

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF INTERNATIONAL AFFAIRS AND FOREIGN TRADE
MINISTRY OF ECONOMIC DEVELOPMENT
SANTA CRUZ REGIONAL DEVELOPMENT BOARD
REPUBLIC OF BOLIVIA


THE MASTER PLAN STUDY
ON
FLOOD CONTROL IN THE NORTHERN
RURAL REGION OF SANTA CRUZ
IN
THE REPUBLIC OF BOLIVIA

FINAL REPORT
MAIN REPORT

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF SUSTAINABLE DEVELOPMENT AND ENVIRONMENT
MINISTRY OF ECONOMIC DEVELOPMENT
SANTA CRUZ REGIONAL DEVELOPMENT CORPORATION
REPUBLIC OF BOLIVIA

**THE MASTER PLAN STUDY
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FLOOD CONTROL IN THE NORTHERN
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FINAL REPORT

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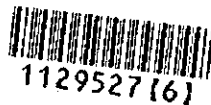
JUNE 1996

**PACIFIC CONSULTANTS INTERNATIONAL TOKYO
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(As of October, 1995)



PREFACE

In response to a request from the Government of the Republic of Bolivia, the Government of Japan decided to conduct a master plan study on Flood Control in the Northern Rural Region of Santa Cruz in the Republic of Bolivia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Bolivia a study team headed by Mr. Hajime Tanaka of Pacific Consultants International and composed of members from Pacific Consultants International and Central Consultants INC., three times between March 1995 and June 1996.

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

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

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

June 1996



Kimio Fujita
President

Japan International Cooperation Agency

The first part of the report deals with the general situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The second part of the report deals with the economic situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The third part of the report deals with the social situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The fourth part of the report deals with the political situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The fifth part of the report deals with the cultural situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The sixth part of the report deals with the educational situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The seventh part of the report deals with the health situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The eighth part of the report deals with the environmental situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The ninth part of the report deals with the international situation of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The tenth part of the report deals with the future of the country and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The eleventh part of the report deals with the conclusion of the report and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The twelfth part of the report deals with the appendix and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

The thirteenth part of the report deals with the bibliography and the position of the various groups. It is a very interesting and well-written account of the situation in the country and the position of the various groups.

THE MASTER PLAN STUDY
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FLOOD CONTROL IN THE NORTHERN RURAL REGION OF SANTA CRUZ
IN
THE REPUBLIC OF BOLIVIA

June, 1996

Mr. Kimio FUJITA
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

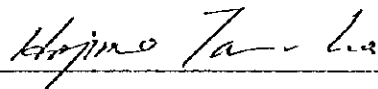
Dear Sir,

We are pleased to submit the final report entitled the "The Master Plan Study on Flood Control in the Northern Rural Region of Santa Cruz in the Republic of Bolivia." This report has been prepared by the Study Team in accordance with the contract signed on March 20, 1995, January 22, 1996 and May 20, 1996 between the Japan International Cooperation Agency and Pacific Consultants International in associate with Central Consultant Inc.

In the study, the Study Team based on the analysis of the existing flood and drainage problems in the northern rural region of Santa Cruz, presents a master plan of flood mitigation and drainage improvement measures and priority projects for Feasibility Study were identified. The report consists of the Summary, Main Report, Supporting Report and Data Book.

All members of the Study Team wish to express sincere appreciation to the personnel of your Agency, Advisory Committee, and Embassy of Japan in Bolivia, and also to the officials and individuals of the Government of the Republic of Bolivia for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of the study will contribute to the flood mitigation and drainage improvement and the socio-economic development in the northern rural region of Santa Cruz.

Yours Faithfully



Hajime TANAKA

Team Leader of the Study Team



THE MASTER PLAN STUDY ON FLOOD CONTROL IN THE NORTHERN RURAL REGION OF SANTA CRUZ IN THE REPUBLIC OF BOLIVIA

OUTLINE OF THE STUDY

1. The study area (approximately 7,000 km²) is situated in the northern rural area of Santa Cruz that is the capital city of the Department of Santa Cruz, located in the eastern part of the Republic of Bolivia. The population of the Department was 1,364,389 in 1992 that accounted for 21 % of the population of the country. The GDP of the Department accounted for about 30 % of the Bolivian GDP in 1992.

The study area was mostly cleared of forest for cultivation or grazing ground by the first half of 1980s and has become an important agricultural center, producing soybeans, sugarcane, rice and livestock. Also the agro-based industries in the Department are mostly located in the study area and play an important role in the regional socio-economy.

However, the study area has been suffering from floods yearly from the rivers, including the major rivers such as the Rio Grande, Rio Pirai and Rio Yapacani. The most severe damages in record were caused by the 1992 floods. The flood hazard areas by the annual floods and by the 1992 floods are estimated to be 2,444 km² and 4,857 km² respectively. The dominant colonies such as Okinawa, Aroma, Puest Fernandez, San Juan and Antofgasta, are mostly located in the flood hazard area.

The study area is extremely vulnerable to flood and drainage problems due to the flat topography and difficult meteo-hydrological conditions. These problems are serious constrains for stabilization and further development.

The situation of flood damages and flood hazard area have been studied and optimum flood mitigation and drainage improvement measures have been studied for the study area.

2. Master Plan for Flood Mitigation and Drainage Improvement

2.1 Basic Concept

The flood hazard areas and poor drainage areas have been assessed based on the flood conditions such as flood depth, duration, damage and land use, and divided into the following areas:

- 1 The area for structural measures with non-structural measures:

The area was selected based on the following criteria:

- Intensive land use areas such as urban and intensive farming areas affected by annual floods,
- Intensive land use areas severely affected by the 1992 floods i.e., flood depth more than 50 cm and duration more than 2 days,

- 2 The area for non-structural area:

The area was selected based on the following criteria:

- Not intensive land use areas such as pasture and forest areas both in the annual flood hazard area and in the 1992 floods hazard area,
- Intensive land use areas in the 1992 flood hazard area with less than 50 cm deep and 2 days long.

However, the area influenced directly by the Rio Pirai is not included, because the main reach of the Rio Pirai has already had a master plan for the management and training of the main river reach.

The structural measure area was divided by river or drainage basin into the following seven basins:

a. Chane - Pailon Area

- 1 Rio Chane,
- 2 Rio Pailon,
- 3 Chane - Chacras,
- 4 Queb. Chane,
- 5 Okinawa drainage.

b. San Juan - Antofagasta

- 1 San Juan,
- 2 Antofagasta.

The design scales were decided as follows:

- 1 Flood mitigation facilities: 10-year frequency flood with an allowable inundation depth of 30 cm,
- 2 Drainage improvement facilities: 5-year frequency storm runoff with an allowable inundation depth of 30 cm
- 3 Important or fundamental public facilities such as national road bridges, the design scale of a 50-year frequency flood should be considered according to the scale of 1992 floods.

The target year of the Master Plan was decided to be the year of 2010 considering the target years of the national development plan and the regional development plan.

Socio-economic frames of the target year of 2010 were estimated as follows:

- The mean annual growth rate of population in the study area was estimated to be 2.3 % for the period. The population of the study area was estimated to be 300,000 in 2010 from 198,000 in 1992, according to CORDECRUZ.

The population will increase in the urban areas, but not increase in the rural area.

- According to the Land Use Plan of the Department, the study area is located in the intensive agricultural area, including intensive cattle raising area. The land uses in 2010 was estimated to be the same as those in 1995, because the study area was mostly cleared for cultivation or grazing ground by the first half of 1980s and the land use has been kept same since the 1980s.

- The national economic growth for the next decade was targeted by the national economic development plan at a rate of 5 % per annum in GDP.

2.2 Flood Mitigation Measures

The proposed measures for flood mitigation and drainage improvement are consisting of structural measures and non-structural measures as follows:

(1) Structural Measures

The structural measures are composed of river improvement works that increase conveyance capacities of channels by widening, deepening and improving channels, and embankment (including road-cum embankment) that confine the flow within a channel, and drainage improvement works.

The road-cum-embankment is planned between the Arroyo Yapacanicito Basin and Arroyo Jochi Basin. The purpose of the road-cum-embankment is to separate the flood water of these two basins as well as to reinforce the evacuation and transportation route during floods.

The flood mitigation and drainage improvement works are summarized in the following table:

<u>Structural Measures</u>				
Project	River Improvement	Main Drainage	Secondary Drainage	Road cum Embankment
1. Chane-Pailon				
-1 Rio Chane	27.0 km	0	0	0
-2 Rio Pailon	32.0 km	6.5 km	50.0 km ²	0
-3 Okinawa Drainage	-	21.5 km	147.0 km ²	0
-4 Quebrada Chane	34.0 km	8.0 km	0	0
-5 Chane-Chacras	36.5 km	21.0 km	284.0 km ²	0
2. San Juan-Antofagasta				
-1 San Juan	14.1 km	41.3 km	115.0 km ²	0
-2 Antofagasta	20.3 km	10.0 km	97.0 km ²	9.0 km
Total	163.9 km	108.3 km	693.0 km ²	9.0 km

For Chane-Pailon area, considering the situation of the Rio Chane that is strongly affected by the flood of the Rio Pirai, two alternative plans were planned as follows:

- Alternative-I is consisting of the Rio Chane and all the other sub projects,
- Alternative-II is consisting of all the sub projects except the Rio Chane.

For San Juan-Antofagasta area, considering the flow capacities of approximately 2 year frequency of the existing drainage mains, two alternatives were planned as follows

- Alternative-I is consisting of San Juan and Antofagasta sub projects. In alternative-I the flow capacities of the existing drainage mains of San Juan area are planned to be maximized by rehabilitation and the surplus storm runoffs are planned to be drained by supplementary drainage facilities to the Arroyo Yapacanicito.
- Alternative-II is also consisting of San Juan and Antofagasta sub projects. In alternative-II the drainage mains of San Juan area are planned to be enlarged to discharge the design storm runoffs by improvement.

(2) Non-structural Measures

Non-structural measures are planned to be applied for the entire flood hazard area. The structural measures will generally need a long time before completion and the flood and drainage problems should be mitigated by non-structural measures as much as possible. The proposed non-structural measures are composed of the followings:

a. Non-structural measures for flood mitigation

- 1 Flood warning and evacuation systems for reducing casualties and flood damages,
- 2 Flood proofing and flood plain management for reducing flood damages caused by inappropriate land use in the flood hazard area,
- 3 Land use control for retarding basins and others for utilization and maintenance of retarding or regulation effects of natural swampy areas,
- 4 Preservation of protected forest along river channels for preservation of the natural environmental resources,
- 5 Land use management for farm lands and forest areas for reducing flood damages by appropriate management of farm lands and forest areas.

b. Non-structural measures for drainage improvement

- 1 Introduction of appropriate water tolerant crops or varieties for reducing damages caused by drainage problems,
- 2 Introduction of proper farm land management for reducing the damages caused by drainage problems by proper farm land management.

2.3 Project Cost

The construction costs are composed of direct cost and indirect cost. The indirect construction costs are estimated to be 30 % of the direct construction cost.

The project costs are composed of direct cost, indirect cost and contingency. The indirect costs of administration, engineering service and physical contingency are estimated to be 5 %, 10 % and 15 % of the direct construction cost.

The project costs were estimated and summarized as follows:

1) Alternative-I

(Unit: 1,000 Bs.)

Sub-Project	L/C	F/C	Total
1. CHANE-PAILON	449,234	453,041	902,275
(1) Rio Chane	82,582	93,166	175,748
(2) Rio Pailon	144,415	145,967	290,382
(3) Chane Chacras	110,375	107,675	218,050
(4) Queb. Chane	66,771	59,508	126,279
(5) Okinawa Drainage	45,091	46,725	91,816
2. SAN JUAN-ANTOFAGASTA	92,613	94,727	187,340
(6) San Juan	42,042	44,796	86,838
(7) Antofagasta	50,571	49,931	100,502
Total	541,847	547,768	1,089,615

Note: 1.0 US\$ = Bs. 4.86 = Yen 100.0

2) Project costs of Alternative-II

(Unit: 1,000 Bs.)

Project	L/C	F/C	Total
1. CHANE-PAILON	366,652	359,875	726,527
(1) Rio Chane	-	-	-
(2) Rio Pailon	144,415	145,967	290,382
(3) Chane Chacras	110,375	107,675	218,050
(4) Queb. Chane	66,771	59,508	126,279
(5) Okinawa Drainage	45,091	46,725	91,816
2. SAN JUAN-ANTOFAGASTA	98,204	100,663	198,867
(6) San Juan	47,633	50,732	98,365
(7) Antofagasta	50,571	49,931	100,502
Total	464,856	460,538	925,394

Note: 1.0 US\$ = Bs. 4.86 = Yen 100.0

For economic evaluation, OM cost of 1 % of the direct construction cost, the price contingency is estimated assuming the inflation rate to be 4 % per annum for foreign currency and 7 % per annum for the local currency portion.

- 2.4 The implementation period is planned to be complete by 2010, including a preparation period.
- 2.5 The economic benefit was assessed by comparing the flood damages in the "with and without project" situation. The flood damages are classified into the following categories:
- Direct damage to building and household effects,
 - Direct damage to agricultural crops and livestock,
 - Damage to public facilities, including transportation and agricultural facilities,
 - Income /profit losses in business activities.

The EIRR values of the projects are estimated as follows:

	Sub Projects	EIRR (%)	
		Alternative-1	Alternative-2
1	Chane-Pailon	11.04	14.00
	-Rio Chane	Negative	Excluded
	-Rio Pailon	14.33	14.33
	-Queb. Chane	12.52	12.52
	-Chane Chacras	15.38	15.38
	-Okinawa Drainage	12.21	12.21
2	San Juan-Antofagasta	13.41	12.51
	-San Juan	9.97	8.48
	-Antofagasta	16.24	16.24

2.6 Environmental Impact

The improvement of river channels will increase their flow capacities and might give impacts not only to the fauna and flora along the river channels, but also to the ground water table in the flood mitigation areas. However, the adverse environmental impacts will not be significant. From Initial Environmental Evaluation (IEE), Environmental Impact Assessment (EIA) will be required for the further study stage.

2.7 Project Evaluation

The structural measures in the Master Plan were evaluated from technical, economical, social and environmental terms. The technical efficiency is evaluated by reduction effect in flood area, depth and duration. The economic efficiency is evaluated mainly by EIRR of which the values of higher than 10 % is considered to be feasible due to the opportunity cost of capital, estimated to be between 10 % and 12 %. The social and environmental terms are evaluated by reduction of flood hazard area.

1) Chane-Pailon Area

The structural measures for the area are feasible as a whole in technical, economical, social and environmental.

The conditions of inundation at the sub projects, i.e., Rio Pailon, Quebrada Chane, Chane-Chacras and Okinawa Drainage, will be very much improved by both of Alternative-I and Alternative-II. However, the amount of the increasing of flood water level of Rio Chane of Alternative II will be 0.5 m to 0.9 m for 10 year floods.

The EIRR values of 11.04 % for alternative-I and 14.00 % for alternative-II (without improvement of the Rio Chane). The EIRR values of all sub-projects except the Rio Chane show higher values than 12.21 %.

The social impacts will be significant both of Alternative-I and Alternative-II due to the protected area of 470 km²,

As positive social impacts, the mitigation of flood damages, the generation of employment opportunity and enhancement of land use potential of flood protected land will be expected.

Environmental adverse effects by the projects will be not significant, except the Rio Chane in Alternative-II.

From technical, economic, social and environmental aspects, the alternative-I is recommended in order to avoid any adverse social and environmental effects, because the estimated flood conditions will become worse than the existing condition. The priority orders of the sub projects are:

1st Priority:

- Rio Chane
- Rio Pailon
- Okinawa drainage

2nd Priority:

- Chane-Chacras

3rd Priority:

- Quebrada Chane

2) Sun Juan-Antofagasta Area

The structural measures for the area are feasible as a whole in technical, economical, social and environmental. The conditions of inundation will be very much improved by both of Alternative-I and Alternative-II.

The structural measures for the area are feasible as a whole with the EIRR values of 13.41 % for Alternative-I (with rehabilitation of the drainage mains) and 12.51 % for Alternative-II (with improvement of the drainage mains). Although the structural measures for San Juan was evaluated marginal with EIRR value of 9.97 %.

The social impacts will be significant at both of Alternative-I and Alternative-II due to the protected area of 210 km². The positive social impacts like the Chane-Pailon area will be expected. It is considered to be viable from the socioeconomic aspects because the area is one of the most developed agricultural area. Environmental adverse effects by the projects will be not significant.

From technical, economic, social and environmental aspects, the alternative-I is recommended. The priority orders of the sub projects are:

1st Priority:

- Antofagasta

2nd Priority:

- San Juan

2.8 Priority Projects for F/S

According to the project evaluation urgent measures that have high technical, economic efficiencies and social importance were selected for the priority projects as follows:

- 1 Alternative-I of Chane Pailon area
 - Rio Chane,
 - Rio Pailon,
 - Okinawa Drainage.
- 2 Alternative-I of San Juan-Antofagasta area
 - Antofagasta.

A draft of terms of reference of the F/S is attached to Appendix-C of the main report.

2.9 The existing organizations related to flood mitigation are MDS, SENAMHI, SEARPI, CDF, CORDECRUZ, MDN and Municipalities. For implementation of the Master Plan,

the overall coordination shall be provided by the Ministry of Sustainable Development and Environment and CORDECRUZ.

2.10 The implementation of the proposed measures is planned to be carried out from 1996 to 2010 as follows:

Stage-1: Preparatory period from 1996 to 2000

- 1 Institutional Arrangement
- 2 Execution of F/S and D/D on the priority projects,
- 3 Preparation of execution of non-structural measures,
- 4 Implementation of measures for early implementation,
- 5 Improvement of the hydrological observation network,
- 6 Preparation of complementary studies on the Rio Grande, Rio Pirai and Rio Yapacani, and improvement works of secondary roads.

Stage-2: Implementation of proposed measures from 2001 to 2010.

- 1 Institutional arrangement for execution of the Master Plan,
- 2 Implementation of the priority measures identified in the F/S,
- 3 Execution of non-structural measures,
- 4 Implementation of complementary works and studies.

3. Conclusion and Recommendation

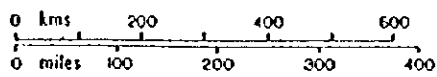
(1) It is concluded that the proposed flood mitigation and drainage improvement plans will be feasible in technical, economic, social and environmental terms. The study area needs immediate action for implementation of the proposed plans.

