

Asian market). The following two (2) new highways are the part of the above economic corridor concept:

- a. The new road connecting Santa Cruz - Concepcion - San Ignacio - San Matias to Brazil to open the land access,
- b. The new road connecting Santa Cruz - San Jose - Puerto Suarez to Paraguay and Argentine, to open the land and river access.

(2) **Railway**

The railway is under by the National Railway Company (Empresa Nacional de Ferrocarriles:ENFE). There are two (2) separate systems as shown in *Fig.D.4.2*. The total length of the railroad is as follows:

- a. Andean system: 2,274 km
- b. Oriental system: 1,423 km

(3) **Airport**

There are two (2) airports under by the AASANA in the Department, one is the old airport, Trompillo Airport, located in the urban area of Santa Cruz, and the other is the new international airport, Viru Viru Airport that is located at 15 km north of the city and opened since 1983.

The LAB is the national airline, connecting to Santa Cruz to eleven (11) foreign cities and five (5) domestic cities, and AEROSUR is a private airline only for domestic services and TAM is operated by the military for international and domestic cargo and passengers. Eight (8) foreign airlines from USA, Argentine, Brazil, Peru and Chile are operating at present.

#### 4.2 **Road Conditions of the Study Area**

(1) **The Fundamental Roads in the Region**

The total length of the road in the Department is 6,974 km that is account for 15.1% of the road length in Bolivia. The road is consisting of 1,830 km of fundamental road, that is account for 24% of the fundamental road in the country, 1,368 km of complement road that is 23% of the country, 3,776 km of district road that is 11% of the country.

The fundamental road in the Department is relatively developed and well maintained as the city of Santa Cruz is the transportation hub in the Department.

There are two (2) routes connecting Santa Cruz to Cochabamba. One is the Route No.4 (500 km), opened in 1954 and another is the Route No.7 (470 km), opened in 1989. The Route No.4 also extends to the Puerto Suarez by Cotoca.

Another fundamental road is the Route No.9 extends towards both the northern region and the southern region of the city of Santa Cruz. The northern part of 500 km is connecting Santa Cruz - Guabira - Río Grande - San Ramon - Ascencion de Guarayos toward Trinidad in the Department of Beni and the southern part of 460 km is connecting Santa Cruz - Abapo - Ipati - Boyuibe - Yacuiba in the Department of Tarija. *Fig. D.4.3* shows the existing major road network of the study area.

## (2) Road Conditions of the Study Area

The length of the roads by type of surface scaled on the road map (*Fig. D.4.4*) that was prepared by the study team based on the aerial photographs taken in June 1995, are as follows (see *Table D.4.1.(1)*):

### 1) Total Length of the Roads (including the fundamental road)

a. Asphalt road:	187 km (8%)
b. Gravel road:	808 km (34%)
c. Earth roads:	1,354 km (58%)
<u>Total length:</u>	<u>2,349 km (100%)</u>

### 2) Length of the Secondary Roads

a. Asphalt road:	36 km (8%)
b. Gravel road:	757 km (34%)
c. Earth road:	1,354 km (58%)
<u>Total length:</u>	<u>2,147 km (100%)</u>

The fundamental road is mostly paved except the road No. 7 between Guabira and Okinawa / Río Grande that is likely to be paved within two years. The rest of the roads are categorized as the district road and not paved. There are some graveled roads in the colonies of Okinawa, San Juan and Puesto Fernandez.

### 4.3 Accessibility of the Secondary Roads

#### (1) Accessibility of the Secondary Road

The accessibility of the secondary roads was surveyed by the study team and tentatively shown in *Figs. D.4.4* and *D.4.5*. According to the information from the field, the most of the earth road is said to be not accessible when it rains for 2 days or more than 50 mm continuously, because of their surface conditions, poor drainage facilities and poor maintenance works. The accessibility of the secondary road in the study area is summarized as follows (see *Table D.4.1 (2)*):

	Accessible Conditions	
	in Normal Year	in 1992
a. Good:	935 km (40%)	846 km (36 %)
b. Bad:	1,317 km (56%)	540 km (23 %)
c. Very bad:	97 km ( 4%)	940 km (41 %)

Notes:

1. Good: Accessible though the year,
2. Bad: Not accessible at least more than one month,
3. very bad: Not accessible at least more than five months.

#### (2) Transportation and Crop Harvest Calendar

The harvest calendar of the major crops in the study area is shown in *Table D.4.2*. The crops such as summer soybeans, rice and cotton, are to be transported in the rainy season, but the yields of sugar cane and winter soybeans are in the dry season. The number of trucks for transportation of the major crops is estimated and shown in *Table D.4.3*. The table shows that the transportation of the yield of sugar cane shares 77 % of the crop transportation. The harvest of sugar cane is from May to October.

#### (3) The Secondary Road by Canton/sub-zone

The conditions of the secondary road were assessed on the road density, accessibility, number of inhabitants depending on, land use pattern, etc., and summarized by canton/sub-zone in *Table D.4.4* and *Fig. D.4.4-4.6*.

##### 1) Comparatively High Road Density with Good Accessibility:

- a. Colonia Okinawa (major crops: soybeans and livestock),

b. Colonia San Juan (major crops: soybeans, rice and poultry).

2) Comparatively High Road Density with Bad Accessibility:

a. Colonia Aroma (major crop: sugar cane),

b. Colonia Puesto Fernandez (major crop: Sugar cane),

c. Chane-Pirai (major crop (major crops: soybeans and rice),

d. Portachuelo (major yield: livestock).

3) Low Road Density with Bad or Very Bad Accessibility:

a. Canton Palmar,

b. Canton Cotoca,

c. Canton Chuchio,

d. Canton Los Chacos (major crop: soybeans),

e. Canton Montero (major crop: sugar cane)

f. Canton Mineros (major crop: sugar cane)

g. San Ignacio (major yield: livestock)

h. Colonia Antofagasta (major crop: rice)

i. The rest of the Cantons/sub-zones such as the most part of the province of Warnes, Saavedra, Palometas, Santa Rosa and Buena Vista.

#### 4.4 Improvement of the Secondary Roads

Recently in the study area the traffic volumes and the number of vehicles are increasing rapidly as shown in *Tables D.4.5* and *D.4.7*.

(1) The Development trend of the Road Network

*Fig.D.4.7* illustrates a history of the regional development trend since 1950s. It is explained as follows:

a. 1950s-60s: Exploitation of the virgin land,

b. 1970s-80s: Development of large-scale colonies,

c. Now: Expansion to the surroundings

d. Future: Expansion and integration

The study area will require to have the central functions of various services to be developed in order to support the people in the urban area and in the huge hinterland. The central functions required are such as technical and financial supports,

transportation and storage, agro-industries and manufacturing factories. The strengthen of the regional road network is essential in this context.

(2) **Secondary Road Required to be Improved**

In order to secure a smooth traffic flow in the study area, the followings are required for the secondary road:

- 1) The financial support and the institutional organization should be strengthen for improvement and maintenance of the secondary road,
- 2) The following parts of the secondary road should be up-graded or improved from earth surface to gravel or asphalt in short-term (*Fig.D.4.8*):
  - a. From Okinawa 2 to the north of Warnes (26 km),
  - b. From Okinawa 3 to the industrial park in the Santa Cruz city (34 km),
  - c. From Okinawa 3 to Cotoca (25 km),
  - d. From Okinawa 3 to Monte Hoyos (16 km).
- 3) In order to improve the secondary road network, the improvement or construction of the following roads in mid- to long-term:
  - a. From the north end of Okinawa 1 to Mineros (24 km),
  - b. From Mineros to Loma Alta (28 km),
  - c. From Loma Alta to Santa Rosa del Sara (14 km),
  - d. From Santa Rosa del Sara to Antofagasta (18 km),
  - e. From Antofagasta to Colonia San Juan (8 km).

**4.5 Other Basic Infrastructures**

(1) **Water Supply**

The potable water supply is managed by the SAGUAPAC for the city of Santa Cruz and by other cooperatives for the other urban and rural areas. The SAGUAPAC supplies 85 million Lit. per day to 69,082 house connections from sixteen (16) deep wells with 1,100 km of water pipes in 1993.

The water supply condition in the study area is relatively good in the country, but numerous households are still depending on individual shallow wells or surface water from river and pond.

On the other hand, in the urban areas, the problem is that the most part of the potable water supply system was 20-30 years old and is required replacement or substantial improvement.

(2) Sanitary Sewer

The SAGUAPAC is also responsible for the sanitary services in the city of Santa Cruz, and the number of households with house connection to the sewerage system is 27,772 units that is less than 20 % of the total households according to the data in 1993. The sewer pipes are 392 km long in total and cover the area inside of the third ring road and partly between the third ring and the fourth ring roads. There is no such sewerage system in the other cities, including Montero, Warnes, Mineros, etc., and they are using open holes for black water.

(3) Electricity Supply

The CRE (Rural Electrification Cooperatives) is the responsible organization for the electricity supply service in the region, buying the national electric power managed by the ENDE (National Electricity Company). The numbers of the households with electricity supply from the CRE are 45,000 units, which are around 80% of the total households in the region.

(4) Telephone

The COTAS is the agent of the national organization of the telephone service (ENTEL) in the region. The number of the telephone lines is 56,695 in 1993 in total, of which 51,397 are in the urban and 5,298 in the rural areas. The service ratios are estimated as around 18% in total, 24% in the urban and 5% in the rural areas.

(5) Oil and Gas

There is one oil refinery in the city of Santa Cruz and several oil and gas fields are in the southeast of the city. The following two projects are on-going to extend the gas pipeline system:

- a. Construction of the gas pipeline to Brazil (Kfo Grande - Puerto Suarez),
- b. Construction of the gas pipeline connecting Colpa and Carrasco.

## 5. Inventory of Agroindustrial Factories

The number of agroindustrial factories in the study area is listed in *Table D.5.1*. The most of the factories stand along the fundamental roads (Cotoca - Santa Cruz - Warnes - Montero - Portachuelo) as shown in *Fig.D.5.1*. Those factories play an important role in the regional economy. It is assumed that the development of agroindustrial factories in the study area will be not only to encourage the farmers in and outside of the study area to increase agricultural products, but also to increase employment opportunities of the region.

Those agroindustrial areas should be protected from flood damages and stabilized.

## 6. Priority Areas for Flood Mitigation and Drainage Improvement

The study area is mostly suitable for agricultural and livestock activities and has a significant development potential for agriculture, livestock, forestry and tourism in the Department. Also it has a good geographical advantage for the future international transportation corridor of the South America.

The following areas shall be mitigated from the flood and drainage problems to stable the regional socio-economic activities and to promote a sustainable development:

- 1) Municipalities and other urban areas (including the future expansion areas),
- 2) Large-scale and well established colonies,
- 3) Regional main roads and important building locations including infrastructure and agroindustrial factories

*Fig.D.6.1* shows the proposed priority areas for flood mitigation and drainage improvement from the regional development aspect.

**TABLES**



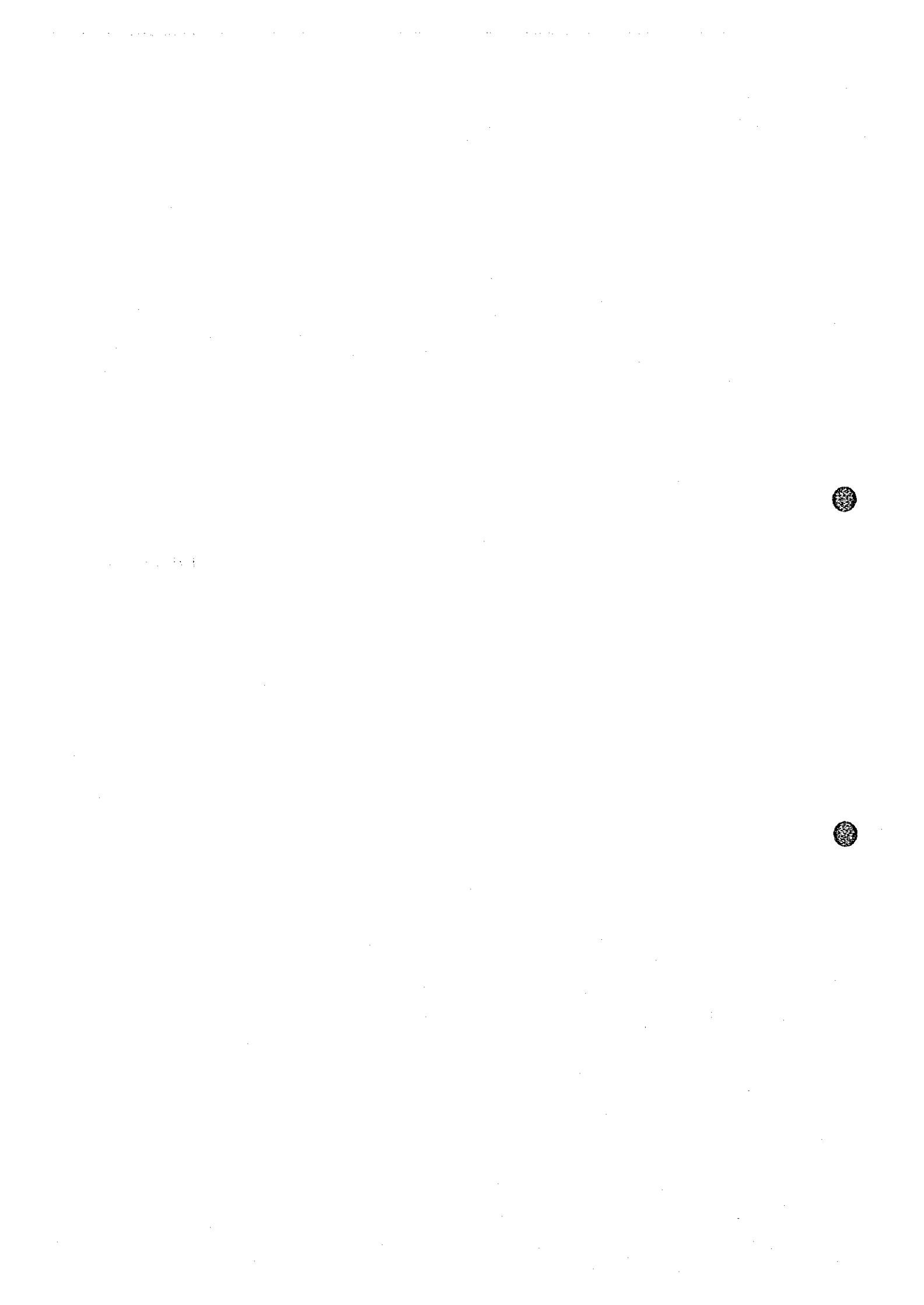


TABLE D.3.1 EXISTING AND FUTURE POPULATION OF THE URBAN AREAS IN THE STUDY AREA

Name of urban area	Total Population		Increase ratio(76-92)	Municipality	Population 1950	Increase ratio(50-76)	Estimated Population			Assumed Increase Ratio				
	1992	1976					2000	2005	2010	92-2000	2000-05	2005-10	92-2010	
1 Santa Cruz	697,278	254,682	6.5%	#	42,746	7.1%	1,098,623	1,415,403	1,767,905	1,767,905	5.8%	5.2%	4.5%	5.3%
2 Montero	57,027	28,686	4.4%	#	2,713	9.5%	75,154	87,428	99,559	99,559	3.5%	3.1%	2.6%	3.1%
3 Mineros	11,181	6,230	3.7%	#	-	-	14,140	16,081	17,959	17,959	3.0%	2.6%	2.2%	2.7%
4 Warnes	10,866	4,288	6.0%	#	1,581	3.9%	15,795	19,392	23,132	23,132	4.8%	4.2%	3.6%	4.3%
5 Portachuelo	9,453	7,059	1.8%	#	2,456	4.1%	10,627	11,330	11,970	11,970	1.5%	1.3%	1.1%	1.3%
6 Coloca	9,229	2,107	9.7%	#	910	3.3%	16,752	23,245	30,818	30,818	7.7%	6.8%	5.8%	6.9%
7 Santa Fe de Yapacani	4,029	1,671	5.7%	(#)	-	-	5,740	6,970	8,235	8,235	4.5%	4.0%	3.4%	4.1%
8 San Carlos	3,223	2,021	3.0%	#	-	-	3,887	4,306	4,703	4,703	2.4%	2.1%	1.8%	2.1%
9 Puesto Fernandez	3,196	1,632	4.3%		-	-	4,186	4,854	5,512	5,512	3.4%	3.0%	2.6%	3.1%
10 Santa Rosa del Sara	3,125	2,626	1.1%	#	-	-	3,350	3,481	3,596	3,596	0.9%	0.8%	0.7%	0.8%
11 Saavedra	2,918	2,243	1.7%	#	-	-	3,242	3,435	3,609	3,609	1.3%	1.2%	1.0%	1.2%
12 Okinawa I	2,586	1,006	6.1%	(#)	-	-	3,781	4,657	5,570	5,570	4.9%	4.3%	3.6%	4.4%
13 San Juan de Yapacani	2,344	1,268	3.9%		-	-	3,000	3,434	3,857	3,857	3.1%	2.7%	2.3%	2.8%
TOTAL	816,455	315,519	6.1%	-	50,406	-	1,258,278	1,604,014	1,986,424	1,986,424	5.6%	5.0%	4.4%	5.1%
TOTAL(excluded Santa Cruz)	119,177	60,837	4.3%	-	7,660	-	159,655	188,611	218,519	218,519	3.7%	3.4%	3.0%	3.4%

Source; Census and JICA estimations

Notes; (#) will be designated for new municipality

The forecast is made that Santa Cruz will have the increase ratios at 90 % up to 2000, 80 % up to 2005 and 70 % up to 2015 of the past increase ratio of 5.8 % (1976-1992), and The other cities will have the increase ratios at 80 % up to 2000, 70 % up to 2005 and 60 % up to 2015 of the past increase ratio of each cities(1976-1992)

TABLE D.3.2 THE MAJOR COLONIES IN THE STUDY AREA

Name of Colony	Okinawa	San Juan	Antofagasta
Initiated in	1956	1957	1963
Municipality	Warnes(Los Chacos)	San Carlos(Yapacani)	San Carlos(Yapacani)
Area(ha)	46,980	27,132	19,700
Population(persons)	3,650	2,759	2,259
Households(units)	730	577	563
Farmer's Households(units)	106(Jap)	103(Jap)	526
Density(persons/km <sup>2</sup> )	8	10	11
Origin of the farmers	Japanese	Japanese	Bolivian
Income level	high	high	low
Average farm size(ha)	412	239	33
Major products	soy beans/cattle	soy beans/poultry	rice
Cattle(heads)	1,120	1,794	5,000
Land use composition(%)	100%	100%	100%
1) Crop	30%	22%	13%
2) Pasture	45%	9%	17%
3) Fallow land	8%	0%	59%
4) Forest	18%	69%	8%
5) Others	0%	0%	4%
Length of the roads(km)			
1) Main	42.0	43.9	16.0
2) Others	238.0	139.3	96.0
Total	280.0	183.2	112.0
L.Road/Area(km/km <sup>2</sup> )	0.6	0.7	0.6
L.Road/Pop(km/1,000person)	76.7	66.4	49.6
Traffic volume on main road	200-300 cars	400-500 cars	8 cars
Land Use of average farmer(ha)			
1) Crop land	270.8	136.8	na
2) Fallow land	13.9	5.5	na
3) Fruits	0.2	7.3	na
4) Pasture	58.3	31.3	na
5) Forest	0	0	na
6) Not cultivated land	63.2	61.4	na
7) Others	5.7	6.3	na
Total	412.1	238.6	na

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	Okinawa	San Juan	Antofagasta
Vehicles of average farmer			
1) Truck	2.6	2	155(total)
2) Combaine	0.8	0.4	7(total)
3) Cars	1.7	1.7	1(total)
Total	5.1	4.1	163(total)
Cultivated areas of average farmer(ha)			
1) Soy beans	272.5	79.8	n.a.
2) Rice	27	79.5	n.a.
3) Others	72.9	8.5	n.a.
Total	372.4	167.8	n.a.
Yields of average farmer(tons)			
1) Soy beans	527.4	151.8	n.a.
2) Rice	57.3	272.2	n.a.
3) Others	151.49	26	n.a.
Total	736.19	450	n.a.
Products of average farmer(\$US)			
1) Soy beans	86,230	24,210	n.a.
2) Rice	6,598	36,585	n.a.
3) Others	19,552	3,551	n.a.
Total	112,380	64,346	n.a.
Animals of average farmer(heads)			
1) Cattle	67	35	n.a.
2) Chicken	153	7,510	n.a.
3) Others	42	0	n.a.
Total	262	7,545	n.a.
Animals products of average farmer(US\$)			
1) Cattle/Milk/Cheese	6,620	1,066	n.a.
2) Chicken/Eggs	1,610	76,859	n.a.
3) Others	3,063	963	n.a.
Total	11,293	78,888	n.a.
Total products of average farmer(US\$)	123,673	143,234	n.a.
O/M cost of average farmer(US\$)	84,846	106,432	n.a.
Net income of average farmer(US\$)	38,827	36,802	n.a.
Other income of average farmer(US\$)	3,586	6,657	n.a.
Total income of average farmer(US\$)	42,413	43,459	n.a.

TABLE D.3.3 THE EXISTING AND FUTURE POPULATION OF THE STUDY AREA BY CANTONS

No.	(Province) Name of Cantons	Population in 1992			Area (km <sup>2</sup> )	Density (p/km <sup>2</sup> )		Future Population			
		Total	Urban	Rural		Total	Rural	2000	2010	Urban	Rural
	(A. IBAZES)	20,370	9,229	11,141	615	33	18	27,893	41,959	30,818	11,141
1	PALMER DEL ORATORIO	1,928	0	1,928	154	13	13	1,928	1,928	0	1,928
2	COTOCA	14,723	9,229	5,494	295	50	19	22,246	36,312	30,818	5,494
3	MONTERO HOYOS	3,719	0	3,719	166	22	22	3,719	3,719	0	3,719
	(WARNES)	38,285	13,452	24,833	2,161	18	11	44,409	53,535	28,702	24,833
4	LOS CHACOS	15,241	2,586	12,655	1340	11	9	16,436	18,225	5,570	12,655
5	WARNES	13,117	10,866	2,251	173	76	13	18,046	25,383	23,132	2,251
6	TOCOMECHI	2,704	0	2,704	151	18	18	2,704	2,704	0	2,704
7	JUAN LATINO	818	0	818	43	19	19	818	818	0	818
8	AZUSAQUI	3,150	0	3,150	151	21	21	3,150	3,150	0	3,150
9	CHUCHIO	3,255	0	3,255	303	11	11	3,255	3,255	0	3,255
	(CHILO)	22,065	9,596	12,469	1,550	14	8	25,096	29,264	16,795	12,469
10	BUENA VISTA	1,229	0	1,229	75	16	16	1,229	1,229	0	1,229
11	SAN JAVIER	325	0	325	54	6	6	325	325	0	325
12	SAN CARLOS*1)	20,511	9,596	10,915	1,421	14	8	23,542	27,710	16,795	10,915
	(SARA)	21,684	12,578	9,106	1,182	18	8	23,083	24,672	15,566	9,106
13	PALOMETAS	2,920	0	2,920	366	8	8	2,920	2,920	0	2,920
14	PORTACHUELO	10,584	9,453	1,131	272	39	4	11,758	13,101	11,970	1,131
15	SAN IGNACIO DE SARA	1,859	0	1,859	166	11	11	1,859	1,859	0	1,859
16	SANTA ROSA DEL SARA	6,321	3,125	3,196	378	17	8	6,546	6,792	3,596	3,196
	(O. SANTISTEVAN)	95,358	74,322	21,036	1,659	57	13	117,758	147,675	126,639	21,036
17	GRAL. A. SAAVEDRA	11,639	2,918	8,721	504	23	17	11,963	12,330	3,609	8,721
18	MONTERO	58,569	57,027	1,542	275	213	6	76,696	101,101	99,559	1,542
19	(MINEROS*2)	25,150	14,377	10,773	880	29	12	29,099	34,244	23,471	10,773
	STUDY AREA TOTAL	197,762	119,177	78,585	7,167	28	11	238,239	297,105	218,520	78,585

Notes: \*1) San Carlos, Santa Fe and San Juan and \*2) Mineros and P. Fernandez

Source: Census and JICA Estimation

TABLE D.3.4 POPULATION DISTRIBUTION BY CANTONS (URBAN AND RURAL) IN 1992 AND 2010

ANDRE IBANES PROVINCE

Canton	Places	Households	Population	Share	Area(km2)	Pop. density	pop 2000	pop 2005	pop 2010
<b>PALMER DEL ORATORIO</b>									
a.	0	0	0	0%	154	19.1	0	0	0
b.	1	467	1,928	66%			1,928	1,928	1,928
<b>COTOCA</b>									
a.	1	1,931	9,229	63%	295	49.9	16,752	23,245	30,818
b.	3	1,260	5,494	17%		18.6	5,494	5,494	5,494
Total	15	3,191	14,723	100%			22,246	28,739	36,312
<b>MONTERO HOYOS</b>									
a.	0	0	0	0%	166	22.4	0	0	0
b.	2	534	2,606	70%			2,606	2,606	2,606
c.	4	140	1,113	30%			1,113	1,113	1,113
Total	6	674	3,719	100%			3,719	3,719	3,719
<b>SUB-TOTAL</b>									
a.	1	1,931	9,229	43%	615	34.8	16,752	23,245	30,818
b.	6	1,490	7,038	33%		19.8	7,038	7,038	7,038
c.	21	1,136	5,111	24%			5,111	5,111	5,111
Total	28	4,557	21,378	100%			28,901	35,394	42,967

Note: a. Population center (more than 2,000 inhabitants)

b. Populated area (Village)

c. Dispersed rural area

(To be Continued)

WARNES PROVINCE

Canton	Plazas	Households	Population	Share	Area(km2)	Pop. density	pop 2000	pop 2005	pop 2010
LOS CHACOS									
					1,340	11.4			
a.	1	525	2,566	17%		9.4	3,781	4,657	5,570
b.	8	809	3,943	26%			3,943	3,943	3,943
c.	35	1,952	8,712	57%			8,712	8,712	8,712
Total	44	3,286	15,241	100%			16,436	17,312	18,225
WARNES									
a.	1	2,311	10,866	83%	173	75.8	15,795	19,392	23,132
b.	2	213	925	7%		13.0	925	925	925
c.	7	292	1,326	10%			1,326	1,326	1,326
Total	10	2,816	13,117	100%			18,046	21,643	25,383
TOCOMECHI									
a.	0	0	0	0%	151	17.9	0	0	0
b.	1	152	751	28%		17.9	751	751	751
c.	8	402	1,953	72%			1,953	1,953	1,953
Total	9	554	2,704	100%			2,704	2,704	2,704
JUAN LATINO									
a.	0	0	0	0%	43	19.0	0	0	0
b.	2	137	649	79%		19.0	649	649	649
c.	2	43	169	21%			169	169	169
Total	4	180	818	100%			818	818	818
AZUSAQUI									
a.	0	0	0	0%	151	20.9	0	0	0
b.	2	254	1,215	39%		20.9	1,215	1,215	1,215
c.	7	386	1,935	61%			1,935	1,935	1,935
Total	9	640	3,150	100%			3,150	3,150	3,150
CHUCHIO									
a.	0	0	0	0%	303	10.7	0	0	0
b.	2	193	825	25%		10.7	825	825	825
c.	9	543	2,430	75%			2,430	2,430	2,430
Total	11	736	3,255	100%			3,255	3,255	3,255
SUB-TOTAL									
a.	2	2,836	13,452	35%	2,161	17.7	19,576	24,049	28,702
b.	17	1,758	8,308	22%		11.5	8,308	8,308	8,308
c.	63	3,618	16,525	43%			16,525	16,525	16,525
Total	87	8,212	38,285	100%			44,409	48,882	53,535

(To be Continued)

PROVINCE ICHILO

Canton	Places	Households	Population	Share	Area(km2)	Pop. density	pop 2000	pop 2005	pop 2010
<b>BUENA VISTA</b>									
					75	16.4			
a.	0	0	0	0%		16.4	0	0	0
b.	0	0	0	0%			0	0	0
c.	4	267	1,229	100%			1,229	1,229	1,229
Total	4	267	1,229	100%			1,229	1,229	1,229
<b>SAN JAVIER</b>									
					54	6.0			
a.	0	0	0	0%		6.0	0	0	0
b.	0	0	0	0%			0	0	0
c.	2	97	325	100%			325	325	325
Total	2	97	325	100%					
<b>SAN CARLOS</b>									
					1,421	14.4 San Carlos, Santa Fe and San Juan			
a.	3	2,033	9,596	47%		7.7	12,627	14,710	16,795
b.	2	456	2,149	10%			2,149	2,149	2,149
c.	40	2,153	8,766	43%			8,766	8,766	8,766
Total	45	4,642	20,511	100%			23,542	25,625	27,710
<b>SUB-TOTAL</b>									
					1,550	14.2			
a.	3	2,033	9,596	43%		8.0	12,627	14,710	16,795
b.	2	456	2,149	10%			2,149	2,149	2,149
c.	46	2,517	10,320	47%			10,320	10,320	10,320
Total	51	5,006	22,065	100%			24,771	26,854	28,939

(To be Continued)



PROVINCE OF SARA

Canton	Places	Households	Population	Share	Area(km2)	Pop. density	pop 2000	pop 2005	pop 2010
<b>PALOMETAS</b>									
			366			8.0			
a.	0	0	0	0%		8.0	0	0	0
b.	4	553	2,403	82%			2,403	2,403	2,403
c.	5	113	517	18%			517	517	517
Total	9	666	2,920	100%			2,920	2,920	2,920
<b>PORTACHUELO</b>									
			272			38.9			
a.	1	2,004	9,453	89%		4.2	10,627	11,330	11,970
b.	0	0	0	0%			0	0	0
c.	7	292	1,131	11%			1,131	1,131	1,131
Total	8	2,296	10,584	100%			11,758	12,461	13,101
<b>SAN IGNACIO DE SARA</b>									
			166			11.2			
a.	0	0	0	0%			0	0	0
b.	2	153	760	41%			760	760	760
c.	6	248	1,099	59%			1,099	1,099	1,099
Total	8	401	1,859	100%			1,859	1,859	1,859
<b>SANTA ROSA DEL SARA</b>									
			378			16.7			
a.	1	688	3,125	49%		8.5	3,350	3,481	3,596
b.	0	0	0	0%			0	0	0
c.	15	722	3,196	51%			3,196	3,196	3,196
Total	16	1,410	6,321	100%			6,546	6,677	6,792
<b>SUB-TOTAL</b>									
			1,182			18.3			
a.	2	2,692	12,578	58%		7.7	13,977	14,811	15,566
b.	6	706	3,163	15%			3,163	3,163	3,163
c.	33	1,375	5,943	27%			5,943	5,943	5,943
Total	41	4,773	21,684	100%			23,083	23,917	24,672

