

THE REPUBLIC OF BOLIVIA



THE FEASIBILITY STUDY
ON
AGRICULTURAL AND
RURAL DEVELOPMENT PROJECT
IN SANTA ANA, TARIJA

FINAL REPORT

SEPTEMBER 1990

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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CORPORACION REGIONAL
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P R E F A C E

In response to a request from the Government of the Republic of Bolivia, the Japanese Government decided to conduct a Feasibility Study on the Agricultural and Rural Development Project in Santa Ana, Tarija and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA sent to Bolivia a Study Team headed by Mr. Yasuo Maeda, Naigai Engineering Co., Ltd. from July to September, 1989, and from November, 1989 to January, 1990.

The Team held discussions with the concerned officials of the Government of the Republic of Bolivia, and conducted field surveys.

After the Team returned to Japan, further studies were made and the present report was prepared.

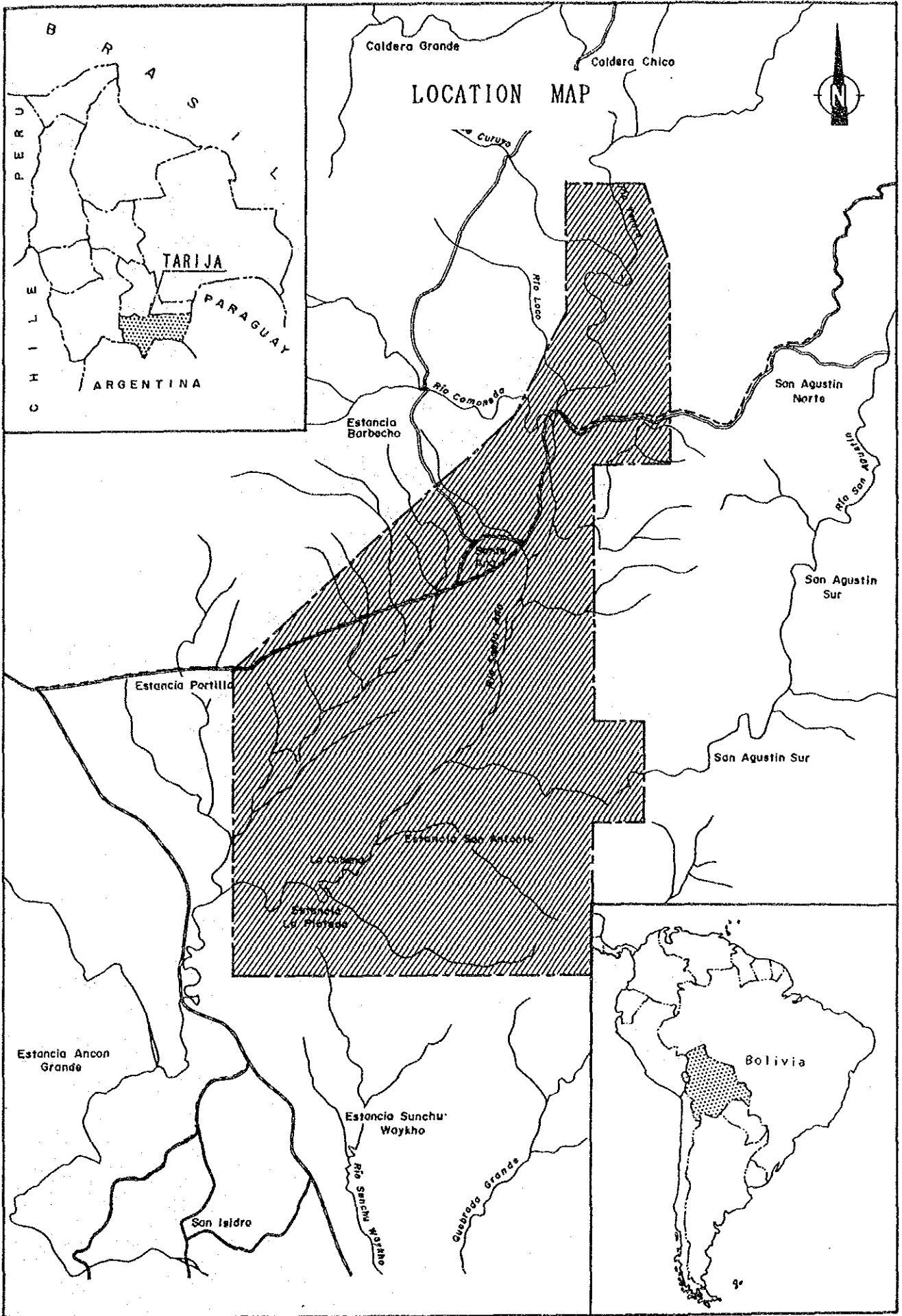
I hope that this report will contribute to the development of the Project and to the promotion of friendly relations between our two countries.

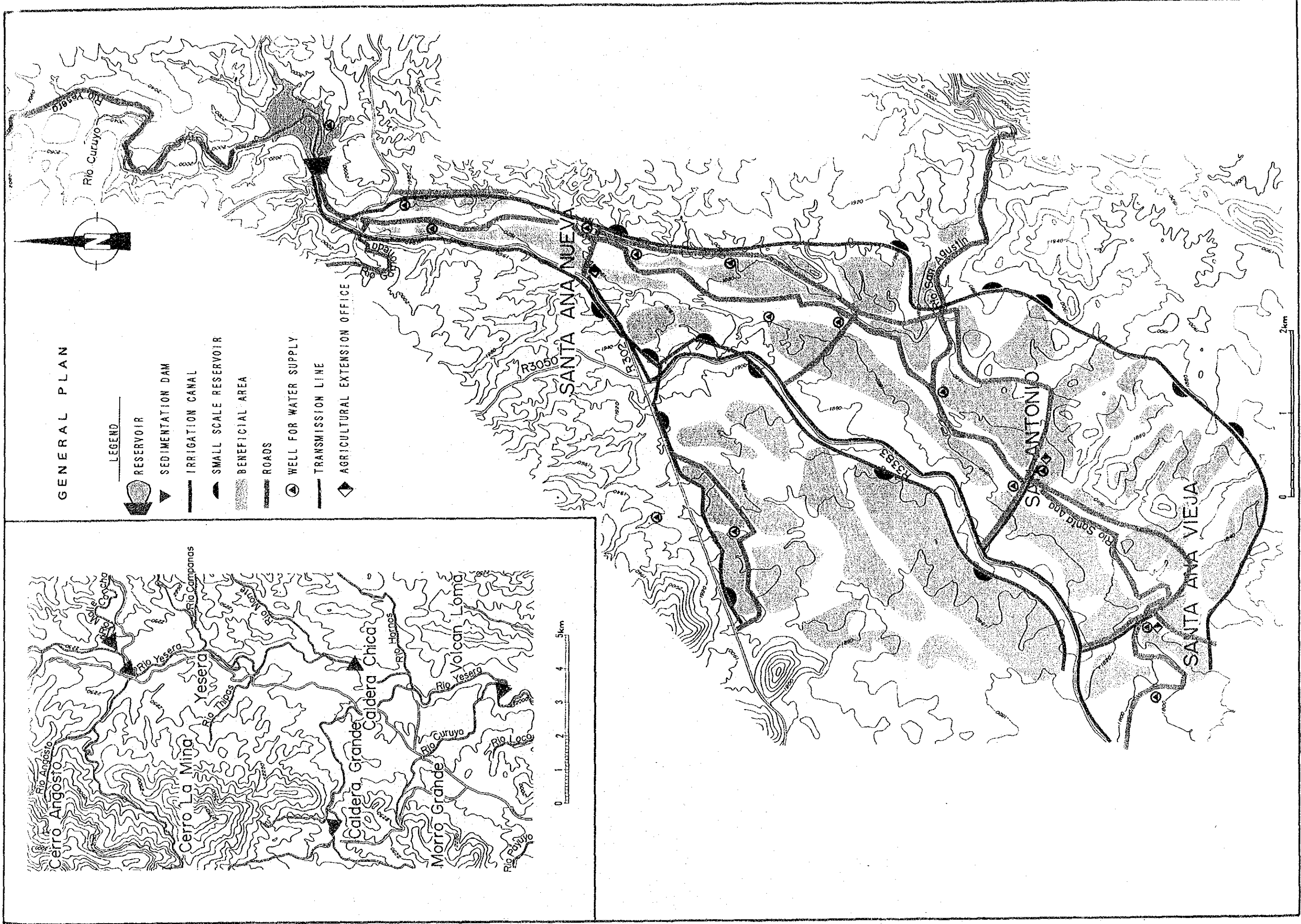
I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Bolivia for their close cooperation extended to the Team.