The proposed plans will enable the study area to mitigate flood and drainage problems and to stabilize the agricultural sector. The stabilization will enable the study area to achieve a growth rate of 5 % per annum that is the target of the national economic development plan by enhancement of high land use efficiency, expansion of planted area, increase of yield, decrease of post harvest damage and introduction of high

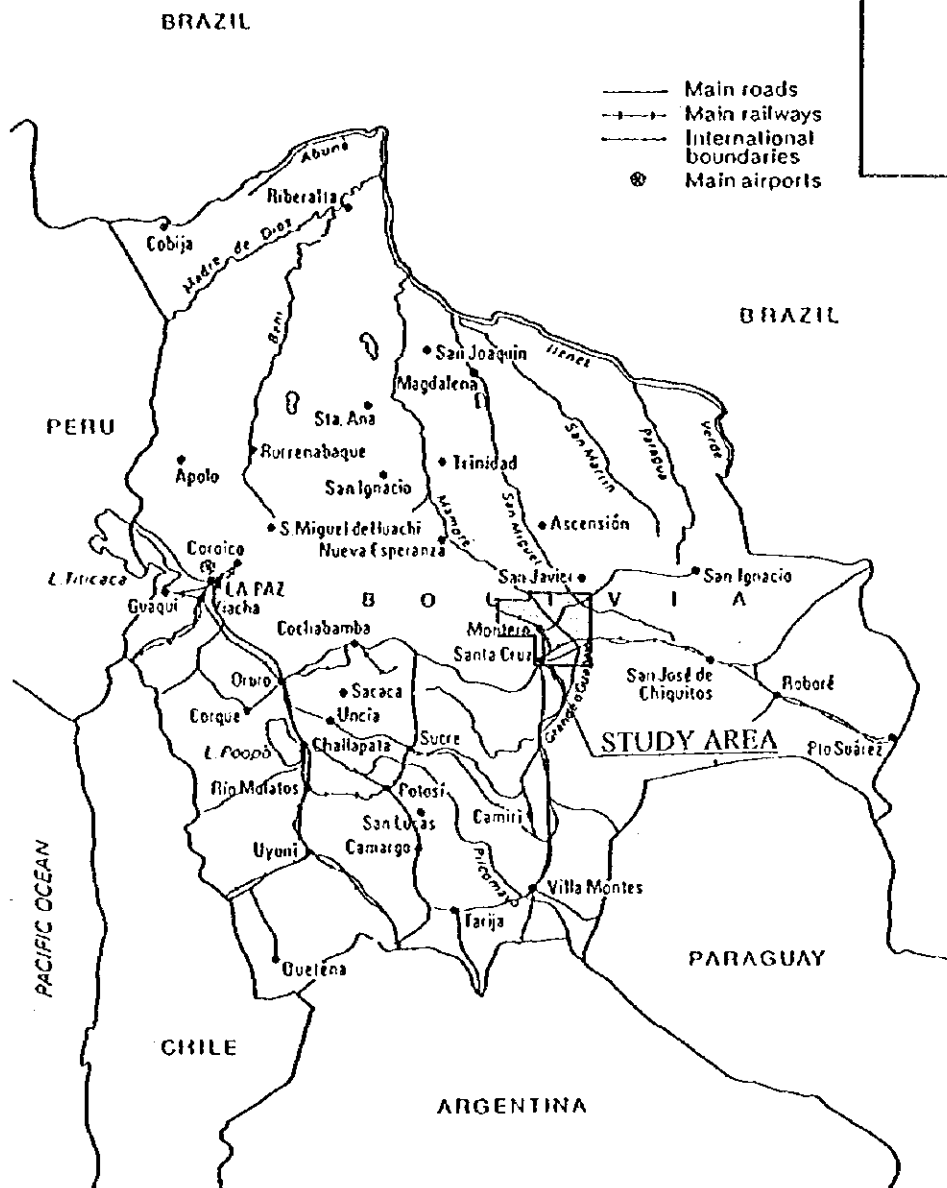
productive crops. Also high positive social impacts such as the generation of employment opportunities will be expected.

In order to attain the expected project benefit, prompt actions will be required for the following actions.

- (2) It is necessary for the study area to take an immediate action for execution of F/S for the urgent measures.
- (3) Preparatory works for regulation or preliminary design of non-structural measures should be started immediately in order to facilitate the non-structural measures for flood mitigation.
- (4) An implementation organization should be established for smooth execution of the Master Plan, in order to carry out structural and non-structural measures smoothly, and also to control & manage the land use effectively. The following ideas should be taken into consideration for establishing the organization:
 - 1 The organization should be a strong implementation and coordination organization at Prefecto level.
 - 2 Some of the counterpart of the Master Plan Study should be assigned for the organization because of their basic knowledge of the Master Plan.
 - 3 Also some of the members should be selected from CORDECRUZ, SEARPI and SENAMHI.
 - 4 The Organization is responsible to establish new organization for execution of the proposed measures and OM after implementation of urgent flood mitigation and drainage improvement measures.
- (5) Improvement of the existing hydrological observation network should be carried out immediately in connection with warning systems and complementary development studies.
- (6) Complementary development studies and works mentioned in the Master Plan should be carried out to support the regional development.



- Main roads
- +— Main railways
- |— International boundaries
- ⊙ Main airports



LOCATION MAP

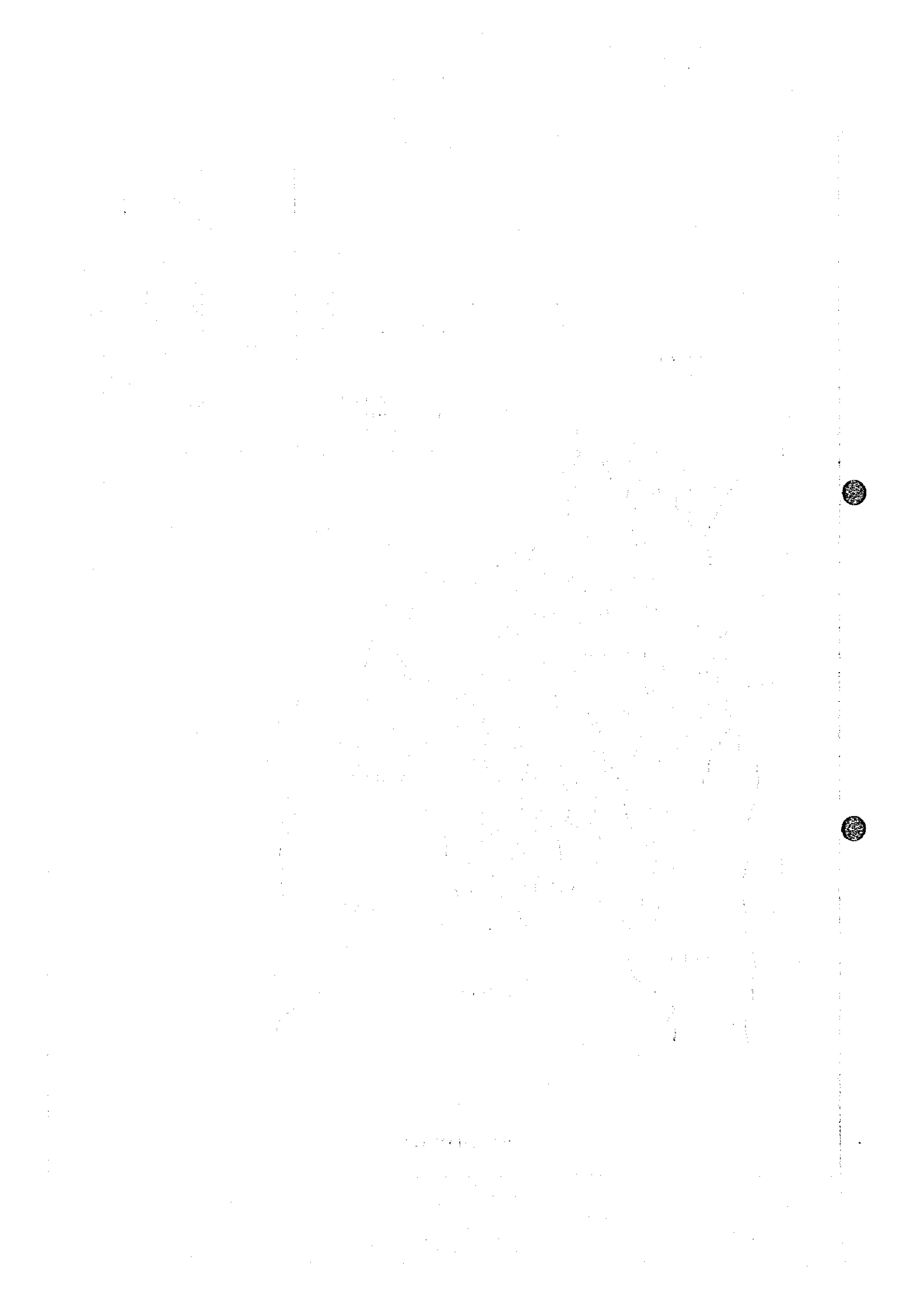


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ABBREVIATIONS

AASANA:	Administración Autónoma de Servicios la Navegación Aérea
ADEPLE:	Asociación de Productores de Leche
CAICO:	Cooperativa Agropecuaria Integral Colonias Okinawa Ltda.
CAISY:	Cooperativa Agropecuaria Integral San Juan de Yapacaní Ltda.
CAO:	Cámara Agropecuaria del Oriente
CDF:	Center of Forest Development
CETABOL - JICA:	Centro Tecnológico Agropecuario en Bolivia - JICA
CIF:	Cost, Insurance and Freight
CNPV:	Encuesta Demográfica Nacional de Población y Vivienda
COD:	Chemical Oxygen Demand
CORDECRUZ:	Corporación Regional de Desarrollo de Santa Cruz (Santa Cruz Regional Development Corporation)
DHI:	Internacional Hydrological Decade
EDEN:	Encuesta Demográfica Nacional
EEC:	European Economic Community
EIA:	Environmental Impact Assessment
ENDSA:	Encuesta Nacional de Demografía y Salud
ENPV:	Encuesta Nacional de Población y Vivienda
FEGASACRUZ:	Federación de Ganaderos de Santa Cruz
FOB:	Free on Board
GDP:	Gross Domestic Product
GOB:	The Government of Bolivia
GOJ:	The Government of Japan
JICA:	Japan International Cooperation Agency (Agencia de Cooperación Internacional del Japón)
MDN:	Ministerio de Defensa Nacional (Ministry of National Defense)
MDSMA:	Ministerio de Desarrollo Sostenible y Medio Ambiente (Ministry of Sustainable Development and Environment)
OMM:	World Meteorological Organization
OTAI:	Organización de Técnicos de la Agro-Industria
SEARPI:	Servicio Encauzamiento de Aguas y Regularización del Río Piraií
SEDAMA:	Secretarías Departamentales del Medio Ambiente
SENAMHI:	Servicio Nacional de Meteorología e Hidrología
SENMA:	Secretaría Nacional de Medio Ambiente
SNA:	Servicio Nacional de Aerofotogrametría
SNC:	Servicio Nacional de Caminos

CHAPTER 1
INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background

This is the Final Report for the Master Plan Study on Flood Control in the Northern Rural Region of Santa Cruz, in the Republic of Bolivia.

The Study was conducted according to the Scope of Work agreed upon between the Santa Cruz Regional Development Corporation (hereinafter referred as "CORDECRUZ") and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on December 14, 1994. The Master Study was started at the end of March 1995.

The Department of Santa Cruz is located in the east central region of the country and covers an area of 370,000 km². The population of the Department is 1.4 million and about 80 % of the population is living in the urban area of Santa Cruz which is the second largest city in the country.

The Department is not only rich in the natural resources such as oil, natural gas and iron ore, but also favored with a vast potentially good farming land. The Department has 42 % of the agricultural land of the country, accounted for 36 % of the national agricultural production according to the agricultural census in 1991.

The Department has been developed as one of the most important colonization centers since 1954, when the national road from Cochabamba to Santa Cruz was open. The population of the Department has increased rapidly by emigrants from the Altiplano and immigrants from outside the country foreign and now the Department has become the most important agricultural area in the country. The urban area and the northern rural area of Santa Cruz have formed an integrated development area.

However, the area is vulnerable to flood and drainage problems, because of the natural conditions. The area is composed of flat alluvial plains formed by the Rio Grande, Rio Pirai and Rio Yapacani and there are a lot of low-lying or depressed lands. Also the area has been affected by heavy rainfalls periodically.

The urban area of Santa Cruz was damaged severely by the floods from the Rio Pirai in 1983. Soon after the 1983 floods, CORDECRUZ established the Servicio de Encauzamiento y Regulacion de Aguas del Rio Pirai (SEARPI), to deal with the coordination and planning of social and economic development of the Rio Pirai basin

and in particular with its preservation and reclamation. SEARPI has conducted a Master Plan Study on the Rio Pirai basin by the EEC's assistance and constructed a flood embankment for the urban area of Santa Cruz.

The northern rural area of Santa Cruz was damaged severely by the floods in 1992. More than a half of the rural area was inundated and damaged by the floods. Not only the rural settlements and their agricultural products, but also major transportation facilities such as fundamental roads and bridges, were damaged severely. In order to promote the sustainable development that is the national development policy, the northern rural area should be stabilized by optimum flood mitigation and drainage improvement measures.

The Government of Bolivia requested the Government of Japan to conduct a Master Plan Study for flood mitigation of the northern rural area of Santa Cruz.

1.2 Objectives and Study Area

The objectives of the study are:

- (1) To formulate a comprehensive master plan on flood control for the study area.
- (2) To pursue technological transfer to the counterpart personnel through on the job training in the course of the study.

The study area is approximately 7,000 km² in the northern rural region of the city of Santa Cruz between the Rio Grande and the Rio Yapacani. The study area is shown in *Fig. 1.1*.

As for the main reach of Rio Pirai the study is limited to the review of existing data in order to plan necessary measures for the other river basins, because the basin has already had a master plan for the management and training of the main reach.

1.3 General Approach

The study has been conducted in collaboration with CORDECRUZ and other related government authorities. In order to make an optimum plan for mitigation of flood and drainage problems of the study area, necessary studies and supplementary field surveys have been conducted on the existing conditions and the current flood damages, including the 1992 floods that caused the most severe flood damage registered in the

study area. An optimum Master Plan including Priority Projects for the F/S study and an implementation program are proposed.

1.4 Study Schedule

The Study is composed of the following two phases:

(1) Phase-1: Basic Study (from March 1995 to August 1995)

The major works are as follows:

- Collection of data and information,
- Execution of field investigation and surveys,
- Review and preliminary analysis of collected data and information,
- Formulation of a basic idea of optimum flood mitigation measures for a Master Plan.

During the Phase-1 the following reports were issued:

- Inception Report (March 1995)
- Progress Report-1 (June 1995)
- Interim Report (August 1995)

(2) Phase-2: Formulating of a Master Plan (from September 1995 to March 1996)

The major works are as follows:

- Supplementary data collection,
- Execution of supplementary surveys and analyses,
- Formulation of a master plan,
- Initial environmental examination,
- Evaluation of the proposed master plan,
- Preparation of an implementation program,
- Identification of high priority projects for a feasibility study.

During the Phase-2 the following report was issued before this report:

- Progress Report -2 (December 1995)
- Draft Final Report (March 1996)

1.5 Composition of Report

The report consists of four parts; a Summary Report and a Main Report briefing the study results and the proposed master plan, and Supporting Reports from A to K dealing with detailed technical aspects of the study, and a Data Book. These outputs are listed below:

- 1) Summary Report
- 2) Main Report
- 3) Supporting Reports: I (A to K)
 - A: HYDROLOGY
 - B: SOCIO-ECONOMY
 - C: FLOOD AND FLOOD DAMAGE
 - D: REGIONAL DEVELOPMENT
 - E: AGRICULTURE AND LAND USE
 - F: FLOOD MITIGATION
 - G: DRAINAGE IMPROVEMENT
 - H: ENVIRONMENT
 - J: ORGANIZATION
 - K: PROJECT EVALUATION
- 4) DATA BOOK

1.6 Execution of the Study

The study was carried out by the study team composed of consultants retained by JICA and officials of CORDECRUZ and concerned agencies of the Government of Bolivia.

A list of study participants and the minutes of meetings are shown in Appendix - A and Appendix - B respectively.

FIGURES

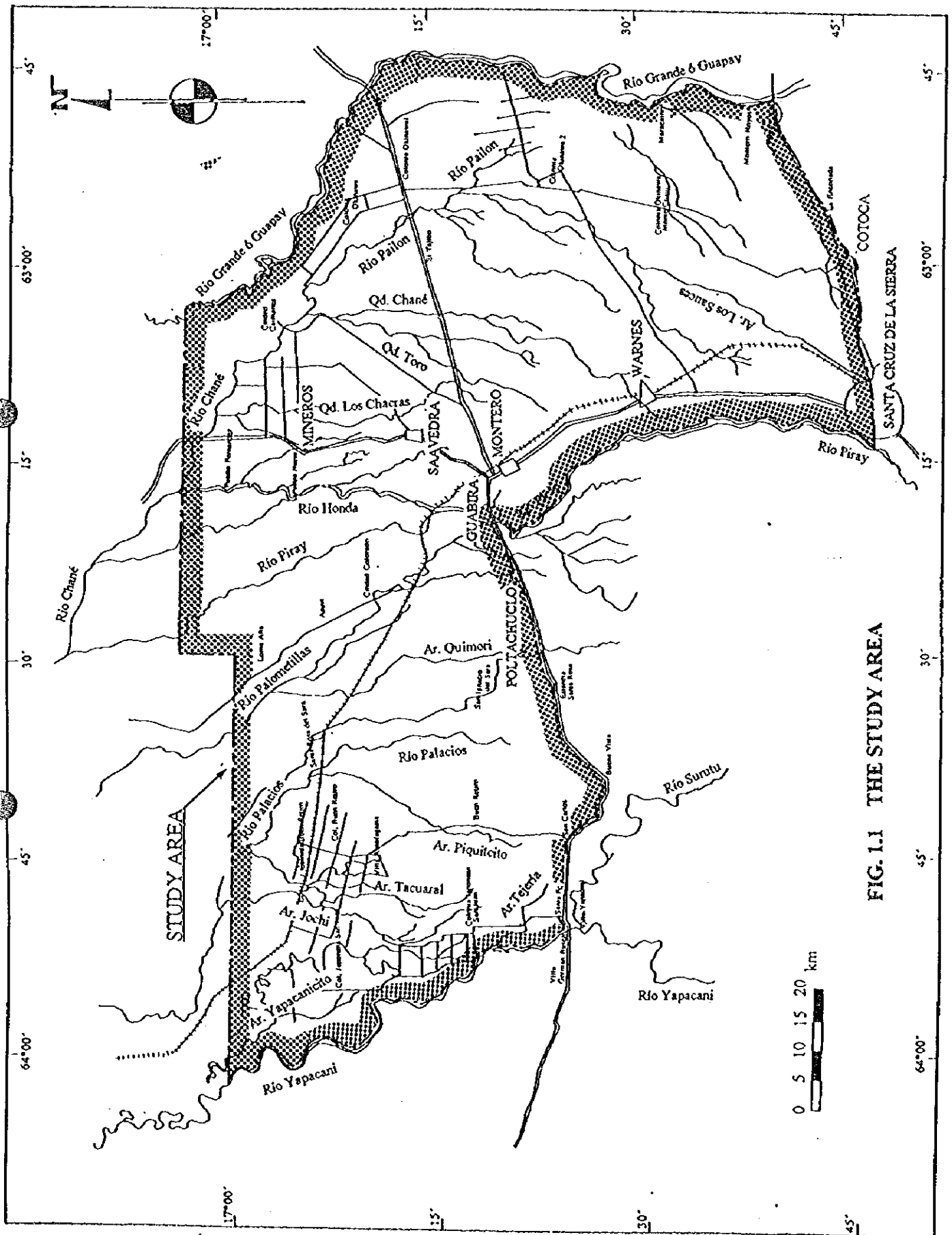


FIG. 1.1 THE STUDY AREA

CHAPTER 2
STUDY AREA



CHAPTER 2 STUDY AREA

2.1 General

The study area (approximately 7,000 km²) is situated between lat. 16° 50' S - 17° 50' S and long. 62° 45' W - 64° 00' W in the northern part of the city of Santa Cruz, which is the capital city of the Department of Santa Cruz.

