CHAPTER 13
PROJECT EVALUATION

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13.1 General

The project evaluation is carried out from economic point of view, taking into account social and environmental aspects as well. The economic evaluation is indicated by Economic Internal Rate of Return (EIRR) which is determined by using present values of economic cost and benefit of the project.

The economic prices, which are required to estimate the economic benefit and cost, are given under the conditions and assumptions as shown below:

(a) Transfer payments such as value added tax, income tax and corporation tax are not included in the economic prices,

(b) Standard conversion rate applied to equipment and materials procured locally is assumed to be 88 %, based on the external trade amount and duties of Bolivia in recent years shown in *Table 13.1.1*,

(c) Opportunity cost of wages for unskilled laborers are taken at 80 % of their market prices, under the prevailing unemployment rate of approximately 20 %,

(d) Opportunity cost of land to be acquired for the project is assumed to be 70 %, taking into consideration the existing conditions of land use in the objective area,

(e) Inflation factor is not taken into account for the economic evaluation.

Economic life of the project (hereinafter referred to as the "project life") is taken as 30 years after the construction of facilities was completed, and the benefit and the operation and maintenance cost (hereinafter referred to as the "OM cost") of the facilities are assumed to occur every year during the period of project life.

The evaluation of proposed projects will be conducted based not only on economic analysis of benefits and costs by EIRR and NPV, but also on other socioeconomic impacts, including direct / indirect and quantitative / qualitative socioeconomic impact.

13.2 Economic Benefit

(1) Concept of Flood Control Benefit

The economic benefit of a flood control project could be presented as an expected reduction effect in flood damage by implementing the flood control project, that is, a difference between with-project and without-project situations.

The economic benefit is estimated for two distinct stages; in the first stage the direct effect of reduction in the flood damage to assets, and in the second stage the reduction effect in flood damage to public facilities and economic activities as a function of the damage to assets.

For the purpose of estimating the economic benefit, a flood damage analysis was made to assets, which were composed of general assets (buildings and household effects), livestock and agricultural field crops, using results of a flood damage survey illustrated in the Supporting Report C.

(2) Flood Damage Analysis

The flood damages to the general assets and livestock could be estimated by using (a) number of the assets to be inundated by flood, (b) appraisal values of the assets, and (c) damage rate of the assets inundated.

On the other hand, the damages to agricultural field crops could be estimated by using (a) inundation areas in the agricultural crop fields, (b) production per unit area, and (c) the damage rate of agricultural field crops inundated.

1) Number of General Assets and Area of Agricultural Crop Fields in Inundation Area

In the inundation area, major buildings include residential houses (high, medium, and low classes), shops, restaurants, schools, churches, factories, hospitals, etc., and agricultural crop fields are mainly composed of soybeans, rice, sugar cane, maize and pasture.

In the present study, an increase in number of buildings in the future is taken in no account in the flood prone area, and the number in 1995 is applied to estimate the flood damage, because the numbers of population and households in the rural area of the Department of Santa Cruz were only a little variation during the intercensal period between 1976 and 1992.

On the other hand, the agricultural crop lands in the Study Area have fully been developed, that is, it is considered to be difficult to expect a further increase in the agricultural land area, even though the kinds of planted crops are varied in the future. Accordingly in the present study, an increase in the agricultural crop areas is also taken into no account in the flood prone area during the period of project life.

2) Appraisal Values of Assets

An interview survey was carried out to obtain the present appraisal values of buildings, household effects and livestock for each of residences, shops, restaurants, schools, churches, factories, hospitals, etc. in the flood prone area.

With regard to the agricultural field crops, production (tons/ha), prices (Bs/ton) and yield (Bs/ha) at the farm gate were estimated on the basis of agricultural production statistics and the result of questionnaire survey.

3) Flood Damage Rates of Assets

The flood damage rates of building, household effects, livestock and agricultural crops are estimated on the basis of the results of interview survey on the past flood damages in the flood prone area. The damage rate are given according to the water depth of inundation for building, household effects, livestock and agricultural crops, and the respective average damage rates.

In addition to the said flood damage to assets, a damage to public facilities and a loss in business activities are considered. The public facilities contain transportation and agricultural facilities, electric and water supply systems, etc. However, it was difficult to estimate the flood damage to these facilities from the past flood damage records. Therefore, in the present study the total damage to these public facilities is assumed to be 34 % of the damage to general assets, in accordance with similar projects in the South-east Asian countries.

On the other hand, major economic losses in the business activities are caused by suspensions of business activities and road traffic in and around the inundation area. According to records of the past flood, inhabitants and enterprises in and around the flooded area have been obliged to suspend all or a part of their business and production activities during some periods in and after flooding. For example, it is reported that some sugar factories reduced remarkably their sugar productions over two years, caused by flood damage to the planted sugar cane and suspension of road traffic.

Generally, the economic basic loss in the example above could be evaluated by a reduction in the profit. However, it is very difficult to have an accurate grasp of the economic loss for all sectors in and around the flooded area. Therefore, in the present study, the economic loss in business suspension (including the traffic suspension) is assumed to be approximately 6 % of the flood damage to general assets, according to similar project in the South-east Asian countries.

(3) Estimates of Flood Damage

Under the conditions above, the damage amounts are estimated according to kind of assets and return periods of flood. Estimates of the flood damage are carried out for the without-project and with-project situations of respective projects. The results are summarized as follows:

Flood Damage reduced by Return Period

Name of Projects	Return Period (year)		
	2	5	10
1. Rio Chane	4,326	392	-313
2. Rio Pailon	49,277	65,348	73,457
3. Quebrada Chane	17,752	26,276	31,980
4. Chane Chacras	39,080	53,674	54,399
5. Okinawa Drainage	15,916	24,214	-
6. San Juan	9,688	15,946	19,068
7. Antofagasta	18,693	25,583	30,626
Total	154,732	211,433	209,217

Unit : Bs. 1,000

(4) Expected Average Annual Benefit

The average annual flood damage is calculated for the period of ten years for each project (five year for the Okinawa Drainage project), taking the occurrence probability of flood into account. The result is summarized as follows:

Average Annual Flood Damage

Name of Projects	Without-Project	With-Project	Reduction in Damage (Annual Benefit)
1. Rio Chane	17,450	15,656	1,794
2. Rio Pailon	38,890	2,436	36,454
3. Quebrada Chane	17,310	3,350	13,960
4. Chane Chacras	30,912	1,825	29,087
5. Okinawa Drainage	13,458	3,458	10,000
6. San Juan	8,828	810	8,018
7. Antofagasta	17,572	3,447	14,125
Total	144,420	30,982	113,438

Unit : Bs. 1,000

As shown in the above table, the average annual flood damage in the Study Area would be expected to reduce by Bs. 113.438 million in total by executing the flood mitigation project for all return period floods from every year to ten year. Among projects, the two projects of Rio Pailon and Chane Chacras indicate the comparatively large reduction effect of Bs. 36.454 million and 29.087 million, respectively.

These annual reduction effects in flood damage would be considered as a direct tangible benefit of the projects which are expected to accrue every year during the period of project life of 30 years after completion of the construction works.

In addition to the annual benefit after completion of construction works, a partial annual benefit would be expected to accrue before completion of the construction works. It is assumed to be proportional to progress of the construction works, i.e. the partial benefit could be approximately estimated by a ratio of the invested construction cost to the total construction cost.

13.3 Economic Cost

The economic cost are converted from the project costs given in the Supporting Report J, by taking into account the conditions and assumptions listed in Section 13.1. In addition to these conditions and assumptions, the following aspects are taken into consideration:

(1) Value Added Tax (VAT) is set at as 13 % of costs of commodities and services to be procured locally (L.C.) and costs of commodities to be imported from abroad (F.C.) for

the project. Since this tax is already included in the project cost shown in the Supporting Report J, it would be excluded from the project cost for estimating the economic cost.

(2) Ratio of commodity costs and unskilled labor wages in the L.C. of the construction cost is assumed to be 55 : 45 on average judging from the distribution of construction cost. The economic cost of this labor wages was estimated by taking into account the opportunity cost of labor (80 %) together with the standard conversion rate (88 %) and the VAT (13 %).

(3) The engineering services of foreign consultants were assumed to be tax-free.

Based on the above considerations, the economic cost of the project can be estimated by multiplying the project cost by the following rates:

Rates to be Multiplied to the Project Cost for Estimating the economic costs

Items of Cost	Rates	Calculation Formula
Local Currency Portion (L.C.)		
1. Construction Cost	0.71	0.88 (0.55+0.45x0.80)/1.13
2. Land acquisition Cost	0.55	0.88x0.70/1.13
3. Administration Cost	0.88	1/1.13
4. Engineering Service Fee	0.88	1/1.13
Foreign Currency Portion (F.C.)		
1. Construction Cost	0.88	1/1.13

The annual economic costs of the projects were calculated using the above rates as shown in *Tables K.3.1* to *K.3.12*, and these results are transferred to *Tables K.4.1* to *K.4.20* for estimating the EIRR. For respective projects, the total economic costs and financial costs together with the financial costs together with the financial costs (project costs) are summarized below:

Economic costs and Financial Costs of the projects

Name of Project	Construction Cost		Annual OM Cost	
	Financial	Economic	Financial	Economic
Chane-Pailon (Alt.-1)	1,431,153	735,561	15,215	5,472
Chane-Pailon (Alt.-2)	1,161,509	591,401	12,402	4,398
-Rio Chane (Alt.-1)	269,644	144,160	2,813	1,074
-Rio Chane (Alt.-2)	0	0	0	0
-Rio Pailon	452,058	236,795	4,649	1,763
-Queb. Chane	199,979	102,260	2,019	1,763
-Chane Chacras	370,449	177,400	4,267	1,318
-Okinawa Drainage	139,023	74,946	1,467	557
San Juan-Antof.(Alt.-1)	280,753	152,779	2,899	1,135
(Alt.-2)	297,020	162,208	3,072	1,206
-San Juan (Alt.-1)	129,800	70,995	1,297	528
-San Juan (Alt.-2)	146,067	80,424	1,470	599
-Antofagasta	150,953	81,953	1,602	607

The total cost of each alternative-1 and -2 is summarized as follow:

Name of Project	Construction Cost		Annual OM Cost	
	Financial	Economic	Financial	Economic
Alternative-1				
Chane-Pailon area	1,431,153	735,561	15,215	5,472
Sun Fun-Antofagasta	280,753	152,779	2,899	1,135
Total	1,711,906	883,340	18,114	6,607
Alternative-2				
Chane-Pailon	1,161,509	591,401	12,402	4,398
San Juan Antofagasta	297,020	162,208	3,072	1,206
Total	1,458,529	753,609	15,474	5,604

13.4 Cost-Benefit Analysis

Five sub projects of Rio Pailon, Quebrada Chane, Chane Chacras, Okinawa Drainage and Antofagasta have been planned under the same condition for both Alternative-1 and Alternative-2. The Rio Chane project is not included in Alternative-2, and also the San Juan is planned under a different condition between Alternative-1 and Alternative-2.

Under such a condition, an economic feasibility for each project is examined using annual flows of the economic cost and benefit shown in the *Table 13.4.1* to *13.4.4*. As a result, the evaluation factors such as the Economic Internal Rate of Return (EIRR), the Net Present Value (NPV) and the Benefit-Cost (B/C) are listed at the lower parts of respective tables. Out of these evaluation factors, the EIRR is summarized 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

According to information received from international financial agencies, the opportunity cost of capital is estimated to be between 10 % and 12 % in Bolivia. Based on such an economic standard, the five sub-projects other than two projects of Rio Chane and San Juan are considered to be economically feasible. In particular, the three projects of Antofagasta, Chane Chacras and Rio Pailon are expected to produce a fairly high economic return.

Although EIRR of Sun Juan sub project resulted in somewhat lower value than 10 % in both Alternative-1 and -2, it is considered to be viable from the socioeconomic point of view.

The Rio Chane project is regarded to be economically infeasible, because of the negative EIRR and NPV.

13.5 Sensitivity Test

Based on professional experience and appropriate judgment by experts, several conditions and assumptions have been carefully set throughout the study. However, there are always some questions as to the degree of reliability of the inputs. A test is therefore carried out on the sensitivity of EIRR effected by variation in the economic costs and benefits.

The EIRR sensitivity test has been examined under the conditions of 5 % and 10 % increase of the economic cost and 5 % and 10 % decrease of the economic benefit, on both the alternative-1 and -2 for each area. The results are summarized as follows:

Chane-Pailon Alternative-1

EIRR Sensitivity Test (%)

Decrease in Benefit	Increase in Cost 0 %	5 %	10 %
0 %	10.18	9.64	8.59
5 %	9.61	9.08	8.59
10 %	9.03	8.51	8.04

Chane-Pailon Alternative-2

EIRR Sensitivity Test (%)

Decrease in Benefit	Increase in Cost 0 %	5 %	10 %
0 %	14.04	13.30	12.62
5 %	13.26	12.55	11.90
10 %	12.40	11.76	11.17

San Juan - Antofagasta Alternative-1

EIRR Sensitivity Test (%)

Decrease in Benefit	Increase in Cost 0 %	5 %	10 %
0 %	13.41	12.69	12.03
5 %	12.65	11.96	11.33
10 %	11.89	11.27	10.62

San Juan - Antofagasta Alternative-2

EIRR Sensitivity Test (%)

Decrease in Benefit	Increase in Cost 0 %	5 %	10 %
0 %	12.51	11.82	11.19
5 %	11.79	11.13	10.53
10 %	11.06	10.43	9.85

13.6 Project Evaluation

(1) Direct Effects

The economic evaluation of the projects are summarized as follows:

-1 The proposed structural measures are economically feasible for either of Alternative-1 or -2, but the Alternative-1 of Chane-Pailon area is marginal.

-2 According to the sensitivity test, the EIRR for alternative -1 of Chane -Pailon falls to 9.6 % for the 5 % increase in cost, or the 5 % decrease in benefit, and also for alternative-2 of San Juan-Antofagasta comes to 9.8 % for case where the 10 % increase in cost and 10 % decrease in benefit is combined.

-3 Although the two areas do not attain a standard of the economic feasibility for some special case, these projects are considered to be feasible from the socio-economic point of view, by taking into account the benefits realized by the improvement of social environment. Moreover, a fairly high indirect economic return could be expected owing to the large investment.

-4 Five sub projects of Rio Pailon, Quebrada Chane, Chane Chacras, Okinawa Drainage and Antofagasta are economically feasible. Especially, for the three projects of Rio Pailon, Chane Chacras and Antofagasta a high economic return can be expected.

-5 San Juan can be considered to be feasible from the socioeconomic point of view, on the grounds that it is very useful for improvement of social environment. Moreover a fairly high indirect economic benefit could be expected.

-6 The Rio Chane is regarded to be economically infeasible, because of negative EIRR and NPV.

(2) Indirect Effects

In addition to the direct effects, the projects are expected to produce numerous indirect effects. They are:

-1 To contribute to the improvement of study area from social and economic aspects through reduction in the adverse effects of floods such as interruption of traffic and communication, increase in idle labor, spread of disease, drop in quality of crops, increase in unit production costs in factories and agricultural lands, and rise in consumer prices.

-2 To contribute to the development of regional economy owing to the large scale investment.

The results of project assessment are sumarized in *Tables 13. 6.1* and *13.6. 2*.

(3) Project Evalution

The results of project assessment are sumarized in *Tables 13.6.1* and *13.6.2*.

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 for which values 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 benefits 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 terms.

The conditions of inundation at the sub project, areas, namely, Rio Pailon, Quebrada Chane, Chane-Chacras and Okinawa Drainage, will be very much improved by either of Alternative-I or Alternative-II. However, the amount of the increase of flood water level in Rio Chane by Alternative II will be 0.5 m to 0.9 m for 10 year floods.

The EIRR values are 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 values higher than 12.21 %.

The social impacts will be significant either by Alternative-I or Alternative-II due to the protected area of 470 km^2, and adverse environmental effects by the projects will be not significant, except in the Rio Chane by 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 in case of alternative-II the estimated flood conditions will become worser than the existing condition. The priority sequence of the sub projects are:

1st Priority:

- Rio Chane
- Rio Pailon
- Okinawa drainage

2nd Priority:

- Chane-Chacras

3ir Priority:

- Quebrada Chane

2) San Juan-Antofagasta Area

The structural measures for the area are feasible as a whole in technical, economical, social and environmental terms. The conditions of inundation will be very much improved by either of Alternative-I or 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 as marginal with EIRR value of 9.97 %.

The social impacts will be significant by either of Alternative-I or Alternative-II due to the protected area of 210 km^2. The project it is considered to be viable from the

socioeconomic aspects because the area is one of the most developed agricultural area. Adverse environmental effects by the projects are not significant.

