	-	230,899	169,055	169,945	140,235	157,212	165,266	162,481	201,742
Indag	Chemical Products	-	498,029	308,868	770,458	798,236	1,136,599	1,206,535	1,004,091	-
Liquid Carbonic	"	-	27,170	19,320	39,170	37,764	52,574	42,900	-	-
Liquid Quimica	"	-	1,627	1,820	2,212	3,100	3,554	4,000	4,100	-
Manah	Fertilizer	-	138,028	193,825	305,629	313,610	390,168	352,892	290,683	211,531
Petrobras	Chemical Products	-	5,780,593	5,507,016	5,152,646	4,491,274	5,479,594	5,535,621	4,777,998	4,445,608
Petrocoque	"	-	402,424	507,542	623,563	537,331	504,851	576,170	745,422	868,076
Rhodia	"	-	17,618	16,376	18,549	60,000	55,831	57,835	57,209	53,801
Santista de Papel	Paper	-	56,859	51,202	59,179	91,930	73,414	73,551	68,546	66,101
Solorrico	Chemical Products	-	-	-	-	347,975	432,935	385,023	693,358	607,750
Titanor	"	-	-	-	-	-	-	-	-	-
Ultrafertil	"	-	1,400,823	1,411,656	1,628,218	1,217,665	1,812,383	1,923,175	1,693,248	1,947,728
Union Carbide	"	-	102,830	112,400	114,000	101,782	94,112	100,545	103,720	86,198
Total		0	12,924,083	13,140,042	14,147,258	13,237,763	15,599,270	15,020,968	17,853,872	11,671,353

Source: Boletim Informativo, 1974: PMC
" , 1976
" , 1981
" , 1988

Remarks: - Denotes no data available
* Figures in 1989 are provisional.

TABLE A.10 VALUE OF PRODUCTION BY MAJOR INDUSTRIAL ESTABLISHMENTS IN CUBATÃO (1/2)

(Unit:Cr$)

Establishment	Major Products	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Adubos Trevo	Fertilizer	-	-	-	-	-	-	-	636	1,399	-
Alba Quimica	Chemical Products	42	50	74	-	124	205	281	342	573	-
Carbocloro	"	27	77	97	-	141	465	865	666	942	-
Cimento Santa Rita	Cement	31	32	42	-	73	103	135	208	475	-
Cosipa	Iron & Steel	584	875	1,028	-	2,465	3,782	7,857	8,686	18,762	-
Copebras	Chemical Products	87	125	163	-	561	1,185	1,935	2,625	4,689	-
Engebasa	Metal Products	-	-	-	-	4	5	7	15	27	-
Engeclor	Chemical Products	-	4	8	-	19	16	24	40	56	-
Estireno	"	39	57	118	-	313	574	791	1,212	1,427	-
Gespa	Plaster	-	-	-	-	-	4	21	57	98	-
Indag	Chemical Products	-	-	-	-	17	225	574	560	1,166	-
Liquid Carbonic	"	8	13	18	-	32	6	10	19	33	-
Liquid Quimica	"	-	-	-	-	-	-	-	-	-	-
Manah	Fertilizer	-	-	-	-	-	10	82	296	825	-
Petrobras	Chemical Products	1,847	1,621	1,858	-	6,696	10,966	12,898	19,059	30,808	-
Petrocoque	"	-	-	-	-	36	76	172	197	389	-
Rhodia	"	-	-	-	-	47	139	218	239	255	-
Santista de Papel	Paper	70	83	120	-	238	229	379	421	732	-
Solorrico	Chemical Products	-	-	-	-	-	-	-	-	-	-
Titanor	"	-	-	-	-	-	-	-	-	-	-
Ultrafertil	"	84	282	366	-	1,000	1,526	3,490	4,825	8,044	-
Union Carbide	"	63	69	124	-	296	499	742	926	1,303	-
Total		2,883	3,288	4,015	0	12,061	20,016	30,480	41,029	72,003	0

Source: Boletim Informativo, 1974: PMC
" , 1976
" , 1981
" , 1988

Remarks: - Denotes no data available

TABLE A.10 VALUE OF PRODUCTION BY MAJOR INDUSTRIAL ESTABLISHMENTS IN CUBATÃO (2/2)

(Unit:Cr$)

Establishment	Major Products	1981	1982	1983	1984	1985	1986	1987	1988	1989
Adubos Trevo	Fertilizer	-	15,915	26,915	104,029	-	-	-	-	-
Alba Quimica	Chemical Products	-	3,723	10,421	34,831	-	-	-	-	-
Carbocloro	"	-	13,495	36,149	162,803	444,304	773,579	2,320,595	18,657,177	235,815,112
Cimento Santa Rita	Cement	-	5,164	13,227	30,636	-	193,652	435,562	3,529,548	-
Cosipa	Iron & Steel	-	160,437	538,289	1,741,606	4,141,111	7,475,706	32,849,505	224,524,788	-
Copebras	Chemical Products	-	32,984	91,249	278,180	1,716,255	2,431,898	5,019,036	49,392,360	714,993,000
Engebasa	Metal Products	-	866	1,877	4,626	23,744	51,366	168,548	1,852,617	-
Engeclor	Chemical Products	-	502	839	3,473	9,393	28,432	80,809	671,670	6,455,851
Estireno	"	-	11,313	30,351	101,759	691,859	1,023,290	3,056,552	24,408,286	248,376,000
Gespa	Plaster	-	639	1,239	3,668	10,826	33,528	92,130	715,930	9,901,000
Indag	Chemical Products	-	12,287	14,849	67,435	563,499	1,822,075	450,232	3,484,592	-
Liquid Carbonic	"	-	204	637	3,545	11,678	25,189	-	-	-
Liquid Quimica	"	-	300	772	3,132	12,201	32,282	106,562	818,721	-
Manah	Fertilizer	-	7,504	28,893	107,177	269,358	725,013	1,934,812	5,137,279	90,135,517
Petrobras	Chemical Products	-	319,447	872,496	2,535,556	6,909,874	16,564,171	53,914,350	310,327,817	2,284,190,446
Petrocoque	"	-	5,823	15,950	90,125	324,395	239,806	919,046	9,117,935	88,216,386
Rhodia	"	-	1,249	2,800	12,156	72,000	-	-	2,608,569	392,125,000
Santista de Papel	Paper	-	10,092	20,668	78,052	230,794	424,574	1,533,816	12,255,944	141,892,000
Solorrico	Chemical Products	-	-	-	-	16,948	47,350	125,646	16,337,768	248,440,000
Titanor	"	-	-	-	2,973	16,567	37,732	-	-	-
Ultrafertil	"	-	13,309	28,301	93,371	309,201	3,065,776	10,639,972	-	595,284,275
Union Carbide	"	-	14,424	43,004	148,300	4,643	697,576	2,163,892	16,308,105	147,126,818
Total		0	629,677	1,778,926	5,607,433	15,778,650	35,692,995	115,811,065	700,149,106	5,202,951,405

Source: Boletim Informativo, 1974: PMC
" , 1976
" , 1981
" , 1988

Remarks: - Denotes no data available
* Figures in 1989 are provisional.