The study area is administratively related to five provinces, i.e., Andres Ibanez, Warnes, Ichilo, Sara and Obispo Santistevan, and located in the integrated development area that is the most developed area in the Department. The related administrative districts are shown in *Fig. 2.1.1*.

The topography of the study area is mostly composed of flat alluvial plains, alluvial terraces and low-lying areas, formed by the Rio Pirai, Rio Grande and Rio Yapacani. The land form is inclined at 1/400 - 1/1000 to the northward. There are depressed lands and low-lying areas developed locally which are mostly vulnerable to flood and drainage problems. The general topography and river bed slopes are shown in *Fig. 2.1.2*.

The climate consists of dry season (from April to October), wet season (from October to March) and transition seasons (March to April and September to October).

The annual rainfall amount varies locally and seasonally. The mean annual rainfalls in the western part and in the eastern part are 1898 mm and 1274 mm respectively. Rainfall amount in the wet season is about 60 to 70 % of the total annual rainfall.

The river systems consist of three major rivers, namely, Rio Grande (106,000 sq. km), Rio Pirai (10,660 sq. km) and Rio Yapacani (9,969 sq. km).

The general conditions related to flood mitigation aspects are explained below.

2.2 River Characteristics

2.2.1 River System

The study area is bounded by the Rio Grande in the east, Rio Piray in the center and Rio Yapacani in the west. The Rio Chane Basin, Rio Palometillas Basin and Rio Palacios Basin exist among the above three rivers. Catchment areas of the Rio Chane,

Rio Palometillas and Rio Palacios basins are 2,271 km², 878 km² and 1,827 km² respectively. Those of the Rio Grande, Rio Piray and Rio Yapacani basins in the study area are 1,248 km², 1,165 km² and 536 km² respectively.

The major rivers of Rio Chane Basin are Rio Chane, Rio Pailon, Quebrada Chane and Quebrada Las Chacras. Those of Rio Palometillas Basin are Rio Palometillas and Arroyo Quimori. The major rivers of Rio Palacios Basin are Rio Palacios, Arroyo Tacuaral and Arroyo Jochi. Arroyo Yapacanicito and Tejeria belong to the Rio Yapacani Basin. Location and catchment areas of the river basins in the study area are shown in *Fig. 2.2.1*.

2.2.2 River Topography

(1) Eastern part

In the eastern part of the study area, ground elevation is higher in the south-western direction and lower in the north-eastern direction. This part is related to the Rio Grande and the Rio Chane.

The Rio Grande forms natural levees along the banks and the river bed elevation is slightly higher than those of the Rio Pailon as well as the Rio Chane in the downstream reaches from Okinawa II. Accordingly the drainage basin of Okinawa I belongs to the Rio Grande Basin.

The Rio Chane Basin covers most of the eastern part. Main stream of the river (Arroyo Los Sauces - Rio Pailon - Rio Chane) flows at a distance of about 140 km from the city of Santa Cruz to the junction of the Rio Piray with the Rio Chane.

The Rio Pailon, Quebrada Chane, Quebrada El Toro, Quebrada Las Chacras are the major tributaries of the Rio Chane. Their river bed slopes change at the National Road No. 9. In the upstream basins from the National Road No. 9, there are many swampy areas.

(2) Central Part

The main stream of Rio Piray passess through central part. In the downstream reaches from the National Road No. 7, the Rio Piray has changed its river course to the Rio Honda, since 1983 Floods. The river course of these downstream reaches of the Rio

Piray is still unstable, most likely due to the heavy sediment discharge from the upper reach as well as frequent floods.

(3) **Western Part**

In the western part, elevation is higher in the southern portion and lower in the northern portion. At the northern boundary of the study area around Santa Rosa del Sara, there exists a mountainous area.

The Rio Palometillas flows along the north-west direction. Around the junction of the Rio Palometillas with Arroyo Quimori, there exists a low-lying area.

The Rio Palacios flows around to north-western direction. Around the junction of the Rio Palacios with Arroyo Tacuaral as well as Arroyo Jochi, there exists a vast swampy area.

The Arroyo Jochi flows near the mid-stream of Arroyo Yapacanicito and the flood water affects Arroyo Yapacanicito. At the junction of the Arroyo Tacuaral with the Arroyo Jochi, a swampy area has formed.

The Rio Yapacani meanders in the downstream reaches of the National Road No. 7.

2.2.3 Flow Capacity

The river cross sections are rather small compared to the respective areas of river basins as shown in *Fig. 2.2.2*.

Flow capacities of the major rivers in the study area were checked by using uniform flow calculation based on the river cross sections surveyed. Flow capacities of the rivers in the study area are rather smaller than the annual flood discharges as shown in *Fig. 2.2.3*.

2.2.4 Sediment Transport

The Rio Grande, Rio Piray, Rio Yapacani are active in sediment production, transportation and deposition.

According to the study report on "The Master Plan for Management and Training of the Rio Piray Basin in 1991", the stretch from the confluence of the Rio Guardia to the railway bridge has strong deposition of sediment. The situation of sedimentation

along the main stream from La Angostura to the confluence with Rio Chane, with a river stretch of 170 km, was reported as follows;

<u>River Stretch</u>	<u>Sedimentation</u>
A. La Angostura to La Guardia:	Morphological equilibrium
B. La Guardia to Rio Guenda Confl.:	Low deposition, 2.6 mm/year
C. Rio Guenda Confl. to the railway bridge:	Strong deposition, 35 mm/year
D. The railway bridge to Rio Chane Confl.:	Medium deposition, 7 mm/year

2.3 Related Plans and Facilities

2.3.1 Related Plans and Projects

There are three projects that are related to this project. They are the "Flood Protection Project for the Rio Piray", "Improvement of the National Road No. 9" and the "Bridge Construction Project for the National Road No. 9".

(1) Flood Protection Project for the Rio Piray

SEARPI prepared to start the detailed design of the priority project with the assistance of EC. The design work will undertake Section-A and part of Section-B around Montero that are among the three sections recommended in the feasibility study. The major works are as follows:

<u>Work Item</u>	<u>Section-A</u>	<u>Section-B</u>
1. Dike construction	58.0 km	31.9 km
2. Bank Protection		
Type-A	29.5 km	
Type-B	7.8 km	
Soil cement	2.7 km	0.2 km
3. Excavation	3.2 M m ³	0.7 M m ³

(2) Improvement of the National Road No. 9

SNC is implementing the "Road Improvement Project Second Phase (1992 - 1995)" under the financial assistance of the International Development Association (IDA). This project includes the improvements of major roads with total length of 1,546.8 km composed of paved road of 781.4 km and un-paved road of 765.4 km. Improvement of bridges is included in this project but new bridge construction is not included.

Road improvement between Guabira and Okinawa is one of the component of this project. Its major works are as follows;

1. Guabira - Km 24 (length 24 km)
 - 1) Raising of road: 30 cm height
 - 2) Pavement: 2.5 cm thickness
 - 3) Cross drainage: corrugated steel pipe at 28 places
2. Km 24 - Okinawa I (length 23 km)
 - 1) Raising of road: 45 cm height
 - 2) Pavement: 2.5 cm thickness
 - 3) Cross drainage: corrugated steel pipe at 25 places

(3) Bridge Construction Project for the National Road No. 9

The project is ongoing with JICA grant aid. The construction works started in October 1995. The project consists of seven bridges that are planned at the river crossings between Guabira and Okinawa of the National Road No. 9. They are as follows;

<u>Name of Bridge</u>	<u>Location</u>	<u>Length</u>
1. Las Chacras:	Tributary of Rio Chane	25.80 m
2. Las Maras:	Tributary of Rio Chane	51.55 m
3. El Toro:	Tributary of Rio Chane	77.30 m
4. El Empalme II:	Tributary of Rio Pailon	25.80 m
5. Chaco:	Tributary of Rio Pailon	51.55 m
6. Rancho Chico:	Tributary of Rio Pailon	25.80 m
7. Pailon:	Rio Pailon	92.30 m

2.3.2 Existing Facilities

(1) Facilities for Flood Control and Drainage Improvement

Along the Rio Piray, there are flood embankments, with length of 15 km that was designed in 1987 and constructed in 1993, to protect the city of Santa Cruz. There are main drainage channels in Okinawa I (total length 20.0 km), Okinawa II (total length 5.0 km) and Colonia San Juan de Yapacani (total length 32.0 km).

(2) **Bridges and Culverts**

Major bridges and culverts in the study area are shown in *Table 2.3.1* and *Fig. 2.3.1*.

TABLES

TABLE 2.3.1 EXISTING MAJOR BRIDGES AND CULVERTS ALONG RIVERS

No.	River System / River	Structural Type	Bridge Dimension			Culvert Dimension	Remarks
			L(m)	W(m)	H(m)		
Rio Grande							
Gr-1	Rio Grande	Steel Truss Bridge	1,200.0	7.4	6.0		@Span=68m
2	Qda. Cotoca	Wooden Bridge	8.5	4.5	2.6		1-span
3	Qda. Cotoca	Wooden Bridge	10.5	4.5	1.8		1-span
4	Qda. Churia	RC-Bridge	9.5	5.7	4.5		1-span
5	Qda. Ajal	RC-Pipe Culvert	(15.0)	(4.0)	(1.4)	D-1.0 m x 2 pipes	
6	Qda. Ajal	RC-Box Culvert	(8.0)	(6.0)	(1.8)	W-2.7 m x H-1.8 m x 3 boxes	
7	Qda. Alal	RC-Box Culvert	(6.2)	(4.0)	(1.9)	W-3.1 m x H-1.9 m x 2 boxes	
8	Qda. Alal	RC-Box Culvert	(6.2)	(2.0)	(2.3)	W-1.0 m x H-1.0 m x 1 box	
9	Qda. S/Nombre	RC-Pipe Culvert	(8.0)	(2.0)	(1.5)	D-1.0 m x 1 pipe	
10	Qda. S/Nombre	RC-Box Culvert	(6.2)	(1.0)	(1.5)	W-0.5 m x H-0.5 m x 1 box	
11	Qda. Okinawa	RC-Box Culvert	(17.0)	(6.3)	(2.8)	W-2.1 m x H-2.8 m x 2 boxes	
12	Qda. Okinawa	RC-Box Culvert	(6.0)	(5.5)	(3.0)	W-1.95 m x H-3.0 m x 2 boxes	
Rio Chane							
Ch-1	Rio Pailon	RC-Bridge	28.0	6.0	7.0		3-spans
2	Rio Pailon	RC-Bridge	24.5	5.5	6.0		3-spans
3	Qda. S/Nombre	Wooden Bridge	6.0	3.2	1.7		1-span
4	Qda. Honda	RC-Pipe Culvert	(9.0)	(5.0)	(3.2)	D-1.5 m x 1 pipe	
5	Qda. Asafran	Wooden Bridge	5.5	4.2	2.6		1-span
6	Qda. Asafran	RC-Pipe Culvert	(6.5)	(3.5)		D-1.0 m x 2 pipes	
7	Qda. Asafran	Wooden Bridge	12.0	5.0	4.0		2-spans
8	Qda. Asafran	Wooden Bridge	6.4	3.9	2.8		3-spans
9	Qda. Asafran	Wooden Bridge	20.0	3.5	1.9		4-spans
10	Qda. Asafran	Wooden Bridge	20.0	3.6	5.2		1-span
11	Rio Pailon	RC-Bridge	28.0	8.0	7.0		1-span
12	Rio Pailon	Wooden Bridge	26.0	4.0	4.5		4-spans
13	Qda. Chane	RC-Pipe Culvert	(7.0)	(4.5)	(1.6)	D-1.3 m x 2 pipes	
14	Qda. S/Nombre	RC-Bridge	10.7	3.7	3.9		1-span
15	Qda. Chane	RC-Box Culvert	(5.3)	(13.8)	(2.6)	W-5.3 m x H-2.3 m x 1 box	
16	Qda. Chane	RC-Bridge	23.0	8.0	4.5		1-span
17	Qda. El Toro	RC-Bridge	22.5	8.0	5.5		1-span
18	Rio Chane	Wooden Bridge(Truss)	22.0	4.0	9.0		1-span
19	Rio Chane	Wooden Bridge	8.2	4.0	3.5		1-span
20	Rio Chane	RC-Box Culvert	(2.5)	(9.0)	(2.0)	W-2.5 m x H-2.0 m x 1 box	
21	Qda. S/Nombre	Wooden Bridge	5.0	4.5	2.0		1-span
22	Rio Chane	RC-Bridge	12.0	3.5	4.2		1-span
23	Rio Chane	RC-Bridge	68.5	8.5	40.0		3-spans
24	Rio Linares	RC-Bridge	24.0	5.0	3.0		3-spans
25	Rio Linares	RC-Bridge	15.2	3.5	4.2		1-span
Rio Pirai							
Pi-1	Rio Pirai	Steel Truss Bridge	300.0	7.0	9.7		@Span=60m
2	Rio La Madre	RC-Bridge	38.3	7.6	7.9		1-span
3	Rio Pirai	RC-Bridge	92.5	8.4	11.5		2-spans
4	Rio Honda	RC-Pipe Culvert	(12.5)	(5.0)	(2.7)	D-2.1 m x 2 pipes	
5	Rio Vibosl	RC-Pipe Culvert	(9.5)	(11.0)	(1.6)	D-1.0 m x 2 pipes	
6	Rio Honda	Wooden Bridge	5.6	2.8	1.5		1-span
7	Rio Honda	RC-Pipe Culvert	(5.0)	(4.0)	(2.7)	D-1.2 m x 2 pipes	
Rio Palometillas							
Pm-1	Rio Asuicito	RC-Box Culvert	(9.5)	(8.0)	(2.3)	W-2.5 m x H-1.8 m x 3 boxes	
2	Rio Asuicito	RC-Bridge	19.7	5.0	3.5		1-span
3	Rio Palometilla	Wooden Bridge	19.6	4.6	4.9		4-spans
4	Arry. Quimori	RC-Bridge	46.0	8.2	10.0		1-span
5	Arry. Quimori	Wooden Bridge	20.0	5.0	4.8		4-spans
6	Rio Palacios-Taca	RC-Pipe Culvert	(11.8)	(4.1)	(5.3)	D-2.0 m x 2 pipes	
7	Rio Palacios-Taca	Wooden Bridge	20.0	5.0	4.3		4-spans
Rio Palacios							
Pc-1	Qda. Palometilla	RC-Bridge	26.0	8.2	8.0		1-span
2	Qda. Palometilla	RC-Bridge	9.9	4.0	3.2		1-span
3	Qda. Palometilla	RC-Bridge	35.0	7.4	5.0		3-spans
4	Rio Palacios	Steel Truss Bridge	52.0	5.0	11.0		1-span
5	Arry. Piquiricito	Wooden Bridge	7.4	5.5	2.5		1-span
Rio Yapacani							
Ya-1	Rio Yapacani	RC-Bridge	700.0	7.5	11.0		@Span=40m
2	Arry. Tejeria	RC-Bridge	7.0	8.0	4.6		1-span
3	Arry. Yapacanicito	RC-Bridge	5.0	4.5	5.6		1-span