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

1st Priority:

- Antofagasta

2nd Priority:

- San Juan

TABLES

TABLE 13.1.1 ESTIMATE OF STANDARD CONVERSION RATE (SCR)

Items	1990	1991	1992	1993	1994	Average
Imports (US$ Million)	527.7	1,000.1	1,235.0	1,429.4	1,306.8	1099.8
Import Duty (US$ Million)	133.4	224.2	299.2	321.0	383.2	272.2
Total	661.1	1,224.3	1,534.2	1,750.4	1,690.0	1,372.0
Rate of Import Duty (%)	25.3	22.4	24.2	22.5	29.3	24.7
Exports (US$ Million)	926.8	848.5	712.3	754.5	722.9	793.0
Export Duty (US$ Million)	0.0	0.0	0.0	0.0	0.0	0.0
Total	926.8	848.5	712.3	754.5	722.9	793.0
SCR (%)	91.6	89.2	86.7	87.2	84.1	87.8

Average SCR of Bolivia : 88 %

TABLE 13.4.1 ECONOMIC ANALYSIS FOR ALTERNATIVE-2 PLAN

II-3. Total of the West Area Project

Unit : Bs.1,000

	Year	Economic Cost			Economic	(B)-(C)
		Construction	OM	Total (C)	Benefit (B)	
1	2000	3,130	0	3,130	0	-3,130
2	2001	50,537	0	50,537	0	-50,537
3	2002	37,867	381	38,248	7,235	-31,013
4	2003	35,456	663	36,119	12,166	-23,953
5	2004	25,255	932	26,187	16,914	-9,273
6	2005	9,963	1,127	11,090	20,305	9,215
7	2006	0	1,206	1,206	22,143	20,937
8	2007	0	1,206	1,206	22,143	20,937
9	2008	0	1,206	1,206	22,143	20,937
10	2009	0	1,206	1,206	22,143	20,937
11	2010	0	1,206	1,206	22,143	20,937
12	2011	0	1,206	1,206	22,143	20,937
13	2012	0	1,206	1,206	22,143	20,937
14	2013	0	1,206	1,206	22,143	20,937
15	2014	0	1,206	1,206	22,143	20,937
16	2015	0	1,206	1,206	22,143	20,937
17	2016	0	1,206	1,206	22,143	20,937
18	2017	0	1,206	1,206	22,143	20,937
19	2018	0	1,206	1,206	22,143	20,937
20	2019	0	1,206	1,206	22,143	20,937
21	2020	0	1,206	1,206	22,143	20,937
22	2021	0	1,206	1,206	22,143	20,937
23	2022	0	1,206	1,206	22,143	20,937
24	2023	0	1,206	1,206	22,143	20,937
25	2024	0	1,206	1,206	22,143	20,937
26	2025	0	1,206	1,206	22,143	20,937
27	2026	0	1,206	1,206	22,143	20,937
28	2027	0	1,206	1,206	22,143	20,937
29	2028	0	1,206	1,206	22,143	20,937
30	2029	0	1,206	1,206	22,143	20,937
31	2030	0	1,206	1,206	22,143	20,937
32	2031	0	1,206	1,206	22,143	20,937
33	2032	0	1,206	1,206	22,143	20,937
34	2033	0	1,206	1,206	22,143	20,937
35	2034	0	1,206	1,206	22,143	20,937
36	2035	0	607	607	14,125	13,518
37	2036	0	0	0	0	0
38	2037	0	0	0	0	0
39	2038	0	0	0	0	0
	Total	162,208	38,684	200,892	712,891	511,999

EIRR (%) 12.51

Discount Rate (%)	B/C	PV(Bs. 1,000) Cost	PV(Bs. 1,000) Benefit	NPV (Bs. 1,000)
15	0.85	107,968	91,704	-16,264
12	1.04	118,650	122,996	4,346
10	1.21	126,936	153,278	26,342
5	1.93	154,099	297,284	143,185
3	2.42	169,235	409,737	240,502

III. Total of the Whole Project

Unit : RM 1,000

	Year	Economic Cost			Economic	(B)-(C)
		Construction	OM	Total (C)	Benefit (B)	
1	2000	8,046	0	8,046	0	-8,046
2	2001	134,078	0	134,078	0	-134,078
3	2002	138,493	995	139,488	19,575	-119,913
4	2003	130,380	2,029	132,409	39,379	-93,030
5	2004	150,708	2,990	153,698	57,924	-95,774
6	2005	143,653	4,109	147,762	80,125	-67,637
7	2006	16,380	5,239	21,619	103,589	81,970
8	2007	16,380	5,360	21,740	106,259	84,519
9	2008	15,422	5,482	20,904	108,952	88,048
10	2009	0	5,604	5,604	111,644	106,040
11	2010	0	5,604	5,604	111,644	106,040
12	2011	0	5,604	5,604	111,644	106,040
13	2012	0	5,604	5,604	111,644	106,040
14	2013	0	5,604	5,604	111,644	106,040
15	2014	0	5,604	5,604	111,644	106,040
16	2015	0	5,604	5,604	111,644	106,040
17	2016	0	5,604	5,604	111,644	106,040
18	2017	0	5,604	5,604	111,644	106,040
19	2018	0	5,604	5,604	111,644	106,040
20	2019	0	5,604	5,604	111,644	106,040
21	2020	0	5,604	5,604	111,644	106,040
22	2021	0	5,604	5,604	111,644	106,040
23	2022	0	5,604	5,604	111,644	106,040
24	2023	0	5,604	5,604	111,644	106,040
25	2024	0	5,604	5,604	111,644	106,040
26	2025	0	5,604	5,604	111,644	106,040
27	2026	0	5,604	5,604	111,644	106,040
28	2027	0	5,604	5,604	111,644	106,040
29	2028	0	5,604	5,604	111,644	106,040
30	2029	0	5,604	5,604	111,644	106,040
31	2030	0	5,604	5,604	111,644	106,040
32	2031	0	5,604	5,604	111,644	106,040
33	2032	0	5,604	5,604	111,644	106,040
34	2033	0	5,604	5,604	111,644	106,040
35	2034	0	5,604	5,604	111,644	106,040
36	2035	0	5,005	5,005	103,626	98,621
37	2036	0	1,318	1,318	29,087	27,769
38	2037	0	1,318	1,318	29,087	27,769
39	2038	0	1,318	1,318	29,087	27,769
	Total	753,540	180,867	934,407	3,609,432	2,675,025

EIRR (%) 13.64

Discount Rate (%)	B/C	PV(Bs. 1,000) Cost	PV(Bs. 1,000) Benefit	NPV (Bs. 1,000)
15	0.92	447,665	410,570	-37,095
12	1.12	501,769	562,296	60,528
10	1.31	544,343	711,176	166,833
5	2.09	686,359	1,436,355	749,996
3	2.63	766,373	2,015,370	1,248,997

TABLE 13.4.2 ECONOMIC ANALYSIS FOR ALTERNATIVE-2 PLAN

I-5.Total of The East Area Project

Unit : Bs.1,000

	Year	Economic Cost			Economic	(B)-(C)
		Construction	OM	Total (C)	Benefit (B)	
1	2000	4,916	0	4,916	0	-4,916
2	2001	83,541	0	83,541	0	-83,541
3	2002	100,626	614	101,240	12,340	-88,900
4	2003	94,924	1,366	96,290	27,213	-69,077
5	2004	125,453	2,058	127,511	41,010	-86,501
6	2005	133,690	2,982	136,672	59,820	-76,852
7	2006	16,380	4,033	20,413	81,446	61,033
8	2007	16,380	4,154	20,534	84,116	63,582
9	2008	15,422	4,276	19,698	86,809	67,111
10	2009	0	4,398	4,398	89,501	85,103
11	2010	0	4,398	4,398	89,501	85,103
12	2011	0	4,398	4,398	89,501	85,103
13	2012	0	4,398	4,398	89,501	85,103
14	2013	0	4,398	4,398	89,501	85,103
15	2014	0	4,398	4,398	89,501	85,103
16	2015	0	4,398	4,398	89,501	85,103
17	2016	0	4,398	4,398	89,501	85,103
18	2017	0	4,398	4,398	89,501	85,103
19	2018	0	4,398	4,398	89,501	85,103
20	2019	0	4,398	4,398	89,501	85,103
21	2020	0	4,398	4,398	89,501	85,103
22	2021	0	4,398	4,398	89,501	85,103
23	2022	0	4,398	4,398	89,501	85,103
24	2023	0	4,398	4,398	89,501	85,103
25	2024	0	4,398	4,398	89,501	85,103
26	2025	0	4,398	4,398	89,501	85,103
27	2026	0	4,398	4,398	89,501	85,103
28	2027	0	4,398	4,398	89,501	85,103
29	2028	0	4,398	4,398	89,501	85,103
30	2029	0	4,398	4,398	89,501	85,103
31	2030	0	4,398	4,398	89,501	85,103
32	2031	0	4,398	4,398	89,501	85,103
33	2032	0	4,398	4,398	89,501	85,103
34	2033	0	4,398	4,398	89,501	85,103
35	2034	0	4,398	4,398	89,501	85,103
36	2035	0	4,398	4,398	89,501	85,103
37	2036	0	1,318	1,318	29,087	27,769
38	2037	0	1,318	1,318	29,087	27,769
39	2038	0	1,318	1,318	29,087	27,769
	Total	591,332	142,183	733,515	2,896,541	2,163,026

EIRR (%) **14.00**

Discount Rate (%)	B/C	PV(Bs. 1,000) Cost	PV(Bs. 1,000) Benefit	NPV (Bs. 1,000)
15	0.94	339,696	318,866	-20,831
12	1.15	383,118	439,300	56,182
10	1.34	417,407	557,898	140,491
5	2.14	532,259	1,139,070	606,811
3	2.69	597,138	1,605,633	1,008,495

TABLE 13.4.3 ECONOMIC ANALYSIS FOR ALTERNATIVE-1 PLAN

II-3. Total of the West Area Project

Unit : Bs.1,000

	Year	Economic Cost			Economic	(B)-(C)
		Construction	OM	Total (C)	Benefit (B)	
1	2000	2,853	0	2,853	0	-2,853
2	2001	45,660	0	45,660	0	-45,660
3	2002	33,284	345	33,629	6,985	-26,644
4	2003	35,763	591	36,354	11,667	-24,687
5	2004	25,256	861	26,117	16,705	-9,412
6	2005	9,963	1,056	11,019	20,305	9,286
7	2006	0	1,135	1,135	22,143	21,008
8	2007	0	1,135	1,135	22,143	21,008
9	2008	0	1,135	1,135	22,143	21,008
10	2009	0	1,135	1,135	22,143	21,008
11	2010	0	1,135	1,135	22,143	21,008
12	2011	0	1,135	1,135	22,143	21,008
13	2012	0	1,135	1,135	22,143	21,008
14	2013	0	1,135	1,135	22,143	21,008
15	2014	0	1,135	1,135	22,143	21,008
16	2015	0	1,135	1,135	22,143	21,008
17	2016	0	1,135	1,135	22,143	21,008
18	2017	0	1,135	1,135	22,143	21,008
19	2018	0	1,135	1,135	22,143	21,008
20	2019	0	1,135	1,135	22,143	21,008
21	2020	0	1,135	1,135	22,143	21,008
22	2021	0	1,135	1,135	22,143	21,008
23	2022	0	1,135	1,135	22,143	21,008
24	2023	0	1,135	1,135	22,143	21,008
25	2024	0	1,135	1,135	22,143	21,008
26	2025	0	1,135	1,135	22,143	21,008
27	2026	0	1,135	1,135	22,143	21,008
28	2027	0	1,135	1,135	22,143	21,008
29	2028	0	1,135	1,135	22,143	21,008
30	2029	0	1,135	1,135	22,143	21,008
31	2030	0	1,135	1,135	22,143	21,008
32	2031	0	1,135	1,135	22,143	21,008
33	2032	0	1,135	1,135	22,143	21,008
34	2033	0	1,135	1,135	22,143	21,008
35	2034	0	1,135	1,135	22,143	21,008
36	2035	0	607	607	14,125	13,518
37	2036	0	0	0	0	0
38	2037	0	0	0	0	0
39	2038	0	0	0	0	0
	Total	152,779	36,375	189,154	711,934	522,780

EIRR (%) 13.41

Discount Rate (%)	B/C	PV(Bs. 1,000) Cost	PV(Bs. 1,000) Benefit	NPV (Bs. 1,000)
15	0.90	100,871	91,151	-9,720
12	1.10	111,012	122,382	11,370
10	1.28	118,884	152,620	33,735
5	2.05	144,705	296,494	151,789
3	2.57	159,090	408,885	249,795

III. Total of the Whole Project

Unit : RM 1,000

	Year	Economic Cost			Economic	(B)-(C)
		Construction	OM	Total (C)	Benefit (B)	
1	2000	9,446	0	9,446	0	-9,446
2	2001	158,033	0	158,033	0	-158,033
3	2002	162,742	1,174	163,916	19,684	-144,232
4	2003	159,519	2,387	161,906	39,598	-122,308
5	2004	179,541	3,564	183,105	58,792	-124,313
6	2005	170,808	4,897	175,705	81,560	-94,145
7	2006	16,380	6,242	22,622	105,383	82,761
8	2007	16,380	6,363	22,743	108,053	85,310
9	2008	15,422	6,485	21,907	110,746	88,839
10	2009	0	6,607	6,607	113,438	106,831
11	2010	0	6,607	6,607	113,438	106,831
12	2011	0	6,607	6,607	113,438	106,831
13	2012	0	6,607	6,607	113,438	106,831
14	2013	0	6,607	6,607	113,438	106,831
15	2014	0	6,607	6,607	113,438	106,831
16	2015	0	6,607	6,607	113,438	106,831
17	2016	0	6,607	6,607	113,438	106,831
18	2017	0	6,607	6,607	113,438	106,831
19	2018	0	6,607	6,607	113,438	106,831
20	2019	0	6,607	6,607	113,438	106,831
21	2020	0	6,607	6,607	113,438	106,831
22	2021	0	6,607	6,607	113,438	106,831
23	2022	0	6,607	6,607	113,438	106,831
24	2023	0	6,607	6,607	113,438	106,831
25	2024	0	6,607	6,607	113,438	106,831
26	2025	0	6,607	6,607	113,438	106,831
27	2026	0	6,607	6,607	113,438	106,831
28	2027	0	6,607	6,607	113,438	106,831
29	2028	0	6,607	6,607	113,438	106,831
30	2029	0	6,607	6,607	113,438	106,831
31	2030	0	6,607	6,607	113,438	106,831
32	2031	0	6,607	6,607	113,438	106,831
33	2032	0	6,607	6,607	113,438	106,831
34	2033	0	6,607	6,607	113,438	106,831
35	2034	0	6,607	6,607	113,438	106,831
36	2035	0	6,079	6,079	105,420	99,341
37	2036	0	1,318	1,318	29,087	27,769
38	2037	0	1,318	1,318	29,087	27,769
39	2038	0	1,318	1,318	29,087	27,769
	Total	888,271	212,927	1,101,198	3,665,884	2,564,686

EIRR (%) 11.48

Discount Rate (%)	B/C	PV(Bs. 1,000) Cost	PV(Bs. 1,000) Benefit	NPV (Bs. 1,000)
15	0.79	529,471	416,912	-112,559
12	0.96	593,186	571,054	-22,132
10	1.12	643,285	722,303	79,018
5	1.80	810,199	1,458,960	648,760
3	2.26	904,132	2,047,064	1,142,932

TABLE 13.4.4 ECONOMIC ANALYSIS FOR ALTERNATIVE-1 PLAN

I-5. Okinawa Drainage

Unit : Bs.1,000

	Year	Economic Cost			Economic	(B)-(C)
		Construction	OM	Total (C)	Benefit (B)	
1	2000	1,210	0	1,210	0	-1,210
2	2001	19,894	0	19,894	0	-19,894
3	2002	19,366	148	19,514	2,657	-16,857
4	2003	11,718	296	12,014	5,314	-6,700
5	2004	11,720	383	12,103	6,876	-5,227
6	2005	11,037	470	11,507	8,438	-3,069
7	2006	0	557	557	10,000	9,443
8	2007	0	557	557	10,000	9,443
9	2008	0	557	557	10,000	9,443
10	2009	0	557	557	10,000	9,443
11	2010	0	557	557	10,000	9,443
12	2011	0	557	557	10,000	9,443
13	2012	0	557	557	10,000	9,443
14	2013	0	557	557	10,000	9,443
15	2014	0	557	557	10,000	9,443
16	2015	0	557	557	10,000	9,443
17	2016	0	557	557	10,000	9,443
18	2017	0	557	557	10,000	9,443
19	2018	0	557	557	10,000	9,443
20	2019	0	557	557	10,000	9,443
21	2020	0	557	557	10,000	9,443
22	2021	0	557	557	10,000	9,443
23	2022	0	557	557	10,000	9,443
24	2023	0	557	557	10,000	9,443
25	2024	0	557	557	10,000	9,443
26	2025	0	557	557	10,000	9,443
27	2026	0	557	557	10,000	9,443
28	2027	0	557	557	10,000	9,443
29	2028	0	557	557	10,000	9,443
30	2029	0	557	557	10,000	9,443
31	2030	0	557	557	10,000	9,443
32	2031	0	557	557	10,000	9,443
33	2032	0	557	557	10,000	9,443
34	2033	0	557	557	10,000	9,443
35	2034	0	557	557	10,000	9,443
36	2035	0	557	557	10,000	9,443
37	2036	0	0	0	0	0
38	2037	0	0	0	0	0
39	2038	0	0	0	0	0
	Total	74,945	18,007	92,952	323,285	230,333