TABLE A.11 NUMBER OF MANUFACTURING ESTABLISHMENTS AND PRODUCTION VALUE IN SÃO PAULO AND CUBATÃO

(Unit: Cr$)

Type of Industrial Sub-sector	Sao Paulo				Cubatao				Share of Cubatao to Sao Paulo (%)	
	1975		1980		1975		1980			
	Nos.	Amount	Nos.	Amount	Nos.	Amount	Nos.	Amount	1975	1980
Mining	778	930	871	7,519	8	155	4	59	16.7	0.8
Non-metal products	6,823	14,297	8,147	158,693	8	206	7	1,832	1.4	1.1
Metallurgy	6,433	56,075	6,251	679,102	5	4,222	7	91,085	7.5	13.4
Machinery	4,824	43,534	5,516	497,404	10	327	18	6,270	0.8	1.3
Electric & communication products	1,752	29,326	2,110	331,434	1	-	-	-	-	-
Vehicles	1,794	57,473	1,504	563,288	1	-	-	-	-	-
Timber	2,281	3,444	1,860	36,427	1	-	1	-	-	-
Furniture	3,540	6,405	3,081	65,579	1	-	-	-	-	-
Paper	821	11,249	892	145,099	1	-	1	-	-	-
Rubber	495	10,423	514	112,415	1	-	-	-	-	-
Leather	347	1,078	357	13,145	-	-	-	-	-	-
Chemistry	1,536	65,218	1,553	906,593	42	10,175	44	191,270	15.6	21.1
Medicine	237	7,894	222	68,715	-	-	-	-	-	-
Soap & Perfume	328	5,231	309	53,735	-	-	-	-	-	-
Plastic products	1,412	8,836	1,721	117,695	-	-	-	-	-	-
Textile	3,458	29,034	3,194	320,038	2	2	-	-	-	-
Clothing	5,425	13,855	6,747	172,228	-	-	2	-	-	-
Food products	11,038	49,122	10,540	533,039	23	13	25	133	-	-
Beverage	646	3,875	575	34,839	-	-	-	-	-	-
Tobacco	8	1,389	6	8,668	-	-	-	-	-	-
Printing	2,782	8,660	3,263	77,427	3	-	2	-	-	-
Others	6,117	11,788	7,066	155,941	24	525	26	7,503	4.5	4.8
Total	60,378	439,138	62,426	5.059,027	131	15,625	126	298,152	3.6	5.9

Source: Censo Industrial, 1975: IBGE
Censo Industrial, 1980: IBGE

TABLE A.12 CHANGE OF RESIDENCES, INDUSTRIAL, COMMERCIAL AND SERVICES ESTABLISHMENTS IN CUBATÃO

Year	Residence	Industry	Commercial & Services	Others	Total
1982	12,545	147	1,309	129	14,130
1983	13,424	135	1,312	139	15,015
1984	13,699	138	1,424	171	15,432
1985	14,465	144	1,445	199	16,253
1986	15,381	142	1,445	209	17,177
1987	16,146	162	1,458	202	17,968
1988	17,476	152	1,473	201	19,303

Source: Boletim Informativo, 1988: PMC
Boletim Informativo, 1989: PMC

Remarks: Numbers from ELETROPAULO.

TABLE A.13 INVENTORY OF COMMERCIAL AND SERVICES ESTABLISHMENTS IN CUBATÃO

Sector	Number of Establishments
Commerce	752
- Retail	50
- Wholesale	702
Services	520
- Hotel & Catering	387
- Maintenance & Fixing	61
- Personal Care	32
- Others	40
Total	1,272

Source : Boletim Informativo, 1988: PMC

Remarks : * Data in 1986

TABLE A.14 CHANGE OF PRICE INDEX AND FOREIGN EXCHANGE RATE

Year/Month	Price Inflation: Consumer Price Index: Brazil	Price Inflation: Consumer Price Index: Sao Paulo	Price Inflation: Annual Rate (%): Brazil	Price Inflation: Annual Rate (%): Sao Paulo	GDP Implicit Deflator	Index of Real GDP (1980=100)	Foreign Exchange Rate (Cr$/US$): Official Rate	Foreign Exchange Rate (Cr$/US$): Tourist Rate
1970	3.8	3.9	-	-	3.6	43.7	0.00000489	-
1971	4.6	4.7	19.9	19.9	4.3	48.7	0.00000564	-
1972	5.4	5.5	17.5	17.0	5.1	54.5	0.00000619	-
1973	6.1	6.2	13.8	12.5	6.6	62.1	0.00000620	-
1974	8.1	8.2	31.4	33.1	9.0	67.1	0.00000737	-
1975	10.5	10.8	30.7	31.3	12.0	70.6	0.00000899	-
1976	15.1	15.8	43.6	46.2	16.9	77.9	0.00001215	-
1977	21.4	22.4	41.5	41.5	24.6	81.7	0.00001585	-
1978	30.6	32.5	43.0	45.1	34.0	85.8	0.00002055	-
1979	51.2	52.9	67.1	62.8	52.5	91.6	0.00003959	-
1980	100.0	100.0	95.3	89.2	100.0	100.0	0.00006404	-
1981	191.2	192.3	91.2	92.3	207.9	95.6	0.00012504	-
1982	378.3	383.8	97.9	99.6	427.2	96.3	0.00024481	-
1983	1,056.2	1,044.8	179.2	172.2	1,031.1	93.0	0.00094614	-
1984	3,203.3	3,155.7	203.3	202.0	3,248.8	97.7	0.00300855	-
1985	10,508.1	10,356.1	228.0	228.2	10,781.3	105.7	0.00991200	-
1986	18,625.6	19,305.9	77.2	86.4	26,302.6	113.7	0.01455000	-
1987	92,133.3	92,676.1	394.7	380.0	81,452.9	117.8	0.06748000	-
1988	952,290.0	947,056.7	933.6	921.9	629,399.6	117.8	0.67103000	-
1989	17,758,971.2	17,846,904.7	1,764.9	1,784.5	9,030,940.3	122.1	11.30200000	23.6
1990								
January	27,723,530.7	31,148,202.8	56.1	74.5	-	-	17.643	35.20
February	47,900,716.2	53,001,781.9	72.8	70.2	-	-	30.438	59.10
March	88,290,599.7	94,931,491.6	84.3	79.1	-	-	41.933	44.50
April	127,844,787.8	114,098,159.7	44.8	20.2	-	-	50.845	65.80
May	137,906,172.3	123,830,732.7	7.9	8.5	-	-	54.975	80.50
June	151,076,212.1	138,318,928.5	9.6	11.7	-	-	60.735	83.00
July	170,595,258.0	153,962,799.3	12.9	11.3	-	-		

Source : Estatisticas Historicas do Brasil, 1990:IBGE
Anuario Estatistico do Brasil, 1989:IBGE

Remarks : *1 Quoted at the end of the Year or Month (Base: December 1980=100).
*2 Consumer Price Index is quoted from INPC up to 1987 and from IPC since 1988.
*3 Consumer Price Index in Sao Paulo is measured in Greater Sao Paulo.

TABLE A.15 PRESENT LAND USE IN STUDY AREA : 1990

(Unit: sq.km)

Item	Municipality				Total
	Cubatao	Sao Vicente	Sao Bernardo do Campo	Santo Andre	
1. Build-up Area	34.5 (34.6)	-	-	-	34.5 (13.7)
- Residencial	24.6 (24.7)	-	-	-	24.6 (9.8)
- Others	9.9 (9.9)	-	-	-	9.9 (3.9)
2. Industrial Area	22.9 (23.0)	-	-	-	22.9 (9.1)
3. Grassland	11.8 (11.8)	-	5.0 (4.8)	1.5 (12.0)	18.3 (7.2)
4. Forest & Bush	30.5 (30.6)	36.3 (100.0)	98.5 (95.2)	11.0 (88.0)	176.3 (70.0)
Total	99.7 (100.0)	36.3 (100.0)	103.5 (100.0)	12.5 (100.0)	252.0(100.0)

Remarks: * Each area is measured on the basis of both topographic map and aerial infrared photographs.