FIGURES



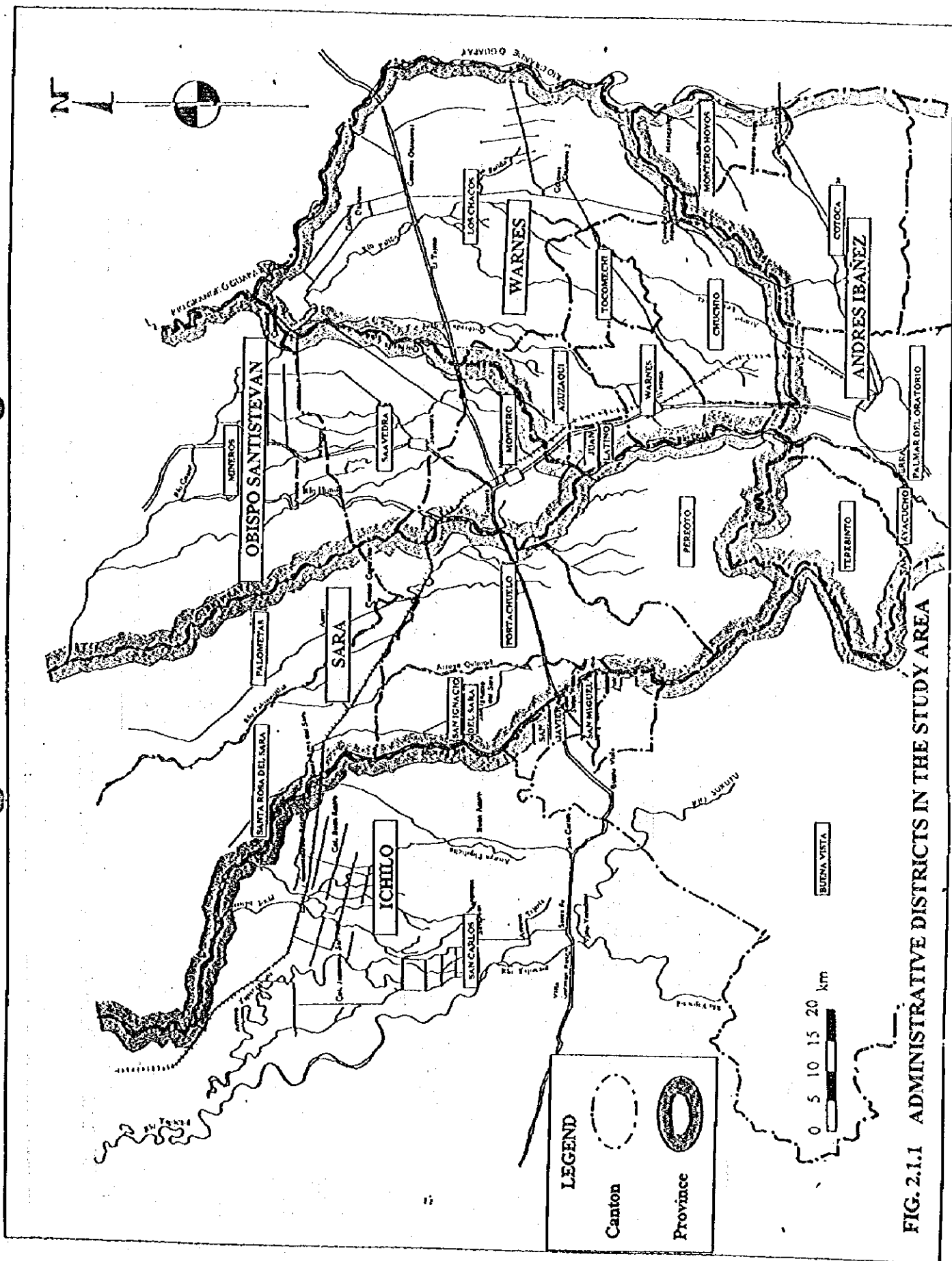


FIG. 2.1.1 ADMINISTRATIVE DISTRICTS IN THE STUDY AREA

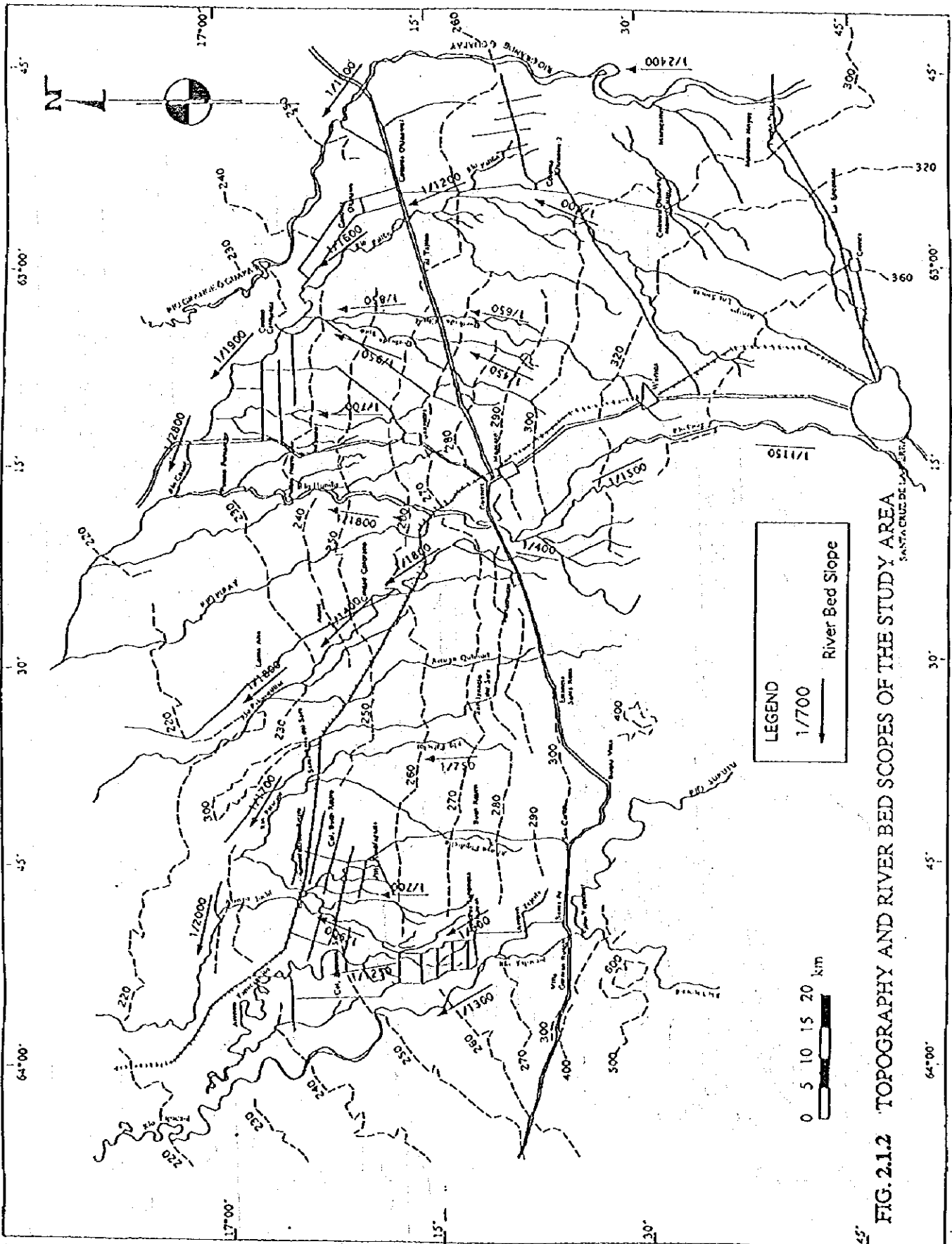


FIG. 2.1.2 TOPOGRAPHY AND RIVER BED SLOPES OF THE STUDY AREA
SANTA CRUZ DE LA SIERRA

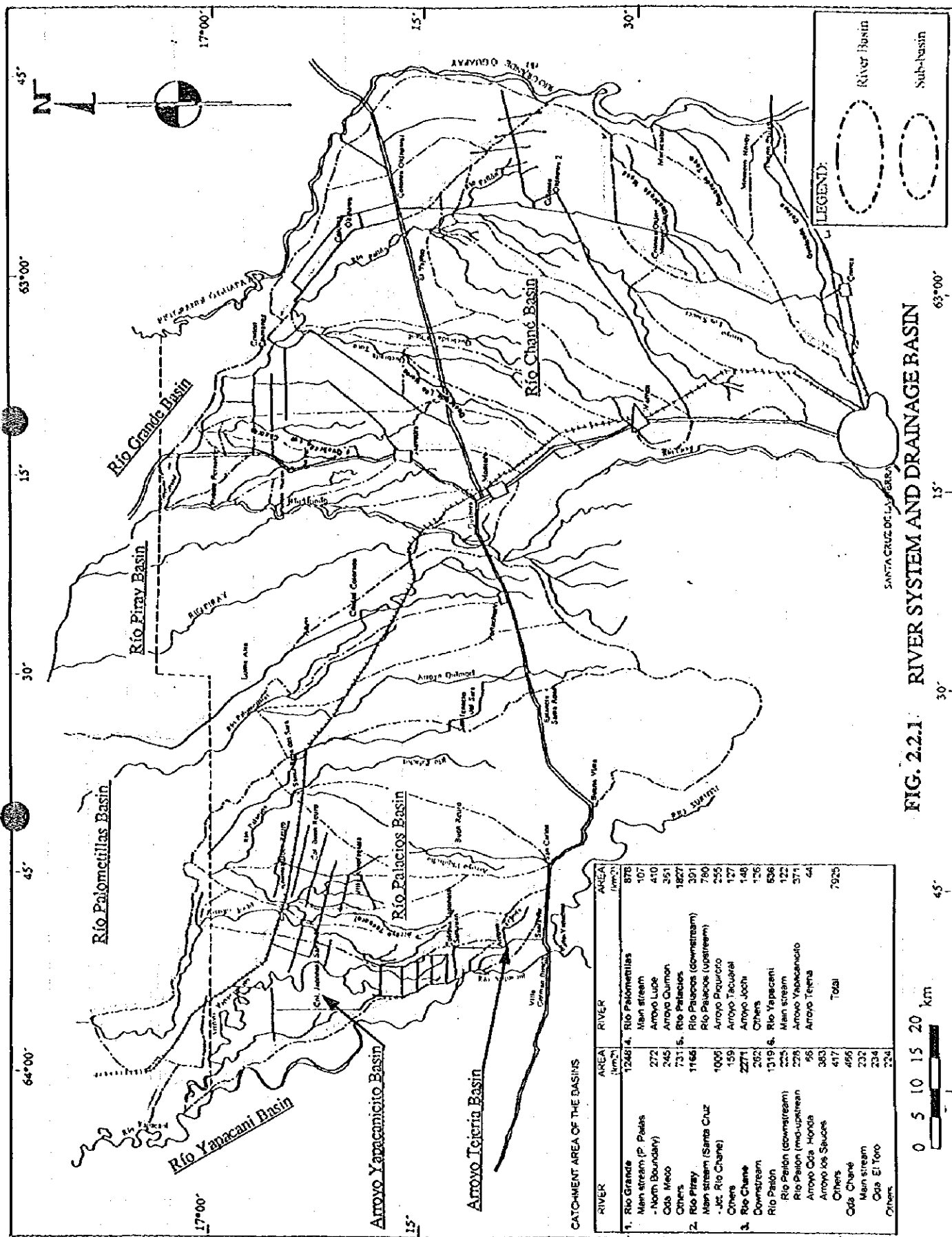
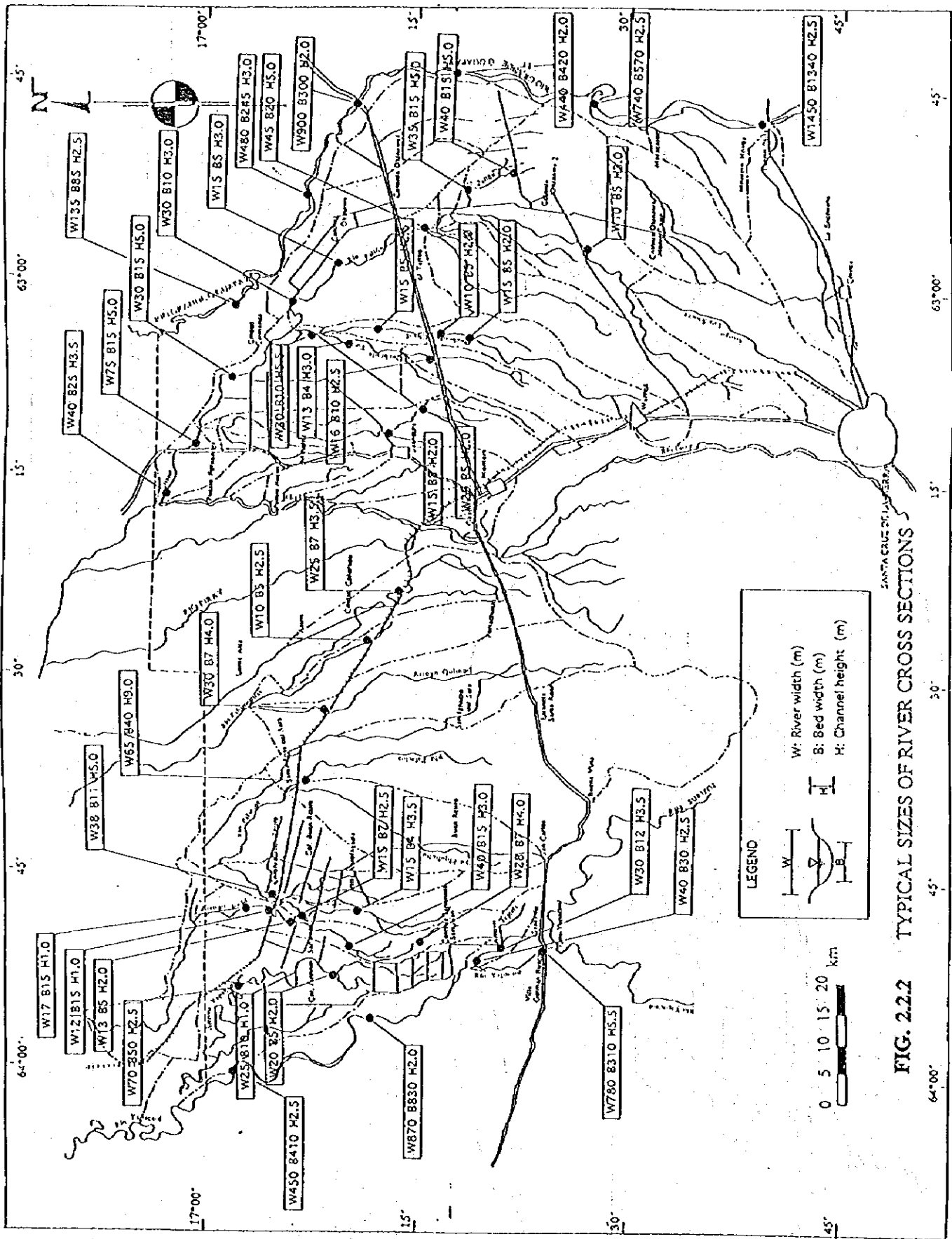