EIRR (%) 12.21

Discount Rate (%)	B/C	PV(Bs. 1,000) Cost	PV(Bs. 1,000) Benefit	NPV (Bs. 1,000)
15	0.83	48,368	40,239	-8,129
12	1.02	53,435	54,255	820
10	1.18	57,383	67,871	10,488
5	1.89	70,397	133,063	62,666
3	2.37	77,679	184,302	106,623

I-6. Total of The East Area Project

Unit : Bs.1,000

	Year	Economic Cost			Economic	(B)-(C)
		Construction	OM	Total (C)	Benefit (B)	
1	2000	6,593	0	6,593	0	-6,593
2	2001	112,373	0	112,373	0	-112,373
3	2002	129,458	829	130,287	12,699	-117,588
4	2003	123,756	1,796	125,552	27,931	-97,621
5	2004	154,285	2,703	156,988	42,088	-114,900
6	2005	160,845	3,841	164,686	61,255	-103,431
7	2006	16,380	5,107	21,487	83,240	61,753
8	2007	16,380	5,228	21,608	85,910	64,302
9	2008	15,422	5,350	20,772	88,603	67,831
10	2009	0	5,472	5,472	91,295	85,823
11	2010	0	5,472	5,472	91,295	85,823
12	2011	0	5,472	5,472	91,295	85,823
13	2012	0	5,472	5,472	91,295	85,823
14	2013	0	5,472	5,472	91,295	85,823
15	2014	0	5,472	5,472	91,295	85,823
16	2015	0	5,472	5,472	91,295	85,823
17	2016	0	5,472	5,472	91,295	85,823
18	2017	0	5,472	5,472	91,295	85,823
19	2018	0	5,472	5,472	91,295	85,823
20	2019	0	5,472	5,472	91,295	85,823
21	2020	0	5,472	5,472	91,295	85,823
22	2021	0	5,472	5,472	91,295	85,823
23	2022	0	5,472	5,472	91,295	85,823
24	2023	0	5,472	5,472	91,295	85,823
25	2024	0	5,472	5,472	91,295	85,823
26	2025	0	5,472	5,472	91,295	85,823
27	2026	0	5,472	5,472	91,295	85,823
28	2027	0	5,472	5,472	91,295	85,823
29	2028	0	5,472	5,472	91,295	85,823
30	2029	0	5,472	5,472	91,295	85,823
31	2030	0	5,472	5,472	91,295	85,823
32	2031	0	5,472	5,472	91,295	85,823
33	2032	0	5,472	5,472	91,295	85,823
34	2033	0	5,472	5,472	91,295	85,823
35	2034	0	5,472	5,472	91,295	85,823
36	2035	0	5,472	5,472	91,295	85,823
37	2036	0	1,318	1,318	29,087	27,769
38	2037	0	1,318	1,318	29,087	27,769
39	2038	0	1,318	1,318	29,087	27,769
	Total	735,492	176,552	912,044	2,953,951	2041906.6

EIRR (%) 11.04

Discount Rate (%)	B/C	PV(Bs. 1,000) Cost	PV(Bs. 1,000) Benefit	NPV (Bs. 1,000)
15	0.76	428,600	325,761	-102,839
12	0.93	482,174	448,672	-33,502
10	1.09	524,401	569,684	45,283
5	1.75	665,494	1,162,465	496,971
3	2.20	745,042	1,638,179	893,137

TABLE 13.6.1 RESULTS OF PROJECT EVALUATION FOR FLOOD MITIGATION AND DRAINAGE IMPROVEMENT - ALTERNATIVE I

Ranking of Viability for Priority Projects : A: High B: Marginal C: Low

Project/Sub-project	Measures	Assessment								Project Viability	
		Technical Evaluation		Economic Evaluation		Social Impact		Environmental Impact			
				Feasibility	EIRR (%)	Impact	Protected Area (km2)				
A. EASTERN AREA											
A-1 CHANE - PAILON	**Structural with non-structural measures**	**Highly Effective**	**A**	**Feasible**	**11.04 A**	**High Impact**	**470.1 A**	**Negligibly small**	**B**	**High viability**	**A**
1) Rio Chane	- ditto -	As the main stream area, indispensable for avoiding any adverse effect. More effective with flood control of the Rio Piray.	A	Not feasible	negative C	Same as present	0.0 B	Same as present	B	High viability for avoiding any adverse effect. More effective with flood control of the Rio Piray.	A
2) Rio Pailon	- ditto -	Indispensable as the main stream area	A	Highly feasible	14.33 A	High impact	117.8 A	Negligibly small	B	High viability as the main stream area	A
3) Quebrada Chane	- ditto -	Effect to only limited area of the tributary area	C	Feasible	12.52 A	Medium impact as the extensive landuse area	54.0 B	Negligibly small	B	Low viability as the tributary area	C
4) Chane - Chacras	- ditto -	High necessity as the tributary area	B	Highly feasible	15.38 A	High impact as wide effective area	226.4 A	Negligibly small	B	Medium viability as the tributary area	B
5) Okinawa Drainage	- ditto -	High necessity as the major drainage area	A	Feasible	12.21 A	High impact as the intensive landuse area	71.9 A	Negligibly small	B	High viability as the major drainage area	A
A-2 SOUTHERN PART	**Non-structural Measures**	**Highly Effective**		-		**High impact**		-		**High viability**	
A-3 RIO GRANDE DOWNSTREAM	**Non-structural Measures**	**Highly effective**		-		**High impact**		-		**High viability**	
B. WESTERN AREA											
B-1 SAN JUAN - ANTOFAGASTA	**Structural with non-structural measures**	**Highly effective**	**A**	**Feasible**	**13.41 A**	**High impact**	**210.3 A**	**Negligibly small**	**B**	**High viability**	**A**
1) San Juan	- ditto -	Necessary	B	Marginal	9.97 B	High impact as the intensive landuse area	81.4 A	Negligibly small	B	High viability	A
2) Antofagasta	- ditto -	Indispensable	A	Highly feasible	16.24 A	High impact as the local colony	128.9 A	Negligibly small	B	High viability	A
B-2 PALACIOS - PALOMETILLAS	**Non-structural Measures**	**Effective**		-		**Medium impact**		-		**Medium viability**	
C. RIO PIRAY	-	**Flood control measures necessary**		-		-		-		-	

Note: 1) Protected area is the mitigated area by flood control and drainage improvement for the 10-year floods.

TABLE 13.6.2 RESULTS OF PROJECT EVALUATION FOR FLOOD MITIGATION AND DRAINAGE IMPROVEMENT - ALTERNATIVE II

Ranking of Viability for Priority Projects : A: High B: Marginal C: Low

Project/Sub-project	Measures	Assessment								Project Viability	
		Technical Evaluation		Economic Evaluation		Social Impact		Environmental Impact			
				Feasibility	EIRR (%)	Impact	Protected Area (km2)				
A. EASTERN AREA											
A-1 CHANE - PAILON	**Structural with non-structural measures**	**Highly Effective**	A	**Feasible**	**14.00** A	**High Impact**	**470.1** A	**Negligibly small**	B	**High viability**	A
1) Rio Chane	Non-structural measures	Highly effective		-	-	High impact	-	-		High viability	
2) Rio Pailon	Structural with non-structural measures	Indispensable as the main stream area	A	Highly feasible	14.33 A	High impact	117.8 A	Negligibly small	B	High viability as the main stream area	A
3) Quebrada Chane	- ditto -	Effect to only limited area of the tributary area	C	Feasible	12.52 A	Medium impact as the extensive landuse area	54.0 B	Negligibly small	B	Low viability as the tributary area	C
4) Chane - Chacras	- ditto -	High necessity as the tributary area	B	Highly feasible	15.38 A	High impact as wide effective area	226.4 A	Negligibly small	B	Medium viability as the tributary area	B
5) Okinawa Drainage	- ditto -	High necessity as the major drainage area	A	Feasible	12.21 A	High impact as the intensive landuse area	71.9 A	Negligibly small	B	High viability as the major drainage area	A
A-2 SOUTHERN PART	**Non-structural Measures**	**Highly Effective**		-		**High impact**		-		**High viability**	
A-3 RIO GRANDE DOWNSTREAM	**Non-structural Measures**	**Highly effective**		-		**High impact**		-		**High viability**	
B. WESTERN AREA											
B-1 SAN JUAN - ANTOFAGASTA	**Structural with non-structural measures**	**Highly effective**	A	**Feasible**	**12.51** A	**High impact**	**206.1** A	**Negligibly small**	B	**High viability**	A
1) San Juan	- ditto -	Necessary	B	Marginal	8.48 B	High impact as the intensive landuse area	77.2 A	Negligibly small	B	High viability	A
2) Antofagasta	- ditto -	Indispensable	A	Highly feasible	16.24 A	High impact as the local colony	128.9 A	Negligibly small	B	High viability	A
B-2 PALACIOS - PALOMETILLAS	**Non-structural Measures**	**Effective**		-		**Medium impact**		-		**Medium viability**	
C. RIO PIRAY	-	**Flood control measures necessary**		-		-		-		-	

Note: 1) Protected area is the mitigated area by flood control and drainage improvement for the 10-year floods.

CHAPTER 14
MASTER PLAN

CHAPTER 14 MASTER PLAN

14.1 General

The study area (7,000 km^2), located in the northern rural region of the Department of Santa Cruz, has been developed as agricultural areas. However, the study area is affected by frequent floods and hence vulnerable to flood and drainage problems and instability of agricultural production. The floods in 1992 caused severe damages to the study area, inundating about 70 % of the study area.

The development policy of the Government of Bolivia is to promote sustainable development of the country. For the development policy purpose, it is indispensable for the area to be stabilized with mitigation of flood and poor drainage problems. A master plan of the flood mitigation and drainage improvement for the study area was formulated in accordance with the policy of sustainable development.

The proposed plan is composed of both non-structural and structural measures. Non-structural measures, such as flood warning and evacuation systems and reduction of flood runoff by land use management, are planned for the whole study area. Structural measures, such as river improvement works, flood embankment and reservoir or retarding basins, are planned for the area where flood and drainage problems are assessed likely more serious resulting in significant flood damage.

14.2 Areas for Structural Measures and Non-structural Measures

The flood hazard areas are mostly composed of agricultural lands, pasture and forest cover, and it is unlikely feasible in economic terms to absolutely mitigate the flood and drainage problems. Though the non-structural measures are applied for the whole flood hazard area, the target area for structural measures is identified based on conditions, such as depth and duration of inundation, and flood damage.

(1) Target Areas for Structural Measures with Non-structural Measures

The target areas for structural measures with non-structural measures were identified based on the following criteria:

- From the annual flood hazard area, intensive land use areas, such as urban areas and intensive farming areas, were delineated.

- From the 1992 flood hazard area intensive land use areas and severe flood damage areas with depth of inundation more than 50 cm and the duration of inundation more than 2 days were delineated.

The identified target areas for structural measures are shown in *Fig. 14.4.1*. They are as follows:

- Eastern part: Chane - Pailon area, consisting of the drainage basins of Rio Chane, Rio Pailon, Quebrada Chane, Chane - Chacras and Okinawa Drainage,

- Western part: San Juan - Antofagasta area, consisting of the drainage basins of San Juan and Antofagasta.

(2) Target Areas for Non-structural Measures

The target areas for non-structural measures only were identified based on the following criteria (ref. *Fig. 14.4.1*):

- Extensive land use areas, such as pasture and forest cover,

- Among the intensive land use areas affected by the 1992 floods, hazard areas, areas with inundation depth less than 50 cm and the duration of inundation less than 2 days.

The target areas were identified as follows:

- Eastern part: Southern area,

- Western part: Palacios - Palometillas area.

Five swampy forest or swampy areas that cover 141.5 km^2 were identified in the upper basin of Rio Pailon and in the tributaries of Rio Chane and planned as retarding basins for the downstream reaches.

The swampy area at the junction of the Arroyo Jochi and Arroyo Tacuaral was planned as a regulating pond for the downstream reaches.

The central part (Rio Pirai) is not included in any target area, because the main reach of the Rio Pirai has not been included in the scope of work.

The target areas of both the structural and non-structural measures are shown in *Fig. 14.4.1.*

14.3 Target Year of the Master Plan

It 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 increase to 300,000 in 2010 from 198,000 in 1992, according to CORDECRUZ. The population increase will be in the urban areas, but not in the rural areas.

- 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 use in 2010 was estimated to be the same as that 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 remained the same since then.

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

14.4 Structural Measures

The structural measures for mitigation of flood problems are composed of river improvement works, flood embankment or road-cum-embankment and reservoir or retarding basin.

The structural measures for improvement of poor drainage conditions are composed of measures such as improvement of drainage systems, improvement of drainage facilities and development of drainage networks.

14.4.1 Design Scales for Structural Measures

The design scales of the flood mitigation and drainage improvement measures are decided based on the results of assessment in technical, economic and social terms. Although the most severe flood damages were caused by the 1992 floods, which was assessed to be approximately a 50 years frequency, the design scale of 50 year is unlikely feasible for flood mitigation and drainage improvement measures for the study area based on the expected benefits. The design scale of structural measures was decided as follows:

1) The design scale of flood mitigation facilities is decided to be 10-year frequency flood. However, an allowable inundation depth of 30 cm is considered based on the study of flood damage for crops.

2) The design scale of drainage improvement facilities is decided to be 5-year frequency storm runoff with an allowable inundation depth of 30 cm.

3) In the design of important or fundamental public facilities such as national road bridges, the design scale of a 50-year frequency flood is considered according to the scale of 1992 floods.

14.4.2 Chane - Pailon

The proposed structural measures for Chane - Pailon are shown in *Fig. 14.4.1* and summarized in *Table 14.4.1*.

(1) River Improvement Plan

River improvement is planned for the following rivers:

River Improvement Reach	Length
a) Rio Chane (Jct. Rio Piray to Jct. Rio Pailon):	35.00 km
- Jct. Rio Piray to Downstream Road Bridge:	8.00 km
- Downstream Road Bridge to Jct. Rio Pailon:	27.00 km
b) Rio Pailon (Jct. Rio Chane to Jct. A. Los Sauces):	32.00 km
c) Queb. Chane (Jct. Rio Chane to Road No. 9):	18.00 km
d) Queb. El Toro (Jct. Queb Chane to Road No. 9):	16.00 km
e) Queb. Las Chacras (Jct. Rio Chane to Road No. 9):	36.50 km

(2) Drainage Improvement Plan

Drainage improvement is composed of improvement and new construction of main drains and secondary drains as follows:

Drainage Improvement	Length/Area
a) Drainage Main:	36.00 km
b) Okinawa Drainage Main:	21.00 km
c) Secondary Drainage:	481.00 km^2

14.4.3 San Juan - Antofagasta

The proposed structural measures for San Juan - Antofagasta are also shown in *Fig.14.4.1* and summarized in *Table 14.4.1*.

(1) River Improvement Plan

River improvement is planned for the following rivers:

River Improvement Reach	Length
a) Arroyo Yapacanicito (Downstream bridge to existing drains):	14.10 km
b) Arroyo Jochi (Downstream Swamp to Mid-stream):	12.60 km
c) Arroyo Tacuaral (Downstream Swamp to Mid-stream):	7.70 km

(2) Drainage Improvement

Drainage improvements are as follows:

Drainage Improvement	Length/Area
a) Main Drainage:	51.30 km
- Rehabilitation of San Juan Drainage Main:	34.20 km
- Improvement of Arroyo Tejeria:	7.10 km
- Main Drainage of Antofagasta:	10.00 km
b) Secondary Drainage:	212.00 km^2

(3) Road-cum-embankment

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 length of the road-cum-embankment is 9.0 km.

14.5 Non-structural Measures

Non-structural measures are planned to be applied for the entire flood hazard area. The structural measures generally require a long time before completion and hence the flood hazard area should be protected by non-structural measures as much as possible.

Non-structural measures for flood mitigation are as follows:

1) Flood warning and evacuation system,
2) Flood plain management,
3) Land use control for retarding basins,
4) Preservation of protected forest along river channels,
5) Land use management.