(To be Continued)

PROVINCE O. SANTISTEVAN

Canton	Places	Households	Population	Share	Area(km2)	Pop. density	pop 2000	pop 2005	pop 2010
<b>GRAL A. SAAVEDRA</b>									
			504		23.1				
a.	1	621	2,918	25%			3,242	3,435	3,609
b.	5	501	2,408	21%			2,408	2,408	2,408
c.	29	1,380	6,313	54%			6,313	6,313	6,313
<b>Total</b>	<b>35</b>	<b>2,502</b>	<b>11,639</b>	<b>100%</b>			<b>11,963</b>	<b>12,156</b>	<b>12,330</b>
<b>MONTERO</b>									
			275		213.0				
a.	1	11,552	57,027	97%		5.6	75,154	87,428	99,559
b.	1	57	273	0%			273	273	273
c.	9	294	1,269	2%			1,269	1,269	1,269
<b>Total</b>	<b>11</b>	<b>11,903</b>	<b>58,569</b>	<b>100%</b>			<b>76,696</b>	<b>88,970</b>	<b>101,101</b>
<b>MINEROS</b>									
			880		28.6 Mineros and P. Fernandez				
a.	2	2,997	14,377	57%		12.2	18,326	20,935	23,471
b.	5	812	3,566	14%			3,566	3,566	3,566
c.	36	1,544	7,207	29%			7,207	7,207	7,207
<b>Total</b>	<b>43</b>	<b>5,353</b>	<b>25,150</b>	<b>100%</b>			<b>29,099</b>	<b>31,708</b>	<b>34,244</b>
<b>SUB-TOTAL</b>									
			1,659		57.5				
a.	4	15,170	74,322	78%		12.7	96,722	111,798	126,639
b.	11	1,370	6,247	7%			6,247	6,247	6,247
c.	74	3,218	14,789	16%			14,789	14,789	14,789
<b>Total</b>	<b>89</b>	<b>19,758</b>	<b>95,358</b>	<b>100%</b>			<b>117,758</b>	<b>132,834</b>	<b>147,675</b>

STUDY AREA TOTAL

Places	Households	Population	Share	Area(km2)	Pop. density	pop 2000	pop 2005	pop 2010
a.	12	24,662	60%		11.1	159,654	188,613	218,520
b.	42	5,790	14%			26,905	26,905	26,905
c.	242	11,864	27%			52,688	52,688	52,688
<b>Total</b>	<b>296</b>	<b>42,306</b>	<b>100%</b>			<b>239,247</b>	<b>268,206</b>	<b>298,113</b>

**TABLE D.4.1(1) LENGTH OF THE ROADS BY TYPE OF SURFACE(km)**

Type of pavement	Secondary roads only		Included Fundamental roads	
	Length(km)	Share	Length(km)	Share
Asphalt	36	2%	187	8%
Gravel	757	35%	808	34%
Earth	1,354	63%	1,354	58%
Total	2,147	100%	2,349	100%

Type of Surface(Incl. Fundamental Roads)

Surface Type	Share (%)
Earth	58%
Gravel	34%
Asphalt	8%

**TABLE D.4.1(2): LENGTH OF THE ROADS BY ACCESSIBILITY(km)**

Accessibility	Normal year		In 1992	
Good	935	40%	846	36%
Bad	1,317	56%	540	23%
Very bad	97	4%	940	40%
Total	2,349	100%	2,349	100%

Conditions of accessibility in the normal year

Condition	Share (%)
Bad	56%
Good	40%
Very bad	4%

Source: JICA

TABLE D.4.2 TRANSPORTATION AND HARVEST PERIODS

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Seasons	Dry season		Wet season									
Heavy rains in the Past	23%	8%	8%	8%	15%	8%	4%	4%	0%	4%	12%	12%
Rain fall(m/m) 1974-84	227	176	132	99	105	75	56	55	73	110	140	208
Rain days(1974-84 av.)	14	12	11	8	9	7	5	4	14	7	9	12
1992 data(mm/month)												
Santa Cruz	194	314	115	414	184	133	47	100	234	71	149	296
La Belgica	343	335	138	392	207	82	28	90	210	123	128	477
Saavedra	500	340	182	349	191	62	25	124	239	68	138	490
Mineros	391	346	242	331	208	46	14	91	282	68	162	364
Okinawa II	380	393	98	291	194	52	4	80	215	50	140	362
Portachuelo	361	445	128	371	232	102	21	84	243	118	90	436
San Ishidro	463	432	202	512	283	141	53	147	244	119	185	539
San Juan	353	474	265	421	334	180	48	119	182	87	146	555
Total average	373	385	171	385	229	100	30	104	231	88	142	440
SUMMER CROPS												
Maize					(Manual)							
Rice	(Spring)		(Summer)									Rice
Cotton											Cotton	
Potatoes								(Winter)				(Winter)
WINTER CROPS												
Sorghum			(Summer)						(Winter)			
Wheat								(V Misoter.)				
Sanflower												
Soy beans				(Summer)					(Winter)			
Col. San Juan		Rice										Soy beans
Col. Okinawa					Soy beans							
Sugar Mill Factories				Soy beans/Rice					Soy beans			
								Sugar Cane				

TABLE D.4.3 AGRICULTURAL PRODUCTION AND TRANSPORTATION LOAD

Major crops	Santa Cruz Department						Study Area					
	Harvest(ton)	share	No. of trucks	Area(ha)	ton/ha	Harvest(ton)	share	No. of trucks	Area(ha)	ton/ha		
Cotton seed	133,000	4%	17,733	19,000	7.0	2,599	0%	345	5,090	1		
Rice	193,000	6%	25,733	96,500	2.0	138,700	7%	18,493	69,350	2		
Maize	270,300	8%	36,040	85,000	3.2	42,830	2%	5,711	11,900	4		
Soy beans(W)	133,500	4%	17,800	89,000	1.5	132,000	6%	17,600	88,000	2		
Soy beans(S)	592,900	17%	79,053	242,000	2.5	135,491	6%	18,065	57,265	2		
Sugar cane	1,844,000	53%	245,867	64,354	28.7	1,647,036	77%	219,605	57,468	29		
Others	326,243	9%	43,499	161,050	2.0	30,115	1%	4,015	22,840	1		
TOTAL	3,492,943	100%	465,726	756,904	4.6	2,128,761	100%	283,835	311,913	7		

Notes: Average traffic volume will be 1,280 trucks for the Department and 780 trucks in the Study Area per day.

Average traffic volume of sugarcane transport will be more than 1,360 trucks during harvest-delivery period(May-October)in the Study Area.

Tons of truck is set at 7.5 tons

Source: JICA Study Team

TABLE D.4.4 ANALYSIS OF THE ROAD CONDITIONS BY CANTONS/SUB-ZONES

Canton/Sub-zone	Total Length	Type of Surface(km)			Type of Accessibility(km)			Population		Area (km <sup>2</sup> )	Road density		Share of good roads
		Asphalt	Gravel	Earth	Good	Bad	Very bad	Total	Rural		(km/km <sup>2</sup> )	(m/p)	
Col. San Juan	183	0	183	0	183	0	0	6,950	1,377	271	0.68	132.90	100.0%
Col. Okinawa	280	0	280	0	280	0	0	3,650	1,064	470	0.60	263.16	100.0%
Col. Aroma	64	0	26	38	26	38	0	2,974	2,974	108	0.59	21.52	40.6%
Col. Antofagasta	112	0	16	96	16	96	0	2,259	2,259	197	0.57	49.58	14.3%
Canton Cotoca	150	0	0	150	6	144	0	14,771	5,542	295	0.51	26.98	4.0%
Canton Chuchio	154	0	0	154	0	154	0	3,255	3,255	303	0.51	47.16	0.0%
Col. P. Fernandos	137	15	68	54	25	47	65	4,957	1,761	288	0.48	77.80	18.2%
Canton Mineros	21	0	0	21	0	21	0	15,000	623	48	0.44	33.71	0.0%
Pontachuelo	104	0	20	84	20	84	0	10,531	1,078	272	0.38	96.47	19.2%
Canton Palmar	56	0	0	56	8	48	0	1,950	1,950	154	0.36	28.46	14.4%
Canton Tocomechi	53	0	7	46	7	46	0	2,704	2,704	151	0.35	19.42	13.3%
Chane-Pirai	146	0	16	130	16	130	0	1,982	1,982	436	0.33	73.66	11.0%
San Ignacio	50	0	28	22	28	22	0	1,856	1,856	166	0.30	26.94	56.0%
Canton Warnes	51	0	8	43	8	43	0	13,117	2,251	173	0.29	22.66	15.7%
Los Chacos East	104	0	0	104	0	72	32	2,135	2,135	400	0.26	48.71	0.0%
Canton Montero	60	6	0	54	6	54	0	58,569	1,542	275	0.22	38.91	10.0%
Los Chacos West	89	0	29	60	29	60	0	9,456	9,456	470	0.19	9.41	32.6%
Canton M. Hoyo	30	0	0	30	0	30	0	3,719	3,719	166	0.18	8.07	0.0%
Canton Saavedra	89	15	18	56	33	56	0	11,639	8,721	504	0.18	10.21	37.1%
Santa Rosa	54	0	7	47	7	47	0	6,321	3,196	378	0.14	16.90	13.0%
Canton Juan Latino	5	0	0	5	0	5	0	818	818	43	0.12	6.11	0.0%
Palometas	41	0	11	30	0	41	0	2,920	2,920	366	0.11	14.04	0.0%
Canton Azuzaqui	16	0	10	6	5	11	0	3,150	3,150	151	0.11	5.08	31.3%
Buena Vista B. Retiro	100	0	30	70	30	70	0	10,586	10,199	1,082	0.09	9.80	30.0%

Source: JICA Study Team

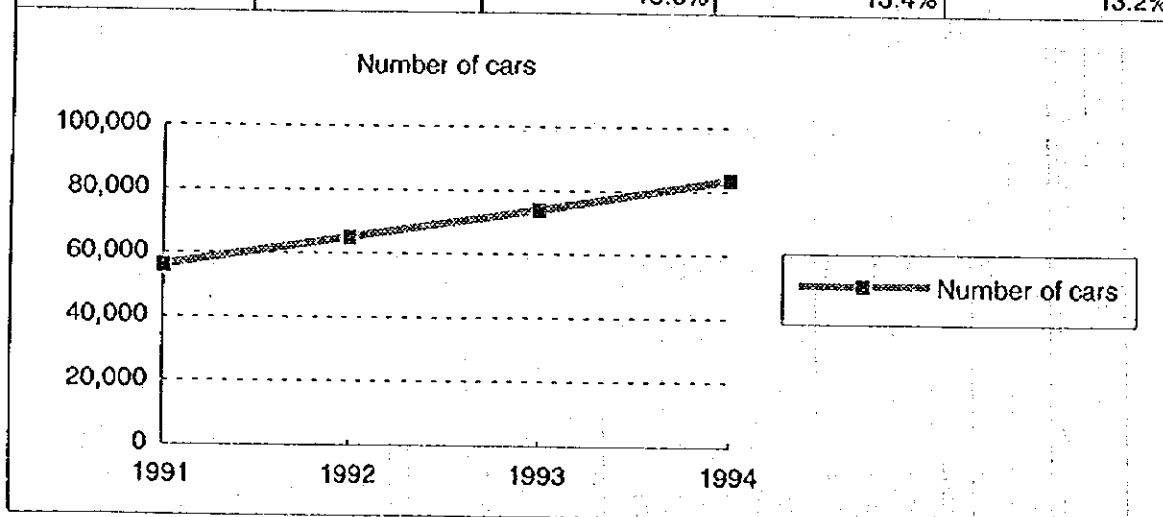
**TABLE D.4.5 NUMBER OF THE REGISTERED VEHICLES IN 1995**

Type of vehicles	Santa Cruz	Warnes	Montero	Total
Car	28,339	3,609	2,557	34,505
Jeep	9,119	588	274	9,981
Wagon	15,459	1,219	1,463	18,141
Pick-up	14,894	1,361	513	16,768
Truck	8,275	2,315	710	11,300
Bus	321	-	-	321
Mini bus	4,197	397	530	5,124
Motorcycle	3585	141	252	3,978
<b>TOTAL</b>	<b>84,189</b>	<b>9,630</b>	<b>6,299</b>	<b>100,118</b>

Source; Municipalities

**TABLE D.4.6: INCREASE OF THE REGISTERED VEHICLES IN SANTA CRUZ CITY**

	1991	1992	1993	1994
Number of cars	56,248	65,030	73,728	83,479
Increase ratio	-	15.6%	13.4%	13.2%



Source; SISTECO

TABLE D.4.7 TRAFFIC VOLUME OF THE STUDY AREA

(UNIT : CARS/DAY)

	Santa Cruz-Warnes	Warnes-Santa Cruz	Warnes-Montero	Montero-Warnes	Montero-Guabira	Guabira-Montero	Guabira-Portachuelo	Portachuelo-Guabira	Portachuelo - San Carlos	San Carlos-Portachuelo	San Carlos -Yapacani	Yapacani-San Carlos	Santa Fe-Cokoria san Juan	Col.San Juan - Santa Fe	Yapacani-Rio Ichilo	Rio Ichilo-Yapacani	Rio Grande-Okinawa	Okinawa-Rio Grande	Okinawa-CTT9	CTT9-Okinawa	Okinawa-Guabira	Guabira-Okinawa
Car-wagon	872	834	651	707	681	713	261	209	95	122	98	117	30	36	40	27	21	30	38	57	110	111
Pick up(2 tn)	212	181	158	139	194	138	126	117	64	62	42	62	22	24	23	25	35	36	21	24	39	52
Other(2 Tn)	152	150	134	129	90	81	90	98	42	42	41	55	17	18	22	22	30	23	16	29	26	36
Small Bus	114	102	95	95	38	35	30	30	14	11	18	17	10	12	13	10	1	3	13	15	18	12
Middle bus	4	4	2	4	22	25	17	14	12	15	10	10	1	2	1	1	2	1	0	1	2	1
Bus	46	37	46	54	57	51	44	40	30	30	27	48	0	0	27	22	0	1	1	1	0	1
Small truck	47	28	40	33	69	55	33	28	13	22	10	19	8	10	8	8	3	6	5	5	10	14
Mid truck	63	50	81	66	113	91	79	70	40	40	26	40	18	25	22	29	21	25	34	43	61	89
Truck	115	74	82	91	134	111	120	61	65	80	71	77	6	7	56	52	9	9	9	16	17	25
Truck	71	36	57	50	64	63	40	40	31	36	28	29	3	4	23	26	5	7	7	5	9	9
Motorcycle	16	9	47	48	1,391	1,419	47	43	21	37	25	19	44	38	19	18	16	24	6	8	23	26
Other	44	31	25	31	60	38	38	41	39	40	76	70	22	21	18	17	9	11	6	7	58	54
Total	1,756	1,536	1,419	1,447	2,913	2,820	925	791	466	537	472	563	181	197	272	257	152	176	156	211	373	430
TOTAL	3,292	2,866	5,793	1,716	1,003	1,035	378	529	328	367	803											

Source: Servicio Nacional de Caminos -Distrito 5 SNC 1995



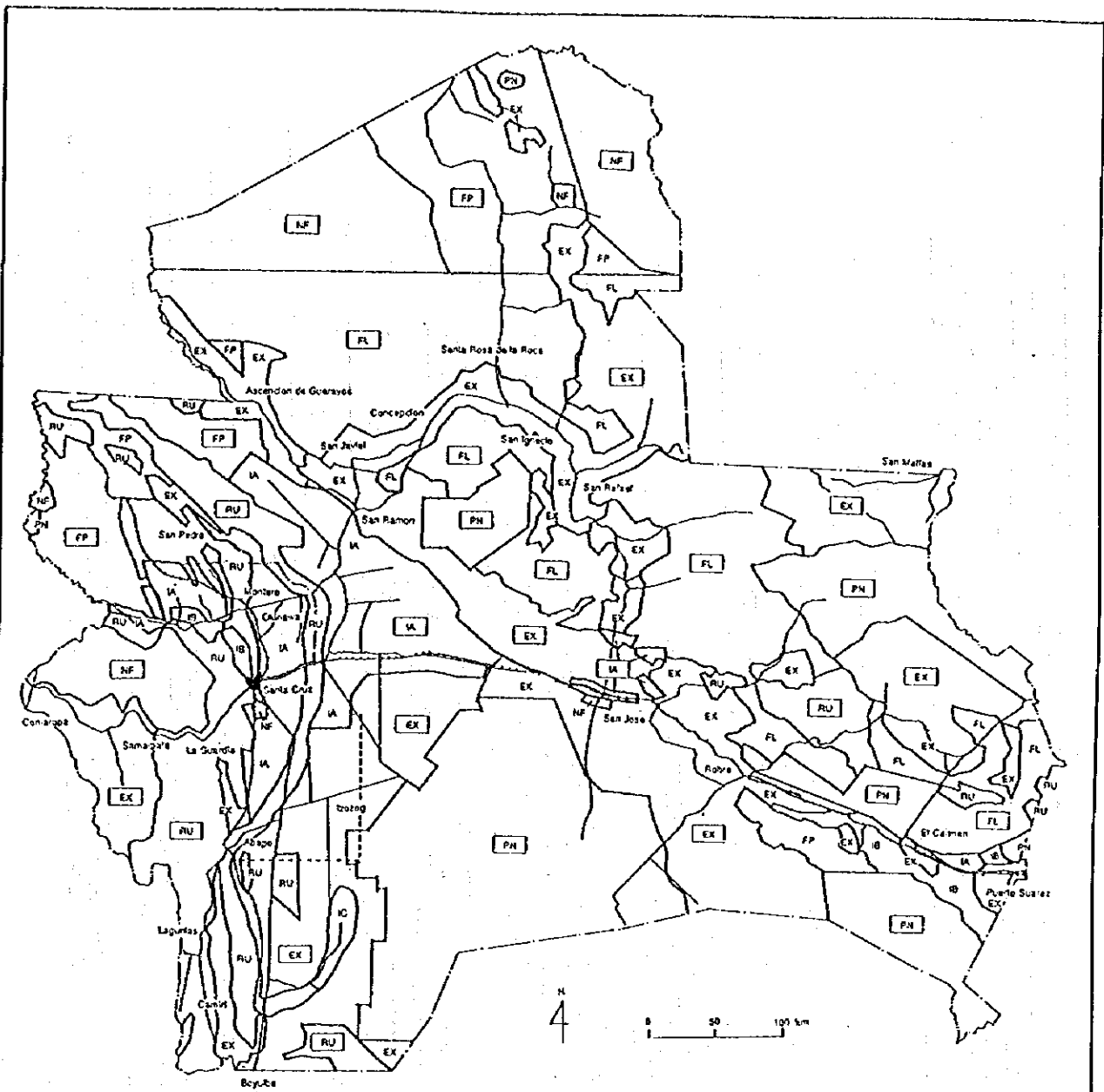
TABLE D.5.1 GDP, EXPORT, NON TRADITIONAL AND AGROINDUSTRY

	1988	1989	1990	1991	1992	1993	1994
<b>A. GDP</b>							
1 GDP of BOLIVIA (Million US\$)*1)	4,630.0	4,778.6	4,939.4	5,356.7	5,534.9	na	na
2) Increase Ratio of GDP BOLIVIA	-	3.2%	3.4%	8.4%	3.3%	-	-
3 GDP of SCZ (Million US\$)*1)	1,224.0	1,259.6	1,376.3	1,508.3	1,672.3	na	na
4) Increase Ratio of GDP SCZ	-	2.9%	9.3%	9.6%	10.9%	-	-
5) Share of SCZ in BOLIVIA(=3/1)	26.4%	26.4%	27.9%	28.2%	30.2%	-	-
6 GDP of BOLIVIA (Million Bs)*2)	12,766.4	13,173.1	13,844.8	14,533.8	14,911.4	na	na
7 GDP of SCZ (Million Bs)*2)	3,920.1	4,056.8	4,362.8	4,644.7	4,731.8	na	na
<b>B. Breakdown GDP SCZ (Million Bs)*2)</b>							
8) Agriculture/Livestock Sector	730.0	792.1	875.3	1,066.3	1,000.3	na	na
9) Agriculture sub-sector	233.7	249.5	290.9	348.7	346.3	na	na
10) Agroindustry sub-sector	160.9	212.9	229.8	356.3	294.0	na	na
11) Livestock sub-sector	252.6	260.1	273.3	275.5	277.7	na	na
12) Forestry, hunting and fishing sub-sector	82.8	69.6	81.3	65.7	82.3	na	na
13) Share of Agric. GDP to Total GDP (=8/7)	18.6%	19.5%	20.1%	23.0%	21.1%	-	-
14) Share of Agroindustry in Agriculture(=10/8)	22.0%	26.9%	26.3%	33.4%	29.4%	-	-
15) Share of Agroindustry in Total GDP(=10/7)	4.1%	5.2%	5.3%	7.7%	6.2%	-	-
16) Increase Ratio of Agroindustry	-	32.4%	7.9%	55.1%	-17.5%	-	-
17) Drop of Agroindustry in 1992(from 1991,Million US\$)	-	-	-	-	-62.31	-	-
<b>C. Total Export (Million US\$)</b>							
18) Total Export of BOLIVIA	600.2	821.9	926.8	848.5	712.3	754.5	722.9
19) Mineral of BOLIVIA	273.1	403.4	407.2	356.0	379.7	362.0	307.3
20) Hydrocarbon of BOLIVIA	218.9	214.2	227.1	241.2	126.3	96.5	74.0
21) Total Traditional Export of BOLIVIA	492.0	617.6	634.3	597.2	506.0	458.5	381.3
22) Share of Traditional to Total BOLIVIA(=21/18)	82.0%	75.1%	68.4%	70.4%	71.0%	60.8%	52.7%
23) Export excl. Hydrocarbon of BOLIVIA	381.3	607.7	699.7	607.3	586.0	658.0	648.9
24) Total Export of SCZ(excl. hydrocarbon)	42.9	105.3	136.7	143.1	107.2	119.4	216.4
25) Increase Ratio Total Export of SCZ	-	145.5%	29.8%	4.7%	-25.1%	11.4%	81.2%
26) Share of SCZ in BOLIVIA (=24/23)	11.3%	17.3%	19.5%	23.6%	18.3%	18.1%	33.3%
27) Increase Ratio of Export SCZ(1991=100%)	-	-	-	100.0%	74.9%	83.4%	151.2%
28) Drops in 1992/93/94 SCZ(from 1991,Million US\$)	-	-	-	0.0	-35.9	-23.7	73.3
<b>D. Non Traditional Export (Million US\$)</b>							
29) Non Traditional of BOLIVIA	108.2	204.3	292.5	251.3	206.3	296	341.6
30) Increase Ratio of BOLIVIA	-	88.8%	43.2%	-14.1%	-17.9%	43.5%	15.4%
31) Share of Non Traditional to Total BOLIVIA(=29/18)	18.0%	24.9%	31.6%	29.6%	29.0%	39.2%	47.3%
32) Non Traditional of SCZ	na	na	na	142.5	106.6	118.8	211.5
33) Increase Ratio Non Traditional of SCZ	-	-	-	-	-25.2%	11.4%	78.0%
34) Increase Ratio of SCZ(1991=100%)	-	-	-	100.0%	74.8%	83.4%	148.4%
35) Drops in 1992/93/94 SCZ(from 1991,Million US\$)	-	-	-	0.0	-35.9	-23.7	69.0
36) Share of Non Traditional to Total SCZ(=32/24)	-	-	-	99.6%	99.4%	99.5%	97.7%
37) Share of SCZ to BOLIVIA(=32/29)	-	-	-	55.7%	51.7%	40.1%	61.9%
<b>E. Agroindustry Export (Million US\$)</b>							
38) Agroindustry Export BOLIVIA	na	na	na	na	na	na	na
39) Agroindustry Export SCZ	19.8	53.4	48.8	56.4	52.3	56.7	91.9
40) Increase Ratio SCZ	-	169.7%	-8.6%	15.6%	-7.3%	8.4%	62.1%
41) Increase Ratio(1991=100%)	-	-	-	100.0%	92.7%	100.5%	162.9%
42) Share Agroindustry to Total Export SCZ	46.2%	50.7%	35.7%	39.4%	48.8%	47.5%	42.5%
43) Drops in 1992/93/94(from 1991,Million US\$)	-	-	-	0.0	-4.1	0.3	35.5

Note: \*1) at current price, and \*2) at 1990 constant prices, Source: INE- CAO Numeros de Nuestra Tierra 1995

**FIGURES**





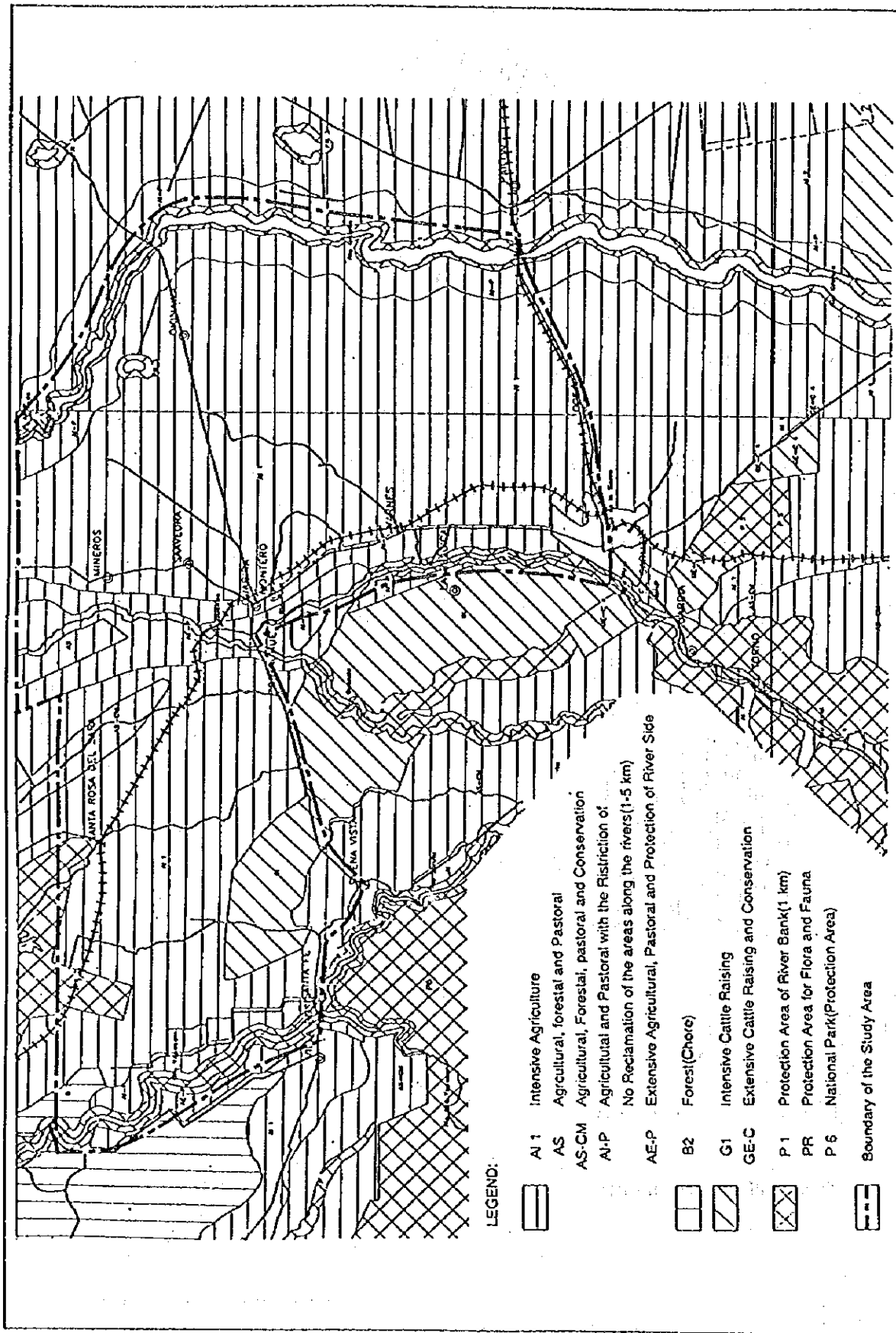
LEGEND:

- Area for Intensive Agriculture/Livestock Use
- IA Intensive Agriculture Area
- IB Intensive Livestock Area
- IC Intensive Agriculture and Livestock Area













- EX Area for Extensive Agriculture/Livestock Use
- Area for Forestry
- FP Permanent and Production Forest
- FL Forest with Limited Livestock
- RU Area for Restricted Use
- Area for Protection
- NF Established National Park and Forest Reserve Areas
- PN Potential Natural Reserve Areas

Source : PLUS, CORDECRUZ

FIG.D.2.1(1) LAND USE PLAN OF SANTA CRUZ DEPARTMENT(PLUS)