FIG. 2.2.1. RIVER SYSTEM AND DRAINAGE BASIN



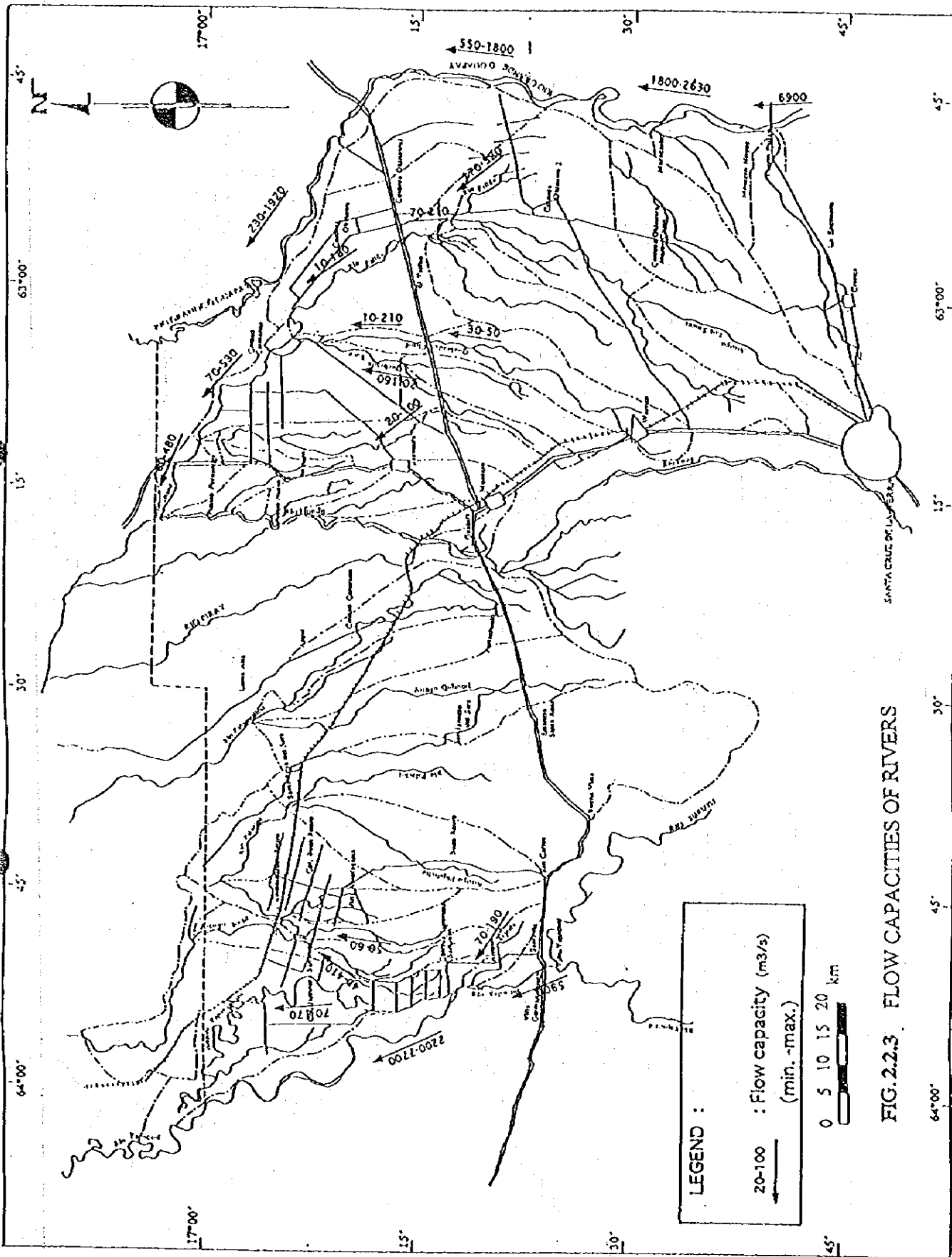


FIG. 2.2.3. FLOW CAPACITIES OF RIVERS

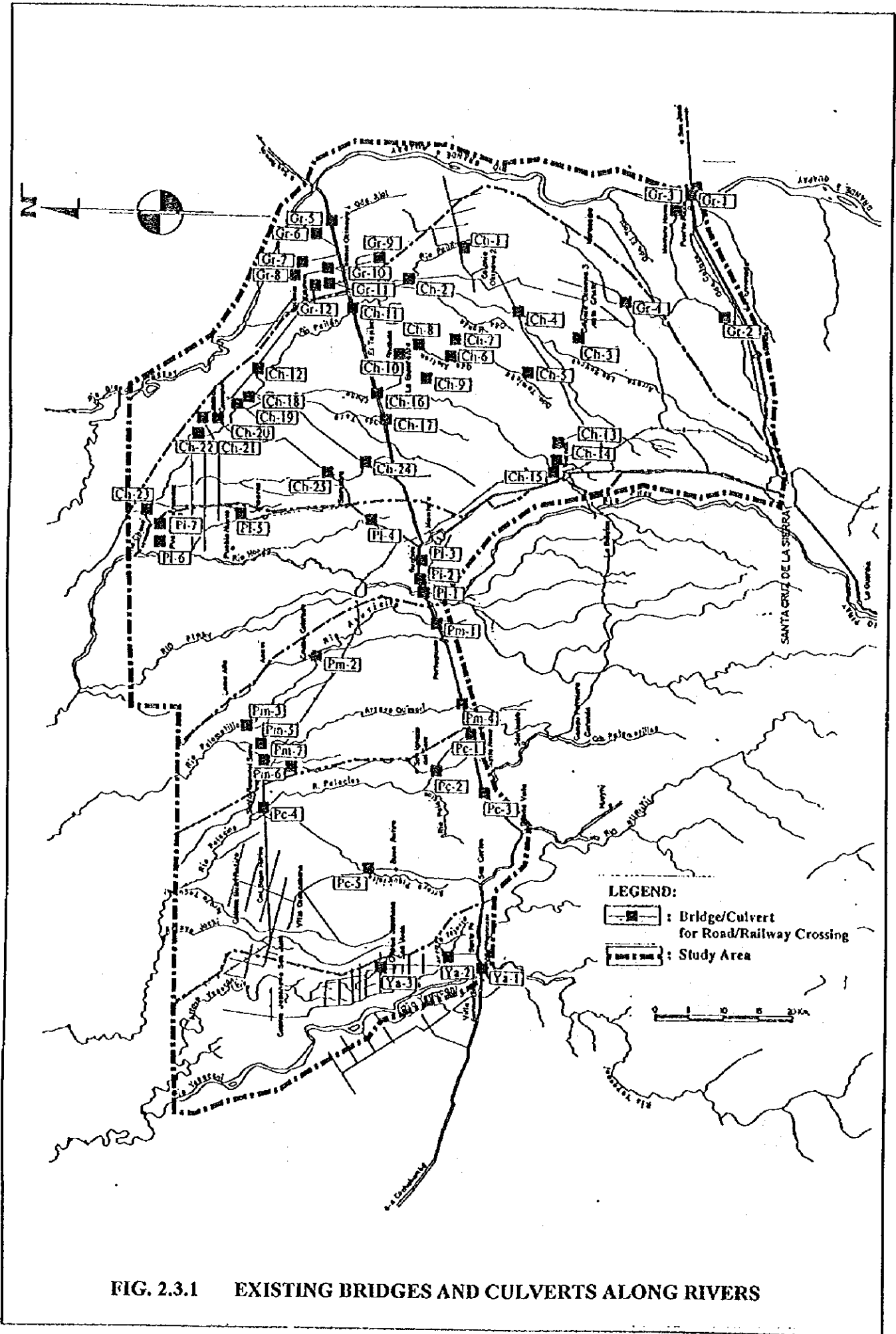


FIG. 2.3.1 EXISTING BRIDGES AND CULVERTS ALONG RIVERS

CHAPTER 3
SOCIO-ECONOMY



CHAPTER 3 SOCIO-ECONOMY

3.1 General

The Republic of Bolivia borders the Republic of Brazil to the north and east, the Republics of Paraguay and Argentina to the south, and the Republics of Chile and Peru to the west. The country occupies a total land area of 1,098,582 km² and has a population of 6,420,792, according to the 1992 Census.

The Department of Santa Cruz consists of 15 Provinces, 46 Municipal Sections and 162 Cantons. It has an area of 370,621 km² and a population of 1,364,389, according to the 1992 Census. The city of Santa Cruz, with a population of 697,278, is a center of political, administrative, commercial and industrial activities, and the second largest city in the country.

The Study Area is located in the northern part of the city of Santa Cruz and spreads over five provinces; Andres Ibanez, Warnes, Ichilo, Sara and Obispo Santistevan. It has an area of approximately 7,000 km² and a population of 220,000.

3.2 Population

3.2.1 Census Population

(1) Bolivia

Since 1950, population census in the Republic of Bolivia has been conducted three times; 1950, 1976 and 1992. The Bolivian population reached 6,420,792 in 1992, growing at an average annual rate of 2.09 % for the period of 1976-1992 and 1.64 % for the period of 1950-1976, and in 1992 the population density reached 5.84 persons/km² which is over twice the population density of 1950 (see *Table 3.2.1*).

(2) Department of Santa Cruz

The population of the Department of Santa Cruz amounted to 1,364,389 in 1992, which corresponded to 21 % of the entire country population. The average annual growth rate of population was 3.56 % for the period of 1950-1976 and 4.16 % for the period of 1976-1992. These population growth rates are the highest among the nine Departments, and still showing an upward trend.

The population density of the Department of Santa Cruz in 1992 indicated 3.68 persons/km², which is lower than the national average, due to the extensive area of the Department.

Table 3.2.2 presents a provincial distribution of the population in the Department of Santa Cruz in 1976 and 1992. In 1992 the Andres Ibanez province had a population of 784,678 which accounted for 57 % of the total population of the Department. In this Andres Ibanez province, the city of Santa Cruz had a population of 725,087 which corresponds to 92 % of the provincial population. Accordingly, the Santa Cruz city accounted for more than half (53 %) of the total population of the Department in 1992.

During the intercensal period from 1976 to 1992, the average annual population growth rate of the Department of Santa Cruz indicated 4.16 %, consisting of 6.21 % for the urban area and 0.80 % for the rural area. It is noticeable that the urban population increase was very high during this period. Especially, the urban population of Ichilo province indicated extremely high growth, at an annual rate of 9.24 % on average for the same period. Following the Ichilo province, the urban populations of Valasco, Warnes and Andres Ibanez provinces were at the annual growth rate of 7.68 %, 7.41 % and 6.59 % respectively.

(3) Study Area

The Study Area is composed of five provinces; Andres Ibanez (except the Santa Cruz city), Warnes, Ichilo, Sara and Obispo Santistevan. It contains 23 Cantons in total and has a population of 219,771 in 1992, composed of urban population of 119,485 and rural population of 100,286. In the same year, the number of households was 46,801, and the family size indicated 4.70 persons per household on average. These distributions by province and canton are given in *Table 3.2.3*.

Communities in the Study Area reaches about 370 in number. Their population, number of households and family size according to each community are given in *Tables B.2.4 to B.2.8* in the Supporting Report B. These data are utilized as the basic material for the flood damage analysis described in the Supporting Report "K".

3.2.2 Population Projections

The population projections for the whole country and the Department of Santa Cruz were prepared by INE and CORDECRUZ, respectively as follows:

1. Estimaciones y Proyecciones de La Poblacion 1950-2050, Bolivia, Instituto Nacional de Estadística (INE), 1994
2. Proyecciones de Poblacion por Sexo y Edad 1991-2010, Dept. de Santa Cruz, CORDECRUZ, 1991

These population projections exclude the result of the 1992 census, since the projections were conducted in 1991. As a result, the projected population in 1992 was estimated to be 1,409,226, an increase by 44,837 (3.3 %) compared to the 1992 census population (1,364,389).

If it is assumed that the future population projected herein will indicate a high figures by approximately 3.3 %, the adjusted figures of the future population are given as follows:

<u>Year</u>	<u>1992</u>	<u>1995</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>
Adjusted Population ('000)	1,364	1,525	1,821	2,163	2,552
Ratio to National Pop. (%)	21.2	20.5	21.9	23.3	24.9

<u>Period</u>	<u>(1992-95)</u>	<u>(1995-2000)</u>	<u>(2000-05)</u>	<u>(2005-10)</u>
Annual Growth Rate (%)	3.79	3.61	3.50	3.36

According to the population projection which was published in August of 1995 by CORDECRUZ, population of the Department was estimated to be 1,545,741 in 1995 and 1,903,559 in 2000, using an average annual growth rate of 4.16 % for the intercensal period of 1976-1992.

3.3 Gross Domestic Product (GDP)

3.3.1 GDP and Per Capita GDP

(1) Bolivia and Santa Cruz

The Bolivian GDP at current prices amounted to US\$ 5,534,945 thousand in 1992, increasing at an average annual rate of 4.56 % from US\$ 4,629,969 thousand in 1988. The per capita GDP grew at an annual rate of 2.37 % (US\$ base) on average during the same period and reached US\$ 804 in 1992 as shown in *Table 3.3.1*.

On the other hand, GDP of the Department of Santa Cruz achieved US\$ 1,672,301 thousand in 1992, increasing at a high average annual rate of 8.11 % from US\$ 1,223,997 thousand in 1988. In 1992 the GDP of the Department of Santa Cruz accounted for approximately 30 % of the Bolivian GDP.

In the same year, the per capita GDP of the Department indicated US\$ 1,177, which corresponded to about 1.5 times of the average per capita GDP of Bolivia. During the period of 1988-1992, the annual growth rate was 4.29 % on average.

3.3.2 Sector GDP

Table 3.3.2 provides the GDP of Bolivia at 1990 constant prices, by economic activity. The real annual growth rate of GDP indicated 3.85 % on average for the period of 1988-1992. Of all sector GDP, the highest growth was in the agro-industrial sector with the annual rate of 14.39 % on average during the same period, and in contrast the slowest growth rate of 0.83 % was in the agricultural sector. Following the agro-industrial sector, communications and mineral sectors indicated high average annual growth rates of 12.02 % and 9.80 %, respectively.

The total GDP of agricultural sector and the related sectors (agro-industry, Stock raising, hunting, forestry and fishing) accounted for 17.7 % of the Bolivian GDP in 1992. Following these sectors, manufacturing industrial sector had a share of 15.4 % in the same year.

Table 3.3.3 shows the GDP of the Department of Santa Cruz at 1990 constant prices, by economic activity. The real average annual growth rate of GDP indicated 4.82 % during the period 1988-1992. This growth rate is higher, by about 1 %, than that of the Bolivian GDP.

Of all sector GDP of the Department of Santa Cruz, the agro-industrial sector also indicated the highest growth, an average annual rate of 16.27 % during the same period. Following the agro-industrial sector, the communications and construction & public works sectors indicated high average annual growth rates of 16.50 % and 13.40 %, respectively. Concerning the agricultural sector, despite the slowest growth rate of the Bolivian GDP, the Department's GDP achieved a comparatively rapid growth at an annual rate of 10.32 % during the same period.

In the Department of Santa Cruz, agriculture and the related sectors (agro-industry, Stock raising, hunting, forestry and fishing) made the greatest contribution to economic growth of the Department, with a share of 21.1 % of the total Departmental GDP in 1992. Following the agricultural sector, manufacturing industrial and trade sectors indicated high shares of 19.2 % and 12.5 %, respectively.

Further information regarding 'Agricultural Production' and 'Manufacturing Industrial Production' is provided in the Supporting Report B.

3.4 External Trade

3.4.1 Exports

In 1994, the total export of Bolivia amounted to US\$ 722.9 million, and its distribution was US\$ 307.3 million (share of 42.5 %) for minerals, US\$ 74.0 million (share of 10.2 %) for hydrocarbons, and US\$ 341.6 million (share of 47.3 %) for non-traditional products. During the period of 1988-1994, the average annual export growth rate indicated 3.15 % for the whole products, with 1.99 % for the minerals, -16.54 % for the hydrocarbons, and 21.12 % for the non-traditional products (*Table 3.4.1*).

As evident from *Table 3.4.1*, no dominant export products in amount are found. Products such as tin, zinc, gold, natural gas, soybeans and jewelry had a comparatively high shares of 9.5 %, 11.1 %, 12.0 %, 10.1 %, 9.7 % and 11.0 % respectively, in the 1994 exports.

3.4.2 Imports

The total import in 1994 amounted to US\$ 825.9 million, increasing at an average annual rate of 5.75 % since 1988. Breakdown of the import was US\$ 210.2 million (share of 25.3 %) for the consumption goods, US\$ 307.2 million (share of 37.2 %) for

the interim goods, US\$ 300.3 million (share of 36.4 %) for the capital goods, and US\$ 8.2 million (share of 1.0 %) for the other goods. During the period of 1988-1994, the average annual increase rate indicated 8.58 %, 5.07 %, 4.41 % and 25.49 %, respectively (Table 3.4.2).

During the period of 1988-1994, although exports exceeded imports for the period from 1988 to 1990, after that period imports have exceeded exports.

3.4.3 Balance of International Payments

Table 3.4.3 shows the balance of international payments in 1992 and 1993. The export value of goods were US\$ 638 million in 1992 and US\$ 710 million in 1993, in FOB prices. On the other hand, the import values were US\$ 1,090 million and US\$ 1,206 million in each year, in CIF. Accordingly, the external trade of Bolivia indicated an unfavorable deficit balance of 452 million and 496 million in each year.

The balance of services and interests of investment also indicated a deficit in both years. Accordingly, the current account deficit (except the transfers account) amounted to US\$ 655 million in 1992 and US\$ 710 million in 1993. These deficits are high when compared with the total export in the respective years. Such deficits in both years were almost compensated by transfers and capital accounts. However, as a result the international payments of Bolivia indicated an unfavorable deficit balance of US\$ 146 million in 1992 and US\$ 123 million in 1993, due to the negative values of errors and omissions.

3.4.4 Foreign Exchange Rate

Table 3.4.4 lists trend of the average monthly exchange rate of Bolivians to US\$ for the period of 1990-1994. The average exchange rate indicated Bs. 4.62/US\$ in 1994, changing at the annual average rate of 9.91 % from Bs. 3.17/US\$ in 1990.

However, this variation was on a downward trend in recent years, for example, average monthly variation rate decreased from 1.09 % in 1990 to 0.43 % in 1994.

3.5 Consumer Prices

Table 3.5.1 shows the consumer price indices at the national average, the La Paz city and the Santa Cruz city in the year 1994 (1991=100). During the period of 1991-1994, the general consumer prices recorded an increase rate of 32.2 % as the national average

and in the La Paz city, and 30.3 % in the Santa Cruz city, while, the average annual inflation rate was 9.76 % and 9.22 %, respectively. These inflation rates are close to the average annual variation rate (9.91 %) of the exchange rate shown in *Table 3.4.4*.

During the same period, the consumer prices of food and beverages, which have a weight of 49.1 % of the whole consumer goods in 1991, indicated an increase rate of 33.2 % as the national average and 31.5 % in the La Paz city, and 31.7 % in the Santa Cruz city, while the average annual inflation rate was 10.02 %, 9.57 % and 9.63 %, respectively. The price indices of other sectors are listed in *Table 3.5.1*.

3.6 Budgets

3.6.1 Central Government

Table 3.6.1 provides a financial statement of the Central Government of Bolivia for the period from 1988 to 1991. Revenue of the Central Government achieved Bs. 2,775 million in 1991, increasing as much as 2.2 times compared with the revenue of Bs. 1,246 million in 1988. The average annual growth showed a high rate of 30 % during the said period.

Of the total revenue, revenue of the petroleum royalty accounted for approximately 50 %, and amounted to Bs. 1,348 million in 1991 at the average annual growth rate of 25 % for the period of 1988-1991. Following the petroleum royalty, domestic tax revenue indicated Bs. 819 million in 1991 at the annual growth rate of 31 % during the same period.

On the other hand, the budget expenditure of the Central Government amounted to Bs. 2,725 million in 1991, at the average annual growth rate of 28 % during the same period. The expenditure in 1991 corresponds to 2.1 times of the 1988 expenditure.

Of the expenditure, it is noted that the public debt amounted to Bs. 690 million in 1991 which corresponded to 3.7 times the 1988 public debt, with the high annual increase rate of 55 %.

3.6.2 CORDECRUZ

In 1994, the income of CORDECRUZ amounted to US\$ 42,413 thousand, consisting of US\$ 27,934 thousand for the own income and US\$ 14,479 thousand for the external income. The oil bonus, which contributed the highest share of 30 % in the total

income, was US\$ 12,788 thousand in the same year. Following the oil bonus income, the internal credit and the tax revenue indicated US\$ 9,434 thousand and US\$ 8,008 thousand, respectively. However, the 1994 income of Cordecruz decreased somewhat compared with those in 1991, 1992 and 1993, as shown in *Table 3.6.2*.

On the other hand, the expenditure amounted to US\$ 40,994 thousand in 1994, composed of US\$ 27,249 thousand for the own expenses and US\$ 13,745 thousand for the external expenses. Of individual expenses in 1994, the investment to projects amounted to US\$ 8,766 thousand accounting for 21.4 % of the total expenses. Expenses to the debt service with US\$ 8,563 thousand (20.9 %) and the internal credits with US\$ 8,116 thousand (19.8 %) followed the investment to projects.

As shown in *Table 3.6.2*, the investment expenses had the highest share in the budget expenditure of CORDECruz every year, and it is expected that this share will remain so for the time being. According to the investment plan of CORDECruz for the period of 1995-1999, it is expected that in 1999 the investment will amount to US\$ 142,926 thousand, consisting of US\$ 102,302 thousand (71 %) for the transportation sector, US\$ 21,032 thousand (15 %) for the agricultural sector, US\$ 15,310 thousand (11 %) for the basic sanitation sector, and US\$ 4,282 thousand for other sectors. High investment to the transportation sector is noticeable.

3.6.3 Public Investment of Municipalities

The department of Santa Cruz is composed of 47 municipalities. *Table 3.6.4* lists the budget for public investment of each municipality in the Department in 1995. The public investment budget amounted to Bs. 342 million (US\$ 71.2 million) for the whole municipalities, of which the Santa Cruz city received Bs. 251 million (US\$ 52.3 million) corresponding to 73 % of the whole budget. The average budget per municipality, except the Santa Cruz city, is estimated at Bs. 1.94 million (US\$ 0.40 million).

On the other hand, the public investment budget is divided into two categories; local and external finances. The 1995 budget was Bs. 306 million (US\$ 63.7 million) for the former and Bs. 36 million (US\$ 7.5 million) for the latter. Of the external finance, the grant in foreign aid was Bs. 14 million (US\$ 3.0 million).