Non-structural measures for drainage improvement are as follows:

1) Introduction of water tolerant crops in poor drainage areas,
2) Introduction of proper farm land management.

14.5.1 Non-structural Measures for Flood Mitigation

(1) Flood Warning and Evacuation System

This measure should be applied for the entire flood hazard area.

Settlements in the flood hazard area should be provided with optimum flood warning and evacuation system. For flood warning and evacuation purposes, the existing hydrological observation systems and facilities should be reinforced and the flood warning and evacuation system should be studied and established. The required actions are as follows:

1) Reinforcement of the existing hydrological observation networks,

2) Establishment of a flood forecasting and warning center and monitoring stations, linked with a telecommunication system,

3) Establishment of a regional flood forecasting and warning system,

4) Publication of the flood hazard area map for proper operation of flood mitigation scheme.

For flood evacuation purposes, some roads in the severe inundation area should be elevated higher than the flood stage of a 10 year flood frequency.

Evacuation road networks should be incorporated along with the improvement plan of secondary roads in the flood hazard area.

(2) Flood Proofing and Flood Plain Management

This measure should be applied for the entire flood hazard area, especially for Chane - Pailon area, San Juan Antofagasta area and Palacios - Palometillas. For execution of the measure, local flood conditions should be studied in more detail. The required actions are as follows:

1) Declaration of potential flood hazard area,

2) Relocation of the settlement in the severe flood hazard area,

3) Promulgation of flood stage of a 10 year flood frequency,

4) Guidance for land use management,

5) Introduction of water tolerant crops and varieties.

(3) Land Use Control for Retarding Basins

This measure should be applied for the southern area of eastern part and San Juan - Antofagasta area.

From the flood mitigation aspects, provision of retarding ponds is very important for the study area. Based on the national policy of sustainable development, rational use of under utilized lands shall be promoted.

Depending on the location, multi purpose uses should be studied for the retarding areas. The required actions are as follows:

1) Detailed study of the proposed five retarding basins (141.5 km^2), in the southern area,
2) Detailed survey on the natural swamp area at the junction of the Arroyo Jochi and Arroyo Tacuaral,
3) Preparation of appropriate regulation with necessary legal basis for controlling the land use of retarding basins,
4) Incorporation with PLUS.

(4) Preservation of Protected Forest along River Channels

This measure should be applied for the entire flood hazard area.

The existing forest cover is mostly located along the rivers and reported to contain plenty of ecological resources. For preservation of the natural environmental conditions along the rivers, restoration of the protected forests is very important from both technical and environmental aspects. The protected forests were proposed as follows:

- Protected forest along the major rivers: 1 km wide along both banks
- Protected forest along the tributaries: 100 m wide along both banks

The required actions are as follows:

1) Study of ecological resources in the forest areas along the rivers,
2) Incorporation with PLUS.

(5) Land Use Management for Farm Lands and Forest Areas

This measure should be applied for the entire flood hazard area.

For flood mitigation purpose, management of land use will be very effective in the study area. Especially this measure will be effective for reducing flood damage in those flood hazard areas with inappropriate land use. Also in order to contain the increment of rainfall runoffs and flood discharges from upper basins, the existing forest areas are to be kept as much as possible. The required action is the preparation of appropriate regulations with necessary legal basis.

14.5.2 Non-structural Measures for Drainage Improvement

(1) Introduction of Water Tolerant Crops or Varieties in the Poor Drainage Area

This measure should be applied for the entire flood hazard area. It is important to introduce appropriate planting program in conformity with the drainage situation to mitigate damage caused by the poor drainage conditions with the introduction of water tolerant crops and varieties.

(2) Introduction of Proper Farm Land Management

This measure should be applied for the entire flood hazard area.

For reducing damages caused by poor drainage conditions it is necessary for farmers to improve on-farm drainage conditions. The required actions are as follows:

1) Improvement of the agricultural extension program.

2) Preparation of guidelines for the followings:

- Conservation of natural streams and small drains in field when developing a farm land,
- Installation of cross drains for farm roads,
- Improvement of permeability in field by changing cultivation method,

The proposed non-structural measures for the each target area are shown in *Fig. 14.4.1* and in *Table 14.4.1*.

14.6 Operation and Maintenance

14.6.1 Basic Concept

Proper operation and maintenance (OM) activities are required to gain the expected benefits with the implementation of proposed flood mitigation and drainage improvement measures, and shall be carried out by the implementation organization and the related municipalities.

Basic OM requirement of the flood mitigation and drainage improvement measures are summarized as follows:

-1 The OM activities are important task and responsibility of the implementation organization,

-2 Practical OM manual and routine programs should be prepared by the implementation organization during the implementation stage of the proposed measures,

-3 An active local participation should be promoted at field level of OM activities, including the routine maintenance works,

-4 Collaboration and coordination among the implementation agency and the elated municipalities should be required in order to carry out OM activities smoothly,

14.6.2 Required OM Organization

The OM organization is planned as follows:

- The OM activities of flood mitigation measures shall be conducted by the implementation organization of master plan with the assistance of the related municipalities and local participants,

- The OM activities for drainage facilities shall be conducted by the related municipalities and local participants.

- The field level routine activities shall be conducted by crews of local participants.

14.6.3 OM Activities

The routine OM activities for structural measures that shall be started soon after the completion of works, are summarized as follows:

- Periodical inspection of the river and drainage channels, road-cum-embankment, and other related facilities like bridges and culverts,

- Dredging, clearing and grass cutting to maintain the conveyance capacities of river and drainage channels,

- Repairing of slope failure, erosion of channel, and settlement of embankment as stability control works,

- Inspection and prohibition of any activities harmful to the flood mitigation and drainage improvement facilities,

The OM activities for non-structural measures are summarized as follows:

- Inspection of hydrological observation network,
- Management and control of land use to ensure its conformity to the relevant land use regulations.

14.6.4 Tasks and Responsibilities

Tasks and responsibilities of the implementation organization are as follows:

- To organize the groups of local people to assist in OM activities through the municipalities where facilities are located,
- To carry out regular OM activities of flood mitigation and drainage improvement facilities,
- To undertake immediate actions of maintenance works, including repairing works as required, according to the field inspection,
- To prepare the budget of OM activities.

14.7 Cost Estimation

The project costs were estimated at the price level as of October 1995.

14.7.1 Project Cost of Structural Measures

(1) Project Cost

The project cost of the structural measures is composed of direct cost, indirect cost and contingency. The indirect costs of administration and engineering service are assumed to be 5 % and 10 % of the direct construction cost, respectively. Physical contingency is assumed to be 15 % of the direct construction cost. The project cost of the structural measures in 1995 price was estimated and summarized as follows:

(Unit: 1000 Bs.)

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

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

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

(2) Construction Schedule

The construction schedule of the major structural measures are prepared based on the followings:

- The proposed major construction works in the master plan are to be completed within ten (10) years from the year of 2001 to 2010,
- The supposed urgent works are to be executed within five (5) years from 2001,
- The major construction work is planned to utilize heavy equipment.

14.7.2 Project Cost of Non-structural Measures

The major components of the non-structural measures are regulation and guidance works such as land use control and flood plain management. These works can be done within the ordinary range of administrative works. Hence, additional cost for the administrative works relating to the non-structural measures is estimated to be insignificant.

In relation to the flood warning and evacuation system, the improvement of the hydrological observation networks is composed of eight (8) new automatic rain gauges

and eighteen (18) new automatic water level gauges, proposed as described in 14.10.2. Installation cost of these gauges was estimated as follows;

Automatic Rain Gauges and Water Level Gauges

Item	Quantity (No.)	Cost (Bs. 1,000)
1. Automatic rain gauge	8	303
2. Automatic water level gauge	18	789
Total		1,092

14.8 Project Evaluation

Project evaluation for the proposed structural measures as well as non-structural measures was conducted for each target area. Structural measures were evaluated in technical, economic, social and environmental terms. Non-structural measures were evaluated in technical and social terms. The results of the evaluation are summarized in *Table 14.4.1.*

14.8.1 Project Evaluation for Structural Measures

(1) Chane-Pailon Area

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

The conditions of inundation due to the sub-projects, namely Rio Pailon, Quebrada Chane, Chane-Chacras and Okinawa Drainage, will be improved very much by the proposed structural measures.

The economic benefit of a flood control project could be presented by the expected reduction effect in flood damage by implementing the flood mitigation project, that is the difference between with and without project situations.

The economic efficiency is evaluated mainly by EIRR for which values higher than 10 % is considered to be feasible in consideration to the opportunity cost of capital, estimated to be between 10 % and 12 %. The social benefits are evaluated as reduction of flood hazard area.

The EIRR value for the entire Chane - Pailon area is 11.04 %. However, the EIRR values of all sub-projects except the Rio Chane show values higher than 12.21 %.

The area protected by the structural measures is estimated to be 470 km^2 and the social benefits by the projects will be significant, while the adverse environmental effects will not be significant. However, based on Initial Environmental Evaluation (IEE), Environmental Impact Assessment (EIA) will be required for the further study stage.

From technical, economic, social and environmental aspects, the priority sequence of the sub-projects are:

1st Priority:

- Rio Chane
- Rio Pailon
- Okinawa drainage

2nd Priority:

- Chane-Chacras

3rd Priority:

- Quebrada Chane

(2) San Juan - Antofagasta Area

The structural measures for the area are feasible as a whole in technical, economic, social and environmental terms. The conditions of inundation will be improved very much by the proposed structural measures.

The structural measures for the area are feasible as a whole with the EIRR value of 13.41 % for the Master Plan, even though the structural measures for San Juan was evaluated as marginal with the EIRR value of 9.97 %.

The social benefits will be significant in the protected area of 210 km^2. Moreover, the project is considered to be viable from socio-economic aspects because the area is one of the most developed agricultural area in the Department. Adverse environmental effects by the projects will not be significant. However, based on the Initial

Environmental Evaluation (IEE), Environmental Impact Assessment (EIA) will be required for the further study stage.

From technical, economic, social and environmental aspects, the priority sequence of the sub projects are:

1st Priority:

- Antofagasta

2nd Priority:

- San Juan

14.8.2 Project Evaluation for Non-structural Measures

(1) Areas for Structural with Non-structural Measures

Chane - Pailon and San Juan - Antofagasta are the areas for the provision of structural and non-structural measures. As the flood conditions in these areas are very severe, both structural and non-structural measures are indispensable.

Non-structural measures such as flood warning and evacuation system, land use control and flood plain management are very effective in technical and social terms, because it takes a long time to complete the implementation of the structural measures.

Furthermore, non-structural measures for the Rio Chane area and downstream part of the San Juan area are very effective, because the flood conditions in these areas cannot be improved very much even with the implementation of the proposed structural measures.

(2) Areas for Non-structural Measures

Southern area of the eastern part and Palacios - Palometillas are the areas for non-structural measures.

Non-structural measures for the southern part are very effective in technical and social terms, because this area is intensive agricultural area. Furthermore, as the five swampy areas in this southern area are identified as retarding basins for the downstream

reaches, land use control of these retarding basins is very effective for the flood mitigation in the downstream reaches.

Non-structural measures for the Palacios - Palometillas area are technically effective and have medium social benefit, because of the extensive land use in this area.

14.9 Priority Projects for F/S

14.9.1 Priority Projects

Among the projects of structural measures, priority projects were identified and proposed for the Feasibility Study. Based on the results of the project evaluation, the feasible priority projects identified both for the Chane-Pailon area and the San Juan - Antofagasta are as follows:

1) Chane-Pailon area
   - Rio Chane,
   - Rio Pailon,
   - Okinawa Drainage.

2) San Juan - Antofagasta area
   - Antofagasta.

Non-structural measures for the Chane - Pailon area and San Juan - Antofagasta area are also of high priority to be studied in detail.

14.9.2 Main Study Items for the F/S

The main study items required for the feasibility study are listed as follows:

1) Supplementary data collection, field investigation and field survey
   - Supplementary data collection
   - Supplementary field investigation and survey
   - Supplementary agriculture and land use survey
   - Mapping of aerial photographs

2) Supplementary data analysis

- Hydrological data
- Flood damage
- Flood hazard area
- Agriculture and land use
- Socio-economic data

3) Agricultural development plan

- Farming plan
- Farm facility plan
- Irrigation and drainage Plan

4) Urgent flood mitigation and drainage improvement plan

- Preliminary design of structural measures
- Construction schedule and cost estimation
- Execution of EIA
- Project evaluation
- Institutional development
- Preparation of implementation program

5) Preparation of strategy for flood hazard area management

- Design of flood warning and evacuation systems

A draft of terms of reference of the Feasibility Study is attached to Appendix-C.

14.10 Implementation Plan

14.10.1 Project Component and Priority Ranking

The priority ranking of each component is evaluated from technical, economic and other potential effects, including social and environmental effects. The priority sequence of the proposed major measures is ranked based on the expected reduction effect in flood damage as follows:

1) Priority ranking of the structural measures from technical aspects is as follows:

Structural Measure	Ranking
-Road cum embankment:	High
-River improvement:	High
-Main drainage improvement:	Medium
-Secondary drainage improvement:	Medium

2) Priority ranking for the non-structural measures from technical aspects is considered as follows:

Non-structural Measure	Ranking
-Flood warning and evacuation system:	High
-Flood proofing for settlement :	High
-Land use control for retarding basins:	High
-Protection of forest along river channels:	Medium
-Land use management for farm lands:	Low
-Planting habit management:	Low

3) Priority ranking of supplementary development measures is as follows:

Measure	Ranking
-F/S study on priority projects	High
-Improvement of hydrological observation systems:	High
-Improvement of district and secondary roads:	High
-Supplementary development studies	Medium

14.10.2 Implementation Period

The implementation period was planned to be divided into the following two stages:

1. Stage-1: Preparatory period (from 1996 to 2000)
2. Stage-2: Implementation of urgent works (from 2001 to 2010)

The major works of each stage are explained below (refer to *Fig. 14.10.1*).

(1) Stage-1: Preparatory Period (from 1996 to 2000)

The major actions to be carried out in this stage are summarized as follows:

1) Institutional Arrangement for Stage-1

An optimum organization should be established to carry out the preparatory works for the implementation of the Master Plan. The organization should have administrative functions of planning, managing and raising necessary funds for the execution of the proposed measures. The following recommendation shall be taken into consideration for establishing the organization:

a) The organization shall be a strong implementation and coordination organization at general secretary level.

b) Some of the counterpart of the Master Plan Study shall be assigned to the organization because of their basic knowledge of the Master Plan.

c) Some of the members shall be selected from CORDECRUZ, SEARPI and SENAMHI.

d) The organization should have jurisdiction to establish new organizations for the execution of the proposed measures and OM after the execution of the Master Plan.

2) Execution of F/S on the Priority Projects identified in the Master Plan

Based on the expected reduction effect in flood damage, the priority projects should be studied more in detail for an early implementation.

3) Preparation for Execution of Non-structural Measures

Preparatory works for the required non-structural measures shall be started in order to facilitate the provision of non-structural measures for mitigation of flood problems. The preparatory works are required for the followings:

a) Flood warning and evacuation system,

b) Flood proofing of settlements in the flood hazard area,

c) Land use control of the proposed retarding basins,

d) Preservation of protected forests along river channels.

4) Measures for Early Implementation

Some simple measures among the priority measures are recommended to be executed even before F/S, if possible, because of their importance and likely high efficiency in technical and economic terms. They are listed as follows:

a) Main drainage works of Okinawa Drainage,

b) Road cum embankment of San Juan.

5) Improvement of the hydrological observation network

a) Installation of eight (8) new rain gauges:

In order to obtain optimum data for analysis of rainfall intensities and storm patterns in the study area, automatic rain gauges are recommended to be installed at the following sites shown in *Fig. 14.10.2*:

1. Cotoca,
2. Puesto Fernandes
3. Santa Rosa de Sara
4. Antofagasta
5. Okinawa-3
6. San Juan de Yapacani
7. Rio Yapacani basin
8. Rio Yapacani basin

The data can be applied for establishing an effective flood warning system.

b) Installation of eighteen (18) water-gauges

In order to obtain optimum data for analysis of flow regimes and runoffs in the study area, automatic water-gauges are recommended to be installed at the following sites shown in *Fig. 14.10.2*:

Rio Grande:	4 sites (Abapo, Puerto Pailas, Okinawa-1 and -2)
Rio Pirai:	3 sites (Belgica bridge, Eisenhower bridge, Chane)
Rio Yapacani:	2 sites (Rout No. 7 bridge, Downstream)
Rio Pailon-Rio Chane:	3 sites (Rout No. 9 bridge, Caimanes, Chane Bridge)
Rio Palometillas:	2 sites (Rout No. 7 bridge, Downstream)
Rio Palacios:	1 site (Santa Rosa)
Arroyo Jochi:	1 site (Antofagasta)
Arroyo Tacuaral:	1 site (Antofagasta)
Arroyo Yapacanicito:	1 site (Downstream bridge)

In order to facilitate the development of the study area, the following supplementary development studies are proposed:

6) Supplementary Works and Studies

a) Supplementary Development Study

In order to sustain economic growth, the following studies will be necessary:

1. Development study on agricultural development in the study area
   - Farm facility plan of post harvest facilities and farm conservation
   - Introduction of appropriate crop rotation to sustain soil fertility
   - Introduction of high productive crops such as fruits to increase farm income
   - Introduction of water tolerant crops and varieties
   - Extension of technical services
   - Diversification of agriculture

2. Development studies on the Rio Grande, Rio Pirai and Rio Yapacani
   - Study on Flood Mitigation and Drainage Improvement for the Mid-reaches of Rio Pirai
   - Study on Water Resources Management for the Mid-reaches of the Rio Grande
   - Study on Water Resources Management for the Rio Yapacani

b) Supplementary Development Work

In order to facilitate a smooth traffic flow, the following parts of the secondary roads should be up-graded or improved:

1. Okinawa-2 to the north of Warnes (26 km)
2. Okinawa-3 to the industrial park in the city of Santa Cruz (34 km)
3. Okinawa-3 to Cotoca (25 km)
4. Okinawa-3 to Monte Hoyos (16 km)

Improvement plans for the secondary roads in the severe flood hazard area should be prepared as components of flood evacuation road network.