September, 1990


Kensuke Yanagiya

President
Japan International Cooperation Agency

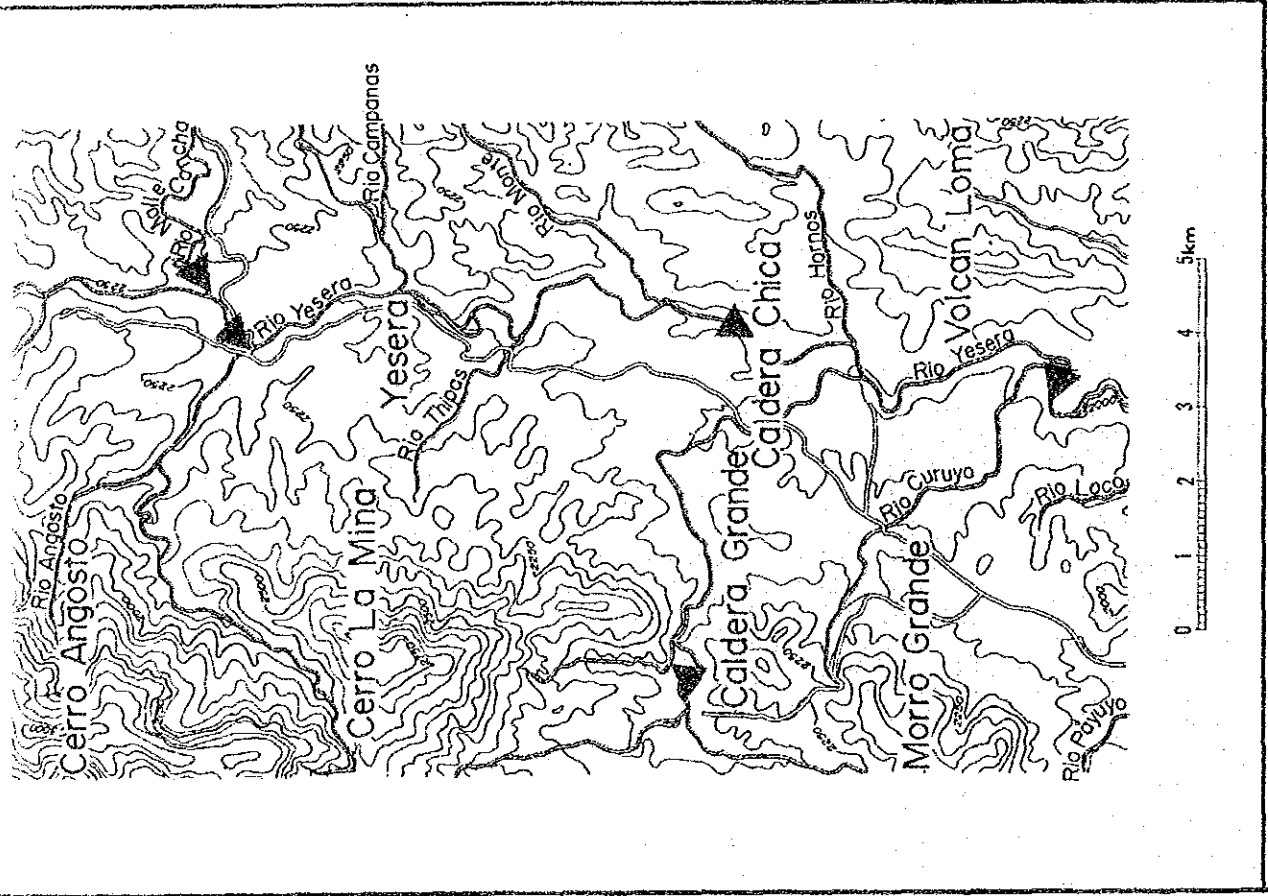




GENERAL PLAN

LEGEND

- RESERVOIR
- SEDIMENTATION DAM
- IRRIGATION CANAL
- SMALL SCALE RESERVOIR
- BENEFICIAL AREA
- ROADS
- WELL FOR WATER SUPPLY
- TRANSMISSION LINE
- AGRICULTURAL EXTENSION OFFICE



0 1 2 3 4 5 km

0 1 2 km

SUMMARY

S U M M A R Y

1. INTRODUCTION

1. 1 Background of the Study

In order to develop the Santa Ana area as the model of agriculture and rural communities development in mountainous areas, the Government of Bolivia requested the Government of Japan in February 1986 to carry out the feasibility study. In response to this request, the Japan International Cooperation Agency (JICA) dispatched a preliminary study mission to Bolivia in December 1988 and the "Scope of Work" for the study was signed between the mission and the Government of Bolivia. As the results, the study was started in July, 1989. This report describes in detail the results of field study and the development plan based on the study results.

1. 2 Objectives of the Study

Objectives of the study are to establish an agricultural development plan introducing the technical irrigation on the basis of water resources development for approximately 1,000 hectares of farmland and reclaimed land in the Santa Ana district of Tarija department. In addition, rural development plan consisting of road improvement, rural water supply, and soil conservation in the same district is to be established. In the project formulation, a development plan which basic concept can be applied not only for the Santa Ana district but also for other regions should be established as a model agricultural and rural development in the mountainous areas of Bolivia.

1. 3 Scope of the Study

The area to be studied is the area around Santa Ana located southeast of Tarija City, Tarija Department and has an extension of approximately 76 km². Feasibility study on agricultural and rural development project in Santa Ana district is carried out.

2. GENERAL FUTURES OF BOLIVIA

2. 1 GENERAL

Bolivia is located in the middle of the South American Continent, south latitude 9°38' to 22°53' and west longitude 57°26' to 69°38'. It is a landlocked country circled by five countries: Brazil, Paraguay, Argentina, Chile, and Peru. Bolivia is roughly divided into three areas

on the basis of its altitude: the Andean highland area in the west part, the Andean mid-slope, and the eastern plain. Approximately 60% of the total area of the country (1.09 million km²), is occupied by the eastern plain area.

The total population of Bolivia is estimated approximately 6.9 million. Although the average annual growth rate of the population in the 1970's was 2.3%, the growth rate for the last five years was 2.6% with a tendency to increase slightly. On the other hand, the ratio of urban to rural population is estimated at 44% to 56%. The growth rate of the urban districts in 1965 - 1980 was 2.9% but the growth rate during the last five years was 5.6%, which is nearly twice as high as the said 2.9%.

Major industries are the mining represented by tin and the agriculture. The agricultural production sector has an approximately 20% share (1988) of the GDP, employs approximately one million peoples, which is equivalent to 49% of the total work force (2.1 million), and plays an important role in the society and economy of the country.

2. 2 National Economy and Agriculture

The GDP of Bolivia had maintained the average annual growth rate of 5% from the 1960's to the second half of the 1970's, but the cumulative rate of change from 1981 through 1988 dropped to -8.4%. The major causes by which the growth rate dropped is thought to be an activity in the production of the mining and agricultural industries sectors, which are the basic industries of the country. In particular, the growth rate of the agricultural production sector, which played the most important role in the GDP, had maintained 2% per year from 1970 through 1981, but it turned to a negative growth in 1982, a 22% negative growth in 1983 versus 1982, and the share in the GDP dropped under 16%. However, the growth rate of the agricultural production sector in the last five years (1984 to 1988) compared to each previous year is plus 2.5% per year on the average, and the share in the GDP is as high as 23% (1988). The recent increase of the agricultural production sector have favorably affected the national economy, and the growth rate of the GDP in 1987 and 1988 were 2.5% compared to each previous year. Thus, the national economy is showing a trend of recovery.

The major export goods of Bolivia are mining products mainly represented by tin, petroleum, and natural gas. These account for more than 80% of the total export amount. Natural gas is the most important export goods and accounts for 60% (1988) share in the total export amount. Although agricultural and forestry products such as timber, coffee, and sugar have been exported, they have small shares.

On the other hand, the major import goods are capital goods and

intermediate goods for production such as machinery and transport equipment, which account for 85% share in the total import amount. The main features of import are that there is very little import of materials and equipment relating agriculture production, which negatively affects the improvement of agricultural productivity in the country. Moreover the import of foods, including wheat as a main item, shows a trend of increase, and that oils and fats, soybeans, and dairy products, added to wheat, have an 80% share in the total foods import amount.