3.7 International Aid to Bolivia

3.7.1 Outline of International Aid

Table 3.7.1 shows the economic aid received from major countries and international fund agencies for the period of 1990-1994. During this period, the external aid amounted to US\$ 2,095 million, consisting of US\$ 824 million (39 %) from foreign countries and US\$ 1,271 million (61 %) from international fund agencies. The average annual amount was approximately US\$ 400 million. Among these countries and agencies, United State of America (USA), Banco Interamericano de Desarrollo (BID) and Banco Internacional de Reconstruccion y Fomento (BIRF) had a comparably high share of aid, as shown in *Table 3.7.1*.

3.7.2 International Aid Projects in the Department of Santa Cruz

The number of projects related to international aid by industrial sectors in the Department of Santa Cruz for until 1991, reached 50 in total, consisting of 19 agricultural projects, 2 livestock projects, 2 manufacturing industrial projects, and 27 transportation projects.

The total project value for the period of 1991-1995 amounted to US\$ 126,260 thousand, composed of US\$ 41,742 thousand (33 %) in local currency (own fund) and US\$ 84,518 thousand (67 %) in foreign currency (aid fund).

The average annual value is estimated at US\$ 25,252 thousand, consisting of US\$ 8,348 thousand in own fund and US\$ 16,904 thousand in foreign aid fund.

On the other hand, international technical cooperation projects in the Department of Santa Cruz for the period of 1988-1995 reached 33 in number, and the value amounted to US\$ 57,214 thousand in total, comprised of US\$ 44,394 thousand (78 %) for agricultural projects, US\$ 2,558 thousand (4 %) for industrial projects, and US\$ 10,262 thousand (18 %) for transportation projects. Almost all of them have been funded by the grant-in-aid, at the average amount of US\$ 7,152 thousand per annum.

Further information regarding foreign aid projects and aid conditions of international agencies, is given in the Supporting Report B.

TABLES

**TABLE 3.2.1 POPULATION BY DEPARTMENT IN THE REPUBLIC OF BOLIVIA
IN 1950, 1976 AND 1992**

Department	Area (km ²)	Census Population			Average Annual Growth Rate (%)		Population Density (Persons/km ²)		
		1950	1976	1992	1950-76	1976-92	1950	1976	1992
Republic of Bolivia	1,098,581	3,019,031	4,613,486	6,420,792	1.64	2.09	2.75	4.20	5.84
1 Chuquisaca	51,524	282,980	358,516	453,756	0.91	1.48	5.49	6.96	8.81
2 La Paz	133,985	948,446	1,465,078	1,900,786	1.69	1.64	7.08	10.93	14.19
3 Cochabamba	65,631	490,475	720,952	1,110,205	1.49	2.74	7.47	10.98	16.92
4 Oruro	53,588	210,260	310,409	340,114	1.51	0.57	3.92	5.79	6.35
5 Potosi	118,218	534,399	657,743	645,889	0.80	-0.11	4.52	5.56	5.46
6 Tarija	37,623	126,752	187,204	291,407	1.51	2.80	3.37	4.98	7.75
7 Santa Cruz	370,621	286,145	710,724	1,364,389	3.56	4.16	0.77	1.92	3.68
8 Beni	213,564	119,770	168,367	276,174	1.32	3.14	0.56	0.79	1.29
9 Pando	65,827	19,804	34,493	38,072	2.16	0.62	0.31	0.54	0.60

Source : Censo Nacional de Poblacion y Vivienda 1950, 1976 y 1992 Instituto Nacional de Estadística

TABLE 3.2.2 POPULATION BY PROVINCE IN DEPARTMENT OF SANTA CRUZ IN 1976 AND 1992

Province	1976			1992			Distribution of Population in 1992 (%)			Average Annual Growth Rate (%), 1976 - 1992		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
	1 Andres Ibanez	261,236	55,174	316,410	725,087	59,591	784,678	57.5	6.59	0.48	5.84	
2 Warnes	4,288	26,628	30,916	13,452	24,833	38,285	2.8	7.41	-0.44	1.35		
3 Valasco	4,898	19,630	24,528	16,012	26,917	42,929	3.1	7.68	1.99	3.56		
4 Ichilo	5,120	32,673	37,793	21,054	28,430	49,484	3.6	9.24	-0.87	1.70		
5 Chiquitos	15,094	18,602	33,696	22,584	19,935	42,519	3.1	2.55	0.43	1.46		
6 Sara	13,943	14,576	28,519	17,193	12,414	29,607	2.2	1.32	-1.00	0.23		
7 Cordillera	19,499	34,753	54,252	32,953	55,675	88,628	6.5	3.33	2.99	3.12		
8 Vallegrande	5,040	25,251	30,291	6,341	20,403	26,744	2.0	1.45	-1.32	-0.78		
9 Florida	0	21,390	21,390	5,795	16,955	22,750	1.7	-	-1.44	0.39		
10 Obispo Santistevan	39,645	38,971	78,616	76,738	27,922	104,660	7.7	4.21	-2.06	1.80		
11 Nuflo de Chavez	3,555	29,615	33,170	8,664	52,344	61,008	4.5	5.73	3.62	3.88		
12 Angel Sandoval	0	8,044	8,044	3,849	6,846	10,695	0.8	-	-1.00	1.80		
13 Manuel Maria Caballero	2,287	10,812	13,099	3,221	12,853	16,074	1.2	2.16	1.09	1.29		
14 German Busch	0	0	0	18,517	6,909	25,426	1.9	-	-	-		
15 Guarayos	0	0	0	10,936	9,966	20,902	1.5	-	-	-		
Total	374,605	336,119	710,724	982,396	381,993	1,364,389	100.0	6.21	0.80	4.16		

Source : 1. Censo Nacional de Poblacion y Vivienda 1992, Instituto Nacional de Estadistica
 2. Compendio Estadistico de Poblacion y Vivienda a Nivel de Subregion y Provincia, 1976 y 1992, CORDECruz y USAID

TABLE 3.2.3 POPULATION AND NUMBER OF HOUSEHOLDS BY PROVINCE AND CANTON IN THE STUDY AREA IN 1992

Province/ Canton	Number of Communities	Population			Number of Households	Average Size of Household (person/hh)
		Urban	Rural	Total		
I. Andres Ibanez						
1. Palmar del Oratorio	23	0	4,820	4,820	1,167	4.13
2. Cotoca	32	9,229	10,402	19,631	4,255	4.61
3. Ayacucho	17	0	4,690	4,690	1,146	4.09
4. Terebinto	15	0	3,582	3,582	863	4.15
5. Montero Hoyos	6	0	3,719	3,719	674	5.52
Total	93	9,229	27,213	36,442	8,105	4.50
II. Warnes						
1. Warnes	10	10,866	2,251	13,117	2,816	4.66
2. Tocomechi	9	0	2,704	2,704	554	4.88
3. Los Chacos	44	2,586	12,655	15,241	3,286	4.64
4. Juan Latino	4	0	818	818	180	4.54
5. Azusaoui	9	0	3,150	3,150	640	4.92
6. Chuchio	11	0	3,255	3,255	736	4.42
Total	87	13,452	24,833	38,285	8,212	4.66
III. Ichilo						
1. Buena Vista	23	2,873	6,584	9,457	2,113	4.48
2. San Javier	2	0	325	325	97	3.35
3. San Miguel	2	0	490	490	101	4.85
4. San Isidro	2	0	512	512	107	4.79
Total	29	2,873	7,911	10,784	2,418	4.46
IV. Sara						
1. Portachuelo	12	9,453	1,807	11,260	2,434	4.63
2. San Ignacio de Sara	9	0	2,021	2,021	444	4.55
3. Pereoto	10	4,615	2,463	7,078	1,262	5.61
4. Santa Rosa del Sara	16	3,125	3,196	6,321	1,410	4.48
5. Palomeñas	9	0	2,920	2,920	666	4.38
Total	56	17,193	12,407	29,600	6,216	4.76
V. Obispo Santistevan						
1. Montero	11	57,027	1,542	58,569	11,903	4.92
2. Gral. A. Saavedra	35	2,918	8,721	11,639	2,502	4.65
3. Mineros	59	16,793	17,659	34,452	7,445	4.63
Total	105	76,738	27,922	104,660	21,850	4.79
Grand Total	370	119,485	100,286	219,771	46,801	4.70

Source: Censo Nacional de Poblacion y Vivienda 1992, Instituto Nacional de Estadistica
 Note : Ciudad de Santa Cruz is excluded.

TABLE 3.3.1 GROSS DOMESTIC PRODUCT (GDP) AT CURRENT PRICES

Items	1988	1989	1990	1991	1992	Average Annual Growth Rate (%) 1988-1992
A Republic of Bolivia						
GDP (Bs. 1.000)	10.880,426	12.854,492	15.657,979	19.177,144	21.586,285	18.68
GDP (US\$ 1.000)	4,629,969	4,778,622	4,939,426	5,356,744	5,534,945	4.56
Per Capita GNP (Bs)	1.721	1.990	2.373	2.845	3.134	16.17
Per Capita GNP (US\$))	752	740	749	795	804	2.37
B Department of Santa Cruz						
GDP (Bs. 1.000)	2,876,394	3,388,274	4,362,831	5,399,847	6,521,974	22.71
GDP (US\$ 1.000)	1,223,997	1,259,581	1,376,287	1,508,337	1,672,301	8.11
Per Capita GNP (Bs)	2,338	2,657	3,300	3,939	4,589	18.36
Per Capita GNP (US\$))	995	988	1,041	1,100	1,177	4.29

Source : Cuentas Regionales, Resumen General, 1994, Instituto Nacional de Estadística

TABLE 3.3.2 GDP BY ECONOMIC ACTIVITY OF BOLIVIA, 1988-1992
(AT THE 1990 CONSTANT PRICES)

Unit : Bs. 1,000

Items	1988	1989	1990	1991	1992	Average Annual Growth Rate (%) 1988-1992	Distribution of GDP in 1992(%)
A Industries							
1 Agriculture, hunting, forestry and fishing	12,766,388	13,173,117	13,844,829	14,533,788	14,911,405	3.96	89.4
1) Agriculture	1,397,040	1,314,644	1,359,958	1,508,064	1,444,253	0.83	8.7
2) Agro-industry	196,302	248,154	268,918	397,861	336,112	14.39	2.0
3) Stock raising	898,512	941,133	969,352	971,030	955,294	1.54	5.7
4) Hunting, forestry and fishing	186,017	176,646	206,662	212,236	216,168	3.83	1.3
2 Mining and quarrying	1,341,164	1,502,433	1,653,566	1,683,952	1,699,637	6.10	10.2
1) Oil and gas	685,017	711,473	734,094	748,950	745,796	2.15	4.5
2) Metallic and non-metallic mineral	656,147	790,960	919,472	935,002	953,841	9.80	5.7
3 Manufacturing industries	2,138,429	2,222,181	2,379,110	2,472,585	2,571,586	4.72	15.4
4 Electricity, gas and water	225,127	234,741	249,205	273,189	295,664	7.05	1.8
5 Construction and public works	574,188	598,111	619,538	637,038	716,196	5.68	4.3
6 Trade	1,673,185	1,683,781	1,766,789	1,866,890	1,966,879	4.13	11.8
7 Transport and storage	1,509,533	1,541,958	1,600,897	1,657,786	1,718,494	3.29	10.3
8 Communications	171,677	193,724	203,851	218,010	270,328	12.02	1.6
9 Finance, insurance, business and other services	1,994,812	2,053,658	2,097,680	2,158,339	2,220,145	2.71	13.3
10 Restaurants and hotels	460,402	461,953	469,304	476,809	500,649	2.12	3.0
B Administrative public services	1,492,786	1,546,399	1,546,696	1,617,207	1,678,764	2.98	10.1
C Domestic service	88,405	91,060	92,534	94,311	96,339	2.17	0.6
Total	14,347,579	14,810,576	15,484,059	16,245,306	16,686,508	3.85	100.0

Source : Cuentas Regionales 1988-1992, Instituto Nacional de Estadística

TABLE 3.3.3 GDP BY ECONOMIC ACTIVITY OF DEPARTMENT OF SANTA CRUZ, 1988-1992
(AT THE 1990 CONSTANT PRICES)

Unit: Bs. 1,000

Items	1988	1989	1990	1991	1992	Average Annual Growth Rate (%) 1988-1992	Distribution of GDP in 1992(%)
A Industries	3,634,403	3,771,428	4,067,980	4,349,541	4,418,605	5.01	93.4
1 Agriculture, hunting, forestry and fishing	730,042	792,065	875,282	1,066,326	1,000,272	8.19	21.1
1) Agriculture	233,743	249,452	290,874	348,696	346,283	10.32	7.3
2) Agro-industry	160,862	212,945	229,817	356,337	294,025	16.27	6.2
3) Stock raising	252,640	260,074	273,326	275,480	277,708	2.39	5.9
4) Hunting, forestry and fishing	82,797	69,594	81,265	85,813	82,256	-0.16	1.7
2 Mining and quarrying	446,251	401,407	422,991	387,888	343,593	-6.33	7.3
1) Oil and gas	412,896	369,322	383,799	367,889	325,989	-5.74	6.9
2) Metallic and non-metallic mineral	33,355	32,085	39,192	19,999	17,604	-14.77	0.4
3 Manufacturing industries	708,092	745,761	826,089	867,618	908,892	6.44	19.2
4 Electricity, gas and water	78,911	79,468	84,487	90,663	95,536	4.90	2.0
5 Construction and public works	124,674	171,423	194,164	180,612	206,153	13.40	4.4
6 Trade	459,670	461,421	506,554	553,196	593,718	6.61	12.5
7 Transport and storage	432,596	443,058	465,071	483,309	501,321	3.75	10.6
8 Communications	47,627	51,723	55,485	60,590	87,721	16.50	1.9
9 Finance, insurance, business and other services	494,394	512,578	523,452	543,035	559,129	3.12	11.8
10 Restaurants and hotels	112,146	112,524	114,404	116,304	122,269	2.18	2.6
B Administrative public services	264,393	263,880	273,255	273,412	291,059	2.43	6.2
C Domestic service	21,255	21,513	21,595	21,779	22,205	1.10	0.5
Total	3,920,051	4,056,821	4,362,830	4,644,732	4,731,849	4.82	100.0

Source: Cuentas Regionales 1988-1992, Instituto Nacional de Estadística

TABLE 3.4.1 EXPORT STRUCTURE OF BOLIVIA, 1988-1994

Products	Unit : US\$ Million								Average Annual Growth Rate(%) 1988-1994	Share of Export Products in 1994 (%)
	1988	1989	1990	1991	1992	1993	1994			
1 Minerals	273.1	403.4	407.2	356.0	379.7	362.0	307.3	1.99	42.5	
Tin	77.0	126.5	106.5	99.7	107.4	83.4	68.7	-1.88	9.5	
Zinc	60.1	132.2	146.0	139.7	172.8	119.5	80.0	4.88	11.1	
Silver	45.1	58.8	50.8	43.1	44.4	56.0	48.3	1.15	6.7	
Antimony	17.4	15.8	12.8	10.3	9.3	7.8	8.4	-11.43	1.2	
Tungsten	5.3	6.9	4.7	7.7	5.7	1.6	1.7	-17.26	0.2	
Gold	59.8	44.4	64.6	39.1	21.9	76.3	86.4	6.33	12.0	
Others	8.4	18.8	21.8	16.4	18.2	17.4	13.8	8.63	1.9	
2 Hydrocarbons	218.9	214.0	227.0	241.2	126.3	96.5	74.0	-16.54	10.2	
Petroleum	0.0	0.0	0.0	5.9	1.6	6.1	1.1	-	0.2	
Natural gas	214.9	213.8	225.3	232.6	122.8	90.2	72.9	-16.49	10.1	
Propane gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	
Butane gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	
Others	4.0	0.2	1.7	2.7	1.9	0.2	0.0	-	0.0	
3 Non-traditional	108.2	204.5	292.6	251.3	206.3	296.0	341.6	21.12	47.3	
Coffee	16.9	12.7	14.3	7.2	6.8	3.7	12.2	-5.29	1.7	
Wood	25.5	44.2	49.9	48.8	49.9	52.3	51.4	12.39	7.1	
Sugar	6.3	19.3	31.7	30.8	25.3	18.5	32.1	31.18	4.4	
Rubber	2.0	1.4	2.0	1.0	0.7	1.3	0.0	-	0.0	
Leather	19.5	17.7	26.5	12.5	10.3	12.2	7.4	-14.91	1.0	
Soybeans	20.2	54.3	48.2	69.3	51.5	68.9	70.4	23.13	9.7	
Metal machine	0.1	0.5	0.4	0.5	0.0	0.0	0.0	-	0.0	
Craft products	0.0	0.0	0.0	7.7	8.1	7.9	5.7	-4.89	0.8	
Chestnut	0.0	0.0	0.0	11.5	11.3	14.9	11.6	0.14	1.6	
Cattle	0.0	0.0	0.0	14.9	0.0	0.4	0.0	-	0.0	
Cotton*	0.0	0.0	0.0	13.1	6.5	10.3	14.4	1.59	2.0	
Clothes*	0.0	0.0	0.0	6.8	6.6	8.3	9.9	6.46	1.4	
Oils*	0.0	0.0	0.0	7.4	3.9	7.3	14.8	12.25	2.0	
Jewelry	0.0	0.0	0.0	0.0	5.9	58.0	79.2	-	11.0	
Others	17.7	54.4	119.6	19.8	19.5	32.0	32.5	10.66	4.5	
4 Total**	600.2	821.9	926.8	848.5	712.3	754.5	722.9	3.15	100.0	

Source : Boletín Estadístico No.283, Sep.1994, Banco Central de Bolivia

Note : * Average annual growth rates for cotton, clothes and oils are for the period 1991-1994.