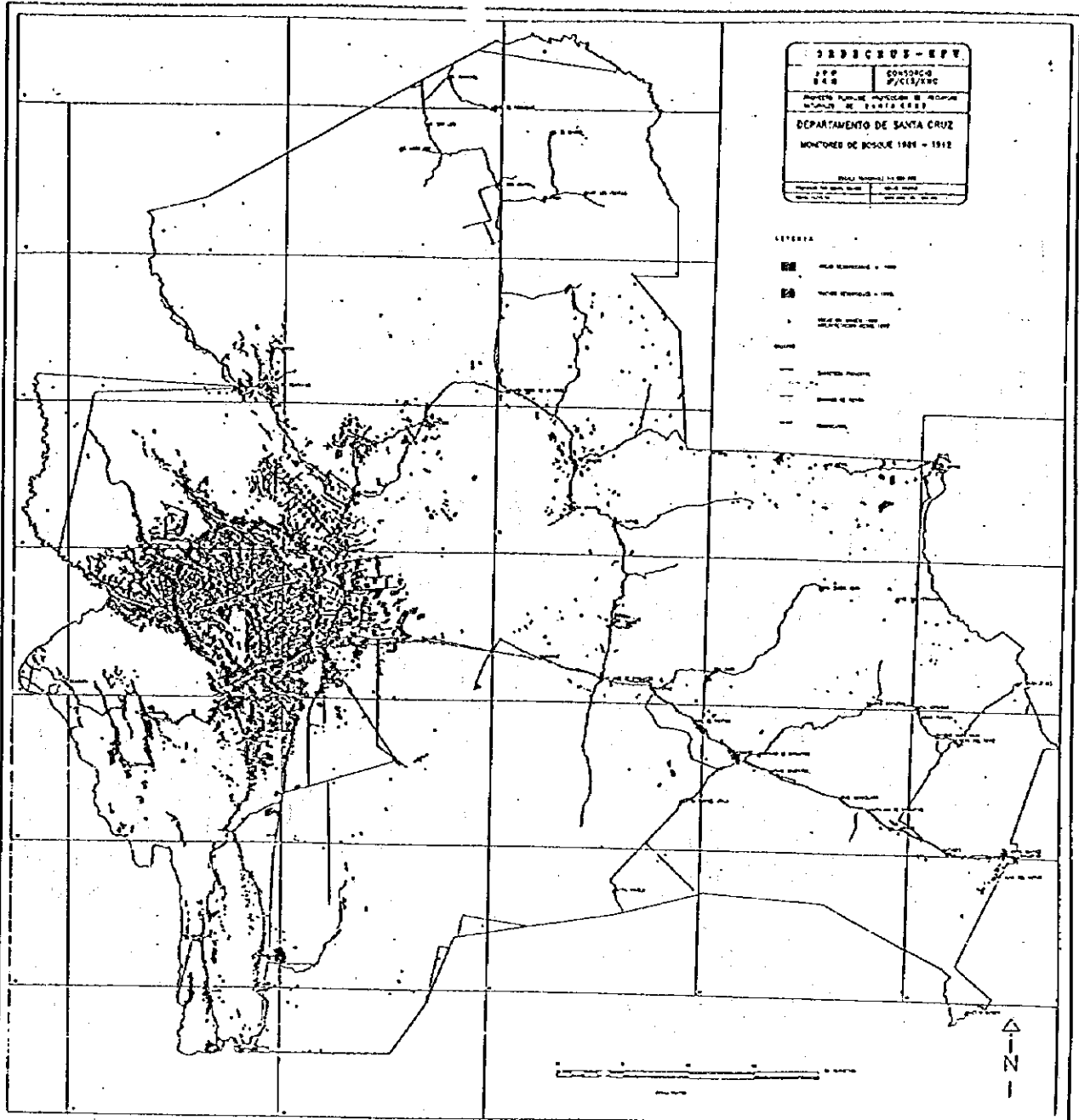


**LEGEND:**



-  A1 Intensive Agriculture
-  AS Agricultural, forestal and Pastoral
-  AS-CM Agricultural, Forestal, pastoral and Conservation
-  A1-P Agricultural and Pastoral with the Restriction of No Reclamation of the areas along the rivers (1-5 km)
-  AE-P Extensive Agricultural, Pastoral and Protection of River Side
-  B2 Forest(Chere)
-  G1 Intensive Cattle Raising
-  GE-C Extensive Cattle Raising and Conservation
-  P 1 Protection Area of River Bank(1 km)
-  PR Protection Area for Flora and Fauna
-  P 6 National Park(Protection Area)
-  Boundary of the Study Area

Source : PLUS, CORDECruz

**FIG.D.2.1(2)- LAND USE PLAN OF THE STUDY AREA(PLUS)**

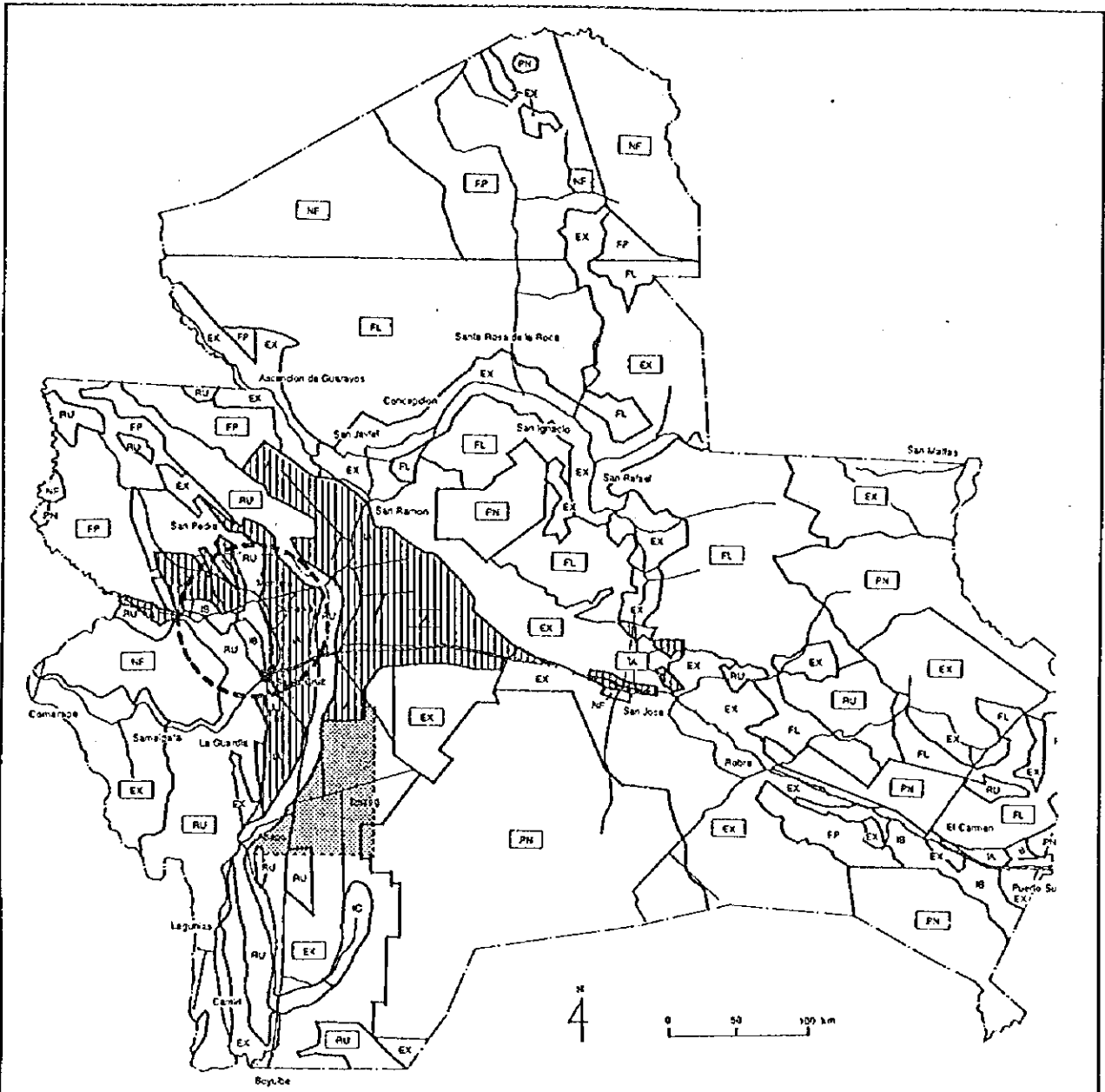


LEGEND:




-  Area with deforestation until 1992
-  Study Area

Source : PLUS, CORDECRUZ

FIG.D.2.2 AREA WITH DEFORESTATION UNTIL 1992



LEGEND:

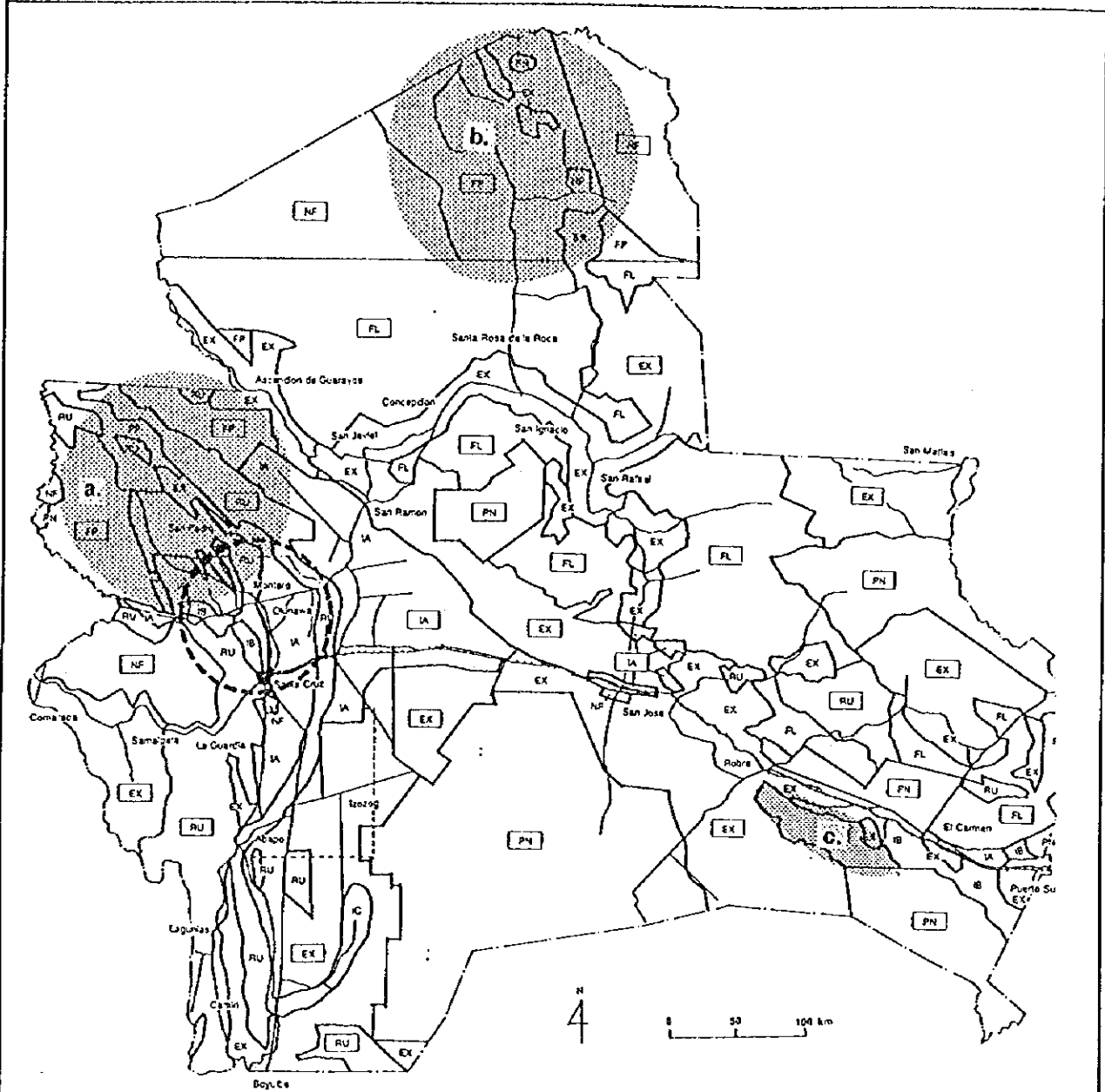
-  Intensive Agricultural Area(PLUS)
-  Rio Grande-Abapo-Izozog Zone
-  Study Area

Source : PLUS, CORDECruz


FIG.D.2.3 AGRICULTURAL POTENTIAL AREAS(PLUS)








**LEGEND:**

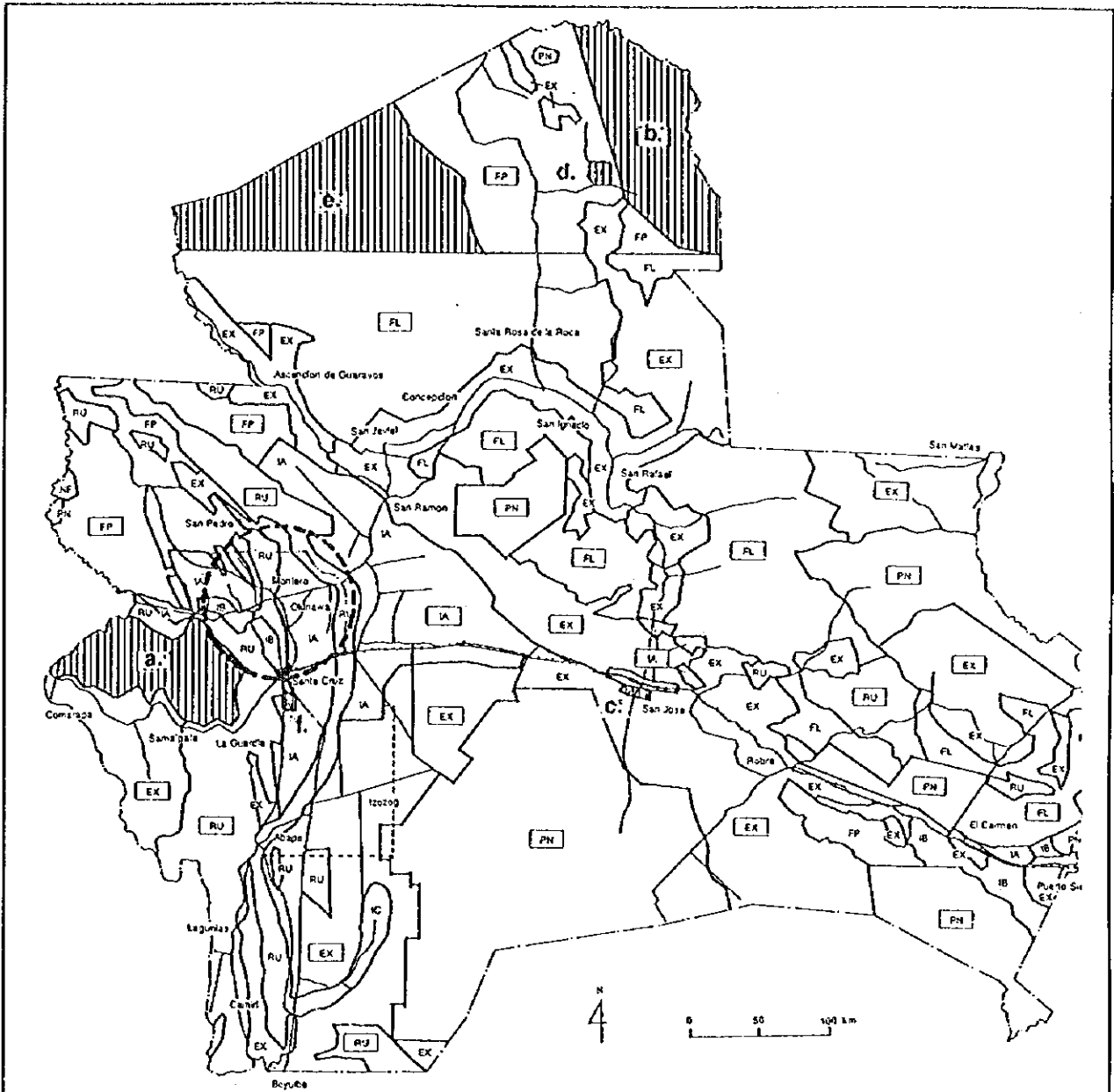
 Permanent and production Forest Area(PLUS)

- a. North-west zone
- b. North zone
- c. South-east zone



 Study Area

Source : PLUS, CORDECRUZ

**FIG.D.2.5 FOREST POTENTIAL AREAS(PLUS)**

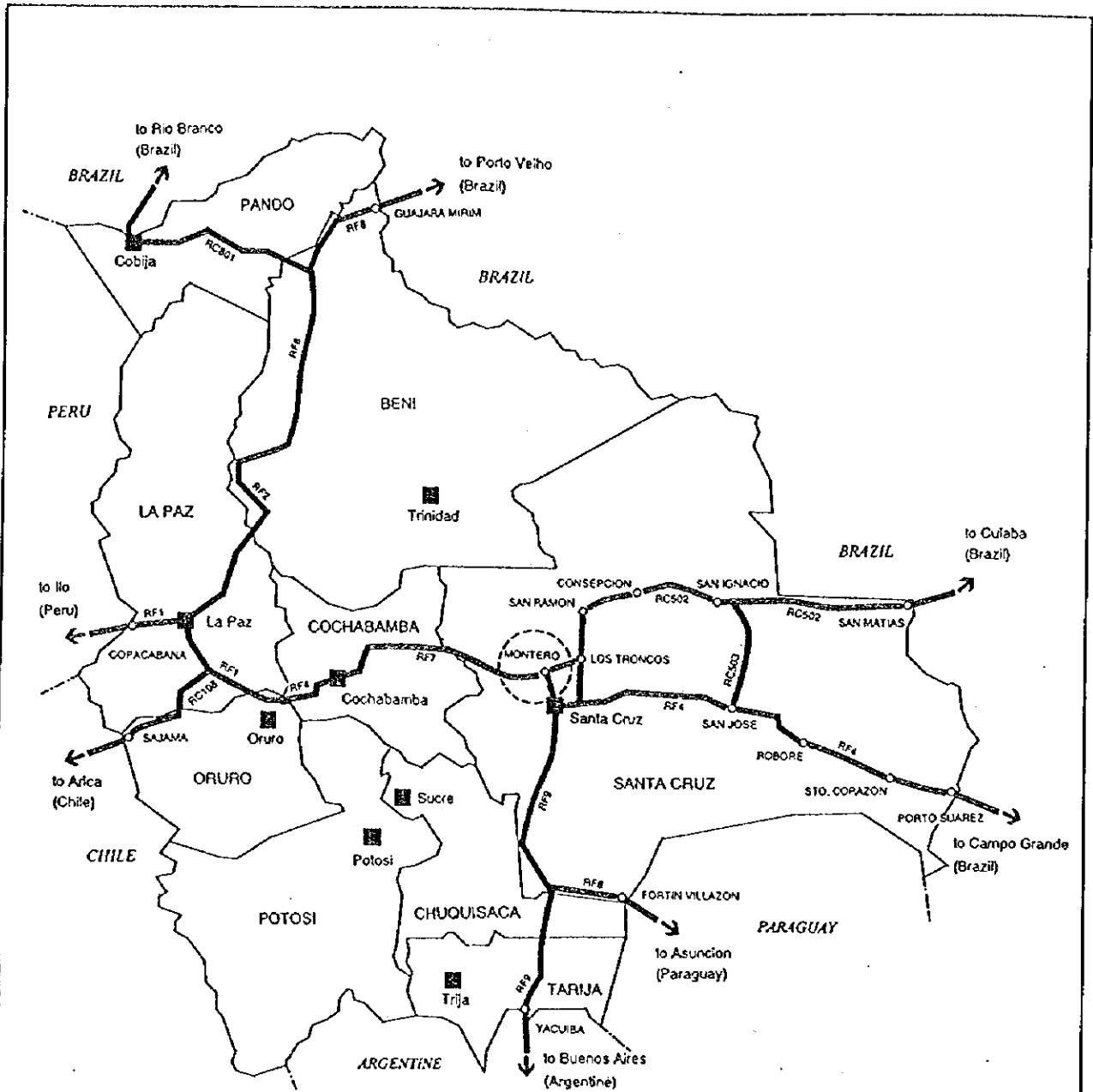





**LEGEND:**

-  Established Protected Area(PLUS)
  - a. Amboro national park
  - b. Noel kempff national park
  - c. Santa Cruz La Vieja historical national park
  - d. Noel kempff(Laguna Bahia) biological reserve
  - e. Rios Blanco y negro wildlife reserve
  - f. Lomas de Arena regional park
-  Study Area

Source : PLUS, CORDECRUZ

**FIG.D.2.6 ESTABLISHED PROTECTED AREAS(PLUS)**

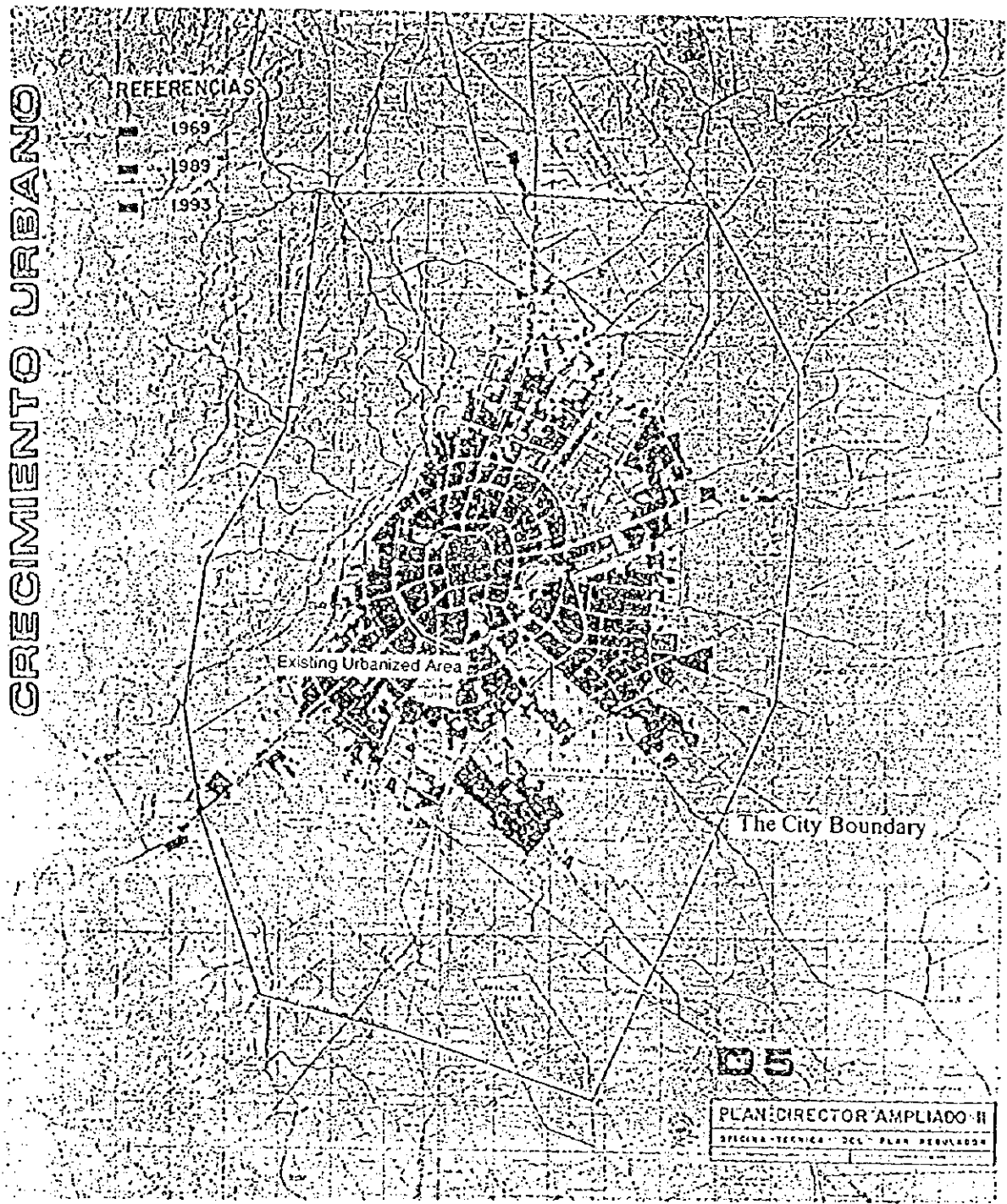


- LEGEND:
-  Export Lanes
  -  Capital Cities
  -  Study Area

Source : PGPES, Ministry of Sustainable Development and Environment

FIG.D.2.7 DEVELOPMENT OF "EXPORT LANES"