(2) Stage-2: Implementation of urgent works (from 2001 to 2010)

1) Institutional arrangement for execution of the master plan

According to the implementation program of organization that would be prepared in the Stage-1, a new organization shall be established for implementation of the priority projects identified in the F/S. During this stage, an organization for OM activities shall also be established.

2) Implementation of the priority measures identified in the F/S

The priority measures identified in the F/S shall be carried out.

According to the investment plan of CORDECRUZ for the period of 1995 - 1999 and the budget for public sector investment of municipalities, major works may require external assistance for implementation, but minor works could be executed by the local government and the municipalities.

3) Supplementary development studies and works

The development studies proposed for the Stage-1 are recommended be carried out, if possible.

TABLES

TABLE 14.4.1 SUMMARY OF THE MASTER PLAN

PROJECT/SUBPROJECT	FLOOD MITIGATION AND DRAINAGE IMPROVEMENT MEASURES			PROJECT EVALUATION										
	STRUCTURAL MEASURES		NON-STRUCTURAL MEASURES	ASSESSMENT									PROJECT VIABILITY	
		PROJECT COST (1,000 Bs)		Technical Evaluation		Economic Evaluation (EIRR: %)		Social Impact (Protected Area: km2)		Environmental Impact				
1.CHANE - PAILON		902,275		Highly effective	A	Feasible	11.04 A	High Impact	470.1 A	Negligibly small	B	High viability	A
1-1 Rio Chane	Improvement of Rio Chane 27.0 km	175,748		As the main stream area, indispensable for avoiding any adverse effect. More effective with flood control of the Rio Piray.	A	Not feasible	negative C	Same as present	0.0 B	Same as present	B	High viability for avoiding any adverse effect. More effective with flood control of the Rio Piray.	A
1-2 Rio Pailon	Improvement of Rio Pailon 32.0 km Main Drainage 6.5 km Secondary Drainage 50.0 sq km	290,382	- Flood warning and evacuation system, - Preservation of protection forest along river channels, - Land use management for farm lands in the flood hazard area,	Indispensable as the main stream area	A	Highly feasible	14.33 A	High impact	117.8 A	Negligibly small	B	High viability as the stream area	A
1-3 Okinawa Drainage	Main Drainage 21.5 km Secondary Drainage 147.0 sq km	91,816	- Land use management in the poor drainage area, - Planting habit management in the poor drainage area.	High necessity as the major drainage area	A	Feasible	12.21 A	High impact as the intensive landuse area	71.9 A	Negligibly small	B	High viability as the major drainage area	A
1-4 Quebrada Chane	Improvement of Qda. Chane 34.0 km Main Drainage 8.0 km	126,279		Effect to only limited area of the tributary area	C	Feasible	12.52 A	Medium impact as the extensive landuse area	54.0 B	Negligibly small	B	Low viability as the tributary area	C
1-5 Chane -Chacras	Improvement of Qda. Chacras 36.5 km Main Drainage 21.0 km Secondary Drainage 284.0 sq km	218,050		High necessity as the tributary area	B	Highly feasible	15.38 A	High impact as wide effective area	226.4 A	Negligibly small	B	Medium viability as the tributary area	B
2.SAN JUAN - ANTOFAGASTA		187,340		Highly effective	A	Feasible	13.41 A	High Impact	210.3 A	Negligibly small	B	High viability	A
2-1 San Juan	Improvement of A. Yapacanicito 14.1 km Main Drainage 41.3 km Secondary Drainage 115.0 sq km	86,838	- Flood warning and evacuation system, - Preservation of protection forest along river channels,	Necessary	B	Marginal	9.97 B	High impact as the intensive landuse area	81.4 A	Negligibly small	B	High viability	A
2-2 Antofagasta	Improvement of A. Jochi, A. Tacuaral 20.3 km Main Drainage 10.0 km Secondary Drainage 97.0 sq km Road Cum Embankment 9.0 km	100,502	- Land use management for farm lands in the flood hazard area, - Land use management in the poor drainage area, - Planting habit management in the poor drainage area.	Indispensable	A	Highly feasible	16.24 A	High impact as the local colony	128.9 A	Negligibly small	B	High viability	A
3.RIO GRANDE DOWNSTREAM	None		- Flood warning and evacuation system, - Flood proofing for settlement in the flood hazard area, - Preservation of protection forest along river channels, - Land use management for farm lands in the flood hazard area, - Land use management in the poor drainage area,	Highly effective		-		High Impact		-		High viability	
4.SOUTHERN PART	None		- Planting habit management in the poor drainage area. - Flood warning and evacuation system, - Flood proofing for settlement in the flood hazard area, - Land use control for retarding basins, - Preservation of protection forest along river channels, - Land use management for farm lands in the flood hazard area, - Land use management in the poor drainage area,	Highly effective		-		High Impact		-		High viability	
5.PALACIOS - PALOMETILLAS	None		- Planting habit management in the poor drainage area. - Flood warning and evacuation system, - Preservation of protection forest along river channels, - Land use management for farm lands in the flood hazard area, - Land use management in the poor drainage area, - Planting habit management in the poor drainage area.	Effective		-		Medium Impact		-		Medium viability	
6.RIO PIRAY	MASTER PLAN OF RIO PIRAY												

REMARKS Ranking of viability for priority projects: A: High B: Marginal C: Low

WORK VOLUME OF STRUCTURAL MEASURES

Project/Sub-project	River Improv. (km)	Main Drainage Improve. (km)	Main Drainage Rehabili (km)	Secondary Drainage (km2)	Road-Cum Embank. (km)	Bridge (Nos.)	Culvert (Nos.)	Divers Weir (Nos.)	Land Acquisi (ha.)	Retard Basin (km2)
1. CHANE - PAILON	137.50	57.00	0.00	481.00	0.00	21	78	0	1550.0	141.5
1-1 RIO CHANE	35.00	0.00	0.00	0.00	0.00	5	0	0	222.0	0.0
1-2 RIO PAILON	32.00	6.50	0.00	50.00	0.00	1	8	0	383.0	116.5
1-3 QUEBRADA CHANE	34.00	8.00	0.00	0.00	0.00	1	0	0	290.0	25.0
1-4 CHANE - CHACRAS	36.50	21.50	0.00	284.00	0.00	12	43	0	445.0	0.0
1-5 OKINAWA DRAINAGE	0.00	21.00	0.00	147.00	0.00	2	27	0	210.0	0.0
2. SAN JUAN - ANTOFAGASTA	34.40	17.10	34.20	212.00	9.00	6	36	4	487.0	0.0
2-1 SAN JUAN	14.10	7.10	34.20	115.00	0.00	3	17	4	174.0	0.0
2-2 ANTOFAGASTA	20.30	10.00	0.00	97.00	9.00	3	19	0	313.0	0.0

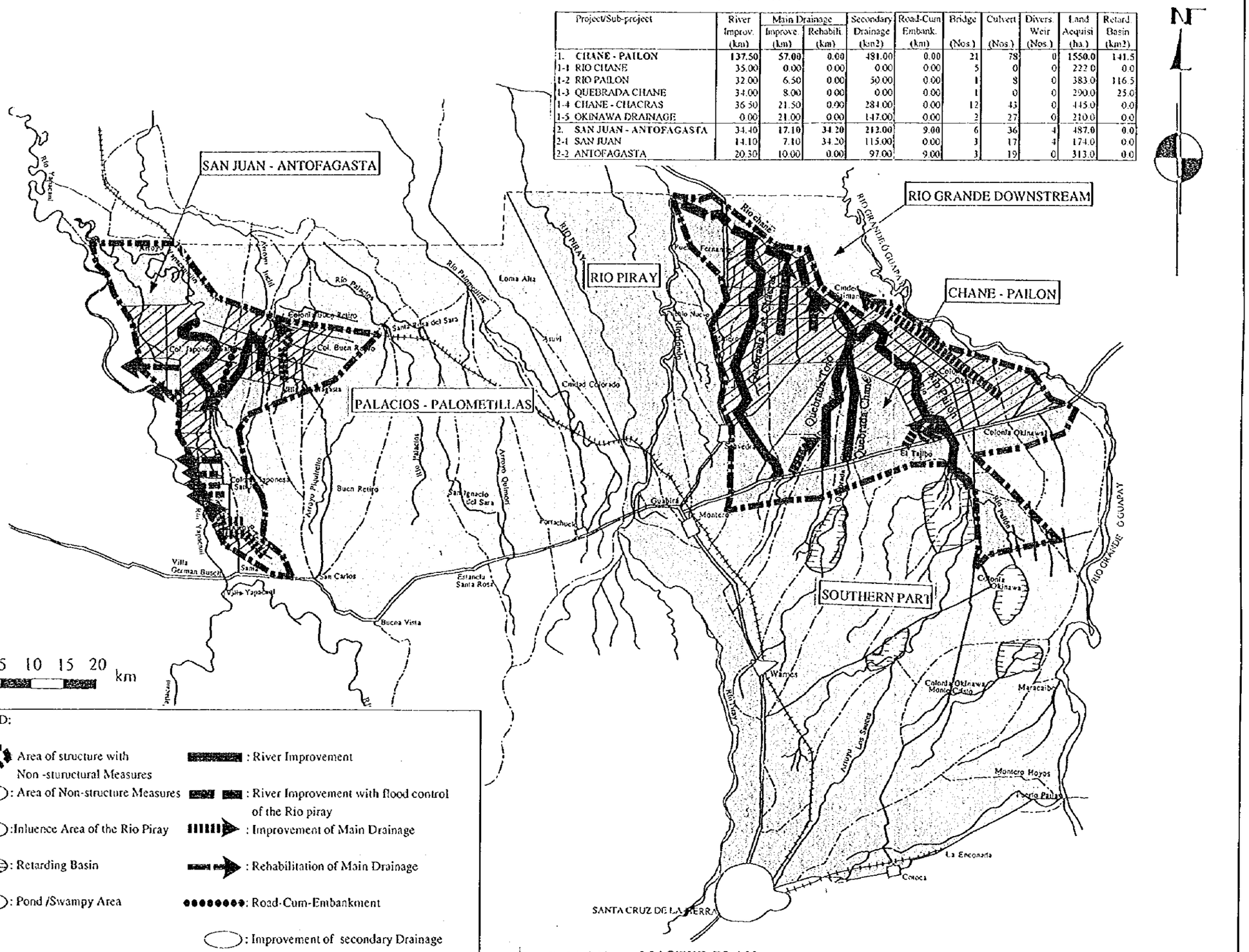


FIG. 14.4.1 MASTER PLAN

FIGURES

FIG. 14.10.1 IMPLEMENTATION PLAN OF THE MASTER PLAN

ITEMS	STAGE	STAGE-1 PREPARATION PERIOD					STAGE-2 IMPREMENTATIONOF URGENT WORKS									
	YEAR	1 1996	2 1997	3 1998	4 1999	5 2000	1 2001	2 2002	3 2003	4 2004	5 2005	6 2006	7 2007	8 2008	9 2009	10 2010
1. Institutional Arrangement																
1-1 Establishing an organization to carry out the preparation works for implemenattion of the Master Plan			———	———	———	———										
1-2 Establishing a new implementation organization to i,plement the Master Plan							———	———	———	———	———	———	———	———	———	———
1-3 Establishing a new organization for O/M activities												———	———	———	———	———
2. Execution of F/S and D/D on the Priority Projects				———	- - -	———										
- Chane - Pailon Area				F/S		D/D										
- San Juan - Antofagasta Area																
3. Preparation of Regulation or Preliminary Design Related to the Non-structural Measures			———	———	———	———										
4. Improvement of the Hydrological Obserbation Networks			———	———												
- Installation of rain guages																
- Installation of water level guages																
5. Complementary Works and Studies			———	———	———	———	———	———	———	———	———	———	———	———	———	———
- Complementary development study																
- Improvement of the secondary roads																
6. Implementation of the Structural Measures Identified in the F/S																
6-1 Chane - Pailon Area																
(1) Rio Chane Basin							———	———	———	———	———					
(2) Rio Pailon Baisn												———	———	———	———	———
(3) Chane Chacras Basin									———	———	———	———	———	———	———	———
(4) Quebrada Chane												———	———	———	———	———
(5) Okinawa Drainage							———	———	———	———	———					
6-2 San Juan - Antofagasta Area																
(1) San Juan Baisn							———	———	———	———						
(2) Antofagasta Baisn							———	———	———	———	———					
7. Execution of Non-structural Measures				·····	·····	·····	———	———	———	———	———	———	———	———	———	———
- Flood warning and evacuation system																
- Flood proofing of settlements in the flood hazard area																
- Land use control of the proposed retarding basins																
- Preservation of protection forests along river channels																
- Land use management for farmlands in the flood hazard area																
- Lamd use management in the poor drainage area																
- Planning habit management in the poor drainage area																

(Unit: No.)

Item	Rain Gauge	Water Level Gauge
1. Existing Manual Gauge	25	1
2. Existing Automatic Gauge	6	0
3. Automatic Gauge to be Newly Installed	5	15
4. Existing Manual Gauge to be replaced by Automatic Gauge	3	3
Total	39	18

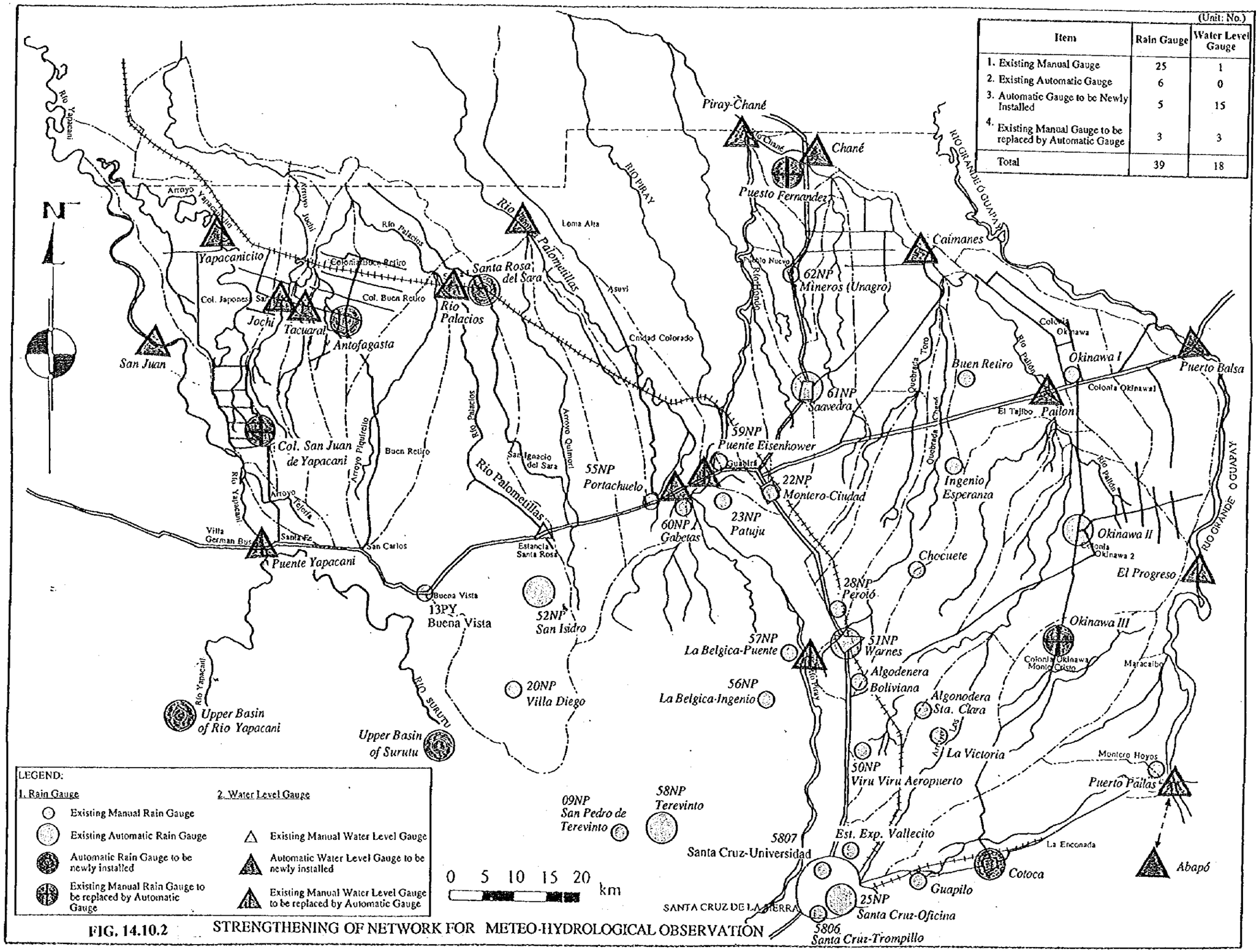


FIG. 14.10.2 STRENGTHENING OF NETWORK FOR METEO-HYDROLOGICAL OBSERVATION

CHAPTER 15
CONCLUSION AND RECOMMENDATION

CHAPTER 15 CONCLUSION AND RECOMMENDATION

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

The proposed plan 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 land use efficiency, expansion of planted areas, 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, are expected.