** Total does not express FOB value.

**TABLE 3.4.2 IMPORT GOODS ACCORDING TO ECONOMIC PURPOSE, BOLIVIA
1988-1994**

Classification	Unit : US\$ Million								Share of Import Goods in 1994(%)
	1988	1989	1990	1991	1992	1993	1994	Average Annual Growth Rate(%) 1988-1994	
1 Consumption goods	128.3	137.5	152.9	206.0	204.8	242.7	210.2	8.58	25.5
Non-perishables	57.4	70.2	63.3	96.3	88.9	109.9	92.4	8.26	11.2
Perishables	70.9	67.3	89.6	109.7	115.9	132.8	117.8	8.83	14.3
2 Interim goods	228.3	249.0	253.5	351.2	384.7	422.8	307.2	5.07	37.2
Fuel and lubricants	4.8	2.6	3.5	7.8	12.0	2.6	3.4	-5.59	0.4
For agriculture	8.3	9.7	10.9	21.8	13.1	16.6	17.0	12.69	2.1
For industry	185.7	199.3	194.1	263.4	307.3	347.6	223.8	3.16	27.1
For construction	29.5	37.4	45.0	58.2	52.3	56.0	63.0	13.48	7.6
3 Capital goods	231.8	220.8	270.8	383.5	469.5	518.3	300.3	4.41	36.4
For agriculture	13.4	13.9	16.0	24.6	18.6	20.8	11.7	-2.24	1.4
For industry	137.4	127.6	169.2	252.3	301.5	309.4	185.9	5.17	22.5
Transport equipment	81.0	79.3	85.6	106.6	149.4	188.1	102.7	4.04	12.4
4 Others	2.1	3.7	10.0	28.7	31.3	22.1	8.2	25.49	1.0
5 Total (CIF value)	590.5	611.0	687.2	969.4	1,090.3	1,205.9	825.9	5.75	100.0

Source : Boletín Estadístico No.283, Sep.1994, Banco Central de Bolivia

**TABLE 3.4.3 BALANCE OF INTERNATIONAL PAYMENTS,
BOLIVIA, 1992 AND 1993**

Unit : US\$ Million		
Items	1992	1993
I. Current Account (A+B)	-408	-472
A. Goods, Services and Interests (1+2+3)	-655	-710
1 Trade	-452	-496
-Exports (FOB)	638	710
-Imports (CIF)	-1,090	-1,206
2 Services	-10	-9
-Exports	177	184
-Imports	-187	-193
3 Interests of Investment	-193	-205
i) Received	15	12
ii) Paid	-208	-217
-Interests for public external debt	-99	-119
-Other interents	-109	-98
B. Transfers	247	238
II. Capital Account (A+B)	406	377
A. Direct Investment	120	122
B. Other Capital	286	255
III. Basic Balance (I+II)	-2	-95
IV. Errors and Omissions	-144	-28
V. Total (III+IV))	-146	-123

Source : Boletin Estadistico No.283, Sep.1994, Banco Central de Bolivia

**TABLE 3.4.4 OFFICIAL EXCHANGE RATE OF FOREIGN CURRENCY
(BOLIVIANS/UNITED STATE DOLLAR)**

Month/Year	1990	1991	1992	1993	1994	Average Annual Variation Rate (%)
January	2.9915	3.4344	3.7534	4.1027	4.4844	10.65
February	3.0296	3.4671	3.7726	4.1296	4.5164	10.50
March	3.0653	3.4969	3.7921	4.1595	4.5585	10.43
April	3.0953	3.5207	3.8113	4.1880	4.5870	10.33
May	3.1224	3.5424	3.8369	4.2176	4.6147	10.26
June	3.1427	3.5690	3.8647	4.2483	4.6500	10.29
July	3.1660	3.5937	3.8992	4.2782	4.6495	10.08
August	3.1927	3.6131	3.9437	4.3050	4.6640	9.94
September	3.2360	3.6377	3.9883	4.3323	4.6753	9.64
October	3.2798	3.6676	4.0185	4.3666	4.6700	9.24
November	3.3197	3.6960	4.0467	4.4070	4.6900	9.02
December	3.3698	3.7208	4.0795	4.4476	4.7000	8.67
Annual Average	3.1676	3.5800	3.9006	4.2652	4.6217	9.91
Average Monthly Variation Rate(%)	1.09	0.73	0.76	0.74	0.43	-

Source : (1) Boletín Estadístico No.283, Sep.1994, Banco Central de Bolivia

(2) Devaluación e Inflación de Bolivia y los Países Limitrofes, Enero 1995, INE

Note : Exchange rate in table indicates an average between purchase and sale rates.

TABLE 3.5.1 CONSUMER PRICE INDEX FOR MAIN GROUPS AT NATIONAL AVERAGE, LA PAZ AND SANTA CRUZ
(1991=100)

Classification	National Average			La Paz			Santa Cruz		
	Weight in 1991	Price Index in 1994	Average Annual Rise Rate(%) 1991-1994	Weight in 1991	Price Index in 1994	Average Annual Rise Rate(%) 1991-1994	Weight in 1991	Price Index in 1994	Average Annual Rise Rate(%) 1991-1994
1 General	100.00	132.24	9.76	100.00	132.23	9.76	100.00	130.28	9.22
2 Foods and beverages	49.10	133.19	10.02	50.44	131.53	9.57	45.68	131.75	9.63
3 Clothes and footwears	8.17	127.92	8.55	7.83	129.95	9.13	9.45	124.35	7.53
4 Housing	9.77	133.28	10.05	8.98	127.88	8.54	9.12	126.93	8.27
5 Equipment and furnishings of household	6.69	132.38	9.80	6.59	136.81	11.01	7.80	130.59	9.30
6 Health	3.83	134.47	10.38	3.80	135.56	10.67	4.10	135.15	10.56
7 Transport and communications	10.80	126.22	8.07	10.42	130.43	9.26	11.82	125.94	7.99
8 Education	4.57	136.66	10.97	4.31	143.32	12.75	5.05	130.93	9.40
9 Recreation and cultural services	3.31	138.53	11.48	3.97	143.42	12.77	2.66	134.35	10.34
10 Miscellaneous goods and services	3.77	130.55	9.29	3.66	125.66	7.91	4.34	136.09	11.36

Source : Índice de Precios al Consumidor, Resume Anual 1994, Instituto Nacional de Estadística

TABLE 3.6.1 FINANCIAL STATEMENT OF CENTRAL GOVERNMENT

Financial Items	1988	1989	1990	1991	Unit : Bs. Million
					Average Annual Growth Rate (%)
I. Revenue					
1. Tax Revenue	1,203.3	1,342.4	1,733.2	2,335.2	24.7
1) Domestic Revenue	367.2	446.6	560.5	819.3	30.7
2) Custom Revenue	140.4	138.3	139.7	160.1	4.5
3) Royalty	695.7	757.5	1,033.0	1,355.8	24.9
Mineral	7.6	16.6	11.3	7.7	0.4
Petroleum	688.1	740.9	1,021.7	1,348.1	25.1
2. Other Revenue	43.4	210.6	124.2	440.4	116.5
3. Total (Bs. million)	1,246.7	1,553.0	1,857.4	2,775.6	30.6
(US\$ million)			586.4	775.3	
II. Expenditure					
1. Personnel Expenses	646.1	777.0	915.1	1,120.9	20.2
2. Purchase of Services	96.6	119.2	133.7	172.6	21.3
3. Purchase of Materials	114.1	149.2	160.6	188.2	18.2
4. Fixed Assets	45.4	46.8	64.7	82.6	22.1
5. Public Debt	185.2	234.2	389.6	690.2	55.0
1) Domestic Debt	16.2	22.3	138.5	320.0	170.3
2) Foreign Debt	169.0	211.9	251.1	370.2	29.9
Repayment	69.9	89.1	111.7	370.2	74.3
Interest	99.1	122.8	139.4	0.0	-
6. Transfer/Investment	200.0	225.3	322.7	350.8	20.6
7. Other Expenses	9.7	15.8	47.9	119.9	131.2
3. Total (Bs. million)	1,297.1	1,567.5	2,034.3	2,725.2	28.1
(US\$ million)			642.2	761.2	
III. Surplus/Deficit	-50.4	-14.5	-176.9	50.4	-

Source : INE

TABLE 3.6.2 BUDGET EXECUTION OF CORDECruz FOR THE PERIOD 1988 - 1994

Unit: US\$ 1,000

Description	1988		1989		1990		1991		1992		1993		1994	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
I. TOTAL INCOME	29,467	100.0	34,744	100.0	29,811	100.0	47,536	100.0	50,107	100.0	57,748	100.0	42,413	100.0
1. Own Income	29,467	100.0	34,744	100.0	29,811	100.0	35,874	75.5	37,114	74.1	43,204	74.8	27,934	65.9
1.1 Current Income	23,000	78.1	21,725	62.5	22,482	75.4	26,385	55.5	25,734	51.4	26,057	45.1	21,149	49.9
Tax collection	6,394	21.7	8,040	23.1	7,191	24.1	8,488	17.9	12,231	24.4	13,113	22.7	8,008	18.9
Oil bonus	15,719	53.3	12,336	35.5	14,019	47.1	15,721	33.1	12,173	24.3	12,261	21.2	12,788	30.2
Wood bonus	215	0.7	234	0.7	155	0.5	290	0.6	556	1.1	121	0.2	251	0.6
Mining bonus	0	0.0	0	0.0	16	0.1	1	0.0	1	0.0	1	0.0	0	0.0
Various current income	672	2.3	1,115	3.2	1,071	3.6	1,885	4.0	773	1.5	391	0.7	102	0.2
Sale of disused goods	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	170	0.3	0	0.0
1.2 Extraordinary Income	0	0.0	0	0.0	0	0.0	0	0.0	514	1.0	7,465	12.9	331	0.8
Privatization	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6,967	12.1	119	0.3
Extraord. payment (Oil Export)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	498	0.9	0	0.0
Fund deposit FINDESA	0	0.0	0	0.0	0	0.0	0	0.0	514	1.0	0	0.0	0	0.0
Toll collections	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	212	0.5
1.3 Recoveries	6,249	21.2	12,832	36.9	6,024	20.2	8,996	18.9	10,866	21.7	9,169	15.9	4,562	11.7
Debt recoveries	1,304	4.4	190	0.5	189	0.6	250	0.5	3,454	7.0	1,024	1.8	3,454	8.1
Bonus of debt recovery	4,945	16.8	12,642	36.4	5,835	19.6	8,746	18.4	7,382	14.7	8,145	14.1	1,508	3.6
Fixed term deposit recovery	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
1.4 Balance in Bank	218	0.7	187	0.5	1,305	4.4	493	1.0	0	0.0	513	0.9	1,492	3.5
2. External Income	0	0.0	0	0.0	0	0.0	11,662	24.5	12,993	25.9	14,544	25.2	14,479	34.1
2.1 Internal Credit	0	0.0	0	0.0	0	0.0	4,540	9.6	8,538	17.0	9,592	16.6	9,436	22.2
2.2 Internal Transfers	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	376	0.7	714	1.7
2.3 External credits	0	0.0	0	0.0	0	0.0	2,530	5.3	1,890	3.8	2,827	4.9	1,709	4.0
2.4 Donations	0	0.0	0	0.0	0	0.0	4,592	9.7	2,565	5.1	1,749	3.0	2,620	6.2
II. TOTAL EXPENSES	29,335	100.0	32,573	100.0	29,401	100.0	47,382	100.0	49,373	100.0	48,795	100.0	40,994	100.0
1. Own Expenses	29,335	100.0	32,573	100.0	29,401	100.0	35,720	75.4	36,380	73.7	35,954	73.7	27,249	66.5
1.1 Current Expenses	4,660	15.9	6,312	19.4	7,109	24.2	8,159	17.2	14,131	28.6	17,906	36.7	14,765	36.0
Personal services	2,915	9.9	3,551	10.9	4,441	15.1	5,157	10.9	4,903	9.9	4,198	8.6	3,110	7.6
Non-personal services	1,146	3.9	1,432	4.4	1,528	5.2	2,088	4.4	2,190	4.4	2,497	5.1	1,040	2.5
Material and supplies	503	1.7	492	1.5	568	1.9	739	1.6	690	1.4	381	0.8	266	0.6
Financing assets	0	0.0	0	0.0	0	0.0	0	0.0	18	0.0	55	0.1	6	0.0
Debt service	0	0.0	0	0.0	0	0.0	0	0.0	5,722	11.6	8,529	17.5	8,563	20.9
Social reserves	96	0.3	837	2.6	572	1.9	175	0.4	608	1.2	2,246	4.6	1,780	4.3
1.2 Transfers	6,215	21.2	4,201	12.9	3,769	12.8	3,889	8.2	2,950	6.0	3,664	7.5	3,693	9.0
1.3 Investments	18,460	62.9	22,060	67.7	18,523	63.0	23,672	50.0	19,299	39.1	14,384	29.5	8,791	21.4
Investments in assets	107	0.4	21	0.1	137	0.5	72	0.2	186	0.4	26	0.1	25	0.1
Investments in projects	18,353	62.6	22,039	67.7	18,386	62.5	23,600	49.8	19,113	38.7	14,358	29.4	8,766	21.4
2. External Expenses	0	0.0	0	0.0	0	0.0	11,662	24.6	12,993	26.3	12,841	26.3	13,745	33.5
2.1 Internal credits	0	0.0	0	0.0	0	0.0	4,540	9.6	8,538	17.3	9,593	19.7	8,116	19.8
2.2 Internal transfers	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	690	1.4	714	1.7
2.3 External credits	0	0.0	0	0.0	0	0.0	2,530	5.3	1,890	3.8	1,036	2.1	2,662	6.5
2.4 Donations	0	0.0	0	0.0	0	0.0	4,592	9.7	2,565	5.2	1,522	3.1	2,253	5.5
III. SURPLUS/DEFICIT	132	-	2,171	-	410	-	154	-	734	-	8,953	-	1,419	-

Source: Finance Office, CORDECruz, 1995

TABLE 3.6.3 INVESTMENT PLAN OF CORDECruz FOR THE PERIOD 1995 - 1999

Unit : US\$ 1,000

Sector	1995		1996		1997		1998		1999		Average Annual Growth Rate (%)					
	Proj.	Non-proj.	Sum	Proj.	Non-proj.	Sum	Proj.	Non-proj.	Sum	Proj.		Non-proj.	Sum			
1 Agriculture	1,085	1,110	2,195	4,562	5,158	9,720	13,611	12,344	25,955	17,552	11,610	29,162	17,559	3,493	21,052	75.9
2 Education	298	0	298	200	0	200	557	0	557	557	0	557	557	0	557	16.9
3 Electricity	105	501	606	792	300	1,092	86	0	86	86	0	86	86	0	86	-38.6
4 Industry	0	242	242	0	297	297	0	188	188	0	102	102	0	192	192	-5.6
5 Mining	0	0	0	0	300	300	0	850	850	0	550	550	0	550	550	-
6 Multisectors	6,607	3,891	10,498	8,647	6,617	15,264	7,548	4,968	12,516	4,908	3,668	8,576	972	1,275	2,247	-52.0
7 Water Resources	0	0	0	0	0	0	0	117	117	0	318	318	0	0	0	-
8 Health	1	141	142	50	152	202	650	152	802	650	152	802	650	0	650	46.3
9 Basic Sanitation	1,233	0	1,233	3,547	0	3,547	14,328	0	14,328	13,307	0	13,307	15,310	0	15,310	87.7
10 Transportation	2,351	10,571	12,922	8,756	53,679	62,435	7,515	60,326	67,841	23,099	60,055	83,154	43,756	58,546	102,302	67.7
Total	11,680	16,456	28,136	26,554	66,503	93,057	44,295	78,945	123,240	60,159	76,455	136,614	78,870	64,056	142,926	50.1

Source : Finance Office, CORDECruz, 1995

TABLE 3.6.4

BUDGET FOR PUBLIC INVESTMENT OF MUNICIPALITIES IN 1995
IN DEPARTMENT OF SANTA CRUZ

Unit: Bz.

No.	Municipalities	Grand Total			Local Finance					External Finance			
		Amount (%)	Amount (%)	Total (%)	National Fund	Own Resources	Popular Participation	Community Contribution	Others	Total Amount (%)	External Credit	Donation	
1	COMARAPA	1,352,534	0.40	1,352,534	0.44	0	18,284	1,334,250	0	0	0	0	0
2	SAINPA	271,985	0.08	271,985	0.09	0	10,500	261,485	0	0	0	0	0
3	SAN JOSE	1,527,570	0.45	1,527,570	0.50	0	162,651	1,364,919	0	0	0	0	0
4	PAILON	2,740,307	0.80	2,740,307	0.89	0	13,283	1,102,274	0	1,624,750	0	0	0
5	ROBORE	2,160,306	0.63	2,160,306	0.70	0	41,981	1,650,325	0	468,000	0	0	0
6	CONCEPCION	1,677,860	0.49	1,258,049	0.41	0	19,434	1,238,615	0	0	419,831	1.17	-419,831
7	SAN JAVIER	655,921	0.19	655,921	0.21	0	0	403,201	0	252,720	0	0	0
8	SAN JULIAN	4,778,502	1.40	4,778,502	1.56	0	11,000	4,256,177	165,511	345,814	0	0	0
9	BOYUTIB	1,160,284	0.34	452,300	0.15	0	4,710	360,110	0	87,480	707,984	1.97	707,984
10	CABEZAS	1,292,947	0.38	1,292,947	0.42	0	7,600	1,285,347	0	0	0	0	0
11	CAMARI	4,997,800	1.46	4,997,800	1.63	0	704,988	3,350,774	0	942,038	0	0	546,894
12	CHARAGUA	2,723,775	0.80	2,176,879	0.71	0	12,000	951,792	0	1,213,087	0	0	0
13	CUEVO	289,860	0.08	289,860	0.09	0	4,593	285,267	0	14,872	0	0	0
14	GUTIERREZ	593,624	0.17	593,624	0.19	0	0	578,752	0	300,983	1,087,818	3.03	1,087,818
15	LAGUNILLAS	1,797,348	0.52	709,530	0.23	0	0	408,547	0	0	0	0	0
16	MAIRANA	529,796	0.15	529,796	0.17	0	28,650	501,146	0	0	0	0	0
17	PAMPA GRANDE	684,322	0.20	684,322	0.22	0	0	684,322	0	0	0	0	0
18	QUIRUSILLA	283,147	0.08	283,147	0.09	0	5,530	151,527	0	126,090	0	0	0
19	SAMAIPATA	938,391	0.27	938,391	0.31	0	28,418	728,173	0	181,800	0	0	0
20	PUERTO QUIBARRO	1,747,467	0.51	1,747,467	0.57	0	838,558	908,909	0	0	0	0	0
21	PUERTO SUAREZ	2,288,986	0.67	2,288,986	0.75	0	224,083	1,957,703	0	97,200	0	0	0
22	ASCENSION DE QUARAYOS	1,617,524	0.47	1,055,505	0.35	0	63,355	1,022,150	0	0	532,019	1.48	532,019
23	EL PUNTE	834,856	0.24	395,130	0.13	0	0	382,860	0	12,270	439,726	1.23	439,726
24	URUBICHA	303,641	0.09	303,641	0.10	0	1,100	302,541	0	0	0	0	0
25	COTOGA	2,653,308	0.78	2,653,308	0.87	0	1,114,062	1,393,746	0	145,500	0	0	0
26	LA GUARDIA	2,761,013	0.81	2,761,013	0.90	0	460,460	2,300,553	0	0	0	0	0
27	PORONGO	906,670	0.26	906,670	0.30	0	43,200	863,470	0	0	0	0	0
28	SANTA CRUZ	251,524,915	73.47	228,443,982	74.54	0	64,888,262	18,105,396	0	145,450,324	23,080,933	64.34	21,591,959
29	EL TORNO	2,957,142	0.86	2,957,142	0.96	0	400,000	2,373,606	0	183,536	0	0	0
30	BUENA VISTA	3,448,725	1.01	1,471,002	0.48	0	52,494	827,781	396,327	194,400	1,977,723	5.51	1,977,723
31	SAN CARLOS	2,374,550	0.69	1,805,845	0.59	0	1,669,765	0	0	136,080	568,705	1.59	568,705
32	YAPACANI (SAN JUAN)	4,322,292	1.26	2,395,330	0.78	0	274,208	1,148,334	0	972,790	1,926,942	5.37	1,926,942
33	SAN MATIAS	1,039,003	0.30	630,725	0.21	0	33,000	500,725	0	97,000	408,278	1.14	408,278
34	MINERO	4,747,900	1.39	4,747,900	1.55	0	310,500	3,317,772	0	1,119,628	0	0	0
35	MONTERO	6,033,161	1.76	6,033,161	1.97	0	0	5,305,661	0	727,500	0	0	0
36	GENERAL SAAVEDRA	1,125,144	0.33	1,125,144	0.37	0	53,501	1,023,143	0	48,500	0	0	0
37	PORTACHUELO	2,875,741	0.84	2,555,780	0.83	0	2,500	1,045,969	0	72,600	1,758,483	4.90	1,758,483
38	SANTA ROSA	527,566	0.15	527,566	0.17	0	0	488,686	0	38,880	0	0	0
39	MORO MORO	268,199	0.08	268,199	0.09	0	0	243,899	0	24,300	0	0	0
40	POSTRER VALLE	357,877	0.10	357,877	0.12	0	0	327,031	0	30,846	0	0	0
41	PUCARA	435,011	0.13	435,011	0.14	0	0	352,391	0	82,620	0	0	0
42	EL TRIGAL	1,814,179	0.53	1,814,179	0.59	0	133,086	1,628,648	0	52,445	0	0	0
43	VALLE GRANDE	2,945,332	0.86	2,945,332	0.96	0	0	2,154,772	0	790,560	0	0	0
44	SAN IGNACIO	1,278,936	0.37	975,900	0.32	0	159,792	814,108	0	0	305,086	0.85	305,086
45	SAN MIGUEL	489,226	0.14	152,356	0.05	0	0	152,356	0	0	0	0	0
46	SAN RAFAEL	5,910,655	1.73	5,910,655	1.93	0	1,493,410	4,417,245	0	0	0	0	0
47	WARNES	342,359,579	100	342,359,579	100	0	71,629,191	78,409,403	561,838	155,883,013	35,876,134	100	21,591,959
	Grand Total (Bs.)	71,324,912	100	63,850,218	100	0	14,922,748	16,335,292	117,050	32,475,628	7,474,195	100	4,498,325
	Grand Total (US\$)												2,975,870