TABLE A.16 TRAFFIC VOLUME OF MAJOR STATE HIGHWAYS

Year	Anchieta(SP-150)				Imigrantes(SP-160)				Piaçaguera(SP-140)			
	Automobile	Truck	Buss	Total	Automobile	Truck	Buss	Total	Automobile	Truck	Buss	Total
1,972	3,274,896	964,165	108,733	4,347,794	-	-	-	-	2,483,676	1,384,212	356,484	4,224,372
1,973	3,493,232	1,117,087	116,007	4,726,326	-	-	-	-	2,271,760	1,455,255	325,215	4,052,230
1,974	2,551,272	1,054,328	84,720	3,690,320	1,931,958	268,109	75,626	2,275,693	2,461,195	1,322,395	333,975	4,117,565
1,975	2,044,370	1,004,670	67,885	3,116,925	2,175,956	179,397	85,184	2,440,537	2,892,990	1,465,110	511,365	4,869,465
1,976	2,789,353	1,050,373	92,626	3,932,352	2,474,791	156,859	96,900	2,728,550	2,700,714	1,724,958	675,270	5,100,942
1,977	2,742,097	984,960	91,054	3,818,111	2,724,519	253,479	106,695	3,084,693	3,130,970	1,680,825	706,640	5,518,435
1,978	2,760,610	919,543	91,652	3,771,805	3,109,825	370,962	121,771	3,602,558	3,343,765	2,292,930	685,835	6,322,530
1,979	2,832,054	810,572	94,043	3,736,669	3,641,666	547,288	142,570	4,331,524	3,622,260	2,107,145	736,935	6,466,340
1,980	2,594,788	816,951	86,140	3,497,879	3,415,610	647,384	133,718	4,196,712	3,829,092	2,532,720	959,286	7,321,098
1,981	2,486,185	695,500	82,554	3,264,239	3,504,939	596,552	137,203	4,238,694	3,440,855	1,743,605	980,025	6,164,485
1,982	2,422,738	604,191	80,430	3,107,359	3,682,022	555,725	144,167	4,381,914	2,827,655	1,925,375	884,030	5,637,060
1,983	2,272,971	607,522	75,451	2,955,944	3,741,652	596,711	145,418	4,483,781	3,886,885	1,774,630	766,500	6,428,015
1,984	2,248,755	684,908	74,704	3,008,367	3,756,067	660,841	147,066	4,563,974	3,245,580	1,939,245	896,440	6,081,265
1,985	2,419,833	688,027	80,327	3,188,187	3,909,561	644,641	153,051	4,707,253	3,449,141	1,979,030	861,857	6,290,028
1,986	2,711,888	712,741	90,256	3,514,885	4,640,477	713,760	181,663	5,535,900	3,652,701	2,018,815	965,151	6,636,667
1,987	2,601,837	766,255	86,785	3,454,877	4,812,524	786,663	188,389	5,787,576	3,887,031	2,224,602	849,538	6,961,171
1,988	2,509,010	817,416	83,448	3,409,874	4,644,658	739,908	181,826	5,566,392	3,775,144	2,160,425	824,964	6,760,533
1,989	2,861,954	821,709	86,407	3,770,070	5,180,212	743,071	196,475	6,119,758	3,551,085	2,417,030	871,620	6,839,735

Source : DERSA

TABLE A.17 INVENTORY OF SOCIAL INFRASTRUCTURE IN CUBATÃO

Item	Numbers
1. Education Facility	78
- Nursery School / Kindergarten	11
- First & Secondary Grade School	20
- Miscellaneous School	44
- University / College	3
2. Medical Facility	14
- Hospital	3
- Clinic	11
3. Religious Facility	
- Church	82
4. Public Facility	64
- City Hall	1
- Assembly Hall	1
- Welfare Facilities	12
- Residential Association	12
- Chamber of Commerce	5
- Others	2

Source : Boletim Informativo, 1988: PMC

Remarks : Data in 1986

TABLE A.18 PROJECTION OF POPULATION AND LABOR FORCE

Item	Population					Average Annual Growth Rate (%)			
	1980	1990	2000	2010	2020	1980-1990	1990-2000	2000-2010	2010-2020
(1) Brazil									
1. Population	119,003,000	150,368,000	179,487,000	208,302,000	234,692,000	2.3	1.8	1.5	1.2
2. Economically Active	87,677,000	112,344,000	134,615,000	156,227,000	176,019,000	2.5	1.8	1.5	1.0
3. Labor Force	43,236,000	67,406,000	84,134,000	101,548,000	118,813,000	4.5	2.2	1.9	1.6
4. Labor Force Participation(%)	49.3	60.0	62.5	65.0	67.5	2.0	0.4	0.4	0.4
(2) Sao Paulo									
1. Population	25,041,000	33,070,000	40,080,000	47,439,000	55,055,000	2.8	1.9	1.7	1.5
2. Economically Active	19,328,000	26,698,000	32,064,000	37,951,000	44,044,000	3.3	1.9	1.7	1.5
3. Labor Force	10,412,000	16,301,000	20,040,000	24,668,000	29,730,000	4.6	2.1	2.1	1.9
4. Labor Force Participation(%)	53.9	61.1	62.5	65.0	67.5	1.3	0.2	0.4	0.4
(3) Cubatao									
1. Population	79,162	105,547	135,100	164,700	194,900	2.9	2.5	2.0	1.7
2. Economically Active	59,177	79,160	101,300	123,500	146,200	3.0	2.5	2.0	1.7
3. Labor Force	31,576	45,630	63,300	80,300	98,700	3.8	3.3	2.4	2.1
4. Labor Force Participation(%)	53.4	57.6	62.5	65.0	67.5	0.8	0.8	0.4	0.4

Source: Anuario Estatistico do Brasil 1989: IBGE
Table A.1

TABLE A.19 PROJECTED GDP AND GRDP AT1989 CONSTANT PRICES

(Unit : Cr$ billion)

Item	1980	1989	1990	2000	2010	2020	Average Annual Growth Rate (%) 1980/1990	1990/2000	2000/2010	2010/2020
GDP	1,119.4	1,366.4	1,396.5	1,876.8	2,287.8	2,788.8	2.2	3.0	2.0	2.0
GRDP	476.9	573.9	586.5	788.2	960.9	1,171.3	2.4	3.0	2.0	2.0
Agriculture	18.1	21.1	21.4	24.6	27.7	31.0	1.7	1.4	1.2	1.1
Industry	229.8	276.0	281.8	374.0	464.9	566.8	2.1	2.9	2.2	2.0
Services	229.0	276.8	283.3	389.7	468.1	573.4	2.1	3.2	1.9	2.1
Percentage Share of GRDP to GDP (%)	477.0	573.9	586.5	788.3	960.7	1,171.2				
	42.6	42.0	42.0	42.0	42.0	42.0				

Remarks : Estimated on the basis of GDP of Cr$1,366.4 billion in 1989.