The average annual increase rate of the consumer price index for the period 1975 through 1981 was approximately 18%. However, it exceeded 200% from 1982, and an 8,200% price increase rate was recorded in 1985 as compared with the previous year. Among all, the steep rise of food prices was the most remarkable, and a 1,200% increase was recorded in 1984 as compared with the previous year, which is regarded as the most significant cause for the high inflation. As the result of execution of the new economic policy in 1985, however, the high inflation was decreased to 66% in 1986, 10.7% in 1987, and 20.9% in 1988. Since the steep rise of prices lowered actual wages to such a significant degree, the government has instituted a legal minimum wage system since 1985. The current legal minimum wage is B.S. 70.4/month (as of March, 1989).

The estimated labor population in the country is 2.1 million which is equivalent to approximately 30% of the total population. Out of the 2.1 million (1989) labor population, approximately 49% is employed in an agricultural production sector. The number of unemployed laborers was approximately 147,000 at the end of 1988. The unemployment rate in urban areas was 13 - 15% per year on the average by the first half of the 1980's, but the rate has increased to 22% in the last three years (1986 to 1988). This increase is said to be attributable to the population flow from rural to urban districts in recent years.

2. 3 Trend of Agricultural Production

Agricultural lands of about 8,770 thousand ha, which is equivalent to 8% of the total area of the country, are distributed throughout the country at present. An area of cultivated land is only 1,270 thousand ha, which is equivalent to 15% of the total agricultural land. The other 85% is non-cultivated land.

The scale of land holding per farm household differs at each area. In the Andean highland and Andean mid-slope areas, farm households with less than 20 ha account for more than 91%, while in the eastern plain area farm households with 50 - 75 ha are most typical and account for more than 25% share. In the Andean highland and Andean mid-slope areas, according to the limitation of the existing farmland area and the concentration of the number of farm households and farming laborers, a trend which fractionization of farm lands are progressing is shown. To

prevent such a trend, the Bolivian government has set the farmland fractionization limit depending on the scale of land holding in each area based on the Agrarian Reform of 1952. According to its reform, the land fractionization limit is 3 - 4 ha to small scale farm household located in an irrigated area of the gorge and a grape cultivation area in Andean highland and Andean mid-slope areas.

The main agricultural products in Bolivia are grain crops such as rice, maize, and wheat and root crops such as potatoes. The greater part of the products are for the domestic market and farmers' consumption. For export crops, sugar cane, cotton, and coffee beans are mainly produced. Among the main crops, the traditional crops such as rice, wheat, maize, potato, cotton, and sugar cane show a trend of level or decreased in production. In contrast, however, coffee beans and soybeans are showing a sharp increase, supported by the government's promotion policy; the growth was 6 times in harvest area and 8 times in production volume versus the records in 1976. Taking the total agricultural production including fruit and vegetables added to the main crops mentioned above, the annual change is great; with approximately 6.7 million tons in 1982 as the peak, the last five years' annual average increase or decrease rate was 10 - 15%. Irrespective of increase or decrease of cultivated land area, the changes mentioned above are attributable mainly to the instability of the yield per ha.

Except for wheat, the production of the basic foods such as rice, maize, and potato can nearly satisfy the total domestic demand. Due to the unstable supply capacity of such basic foods, however, a part of demand may depend on import in some years. More than 90% of wheat demand, in particular, must depend on import. The average import volume of wheat per year during the last five years (1982 to 1986) was 300,000 tons, and it tends to increase year by year. The import increase is said to be attributable to the decrease of the domestic production due to discouragement of farmers' will because of suppressing wheat producer's price and to the increase of its consumption per capita.

Comparing the yield per ha in Bolivia with that of surrounding Andean group countries, Bolivian yields of each main crops are lower. This is because the greater part of main crops production depend on small farmers with self-supply agriculture occupying 62% of the total farm households. Besides, the low labor productivity, lack of production materials and equipment, and poor production infrastructure including irrigation facilities as a major item are causing the poor yield in Bolivia.

3. NATIONAL DEVELOPMENT PLAN

3. 1 Administrative Organization

Out of the domestic administrative organization, the Ministry of Planning and Coordination will plan and formulate main economic and social development plans, such as the national development plan, regional development plans, etc. In addition, the ministry determines priority of development plans presented by various ministries and agencies. The competent authority for agricultural policy such as domestic agriculture development and production support, on the other hand, is the Ministry of Farmers, Agriculture and Stockbreeding (MACA). The MACA formulates plans for agricultural policy, agricultural investigation and research, agricultural product marketing, improvement of farmland, settlement, irrigation and drainage, and natural resource development on the national level.

Separately from the central administrative organization, the Regional Development Corporation is established in each department. Each Regional Development Corporation established in 1978 under Bolivian Government Law, although different in organization and system to some degree depending on the department, consists of a board of directors, president, and various development departments and agencies. The president of the corporation is nominated by the president of the Government of Bolivia. Under the instruction of the Ministry of Planning and Coordination, the Regional Development Corporation determines development plans, policies, and strategic ideas of its department.

3. 2 Development Plan

The national development plan of Bolivia, "Economic and Social Development Plan 1989 - 2000", was determined in 1989 by the Ministry of Planning and Coordination based on the Emergency Economic Reconstruction Plan designated in 1985 and the Long-term Plan designated in 1981. The basic objectives of the development plan, which includes all the said items, are as follows.

- Restoration and activation of the domestic economy, and increase of domestic investment and stabilization and maintenance of prices in order to achieve this purposes
- Improvement of productivity
- Diversification and expansion of export on mining, energy, and agricultural productions sectors
- Stable supply of basic foods to domestic markets
- Increase of opportunity for employment
- Improvement of public services through improved education, medical treatment, water supply and sewer, and housing
- Correction of regional difference and increase of limit on

local administrative organizations

3. 3 Agricultural Development Policy

For agricultural production sector in the national development plan, three items, "Stable Supply of Food", "Increase of Substitute Agricultural Products for Import", and "Increase of Agricultural Products for Export", are taken up as the objectives of development. In order to realize the objectives, the necessity of structural improvement of the following items as the domestic agricultural development policy is emphasized.

- Improvement of cropping intensity and extension of cultivated land per household through improved irrigation facilities in Andean high-land and Andean mid-slope areas
- Promotion of the settlement policy for effective utilization of land resources
- Utilization of family labor and introduce of suitable techniques
- Improvement and expansion of agricultural producers' organizations

Through the execution of the policy mentioned above, the following extension of cultivated land and products are expected.

- Extending cultivated lands from present to 2.0 million ha during the planned period.
- Increasing a 56% of gross agricultural production, and a 76% of gross production value
- Setting 5.4% annual growth rate of gross agricultural production value during the planned period
- Expanding export of agricultural products from US\$ 77 million to US\$ 518 million

More than 60% of the total investment amount in the plan is allocated to regional agricultural development plans, and the investment amount for Tarija Department has the largest share (13%) among the investment amount for agricultural sector in the departments.

4. GENERAL FEATURES OF TARIJA DEPARTMENT

4. 1 General

Tarija Department is located between south latitude 20°50' to 22°50' and west longitude 62°15' to 65°20'. Its southern side borders Argentina, and its eastern side borders Paraguay, respectively. The total area of the department is 37,623 km². Topographically, the depart-

ment is divided into three areas: the mountain area located along the periphery of the department, the gorge area located from the central part to the west, and the plain area in the east. The mountain area covers 47% of the total department area. The annual mean precipitation is 400 to 2,000 mm. Although the distribution of rainfall differs depending on the topographical conditions, the rainfall is concentrated in all the areas during the rainy season from October to April. The annual mean temperature is 9.5°C in the mountain area, 18°C in the gorge area, and 22°C in the plain area. In the department, in addition to Pilcomayo River, one of the leading rivers in Bolivia, there are many medium and small tributaries such as Piraya River, Camblaya River, San Juan de Oro River, etc., forming major sources of water supply.

Administratively, Tarija department consists of six provinces and is moreover divided into 175 districts. Under the unit of district, communities are formed with villages, and a governor is nominated by the central government to control each community. The total population of the department is estimated to be approximately 296,000 (1988), of which 51% is in urban areas and 49% in rural areas. The average annual growth rate of population in the past 15 years (1950 to 1976) was 2.3%, but it increased to 3.5% in the last eight years (1980 to 1988), exceeding the average annual growth rate of the country. The 68,000 population of Tarija City, which is the capital of the department, is equivalent to 23% of the total population of the department, and the growth rate in the said period was 4.5%, which was higher than that of the total department. The total population of the department in year 2000 is expected to reach at 530,000, and the economically active population is also expected to increase at the rate of 4.9% per year in the period 1988 through 2000 along with the total population increase.