CRECIMIENTO URBANO



Source : Santa Cruz Municipality

FIG.D.3.1 CITY BOUNDARY OF SANTA CRUZ

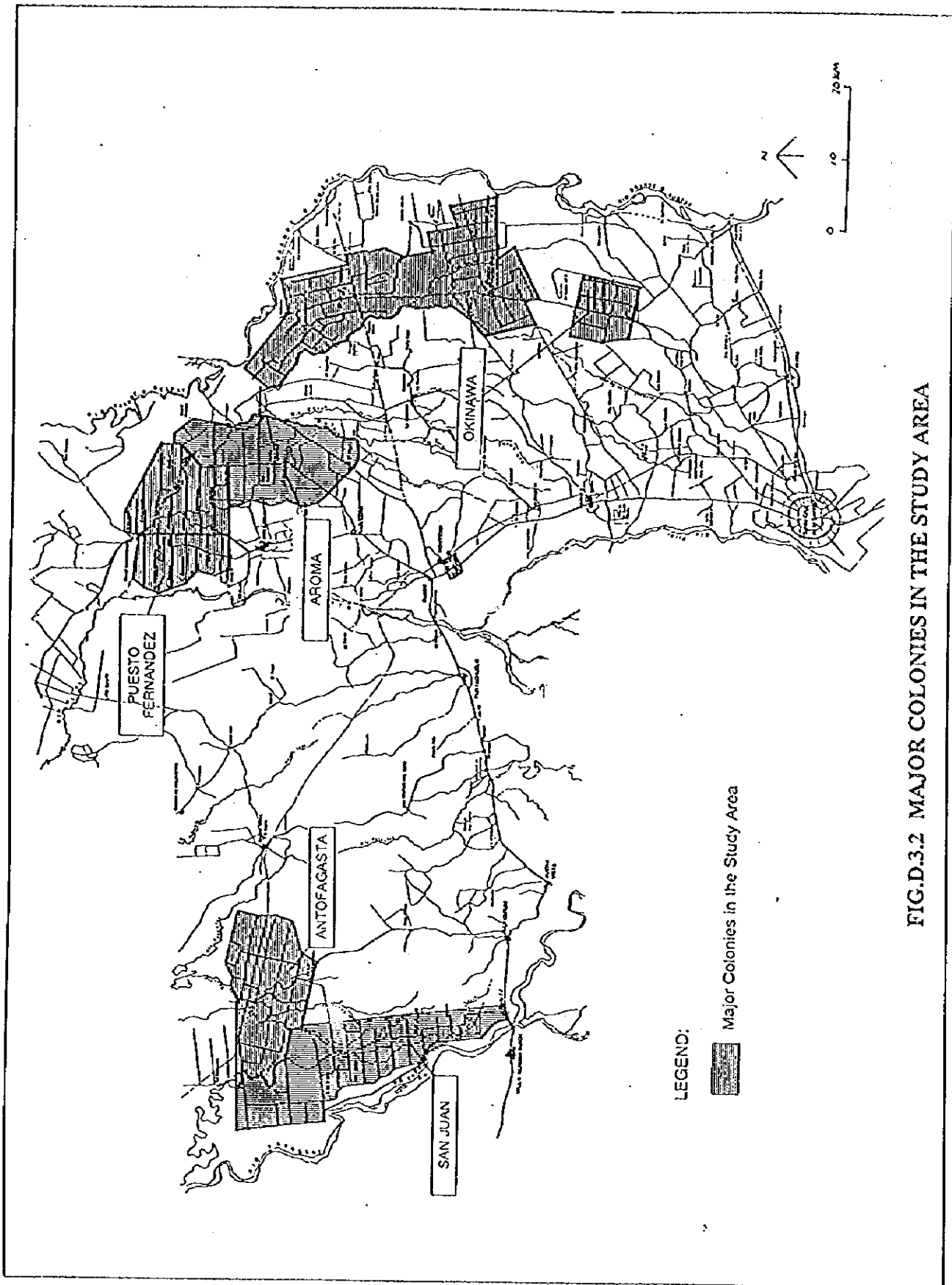


FIG.D.3.2 MAJOR COLONIES IN THE STUDY AREA

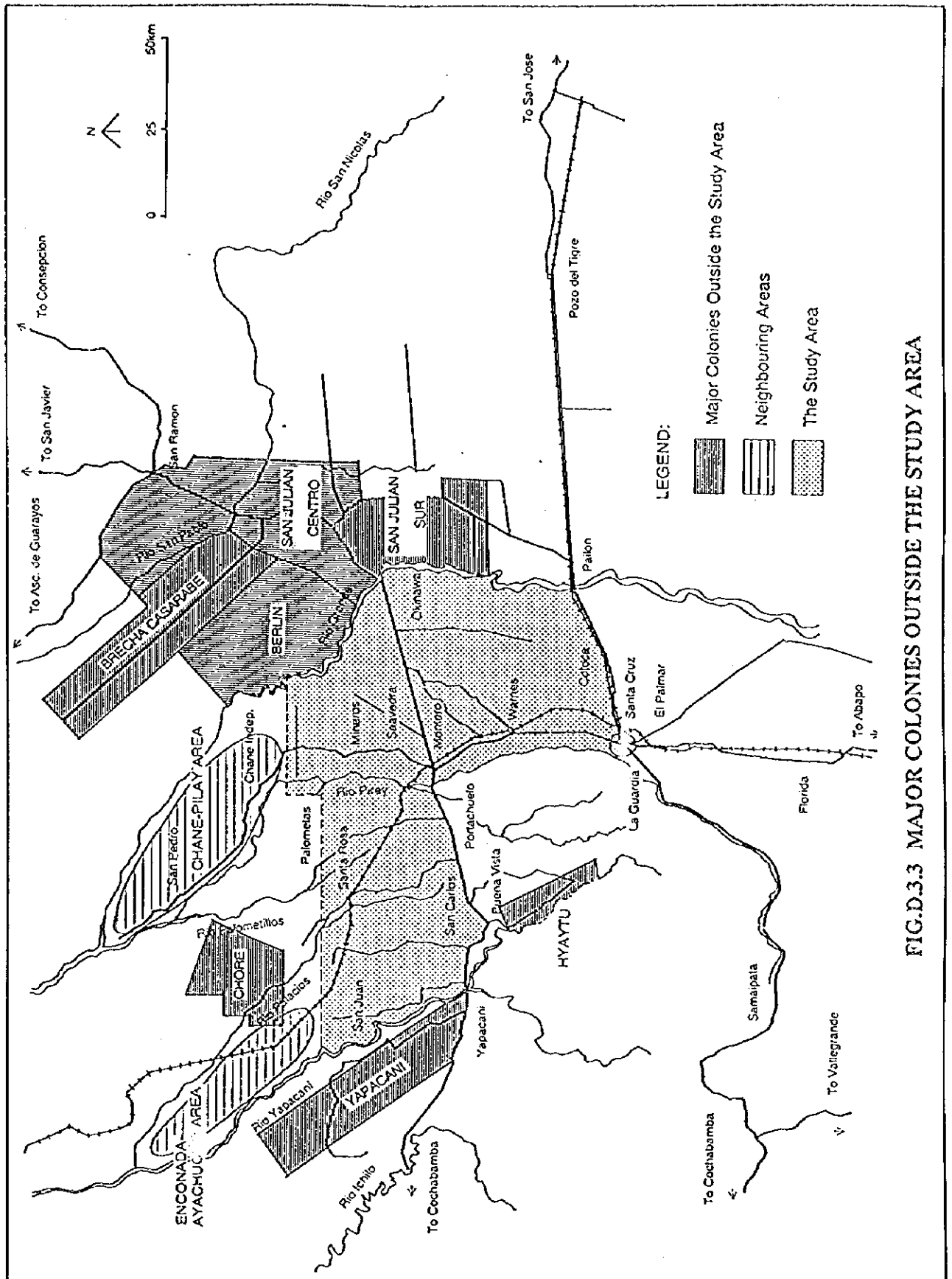


FIG.D.3.3 MAJOR COLONIES OUTSIDE THE STUDY AREA

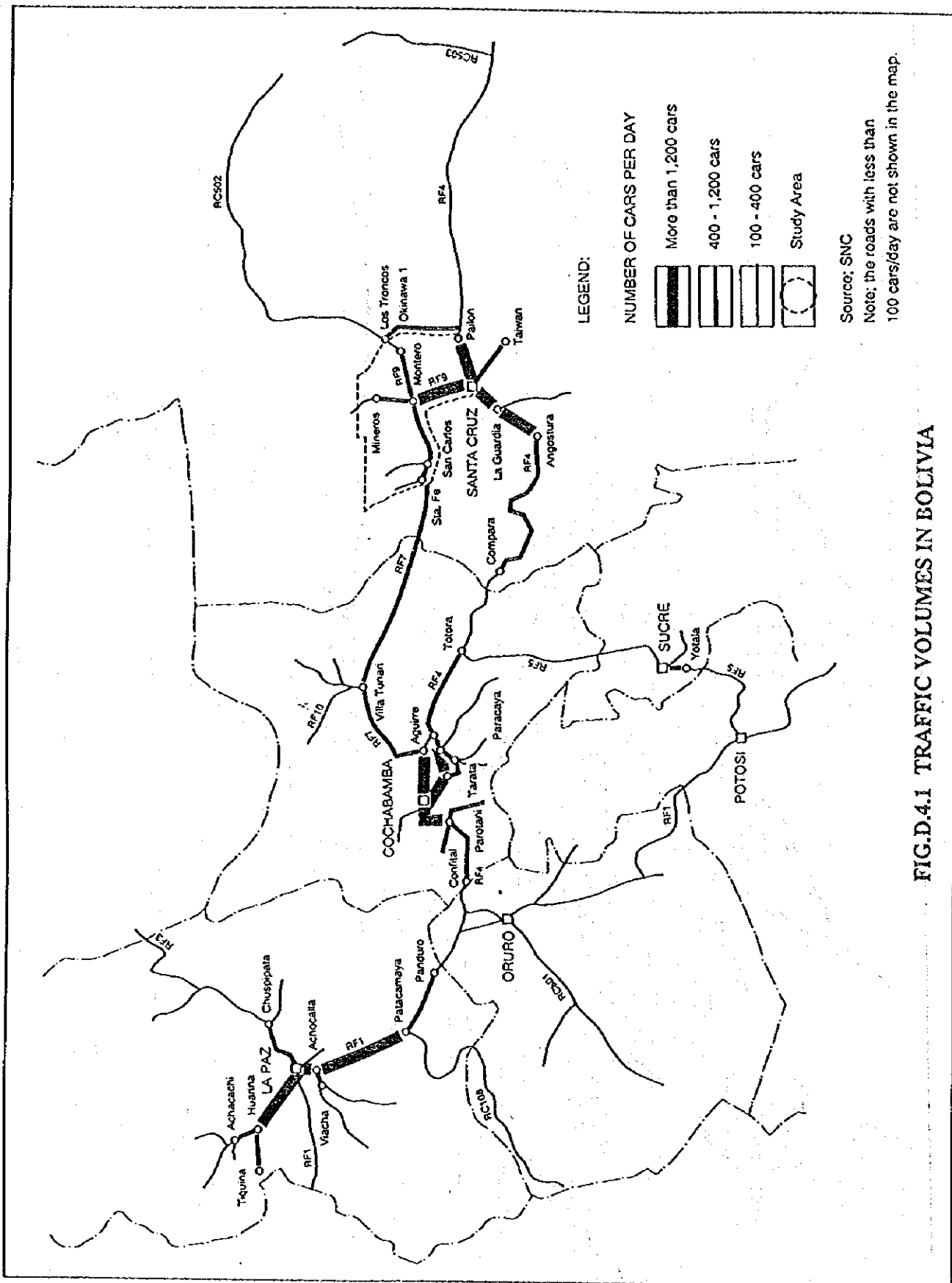
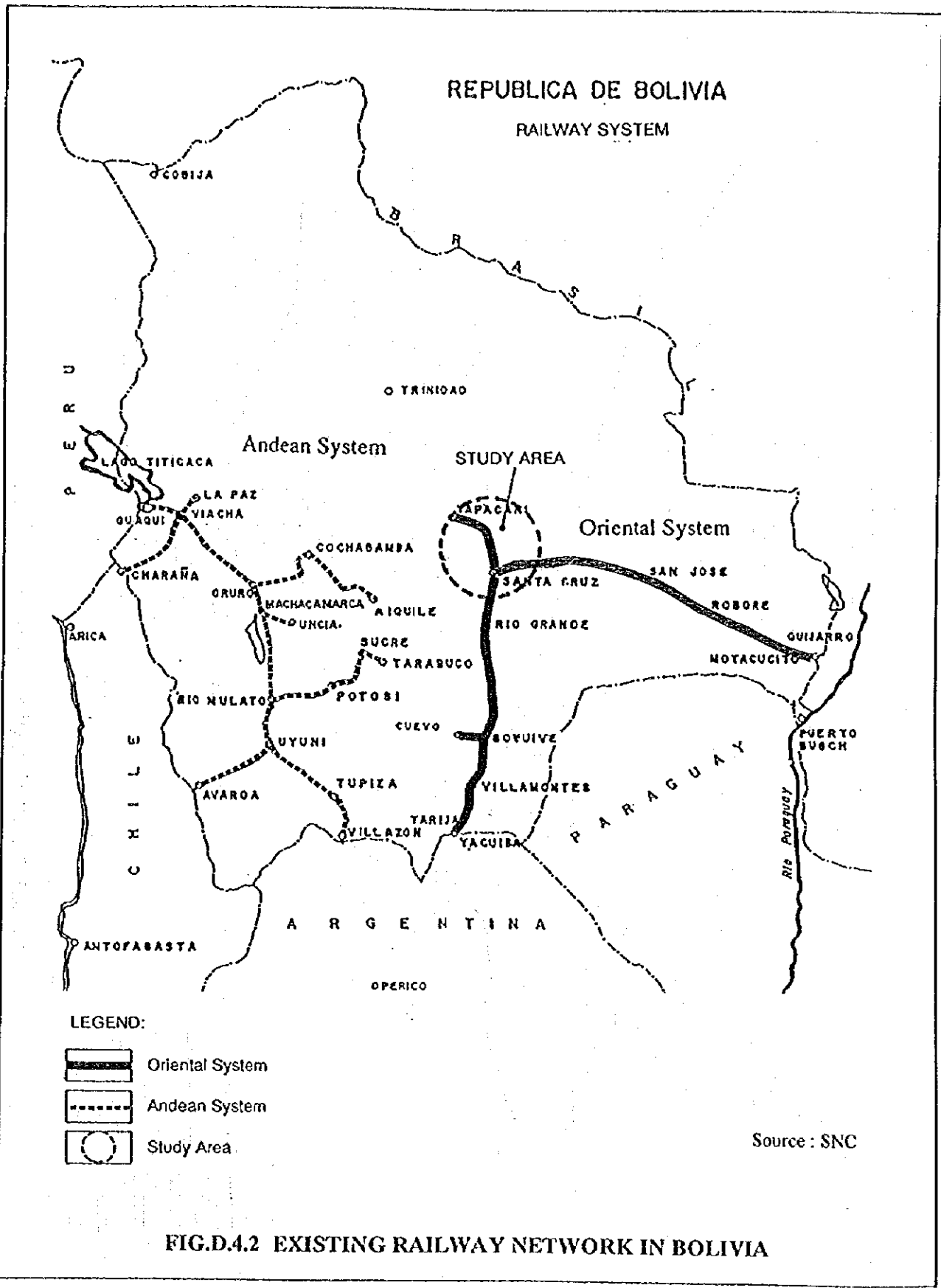


FIG.D.4.1 TRAFFIC VOLUMES IN BOLIVIA



**FIG.D.4.2 EXISTING RAILWAY NETWORK IN BOLIVIA**



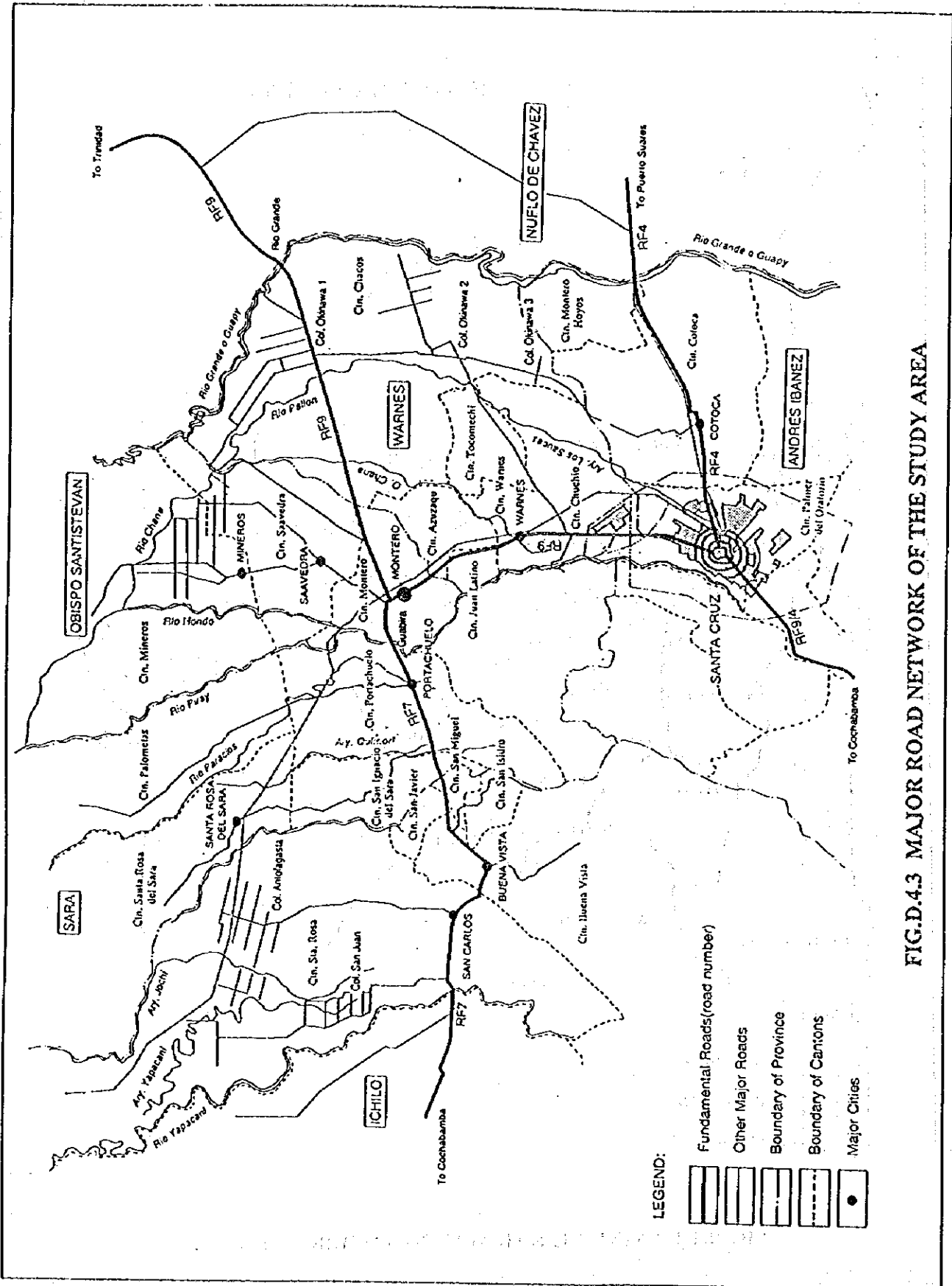


FIG.D.4.3 MAJOR ROAD NETWORK OF THE STUDY AREA

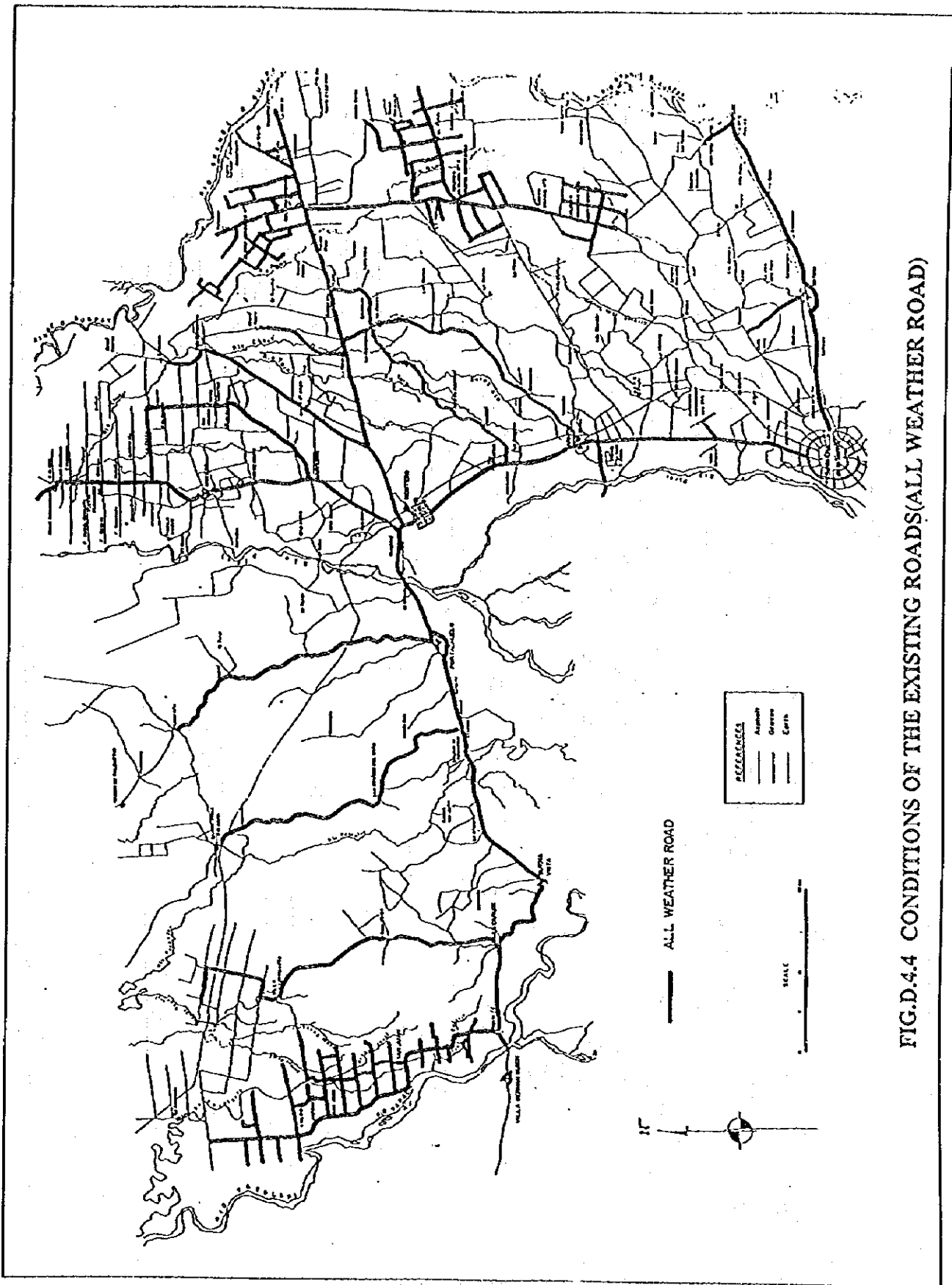


FIG.D.4.4 CONDITIONS OF THE EXISTING ROADS(ALL WEATHER ROAD)

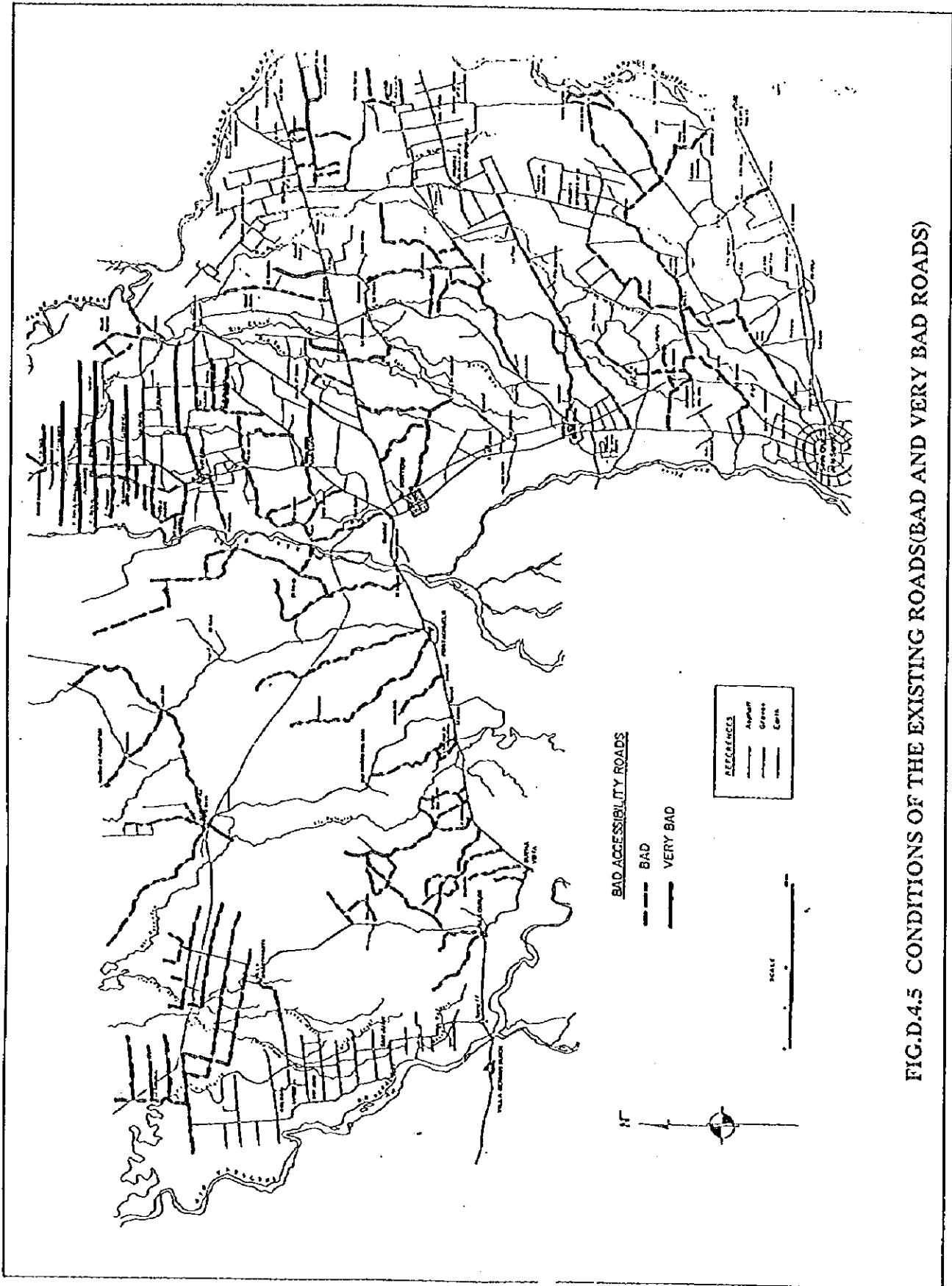


FIG.D.4.5 CONDITIONS OF THE EXISTING ROADS(BAD AND VERY BAD ROADS)

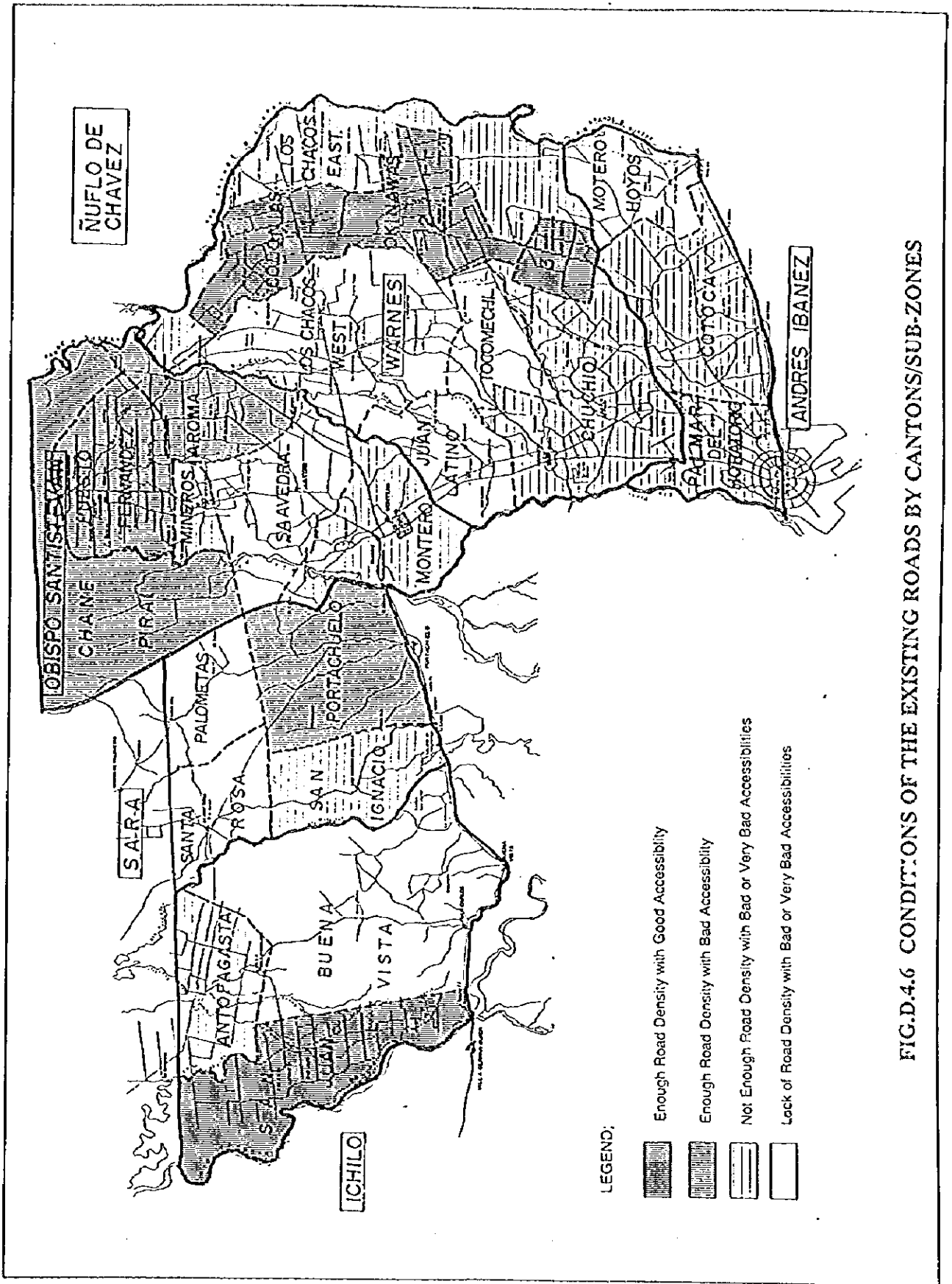
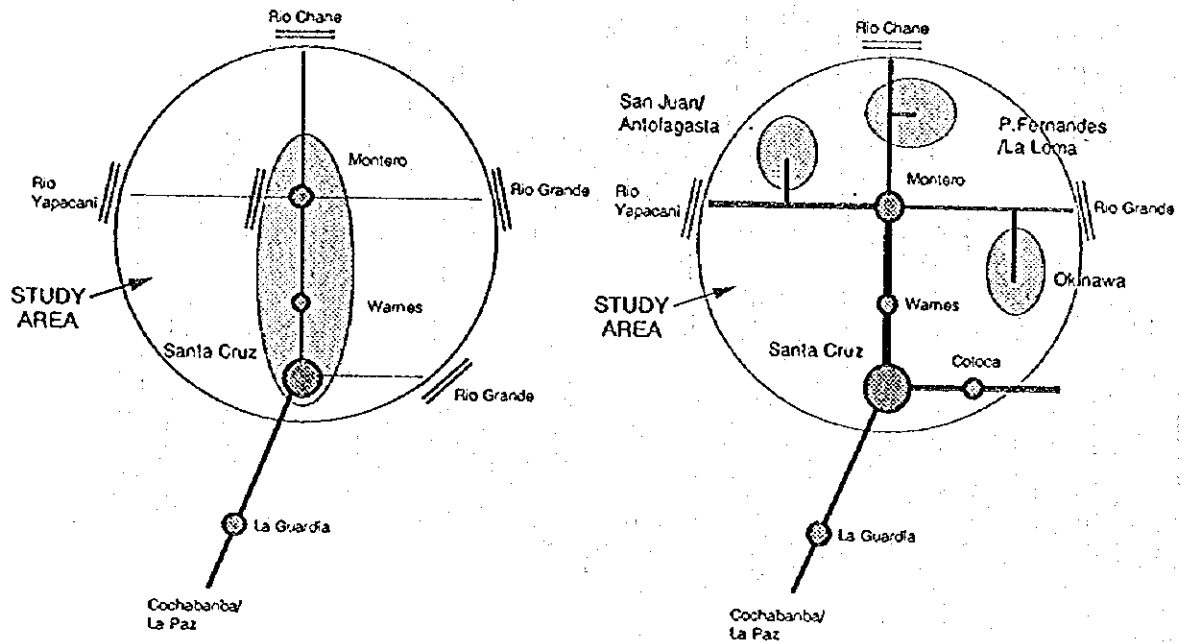