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

(2) It is necessary to take an immediate action for the execution of F/S for the urgent measures in the study area.

(3) Preparatory works for regulation and preliminary design of non-structural measures should be started immediately in order to facilitate the implementation of 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 and manage the land use effectively. The following suggestions should be taken into consideration for establishing the organization:

-1 The organization should be a strong implementation and coordination organization at General Secretary or Prefecto level.

-2 Some of the counterpart engaged in 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 shall be 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 relation to the flood warning systems and supplementary development studies.

(6) Supplementary development studies and works mentioned in the Master Plan should be carried out to support the regional development:

APPENDIX A
PARTICIPANTS

APPENDIX-A PARTICIPANTS

1. Counterparts

Ing. Manlio Alberto Roca Zamora	Coordinator of Counterparts/Drainage
Ing. Mario Ribera Velez	Head, Team of Natural Resources Hydrologist
Ing. Juan de Dios Algaranaz	Soi Expert
Ing. Hector Rivero	Agronomist/Planner
Lic. Dunia Mercado	Socioeconomist
Egr. Arq. Raul Velazquez Nieto	Planner
Lic. Patricia Mendez	Responsible GIS
Ing. Francisco Kempff	Agronomist/Planner
Ing. Oscar Mendez	Agronomist/Planner
Ing. Jorge Montaño	Hydrometeologist
Ing. Carlos Lambropulos Suarez	Geologist
Lic. Ricardo Rondó Quique Luna	Planner/Economist
Lic. Gloria Peredo Gutierrez	Economist
Ing. Francis Justiniano Lijeron	Civil Engineer

2. JICA Study Team

Mr. Hajime TANAKA	Team Leader
Mr. Takashi FURUKAWA	Hydrologist/Hydraulic Engineer
Dr. Michiaki HOSONO	Agriculture/Land Use
Mr. Hiroshi MATSUO	Regional Development Planner
Dr. Kinichi OHNO	Socioeconomist
Mr. Kazuo FURUKATA	Topographic Survey Expert
Mr. Toshinori OSHITA	River Engineer/Flood Damage Survey Expert
Mr. Kazuhiro TSUCHIDA	Drainage Engineer
Mr. Shigehiko HONMA	Structure Design/Cost Estimation Expert
Dr. Hiroshi HASHIMOTO	Institution/Environment Expert
Mr. Victor ARITOMI	Coordinator

APPENDIX B
MINUTES OF MEETING

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

AGREED UPON BETWEEN
SANTA CRUZ REGIONAL DEVELOPMENT CORPORATION
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

SANTA CRUZ, DECEMBER 14, 1994
LA PAZ, DECEMBER 15, 1994

Uc. RONALD PARADA GIL
ACTING PRESIDENT
SANTA CRUZ REGIONAL
DEVELOPMENT CORPORATION

Ing. KENJI KIYOMIZU
LEADER,
PREPARATORY STUDY TEAM,
JAPAN INTERNATIONAL
COOPERATION AGENCY

Uc. ALFONSO E. KREIDLER GILLAUX
SECRETARY,
NATIONAL SECRETARIAT OF
PLANNING, MINISTRY OF
SUSTAINABLE DEVELOPMENT
AND ENVIRONMENT

Ing. EDGAR TALAVERA SOLIZ
SECRETARY,
NATIONAL SECRETARIAT OF
AGRICULTURE AND CATTLE RAISING,
MINISTRY OF ECONOMIC
DEVELOPMENT

Uc. MARCELO MENDEZ FERRY
UNDERSECRETARY OF PUBLIC INVESTMENT
AND EXTERNAL FINANCE, MINISTRY OF
FINANCE

In response to the request of the Government of the Republic of Bolivia, (hereinafter referred to as "the Government of Bolivia") the Government of Japan has decided to conduct a Master Plan Study on Flood Control in the Northern Rural Region of Santa Cruz (hereinafter referred to as "the Study"), through Japan International Cooperation Agency (hereinafter referred to as "JICA").

The JICA preparatory study team, headed by Kenji Kiyomizu,visited Bolivia from December 2,1994 to December 17,1994, where it was held a series of meetings with Santa Cruz Regional Development Corporation (hereinafter referred to as "CORDECRUZ"), and other authorities concerned of the Government of Bolivia. The list of attendants is shown in appendix.

During the visit, both sides agreed to the Scope of Work for the Study, which defines the terms and conditions of the Study and implementing and coordination in Bolivia and Japan. In addition to the Scope of Work, the JICA preparatory study team and the Bolivian representatives confirmed the following.

1. The purpose of the Study is to formulate a comprehensive flood control master plan in rural area,which aims to mitigate flood damages mainly concerning agricultural activities in farming area.

2. The Study area includes Pailon and Chane river basins , and parts of Grande, Piray and Yapacani river basins.As to Piray river basin, however, there already exists a river management plan named "Plan directivo de acondicionamiento de la cuenca del Rio Piray". Accordingly,as far as Piray river basin is concerned,the Study shall be limited to collection of existing data (such as hydrological data) for necessity in connection with the other river basins.But if it would be recognized necessary in the course of the Study,more detailed study (than existing data collection) for Piray river basin will be conducted in harmony with the aforesaid river management plan and within the purpose of the Study.

3. The both sides agreed that the target year of the Study shall be decided in the first work period of the Study Team in Bolivia through mature discussions about the conditions in the Study Area.

4. CORDECRUZ shall provide coordination required with other government agencies and non-government agencies to ensure smooth and accurate conduct of the Study.

5. At the request of the Bolivian side, the Japanese Study Team will prepare Inception, Draft Final and Final Reports in Spanish as well as English,and also prepare summaries of Progress and Interim Reports in Spanish for reference.However,drawings and diagrams will be remained in English.

6. As to the counterpart personnel,CORDECRUZ agreed to assign enough engineers/technicians during the conduct of the Study.

7. CORDECRUZ will provide two vehicles with drivers. The Japanese side will cover the rest of the transportation expenses.

8. CORDECRUZ will provide suitable office space with necessary equipment and furniture except copy machine, facsimile and computer in Santa Cruz City.Rest of the equipment necessary for the Study will be prepared by the Japanese side.

9. The Bolivian side requested that counterpart personnel will be trained in Japan. The Japanese side will convey the request to JICA headquarters.

10. The Japanese side suggested that it will be effective to hold a seminar at the end of the Study. At the suggestion,the Bolivian side also agreed the effectiveness and requested to perform a seminar related to flood control in rural area.The Japanese side replied that they will make effort to meet the request.

11. As to the disclose of the Final Report, the Bolivian side expressed that it shall be opened to the public at present opinion , but the final request about the disclose will be made after the explanation of Draft Final Report.

The Scope of Work and the Minutes of Meetings are prepared in both English and Spanish. In case any doubt arises in interpretation, the English text shall prevail.

Appendix

List of Attendants

Bolivian side

<Santa Cruz>

1.Lic.Ronald Pareda Gil	Acting President,CORDECRUZ
2.Ing.Mario Ribera Velez	Director,Team of Natural Resources, CORDECRUZ
3.Ing.Gustavo Pereyra Carvallo	Chief,Department of Rural Agriculture and Cattle Raising,CORDECRUZ
4.Ing.Juan de Dios Algaranaz	Expert of Soil,Team of Natural Resources,CORDECRUZ
5.Ing.Manlio Alberto Roca Zamora	Expert of Irrigation and Drainage, CORDECRUZ

<La Paz>

1.Lic Alfonso E. Kreidler G.	Secretary,National Secretariat of Planning, Ministry of Sustainable Development and Environment
2.Ing.Edgar Talavera Solis	Secretary,National Secretariat of Agriculture and Cattle Raising,Ministry of Economic Development
3.Ing.Oscar Ponce Blanco	Undersecretary,National Secretariat of Agriculture and Cattle Raising,Ministry of Economic Development
4.Ing.Fernando Landivar Bowles	Undersecretary,National Secretariat of Agriculture and Cattle Raising,Ministry of Economic Development
5.Lic.Marcelo Machicao Barbery	Director,International Cooperation Division, Under Secretariat of Public Investment and External Finance, Ministry of Finance
6.Lic.Pilar Rollano	Staff,International Cooperation Division, Under Secretariat of Public Investment and External Finance, Ministry of Finance

Japanese side

<Preparatory Study Team>

1.Ing.Kenji Kiyomizu	Leader/ Development Specialist, Institution for International Cooperation, JICA
2.Ing.Yukio Miyaishi	Member/ Senior Staff,Design Division, Construction Department,Tokai Administration Office,Ministry of Agriculture,Forestry and Fisheries
3.Ing.Kojiro Matsumoto	Member/ Second Development Study Division, Social Development Study Department, JICA
4.Ing.Nobuyuki Okabe	Member/ Japan Engineering Consultants Co.,Ltd.
5.Lic.Masami Adaniya	Member/ Japan International Cooperation Center

<Santa Cruz>

1.Lic.Norioki Honda	Director,Santa Cruz Branch of JICA Bolivia Office
2.Ing.Tokuo Ikeda	Technical Cooperation Staff,Santa Cruz Branch of JICA Bolivia Office
3.Lic.Fusayasu Kamiya	Technical Cooperation Staff,Santa Cruz Branch of JICA Bolivia Office

<La Paz>

1.Lic. Seiji Tomiyasu	Assistant Resident Representative,JICA Bolivia Office
2.Lic.Carlos Omoya	Technical Cooperation Staff,JICA Bolivia Office

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

AGREED UPON BETWEEN

SANTA CRUZ REGIONAL DEVELOPMENT COOPERATION
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

SANTA CRUZ, APRIL 13, 1995

LA PAZ, APRIL , 1995

Lic. FREDY TEODOVICH ORTIZ
PRESIDENT,
SANTA CRUZ REGIONAL
DEVELOPMENT CORPORATION

Mr. HAJIME TANAKA
TEAM LEADER,
STUDY TEAM OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

Lic. ALFONSO E. KREIDLER GILLAX
SECRETARY
NATIONAL SECRETARIAT OF
PLANNING, MINISTRY OF
SUSTAINABLE DEVELOPMENT
AND ENVIRONMENT

Mr. KENJI KIYOMIZU
CHAIRMAN,
ADVISORY COMMITTEE OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

Ing. EDGAR TALAVERA SOLIZ
SECRETARY
NATIONAL SECRETARIAT OF
PLANNING OF AGRICULTURE
AND CATTLE RAISING,
MINISTRY OF ECONOMIC
DEVELOPMENT

Lic. MARCELO MENDEZ FERRY
UNDERSECRETARY OF
PUBLIC INVESTMENT AND
EXTERNAL FINANCE,
MINISTRY OF FINANCE

The study team of Japan International Cooperation Agency (JICA) arrived and submitted thirty (30) copies of the Inception Report (March 1995) for the captioned project to SANTA CRUZ REGIONAL DEVELOPMENT CORPORATION (CORDECRUZ) on March 31, 1995, according to the Scope of Work agreed upon between CORDECRUZ and JICA on December 14, 1994.

The study team held a meeting with CORDECRUZ on the report that presents the study program for the captioned project, on April 3, 1995. The meeting was chaired by Ing. Manlio Alberto Roca Zamora of CORDECRUZ. The study team explained the report to the officials and discussed with the officials on the report. The list of participants is shown in Annex-1 .

The advisory team of JICA, headed by Mr. Kenji KIYOMIZU, visited Bolivia from April 10 to April 16. The advisory team and the study team held a meeting with CORDECRUZ and discussed with the officials on the report on April 12-13, 1995. CORDECRUZ expressed its satisfaction to the report. The list of participants is shown in Annex-2.

During the meeting some observations were made and discussed by the participants. The point discussed and agreed was as follows:

1 CORDECRUZ agreed to assign necessary numbers of counterparts to the study team for conducting the study smoothly, though number of full time counterparts are limited.

The points discussed and agreed to transfer to the JICA headquarters by the JICA Advisory Team were as follows:

1 CORDECRUZ requested JICA to hold a seminar related to the study in Santa Cruz at the timing of submission of the Draft Final Report.

2 CORDECRUZ requested JICA to conduct counterpart training in Japan in the course of the study.

Annex-1 List of the Participants

1 CORDECRUZ

Ing. Manlio Alberto Roca Zamora	Coordinator of Counterparts/ Drainage
Ing. Mario Ribera Velez	Head, Team of Natural Resources/Hydrologist
Ing. Juan de Dios Algaranaz	Soil Expert
Ing. Hector Rivero	Agronomist/Planner
Lic. Dunia Mercado	Socioeconomist
Egr. Arq. Raul Velazquez Nieto	Planner
Lic. Patricia Mendez	Responsable Geographic Information System

2 JICA Study Team

Mr. Hajime TANAKA	Team Leader
Mr. Takashi FURUKAWA	Hydrologist/Hydraulic Engineer
Dr. Michiaki HOSONO	Agriculture / Land Use
Mr. Hiroshi MATSUO	Regional Development Planner
Dr. Kinichi OHNO	Socio-economist
Mr. Victor ARITOMI	Coordinator

Annex-2 List of the Participants

1 CORDECRUZ

Lic. Freddy Teodovich Ortiz	President
Lic. Ronald Parada Gil	General Manager
Ing. Julio Prado Salmon	Head of Development Divisions
Ing. Manlio Alberto Roca Zamora	Coordinator of Counterparts

2 JICA Advisory Committee

Mr. Kenji KIYOMIZU	Chairman of the JICA Advisory Committee
Mr. Kojiro MATUMOTO	JICA Officer

3 JICA Study Team

Mr. Hajime TANAKA	Team Leader
Mr. Takashi FURUKAWA	Hydrologist/Hydraulic Engineer
Dr. Michiaki HOSONO	Agriculture / Land Use
Mr. Hiroshi MATSUO	Regional Development Planner
Dr. Kinichi OHNO	Socio-economist
Mr. Kazuo FURUKATA	Topographic Survey Expert

Mr. Toshinori OSHITA	River Engineering/Flood Damage Survey Expert
Mr. Victor ARITOMI	Coordinator

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

BETWEEN

SANTA CRUZ REGIONAL DEVELOPMENT CORPORATION
AND
STUDY TEAM OF JAPAN INTERNATIONAL COOPERATION AGENCY

SANTA CRUZ, JUNE 9, 1995

LA PAZ, JUNE , 1995

Ing. FERNANDO AMELUNGE MARTINEZ
PRESIDENT
SANTA CRUZ REGIONAL
DEVELOPMENT CORPORATION

Mr. HAJIME TANAKA
TEAM LEADER,
STUDY TEAM OF
JAPAN INTERNATIONAL
COOPERATION AGENCY

Lic. ALFONSO E. KREIDLER GILLAUX
SECRETARY
NATIONAL SECRETARIAT OF
PLANNING,
MINISTRY OF SUSTAINABLE
DEVELOPMENT AND ENVIRONMENT

Lic. MARCELO MACHICAO B.
UNDERSECRETARY a.i. OF
PUBLIC INVESTMENT AND
EXTERNAL FINANCE,
MINISTRY OF FINANCE

Ing. EDGAR TALAVERA SOLIZ
SECRETARY
NATIONAL SECRETARIAT OF
PLANNING OF AGRICULTURE
AND CATTLE RAISING,
MINISTRY OF ECONOMIC DEVELOPMENT

The study team of Japan International Cooperation Agency (JICA) commenced the study since April 1995, based on the Inception Report (March 1995) that was submitted to Santa Cruz Regional Development Corporation (CORDECRUZ) on March 31, 1995 according to the Scope of Work agreed upon between CORDECRUZ and the JICA mission for the captioned study on December 14, 1994.