Agriculture is a main industry, having a 25% share of the gross production amount of the department, and accounts for 50% out of the total labor population. However, the share of the agricultural production sector in the total production amount, which peaked at 27% in the first half of 1980's, is decreasing year by year, and the labor attraction power in its sector shows a decreasing trend also. Consequently, the population of rural areas decreased from 61% to 49% in the last ten years, resulting in an accelerated population out-flow from rural to urban areas, and causing increased unemployment rate in urban areas.

4. 2 Condition of Agricultural Production

At present, there are land for agricultural use of 1,100,000 ha, corresponding to about 30%, distributed in the department. Out of them, cultivated lands are only 140,000 ha, corresponding to 13% of the land for agricultural use. Others are non-cultivated lands mainly covered with natural pasture. Farm lands are estimated at about 83,000 ha (average during 1985 to 1987). The yearly average cropping intensity on the

present farmland is less than 60%. The main reasons why the land use and the cropping intensity remain at such low rates are a chronic through-year shortage of agricultural water in the hilly land and mountainous region and existence of fallow lands caused by soil erosion.

The total number of farm households in the department is approximately 19,300 (1986), out of which approximately 60% is small-scale farmer possessing an average of 4 ha or less. More than 70% of these small scale farmers are distributed in Cercado and Mendez Provinces.

The main agricultural products in the department are vegetables (tomatoes, onions, green peas, etc.), root crops (potatoes), maize, sugar canes, and fruit such as grapes and peaches. All these crops are of a relatively high profitability and marketability in spite of small cultivated land under management, and the conditions of production reflect the scale of management.

On the other hand, sugar cane and soybean for processing crops area cultivated in Chaco district. The greater part of these main crops has a approximately 20% share of the total production of the country. In particular, the yields per ha of grapes, peaches and citrus such as oranges show the highest level in the country.

A hilly area that forms a basin extending from the central part to the western part of the department is called the Valle Central district. It covers an area of 360,000 ha, corresponding to 10% of the department, where 60% of farm household and more than 40% of all farmlands are concentrated. This district forms a central agricultural region in the department. It contains 4 Provinces and 55 Cantos, including Tarija capital city, and is regarded as playing an important role in the social economy.

In 1988, the CODETAR determined a "Five-year Social and Economic Plan for Tarija Department 1988 - 1992". In the development plan, 50 development projects and programs have been determined. Including continued matters, eight projects are currently in operation. Nine projects are being executed, and the rest are in the stage of investigation. The total investment amount is approximately B.S. 412 million. About 53% of the total investment amount and 40 projects in the development plan involve agriculture and rural development including the water source development.

Out of the projects established on the basis of 5-year Plan, the outlines of the "San Jacinto Multi-purpose Development Project" which is under execution, the "Guadalquivir River Upper Stream Development Project" of which the feasibility study has been completed, and the "Santa Ana Agricultural and Rural Development Project" which is under planning are the core project for the agricultural development in the Valle Central district. These projects are set up as the program to

improve farmers' income and settlement at rural areas through expansion of cultivated area and improvement of productivity by means of diffusion of technical irrigation for small-scale farmers in the Valle Central region.

5. PRESENT CONDITIONS OF THE STUDY AREA

5.1 Natural Conditions

The study area is located in the mid-mountain area at an altitude of 1,800 to 1,900 m. It belongs to the semi-dry zone; the annual mean temperature is 18°C, and the annual mean precipitation is 170 to 460 mm. The precipitation of the area is the smallest in all the areas of Valle Central in Tarija Department. More than 95% of the precipitation is concentrated during the rainy season lasting from October through April, and almost no surface run-off on the rivers can be found during the dry season combined with intake at the upper area than the study area.

Almost all the mountain areas around the Santa Ana district and the surrounding areas are mainly underlain by the alternate strata composed of sandstone and mudstone which are sedimentary rocks of the Silurian period to the Carboniferous period in the Paleozoic. Sandstone has been kept without great alteration in general and mudstone is found as phyllite in few places, and stones are dense and tight. The mountains are all steep and its weathered layer is extremely thin. Tight rocks are many exposed. Parent material of the soils is unconsolidated sedimentary rock, mainly in the terrace type there is alluvial deposits from the river and in the hill type there is fluvial and lacustrine deposits from the diluvial era.

The land in the study area is classified broadly into five land categories, cultivated land, forest land, grazing land, waste land and others.

Classification		Area (ha)	Remarks
Cultivated land	annual	537	including fallow land
	perennial	112	
Forest land		425	
Grazing land		190	
Waste land		6,087	
Others		242	urban, road and riversides
Total		7,593	

5.2 Agriculture and Agricultural Economy

The study area is a upland field region that spreads over river terraces extending along the Santa Ana River basin and adjacent hilly

zone. It belongs to the agricultural region of Valle Central district in the department. In the study area, there are 3 communities; i.e., Santa Ana Nueva, Santa Ana Vieja, and San Antonio. Small-scale farmers comprise a large proportion of the population. For these farmers, the shortage of the irrigation water in the dry season is the largest factor restricting their agricultural management to a single-crop in the rainy season production for auto consumption. Accordingly, because of low rates of cultivated land utilization and salable product, such small-scale farmers are restricted to unstable agricultural management. Their actual agricultural income is less than half of the general income.

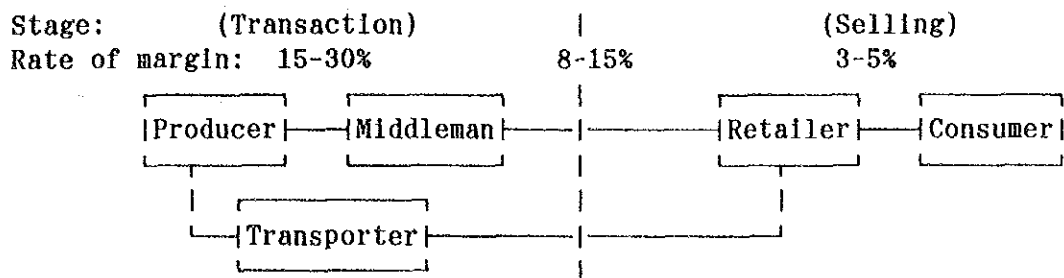
There are 33 tenant farmers in the study area, and the remainder are land-owners. Out of these farm households in the study area, the farm households distributed in the downstream area along Santa Ana River are relatively large in the scale of farm management, and two farm households having more than 300 ha of holding area exist. In the river terrace zone apart from the river, it is a tendency that many small-scale farm exist. The average area of land holding per household is estimated to be approximately 7 ha, and out of this area, 4 ha is considered to be the average arable area.

The main crops in the study area are annual crops such as corn, wheat, potatoes and beans, and vegetables, and perennial vines.

The farm households in the study area can be classified into the small-scale farmer and the large-scale farmer producing grape. The small-scale farm households can be further classified into the farm households which mainly produce annual crops such as corn, wheat, and potatoes, and the farm household which produce grapes. The farming patterns at present are similar for all farmers and the small-scale farm households classified under type A and B shown above account for over 95% of the total number of farm households. Out of them, the percentage of the grape-producing farm households is approximately 10%.

There are six major agricultural markets in Tarija city, such as Mercado Campesino, Central, La Paz, Boris Banzar, Bolivar and Villa Fatima. These major markets have built up the biggest market as distributors and shippers of agricultural produce in the department, and furthermore they appear to be the major supply of basic food to the regional inhabitants. The study area is located in a radius of 25 km from these major markets. Despite the favorable environment, the shipment volume by each farm household to the market is very small because the greater part of the agricultural production is consumed by the farmers themselves, and the water shortage makes it a difficult condition for the all year-round cultivation by the small-scale farmers. In addition, difficulty of access and the scattered small-scale fields are pointed out as common obstacles of the small shipment of the agricultural produce. On the other hand, in the current distribution procedure, the low profit margin does not encourage the farmers to increase their production. The distribution channel

on the agricultural produce of the study area is divided into following stages. A high rate of the distribution cost (Max. 50%) is occurs because of the distribution channel.



Direct sale of the agricultural produce from farmers living in the study area to the market is difficult due to the poor transportation system and lack of know-how of sales management. Because of the basic shortage of shipping volume, and the distribution cost, producer's profit is very low at present.

It is estimated that the total production of wine and liquor in the nation is approximately 4,114 million bottles (1985). Out of this, the Tarija Department accounts for 70% of the total production. There are two wineries in the study area, and their annual production is equivalent to approximately to 60% of the total production in Tarija department. The wineries in the study area employ 80 regular employees and 100 - 200 seasonal laborers during the grape harvesting season, and they offer a major opportunity of employment in the study area.