FIGURES

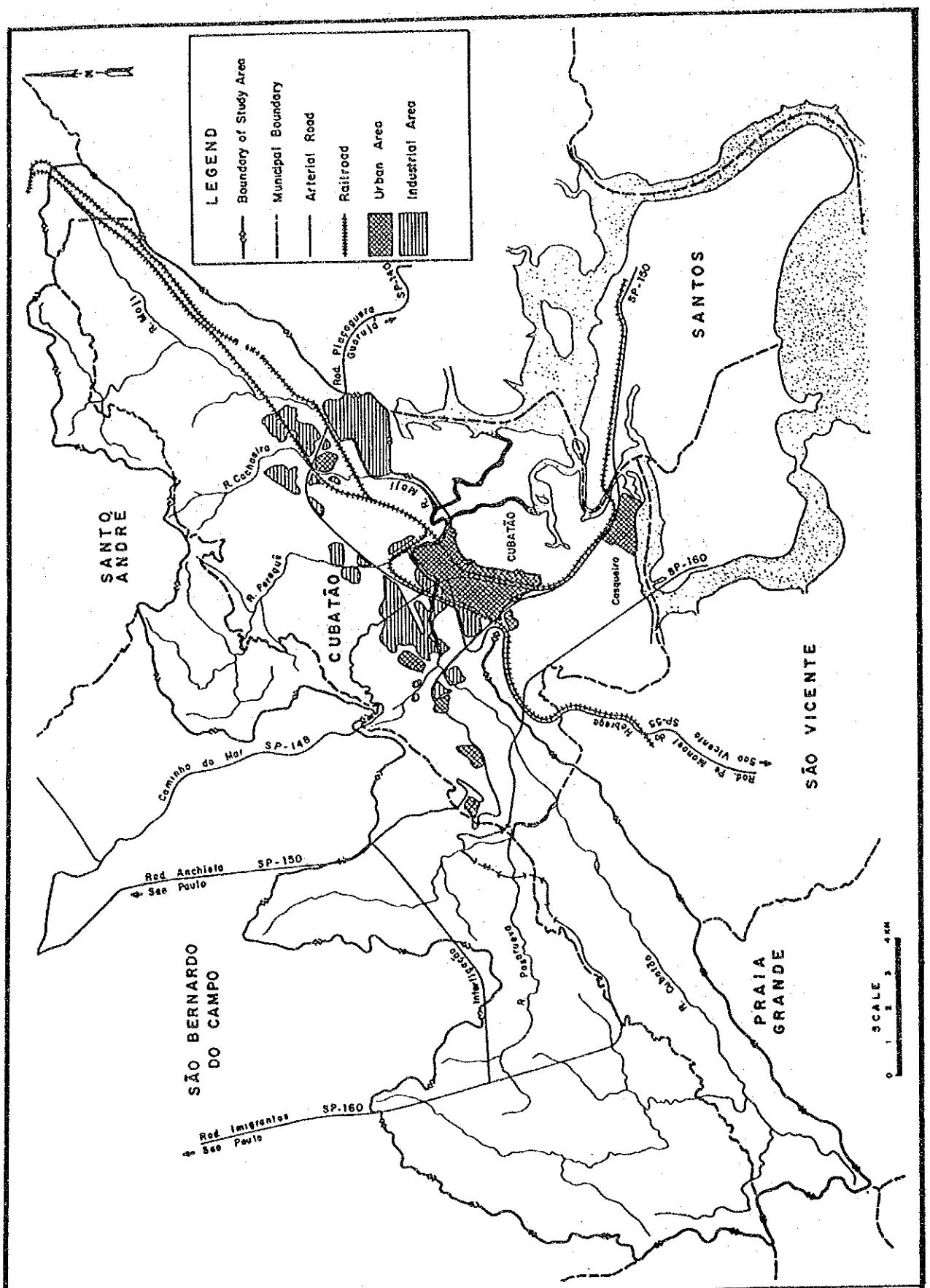

FIG.A.1
ADMINISTRATIVE DIVISION
IN STUDY AREA

GOVERNMENT OF FEDERATIVE REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND RESTORATION PROJECT IN SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO

JAPAN INTERNATIONAL COOPERATION AGENCY

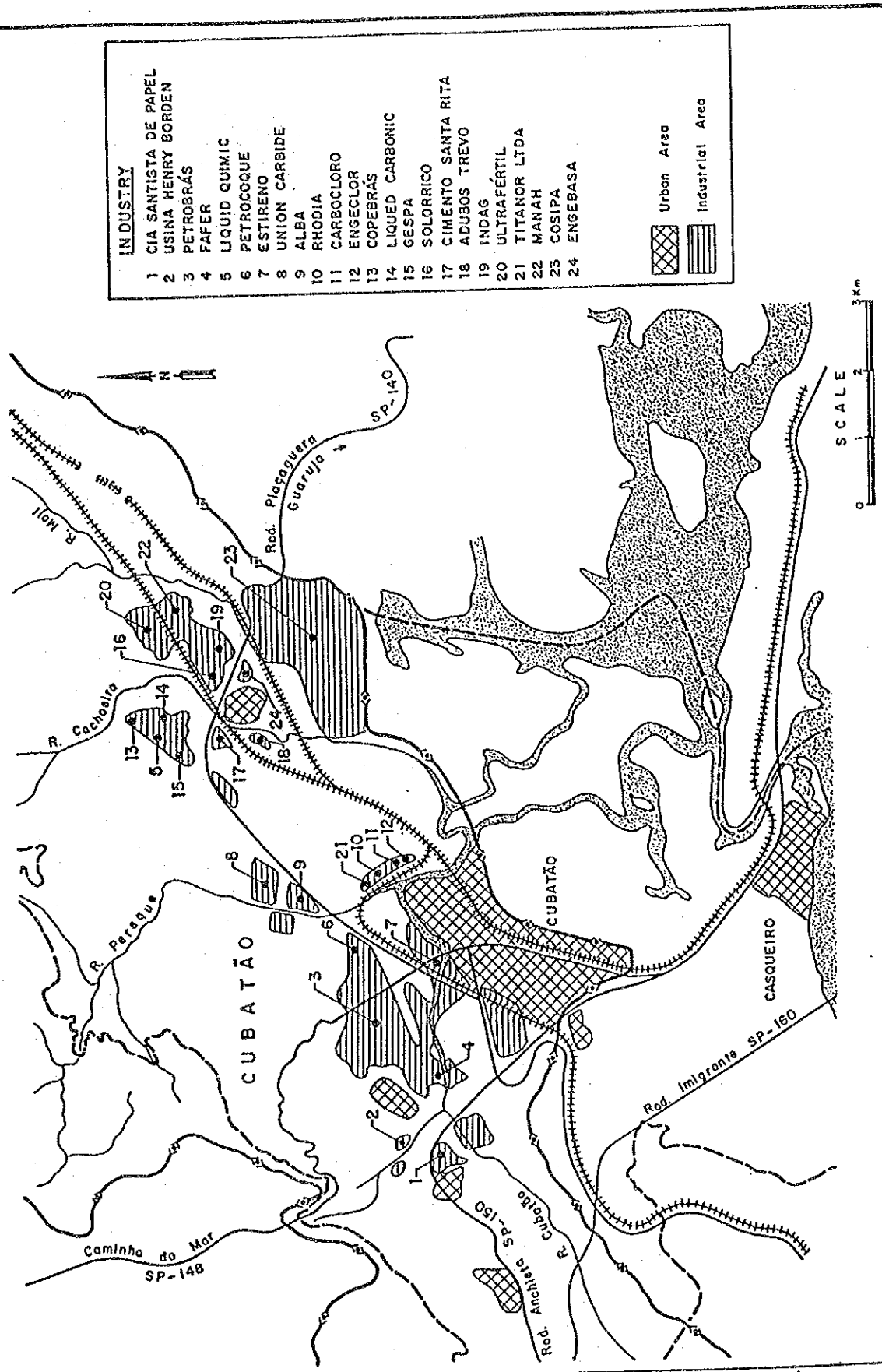

FIG.A.2
LOCATION MAP OF MAJOR INDUSTRIAL ESTABLISHMENTS IN CUBATÃO

GOVERNMENT OF FEDERATIVE REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND RESTORATION PROJECT IN SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO

JAPAN INTERNATIONAL COOPERATION AGENCY

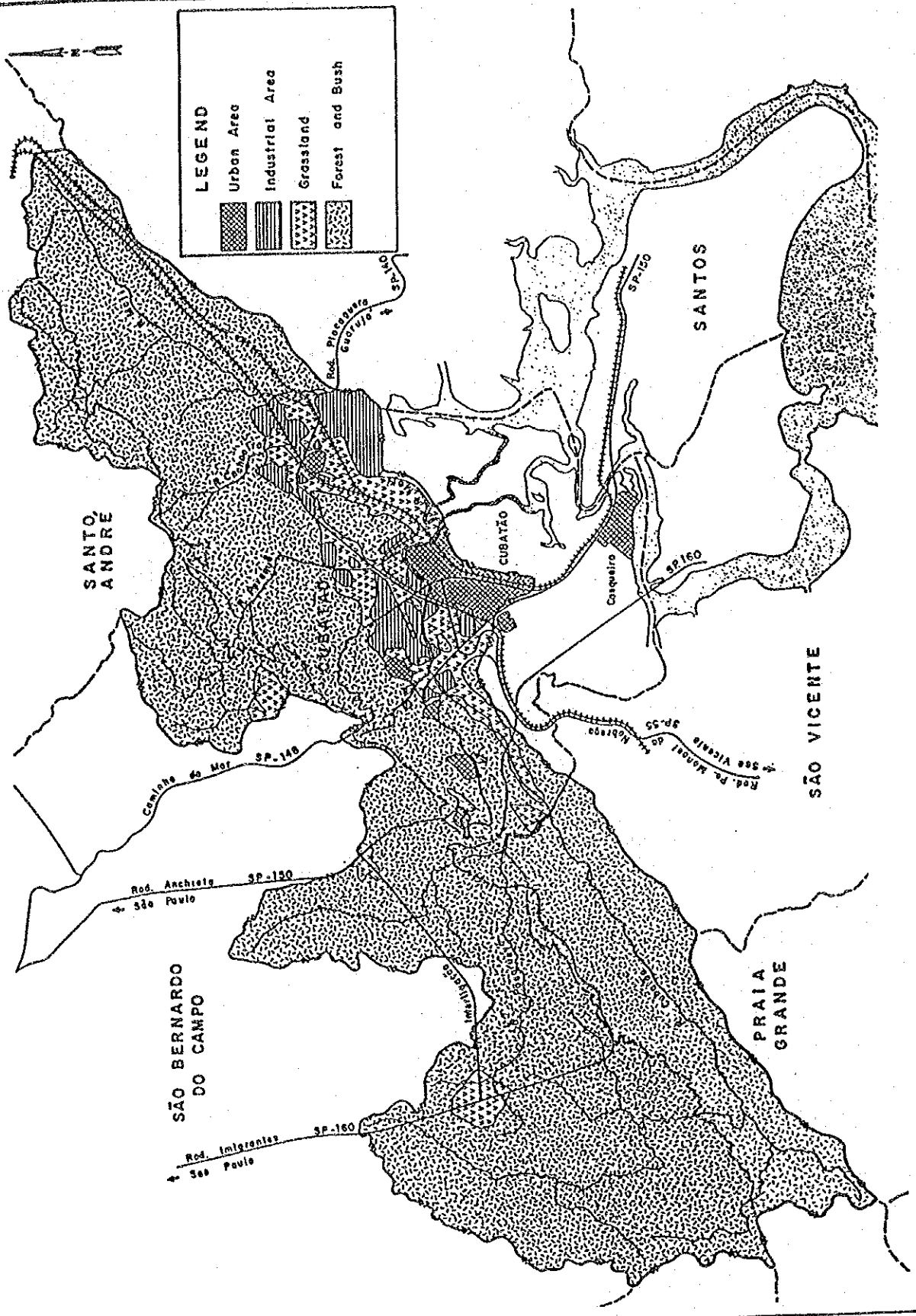

FIG.A.3
PRESENT LAND USE MAP
IN STUDY AREA : 1990

GOVERNMENT OF FEDERATIVE REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND RESTORATION PROJECT IN SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO

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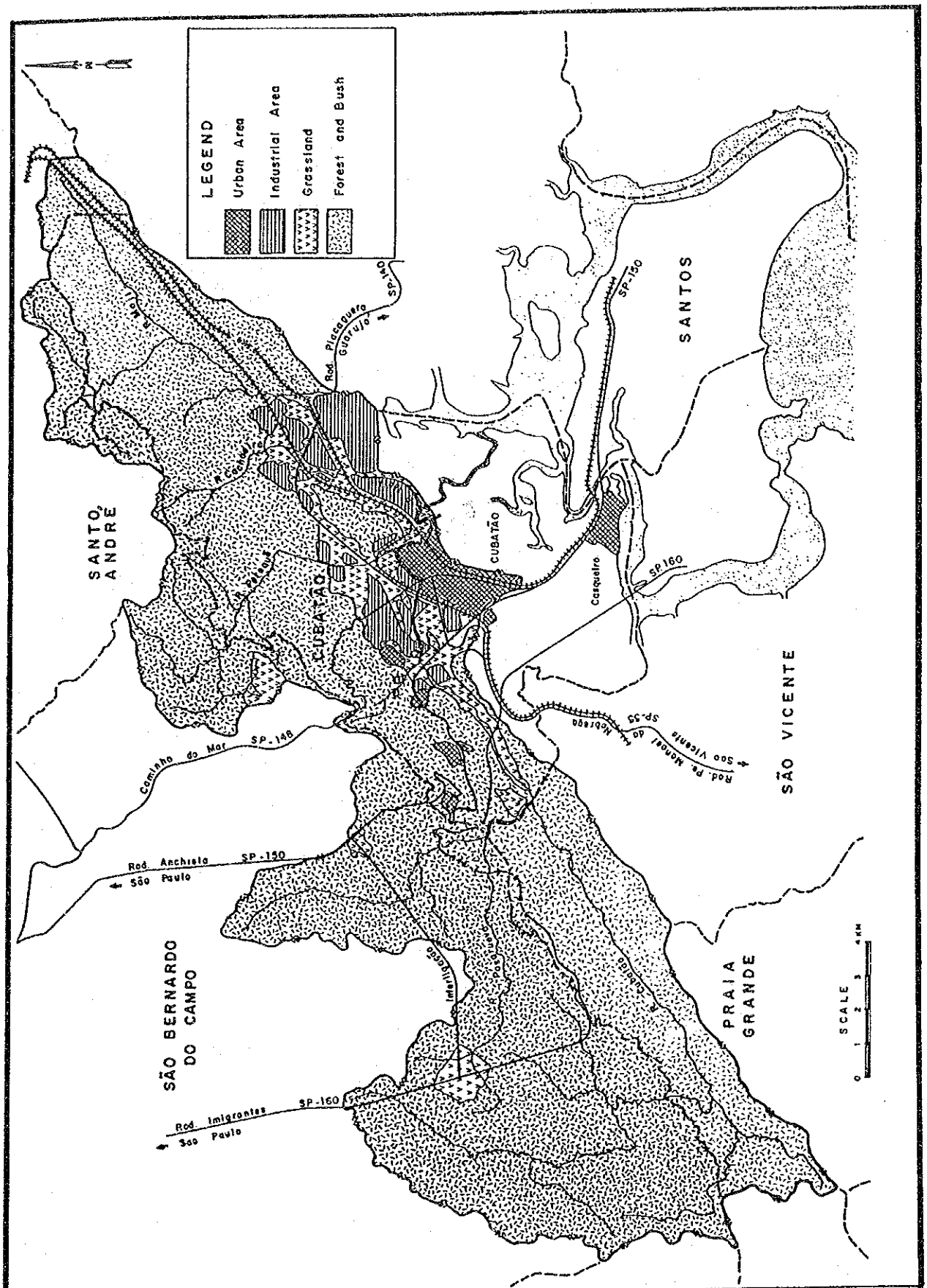

FIG.A.4
FUTURE LAND USE PLAN

GOVERNMENT OF FEDERATIVE REPUBLIC OF BRAZIL
THE STUDY ON THE DISASTER PREVENTION AND RESTORATION PROJECT IN SERRA DO MAR, CUBATÃO REGION, STATE OF SÃO PAULO

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ANNEX B

SEDIMENT RUN-OFF AND FLOOD DISASTER DAMAGE SURVEY

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1. INTRODUCTION

Frequent disasters have occurred in the study area, caused by heavy rain during rainy seasons between October and March. In particular, Cubatão municipality lying downstream of the Serra do Mar has suffered two types of disasters; flood disaster and sediment run-off disaster. Flood disasters have happened in the residential area in the municipal center lying in the Cubatão river basin and an industrial area in Vila Parisi lying in the Moji river basin, respectively. Besides, industrial establishments, which are situated at the very foot of the Serra do Mar to the North of the municipality, have been attacked by sediment run-off disasters. The most serious disasters that have happened were the flood disaster which innundated most of the residential area in 1971, and the sediment run-off disaster which attacked the industrial establishments in January 1985.

Disaster damage surveys aim to collect the actual information on past disasters as well as to clarity the magnitude of the respective disasters in order to estimate accurate disaster damages. These survey activities were made by collecting actual damage records through organizations concerned and by means of interview survey to old local inhabitants and so forth.

Regarding the flood disaster in Cubatão river basin, 1971 flood which was mostly examined hydrologically, is particularly used for inundation analysis. On the other hand, flood in Moji river basin is chiefly analysed by the interview survey conducted by the study team.

As far as the sediment run-off disaster is concerned, damage survey for the industrial establishments is based on questionnaire made by the special commission in 1986 and by SMA at the request from the study team.

In this ANNEX-B, probable damages incurred by the flood and sediment run-off disasters are elaborated through collected data and various information pertaining to the past disasters occurred in the study area.

2. PAST LARGE SCALE DISASTERS

2.1 Flood Disasters

2.1.1 Actual flood damage

From the data and information collected during the survey, and precipitation records observed, major past floods ocurred in February 1971, January 1973, January 1976, November 1979, January 1983, January 1985, and December 1988. Among them, the flood in January 1971 would be considered the largest flood in Cubatão river basin. Meanwhile, in Moji river basin, Vila Parisi area situated between Indio and Piaçaguera rivers has been habitually inundated due to overflow from Moji river and its tributaries.