FIG.D.4.6 CONDITIONS OF THE EXISTING ROADS BY CANTONS/SUB-ZONES

1950'-1960':EXPLOITATION OF THE VIRGIN LAND

1970'-1980':DEVELOPMENT OF LARGESCALE COLONIAS



Existing:EXPANSION TO THE SURROUNDINGS

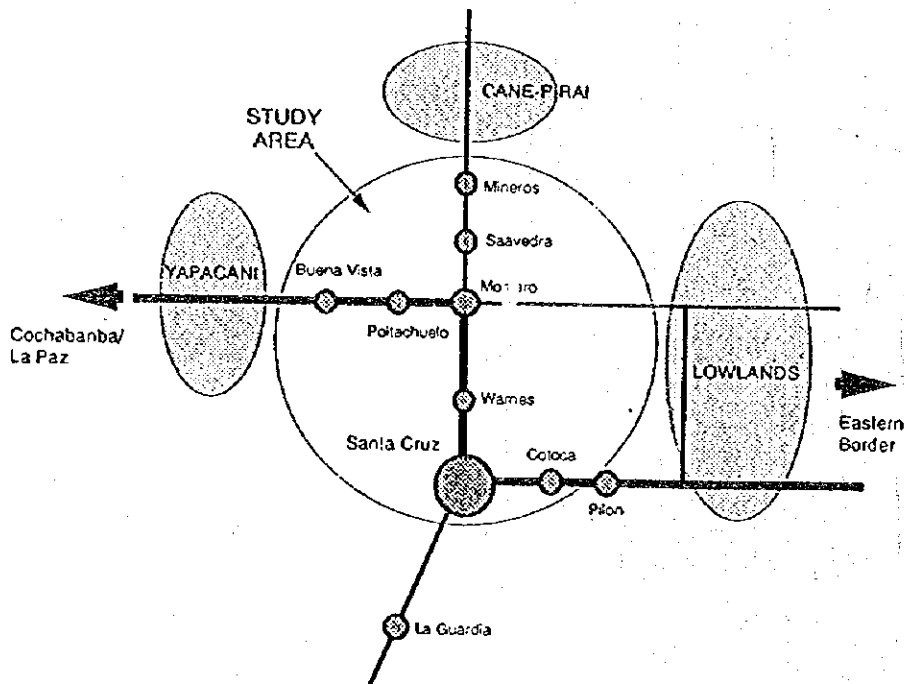
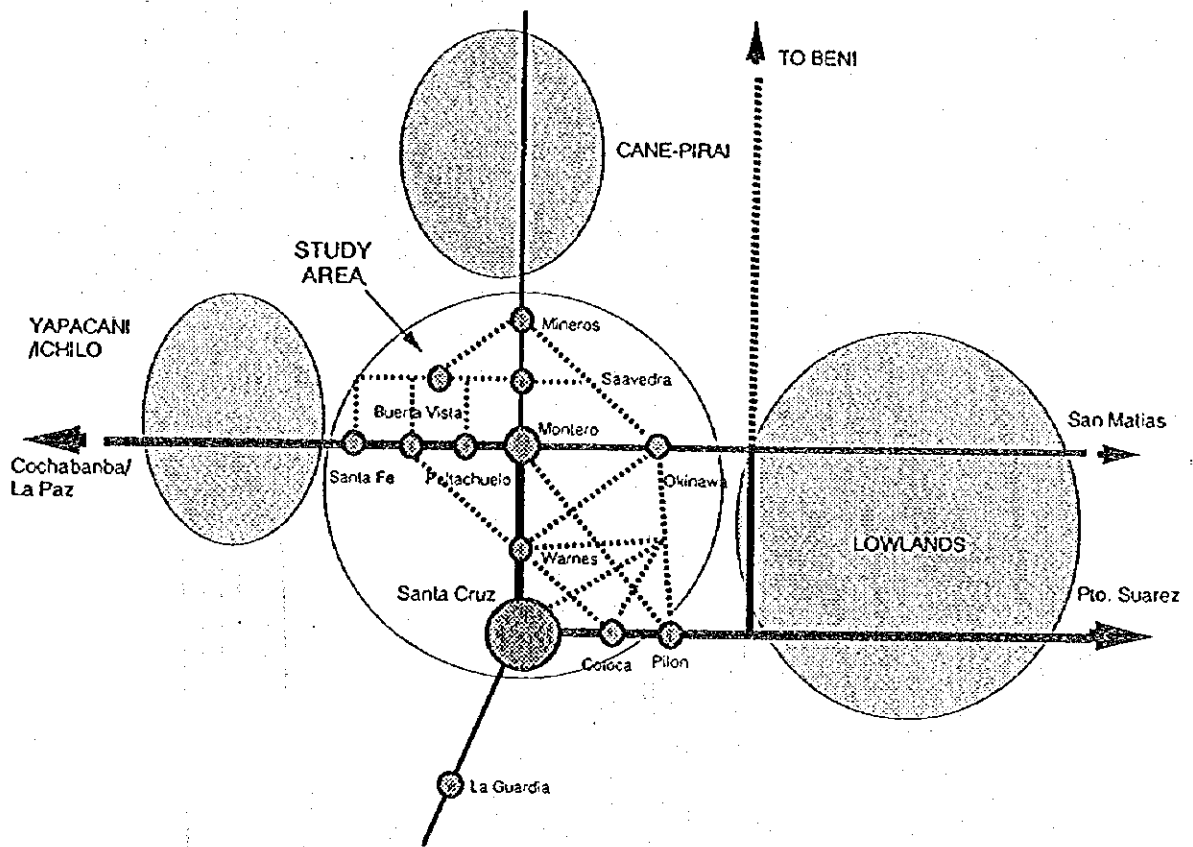


FIG.D.4.7 HISTORY OF THE REGIONAL DEVELOPMENT PATTERNS(1)

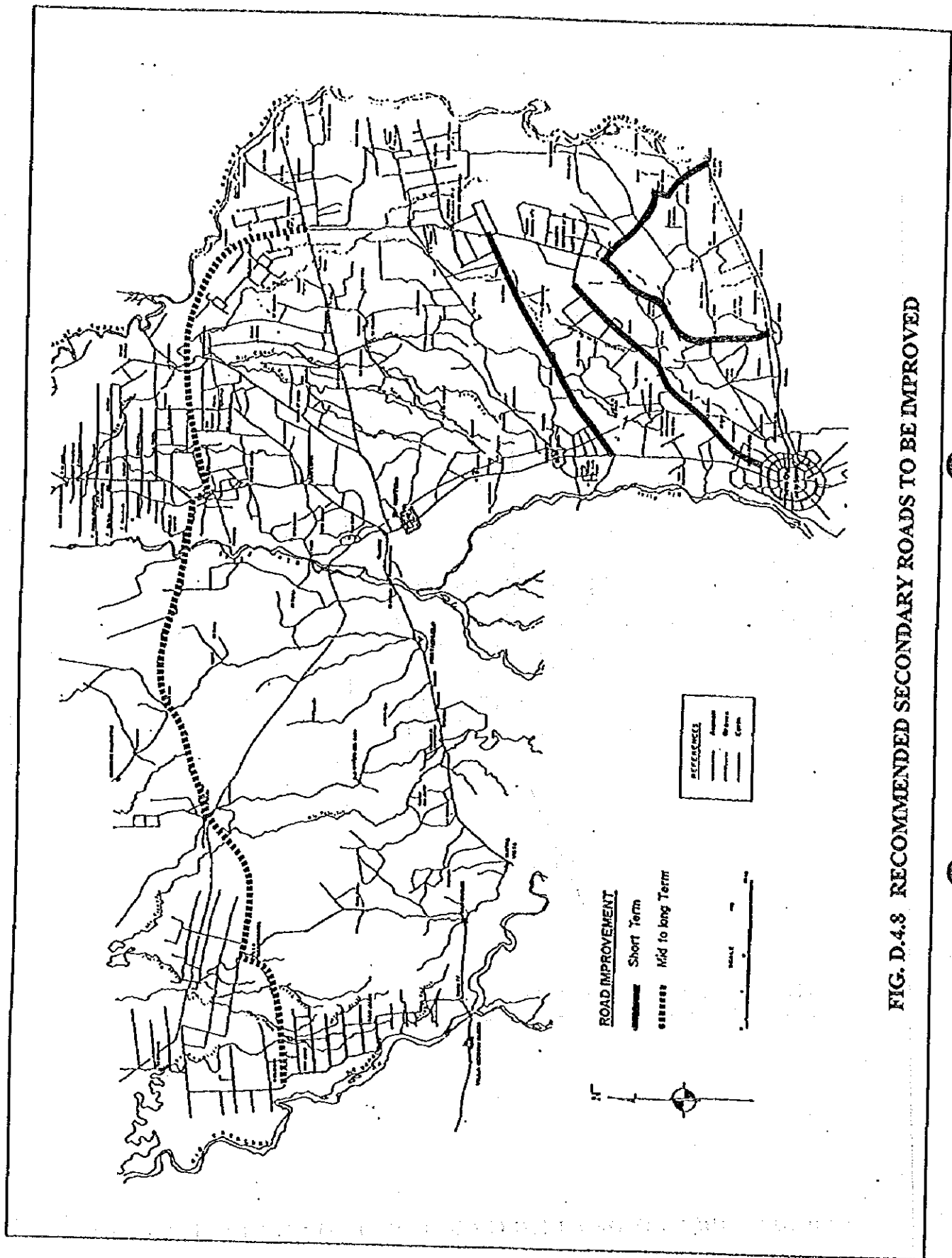
Future: EXPANSION AND INTEGRATION

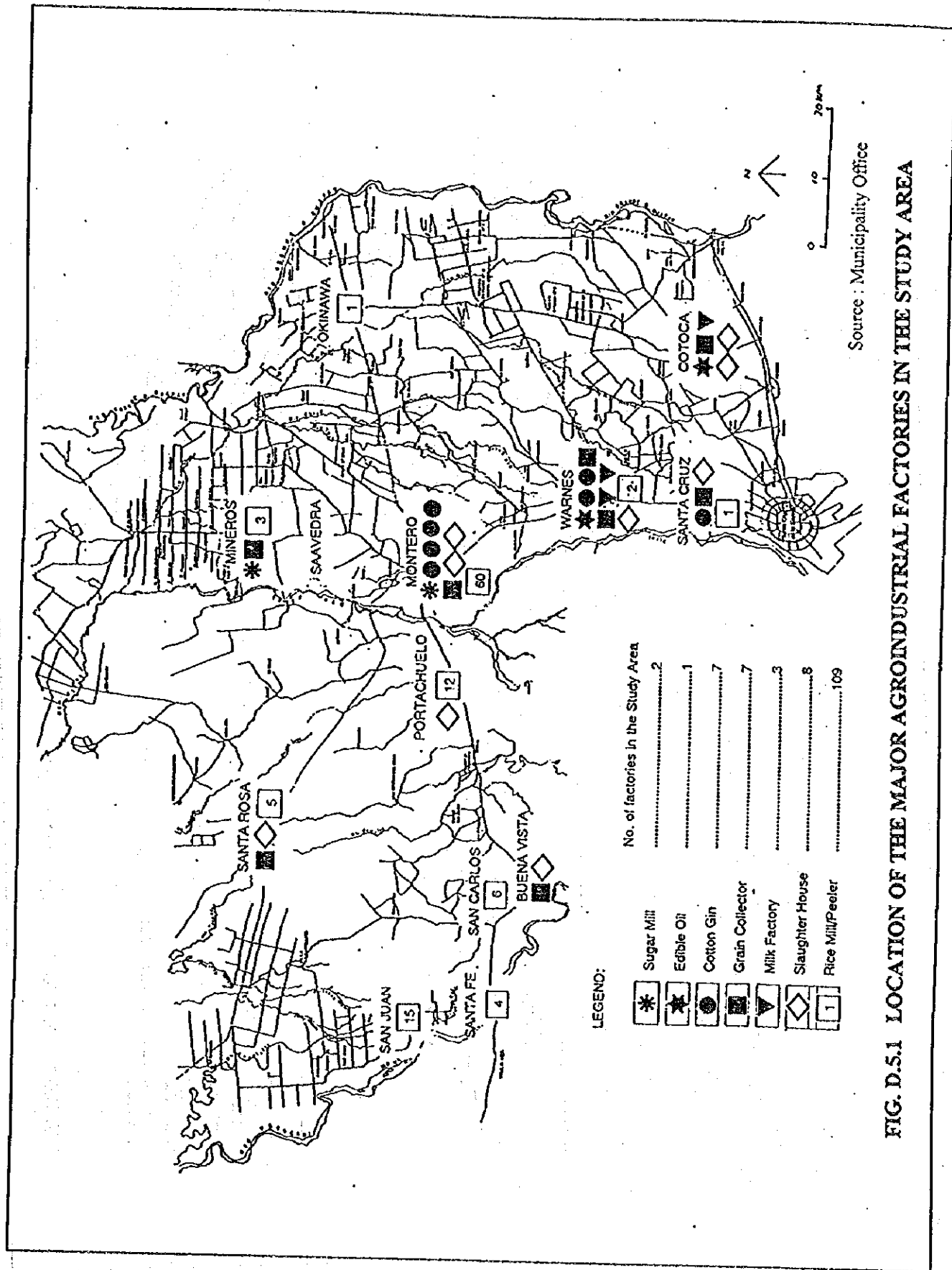


LEGEND:

- Strengthen the municipal functions
- ..... Establishment of secondary road network

FIG.D.4.7 HISTORY OF THE REGIONAL DEVELOPMENT PATTERNS(2)

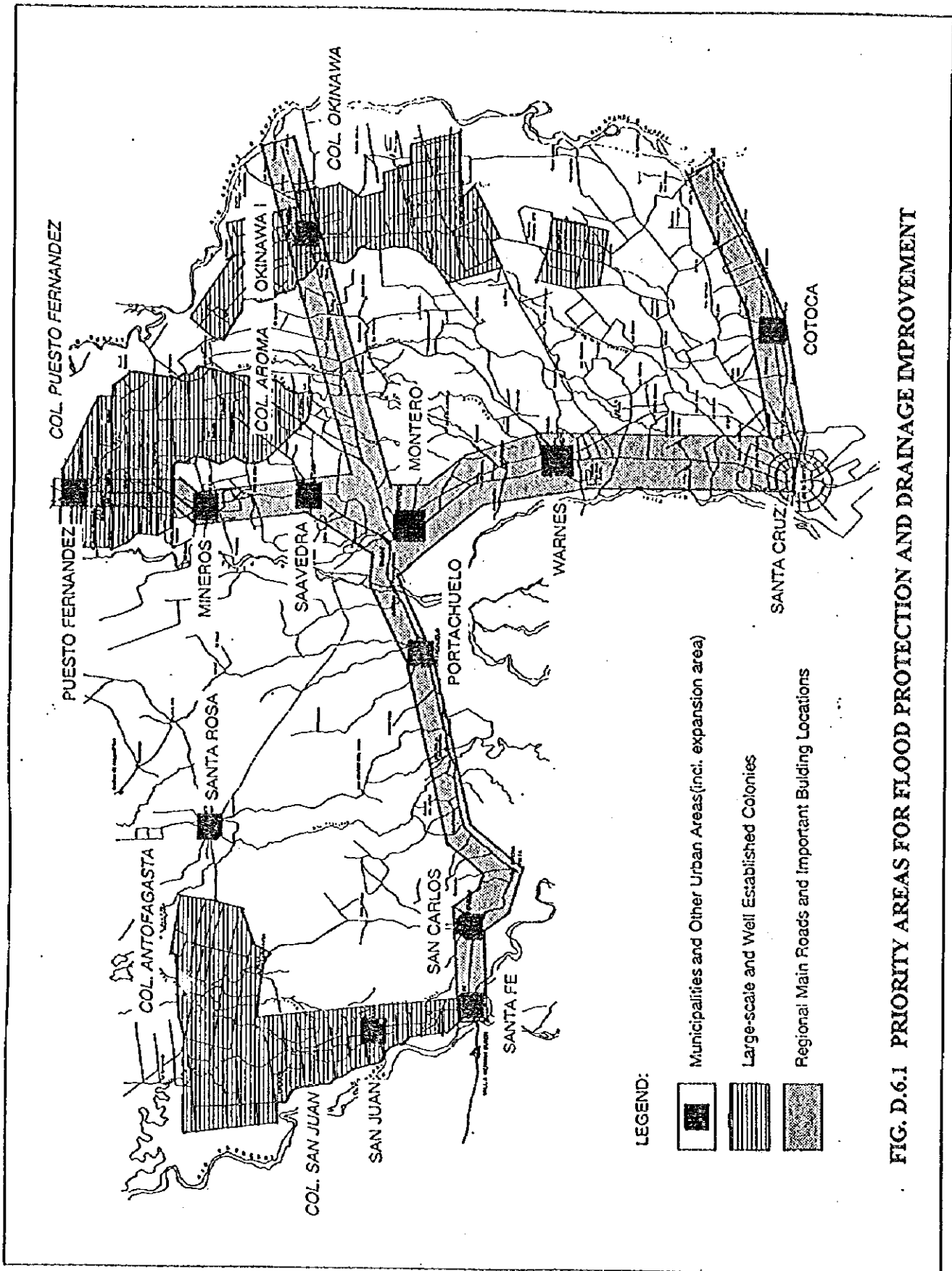







Source : Municipality Office

**FIG. D.5.1 LOCATION OF THE MAJOR AGROINDUSTRIAL FACTORIES IN THE STUDY AREA**





**LEGEND:**

-  Municipalities and Other Urban Areas (incl. expansion area)
-  Large-scale and Well Established Colonies
-  Regional Main Roads and Important Building Locations

**FIG. D.6.1 PRIORITY AREAS FOR FLOOD PROTECTION AND DRAINAGE IMPROVEMENT**

**SUPPORTING REPORT E**  
**AGRICULTURE AND LAND USE**

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## SUPPORTING REPORT E      AGRICULTURE AND LAND USE

### 1.      General

#### 1.1    Role of Agriculture in Economy

The agricultural sector in Bolivia plays an important role in the national economy, which contributes nearly one fifth of the total value added and one fourth of the total foreign exchange earning. The sector grew 2.5 % per annum from 1988 to 1992 and the share to the GDP was between 17.7 % and 19.0 % per the same period (*Table E.1.1*).

The principal crops in the Department of Santa Cruz are soybean, sugarcane, rice and maize and they contributed about 40 % of the agricultural GDP of the Department. The dominant crop was rice until 1988, but soybean after 1988.

The livestock and chicken production also have grown steadily in the period and marked the growth rates of 2.3 % and 5.9 % respectively, however, the growth rate was much less than that of the averages of agricultural GDP in the Department and its share in the GDP has decreased from 34.2 % in 1988 to 27 % in 1992.

#### 1.2    History of Agricultural Development in Santa Cruz

During 1950s the agricultural crops in the area were mostly rice and cattle for self consumption. Since 1958 a high domestic demand for rice and sugarcane, along with the construction of roads and sugar factories, generated a boom. However, by 1966 the over production of rice caused seasonal and annual fluctuation of price and decreased the profit. In addition to that, the draught period from 1968 to 1970 affected these crops seriously and the boom was over.

After the boom of rice and sugarcane, the farmer looked for a more drought resistant crop and started cotton cultivation. A high international price triggered a cotton boom that lasted until the first half of 1970s. In the first half of 1970s, a climatic change, especially increase in moisture and rainfall, caused a decrease of yields and an increase of pest control costs, which joined to the fall of international price, provoked the gradual decrease of cotton production. However, the boom left the seed of commercial agriculture in Santa Cruz.

In the beginning of 1970s; the farmer started diversification of agriculture in the study area, by taking up again old crops, such as rice and sugarcane, and the new ones, such as soybean and sorghum, and cattle raising and poultry farming.

In the mid 1980s, the development of poultry farming, which demands a large amount of high protein feed, much depended on the soybean production, along with the establishment of soybean oil factories, generated the boom of commercial agriculture.

The planted areas and agricultural development stages of the Department of Santa Cruz are shown in *Table E.1.2* and summarized as follows:

Stage	Period	Main crop
1	1954-1958	Self consumption rice and cattle
2	1958-1969	Rice and sugarcane
3	1969-1974	Cotton
4	1974-1985	Diversification,
5	1985-Present	Soybean

## 2 Existing Situation of Agriculture

### 2.1 Crop Production

The main crops in the Department of Santa Cruz and those in the study area are shown in *Tables E.2.1* and *E.2.2*. The main indexes of crop production in the Department and those in the study area are shown in *Tables E.2.3* and *E.2.4* respectively.

The main crops in the Department of Santa Cruz are soybean, sugarcane, maize and rice that are account for about 75 % of the total crop planted area. From 1990 to 1994, the production of crops increased explosively due to the expansion of planted area of soybean, except the summer soybean.

The study area is the agricultural central in the Department. The crop planted area accounts for 44 % of the whole crop planted area in the Department. The main crops in the study area are soybean, sugarcane and rice. The average annual growth rate of soybean and rice production in ton for 1990 to 1994 recorded lower than those of the

Department. However, the share of the crop production is still high (soybean: 37 %, sugarcane: 89 %, and rice: 72 %) and the study area played an important role in the agricultural GDP of the Department.

Among these main crops, soybean is by far the most widely planted, accounting for 47 % of the total main crop planted area in the study area. In the Department, the winter soybean is dominant in the area where are affected by frequent floods and heavy rainfalls in summer, and there are enough rainfall to grow soybean in winter. The winter soybean seed is produced in the area.

The summer soybean is cultivated in a well drained area to avoid a risk of root rotting caused by poor drainage. Double cropping of soybean was popular in the area, however, currently it is rotated with gramineous crops such as rice, sorghum and wheat to avoid the injury caused by the continuous cropping.

*Table E.2.5* shows the consumption of improved seed and *Table E.2.6* shows the fertilizer application ratios.

The application of improved seeds for the main crops has become popular since the later half of 1980s. However, the applications of improved seeds do not seem to have contributed to the increment of crops except maize and summer soybean in the Department. The effect of improved seeds in the study area was lower than that in the Department. The main reasons are assumed as follows:

- 1) The fertility of the soil is decreasing by the continuous cropping without applying fertilizer,
- 2) The physical condition of the soil has been distracted by compacting the soil by using heavy agricultural machinery,
- 3) The forest clearing in the upper reach has likely increase the frequency of floods and the flood damage.

To support item 1), the fertilizer is mainly applied to the seed production such as soybean, rice etc., but the application ratio is still very low.

Generally, maize, rice, and cotton are cultivated in summer, and sorghum, wheat, sunflower and kidney bean are cultivated in winter. The summer crops are harvested



in March and April and the winter crops are seeding in April and May, harvesting in September and October.

## 2.2 Livestock Production

The numbers of cattle in the Department and in the study area are shown in *Tables E.2.7 and E.2.8.*

The main livestock in the study area is cattle. The study area raised 400,000 heads of cattle in 1994 that accounted for 30 % of the livestock in the Department. The cattle varieties obtained from FEGASACRUZ (Federation de Ganaderos de Santa Cruz) and ADEPLE (Asociacion Departamental de Productores de Leche) are shown as follows:

### 1) Beef cattle

<u>Variety</u>	<u>Share (%)</u>
-Zebutine crossing	50
-Nelore	20
-Criollo (native)	15
-Others	15

### 2) Dairy cattle

<u>Variety</u>	<u>Share (%)</u>
-Holstein crossing	80
-Holstein and Brown Swiss	20

The improved pasture area is estimated to be 130,000 hectares according to FEGASACRUZ. The variety of pasture, cultivated in the study area, are Brachiaria, Mutica, Hennatria, Altisima and Brachiaria Humidicola. However, the area has been decreased recently due to the frequent floods and the poor drainage conditions.

The egg production that is mainly in the western part of the study area, becomes one of the main sectors. The area has an advantage of egg production because the area is producing a high quality feed such as the oil cake of soybean.

The swine production accounted for as high as 80 % of the Department. The share may increase higher because currently it has been started also in Okinawa area.

## 2.3 Agriculture Supporting Services

### (1) Agricultural research and extension

#### 1) Agricultural research

Agricultural researches are mainly carried out by CIAT (Tropical Agricultural Center), which is financed by a trust fund. Main items of the research are on breeding of rice, soybean, cotton, wheat. The results of the research have contributed to the improvement of agriculture by providing new varieties. The selection of citrus also was started recently.

Technical Transfer Department (TTD) of CIAT is responsible for transfer the results of research to the organizations to carry out extension services by organizing seminars, publishing technical guideline, etc.

CIAT is receiving technical assistance from the UK, JICA and Washington University, and financial assistance for specific projects from USAID and World Bank.

#### 2) Technical extension

There are four types of the organization, i.e., producer's associations, private enterprises, non-government organizations (NGO) and government projects.

##### a) Producer's organization

There are thirteen (13) producers in Santa Cruz as follows:

- ANAPO (Asociacion de Productores de Oleaginosas y Trigo)  
Product: Soybean and wheat,
- ADEPA (Asociacion Nacional de Productores de Algodon)  
Product: Cotton,
- ASOHERUT (Asociacion de Horticultores y Fruticultores)

- Product: Fruits and vegetables,
- ADEPLE (Asociacion Departamental de Productores de Leche)  
Product: Milk,
- ADA (Asociacion Departamental de Avicultores)  
Product: Poultry,
- ADEPOR (Asociacion Departamental de Porcinocultores)  
Product: Swine,
- FENCA (Federacion National de Cooperativas Arroceras)  
Product: Rice,
- FEGASACRUZ (Federacion Nal. de Ganaderos de Santa Cruz)  
Product: Cattle
- PROMASOR (Asociacion Nacional de Productores de Maize, Sorgo, Girasol y Frejol)  
Product: Maize, sorghum, Sunflower, kidney bean,
- CAO (Camara Agropecaria del Oriente)  
Product: All products,
- ASOPROF (Asociacion Nacional de Productores de Frejol)  
Product: Kidney bean,
- CNF (Camara Nacional Forestal)  
Product: Timber,
- CONALCA (Federacion de Caneros Santa Cruz)  
Product: Sugar cane.

All the associations except FEGASACRUZ have their technical departments that are responsible for provision of extension services. About 35 extension service engineers are working in these technical departments of which 40 % are of small scale. The extension service engineers have to look after 20,000 producers in the Department.

The associations do not carry out any research by themselves. They depend on CIAT or commercial sources from outside the country for such technical information. Occasionally the associations ask CIAT to carry out specific researches.

Most of the associations do not have their own pamphlets, but use those of CIAT or other commercial sources.

They provide services such as input sale and collection of products for domestic and international markets.

## 2) Private enterprises

In the Department of Santa Cruz the agro-chemicals are mostly imported from abroad. The representatives of foreign agro-chemical companies receive technical information from the farmers and carry out field studies to verify their performance under the local conditions before importing them. The importation of an agro-chemical requires to be licensed by the Ministry of Agriculture, given after conduction of field efficiency tests. CIAT is entrusted to carry out these tests.

The representatives provide technical assistance to farmers with using same method of extension services: pamphlets, seminars and demonstrations. However, the quality and quantity of technical assistance received by the farmers is variable.

## 3) Non-government organizations

NGO provides technical extension services, and mostly grant credits in inputs and not in cash to small scale farmers. The technical transfer is not the main goals of them. Their main goals are to improve the standards of living and promote the self-development of small scale farmers. There are many NGOs in the Department. Among them the important ones are as follows:

- Heifer: Dedicated to cattle breeding,
- CEDICA (Centro Educacional de Desarrollo Integral): dedicated to perennial crops and forestry,
- CIPCA (Centro de Investigacion y Promocion del Campesino):
- ICO (Instituto de Capacitacion del Oriente),
- CCM (Comite Central Menonita),

- MEDA (Asociacion Menonita de Desarrollo Economico),
- APCOB (Apoyo al Campesino Indigena Oriente).

NGO work directly with 1,108 families in 143 communities. It is assumed that NGO cover about 6 % directly of the population of the colonization area and 25 % indirectly.

NGO also carry out their own researches in various degrees: experimental and model farms.

Communication between CIAT and NGO is very casual because there are no formal technical communication channels between them.

#### 4) Government projects

Among the main government projects that provide extension services, the most important one is PRODESA (Small Scale Farmers Development Project). It is financed by FIDA (Fondo Internacional de Desarrollo Agricola), OPEP (Organizacion de Paises Expotadores de Petroleo) and CORDECRUZ, and covers an area of 170,000 ha in Antofagasta-Huaitu and Berlin Colonies, San Julian and Brecha Casa Rabe. This project provides technical assistance together with credit to 5,000 families. It ranges from US\$ 100 to US\$ 2,500. After the loan is granted, the farmer receives periodic visits by an extension service engineer.

Most of the researches in the Department are done by CIAT that does not provide the farmer with extension services directly, but transfer the results through the organizations. However, the technology transfer from CIAT to the organizations seems to have not established yet and there is no formal channel at all.

According to the field survey, 44 % of the farmers interviewed, experienced to have received the services. However, the most of small scale farmers had no experience of receiving any services.

#### (2) Agricultural credit

There are two systems for provision of agricultural credits. There are formal financing and semi-formal financing systems as follows:

1) Formal financing system

a) Banks

There are 13 banks in Bolivia that can provide agricultural credit. In the Department the agricultural credit provided by banks account Bs. 1.3 billion in 1994, which shares 82 % of the national. Of the credit, 29 % is short term loans, 37 % mid term and 34 % long term. Most of the loan is granted in foreign currency (US\$) with 18.84 % interest rate and the transaction cost (over US\$ 200 per loan) is added.

The average credit amount is more than US\$ 2,000 and guaranties over the amount and mortgage is necessary. Therefore, small scale farmer less than 50 ha can not get the loan by bank.

b) Financiera de Desarrollo Santa Cruz (FINDESA)

FINDESA, the only organization providing agricultural credit, is a department promotion bank founded by CORDECRUZ (80 %), CAO (10 %); Camara Agropecuaria del Oriente, and CAINCO (10 %); Camara de Industria y Comercio. The organization provides credit to farmers in line with the government policy.

It provides credit for agriculture activities such as tree cutting, cattle raising, crop harvests, excavation and lining of drainage channel, shipment and purchasing of agriculture machinery. The loan conditions are almost the same as the private bank as follows:

- Investment credit

Annual interest rate: 16 %,  
payment term: 2-5 years,  
mortgage guaranty: 3 times of the amount for small holder, 2 times as credit secured by personal property in Montero and Santa Cruz,

- Operative credit

Interest rate: 18 %,  
Payment term: 6-24 years,  
Guaranty: Up to US\$ 2,000, in case of large amount, guaranty should be over the amount.

(2) Semi formal financing system

-FONDECO (Fondo de Desarrollo Comunal),

-PRODEM (Fundacion para la Promocion y Desarrollo de la Microempresa)

There are many organizations that provide agricultural credit. However, there are very few chances for small scale farmers to get loan because they need guarantee and mortgage.

3. Marketing of Main Product

(1) Export

The export trends of main crops from 1984 to 1993 are shown in *Tables E.3.1 and E.3.2*. Soybean and sugar contributed much in the foreign-exchange earning, and accounted for 13.0 % of the total export earnings in 1993. The main exporting countries are those countries in the Andean group such as Colombia and Peru. Since 1985 the exports of soybean and sugar have increased at a rate of 38 % per annum. However, the percentages of production exported were decreased from 80 % in 1987 to 50 % in 1993. This means that currently the domestic consumption has been increasing.

(2) Import

The major import agricultural products are the stable foods such as cereal and flour. The imports have been increasing since 1990 (*Tables E.3.3, E.3.4 and Fig. E.3.2*). The imports became 1.5 times of the exports of soybean in 1992. These agricultural products, wheat shares a large part of the imports, are able to be produced in the study area. The expansion of wheat production in the area would contribute in the saving of foreign currency.

(3) Market price of main crops

The prices of the main crops in the past 10 years are shown in *Table E.3.5*. Those prices were fluctuated considerably during the period. It is likely that the prices will be fluctuated in the future.

The regional economy has largely depend on the production of soybean and sugar.

Considering their price fluctuation, the diversification of agriculture will be necessary to avoid the risk of their price stagnation.

(4) Situation of international market

The demand of cereal and fodder crops is to increase and induce the international market price increase because of the following reasons:

- a) According to USDA (World Agricultural Supply and Demand Estimate), the period inventory rates of cereal and fodder crops in the world have been decreasing since 1986,
- b) The population growth rate in the middle of 1980s overtook that of the crop production,
- c) From environmental point of views, regulation of agricultural inputs will be strengthened. Therefore, it is estimated that the agricultural production will decrease,
- d) Due to the economic growth of development countries, the consumption of livestock production will increase. As the result, the demand for fodder crops will increase.