The study team and the counterparts held meetings on May 15, May 22, May 29 and May 31 on the initial findings. The study team members explained their findings by sector and the result of preliminary analysis to the counterparts during the meetings. Regarding the Central Government, on June 5 and 6, 1995 the team leader summarized the findings to the staff concerned. The initial findings from April through May 1995 have been compiled into Progress Report-1.

The Progress Report-1(June 1995) was submitted to CORDECRUZ on June 9, 1995. The study team held meetings with CORDECRUZ to discuss the report on June 9, 1995. The team leader explained an outline of the report to the participants to which CORDECRUZ expressed its satisfaction. The lists of participants are shown in Annex-1 and Annex-2, respectively.

During the meetings some observations were made and discussed by the participants. The points discussed and agreed upon were as follows:

1 CORDECRUZ agreed to provide the study team with the same office and to assign the same counterparts for the study in the next phase,

2 CORDECRUZ agreed to try to fulfill the agreed points in the Minutes of Meeting between CORDECRUZ and JICA mission for the study on December 14, 1994, and

3 The study team agreed to hold technical meetings with the counterpart personnel periodically to carry out technical transfer effectively.

Annex-1 List of the Participants in the first meeting on June 9, 1995

1 CORDECRUZ

Ing. Manlio Alberto Roca Zamora	Chief of Counterparts/Drainage
Ing. Mario Ribera Velez	Hydrologist Director
Ing. Juan de Dios Algaranaz	Soil Expert
Ing. Hector Rivero	Agronomist / Planner
Lic. Dunia Mercado	Socioeconomist
Egr. Arq. Raul Velazquez Nieto	Planner
Lic. Patricia Mendez	Geographic Information System

2 JICA Study Team

Mr. Hajime TANAKA	Team Leader
Mr. Takashi FURUKAWA	Hydrologist/Hydraulic Engineer
Mr. Toshinori OSHITA	River Engineering/Flood Damage Survey Expert
Mr. Kazuhiro TSUCHIDA	Drainage Engineer
Mr. Shigehiko HOMMA	Structure Design/Cost Estimation Expert

Annex-2 List of the Participants in the second meeting on June 9, 1995

1 CORDECRUZ

Ing. Fernando Amelunge Martinez	President
Lic. Ronald Parada Gil	General Manager
Ing. Sergio Antelo Gutierrez	Planning Manager
Lic. Cecilia Limpias de Cruz	Chief Division of DPOPM
Ing. Manlio Alberto Roca Zamora	Chief of Counterparts

2 JICA Study Team

Mr. Hajime TANAKA	Team Leader
Mr. Takashi FURUKAWA	Hydrologist/Hydraulic Engineer
Mr. Toshinori OSHITA	River Engineering/Flood Damage Survey Expert
Mr. Kazuhiro TSUCHIDA	Drainage Engineer
Mr. Shigehiko HOMMA	Structure Design/Cost Estimation Expert

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

BETWEEN

SANTA CRUZ REGIONAL DEVELOPMENT CORPORATION
AND
STUDY TEAM OF THE JAPAN INTERNATIONAL COOPERATION AGENCY

SANTA CRUZ, SEPTEMBER 26, 1995

LA PAZ, SEPTEMBER , 1995

Ing. FERNANDO AMELUNGE MARTINEZ.

PRESIDENT
SANTA CRUZ REGIONAL
DEVELOPMENT CORPORATION

Mr. HAJIME TANAKA

TEAM LEADER,
JICA STUDY TEAM

Lic. RAMIRO ORTEGA LANDA

SECRETARY
NATIONAL SECRETARIAT OF
PLANNING,
MINISTRY OF SUSTAINABLE
DEVELOPMENT AND ENVIRONMENT

Mr. SHINYA SAITO

MEMBER OF
JICA ADVISORY
COMMITTEE FOR
THE STUDY

Ing. CARLOS AGREDA

UNDER SECRETARY OF
NATIONAL SECRETARIAT OF
PLANNING OF AGRICULTURE
AND CATTLE RAISING,
MINISTRY OF ECONOMIC
DEVELOPMENT

Lic. JUAN CARLOS AGUILAR

UNDER SECRETARY OF
PUBLIC INVESTMENT AND
EXTERNAL FINANCE,
MINISTRY OF FINANCE

From September 1995, the Study Team of the Japan International Cooperation Agency (JICA) commenced the Phase II field study based on the Inception Report (March 1995) that was prepared according to the Scope of Work agreed upon between Santa Cruz Regional Development Corporation (CORDECRUZ) and the JICA Preparatory Study Team for captioned study on December 14, 1994.

The Study Team presented the Interim Report (August 1995) to CORDECRUZ on September 4, 1995 and held meetings with the officials concerned at CORDECRUZ on September 5 and 6, 1995. During the meetings the Team Leader, Mr. Hajime TANAKA, suggested that in case of any comments on the report, the Study Team is ready to discuss on such comments with the counterparts during the technical meetings that will be held in the course of the study.

The Team Leader together with the chief counterpart of CORDECRUZ, Ing. Manlio Roca Zamora, presented the interim report to the Central Government officials concerned in La Paz on September 7 and 8, 1995.

The member of the JICA advisory committee for the study, Mr. Shinya SAITO, and the JICA task manager for the study, Mr. Katsumi OTANI, visited Bolivia from September 20 to September 26, 1995. The Study Team held a meeting on the interim report with the officials of CORDECRUZ on September 22, 1995.

During the meeting, the president of CORDECRUZ, Ing. Fernando Amelunge Martinez, expressed his satisfaction for the study and the Interim Report (August 1995).

Some observations were made and discussed by the participants in the meeting. The points discussed and agreed upon are as follows:

1. CORDECRUZ agreed to assign as many as possible full time counterparts to cooperate with the study team to fulfill the agreed points in the Minutes of Meetings between CORDECRUZ and the JICA Preparatory Study Team for the study on December 14, 1994, and

2. During the study the Study Team agreed to hold regular technical meetings with the counterpart personnel to carry out technical transfer effectively.

The list of participants is shown in Annex-1.

Annex-1 List of Participants in the meetings

1. Bolivian side

(CORDECRUZ)

Ing. Fernando Amelunge Martinez	President
Lic. Ronald Parada Gil	General Manager
Ing. Sergio Antelo Gutiérrez	Planning Manager
Lic. Cecilia Limpias de Cruz	Chief Division of DPOPM,
Ing. Manlio Alberto Roca Zamora	Chief of Counterparts/Drainage
Ing. Juan de Dios Algarañaz	Soil Expert,
Ing. Carlos Lambropulos Suárez	Geologist
Lic. Ricardo Rondo Quique Luna	Planning/ Economist
Lic. Gloria Peredo Gutiérrez	Economist
Ing. Francis Justiniano Lijerón	Civil engineer / Cost Estimate

(Ministry of Sustainable Development and Environment)

Lic. Alfonso E. Kreidler Gillaux	Ex-Secretary, National Secretariat of Planning,
Lic. Ramiro Ortega Landa	Secretary, National Secretariat of Planning,
Dr. Alejandro F. Mercado	Under Secretary, Strategy of Development

Lic. Roberto Camargo	Consultant

(National Secretariat of Planning of Agriculture and Cattle Raising, Ministry of Economic Development)

Ing. Edgar Talavera Soliz	Secretary
Lic. Oscar E. Luna C.	Director, National Planning
Ing. Lucio Colque Gutiérrez	Director, National Irrigation and Soil
Sr. Javier Choquevilca Rocha	Unit of Agrometeorology and Early Alert

(Public Investment and External Finance, Ministry of Finance)

Lic. Pilar Rollano Bravo	Consultant
Lic. Javier Martinez Villanueva	Chief of Multilateral Area of International Cooperation Office Public Investment and Foreign Financing Secretariat

2. Japanese side

(JICA Study Team)

Mr. Hajime TANAKA	Team Leader
Mr. Takashi FURUKAWA	Hydrologist/Hydraulic Engineer
Dr. Michiaki HOSONO	Agriculture/Land Use Expert
Mr. Hiroshi MATUO	Regional Development Planner
Mr. Kazuo FURUKATA	Topographic Survey Expert

Mr. Toshinori OSHITA	River Engineering/Flood Damage Survey Expert
Mr. Kazuhiro TSUCHIDA	Drainage Engineer
Dr. Hiroshi HASHIMOTO	Institution / Environment Expert
Mr. Victor ARITOMI	Coordinator

(JICA Head Office)

Mr. Shinya SAITO	Member of JICA Advisory Committee for the study
Mr. Katsumi OTANI	JICA Task Manager for the study Social Development Study Department, JICA

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

BETWEEN

SANTA CRUZ REGIONAL DEVELOPMENT CORPORATION
AND
STUDY TEAM OF THE JAPAN INTERNATIONAL COOPERATION AGENCY

SANTA CRUZ, DECEMBER 11, 1995

LA PAZ, DECEMBER , 1995

Lic. RONALD PARADA GIL.

PRESIDENT a.i.
SANTA CRUZ REGIONAL
DEVELOPMENT CORPORATION

Mr. HAJIME TANAKA

TEAM LEADER,
JICA STUDY TEAM

Lic. RAMIRO ORTEGA LANDA

SECRETARY
NATIONAL SECRETARIAT OF
PLANNING,
MINISTRY OF SUSTAINABLE
DEVELOPMENT AND
ENVIRONMENT

Ing. EDGAR TALAVERA SOLIZ

UNDER SECRETARY OF
NATIONAL SECRETARIAT OF
PLANNING OF AGRICULTURE
AND CATTLE RAISING,
MINISTRY OF ECONOMIC
DEVELOPMENT

Lic. JUAN CARLOS AGUILAR

UNDER SECRETARY OF
PUBLIC INVESTMENT AND
EXTERNAL FINANCE,
MINISTRY OF FINANCE

The Study Team of the Japan International Cooperation Agency (JICA) started the phase-2 field study from the beginning of September 1995 and issued the Progress Report-2 in the beginning of December 1995. During the period the Study Team has held regular technical meetings with the officials concerned of Santa Cruz Regional Development Corporation (CORDECRUZ) on the results of the study.

The Team Leader, Hajime Tanaka, together with the chief counterpart of CORDECRUZ, Ing. Manlio Roca Zamora, presented the outline of the Progress Report-2 based on the copy of Summary Report to the Central Government officials concerned in La Paz on December 6, 1995.

The Study Team held a meeting with the officials of CORDECRUZ on the Progress Report-2 at CORDECRUZ on December 11, 1995. The president of CORDECRUZ, Ing. Fernando Amelunge Martinez, chaired the meeting. The Team Leader presented the outline of the report to the participants and explained that all basic data and methodologies used for the Study will be provided or explained more in detail in the next report (Draft Final Report) and that any comments raised on the report will be considered and incorporated into the next report.

After exchanging views among the participants on some observations such as priority sequence of proposed measures, required implementation organizations and required preparation works for non-structural measures, CORDECRUZ expressed its satisfaction to both the study and the Progress Report-2.

During the discussion, CORDECRUZ has stressed the following points and the Study Team has agreed to transfer them to the JICA headquarters. They are summarized as follows:

1. CORDECRUZ requested the Study Team to hold technical meetings on the Study instead of a general technical seminar that was stated in the Inception Report (March 1995) to be held just after the explanation of the Draft Final Report in March 1996, because it could be more

effective for technical transfer purposes to hold technical meetings on the results of the Study between the JICA Team and the officials concerned

2 The Study will be followed up by the same counterparts under the authority of the new departmental organization after the reformation from January 1996 in order to avoid any inconvenience for both sides, though CORDECRUZ is to be dissolved by the end of 1995 and to be reformed as a part of the departmental organization from January 1, 1996, in accordance with the Law of Decentralization.

The list of participants is shown in Annex-1.

Annex-1 List of the Participants in the meetings

1. Bolivian Side

(CORDECRUZ)

Ing. Fernando Amelunge Martinez	President
Lic. Ronald Parada Gil	General Manager
Ing. Sergio Antelo Gutiérrez	Planning Manager
Lic. Adaly de Rojas	Chief Division of DPOPM. a.i.
Ing. Manlio Alberto Roca Zamora	Chief of Counterparts/Drainage
Ing. Juan de Dios Algarañaz	Soil Expert,
Ing. Carlos Lambropulos Suarez	Geologist
Lic. Ricardo Rondón Quique Luna	Planning/ Economist
Lic. Gloria Peredo Gutiérrez	Economist
Ing. Francis Justiniano Lijerón	Civil engineer / Cost Estimate
Ing. Rodolfo Candia	Planning Engineer

(Ministry of Sustainable Development and Environment)

Lic. Ramiro Ortega Landa	Secretary, National Secretariat of Planning,

(National Secretariat of Planning of Agriculture and Cattle Raising, Ministry of Economic Development)

Lic. Oscar E. Luna C.	Director, National Planning
Ing. Lucio Colque Gutierrez	Director, National Irrigation and Soil

(Public Investment and External Finance, Ministry of Finance)

Lic. Pilar Rollano Bravo	Consultant
Lic. Roberto Ticona	Public Investment Consultant

2. **Japanese Side**

(JICA Study Team)

Mr. Hajime TANAKA	Team Leader
Dr. Kinichi OHNO	Socio-economist
Mr. Toshinori OSHITA	River Engineering/Flood Damage Survey Expert
Mr. Kazuhiro TSUCHIDA	Drainage Engineer

(JICA, Santa Cruz Office)

Mr. Norioki HONDA	DIRECTOR,
Mr. Fusayasu KAMIYA	General Coordinator,

MINUTES OF MEETINGS
ON
THE DRAFT FINAL REPORT
FOR
THE MASTER PLAN STUDY ON FLOOD CONTROL IN THE NORTHERN RURAL REGION OF SANTA CRUZ IN THE REPUBLIC OF BOLIVIA

SANTA CRUZ, MARCH 19, 1996
LA PAZ, MARCH , 1996

Mr. JULIO LEIGUE HURTADO
PREFECTO
DEPARTMENT OF
SANTA CRUZ

Mr. HAJIME TANAKA
TEAM LEADER
JICA STUDY TEAM

Mr. RAMIRO ORTEGA LANDA
SECRETARY FOR
NATIONAL SECRETARIAT OF
PLANNING,
MINISTRY OF SUSTAINABLE
DEVELOPMENT AND ENVIRONMENT

Mr. SHINYA SAITO
MEMBER OF
JICA ADVISORY
COMMITTEE FOR
THE STUDY

Mr. EDGAR TALAVERA SOLIZ
SECRETARY FOR
NATIONAL SECRETARIAT OF
PLANNING OF AGRICULTURE
AND CATTLE RAISING,
MINISTRY OF ECONOMIC
DEVELOPMENT

Mr. JUAN CARLOS AGUILAR
UNDER SECRETARY FOR
PUBLIC INVESTMENT AND
EXTERNAL FINANCE,
MINISTRY OF FINANCE

The Master Plan Study on Flood Control in the Northern Rural Region of Santa Cruz, Republic of Bolivia, has been conducted by the JICA Study Team since end of March 1995, and the Draft Final Report for the Study was issued in March 1996.

The JICA Study Team visited Bolivia from March 11 to 22, 1996. The JICA Study Team together with the counterpart for the JICA Study, Mr. Manlio Roca Zamora, presented the Draft Final Report to the Ministry of Sustainable Development and Environment, and explained the outline of the Draft to Mr. Alejandro Mercado, Under Secretary for Development Strategies, Ministry of Sustainable Development and Environment, in La Paz on March 12.

The JICA Advisory Committee member for the Study, Mr. Shinya SAITO, and the JICA task manager for the Study, Mr. Katumi OTANI, visited Bolivia from March 13 to 19. The Study Team, the JICA Advisory Committee member and the JICA task manager, together with the counterpart, presented the Draft Final Report, both to the Ministry of Economic Development and to the Ministry of Finance, and explained the outline of the Draft to the officials concerned in La Paz on March 13.

The Study Team presented the Draft Final Report to the Prefectura of Santa Cruz and held meetings on the Draft Final Report with the officials concerned on March 15 and 18. During the first meeting, the Draft was explained to the officials concerned. During the March 18 meeting, the Study Team explained the Draft to the counterpart personnel.

During the meetings, some observations were made and discussed. The points discussed and agreed upon are as follows:

1. The Draft Final Report and the priority projects it includes were agreed in principle without special comments.

2. It was agreed that the Secretariat for Sustainable Development, Prefectura of Santa Cruz shall collect comments, if any, on the Draft and forward them to the Study Team by April 17 - or before - for the Study Team to incorporate them into the Final Report.