With respect to damage records, no exhaustive survey for the past flood has been made except for the flood in 1971, which was investigated thoroughly in 1973 as the works for the Cubatão River Use and Control by the state government. This investigation indicated a peak discharge of nearly 860 cu.m/s with 20-year return period and discharge volume of approximately 19.4 million cu.m with 8-year return period. The flood damage incurred from this flood was estimated to have been Cr$ 18.5 million at price level in October 1973, comprising Cr$ 13.2 million in Cubatão river basin and Cr$ 5.3 million in Moji river basin, respectively.

2.1.2 Area-depth-duration survey

The characteristics of 1971 flood are explained in such a way that the flood seemed to have ocurred when the sea water intruding into low marsh area lying in the South of Cubatão center was rising, causing to prevent overflowed water from mitigating into the ocean. According to the said study report, inundation of flooding lasted 3 to 4 hours in most of the urban area and a couple of days in low elevation area such as Vila Nova in the South of the center. The maximum inundation height was reported to be approximatly 3.5m. The inundation area extended over about 340ha of the city corresponding to this maximum inundation height.

Damage survey to the old inhabitants made by the study team also

reveals the similar results regarding inundation height, duration and direction of the flood water. According to this interview survey, most of the municipality areas were inundated for several hours and only retarded water in low land remained 2 or 3 days.

As far as the inundation in Moji river basin is concerned, flood situation in Moji would be more habitual. In particular, Vila Parisi area, the elevation of which are between 3.2 m and 3.7 m at sea level, has been inundated almost every 2 or 3 years, even though inundation height would be as low as around 10 to 30 cm. This area is said to have been inundated around 2 to 3 meters over 4 to 5 days in 1972 and 1976 floods.

2.2 Sediment Run-off Disasters

2.2.1 Sediment run-off damage

A large number of small scale landslides on the steep slope of the Serra do Mar have occurred almost every 5 to 10 years in rainy seasons during the past 30 years. Six past major sediment run-off are reported since 1960 as follows: 1962, February 1971, January 1976, February 1980, January 1985 and December 1988. Among the above, 1985 sediment run-off disaster was the largest in sediment yield and the most serious to the industrial establishments.

The industrial complex comprising mostly petrochemical establishments suffered serious damages by the massive sediment run-off on its properties in January 1985. The damage extended over destruction of machine, equipment, installation and facilities, damages to products and materials and even temporary suspension of production line. According to the questionnaire survey to affected establishments, total direct damage and losses due to this disaster was reported to amount to approximately Cz$ 17.2 billion.

2.2.2 Sediment yield survey

Sediment yields for the past major sediment run-off disasters were surveyed on the basis of data and reports collected from agencies

concerned. Total sediment volume for respective past disasters in the whole basins are estimated as follows: 7,600 m^3 in 1962, 70,600 m^3 in February 1971, 94,400 m^3 in January 1976, 58,600 m^3 in February 1980, 194,300 m^3 in January 1985 and 103,400 m^3 in December 1988.

Of the above, a sediment run-off disaster in January 1976 damaged some installation and production facilities of COPEBRAS, one of the largest petrochemical establishments in Cubatão. According to the interview survey with the factory personnel concerned, the establishment was forced to remove a massive volume of sediment totalling some 100,000 m^3. On the other hand, the sediment run-off and debris flow which occurred in January 1985 almost reached the storage tanks of petrochemical materials located at the very foot of the Serra do Mar belonging to PETROBRAS, which is one of the nation's largest petrochemical establishments.

This disaster caused serious damage to the factory properties and assets of PETROBRAS. The 1985 sediment run-off motivated several establishments to take possible preventive measures such as constructing a series of 9 gabion check dams upstream on the Pedras river.

3. ESTIMATION OF PROBABLE DAMAGE

3.1 Procedure of Estimation for Probable Disaster Damage

This section sets ort the procedure to estimate the probable disaster damages which will be brought about by sediment run-off and flood disasters. The probable disaster damages are considered to be basic figures to estimate benefits acruing from the disaster prevention works under the present conditions. The benefits from the works is conceptually defined as the surplus in monetary terms between disaster damage with and without the prevention works.

The socio-economic damages due to disaster are primarily classified into two main components as illustrated in Table B.1: (1) Losses of damages to social capital, and (2) Expenses of emergency activities. The first component is further divided into two sub-components: (i) economic activity losses which are composed of (a)

damage and losses to accumulated properties such as buildings, machines, equipment, installation and office supplies, (b) damage to inventory of stocks and products such as raw materials, semi-products, manufactured produts and merchandise, and (c) opportunity losses which consists of losses of expected profits through damageable stocks, products and merchandise, and suspension of business or production activities due to damaged properties and infrastructures. The second sub-component, social activity losses, comprises (a) damages to residencial houses including household effects, and (b) damages to infrastructures which are further divided into social infraestructures such as education facilities, medical facilities and other public entities, and economic infraestructures such as transportation facilities, water supply, electric supply and telephone services.

On the other hand, the second component, or expenses of emergency activities, is composed of (a) restoration activities such as removal of sediment, mud and trash, (b) evacuation of victims, (c) relief activities of food and medical services, and (d) restoration of public hygiene, and so forth.

Taking this damage structure into consideration, the disaster damages are itemized for convinience for benefit estimation as follows:

(1) Direct damages comprising three main categories.

1) Losses of economic values for damageable properties which are, furthermore, divided into two categories; (i) depreciable assets such as residence, building, shops, machines, equipment, installation, office supply, furniture and vehicle, and (ii) inventory of stocks and products.

This category is classified by economic and industry-wise activities for convinience for benefit estimation as follows:

(a) Residence consisting of housing unit and the household effects.

(b) Industrial establishment consisting of depreciable assets such as building, machine, equipment, installation, office

supply and vehicle, and inventory of stock and products including expected profits through damageable inventory of stocks.

(c) Commercial and services establishment consisting of depreciable assets such as shop, machine, equipment, installation, furniture and vehicle, and inventory of stock and products including expected profit through damageable inventory of stocks.

2) Infrastructure damages to social and economic infraestructures, assumed to be zero to 25% of the damageable properties depending upon the importance and vulnerability subject to disaster.

3) Restoration activities such as removal of sediment, mud, trashes and other substances washed away or flowed out by the sediment run-off or flood.

(2) Indirect damages comprising (a) opportunity losses of expected profits through damageable inventory and of business or production activities, and (b) expenses of emergency activities as stated before. Indirect losses incurred in industrial and commercial sectors are estimated based on affected establishments. The amount of indirect damages is assumed to be 10% of the direct damages in case of the flood disaster and varies from zero to 100% in case of the sediment run-off disaster since this disaster will bring about uncountable and tremendous economic damages and losses, and social catastrophe to the entire municipality.

No damages in agricultural sector are incurred from the disasters in the study area, since there is no economic activities involved in this sector.

In case of residences, small and medium scale manufacturing establishs, and commercial and services establishments, the number of damageable properties was basically counted from the latest topographic map with a scale of 1 : 5,000 taken by the study team.

On the other hand, regarding the major industrial establishments

which are mostly vulnerable to sediment run-off disaster damageable properties are estimated from census data by updating latest survey for respective establishment. This is the reason that since the major industrial establishments in Cubatão are enormous in scale and value of production, estimating damageable properties of these establishments by averaged data in São Paulo or Cubatão will be likely to lead to incorrect underestimation of the whole properties as they should be.

3.2 Flood Damage

3.2.1 Area-depth-duration analysis

Area-depth-duration analysis is carried out by using the following probable flood peak discharge flowing into the Cubatão and Moji river basins, as shown in Table B.1 and B.2 respectively, under the present river conditions.

Probable Flood Peak Discharge

(unit:cu.m/s)

River Basin	Return Period					
	2	5	10	25	50	100
Cubatão	916	1301	1,555	1,876	2,121	2,366
Moji	243	367	453	568	652	714

Note: Probable discharges at river mouth.