Agricultural experiment, research and extension activities in Tarija Department are performed mainly by the IBTA (Bolivian Agricultural and Stock Breeding Research Corporation). Technical propagation centers are distributed at seven places in the department, and experiment, research, and demonstration farms are distributed at four places. In the study area, however, no such agricultural experiment and extension centers exist, and only IBTA'S activities are relied on.

It is only the farm households specializing in grape production and a small-scale grape-producing farm households in the study area that are using loans of agricultural financing organizations. Very few ordinary farm households are using loans. This is because many households have not completed land ownership registration, and the unstable agricultural management continuing throughout the year prevents farmers from investing.

As major farmers' organizations in Tarija Department and the study area, there area the Agricultural and Farmers' Federation, the Agricultural Cooperative Association of Tarija Department, the Farmers Integration Association. At the Santa Ana Nueva community in the study area, on the other hand, there is an agricultural cooperative association

consisting of 16 farm households and having 7 ha of land in common. In addition, 45 farm households belong to the Agricultural Congress of Tarija Department.

Along Santa Ana River and its tributaries in the study area, the irrigation canals are prepared by individual farm households or several farm households in common.

5. 3 Rural Infrastructure

The Study Area is located in Cercado Province of Tarija Department. The area extends into the four administrative districts : Yesera Sur, Santa Ana, San Agustin and Portillo. The distance from Tarija City to the study area is about 25 km. The area consists of three communities : Santa Ana Nueva, San Antonio la Cabaña and Santa Ana Vieja. And inhabitants in the area are found clustered along the roads or rivers. The total amount of households and population in the area is 204 and 1,056, respectively.

The main road in the area is Route 302. This road is connected to Route 1 southwest of the area from Tarija to Bermejo. Moreover, this road, connected to Route 9 via Villamontes east of the area, leads to Santa Cruz or Yacuiba. On the other hand, the district roads in the area comprise of Route 3050, 3393 and 3394. Route 3050 joins Route 302 at Santa Ana Nueva village to Yesera Norte. Route 3393 links Route 1 and 302. These roads, trunk roads in the area, are not paved with asphalt. All these trunk roads are arranged in the right bank area of Santa Ana River, therefore the left bank area has no definite road networks. Farm roads link the trunk roads to the cultivated land, but many points in the farm roads are not available for car traffic because of narrow road width and insufficient maintenance works.

Right now, no drinking water supply facilities are available in the study area where rivers, streams and private shallow wells are the predominant source of water. But in the dry season, this area is faced with difficulties to get drinking water. To ensure the drinking water, inhabitants in the area dig the shallow well at the river bed such as Santa Ana river and the daily works to draw water is important for the farmer. The area has one public well for drinking water at Santa Ana Nueva primary school, and no well is available in the other villages. Only four private wells are being utilized in the area.

In the study area, the two wineries have electric supply system, but all farmers remain without electricity because the basic power networks are not established in the whole area except for Santa Ana Vieja village. At Santa Ana Vieja village, trunk line for electric power has been installed and electric supply will start in a few years.

The area has one medical center at Santa Ana Nueva, and it was established in 1974. The center is operated by one nurse and doctor is not available. Therefore, the medical activities at the center are mainly designed for prevention, early treatment of diseases, guidance for pregnant women and there is a midwife. The center has two beds where are mainly used for delivering babies. The users who are mainly made up of babies, children and pregnant women, are about 20 people per month.

As for education facilities in the area, the main school is located in Santa Ana Nueva consisting of a kindergarten, a primary school and junior high-school. The branch school, located in San Antonio and Santa Ana Vieja, has a kindergarten and a primary school.

In the area, communication facilities such as telephone do not exist. Therefore, a few residents have private radio telephone systems.

In the study area, few families have a toilet system, and their sewage is discharged directly into the river or stream or into the earth.

Within the study area, there are no agricultural-related facilities such as collecting/shipping center, agricultural extension center or a meeting place. There is some organization by the farmers along the area of Santa Ana river, some unions for operation, maintenance and control of irrigation water.

6. THE DEVELOPMENT SCHEME

6.1 Basic Concept

The regional development and promotion vary according to the natural and socio-economical conditions of the region, and the objectives of the project. In the case of the area under consideration, given the current conditions there and its regional characteristics, the primary objectives of the plan can be summarized into the following two points: "to enlarge the scale of farm management unit and to establish a district of the agricultural products", and "to improve conditions for settlement in the area by the unified improvement of the infrastructures for agricultural production and living environment". The establishment of the agricultural development plan having a water resources development for a basis, and the establishment of the rural infrastructure improvement plan corresponding to the improvement of conditions required for the agricultural production, are indispensable measures for the realization of the above-mentioned objectives.

6.2 Development Plans

A development plan for the objective area will be defined with

mutual relationship on the extent of the water resources development and agricultural development plans. Therefore, in deciding on a blueprint for development plan in connection with the basic concept for the project, mentioned above, two possible cases need to be considered. The first case would involve the year-round irrigation of arable land during both the rainy and dry seasons. In the second case, there would be a reduction of area to be irrigated, thus decreasing costs and raising the efficiency rate for expenditures (cultivation during the rainy season alone will also be considered, tentatively). The profitability of the undertaking itself as well as the financial effects on farm household, maintenance costs, and the refund of construction costs for the facilities after the completion of the project will be analyzed in regard to both of the cases mentioned above. A development plan that is considered economically and technically most feasible will be decided upon. Although, there is no direct relation between the scale of the rural development plan and those for the development of water resources and farm management in the area, since the plan is a part of the synthetic project, this will be taken into account in calculations regarding the economical efficiency of the project as a whole.

The following 10 cases will be studied as alternatives on the water resource development plan. The objective area for irrigation of each case will be taken as 4 ha per farm household, which is the average arable land per farm household in the study area. In cases where perennial crops are not adopted for the farming plan, 3 ha will be taken as the cultivation area in consideration of the family labor force of each farm household.

CASE	Irrigation area per farm household (ha)	
	Rainy Season	Dry Season
CASE 1	4.0	4.00
CASE 2	4.0	3.00
CASE 3	4.0	2.00
CASE 4	4.0	1.75
CASE 5	4.0	1.50
CASE 6	4.0	1.25
CASE 7	4.0	1.00
CASE 8	4.0	0.50
CASE 9-1	3.0 (for only present cultivated land)	
CASE 9-2	3.0 (for objective area)	

6. 3 Selection of Development Plan

The economical effects for each case are shown as follows:

Case	Project cost (US\$ 1,000)	Objective area (ha)	Project cost per ha (US\$)	FIRR (%)
1	19,195	1,090	17,610	9.6
2	16,748	1,090	15,365	9.0
3	15,844	1,090	14,536	9.1
4	15,185	1,090	13,931	9.4
5	14,999	1,090	13,761	9.3
6	14,632	1,090	13,424	9.0
7	14,482	1,090	13,286	8.8
8	13,535	953	14,203	6.5
9-1	6,531	388	16,832	0
9-2	7,817	817	9,568	2.4
San Jacinto Project	62,000	3,225	19,225	12.0
Guadalquivir Project	35,321	3,215	10,986	5.9

On the basis of the water resources development in the projected area, formulation of a synthetic development plan has been made through the studies and analyses such fundamental dimensions as the extent of the area to be developed, cropping pattern, agricultural production costs, projected yields, proposed facilities and etc. As the results of these deliberations, Case 4 from among the cases discussed above is selected, for the following reasons.

- From the results of the financial analysis of farm household, it is clear that, for an improvement in their income, more than 1 ha of land would have to be cultivated during the dry season. From this, it can be seen that, for the improvement of farming in the area, it will be necessary to introduce intensive farming, which would include the cultivation of dry season crops, particularly perennial crops, as the base. From the viewpoint of the economic standard of the small-scale farmer in the area, cases positioned higher than Case 5 would be desirable.
- For the introduction of dry season crops, the construction of reservoirs is necessary. The size of the reservoir (the amount of water necessary) greatly affects the cost of the project per hectare. From among cases that involve the construction of dams, it will be necessary to choose one in which the cost per hectare is more than US\$ 13,000. When the opportunity costs in Bolivia are considered, cases involving costs per hectare higher than US\$ 15,000 would be inappropriate from the viewpoint of the realization of the project, even if the project itself were considered economical. For this reason, cases positioned lower than Case 3 will need to be considered.