(5) Agro-based industry

The agro-based industries in the study area are listed in *Table E.3.6*. In the study area, those industries play an important role not only in economy and employment but also supporting farming and poultry development.

The processing facilities of the main crops such as edible oil, soybean cake, rice and sugar, can afford to treat more materials. Especially, the running rate of the canned fruits' factories is less than 50 %. Expansion of fruits' production has a high potential in the study area.

#### 4. Land Potentiality and Land Use

##### 4.1 Land potentiality

The area by categories and their distribution are shown in *Table E.4.1* and *Fig. E.4.1*.



The land potentiality is divided into the following five categories:

<u>Category</u>	<u>Land Classification</u>	<u>Criteria</u>
1	II - III	Land suited for agriculture
2	IV	Land marginally suited for agriculture
3	V	Land suited for grazing
4	VI - VII	Land marginally suited for grazing
5	VIII	Land unsuited for any agricultural activity

The land suited for agriculture, category -1, covers 4,431 sq. km that covers 62 % of the study area and the land unsuited for agriculture, category-5, covers 30 % of the study area. The category-4 and -5 are mostly distributed along river channels and have drainage problems.

According to *Table E.2.2*, the annual cropping area is estimated to be 2,200 sq. km and the improved pasture area to be 1,300 sq. km, which are equivalent to 80 % of the category-1 area. Therefore, there is still a room to expand an intensive land use such as crop cultivation and improved pasture.

#### 4.2 Land Use

A land use map has been prepared through the Study Team, based on the LANDSAT data in 1992 and 1994, aerial photographs taken in 1995 and field surveys. The areas by land use and the existing land use are shown in *Table E.4.2* and *Fig. 7.4.2*, and summary of land use in 1984 and 1993 is shown in *Table E.4.3*.

##### (1) Characteristics of the land use

Main findings from the land use map are summarized as follows:

- 1) The forest distributes mainly in the unarable land area and along river courses, that are characterized to have poor drainage conditions.
- 2) The secondary forest distributes also in the unarable land area.
- 3) The farming lands of upland crops and sugar cane distribute mainly in the arable, but flood hazard area.

- 4) The poor drainage area classified unarable land at San Juan, etc., is partly used for upland crops by improving of drainage conditions.
- 5) The low precipitation area, the southern part of the study area, is mainly used for grazing.
- 6) The farming land of sugar cane covers the central part of the study area, in where sugar cane factories are located.

(2) Land use change

The land use data for 1993 were adjusted through the study, because the data did not cover the whole study area and also the land use categories were different from those of the data prepared by the study. The land use data for 1984 were estimated based on the crop planted areas. Major changes in the land use are summarized as follows:

- 1) The share of each land use by province shows almost no change between 1993 and 1995 except Ichilo Province.
- 2) The total agricultural land, including pasture, did not change since 1984. However, the ratio between the farming lands of crops and pasture changed largely during the period. The crop planted area was expanded, but the grazing land decreased.
- 3) Ibanez Province was different from the others. It might be that the area has not enough precipitation for crop cultivation.
- 4) The forest areas in the three stages were almost same. It is assumed that the development of agricultural land was finished in the study area by 1984.
- 5) The secondary forest areas in 1993 and in 1995 are likely corresponding to the idle land in 1984. It is suggesting that the current secondary forest areas were once developed, but later abandoned.

(3) Existing land use by zone

As results of analysis of the existing situations; natural and social condition, the area can be divided into nine zones as shown in *Fig. 7.4.3*. Flood, soil and agricultural

structure are given priority for the zoning because these three factors are related each other and affect the existing land use.

Main characteristic of zone and main factors for zoning are summarized as follows;

<u>Zone No</u>	<u>Main Character (Area)</u>	<u>Main Factor</u>
Zone-1:	Low precipitation area (Cotoca)	Rainfall
Zone-2:	Intensive upland field (Okinawa)	Agricultural structure Flood
Zone-3:	Sugarcane production area (Montero)	Agricultural structure Flood
Zone-4:	Local colony-1 (Minero)	Agricultural structure Flood
Zone-5:	New developed upland crop area (Chane)	Flood
Zone-6:	Intensive diversified agricultural area	Agricultural structure Flood
Zone-7:	Local colony -2 (Antofagasta)	Agricultural structure Flood
Zone-8:	Grazing area (Buena Vista)	Agricultural structure Soil
Zone-9:	Forest area (Sara)	Soil, Land use

## 5. Problem Identification

The questionnaire survey has been conducted by the study team in order to supplement the existing data and to identify problems in the agricultural sector.

Number of the farmers by holding size in 1984 is shown in *Table E.5.1* and *E.5.2*. The survey results are shown in *Table E.5.3*. The major findings are summarized as follows:

### (1) Inundation

72 % of the farmers interviewed have experienced flood damages. Those who are suffering floods yearly, are accounting for 93 % of them. Average depth and duration of flooding are 63 cm and 14 days.

The yields of main crops are fluctuate in the past decade, though the consumption of improved seed, especially soybean and wheat, has been increased rapidly at the same period. They are shown in *Figs. E.5.1* and *E.5.2*.

The ratio between harvest areas and seeding areas of maize, soybean, sorghum and

cotton, which are intolerant species to flooding, are lower than those of the others.

Accordingly the floods have affected the crop productivity, the selection of crops and the composition of agriculture in the study area. In order to stabilize the agricultural production and to accelerate the agricultural diversification, optimum countermeasures will be urgent.

(2) Disparity of farmers by farm size

The farm income per farm family is much different due to the farm size. There is a tendency that the smaller farmer yields the lower. According to the survey results, the main reasons are assumed as follows:

1) Selection of the same crops among different farm sizes

There is no difference in selection of crops among different farm sizes. The main crops are rice, sugarcane and soybean, which are rather advantageous for the large farmers to get profit. It means that profitable or appropriate selection of crops by farm size is required.

2) No supporting services for farmers of small scale

It seems that most of the farmers of large scale had an advantage of receiving the agricultural services such as credit and technical assistance, but most of the farmers of small scale did not have proper supporting services. The farmers of small scale applied less agricultural chemicals and less improved seeds than the farmers of large scale.

3) Low ratio of organized farmers

The ratio of the farmers who belong to the farmer's organization is 73 % in average. The organized large scale farmers are 100 %, but the organized small scale farmers are still low. It is very important for farmers to belong to the farmer's organization in order to get an appropriate technology or to get bargaining power.

(3) Agricultural diversification

Most of the farmers want to continue the same crop cultivation such as soybean, rice,

maize and sugarcane. However, there are about 10 % of the farmers that want to diversify their agriculture by introducing vegetables and fruits. Especially those among the farmers of small scale, have an intention to diversify their agriculture.

For the farmers of small scale, the diversification will be necessary in order to stabilize and to increase their farm income.

The colonies of San Juan and Okinawa are accelerating diversification of their agriculture in order to stabilize the income and to sustain the soil fertility by introducing fruits and livestock.

The diversification may be one of the effective countermeasures for sustainable development of the area.

(4) Low intensity of land use

The fallow and idle lands occupied 16 % of the available land. The efficiency of land utilization, annual cropping area per farm land, is low. The farmers of small scale cultivated their lands less than 110 %. It means that the farmers cultivate their farm lands only once a year.

(5) Degradation of soil fertility

Most of the farmers apply insecticide and herbicide, however, only 15 % of the farmers apply fertilizer, mainly to seed production. The ratio of the farmers that apply fertilizer is lower than that of the national average, as shown in *Table E.2.6*.

(6) Comparison of agricultural situation between the flood prone area and the non-flood area

The main findings are as follows:

- 1) The flood prone area is mainly distributed in the northern part of the study area.
- 2) The non-flood area produced US\$ 153 per hectare, but the flood prone area did only US\$ 113 per hectare.
- 3) On the contrary, crop yield in the flood prone area was higher.

- 4) Concerning land use, the annual crop area is high in the flood area (56 %) and the pasture is high in the non-flood area (46 %).
- 5) The ratio of harvest area to seeding area is higher in the non-flood area.
- 6) As to species, the ratio of beef cattle is high in the non-flood area (85 %), but dairy cattle is high in the flood area.
- 7) The ratio of application of agricultural inputs such as improved seeds and agricultural chemicals, is higher in the flood area.
- 8) The ratio of organized farmers is higher in the flood area.
- 9) The farmers in the flood area have a strong desire for diversification of their agriculture.

Water shortage in the non-flood area is affecting the land use and the productivity because there is frequent drought damage to crops in the non-flood area.

The flood area is characterized as to be more fertile and apply more agricultural input than the non-flood area. The flood area seems playing a central role in the agricultural production.

## **6. Basic Development Concept**

### **6.1 Existing Agricultural policy**

The Development Plan of the Department of Santa Cruz was prepared by CORDECRUZ in 1995. The targets and policies concerned to the agriculture sector are summarized as follows:

#### **(1) Target**

The GDP growth rate of the whole country is set to maintain 5 % level. The main sectors expected to contribute to the target are mining, agriculture, livestock, timber and agroindustry. In order to achieve it, environmental conservation and sustainable development of resources should be duly considered.

## (2) Agricultural policy

The main agricultural policies to achieve the targets are as follows:

- 1) Enforcement of research and technical extension service to improve human resources,
- 2) Increment of budget for agricultural research,
- 3) Improvement of sanitary control for crop and livestock,
- 4) Improvement of secondary road to secure transportation for agricultural products,
- 5) Improvement of agricultural credit for medium and small scale farmers,
- 6) Establishment of land policy to guarantee land ownership and prepare land for landless farmers,
- 7) Management of smuggle,
- 8) Improvement of technical formation to train technicians,
- 9) Decentralization of agricultural supporting services,
- 10) Reforestation in the unarable land to prevent soil degradation,
- 11) Extending a forest concession for sustainable use of the resources.

## 6.2 Basic Development Concept

The basic development concept for the study is summarized in *Fig. E.6.1*. The target is to achieve sustainable development by the execution of optimum countermeasures.

There are several problems to be overcome in order to achieve sustainable development.

## 7. Development Plan

### 7.1 Development Plan by Zone

In order to stabilize regional economy, the mitigation of flood and drainage problems

of the area will be indispensable. At the same time, in order to sustain economic growth, the following measures will be necessary.

- 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 for inundation area

For implementation of the development plan, improvement of agricultural extension services such as technical extension and credit should be necessary. Especially improvements of technical extension services for small scale farmers are essential, because they will play an important role for diversification.

Main existing situation and the development plan by zone are summarized in *Table E.7.1*, and detail of the existing situation and countermeasures of agriculture explain as follows:

(1) Zone-1: Low precipitation area (Cotoca)

1) Existing Situation

- Pasture is dominant in the land use because of low precipitation and sandy soil. The characteristic of agriculture structure is that the area is consisting of small scale farmers and they run the same agriculture as the large scale farmers, which need a large farm land to get a certain amount of farm income for continuous running.
- Forest distributes along river courses and in the unarable land.

2) Countermeasure

- The disparity of farm income among the farming scales is a problem. In order to improve the farm income among the small scale farmers, a high productive crop with labor intensive like fruits should be introduced.
- The expansion of perennial crops in the area will improving the land use condition from flood control aspects.

- Leguminous forage tree such as *Leucaena*, drought resistance tree, should be



introduced for increasing livestock productivity.

- As countermeasures for the shortage of water, drought resistant crop and water resources development for providing supplemental water during seeding stage should be studied.

(2) Zone-2: Intensive upland crop area (Okinawa)

1) Existing Situation

- The dominant land use is upland field. The major crop is soybean, accounting for 70 % of the crop field. The second is wheat in winter and the third upland rice in summer. The crop productivity has been decreasing because of continuous cropping without application of fertilizer. The yields are still high in the Department because of its fertile soil. Forest is distributed only along river courses.
- The area plays an important role in the regional economy through the agricultural production. However, large part of the area is suffering from floods and poor drainage problems. In order to stabilize the agricultural production of the area, it should be indispensable to mitigate flood and drainage problems of the area.

2) Countermeasure

- In order to overcome the degradation of farming conditions, appropriate crop rotation such as the rotation of leguminous crop and gramineous crop should be necessary.
- The area largely depends on soybean. In order to avoid the risk of the price fluctuation, diversification of the agriculture should be required.  
The diversification of agriculture will likely contribute to sustain a high agricultural growth rate of the Department.

(3) Zone-3: Sugarcane production area (Montero)

1) Existing Situation

- The most widespread land use is cropping of sugarcane, because the soil is suited

for sugarcane production. Many sugar factories have been established in the zone. The main problems are decreasing of the productivity because of continuous cropping of sugarcane.

- The northern part of the area is suffering from floods and poor drainage problems. In order to stabilize the agricultural production of the area, it should be indispensable to mitigate flood and drainage problems of the area.

2) Countermeasure

- In order to sustain the productivity, appropriate crop rotation should be required.

(4) Zone-4: Local colony-1 (Minero)

1) Existing Situation

- The area consists of small scale farmers, producing rice, soybean and sugarcane. However, the area is affected by floods from the Rio Pirai and Rio Chane and tributaries.

2) Countermeasure

- In order to mitigate the flood problems, it will be necessary to introduce water tolerant variety and crop, because structural measures might not be feasible.

(5) Zone-5: New developed upland crop area (Chane)

1) Existing Situation

- It is new developed field with fertile soil and the crop productivity is very high, but located in the frequent flood hazard area. The main land use is sugarcane and upland field and the products are soybean and rice.

2) Countermeasure

- It will be necessary to introduce flood tolerant varieties and crops, because the required structural measures will be costly and might not be feasible.
- The area remains high productivity, but there are the same possibilities of

decreasing of yield and soil fertility as the zone-2 and -3. In order to avoid the problems, appropriate crop rotation, diversification of agriculture and soil management technology should be introduced.

**(6) Zone-6: Intensive diversified agricultural area (San Juan)**

**1) Existing Situation**

- The agriculture in the area is already diversified, however the area has flood and poor drainage problems. The main land use is upland field, accounting for more than 79 % of the area.

**2) Countermeasure**

- By mitigation of such problems, further diversification by expanding perennial crops will be possible and accelerate sustainable agriculture.

**(7) Zone-7: Local colony-2 (Antofagasta)**

**1) Existing Situation**

- The area is suffering from flood and poor drainage problems. In order to stabilize the area, it should be indispensable to mitigate flood and drainage problems of the area.
- The area is consisting of small scale farmers, producing rice in summer and soybean in winter.
- The area needs to promote diversification their agriculture and.

**(8) Zone-8: Grazing area (Buena Vista)**

**1) Existing Situation**

- Most of the area is consisting of grazing land and forest because of low fertile soil.
- The area has no serious flood problems.

2) Countermeasure

- Agriculture in the area can not change because most of the area is unsuited for crop cultivation. Therefore, improvement of pasture is necessary to increase productivity.

(9) Zone-9: Forest area (Sara)

1) Existing Situation

- The timber resources are going to exhaust in the area because most of useful timber already cut. However, most of the area can not be used for agricultural activity because soil is unsuitable for crop cultivation.
- There has no serious flood problems.

2) Countermeasure

- Useful timber tree should be reforested to sustain forest industry in the area. Main recommended species for the reforestation are Mara (*Swietenia macrophylla*), Roble (*Amburana cearensis*), Cedro (*Cedrela Sp.*), Cerebó (*Schizolobium paraibium*) and Ochoó (*Hura crepitans*).

## 7.2 Protection Forest along River Course

The forest has an important role for conservation of soil and water resources and conservation of fauna and flora. The forest area has been decreased by development, however, it should be conserved from flood mitigation and environmental protection aspects.

1) Protection forest along the Rio Grande, Rio Pirai and Rio Yapacani

The Forest Regulation (Art. 15) rules that forest should be protected in the area of 500 m wide along the river. It is planned that 1 km wide forest on either bank should be conserved because of flood mitigation and conservation of fauna and flora, as proposed in the Map of Land Use Plan prepared by CORDECRUZ.

## 2) Protection forest along river course in the tributary area

The Forest Regulation rules that forest should cover at least 20 m wide around the river.

It is planned that 100 m wide forest on either bank should be conserved from flood mitigation and environmental conservation aspects, because average natural vegetation along the small rivers in the study area is about 100 m on either river bank according the land use survey.

### 7.3 Agriculture Demonstration Center

In Bolivia, there are many areas where have severe limitations for crop cultivation like San Juan. Of these area, San Juan is the most developed area harmonized with natural conditions.

Farmers of the area is well organized and receive enough benefit from the farmer's organization. Farm infrastructures in the area are well improved and managed by the organization, and post harvest such as agro-industry and collecting system are also organized. Cooperation of Sun Juan, therefore, can be said a model of farmers organization.

According to the questioner survey, most of small scale farmer do not organized and do not know the importance of organization.

Therefore, it is recommend that agricultural center should be established in San Juan to understand importance of organization for small scall farmer as following:

- Management of the organization,
- Activities and role of the organization ,
- Distribution of technical information,
- Magement of farm infrastrucutres.

### 7.4 Research on Water Tolerant Variety

According to the interview survey results, there are many zone where are damaged by flood every year; Zone 4, 5 and 7, and these areas are very difficult to improve the situation.

Therefore, water tolerant variety is necessary to continue agricultural activity in these areas.

Most of them grow rice during rainy season mainly for self consumption and most of farmers leave these field fallow. The yield of rice is very low and others are little.

CIAT has released high yield varieties and has contributed to increase crop productivity. However, water tolerant variety suited for the area is necessary to improve the situation. It is recommended that research on appropriate variety for severe flood areas should be urged by CIAT.

### **7.5 Land Use Plan**

The section summarize the development plan concerning land use mentioned above.

Main changes implementing the proposed plan expect as follows :

- 1) The existing forest area should conserve because the area is not suited for agricultural land use and it plays important roles in flood water retention and conservation of environment.
- 2) Forest area along river should widen ; 1 Km on either big river bank and 100 m on either small river bank, to protect rivers and conserve fauna and flora.
- 3) The agricultural land, crop field and grazing, will not change because the existing areas distribute to the suited area.
- 4) Crop planted area will expand because land use efficient ratio is increased to flood free area after the countermeasures.
- 5) Agricultural production will be diversified by expanding appropriate technology and the productivity will also increase to avoid the damage of continuous cropping.
- 6) High productive crops such as fruits will expand in flood free area and for small scale farmer.

### **7.6 Effect on Agriculture Production**

According to the agriculture production in the study area, GRP of the area estimates

about 55 % of agriculture GRP in the department.

In the department, main agriculture productions are soybean, sugarcane and rice, together sharing 32 % of the departmental agriculture GRP. They also are main crop in the study area, sharing 89 % of total planted area. However, their yield is decreasing and production also decrease without soybean and the area can not contribute to the economic growth targeted by the government if the situations are continue.

Otherwise, the situations such as inundation and supporting survives will be improved by implementing the project. Especially flood damage will alleviate and flood free area will expand.

As a result of the project, the following effects are expected :

- 1) Production will expand by increasing productivity ,
- 2) High productive crop such as fruits will expand, and it will induce farther development of agro-industry and saving foreign currency,
- 3) The ratio of land use efficiency; ratio of dabble cropping area, will expand, then planted area will increase,
- 4) Expanding appropriate crops and technology, land productivity will increase,
- 5) Post harvest damage by flood such as deterioration of road condition will improve and factory will be able to get materials steadily.

The area will much contribute to the growth of the country by achieving above improvements.

**TABLES**





TABLE E.1.1 ANALYSIS OF AGRICULTURAL GDP OF BOLIVIA AND SANTA CRUZ

	1988	1989	1990	1991	1992	Average Annual Growth Rate %
National GDP						3.9
Agricultural GDP / National GDP	18.7	18.1	18.1	19.0	17.7	2.5
STC GRP / National GDP	27.3	27.4	28.2	28.6	28.4	4.8
Agricultural GRP STC / Agricultural GDP	27.3	29.5	31.2	34.5	33.9	8.2
Agricultural GRP STC / GRP STC	18.6	19.5	20.1	23.0	21.1	4.8
Share of Main Subsector in Agricultural GRP of STC						
Soybean	7.5	14.3	10.6	14.2	12.0	22.4
Sugarcane	9.2	9.0	11.3	13.8	11.3	15.1
Rice	10.2	8.6	10.2	8.2	8.3	3.8
Maize	5.1	5.3	3.4	6.2	7.6	20.8
Wheat	0.4	1.1	3.0	2.4	4.5	99.0
Livestock	29.1	27.0	25.3	21.0	22.5	2.3
Chicken	5.1	5.1	5.2	4.1	4.5	5.9
Total	66.6	70.3	68.9	70.0	70.8	10.8

Source : CUENTAS REGIONALES, SECTOR AGROPECUARIO 1988 - 1992

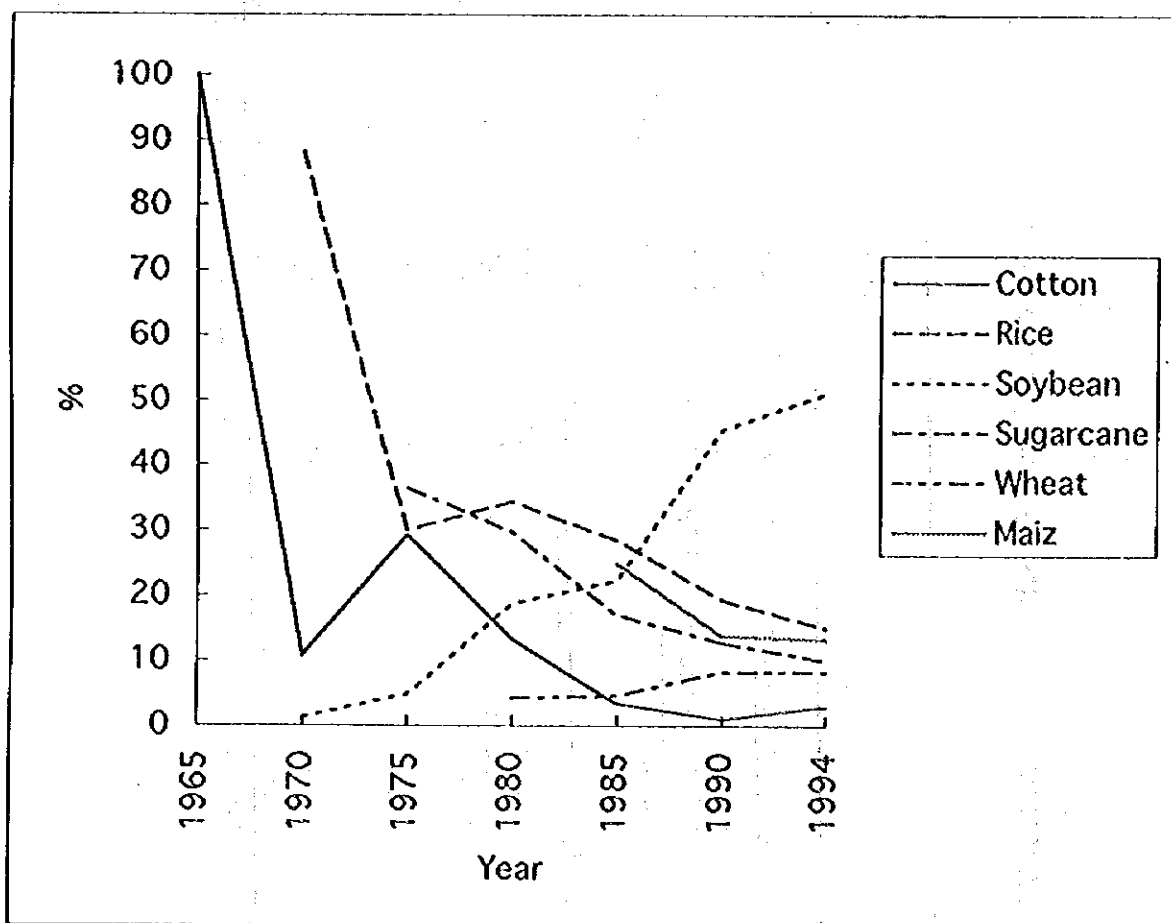
**TABLE E.1.2 CHANGE OF PLANTED AREA**

(Unit : 1,000Ha)

	1965	1970	1975	1980	1985	1990	1994
Cotton	3.5	7.2	50.0	24.9	9.5	3.6	19.0
%	100	11	29	13	3	1	3
Rice		59.1	51.4	64.4	80.0	73.0	96.5
%		88	30	34	28	19	15
Soybean*		0.8	8.3	35.0	63.0	172.3	331.0
%		1	5	19	22	45	51
Sugarcane**			62.3	55.7	47.6	48.0	64.4
%			36	30	17	13	10
Wheat				8.0	13.0	31.2	53.6
%				4	5	8	8
Maize					70.0	52.0	85.0
%					25	14	13
Total	3.5	67.1	172.0	188.0	283.1	380.1	649.4

\* : 1971 \*\* : 1974

Source : CAO



**CHANGE OF PLANTED AREA**

TABLE E.2.1 MAIN CROP PRODUCTION IN SANTA CRUZ

	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
<b>Cotton fiber</b>											
ha	5,741	9,478	10,831	7,463	9,710	1,215	3,555	16,523	26,000	11,400	19,000
qq/ha	8.99	7.01	7.65	8.38	7.26	13.52	12.09	11.20	5.10	14.67	10.00
qq		51,607	66,462	82,876	62,574	70,506	16,425	41,145	185,058	133,640	167,237
<b>Cotton seed</b>											
ha	5,741	9,478	10,831	7,600	9,400	1,200	3,500	16,500	26,000	11,799	19,000
t/ha	0.63	1.01	0.87	0.80	0.80	0.67	0.65	0.60	0.50	0.79	0.70
t	3,617	9,573	9,423	6,080	7,520	804	2,275	9,900	13,000	9,336	133,000
<b>Rice</b>											
ha	60,000	80,000	37,000	50,000	65,000	58,500	73,000	73,000	73,000	85,717	96,500
t/ha	2.11	2.11	2.67	2.68	2.11	2.29	2.50	2.50	2.93	1.90	2.00
t	126,600	168,800	98,790	134,000	137,150	133,965	182,500	182,500	213,890	162,862	193,000
<b>Maize</b>											
ha	50,000	70,000	45,000	32,000	37,500	35,000	52,000	40,000	80,000	83,000	85,000
t/ha	2.05	2.20	2.30	2.30	2.07	2.50	1.10	3.60	2.16	3.60	3.18
t	102,500	154,000	13,500	73,600	77,625	87,500	57,200	144,000	172,800	298,800	270,300
<b>Wheat</b>											
ha	9,000	12,960	10,000	6,500	4,000	13,316	30,219	36,614	63,614	35,115	53,550
t/ha	1.00	1.00	0.47	1.15	0.87	0.81	1.61	1.32	1.52	0.96	1.41
t	9,000	12,960	4,741	7,500	3,500	10,864	48,951	48,400	96,514	33,590	75,505
<b>Frejol</b>											
ha	3,000	5,000	400	670	800	1,500	7,880	18,000	8,000	4,500	5,000
t/ha	1.20	1.20	1.25	1.20	1.20	1.20	1.20	0.70	0.70	0.80	0.76
t	3,600	6,000	5,000	804	960	1,800	9,456	12,600	5,600	3,600	3,800
<b>Sun flower</b>											
ha				40	80	350	10,217	21,500	20,155	23,031	60,000
t/ha				0.60	0.80	0.80	1.16	1.37	1.27	1.22	0.96
t				24	64	280	11,870	29,500	25,572	28,055	57,600
<b>Soy bean (W)</b>											
ha	14,000	12,000	12,358	12,500	20,000	30,000	32,334	45,000	27,600	65,231	89,000
t/ha	1.00	1.01	1.18	1.01	0.70	1.50	1.69	1.60	2.11	1.50	1.50
t	14,000	12,120	14,579	12,600	14,000	45,000	54,781	72,000	58,299	97,847	133,500
<b>Soy bean (S)</b>											
ha	36,316	51,000	50,800	53,878	60,000	110,000	140,000	150,000	164,920	174,923	242,000
t/ha	2.10	1.70	2.50	1.71	2.00	2.20	1.29	2.13	1.52	2.38	2.45
t	76,255	86,790	127,000	92,200	120,000	242,000	180,000	320,000	250,367	415,508	592,900
<b>Sugar cane</b>											
ha	47,727	47,624	42,000	40,000	40,000	38,435	47,995	70,000	64,000	64,354	64,354
t/ha	37.48	33.18	24.61	32.24	33.78	35.45	44.16	45.00	40.00	30.73	28.66
t	1,788,808	1,580,164	1,033,620	1,289,600	1,351,200	1,362,521	2,119,459	3,150,000	2,560,000	1,977,415	1,844,214
<b>Sorghum</b>											
ha	6,000	17,000	12,000	6,000	10,500	15,360	24,000	14,500	15,000	35,000	23,500
t/ha	3.00	3.50	3.90	3.00	3.00	2.50	1.50	3.20	2.80	2.79	2.07
t	1,800	59,500	46,800	18,000	31,500	38,400	36,000	46,400	42,000	97,650	48,645
<b>Total ha</b>	<b>237,525</b>	<b>314,540</b>	<b>231,220</b>	<b>216,651</b>	<b>256,990</b>	<b>304,876</b>	<b>424,700</b>	<b>501,637</b>	<b>568,289</b>	<b>594,070</b>	<b>756,904</b>