Run-off simulation model using non-uniform flow calculation method is applied to converting these flood peak discharge to water level, with due consideration of topography, hydrograph, river and connel conditions.

Based on this simulation analysis against the above probable flood discharges, flood protection area in the study area is determined; approximately 12.0 sq.km in Cubatão river basin and 8.0 sq.km in Moji river basin, respectively, as illustrated in Fig. B.2.

According to this analysis, the maximum inundation depth for 50-

year return period, which is equivalent to the design scale of provisional flood control plan, is simulated approximately at 2.4 m in Cubatão river basin and 1.9 m in Moji river basin, respectively. Meanwhile, flood duration with 50-year return period is also simulated at around 3-4 hours in Cubatão river basin and 2-4 hours to reach peak inundation, lasting 2 days in Moji river basin. Inundation map due to 50-year probable flood is illustrated in Fig. B.3 for Cubatão river basin and in B.4 for Moji river basin.

With river improvement works designed for 10-year return period on the Moji mainstream, probable inundation is also simulated as shown in Table B.4. According to this analysis, flood situation was improved in rather upstream section of the Moji river: no inundation was simulated over the mesh number 20 below the 10-year return period, except for No.24. Maximum inundation depth with 10-year return period was estimated at 0.7 m.

3.2.2 Identification of damageable properties

Damageable properties are identified through the topographic information, aerial photographs, and field survey in order to clarify and acquire more precise indigenous information in some local areas, which will not be identified by static data.

Most of the municipal offices, a large number of commercial and services establishments, and public facilities are situated in the central zone of Cubatão municipality. Meanwhile, densely populated residential areas are located in the South and East of the municipal center. Moreover, in the circunference of the center, large scale industrial establishments are in operation. In particular, huge petrochemical complex is located on the North of Cubatão river, just opposite side of the municipal center. Other major petrochemical establishments are also located at the left bank of Cubatão river downstream the confluence with its tributary Perequê river.

Regarding the Moji river basin, large scale industrial estabilishments are in production as well. Particularly a series of petrochemical establishments are situated in the vicinity of Indio and Piaçaguera rivers, which are both large tributaries of Moji river.

Furthermore, Brazil's largest steel works are lying on the left bank and bending portion of Moji river.

With respect to the type of construction of residences and buildings, two-story buildings are common in the central zone of Cubatão. Most of the residential houses in the South and East of the municipal center are of single-story construction. Meanwhile, Vila Parisi area, the only residential area in Moji river basin, is occupied with slum houses by urban squatter of low income.

3.2.3 Inventory of damageable properties

Through the above procedure, damageable properties in both flood protection areas are estimated, as detailed in Table B.3. In Cubatão river basin, the numbers are as follows: 8,400 residences, 90 medium and small manufacturing establishments, 420 commercial and services establishments, and 6 major manufacturing establishments. In Moji river basin, these numbers are 250 residences, 10 small scale commerce and services shops, and 9 major manufacturing establishments.

In both flood protection areas, no damageable properties in primarity sector or agricultural sector are counted since there is no economic activities and no population engaged in this sector.

3.2.4 Estimation of unit value of damageable properties

(1) Residence

Most of the residences in the South and East of the Cubatão municipality are rather old, although new houses have been constructed in the surrounding areas. There are various types of houses in the flood protection area, varing from 2-story housing unit in center and 1-story house flat apartment to slum house in Vila Parisi area.

According to the state statistical information on population and residence in Cubatão, an average floor size is approximately 75 sq.m, 35 sq.m smaller than the state averge of 110 sq.m. Through the information from the municipality and real state, a standard unit construction cost

for a new house is around Cr$ 15,000 per sq.m. Hence, a complete new house with installed utilities comes to Cr$ 1,125 X 10^3. Household effect is then assumed at arround 25% of the value of a residence. Therefore, a well-furnished new house is estimated at Cr$ 1,406 X 10^3, consisting of Cr$ 1,125 X 10^3 for a housing unit and Cr$ 281 X 10^3 for household effects.

Taking the above results into consideration and actual situation from site survey, an average salvage value of a housing unit is assumed between 10% to 40% and 35% for household effects. In municipal center, a present average value of an existing house is estimated at Cr$ 400,000 comprising Cr$ 300,000 for a residence and Cr$ 100,000 for a household effects. Then the above average value is converted from place to place, considering housing quality and locality as follows: 80% in Vila Nova area, two-thirds or 65% in the East area of the center and 25% in Vila Parisi, where all the houses are made of destructed slum building.

(2) Industrial establishment

Properties of industrial establishment largely consist of fixed assets and inventory of stocks. The fixed assets are furthermore classified into (1) land and building such as office and factory, (2) equipment and machine, (3) installation for production, (4) utencil and furniture, (5) vehicle, and (6) intangible assets such as stock and bonds. Properties from item (2) to (5) and building in item (1), which are termed as depreciable assets, and (6) inventory stocks constitute damageable properties subject to flood disaster.

Asset holdings of the industrial establishments are estimated from the industrial census report in 1980, as shown in Table B.5. Based on the scale of production in the past and industry-wise asset holdings in the report, properties of the major establishments were estimated by establishment because of data availability, as shown in Table B.6.

The damageable values of industrial establishments are converted from that in 1980 to 1990, by price index of approximately 1.38 million over the unit rate in 1980.

Damageable properties for other small manufacturing

establishments in Cubatão is assumed at Cr$ 3 million for depreciable assets and Cr$ 2 million for inventory stocks.

(3) Services establishment

Damageable properties of commercial and services establishments are classified in the same manner as in the industrial establishment. Damageable properties are, hence, composed of (1) building, (2) office equipment and machine, (3) utencil and furniture, (4) vehicle, and (5) inventory stocks.

Asset holdings of the commercial and services establishment were estimated from the census report in 1980 as shown in Table B.7, as an average values in the whole state. The fixed tangible assets were estimated at Cr$ 873,200 at 1980 current prices. Inventory stocks, meanwhile, is estimated at Cr$ 678,000. Hence, damageable properties amount to Cr$ 1,551,200.

The fixed tangible assets of commercial and services establishments in 1990 are converted from that in 1980 by price index, as in the same process for industrial establishments. The estimated tangible assets are estimated at Cr$ 1.09 million, and Cr$ 0.85 million as the state average at the price level in May 1990. Finally, damageable properties for commercial and services establishments located in Cubatão are estimated varying 20-50% of the state average for both depreciable assets and inventory stock.

3.2.5 Flood damage rate

The standard flood damage rate for buildings and other properties is not available in Brazil. Therefore, based on the assumption that flood in study area would be similar to that in Japan in its characteristics and nature, the damage rates are assumed as follows:

(1) The damage rates elaborated by the Ministry of Construction in Japan is applied for estimation of flood damage in the study. Table B.8 indicates the flood damage rates by type of building and by inundation level.

(2) Damage rate to infrastructure is assumed to 25% of damageable properties for flood in Cubatão river basin, and 15% in Moji river basin, respectively.

(3) Damage rate of indirect damage to direct damage is assumed to be 10% of the direct damage which comprises damageable properties and damage to infrastructure.

3.2.6 Probable flood damage

Based on the result from the flood run-off simulation, valuation analysis on damageable properties and damage rate, probable flood damages are estimated for Cubatão and Moji river basins, as summarized below. This result is shown in Table B.9.

Probable Flood Damage

(Unit:Cr$ million)

	Return Period					
Basin	2	5	10	25	50	100
Cubatão	70.5	116.7	166.7	287.7	442.1	520.4
Moji	57.6	92.0	138.9	157.9	183.9	206.7
Moji (*)	64.0	101.3	130.9	140.8	157.4	168.9

Remarks: Moji (*) indicates probable flood damages with river improvement designed for 10-year return period.