- The financial internal rate of return for the project is the highest for Case 4 among cases listed. This case also offers the farmers the highest yield on their investments.

7. AGRICULTURAL AND RURAL DEVELOPMENT PLAN

7.1 Objective Area for the Development

Taking the natural conditions such as topography and soil, and the environmental conditions surrounding the rural area into account, forest and pasture are let alone to preserve the natural environment in the area. The land which is reclaimed as agricultural land by the project, is the land which classified into an arable land out of waste land based on the results of land classification. Accordingly, the proposed land use plan is shown as follows on the basis of the present land use, the land classification and the proposed farm management.

Kind of land	Area (ha)
Cultivated land	1,442
Annual crop	(1,065)
Perennial crop	(357)
Forest	425
Pasture	190
Waste land	5,314
Suitable land for cultivation	(2,040)
Unsuitable land for cultivation	(1,926)
Erosion area	(1,348)
Others	242
Total	7,593

Administrative boundary of the objective area is extended over the Santa Ana, Yesera Sur, San Agustin and Portillo districts. These districts are further divided into several communities. Major villages in the area are composed with these communities as a unit.

Out of the study area of 7,593 ha, arable land is estimated 2,500 ha based on the present land use and soil survey results. Objective irrigation area with the project on the basis of the water resource development plan and proposed canal alignments is proposed at 1,090 ha spreading downstream from the proposed Santa Ana dam site. The area consists of 388 ha of annual crop fields, 112 ha of perennial crop fields and 590 ha of arable land. Therefore, the objective area of agricultural development plan includes these 1,090 ha of irrigable area. The number of beneficial farmers distributed in the project area is 152 and they are small-scale farmers with the average cultivable area of less than 4 ha except two large-scale farmers specializing in grape production.

Besides, other than the projected areas of the existing cultivated and cultivable areas, present agricultural productivity and yield of that areas will be improved taking the problems and measures on the agricultural management and cultivation derived from the field study into account (details in Annex E).

The communities will be taken as a basic unit for the establishment of a rural development plan in the area. With the adjustment of the agricultural development plan and the distribution of villages in the area, three communities, Santa Ana Nueva, San Antonio and Santa Ana Vieja, will be selected as the objective areas for the rural development plan.

7. 2 Agricultural Development Plan

Crops to be introduced on a agricultural production plan will be drawn up as follows:

Annual crops : corn, wheat, potatoes, beans
and vegetables (tomatoes, onion, garlic , etc.)
Perennial crop: grapes
Forage crops and livestock
: alfalfa and dairy cattle

These crops have been decided taking into account social and economic conditions, such as cultivation conditions, marketability, agricultural development plans by CODETAR, crops to be introduced by the agricultural council, and crops increased on a national development plan. The cropping pattern, which is the basis of the farm management plan, will be decided as follows on the precondition that introduction of crops during the dry season will be made possible by the water resources development in the area.

Crop	(Unit: ha)	
	Rainy season	Dry season
Grapes	1.00	1.00
Alfalfa	1.00	-
Wheat	0.25	-
Corn	0.25	-
Potatoes	0.50	-
Beans	0.25	-
Onions	0.20	0.20
Tomatoes	0.30	0.30
Carrot	-	0.25
Garlic	0.25	-
Total	4.00 ha	1.75 ha

From the proposed cropping pattern mentioned above, the cropping acreage in the project area is increased as follows.

Perennial crop	Present	112 ha
	With project	357 ha
Annual crop	Present	388 ha
(dry season)	With project	916 ha (183 ha)

Total agricultural production volume and its production value after completion of the project are shown below. These values increase about 9 times of the present agricultural production volume for major food, including grapes, and 7 times of the present production value. Farm income, which is estimated on the basis of cropping acreage, yield, production cost and value, is become increase of 7 - 8 times of the present one as shown below and farm economy is greatly improved. Agricultural gross income and net income progress and moreover, it can be expected that a surplus for farm economy will come out.

Description	(Unit: US\$)	
	Present	With Project
Gross farm income	1,200 - 1,500	9,945
Production cost	250 - 400	2,288
Net farm income	950 - 1,100	7,657
Living expenses	1,000 - 1,200	2,300
Repayment and etc.	-	4,854
Surplus	-	503

In accordance with the implementation of the project, agricultural production mainly composed of cash crops such as grapes and vegetables will remarkably be increased in each farm. On that account, establishment and promotion of the producer's organization are required to sell the cash crops with favorable conditions and to increase farm income. In establishing the selling system, the producers' organization on the basis of the existing farmers' organization which is formed at each community such as Santa Ana Vieja and San Antonio in the area can be proposed .

7.3 Rural Infrastructure Improvement Plan

Based on the situation of the existing rural facilities and the improvement level of rural area in Cercado province, targets for improvement of the area will be set up. The improvement level will be risen gradually with stage-wise development. The process to complete rural infrastructure improvement are divided into three stages, then, urgent one will designate as the first stage and long-term ones as second and future stage. Above-mentioned, the improvement of the first stage which is made up of urgent problems will be carried out. The target year is scheduled for 10 years (2001 year). As the improvement of the second

and future stage, it will be carried out when agricultural products and farmers' organization are well under way.

With these, the target of improvement for each sector which is based on the administrative division is shown below:

	Santa Ana Nueva				San Antonio		Santa Ana
	I	II	III	IV	I	II	Vieja
Main Roads	△	■	■	△	■	△	■
Farm Roads	●	●	●	●	●	●	●
Water Supply	●	●	●	●	●	●	●
Electrification	○	○	●	○	○	●	●
Medical Care	-	-	●	-	-	●	●
Education	-	-	■	-	-	●	●
Collecting Shipping	-	-	●	-	-	●	●
Meeting Hall	-	-	●	-	-	●	●
Telecommunication	-	-	●	-	-	○	○
Rural Park	△	△	■	△	△	△	△

●:First Stage :Second Stage △:Future Stage
 -:Have no urgent use for ■:Enough

In the roads improvement plan, the urgent improvement items will be set up to establish the farm road networks on the left bank area of Santa Ana river. And these roads will be linked with the trunk road on the right bank area of Santa Ana river. The roads rehabilitated and/or constructed of the project are nine routes and the total distance is 20.2 km.

Since habitats are scattered in the area, there are no stable water sources and there are complex land shapes with undulation, unified water supply system can not be improved from the aspect of the construction cost and the economic effect. Then, to solve the drinking water problem, some public wells will be proposed to be dug in the bank area of Santa Ana river. One public well has to benefit an area of about 2km distance, and it will be made for about 20 households. The number of water supply facilities are 15 sites.

The electric power for the construction works of the water source development will be required. On the plan, transmission line is provided from the Pan American Highway to the dam site. Therefore, rural power supply would be promoted together with the electric power supply plan of dam construction works. The installation of a power transmission line to the center of each administrative district is planned and the cost for installing the service lines to each household will be borne by the individuals. The distance of improved transmission lines is 20 km.

As medical care improvement plan, the present health center in Santa Ana Nueva will be located for the core of medical care facility in the area with improvement of equipment for medical treatment. Sub-health-center is provided for the branch office of the main health center at other two communities to improve medical service for rural habitants. In the future stage, a doctor will be requested to stay permanently at the center. But, for the time being, the medical patrol system will be proposed in the area.

Improvement and expansion of school-houses existing at Santa Ana Vieja and San Antonio and introduction of middle class will be planned as an improvement plan of education facilities.

Agricultural extension center will be installed as the core facility for the regional agriculture and rural developments and to function and maintain the proposed facilities of the project. The main body of the agricultural extension center will be installed in Santa Ana Nueva, and the center will also function for the O & M of the proposed facilities, agricultural extension, collection and shipping facility, etc. The sub-center will be set up as the branch office of the main center in San Antonio and Santa Ana Vieja. The sub-center has the functions of collecting and shipping the agricultural products and as a meeting-hall. Administrative body of the center will be left to the farmers' organization. And the head office of the organization will be set up in the main center.

7.4 Facilities Plan

(1) Water source facility

After comprehensive considering the topographical and geological conditions, the maximum stored capacity and the relationship of location between the dam site and the irrigated area, the Santa Ana site is selected as the site of dam construction. Though a fill-type dam and a concrete gravity-type dam can be considered as the type of the Santa Ana dam, the concrete gravity-type dam is proposed taking construction cost, especially construction cost of spillway, into consideration.