Source: CAO

**TABLE E.2.2 MAIN CROP PRODUCTION  
IN THE STUDY AREA**

		89/90	90/91	91/92	92/93	93/94
Cotton fiber 1)	ha			1,025	898	5,090
	qq/ha			10.82	7.37	11.06
	qq			11,091	6,618	56,281
Cotton seed 1)	ha			1,025	898	5,090
	t/ha			0.58	0.51	0.51
	t			590	458	2,589
Rice 2)	ha		50,000	71,717	74,500	69,350
	t/ha		2.93	1.90	2.00	2.00
	t		146,500	136,262	149,000	138,700
Maize 3)	ha			7,900	7,900	11,900
	t/ha			3.70	3.27	3.60
	t			29,230	25,833	42,830
Wheat 4)	ha	10,684	7,084	10,192	4,600	9,500
	t/ha	1.62	1.57	1.53	1.80	1.95
	t	17,343	11,089	15,642	8,280	18,525
Sunflower 4)	ha			2,960	3,670	8,250
	t/ha			1.08	1.49	1.09
	t			3,208	5,483	9,001
Soybean	ha	31,579	42,820	24,003	63,643	88,000
	t/ha	1.69	1.60	2.14	1.51	1.50
	t	53,369	68,512	51,366	96,073	132,000
Soybean(S) 4)	ha	46,477	44,450	46,535	42,057	57,265
	t/ha	1.27	2.13	1.52	2.22	2.37
	t	59,026	94,679	70,733	93,435	135,491
Total Soybean 4)	ha	78,056	87,270	70,538	105,700	145,265
	t/ha	1.44	1.87	1.73	1.79	1.84
	t	112,394	163,191	122,100	189,509	267,491
Sugarcane 5)	ha	47,994	69,999	57,152	57,468	57,468
	t/ha	44.16	45.00	40.00	30.73	28.66
	t	2,119,420	3,149,960	2,286,080	1,765,995	1,647,036
Total Planted Area	ha	158,739	201,506	221,800	254,736	306,823

Source: 1) ADEPA 2) FENCA 3) PROMASOR 4) ANAPO 5) OTAI

**TABLE E.2.3 MAIN INDEX OF CROP PRODUCTION  
IN SANTA CRUZ**

	Average Annual Groth Rate			Planted Area	
	90 - 94			Ratio	Ratio
	Area	Production	Yield	89/90	93/94
	%	%	%	%	%
Soybean (W)	58.8	24.9	-2.9	7.6	11.8
Soybean (S)	14.7	34.7	17.4	33.0	32.0
Total Soybean	17.7	32.6	7.3	40.6	43.7
Sugarcane	7.6	-3.4	-10.2	11.3	8.5
Maize	13.1	47.4	30.4	12.2	11.2
Rice	7.2	1.4	-5.4	17.2	12.7
Cotton	52.0	46.6	-4.6	0.8	2.5
Sorghum	-0.5	7.8	8.4	5.7	3.1
Wheat	15.4	11.4	-3.3	7.1	7.1
Frejol	-10.7	-20.4	-10.8	1.9	0.7
Total	15.5				

Source : CAO

**TABLE E.2.4 MAIN INDEX OF CROP PRODUCTION  
IN THE STUDY AREA (1990-94)**

	Average Annual Growth Rate			Area 94 %	Share of STC in 93/94		
	Area	Production	Yield		Area	Yield	Production
	%	%	%		%	%	%
Soybean(W) 1)	29.2	25.4	-2.9	29	99	100	99
Soybean(S) 1)	5.4	23.1	16.8	19	10	97	23
Total Soybean 1)	16.8	24.2	6.3	47	44	84	37
Sugarcane 2)	4.6	-6.1	-10.2	19	89	100	89
Maize 3) *	22.7	21.0	-1.4	4	14	113	16
Rice 4) **	11.5	-1.8	-12.0	23	100	100	72
Cotton 5) *	122.8	125.3	1.1	2	27	111	30
Total					44.0		

Source : 1) ANAPO 2) OTAI 3) PROMASOR 4) FENCA 5) ADEPA

\*: 1991/92 - 93/94 \*\*: 1990/91 - 93/94

**TABLE E.2.5 CONSUMPTION OF IMPROVED SEED IN SANTA CRUZ**

(Unit: Ton)

	Soybean	Wheat	Maize	Kidney bear	Rice
1987	4,333	379	655	2	653
1988	7,942	522	479	19	268
1989	11,196	605	425	21	270
1990	11,824	2,070	393	144	96
1991	12,030	2,030	861	665	115
1992	12,825	4,552	151	398	775
1993	14,006	4,120	821	58	394

Source : Annual Estadístico del Sector rural 1994

**TABLE E.2.6 RATIO OF FERTILIZER APPLICATION AREA TO PLANTED AREA (89/90)**

		Cereals	Industrial Crop	Fruits	Horticulture	Tuber
Santa Cruz	Ha	5,699	28,046	49	3,276	4,094
	%	3.2	11.9	9.8	31.6	2.8
Bolivia	Ha	124,770	29,449	3,652	38,694	129,823
	%	19.0	13.9	46.6	0.0	69.4

		Soybean	Maize	Rice	Sugarcane	Wheat
Santa Cruz	Ha	22,592	209	1,923	5,453	3,567
	%	16.6	0.1	1.8	8.6	4.2
Bolivia	Ha	23,343	68,533	2,072	5,453	26,216
	%	16.3	26.7	1.9	2.9	31.2

Source : Annual Estadístico del Sector rural 1994

**TABLE E.2.7 LIVESTOCK PRODUCTION IN SANTA CRUZ**  
(Number of Slaughtered Head)

	1989	1990	1991	1992	1993	Study Area
<b>Bovine</b>						
head	144,993	130,631	136,610	139,583	146,444	
t	20,780	33,670	35,640	24,357	26,489	
<b>Pork</b>						
head	35,299	29,612	33,841	36,850	39,039	31,231
t	2,093	1,857	2,126	2,294	2,495	1,996 1)
<b>Chicken</b>						
head	5,054,000	7,153,582	7,889,393	6,717,915	12,528,391	642,950
t	5,750	7,154	7,889	11,386	22,551	2)
<b>Chickin (Egg)</b>						
	535,500	731,000	1,170,875	1,095,140	1,027,981	516,850
t	1,071	1,462	2,342	2,190	2,056	2)
1,000 und	153,950	268,734	360,258	373,510	356,958	
<b>Milk</b>						
Head	55,556	62,659	66,484	66,680	67,324	
1,000 l	78,041	83,232	90,469	93,844	102,669	49,500 3)

Source: CAO 1) ADEPOR 2) ADA 3) ADEPLE

**TABLE E.2.8 NUMBER OF CATTLE IN SANTA CRUZ AND STUDY AREA**

(Unt:Head)						Study 1) Area
Santa Cruz						
1989	1990	1991	1992	1993		
1,344,267	1,353,072	1,369,986	1,408,960	1,365,801	400,000	

Source: Bolivia Anuario Estadístico del Sector Rural 1994

1) FEGASACRUS



**TABLE E.3.1 SHARE OF MAIN CROP IN VALUE OF EXPORT**

(Unit : 1,000 US\$)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Sugar	6,649	1,765	4,853	8,565	6,292	19,287	31,710	30,807	25,261	18,485
%	0.9	0.3	0.8	1.5	1.1	2.4	3.4	3.6	3.5	2.5
Cotton	0	0	0	0	0	0	0	13,061	6,533	10,330
%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.9	1.4
Soybean	1,527	5,309	18,741	19,204	20,233	54,280	48,168	69,324	51,504	68,916
%	0.2	0.8	2.9	3.4	3.4	6.6	5.2	8.2	7.2	9.1
Share %	1.1	1.1	3.7	4.9	4.4	9.0	8.6	13.3	11.7	13.0

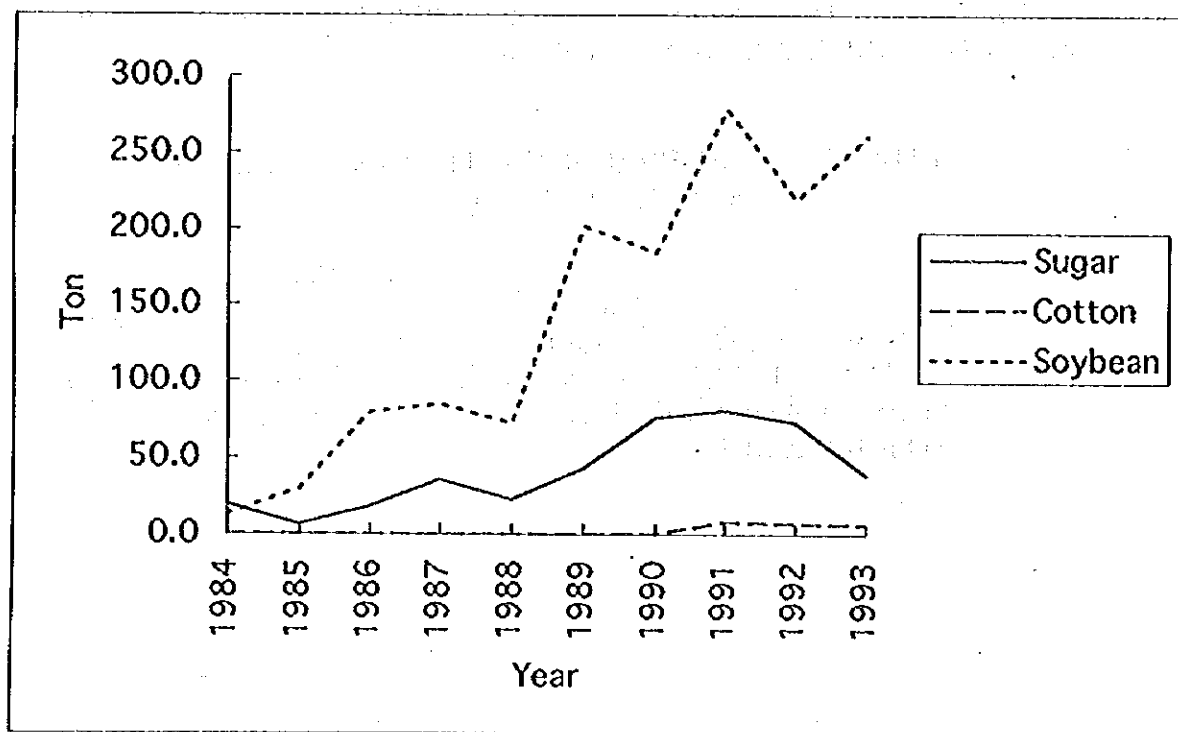
Source : Bolivia Anuario Estadístico del Sector Rural

**TABLE E.3.2 EXPORT OF MAIN CROP PRODUCTS IN VOLUME**

(Unit : 1,000 T)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Sugar	19.0	6.0	17.5	35.1	22.3	42.5	75.5	80.4	72.6	38.7
Cotton	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	6.9	6.3
Soybean	12.5	29.3	79.1	84.3	72.2	201.1	184.0	277.9	218.7	260.6

Source : Bolivia Anuario Estadístico del Sector Rural



Source : Bolivia Anuario Estadístico del Sector Rural

**EXPORT OF MAIN CROP PRODUCTS**

**TABLE E.3.3 IMPORT OF MAIN AGRICULTURAL PRODUCTS IN VALUE**

(Unit : 1,000 US\$)

	1988	1989	1990	1991	1992
Cereals	20,775	26,568	23,706	32,170	39,642
Flours	13,562	33,701	25,765	27,358	39,311
Edible oil	4,532	7,961	3,750	3,920	8,266
Milk, egg	4,991	11,775	4,341	9,650	9,318
Tabaco	3,147	3,375	2,709	4,032	2,245
Sub-Total	47,006	83,380	60,270	77,129	98,781
Share* (%)	8.0	13.4	8.6	7.8	8.0

\*: Sub-Total / Total Value X 100

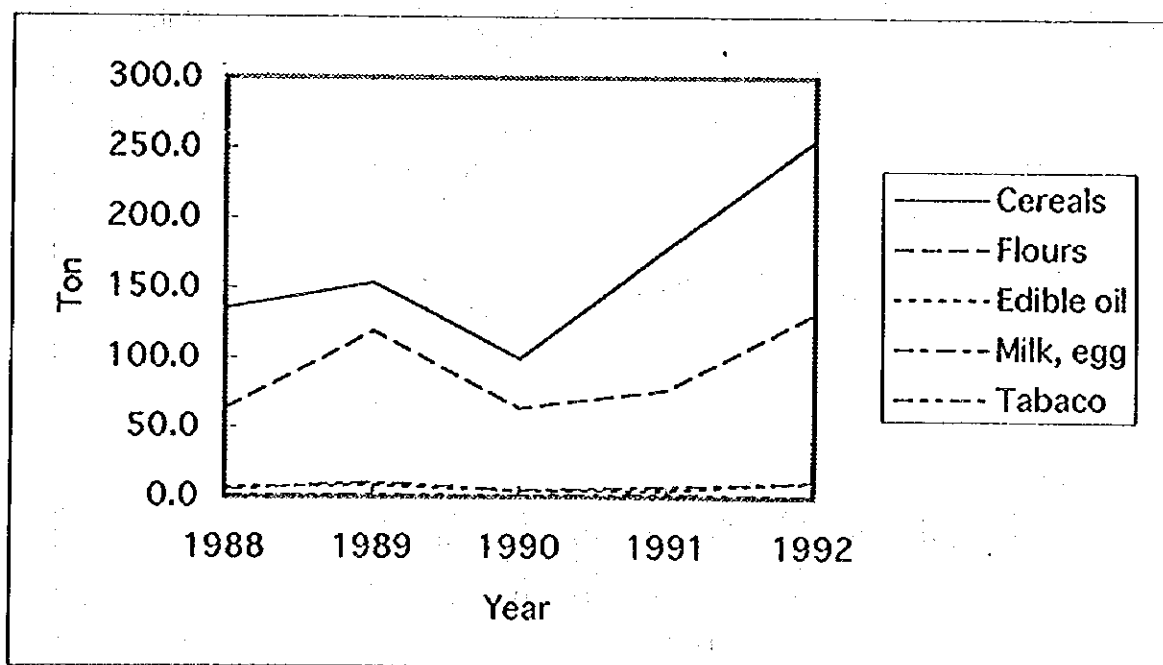
Source : Bolivia Anuario Estadístico del Sector Rural 1994

**TABLE E.3.4 IMPORT OF MAIN AGRICULTURAL PRODUCTS IN VOLUME**

(Unit : 1,000 Ton)

	1988	1989	1990	1991	1992
Cereals	134.8	153.2	99.3	178.4	254.4
Flours	63.1	118.9	63.6	76.4	131.0
Edible oil	6.6	7.7	3.8	3.7	10.2
Milk, egg	5.0	9.4	3.7	6.5	9.6
Tabaco	1.1	0.8	0.5	1.3	0.5

Source : Bolivia Anuario Estadístico del Sector Rural 1994



Source : Bolivia Anuario Estadístico del Sector Rural 1994

**IMPORT OF MAIN AGRICULTURAL PRODUCTS IN VOLUME**

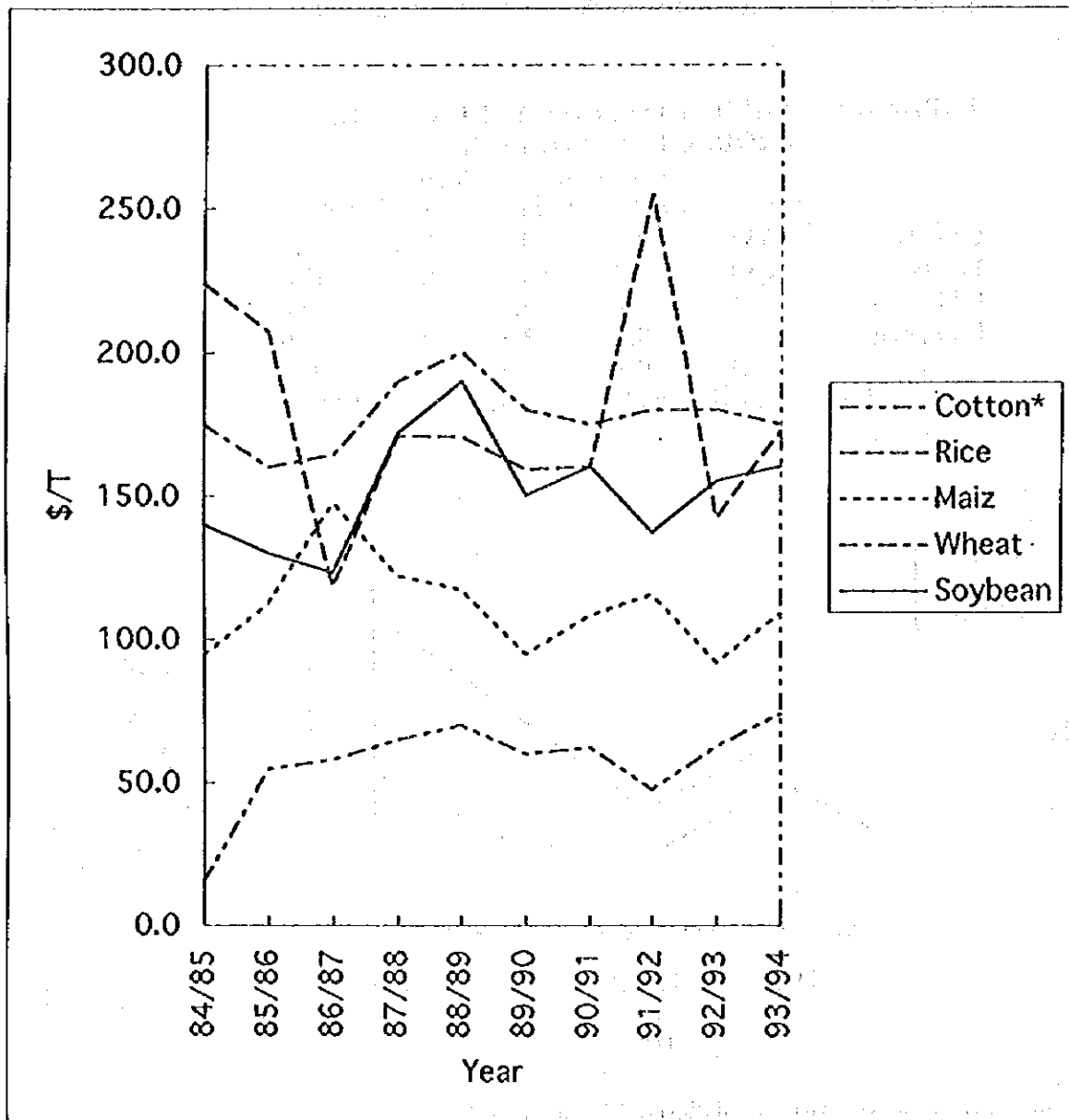
**TABLE E.3.5 PRICE OF MAIN CROPS BY YEAR**

(Unit: US\$/T)

	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94
Cotton*	15.3	54.8	58.0	65.0	70.0	60.0	62.1	47.4	62.6	74.0
Rice	223.8	207.2	118.0	170.8	170.4	159.0	160.0	254.8	142.0	172.4
Maiz	94.4	112.0	147.4	121.8	117.1	94.8	108.0	115.2	91.7	108.4
Wheat	175.0	160.0	164.0	190.0	200.0	180.0	175.0	180.0	180.0	175
Soybean	140.0	130.0	123.0	172.0	190.0	150.0	160.0	137.0	155.0	160.0

\*: qq/US\$

Source: Guia Rural 95



Source: Guia Rural 95

**PRICE OF MAIN CROPS BY YEAR**

TABLE E.3.6 LIST OF AGRO BASED INDUSTRY IN THE STUDY AREA

Type of industry	Name of company	Maximum capacity	Average used capacity	Production per year		Number of Location	Date of fundation
				US\$	Volume employee		
Cotton	ALBOSA	800 qq / day	500 qq / day	2,975,000	4,000 qq	40 Warnes	1965
	DESMOTADORA WARNES	350 qq / day	300 qq / day	20,000,000	42,500 qq	32 Warnes	1970
	ACEITE FINO	660 t / day	400 T / daay	25,000,000		280 Warnes	1953
	ACEITE SAO	24 t / day	180,000 t / year	1,260,000		350 Santa Cruz 12 Okinawa	1977 1988
Soybean cake	AGROPECUARIA INTEGRAL COLONIA OKINAWA SOYEAN OIL PRODUCTION	24 t / day	24 t / day	210,000	600 t	60	1986
	COOP AGROPECUARIA INTEGRAL SAN JUAN DE YAPACANI	600 t / month		1,148,400		5 Okinwa	1988
	AGROPECUARIA INTEGRAL COLONIA OKINAWA SOYEAN OIL PRODUCTION	3,000 t / month	2,600 t / month			San Juan	
	COOP AGROPECUARIA INTEGRAL SAN JUAN DE YAPACANI	662 t / month	150 t / month	360,240	1896 t	17 Portachuelo	1989
Rice mill	INGENIO ARROCERO MINERO	200 qq / day	200 qq / day		13,000 qq	20 Minero	1972
	INGENIO ARROCERO LA ASUNTA	1,000 qq / day	500 qq / day		25,000 qq	15 Minero	1975
	INGENIO ARROCERO EL DORADO	200 qq / day	200 qq / day		15,000 qq	9 Montero	1985
	INGENIO ARROCERO REVOLLO	320 qq / day	280 qq / day	1,693,000	40,000 qq	4 Montero	1970
	INGENIO ARROCERO SAN JUAN DE YAPACANI		200 qq / day			16 Yapacani	1986
	COOP AGROPECUARIA INTEGRAL SAN JUAN DE YAPACANI	6,000 t / day		1,000,000	186,667 qq	Yapakani	1994
Sugar	INGENIO AZUCARERO GUABIRA	5,500 t / day	4,00 qq / day	9,512,275	1,173,280 qq	450 Guabira	1953
	INGENIO AZUCARERO SAN AURELIO	5,600 t / day		Alcohole	7,201,800 l	300 Minero	
Timber	INGENIO AZUCARERO LA BELGICA	4,760 t / day	1,246,342 qq	Alcohole	8,000,000 l	San Aurelio La Belgica	
	INDUSTRIA MADERERA SUTO	50,000 m2			1,027,590 qq		
	COMPANIA BOLIVIANA RIO GRANDE	280 t / day	130 t / day	1,200,000	500,000 qq	47 Parque Industrial	1975
	AVICRUZ	500 / h	350 / h		1,040,584	55 Parque Industrial	1978
Canned fruits	INDUSTRIAL "LAS"	2,500 box / day	1,000 box / day	1,100,000		50 Parque Industrial	1987
						100 Parque Industrial	

Source : Study Team

**TABLE E.4.1 LAND POTENTIALITY**

Class	(Unit : Km <sup>2</sup> )						Total
	Andres Ibanez	Warnes	Sara	Ichilo	Obispo Santistevan		
II - III	408.8	1,392.0	740.2	1,003.0	887.0	4,431.0	
%	66.5	64.4	62.6	64.7	53.5	61.8	
IV	75.4	177.3	161.3	84.3	0.0	498.3	
%	12.3	8.2	13.6	5.4	0.0	7.0	
V	65.3	435.4	156.5	129.0	85.6	871.8	
%	10.6	20.1	13.2	8.3	5.2	12.2	
VI - VII	65.5	156.3	120.6	325.6	156.4	824.4	
%	10.7	7.2	10.2	21.0	9.4	11.5	
VIII	0.0	0.0	3.4	8.1	0.0	11.5	
%	0.0	0.0	0.3	0.5	0.0	0.2	
Unknown	0.0	0.0	0.0	0.0	530.0	530.0	
%	0.0	0.0	0.0	0.0	31.9	7.4	
<b>Total</b>	<b>615.0</b>	<b>2,161.0</b>	<b>1,182.0</b>	<b>1,550.0</b>	<b>1,659.0</b>	<b>7,167.0</b>	
%	100.0	100.0	100.0	100.0	100.0	100.0	

Source : CORDECRUZ

**TABLE E.4.2 EXISTING LAND USE IN 1995**

	(Unit:Km2)					Total
	Andre Ibanez	Warnes	Sara	Ichiro	Obispo Santistevan	
Upland field	134	801	202	472	130	1,738
	22	37	17	30	8	25
Sugar cane	49	449	11	0	667	1,176
	8	21	1	0	40	15
Pasture	235	444	266	339	337	1,621
	38	21	23	22	20	23
Primary Forest	34	218	430	410	398	1,490
	6	10	36	26	24	21
Secondary Forest	116	241	257	315	89	1,017
	19	11	22	20	5	15
Swamp Forest	0	2	0	3	0	5
	0	0	0	0	0	0
Idle Land	0	0	1	0	9	10
	0	0	0	0	1	0
Urban	47	6	8	4	14	78
	8	0	1	0	1	1
River / Lake	0	1	7	6	17	30
	0	0	1	0	1	0
<b>Total</b>	<b>615</b>	<b>2,161</b>	<b>1,182</b>	<b>1,550</b>	<b>1,659</b>	<b>7,167</b>
	100	100	100	100	100	100

Source : Study Team

**TABLE E.4.3 SUMMERY OF LAND USE IN 1995, 1993 AND 1984**

Land use						Total
	Andres Ibanez	Warnes	Sara	Ichilo	Obispo Santistevan	
1995 (%)						
Agriculture	30	58	18	30	48	40
Pasture	38	21	23	22	20	23
Forest	6	10	36	27	24	21
Secondary Forest	19	11	22	20	5	15
Idle	0	0	0	0	1	0
Other	8	0	1	1	2	2
1993 (%) 1)						
Agriculture	71	79	26	27	55	54
Forest	29	21	74	73	14	38
Other	0	0	0	0	32	8
1984 (%) 2)						
Agriculture	34	36	15	20	23	25
Pasture	20	38	45	18	38	32
Forest	38	20	21	33	14	23
Idle land	6	4	17	29	23	15
Other	2	2	2	1	1	2

Source : 1) CORDECRUZ 2) Anuario Estadístico del Sector Rural 1994

TABLE E.5.1 NUMBER OF FARMERS BY FARM SIZE

Farm Size Ha	Ibanez		Warnes		Sara		Ichilo		Santisteban		Total		Santa Cruz	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1>	332	6	489	25	200	11	337	7	258	8	1,616	9	3,439	8
~ 20	2,899	49	693	35	674	38	704	15	980	30	5,950	34	19,043	45
~ 50	1,538	26	271	14	358	20	2,053	45	1,346	42	5,566	32	8,809	21
~ 100	823	14	211	11	294	16	1,194	26	431	13	2,953	17	6,831	16
~ 500	261	4	280	14	182	10	269	6	150	5	1,142	7	2,167	5
500<	59	1	41	2	75	4	40	1	57	2	272	2	1,708	4
Total	5,912	100	1,985	100	1,783	100	4,597	100	3,222	100	17,499	100	41,997	100
Average E./F	38		57		84		48		59		51		132	

Source : Censo Nacional Agropecuario 1984

TABLE E.5.2 AREA BY FARM SIZE

Farm Size Ha	Ibanez		Warnes		Sara		Ichilo		Santisteban		Total		Santa Cruz	
	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%	Ha	%
1>	106	0	102	0	46	0	71	0	59	0	384	0	882	0
~ 20	22,560	10	4,232	4	2,899	2	5,181	2	7,591	4	42,463	5	102,536	2
~ 50	45,630	20	7,542	7	11,129	7	57,876	26	37,784	20	159,961	18	262,885	5
~ 100	49,617	22	12,582	11	16,936	11	64,621	29	25,651	14	169,406	19	375,889	7
~ 500	44,558	20	57,803	51	38,807	26	42,724	19	28,069	15	211,961	24	418,961	8
500<	64,149	28	31,189	27	79,775	53	49,792	23	89,850	48	314,754	35	4,363,942	79
Total	226,620	100	113,450	100	149,592	100	220,264	100	189,003	100	898,929	100	5,525,096	100

Source : Censo Nacional Agropecuario 1984

**TABLE E.5.3 RESULT OF INTERVIEWED SURVEY BY FARM SIZE****1) Number of the Interviewed Farmer by Parentage**

Parentage	Bolivian	Japanese	Others	Total
No. of Farm Family	49	18	9	76
%	64	24	12	100

**2) Number of the Interviewed Farmer by Province**

Province	Ibanez	Warnes	Sara	Ichilo	Santistevan	Total
No. of Farm Family	14	25	12	7	18	76
%	18	33	16	9	24	100
Area	9	30	16	22	23	100



### 3) Results of Agricultural Situation

Farm Size	Ha	20>	21 ~ 50	51 ~ 100	101 ~ 500	501 <	Average	Total
No. of Farm Family		15	16	10	25	10		76
	%	18	33	16	9	24		100
No. of Farm Family Living in Farm		11	16	10	25	10		57
	%	73	94	70	76	50		75
Number of Person per Family		4.6	5.5	5.9	5.2	5.8	5.3	
Land Tenure	Ha	13.0	35.4	80.5	234.2	897.0	215.7	
Farm Income	US\$/Year	723	4,005	8,651	24,365	57,000	21,508	
	\$/Ha	56	113	107	104	64	99.7	
Employee for Agricultural Activity								
No. of Employer per Farm Family		1.1	1.1	0.8	4.2	10.0	1.5	
No. of Employer / 100 Ha		8.2	3.2	1.0	1.8	1.1	1.5	
Wage per Month	Bs	428	433	431	464	513	478	
Land Use								
Annual Crop	Ha	44.5	38.9	58.6	54.8	54.1	54.0	
Perennial Crop	Ha	1.1	2.8	0.3	0.4	2.5	1.6	
Pasture	Ha	31.7	26.4	23.1	20.0	24.5	22.9	
Fallow	Ha	17.3	16.4	14.0	15.6	9.9	12.5	
Idle	Ha	5.4	13.5	4.0	6.7	1.1	3.8	
Other	Ha	0.0	2.0	0.0	2.5	7.9	5.1	
Method of Land Clearing								
By Bulldozer	%	82.9	66.1	88.2	77.8	86.8	82.9	
Others	%	17.9	33.9	11.8	22.2	13.2	17.1	
Planted Area by Crop								
Soybean	%	4.4	24.8	58.9	52.6	57.1	54.6	
Rice	%	34.0	18.1	21.7	27.9	23.8	25.1	
Sugar Cane	%	52.0	29.0	8.7	7.4	11.0	10.0	
Wheat	%	0.0	4.2	0.0	5.6	2.9	3.7	
Maize	%	6.6	18.0	0.3	2.7	2.3	2.6	
Sorghum	%	0.0	1.7	3.1	2.8	1.5	2.0	
Cotton	%	0.0	0.0	0.0	1.0	1.5	1.2	
Total	%	97.0	95.8	92.7	100.0	100.0	99.2	