Source: Ministerio de Hacienda, 1995

TABLE 3.7.1 EXTERNAL AID TO BOLIVIA FOR PERIOD 1990 - 1994

Unit: US\$ 1,000

Countries/Agencies	1990	1991	1992	1993	1994	Total Amount or Technical Assistance(T)	Loan(L), Grant(G) or Assistance(T)
I. Foreign Countries							
1 USA	15,908	37,466	53,495	91,345	91,005	289,219	G,T
2 Japan	13,057	25,593	18,755	21,973	14,682	94,058	G,T
3 Germany	46,051	46,051	46,051	46,051	n.a.	184,204	L,G,T
4 Italy	n.a.	26,533	26,533	26,533	n.a.	79,599	L,G
5 Switzerland	16,839	21,254	19,709	18,820	n.a.	76,622	n.a.
6 Canada	19,170	25,730	n.a.	n.a.	n.a.	44,900	n.a.
7 France	8,667	8,667	8,667	8,667	2,000	36,668	L,G,T
8 Belgium	2,159	4,049	3,719	4,872	3,752	18,551	G,T
Sub-total:	121,851	195,343	176,929	218,261	111,439	823,821	
II. International Agencies							
1 BID	194,200	175,900	111,050	86,750	244,930	812,830	L,G,T
2 BIRF	26,044	59,399	85,849	100,848	76,725	348,865	L
3 CAF	n.a.	n.a.	n.a.	88,800	n.a.	88,800	L
4 CEE	10,468	10,468	n.a.	n.a.	n.a.	20,936	G,T
Sub-total	230,712	245,767	196,899	276,398	321,655	1,271,431	
III. Total	352,563	441,110	373,828	494,659	433,094	2,095,252	

Source: Ministry of Finance, 1995

JICA Office, Bolivia, Sep. 1995

Note: BID: Banco Interamericano de Desarrollo

BIRF: Banco Internacional de Reconstrucción y Fomento

CAF: Corporación Andiana Fomento

CEE: Comunidad Económica Europea

n.a.: not available.

CHAPTER 4
FLOOD AND FLOOD DAMAGE



CHAPTER 4 FLOOD AND FLOOD DAMAGE

4.1 Major Floods

The recorded major floods in the study area from 1960s to 1995 are as follows;

Eastern area: 1968, 1972, 1983, 1987 and 1992

Western area: 1963, 1966, 1982, 1983, 1991 and 1992

1992 Floods is recorded as the largest floods in recent years. The 1983 Floods was caused by the overflow of the Río Piray.

4.2 Flood and Flood Damage Survey

Flood and flood damage survey were conducted to make clear the conditions of 1992 Floods as well as annual floods. The method of the survey was questionnaire to the inhabitants and interview to the local government officials.

4.2.1 1992 Floods

Fig. 4.2.1 shows the area of 1992 Floods in the study area. Total area of 1992 Floods was 4,857 km². Followings describe the condition of 1992 Floods in the eastern area and western area of the study area.

(1) Eastern Area

Fig. 4.2.2 shows the inundation area with average depth and duration due to the 1992 Floods. During the 1992 Floods, overflow occurred along the Río Chané, Río Pailon, Quebrada Chané, Quebrada Toro, Quebrada Las Chacras and Quebrada Las Maras.

In the Río Chané Basin, 46 percent of the area was inundated in the upstream basin and almost the entire area was inundated in the downstream basin from the National Road No.9. Depth of the inundation was 0.4 m to 1.0 m in the upstream basin and 0.4 m to 1.3 m in the downstream basin. Due to the existence of road embankment and insufficient openings at the crossing sites of the rivers, flood condition was made worse along the southern side of the Road No.9.

The Río Piray overflowed in the downstream area from Warnes. Along the Río Grande, overflow occurred at two or three places in the downstream reach from the Road No.9.

(2) Western Area

Fig. 4.2.3 shows the inundation area with average depth and duration due to the 1992 Floods. Overflow occurred along the Río Palometillas, Río Palacios main stream, Arroyo Yapacanicito, Jochi, Tacuaral and Tejeria with average depth of 0.4 m to 1.0 m.

Río Yapacani also overflowed around Santa Fé as well as low-lying areas along the downstream reaches from the National Road No.7.

4.2.2 Annual Floods

Fig. 4.2.4 shows the area of Annual Floods in the study area. Total area of Annual Floods is 2,444 km². *Fig. 4.2.5* and *Fig. 4.2.6* show the inundation areas with average depth and duration of eastern area and western area respectively.

(1) Eastern Area

About 20 percent of the area is inundated in the upstream basin and about 60 percent in the downstream basin from the Road No.9. The Río Piray overflows around Montero. The Río Grande overflows at two or three places in the downstream reach from the Road No.9.

(2) Western Area

About 50 percent of Arroyo Yapacanicito, Jochi and Tacuaral Basins are inundated annually. Most of the area of Arroyo Tejeria Basin is inundated. Overflow occurs along the downstream reach of the Río Palometillas. Inundation also occurs along the mainstream of the Río Palacios.

4.3 Causes of Floods

Causes of floods were studied by analyzing the information and data of 1992 Floods. The causes of floods in the study area are as follows;

- 1) Inundation by the Río Piray, Río Grande or Río Yapacani
- 2) Inundation by its own basin runoff with backwater effect of the Río Piray
- 3) Inundation by its own basin runoff with inflow water from the Río Piray, Río Grande or Río Yapacani
- 4) Inundation by its own basin runoff

Fig. 4.3.1 shows the division of areas corresponding to the above causes of floods.

4.4 Study on Flood Damage

(1) General Assets in the Study Area

The assets are composed of general assets, agricultural crops, public facilities and others. The general assets are composed of buildings and household effects. *Table 4.4.1* shows the general assets of the provinces and municipalities related to the study area. *Table 4.4.2* shows the general assets in the study area divided into river basins.

(2) Agricultural Crops

Supplemental questionnaire survey was conducted to clarify the flood damage of agriculture products. By the survey, it became clear that the crop damage is more related to flood depth than flood duration in both of eastern and western areas of the study area. Furthermore, it became clear that the ratio of agricultural yields such as crop, livestock in 1992 were much smaller than that of average year.

(3) Assets in Potential Damage Area

Assets in the Chané - Pailón and San Juan - Antofagasta were estimated. *Table 4.4.3* shows the estimated assets of these areas.

TABLES

TABLE 4.4.1 ASSETS IN PROVINCES/MUNICIPALS

Province	Municipio	Popu- lation (Person)	House- holds (No.)	Administ. Area (km2)	Residence			Shop (No.)	Factory (No.)	Restau- rant (No.)	School (No.)	Hospital			Clinic (No.)	Church (No.)
					High (No.)	Medium (No.)	Low (No.)					General (No.)	Micro Hospital (No.)	Posta Sanitaria (No.)		
1. Andrez de Ibañes	Cotoca	19,631	4,255	460	(149)	(1,217)	(2,889)	(155)	(11)	(30)	(30)	(1)	(2)	(3)	(2)	(9)
	Cnt. Monter Hoyos	3,719	674	255	(24)	(193)	(458)	(29)	0	8	(6)	0	0	1	0	1
2. Warnes	Warnes	38,285	8,212	2,305	1,068 13%	3,285 40%	3,860 47%	(302)	40	25	49	1	4	25	0	18
	3. Obispo Santiesteban	58,569	11,903	253	238 2%	2,381 20%	9,284 78%	1342	54	39	35	2	10	2	6	10
4. Sara	San Carlos	11,260	2,434	570	(85)	(696)	(1,653)	(89)	(6)	(14)	(17)	(1)	(1)	(2)	(1)	(5)
	Canton Palometa	2,920	666	317	7 1%	133 20%	526 79%	16	0	4	7	0	1	3	0	4
5. Ichillo	Santa Rosa del Sara	6,221	1,410	336	0 0%	71 5%	1340 95%	(50)	3	(4)	30	1	1	8	0	6
	Buena Vista	10,784	2,113	114	0 0%	292 14%	1,821 86%	(85)	0	8	35	1	0	4	0	6
(Average %)					4%	29%	68%									
Total		215,927	45,209	7,178	2,139	15,031	28,038	2,674	146	165	332	9	20	65	9	134

Note: 1. Above figure is obtained by interview from Municipio Offices

2. Figure in parenthesis is estimated based on average-area-ratio of other municipio offices

TABLE 4.4.2 ASSETS IN RIVER SYSTEMS

River System	Province	Municipio	Whole Area (km ²)	Partial Area (km ²)	Ratio (%)	Population (Person)	House-holds (No.)	Admin Area (km ²)	Residence			Shop (No.)	Factory (No.)	Restaurant (No.)	School (No.)	Hospital		Clinic/Church		
									High (No.)	Medium (No.)	Low (No.)					General (No.)	Micro Hospital (No.)	Posta Sanitaria (No.)	(No.)	(No.)
1. Rio Grande Upstream (South from No.9 Road)	Andrez de Ibanes Cotoca		460	234	51%	9,986	2,165	234	76	619	1,470	79	5	15	15	0	1	2	1	5
	C. Fonter Hoyos		255	255	100%	3,719	674	255	24	193	458	29	0	8	6	0	0	1	0	1
	Warnes		2,305	401	17%	6,660	1,429	401	186	571	671	53	7	4	9	0	1	4	0	3
		Sub-total (1)	890	890		20,366	4,265	890	285	1,383	2,599	161	12	28	29	1	2	7	1	9
2. Rio Grande Downstream (North from No.9 Road)	Warnes		2,305	209	9%	3,471	745	209	97	298	350	27	4	2	4	0	0	2	0	2
	O. Santisteban		478	30	6%	730	157	30	8	31	118	4	0	0	2	0	0	0	0	0
	Mineros		650	119	18%	6,307	1,363	119	68	818	477	73	1	4	15	0	0	1	0	11
		Sub-total (2)	358	358		10,509	2,265	358	173	1,147	945	104	5	7	21	0	1	4	0	13
3. Rio Chane Upstream (South from No.9 Road)	Andrez de Ibanes Cotoca		460	173	38%	7,383	1,600	173	56	458	1,087	58	4	11	11	0	1	1	1	4
	Warnes		2,305	1,343	58%	22,307	4,785	1,343	622	1,914	2,249	176	23	15	29	1	2	15	0	10
	Montero		253	59	23%	13,658	2,776	59	56	555	2,165	313	13	9	8	0	2	0	1	2
		Sub-total (3)	1,575	1,575		43,348	9,161	1,575	734	2,927	5,500	548	40	35	48	1	5	16	2	16
4. Rio Chane Downstream (North from No.9 Road)	Warnes		2,305	219	10%	3,637	780	219	101	312	367	29	4	2	5	0	0	2	0	2
	O. Santisteban		478	313	65%	7,621	1,638	313	82	328	1,229	39	0	2	17	1	0	3	0	3
	Mineros		650	64	25%	8,693	1,878	64	94	1,127	657	101	2	6	20	0	0	2	0	15
		Sub-total (4)	696	696		19,951	4,297	696	277	1,767	2,253	169	6	10	42	1	1	7	0	20
5. Rio Pirai	Andrez de Ibanes Cotoca		460	53	12%	2,282	490	53	17	140	333	18	1	3	3	0	0	0	0	1
	Warnes		2,305	133	6%	2,209	474	133	62	190	223	17	2	1	3	0	0	1	0	1
	Montero		253	194	77%	44,911	9,127	194	183	1,825	7,119	1,029	41	30	27	2	8	2	5	8
		Sub-total (5)	1,165	1,165		75,318	15,718	1,165	520	4,982	10,215	1,327	50	53	92	3	9	10	5	48
6. Rio Palometillas	Sara		570	420	74%	8,297	1,793	420	63	513	1,218	66	4	10	13	0	1	1	1	4
	O. Santisteban		336	220	65%	4,139	923	220	0	46	877	33	2	3	20	1	1	5	0	4
	Canton Palometillas		317	90	28%	829	189	90	2	38	149	5	0	1	2	0	0	1	0	1
		Sub-total (6)	730	730		13,265	2,906	730	65	597	2,244	103	6	14	34	1	2	8	1	9
7. Rio Palacios	Sara		570	94	16%	1,857	401	94	14	115	273	15	1	2	3	0	0	0	0	1
	O. Santisteban		336	116	35%	2,182	487	116	0	24	462	17	1	1	10	0	0	3	0	2
	Ichilo		1,440	961	67%	12,244	2,399	961	48	1,200	1,152	97	16	4	12	1	0	5	0	6
		Sub-total (7)	1,114	1,114	100%	10,784	2,113	1,114	0	292	1,821	85	0	8	35	1	0	4	0	6
8. Rio Yapacani	Sara		1,440	479	33%	6,103	1,196	479	24	598	574	48	8	2	6	0	0	2	0	3
	O. Santisteban		479	479	100%	6,103	1,196	479	24	598	574	48	8	2	6	0	0	2	0	3
	Ichilo		7178	7178		215,927	45,209	7,178	2,139	15,031	28,038	2,674	146	165	332	9	20	65	9	134

TABLE 4.4.3 ASSETS OF CHANE - PAILON AND SAN JUAN ANTOFAGASTA

1. NUMBER OF BUILDINGS

Sub-project	Area (km ²)	Buildings (No.)											Total
		Residence			Shop	Resta- rant	School	Church	Factory	Hospital	Health Center	Total	
		High	Medium	Low									
A. CHANE - PAILON	1024.2	193	1024	1615	177	15	19	10	10	2	6	3071	
1) Rio Chane	107.4	17	203	129	18	1	4	3	0	0	0	376	
2) Rio Pailon	260.5	58	179	210	24	2	4	1	3	1	2	483	
3) Chane - Chaclas	318.9	39	339	595	62	8	4	4	2	1	1	1053	
4) Quebrada Chane	159.5	39	182	538	57	2	5	1	3	1	1	850	
5) Okinawa Drainage	177.9	40	122	144	16	1	3	1	2	0	1	330	
B. SAN JUAN - ANTOFAGASTA	663.1	33	827	795	67	2	8	4	11	1	2	1752	
1) San Juan	355.1	18	443	426	36	1	4	2	6	1	2	939	
2) Antofagasta	308.0	15	384	369	31	1	4	2	5	0	0	813	

2. AREA OF AGRICULTURAL CROPS

Sub-project	Area (km ²)	Agricultural Crops (Ha)								Total
		Soy- beans	Rice	Sugar cane	Maize	Soy- ghum	Pasture		Total	
							Natural	Improv.		
A. CHANE - PAILON	1024.2	24455	4986	40136	1464	826	3637	7804	83308	
1) Rio Chane	107.4	2437	497	3340	146	82	119	255	6876	
2) Rio Pailon	260.5	11160	2275	2382	668	377	1249	2680	20791	
3) Chane - Chaclas	318.9	248	51	23166	15	8	1195	2564	27247	
4) Quebrada Chane	159.5	786	160	11248	47	27	443	951	13662	
5) Okinawa Drainage	177.9	9824	2005	0	588	332	631	1354	14732	
B. SAN JUAN - ANTOFAGASTA	663.1	5126	33093	59	74	0	1713	8720	48785	
1) San Juan	355.1	2443	15773	59	35	0	1220	6211	25741	
2) Antofagasta	308.0	2683	17320	0	39	0	493	2509	23044	