Effective reservoir storage is estimated to be 2.30 (MCM) for irrigation water supply in the irrigation plan. Considering the specific sediment volume for dam in the Guadalquivir River basin and the conditions of topography, geology and erosion in the Santa Ana River basin, a value of 1,000 t/km²/year is applied as the specific volume in the area. As the results, the inflow sediment from the sub-basin is estimated to be 0.60 (MCM) taking into account the project life of 50 years. Therefore, the reservoir capacity of the Santa Ana reservoir is as follows.

Effective reservoir capacity	2.30 (MCM)
Dead storage	0.60 (MCM)
Gross reservoir capacity	2.90 (MCM)
Effective water depth	10.85 (m)
Limited water level	EL. 1,962.60 (m)
Normal full water level	EL. 1,973.45 (m)

The designed flood discharge of the Santa Ana dam is for a 200-year flood, which statistically occurs once in 200 years. Since the catchment area at the dam site is larger than the inundation area of the reservoir, storage effects at the reservoir will not be expected. Therefore, the designed flood discharge is applied to the design of the spillway.

Probable year	T = 200 (years)
Designed flood discharge	Q = 676 (m ³ /s)

Considering the longitudinal section of the dam and the transversal section of the river, the effective length of the spillway crest will be 60 m. The total head above crest and the designed flood water level are as follows.

Design Flood Discharge	676 (m ³ /s)
Total head above crest	3.10 (m)
Designed flood water level	EL. 1,976.55 (m)

Taking the lag of the gate operation, the installation of a crest gate is not recommended. A straight crest type as an inlet portion of the spillway, an overflow type as a guide portion and an end sill dissipater type as energy dissipater is proposed, respectively. The maximum intake volume calculated in the irrigation plan is 0.74 m³/s. Irrigation water is taken from the intake installed above low water level and is released to the energy dissipater through the outlet pipe installed in the dam body. The water which is released to the energy dissipater is taken into the Main irrigation canal.

The specific volume of 714 m³/km²/year and the project life of 50 years are adopted as the inflow sediment from the basin. The total amount of inflow sediment from the Santa Ana River basin is estimated to be 8.6 (MCM) during 50 years. These total amount of inflow sediment is stored at the sedimentation dams and the Santa Ana dam. And in order to reduce the construction cost of the sedimentation dam, the sedimentation dam of which the height is lower than 10 m will be constructed with the wet masonry and of which the height is higher than 10 m will be constructed with the concrete.

(2) Irrigation Plan

Irrigation methods with the project conditions are to be the same methods as present. When surplus of farm economy occurs from the invest-

ment of the farming activities, irrigation methods utilizing certain facilities will be planned.

The objective area for irrigation with 1,090 ha is divided into 35 irrigation blocks on the basis of the topography and existing canal systems. The irrigation block varies 2 ha in minimum, 73.8 ha in maximum and 30 ha in average. Because of the decision of canal capacity, water requirement in January which shows maximum water requirement throughout the year. A rotational irrigation method will be carried out in each irrigation block. To decrease the construction cost and to carry out operation and maintenance easily, main and secondary canals and canals in the irrigation blocks will conduct continuously the irrigation water from the dam 24 hours per day.

In order to decide the effective reservoir volume, the water balance from 1959 to 1988 was studied using the crop water requirement and the run-off discharge data of Santa Ana River. The effective reservoir volume is equivalent to the scale that water shortage statistically occurs once in 5 years for the purpose of reduction of construction cost.

Based on the distribution of the irrigation blocks, three canal routes are proposed. Across Santa Ana river, one is on the left bank and the other is on the right bank. The remaining canal route runs along the provincial road located on the north side of the project area. At the dam site, the main canal will start from the right bank and will run up to the junction point of the secondary canal on the left bank. Irrigation blocks governed by canal systems on the right and left banks are mainly distributed along the river, the canal route is set on the river terrace to keep the water head of canals. For the connection between proposed canals and irrigation blocks, which consist of new developed areas, a division structure will be constructed at the highest position in the block, on the other hand, a connection canal will be constructed from the proposed canal to the upstream reach of the existing canal system of the irrigation blocks, which consist of existing canal systems and divisional operations will be made at the downstream reach of the connection canal. As far as the canal structure is concerned, concrete linings are proposed for the main canal and masonry linings for the secondary canals. Canal sections will be trapezoidal and a passage for operation and maintains is provided on the valley side. The width of passage is 2.0 m for the main canal and 1.5 m for the secondary canals.

The site where the canals cross the stream and/or around the diversion point of secondary canals, a small-scale reservoir will be planned. Surplus water during the rainy season will be stored through the canals. The purpose of the reservoirs is to prevent erosion, by planting trees around the reservoirs and to providing supplementary water sources to surrounding farm lands. The role of a regulating reservoir will be

designed for each reservoir which will be constructed around the diversion point of a secondary canal.

7.5 Summary of Agricultural and Rural Development Plan

The Agricultural and Rural Development Project for the objective area are summarized as follows:

Area to be developed:		1,090 ha
Area to be irrigated: Rainy season(fruit and vegetable)		1,090 ha
	Dry season (the same as above)	540 ha
Crops to be introduced:		
Perennial crop	; Grapes	
Annual crops	; Corn, wheat, potatoes, beans, tomatoes, onions, garlic and carrots	
Forage crop	; Alfalfa	
Farming area per household :	Rainy season	4.00 ha
	Dry season	1.75 ha
Improvement of water source facilities:		
	Concrete gravitation-type dam	
	Height of dam	34.55 m
	Dam crest length	166.00 m
	Total storage capacity	2.3 MCM
	Dead storage capacity	0.6 MCM
	Sabo dam	5 Nos.
Improvement of canal facilities:		
	Main canal	5.4 km
	Secondary canals	24.8 km
	Reservoirs	14 Nos.
Road improvement:	9 route	20.2 km
Water supply facilities:	Shallow wells	15 Nos.
Rural electrification:	Transmission line	20 km
Public health center:		3 Places
Education facilities:	Repair of schoolhouse	2 Places
O & M Equipment:	Collection & shipping facilities,	
	Administration office	3 Places
	Bulldozer 11t	1 Unit
	Shovel tractor 0.6m ³	1 Unit
	Back hoe 0.3m ³	1 Unit
	Dump truck 4t	1 Unit

8. **Project Cost**

The cost required for the implementation of the project is estimated to be US\$ 15,185,000 as follows. Out of it, the foreign currency portion is US\$ 7,722,000 and the local currency portion is US\$ 7,436,000.

(Unit: US\$1,000)

Description	Project cost			Remarks
	F/C	L/C	Total	
Agricultural facilities				
Dam	3,148	2,734	5,882	
Sabo Dam	1,141	1,403	2,544	
Irrigation Canal	873	885	1,758	
Reservoir	447	433	880	
On-farm Facilities	188	55	243	
Sub-total	5,797	5,510	11,307	
Rural infrastructure				
Agri. Extension	10	93	103	
Road Improvement	65	436	501	
Electrification	13	51	64	
Water Supply	14	3	17	
Sanitary	29	21	50	
Education	5	45	50	
Sub-total	136	649	785	
Land acquisition	0	31	31	
O/M Equipment	421	22	443	
Consulting services' Fee	673	182	855	
Administration	45	420	465	
Sub-total	1,139	655	1,794	
Total	7,072	6,814	13,886	
Physical Contingency	650	649	1,299	
Grand total	7,722	7,463	15,185	

9. **BENEFIT**

Major project benefits on economic terms expected in target year after completion of the Project are as follows.

(Unit: US\$)

Item	Benefit
Agricultural Production	1,982,000
Roads Improvement	8,370
Erosion Prevention	3,850
Total	1,994,220

With the implementation of the project, following the indirect socio-economic effects (benefits) can be generated adding to the

measurable direct benefits mentioned above. This is expected to result in activation and promotion of the rural community.

With the implementation of the project, the construction works results in the employment of a total of 5,000 laborers over 4 years. Also, the projected increase in agricultural laborers necessary for agricultural production is about 300 persons per years for each farm household, and about 45,000 persons per year in the total projected areas.

The increase in agricultural products in the projected area with the implementation of the project, combined with the extension of agricultural production due to the San Jacinto and the Guadalquivir projects, contributes to increase the agricultural product supply rate: wheat 22 %, corn 67 %, potatoes 50 %, and beans 150 %.

As shown in the result of financial analysis of farmers, the implementation of the project enables farmers' income to increase 7 to 8 times. It also enables farmers' economic residue, which has not been experienced previously, to be realized. The improved farmers' income contributes to improve in the living standards of farmers, minimizing the social gap between farmers in the projected area and in advanced agricultural districts.