3. The Bolivian side agreed to publisize the Final Report

The list of participants is shown in Annex - 1.

Annex-1 List of Participants in the meetings

1. Bolivian Side

(Prefectura of Santa Cruz)

Gustavo Justiniano Aponte	General Secretary (represented by his advisor, Dr. Federico Joffré)
Fernando Amelunge Martinez	Secretary for Economic Development *
Sergio Antelo Gutierrez	Secretary for Sustainable Development and Environment
Julio Maldonado	Director for Planning
Francisco Kempff	Director, Natural Resources
Ulrich Reye	Planning Advisor
Rodolfo Candia	Chief Preinvestment Unit
Mario Ribera	Responsible for Environmental Quality
Guillermo Serrate	Chief of Master Plan of Agricultural Products
Marcelo Ruiz	Soil Expert Land Use Plan
Manlio Alberto Roca Zamora	Counterpart for the JICA Study Team

*(former President of the extinct CORDECRUZ)

(Ministry of Sustainable Development and Environment)

Alejandro F. Mercado	Under Secretary for Development Strategies

(National Secretariat for Agriculture and Cattle Raising, Ministry of Economic Development)

Edgar Talavera Soliz	Secretary

(Public Investment and External Finance, Ministry of Finance)

Roberto Ticona	Public Investment Consultant
Ozman F. Altamirano V.	Agriculture and Cattle Raising Consultant

2. **Japanese Side**

(JICA Study Team)

Hajime TANAKA	Team Leader
Michiaki HOSONO	Agriculture/Land Use Engineer
Takashi FURUKAWA	Hydrologist/Hydraulic Engineer

(Advisory Committee for the Study)

Shinya SAITO	Flood Control

(JICA Head Office)

Katumi OTANI	Task Manager for the Study

(JICA, Santa Cruz Office)

Norioki HONDA	Director,
Fusayasu KAMIYA	General Coordinator,

APPENDIX C

TERMS OF REFERENCE

TERMS OF REFERENCE (DRAFT)
FOR
FEASIBILITY STUDY
ON
FLOOD CONTROL IN THE NORTHERN
RURAL REGION OF SANTA CRUZ IN THE REPUBLIC OF BOLIVIA

I. Background Information

The Department of Santa Cruz is very important from socioeconomic aspects. The Department had 30 % of the Bolivian GDP in 1992 that is the largest share among the nine Departments in the country. Also the Department has the highest population increase rate in the country. The population of the Department was 1,364,389 in 1992 that accounted for 21 % of the population of the country.

The northern rural region of the city of Santa Cruz is the integrated development area in where 80 % of the department population are living, and the most developed agricultural and industrial area in the Department. Most of the agro based industries and manufacturing industries are located in the study area.

However, the area has been suffering from frequent floods from the major rivers and their tributaries. The major rivers are the Rio Grande, Rio Pirai and Rio Yapacani. The severe flood damages in record were caused in 1983 and in 1992. The 1983 floods from the Rio Pirai caused severe damage to the city of Santa Cruz and the area along the Rio Pirai. The 1992 floods caused the severest flood damages to the northern rural region.

After the 1983 floods the GOB established SEARPI and conducted " the Master Plan for the Management and Training of the Rio Pirai"(from 1988 to 1990) by the EEC's assistance. SEARPI has carried out some of the flood mitigation measures along the Rio Pirai.

In response to the request of the GOB the GOJ has decided to conduct " the Master Plan Study on Flood Control in the Northern Rural Region of Santa Cruz" that covers about 7,000 km2 of the northern region. The Master Plan Study was started from March 1995 by JICA.

According to the Master Plan Study, the northern rural region is extremely vulnerable to flood and drainage problems due to the unfavorable natural conditions such as a flat topography and difficult meteo-hydrological conditions. The flood hazard areas by the annual floods and by the 1992 floods were estimated to be 2,444 km2 and 4,857 km2 respectively.

The flood hazard area covers a large part of the intensive agricultural areas in the northern rural region, including major colonies such as Okinawa, Aroma, Puest Ferunandes, San Juan and Antofagasta. In order to mitigate the flood and drainage problems of the intensive agricultural areas, optimum flood mitigation and drainage improvement measures have been studied and the priority areas proposed for F/S.

The proposed F/S area is consisting of Chane-Pailon and San Juan-Antofagasta areas, covering approximately 1,600 km2 in total. Chane-Pailon is situated in the northern east of Santa Cruz, including major colonies such as Okinawa, Aroma and Puest Fernandes. San Juan-Antofagasta is located in the northern west area. The priority areas are most intensively developed agricultural areas in the Department. The flood and drainage problems are severe constraints for the area.

According to the economic evaluation, the proposed measures have high economic efficiencies, though the river improvement works for the Rio Chane are not feasible and for San Juan are marginal. Before implementation of those measures, F/S should be carried out for the basic and urgent measures.

Among the proposed measures the following urgent structural measures for flood mitigation and drainage improvement, are proposed for F/S:

1. Chane - Pailon Area

-Rio Chane,
-Rio Pailon,
-Okinawa Drainage.

2. San Juan - Antofagasta Area

-Antofagasta,

The measures such as secondary drainage and related facilities, and non-structural measures, are proposed to be studied on selected pilot areas.

After execution of the proposed urgent measures, a large part of the existing unstable farm lands in the flood hazard area will become safe from severe flood problems and require optimum countermeasures. In order to accelerate the agricultural diversification that may be one of the effective countermeasures for sustainable development of the area, an optimum agricultural development plan is proposed to be studied on the selected pilot area in Okinawa and San Juan.

2. Objectives of the Study

The objectives of the Study are:

(1) To conduct a Feasibility Study on urgent flood mitigation and drainage improvement measures for the study area, including an agricultural development study in order to support the regional sustainable development,

(3) To pursue technology transfer to the counterpart personnel through on the job training.

3. Study Area

The Study Area (approximately 1,600 km2) is consisting of the following two areas:

1 Chane-Pailon area in the northern east rural region of Santa Cruz, covering approximately 1,000 km2,

2 San Juan-Antofagasta area in the northern west rural region of Santa Cruz, covering approximately 600 km^2.

Their locations are shown in *Fig. 1*.

4. Scope of the Study

4.1 Supplementary Data Collection, Field Investigation and Field Surveys as described bellow:

(1) To collect supplementary data and information

- Hydrological data,
- Flood and flood damages,
- Socio-economic data,
- Agriculture and agro-economy,
- Construction and cost estimation,
- Related institutions for implementation and OM,
- Environmental aspects,
- Other related data and information.

(2) Supplementary field Investigation and survey

- Topographic survey and mapping of aerial photographs for preparation of optimum base maps of the study area,
- Longitudinal and cross sectional surveys for river and drainage channels,
- Geological investigation for earth works and major facilities such as road bridges,

(4) Supplementary Agriculture and Land Use Survey for the flood hazards area

- Farm interview survey,
- Farm economy survey,
- Soil survey.

4.2 Supplementary Data Analysis,

- Hydrological data,
- Flood damage,
- Flood hazard area,
- Agriculture and land use,
- Socioeconomic data.

4.3 Agricultural Development Plan

(1) Farming plan

- Proposed cropping calendar,
- Farming management,
- Cropping technology,
- Farming system,

(2) Farm facility plan

- Post harvest facilities,
- Farm conservation.

(3) Irrigation and Drainage Plan

- Irrigation and drainage facilities.

4.4 Urgent Flood Mitigation and Drainage Improvement Plan

(1) Preliminary Design

- Structural measures for flood mitigation,
- Structural measures for drainage improvement ,
- Secondary drainage system for pilot areas.

(2) Construction schedule and cost Estimation

(3) Execution of EIA

(4) Project Evaluation

- Economic,
- Social.

(5) Institutional Development

- Study on implementation organization
- Study on OM organization

(6) Preparation of Implementation Programs.

-

4.4 Preparation of Strategy for Flood Hazard Area Management,

- Preliminary design of a flood warning system,
- Preliminary design of a flood evacuation system,

5 Study Schedule

The duration of the Study will be 12 months.

6. Reporting Schedule

In the course of the Study, the following reports will be submitted to the Government of Bolivia:

(1) Inception Report

Thirty (30) copies of the report will be submitted at the commencement of the study in Bolivia.

(2) Interim Report

Thirty (30) copies of the report will be submitted within six (6) months after commencement of the Study.

(3) Draft Final Report

Thirty (30) copies of the report will be submitted within ten month (10) months after the commencement of the study.

The government of Bolivia shall provide its comments to JICA within one (1) month after the receipt of the Draft Final Report.

(4) Final Report

Fifty (50) copies will be submitted one month after receipt of comments from the Government of Bolivia.

7 Expertise Required

-1 Team Leader
-2 Hydrologist
-3 Drainage Engineer
-4 River Engineer
-5 Structure Engineer
-6 Agriculture / Land Use Engineer
-7 Flood Damage Survey Expert
-8 Topographic Survey Expert
-9 Survey Expert
-10 Environmental Specialist
-11 Project Economist
-12 Construction Plan & Cost Estimate Specialist,
-13 Geologist
-14 Agriculture Planner
-15 Agroeconomist
-16 Agricultural Extension Expert

-17 Agricultural Infrastructure Expert

8 Undertaking of the Government of the Republic of Bolivia

(1) To secure the safety of the study team,

(2) To permit the members of the study team to enter, leave and sojourn in Bolivian connection with their assignment therein, and exempt them from alien registration required and consular fee,

(3) To exempt the study team from taxes, duties and any other charges on equipment, machinery and other materials brought into and out of Bolivia for the conduct of the study.

(4) To exempt the study team from income tax and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the study team for their services in connection with the implementation of the study,

(5) To provide necessary facilities to the study team for remittance as well as utilization of the funds introduced in Bolivia from Japan in connection with the implementation of the study.

(6) To secure permission or entry into private properties or restricted areas for the conduct of the study,

(7) To secure permission for the study to take all data, documents and necessary materials related to the study out of Bolivia to Japan,

(8) To provide medical services as needed. Its expenses will be chargeable to the members of the study team.

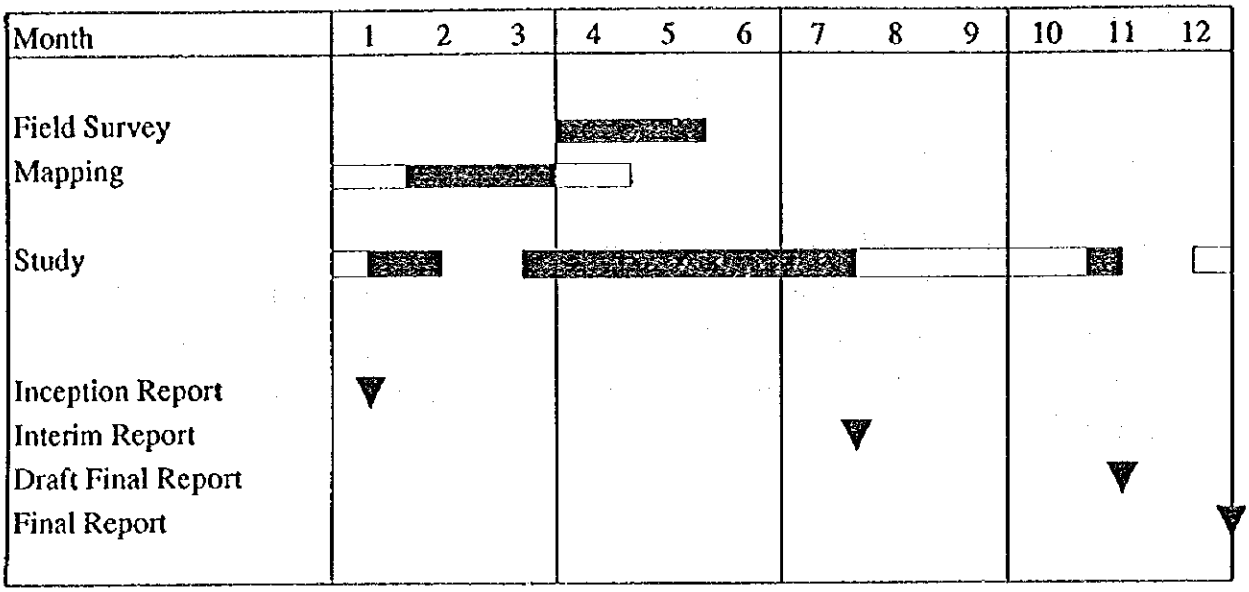
The Government of Bolivia shall bear claims, if any arises against the members of the study team resulting from, occurring in the course of or otherwise connected with the

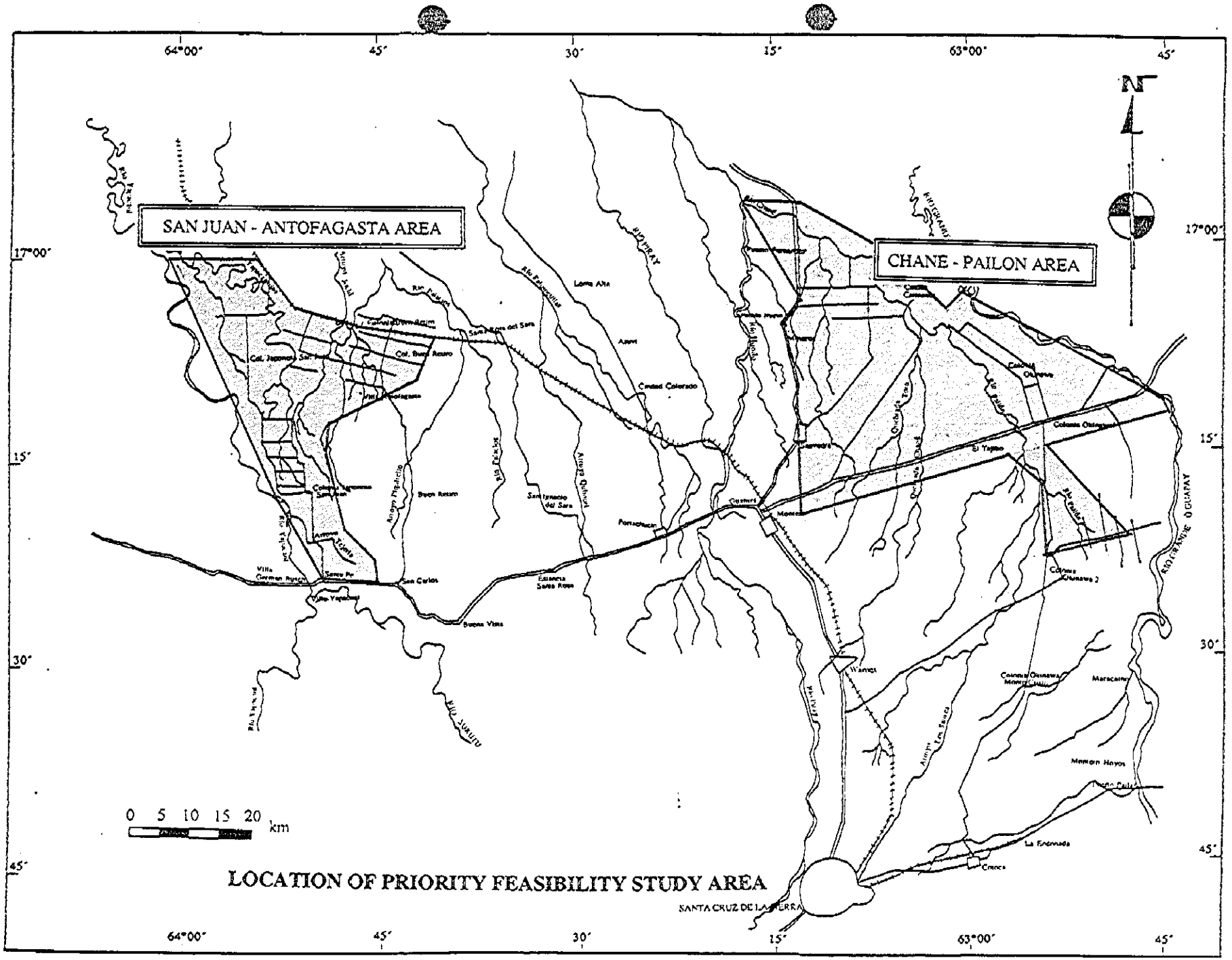
discharge of their duties in the implementation of the study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the study team.

9 Implementing Agency

The Ministry of Sustainable Development and Environment and the Local Government of Santa Cruz shall be the implementation agency and act as counterpart agency to the Study and also as coordinating body in relation with other government and non-governmental organization concerned for the smooth and appropriate implementation of the study.

TABLE 1 TENTATIVE TIME SCHEDULE





LOCATION OF PRIORITY FEASIBILITY STUDY AREA