3.3 Sediment Run-off Damage

3.3.1 Sediment run-off discharge analysis

Sediment run-off discharge analysis was made for design scale of 1/5, 1/25, 1/50 and 1/100 for 12 Sabo sub-basins. Results are shown in Table B.11 and summarized as below:

Design Sediment Run-off Discharge

(Unit: cu.m)

Sabo Sub-basin	Return Period 5	25	50	100
1	0	0	0	0
2	77,600	124,200	142,900	159,400
3	56,400	87,100	99,000	109,400
4	72,900	119,800	139,900	158,700
5	19,100	30,200	34,600	38,700
6	38,400	62,100	71,600	80,100
7	83,000	130,500	149,800	188,600
8	7,500	11,800	13,600	15,200
9	13,700	21,800	24,900	27,700
10	18,700	29,400	33,700	37,700
11	13,000	20,400	23,400	26,100
12	24,500	37,300	42,500	46,800

Fig.B.5 illustrates the general layout of the location of Sabo structures by Sabo Sub-basin.

3.3.2 Identification of damageable properties

Most of the target properties which would be vulnerable to sediment run-off disaster are industrial establishments locating in the very foot of the Serra do Mar as indicated in Table B.11. In particular, large scale petro-chemical refinery establishments are the most serious targets as follows: ULTRAFERTIL in sub-basin 1, COPEBRAS in sub-basin 2 and 3, and PETROBRAS in sub-basin 7 and 8.

On the other hand, sub-station facilities of ELETROPAULO, which is providing electricity for Cubatão as well as São Paulo are the target properties in sub-basin 10 and 11.

The state highway SP-150 (Anchieta) is at the risk of sediment

run-off disaster in sub-basin 12. Residences are the target properties only in sub-basin 9 and 12.

3.3.3 Inventory of damageable properties

Inventory of damageable properties for sub-basin 1, 2, 3, 7 and 8 are single petro-chemical refinery plant. Stockyard facilities of materials for petro-chemical products are the damageable properties in sub-basin 6. The sub-station of ELETROPAULO is also single properties against the risk of sediment run-off in sub-basin 10 and 11.

Collective housing is estimated at 9 units and 20 units with 25-year and 100-year probable sediment run-off, respectively, in sub-basin 9. Residential houses in sub-basin 12 are estimated at 75 and 200 for 25-year and 100-year return period, respectively, through the topographic map of 1 : 5,000 and the study result concerning the probable sediment discharge.

Traffic volume of the Anchieta highway as of the end of 1989 was recorded at annual 3.77 million through traffic survey conducted by DERSA. This traffic volume is equivalent of 10,330 daily, composed of 7,840 passenger cars, 2,250 trucks and 240 buses.

3.3.4 Estimation of damageable properties

(1) Residences

In the same procedure stated in the estimation of the unit value for flood damage, the present value of a furnished new house is estimated at Cr$ 1,406,000 comprising Cr$ 1,125,000 for house and Cr$ 281,000 for household effects. Salvage value is also assumed to be between 10% and 40% for housing unit and 35% for household effects. Then, a present average value of an existing house is estimated at Cr$ 400,000, which consists of Cr$ 300,000 for a residence and Cr$ 100,000 for a household effects.

Taking the above results into consideration, the above value is converted into Cr$ 225,000 for a house and Cr$ 93,000 for a household effects in and around the target area where houses are likely to be

subject to sediment run-off damage in sub-basin 12.

(2) Industrial establishments

Asset holdings of the industrial establishments are estimated by establishment, based on the census report in 1980 by converting into the price in 1990 by price index as explained in the flood damage, which is shown in Table B.6.

Damageable properties of respective establishments are estimated as follows: Cr$ 1,592 million for ULTRAFERTIL, Cr$ 3,430 million for COPEBRAS, Cr$ 1,820 million for UNION CARBIDE. Cr$ 14,485 million for PETROBRAS, and Cr$ 1,067 million for ELETROPAULO.

3.3.5 Damage rate of probable sediment run-off damage

The damage rate due to sediment run-off disaster is quite difficult to estimate. Hence, the estimation of damage rate was based on the experience of the sediment run-off damages in Japan, under the following assumption.

(1) The damage rate for building, equipment and installation is assumed to be 0.5 and 0.8 for other damageable properties such as utencil, vehicle and inventory stock conservatively.

(2) Damage rate to infrastructure is assumed to be from zero to 10% depending on the situation in each sub-basin.

(3) Damage rate of indirect damage to direct damage is assumed to vary 10% to 100%, depending on the possible impact to the society.

3.3.6 Probable sediment run-off damage

Based on the sediment run-off discharge analysis, estimation of damageable properties of industrial establishments and damage rate above, probable sediment run-off damages are estimated for 12 Sabo sub-basins. Results of the estimation is indicated in Table B.12, and summarized below:

Probable Sediment Run-off Damages

(Unit:Cr$ million)

Sabo Sub-basin	Return Period			
	5	25	50	100
1	-	-	-	-
2	82.8	398.9	466.1	513.6
3	21.2	303.3	411.0	538.8
4	27.3	45.0	52.5	59.6
5	7.2	11.4	13.1	14.6
6	14.4	23.3	26.9	75.5
7	127.2	240.9	309.0	420.9
8	31.2	38.3	38.9	39.5
9	10.3	55.3	72.1	114.8
10	9.4	37.4	91.0	123.8
11	96.6	145.2	180.7	204.4
12	65.8	200.1	572.9	758.4

4. PROJECTION OF PROBABLE FUTURE DAMAGE

4.1 Procedure and Preconditions of Projection

The structure and type of damageable properties are assumed to be the same as stated in section 3.1, even in the future. However, economic values of damageable properties might be considered to be different from the present ones. Distribution of damageable properties vulnerable to flood and/or sediment run-off disasters is likely to be different from the current location as well. These changes are assumed to proceed in accordance with the following process, taken into account the projection of future socio-economic conditions.

(1) The number of demageable residences in the future is assumed to be the same as under the present condition, in a conservative way.

(2) The average damageable values of both residence and its household effects are assumed to increase in proportion to GRDP per capita, as estimated in Table A.19.

(3) The total values of both depreciable assets and inventory stock in industrial sector, and commercial and services sector are also assumed to grow in proportion to the growth of GRDP.

4.2 Flood Damage

4.2.1 Change of damageable properties

The present distribution of damageable properties in the flood protection areas is enumerated in Table B.4. This distribution is basically assumed unchanged in Cubatão municipality because of the spacial limitation and overpopulation. Residential distribution of Vila Parisi area in Moji river basin is also assumed to be constant since this area is projected in the future to be used for the sites of services establishments although the implementation schedule and program has not yet formulated.

4.2.2 Probable future flood damage

The total value of damageable properties is estimated as a product of the number of units and the unit value of damageable properties which consist of housing unit and household effects in case of residence, and depreciable assets and inventory stocks in case of industrial, and commercial and services establishments. Unit values of damageable properties are estimated under the assumptions mentioned in the previuos section.

It is projected that flood damage potential will increase owing to development of economic activities, population growth and urbanization in the flood protection area. Project benefit, therefore,

is considered to also increase in accordance with the economic growth of the project area.

Probable flood damage in the future is simulated up to the year 2020, taken into account the change and increase of unit values of damageable properties. Table B.13 shows the probable flood damage for the period from 1990 to 2020 under the assumptions set out previously and without river improvement works. Table B.14, on the other hand, exhibits the probable flood damage with river improvement in the Moji river basin. The following table summarized the flood damage to be mitigated by implementation of the respective flood control plans.

Probable Flood Damage in Future

(Unit:Cr$ million)

Year	Basin	Return Period		
		10	25	50
1990	Cubatão	166.7	287.8	442.1
	Moji	138.9	157.9	183.9
	Moji (*)	130.9	140.8	157.4
2000	Cubatão	212.6	365.9	562.5
	Moji	185.8	211.2	246.0
	Moji (*)	175.7	188.9	211.1
2010	Cubatão	255.6	439.5	675.7
	Moji	226.2	257.2	299.5
	Moji (*)	214.0	230.2	257.2
2020	Cubatão	285.7	487.9	751.4
	Moji	275.2	312.9	364.4
	Moji (*)	260.7	280.4	313.3

Remarks: Moji (*) indicates probable flood damage with river improvement designed for 10-year return period.

4.3 Sediment Run-off Damage

4.3.1 Change of damageable properties

The present asset holdings of the major industrial establishments