Farm Size	Ha	20>	21 ~ 50	51 ~ 100	101 ~ 500	501 <	Average	Total
<b>Yield by Crop</b>								
Soybean	Ton/Ha	2.0	1.4	2.9	1.8	2.1	2.0	
Rice	Ton/Ha	2.9	2.6	3.7	3.5	3.8	3.7	
Sugar Cane	Ton/Ha	43.5	29.7	30.3	41.0	64.4	53.8	
Wheat	Ton/Ha		1.0		2.0	2.0	2.0	
Maize	Ton/Ha	9.0	2.1	2.0	1.7	3.0	2.4	
Sorghum	Ton/Ha		2.3	0.9	3.6	3.4	3.3	
Cotton	Ton/Ha				0.7	0.6	0.7	
<b>Ratio of Harvested Area to Seeding Area</b>								
Total	%	94	86	89	95	88	91	
Soybean	%	100	71	94	94	85	88	
Rice	%	84	93	64	96	95	94	
Sugar Cane	%	100	100	100	100	95	97	
Wheat	%	100		100		100	100	
Maize	%	100	82	100	73	74	75	
Sorghum	%		100	98	97	70	86	
Cotton	%				88	90	89	
<b>Efficiency of Land Utilization( Area of Annual Crop / Planted Area )</b>								
	%	105	104	109	127	141	132	
<b>Diffusion of Improved Seed</b>								
Total	%	20	53	50	67	100	57	
Soybean	%	0	50	100	64	89	70	
Rice	%	25	0	25	50	100	42	
Sugar Cane	%	0	25	0	0	0	4	
Wheat	%		100		50	100	75	
Maize	%	0	38	100	50	67	70	
<b>Diffusion of Agricultural Input</b>								
Fertilizer	%	0	7	0	21	44	15	
Insecticide	%	33	80	50	67	100	69	
Herbicide	%	70	86	70	92	100	85	
Fungicide	%	0	14	20	29	78	26	

Farm Size	Ha	20>	21 ~ 50	51 ~ 100	101 ~ 500	501 <	Average	Total
<b>Marketing</b>								
<b>Sell to</b>								
<b>Soybean</b>								
Wholesaler	%	0	50	100	39	56	48	
Retailer	%	0	25	0	0	0	3	
Cooperative	%	100	0	0	46	44	38	
Others	%	0	25	0	15	0	10	
Farm Gate Price	\$/T	160	153	150	153	152	153	
<b>Rice</b>								
Wholesaler	%	75	80	75	60	80	70	
Retailer	%	25	20	0	13	0	12	
Cooperative	%	0	0	0	20	20	12	
Others	%	0	0	25	7	0	6	
Farm Gate Price	\$/T	118	122	118	124	126	123	
<b>Sugar Cane</b>								
Wholesaler	%	100	100	100	80	100	93	
Retailer	%	0	0	0	0	0	0	
Cooperative	%	0	0	0	0	0	0	
Others	%	0	0	0	20	0	0	
Farm Gate Price	\$/T	18	16	12	15	19	16	
<b>Maize</b>								
Wholesaler	%	100	25	100	50	33	50	
Retailer	%	0	75	0	25	0	29	
Cooperative	%	0	0	0	25	67	21	
Others	%	0	0	0	0	0	0	
Farm Gate Price	\$/T	69	106		96	100	90	
<b>Agricultural Machinery</b>								
Plowing by Tractor	%	47	87	100	100	100	86	
Plowing by Rental Tractor	%	71	54	44	8	0	29	
Rental Fee	\$/ha	115.0	43.3	51.3	75.0		62.8	
<b>Number of Holding</b>								
Tractor	No./F	0.3	0.5	0.6	1.6	3.0	1.3	
Combine	No./F	0.0	0.0	0.1	0.4	1.2	0.3	
Track	No./F	0.1	0.2	0.2	0.1	0.3		
Light Truck	No./F	0.1	0.2	0.5	0.9	1.2	0.6	
Iron Plough	No./F	0.2	0.3	0.5	0.7	1.2	0.6	
Harrow	No./F	0.1	0.2	0.4	1.0	1.4	0.7	
Sower	No./F	0.1	0.1	0.2	0.7	1.5	0.5	
Pulverizer	No./F	0.0	0.0	0.2	1.0	1.6	0.6	
Sprinkler	No./F	0.0	0.0	0.0	0.0	0.0	0.0	
Pumping Equipment	No./F	0.0	0.1	0.2	0.4	0.3	0.2	
Leveller	No./F	0.0	0.0	0.0	0.2	0.1	0.1	

Farm Size	Ha	20>	21 ~ 50	51 ~ 100	101 ~ 500	501 <	Average	Total
<b>Application of Irrigation</b>								
Yes	%	0	6	0	24	10	11	
No	%	100	94	100	76	90	89	
<b>Irrigated Crop</b>								
Rice	%	0	100	0	86	100	89	
Soybean	%	0	0	0	14	0	11	
<b>Demand of Irrigation</b>								
Yes	%	80	71	60	64	60	68	
No	%	20	29	40	36	40	32	
<b>Desired to Cultivate with Irrigation</b>								
	%	Rice 31.6	Soybean 16.5	Sugarcane 11.4	Maize 10.1	Veg. 8.9	Fruits 7.6	
<b>Having Problem of Drainage</b>								
Yes	%	67	69	80	76	90	75	
No	%	33	31	20	24	10	25	
<b>Desired to Cultivate after Improving the Problem</b>								
	%	Soybean 23	Rice 20	Maize 19	Sugarcane 12	Pasture 5	Fruits 4	
<b>Livestock</b>								
<b>Cow</b>								
<b>Number of per Area of Pasture</b>								
	Head/Ha	2.2	3.6	1.0	1.3	0.9	1.1	
<b>Composition of Variety</b>								
For Meet	%	23	24	70	77	68	64	
For Milk	%	35	13	24	17	18	18	
For Both	%	42	64	6	6	14	18	
<b>Number of Selling per Year</b>								
	Head/F	1.6	3.3	3.4	15.5	39.0	11.7	
<b>Selling to</b>								
Wholesaler	%	0	50	50	38	33	35	
Retailer	%	100	50	50	63	67	65	
<b>Supporting Service</b>								
<b>Technical Extension Service</b>								
<b>Taking a Extension Service</b>								
Yes	%	7	33	40	56	90	44	
No	%	93	67	60	44	10	56	
<b>Organization Taking the Service</b>								
Private	%	0	50	100	31	29	38	
Cooperative	%	0	50	0	62	43	50	
Other	%	100	0	0	8	29	13	
<b>Demand of Extension Service</b>								
Yes	%	9	55	67	68	100	59	
No	%	91	46	33	32	0	41	

Farm Size	Ha	20>	21 ~ 50	51 ~ 100	101 ~ 500	501 <	Average	Total
<b>Credit</b>								
<b>Having Agricultural Credit</b>								
Yes	%	13	38	60	68	90	53	
No	%	87	63	40	32	10	47	
<b>Organization</b>								
Bank	%	50	50	50	40	22	40	
Cooperative	%	0	17	33	40	44	34	
Others	%	50	33	17	20	33	26	
Amount	\$/F	850	9,348	16,250	33,889	60,800	28,898	
Intersect	%/Year	9.5	9.5	10.8	12	11.6	11.2	
<b>Membership of Agricultural Organization</b>								
Yes	%	57	73	50	80	100	73	
No	%	43	27	50	20	0	27	
<b>Flood</b>								
<b>Damage of Flood</b>								
Yes	%	77	63	90	67	78	72	
No	%	23	37	10	33	22	28	
<b>Frequency of Flood</b>								
Annually	%	100	100	67	94	100	93	
Duration of Inundation	Day/Year	7.9	20.5	20.8	9.9	19.1	14.2	
Depth of Inundation	Cm	66	64	61	55	89	63	
<b>Desired to Cultivate after Improving the Problem</b>								
	%	Maize	Soybean	Rice	Sugarcane	Fruits	Pasture	
		23.4	22	19.6	10.3	4.7	3.7	
<b>Living Condition</b>								
<b>Water Supply</b>								
Aqueduct	%	20	19	40	28	20	25	
Well	%	27	25	30	44	80	40	
River	%	0	6.3	10	0	0	3	
Other	%	53	50	20	28	0	33	
<b>Distribution of Electricity</b>								
Yes	%	50	40	60	75	90	63	
No	%	50	60	40	25	10	37	
<b>Type of Toilet</b>								
Sewerage System	%	0	0	10	12	0	5	
Septic Well	%	40	50	20	56	70	49	
Latring	%	40	19	60	28	30	33	
No Toilet	%	20	31	10	4	0	13	

Farm Size	Ha	20>	21 ~ 50	51 ~ 100	101 ~ 500	501 <	Average	Total
<b>Problem for Agriculture</b>								
Productivity	%	14	15	13	13	14	14	
Water Shortage	%	9	8	16	10	12	11	
Farm Size	%	13	15	16	13	10	14	
Technical Assistance	%	14	18	13	14	16	15	
Credit	%	14	10	13	16	16	14	
Improved Seed	%	11	7	9	6	4	7	
Price of Production	%	13	14	14	14	14	14	
Transportation	%	13	14	7	13	16	12	
<b>Desire to Cultivate in the Future</b>								
<b>Ranking</b>								
1		Maize	Rice	Soybean	Soybean	Soybean	Soybean	
	%	36	21	32	24	26	20	
2		Rice	Maize	Rice	Rice	Rice	Rice	
	%	15	18	18	20	22	19	
3		Cassava	Soybean	Maize	Fruits	Fruits	Maize	
	%	15	18	14	12	13	18	
4		Veg.	Sugarcane	Veg.	Maze	Maize	Fruits	
	%	9	12	7	12	9	8	
5		Fruits	Veg.	Fruits	Sugarcane	Sugarcane	Sugarcane	
	%	9	9	4	8	9	8	
<b>Reason to Select above Crops</b>								
Profitability	%	55	47	41	69	43	54	
Technological Aspect	%	36	32	53	21	43	35	
Others	%	9	21	6	10	14	12	

**4) Comparison of Agricultural Situation  
Between Flooded and Non-Flooded Area**

	Flooded	Non-Flooded	Total
No. of farm family	55	20	
Ratio of Farm Family Living in Farm (%)	76	70	
Number of Persons per Family	5.6	4.8	
Ratio of Farm Family by Province (%)			
Ibanez	31	69	100
Warnes	72	28	100
Sara	92	8	100
Ichiro	86	14	100
Sanstistevan	89	11	100
Farm Income			
US\$/Family/Year	20,827	21,000	
US\$/Total Ha	88	125	
US\$/Planted Area	113	153	
Land Tenure per Family	237	168	
Land Use (%)			
Annual Crop	59	32	
Perennial Crop	1	3	
Pasture	17	46	
Fallow	14	7	
Idle	3	9	
Other	6	2	
Total	100	100	
Planted Area by Crop (%)			
Soybean	56	41	
Rice	25	29	
Sugar Cane	9	19	
Maize	2	7	
Yield (T/Ha)			
Soybean	2.0	1.9	
Rice	3.7	3.1	
Sugar Cane	59.5	39.3	
Maize	2.3	3.1	
Ratio of Harvested Area to Seeding Area (%)			
Soybean	90	53	
Rice	95	84	
Sugar Cane	96	100	
Maize	76	74	
Livestock			
No. of Cattle			
Beef Cattle	47	85	
Cattle for both Object	27	6	
Dairy Cattle	26	8	
Head per Hectare	1.0	1.3	

	Flooded	Non-Flooded	Total
<b>Using of Agricultural Input (%)</b>			
Improved Seed	58	50	
Fertilizer	17	7	
Insecticidal	75	53	
Herbicide	86	87	
Fungicide	30	13	
<b>Having Problem of Drainage (%)</b>			
Yes	89	20	
No	11	80	
<b>Organized Farmer (%)</b>	76	68	
<b>Farmer Receiving Credit</b>	56	45	
<b>Farmer Receiving Technical Extension</b>	49	32	
<b>Desire to Cultivate in the Future (%)</b>			
<b>Ranking</b>			
1	Soybean	Maize	
(%)	20.3	21.6	
2	Rice	Soybean	
(%)	19.5	18.9	
3	Maize	Rice	
(%)	17.2	16.2	
4	Fruits	Sorghum	
(%)	10.2	10.8	
5	Sugar Cane	Wheat	
(%)	8.6	5.4	



TABLE E.7.1 SUMMARY OF LAND USE PLAN

Zone	Name	Main production	Natural conditions	Type of inundation	Problem of agriculture	Countermeasure for inundation	Alleviation effect for inundation**	Countermeasure for agriculture	Target of agriculture development
1	Low precipitation area (Cococ)	cattle, cotton, sugar cane, Soybean	soil consisting of sand and silt, Low precipitation (1,300mm)	Uncommon (D)	- Disparity of farm income by size, - Drought	-	-	Introduction of high productive crop for small scale farmer	High productive area
2	Intensive upland crop area (Oknawa)	soybean, rice, maize, wheat, cattle	Fertile alluvial soil, Low precipitation (1,300mm)	Flood and drainage (B, C)	- Degradation of soil fertility	-Protection of overflow -Drainage improvement	A, B	Introduction of appropriate crop rotation and diversification	Diversified crop production area
3	Sugar cane production area (Montero)	sugar cane, cattle	Fertile alluvial soil, Medium precipitation (1,300-1,800mm)	Flood and drainage (B, C)	-Decreasing productivity by continuous cropping	-River improvement -Drainage improvement	A, B	Introduction of appropriate crop rotation, diversification	Diversified crop production area
4	Local colony-1 (Minero)	Sugar cane, rice	Fertile alluvial soil, Medium precipitation (1,300-1,800mm)	Flood (A)	- Severe flood damage	-River improvement	C	Introduction of water tolerant variety or crop	Stable production area
5	New developed upland crop area (Chame)	soybean, sugar cane, rice	Fertile alluvial soil, Medium precipitation (1,300-1,800mm)	Flood (A)	- Severe flood damage	-Protection of overflow	C, D	Introduction of water tolerant variety or crop	Stable and high productivity area
6	Intensive diversified agricultural area (San Juan)	Rice, egg soybean, cattle, fruits	Poor drainage soil, High precipitation (more than 1,800mm)	Drainage (B)	- Poor drainage of soil	-Drainage improvement	A	Expansion of perennial crop	Intensive mixed farming area
7	Local colony-2 (Anio Pagasta)	soybean, rice, cattle	Poor drainage, High precipitation (more than 1,800mm)	Drainage (B)	- Poor drainage - Damage of rat	-Drainage improvement	B	Introduction of high productive crop	Stable production area
8	Grazing area (Buena Vista)	cattle, soybean	Low fertile soil, Medium precipitation (1,300-1,800mm)	Uncommon (D)	- Low fertility	-	-	Introduction of high productive pasture	Intensive cattle raising area
9	Forest area (Sera)	timber, cattle	Low fertile soil, High precipitation (more than 1,800mm)	Partially Flood (B, C, D)	- Decreasing of useful timber	-Local drainage improvement	D	Reforestation of useful trees	High productive forest area

\* :Severity of inundation=A>B>C>D  
 \*\*:.Alleviation effects for inundation=A>B>C>D

**FIGURES**



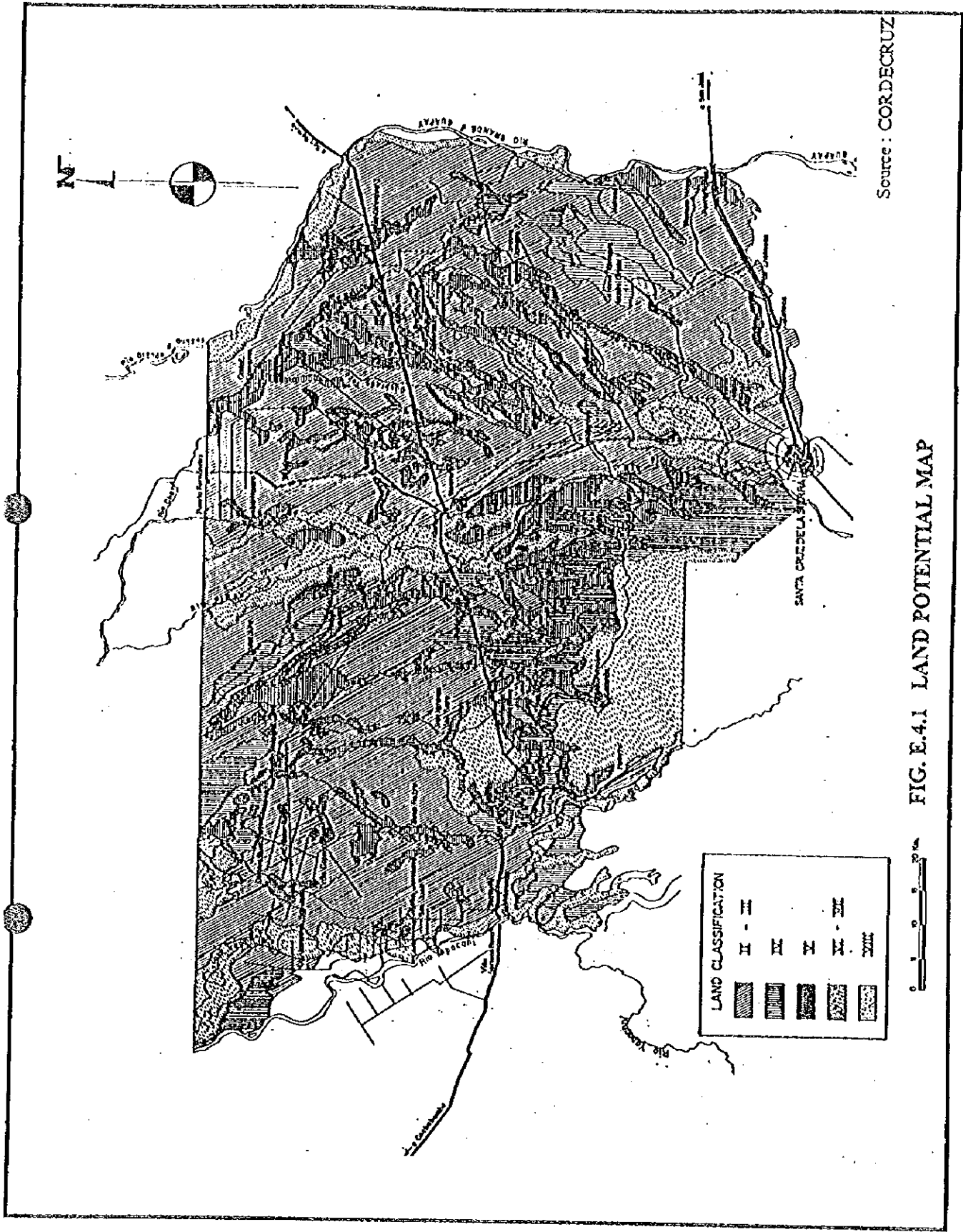
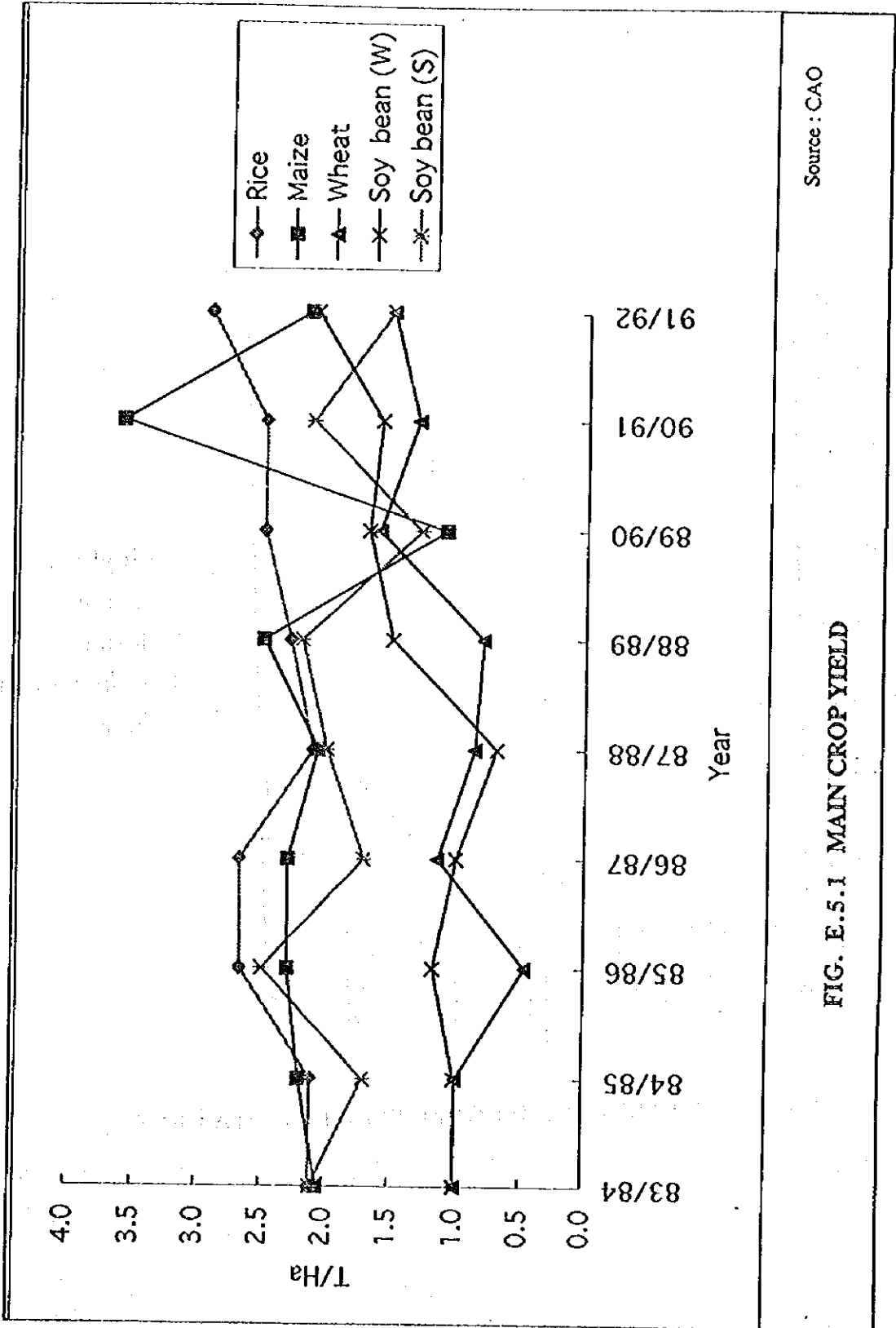


FIG. E.4.1 LAND POTENTIAL MAP





Source : CAO

FIG. E.5.1 MAIN CROP YIELD

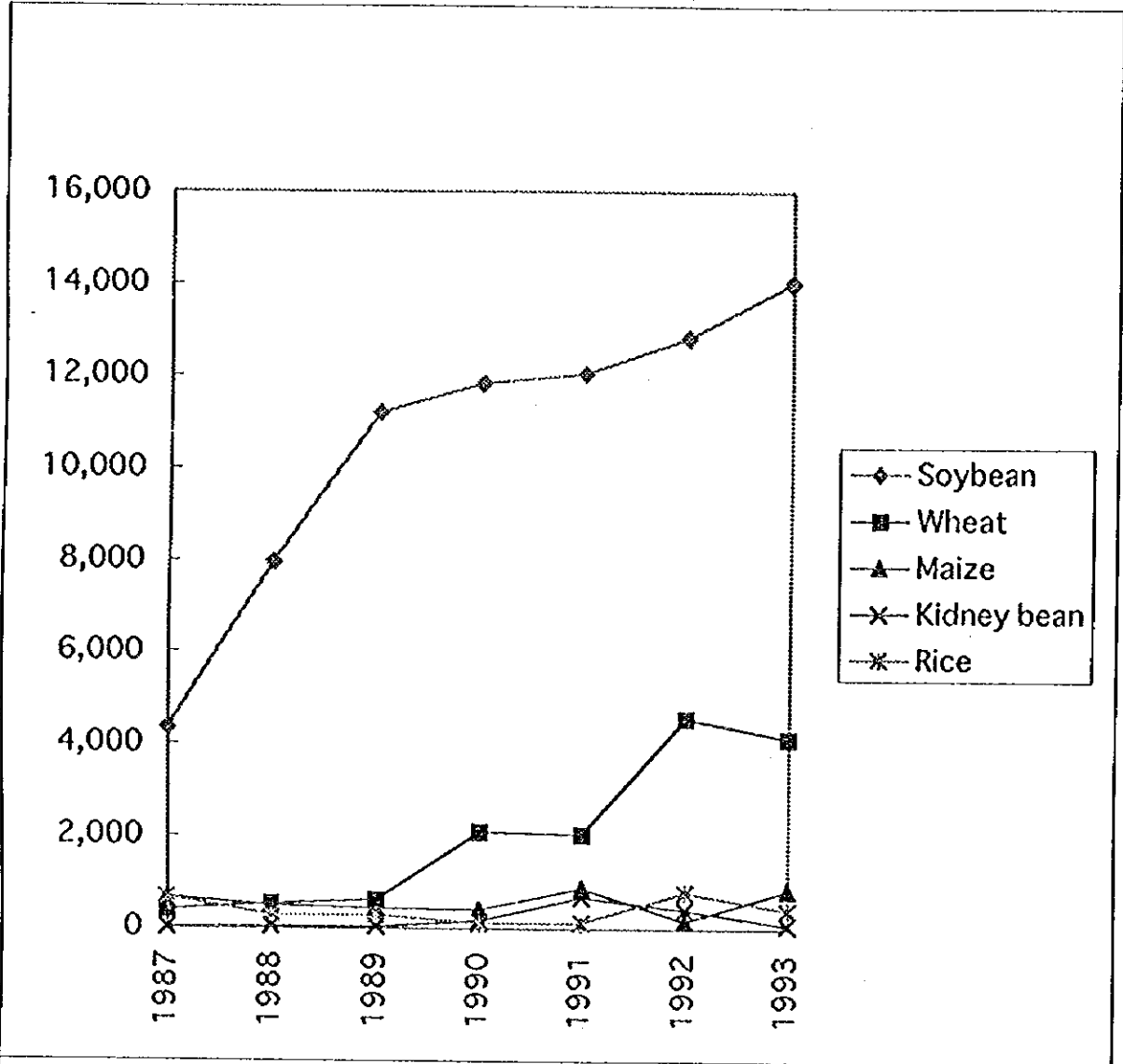


FIG. E.5.2 CONSUMPTION OF IMPROVED SEED IN SANTA CRUZ

Source : Guia Rural 95

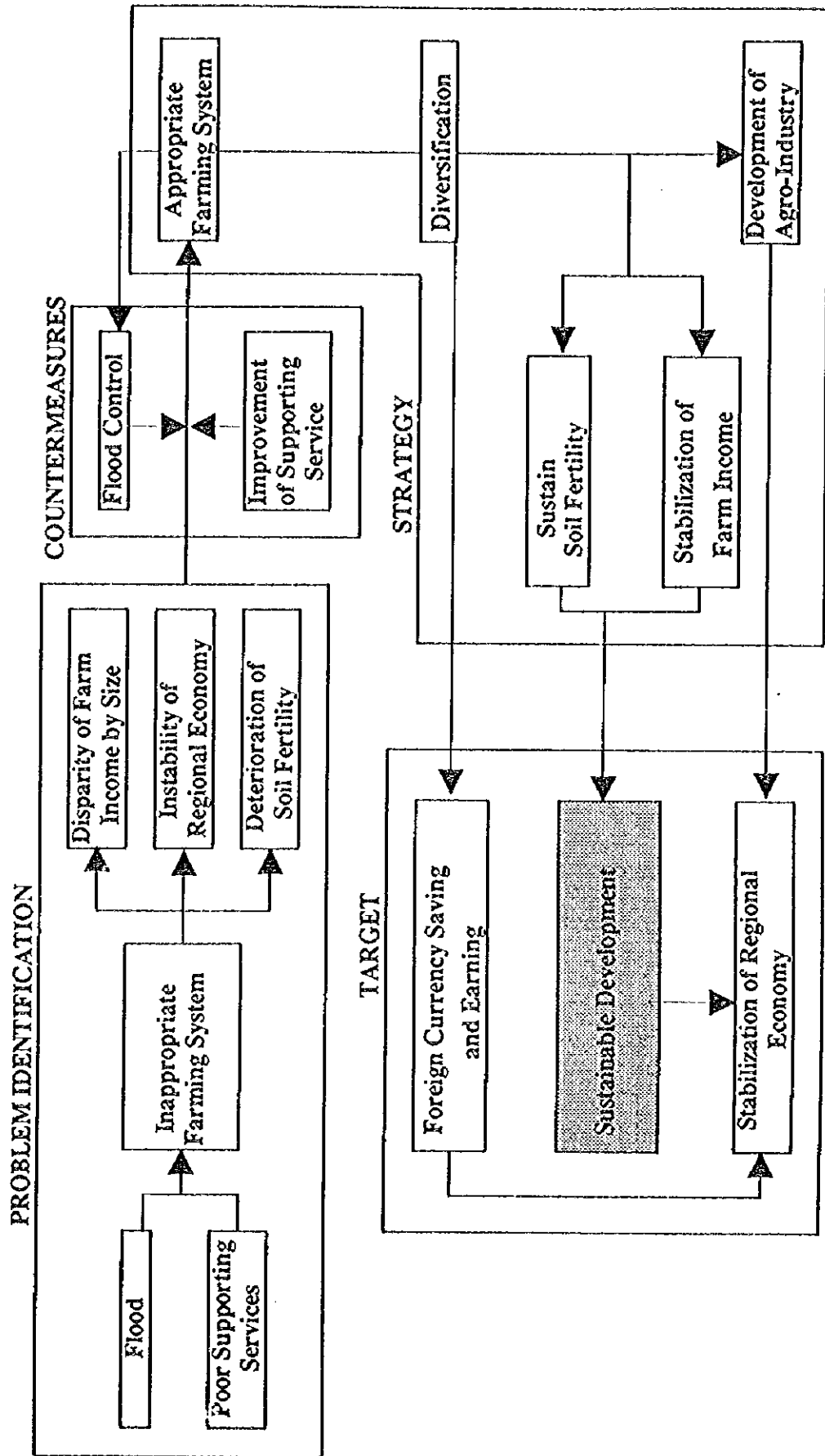


FIG. E.6.1 BASIC AGRICULTURAL DEVELOPMENT CONCEPT