10. PROJECT EVALUATION

The financial and economic internal rate of returns, calculated based on the projected life of 50 years, are 8.9% and 10.2%, respectively. From the results of sensitivity analysis, the numerical values of EIRR are within the range of 8.3% to 11.4% and show the propriety of project implementation.

From the results of the financial analysis for farmer, the short-term loan for agricultural management keeps a balance in the black, and the burden of the repayment of the project cost and O & M cost is tolerable. Consequently, it is indicated that each farmer can get along relying only on his agricultural income after completion of the project, and future investment to the agricultural activities is feasible.

11. PROJECT IMPLEMENTATION PROGRAM

The executing agency of the project shall be the Regional Development Corporation of Tarija (CODETAR) and the Agricultural and Stockbreeding Department, which is one of departments in CODETAR, shall give the technical support. The facilities which are constructed under the responsibility of the CODETAR are dam, main and secondary canal, and their related facilities. On the other hand, civil works such as ter-

tiary canal and terminal facilities are carried out by farmer under the guidance of CODETAR.

Operation and maintenance of the facilities after completion of project will be carried out by the Santa Ana development office established under the CODETAR, in closer cooperation with the producers' association which will be organized by the farmers in the area.

The Project will be completed in the course of four years, namely the detailed design period of one and half years and the construction period of two and half years. The detailed design period includes the financing procedure of half a year and the detailed design of one year. The construction period needs half a year for the land acquisition and two years for the construction works. The tertiary canal and on-farm facilities will be constructed during the construction period of the major facilities.

In order to operate and maintain the facilities, so that they sufficiently fulfill their function after completion of the project implementation, it is ideal that the irrigation association which is composed of its beneficiary would be organized and they would administer the facilities of themselves. However, the farmers in the area have no experience of operation and maintenance of the large-scale irrigation facilities. Since the CODETAR carries out the closer agricultural supporting service to the area, the Santa Ana Project Implementation office which carries out the administration works of the project will continuously carry out the operation and maintenance of the facilities. And also, the office will operate and maintain the facilities in cooperation with the producers' association which is organized by the farmers in the area.

Out of the facilities which are constructed on the Project, the irrigation and the agricultural facilities are placed under the charge of the Santa Ana office and other facilities under their appropriate authorities.

Operation and maintenance costs consists of the administration cost for the office, the maintenance cost of the irrigation facilities and administration cost for the producers' association are estimated to be US\$ 73,800 per year. The O/M costs are collected similarly as the water charges from the appropriate farmers.

12. CONCLUSION AND RECOMMENDATION

The Santa Ana area is located near an urban region of Tarija City, the largest market in the department, and is a place appropriate for profitable vine production. Extension of intensive agricultural management of vine as a basic crop, it is contributive not only for the

unified development of Santa Ana area as well as Valle Central region in Tarija Department, but also promotion of agriculture and rural communities in mid-mountain areas in Bolivia. Prime objects of the regional development are: enlargement of the agricultural management scale of each farmer, formation of a producing center and, furthermore, establishment of the settlement condition by unified improving the production base and the living environment.

The investment necessary for implementation of above-mentioned project is estimated US\$ 15,185,000. Taking account of costs and anticipated benefits, the economic internal rate of return for the project is 10.2%. According to the results of financial analysis for small-scale farm households, who account for more than 90% in the project area, their farm incomes after completion of the project implementation will increase by 7 to 8 times. With these facts, the project is justified economically, financially and socially.

Based on the above-mentioned conclusion, it is desirable to start the project immediately. The Bolivian government should expedite the finance procedure necessary for the project implementation.

Since the project area has many problems in common with those of other rural communities in mid-mountain areas of Bolivia, the policy indicated in the project formulation will be a model for similar regional development project hereafter.

The Republic of Bolivia
Regional Development Corporation of Tarija
The Feasibility Study on Agricultural
and Rural Development Project
in Santa Ana, Tarija

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ABBREVIATIONS

INSTITUTIONS AND ORGANIZATION

BAB	BOLIVIAN AGRICULTURAL BANK
CERCAT	AGRICULTURAL CO-OPERATIVE ASSOCIATION OF TARIJA DEPARTMENT
CODETAR	REGIONAL DEVELOPMENT CORPORATION OF TARIJA
COINCA	INTEGRATED FARMERS ASSOCIATION
IBTA	BOLIVIAN INSTITUTE OF AGRICULTURAL TECHNOLOGY
MACA	MINISTRY OF FARMERS', AGRICULTURE AND STOCKBREEDING
MPC	MINISTRY OF PLANNING AND CO-ORDINATION
SFC	AGRICULTURAL AND FARMERS FEDERATION

MONETARY UNIT

Bs.	BOLIVIANOS
US\$	UNITED STATES DOLLAR

SOCIAL AND ECONOMY

B/C	BENEFIT-COST RATIO
CIF	COST, INSURANCE AND FREIGHT
EIRR	ECONOMIC INTERNAL RATE OF RETURN
FIRR	FINANCIAL INTERNAL RATE OF RETURN
ENPV	ECONOMIC NET PRESENT VALUE
FOB	FREE ON BOARD

OTHERS

BOD	BIOCHEMICAL OXYGEN DEMAND
DO	DISSOLVED OXYGEN
EC	ELECTRIC CONDUCTIVITY
pH	HYDROGEN-ION CONCENTRATION
GL	GROUNDWATER LEVEL
MSL	MEAN SEE LEVEL
EL	ELEVATION ABOVE MEAN SEA LEVEL
mm	MILLIMETER
cm	CENTIMETER
m	METER
m ²	SQUARE METER
MCM	MILLION CUBIC METER
m ³ /s	CUBIC METER PER SECOND
km	KILOMETER
km ²	SQUARE KILOMETER
g	GRAM
kg	KILOGRAM
ton	METRIC TON
ha	HECTARE
°C	DEGREE CENTIGRADE
mmho/cm	MILLIMHO PER CENTIMETER
HP	HORSEPOWER
ppm	PARTS PER MILLION

CHAPTER 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

1. 1 Background of the Study

In Bolivia, as well as the mining industry mainly represented by tin and natural gas production, agriculture is an important industry for the National economy. According to the long-term economic plan up to the year 2000, prepared by the Ministry of Planning and Coordination, called "Economic and Social Development Plan", it is expected that agriculture and stockbreeding will stand the first of the Gross Domestic Production (GDP) to the future national economy. Although approximately 50 % of the employment population in the country is currently engaged in the agriculture and stockbreeding, agricultural and livestock production accounted for only 20 % of the GDP. These situation arise that more than 60 % of domestic agricultural production depends on the majority of small-scale farmers. The important current issue, therefore, is the development and promotion of agricultural produce with an improvement of agricultural productivity for the small-scale farmers.

In order to expand the domestic agricultural production, increase the farmers incomes, improve the standard of living, and secure a stable supply of agricultural produce, the Ministry of Farmers', Agriculture and Stockbreeding (MACA) formulated the "Irrigation Development Plan" in 1983, covering suitable areas for technical irrigation. In accordance with this plan, the Regional Development Corporation of Tarija (CODETAR) decided to plan and carry out the irrigation project at four areas including the study area (Guadalquivir, Santa Ana, Pajonal and Tomayapo), being the important areas in the Department needing irrigation. The development of these areas will serve in the above-mentioned plan as the model of the agricultural and rural development in the mountainous areas of Bolivia, and also to contribute to the expansion of agricultural areas and to the stabilization of the Bolivian economy.

Santa Ana, the objective area of this study, is located at approximately 20 km southeast of Tarija city which is the capital of the Tarija Department. Although, the Pan American Highway connects Santa Ana to Tarija city which is a major market for agricultural produce, overall development and farm management in the area have been ignored except in some flat areas along the Santa Ana River. These circumstances are created by severe natural conditions such as limitation of the river water utilized for agriculture due to drastic decrease of the river flow in the dry season together with little rainfall. Soil erosion due to the undulated topography and alluvial sandy soil and gravels content in the layer of top soil. However, meteorological and soil conditions in the area such as temperature, amount of sunshine and sandy soil are suitable for fruit cultivation, mainly grapes. At present, large scale grape cultivation is carried out in two places in the area where irrigation

facilities such as collecting conduit in the riverbed and several ponds are utilized. Furthermore the grape produce in the area is used for making wine and distilled liquor (singani), although there is a great shortage of prime material. Therefore, if the irrigation facilities are improved and measures are taken for soil conservation in the area, the objective area will have a high potential for development as a stable agricultural area based on the grape cultivation.

In the surrounding area of Tarija city, the Guadalquivir Irrigation Project covers the northeastern part of the city, and the San Jacinto Multi-purpose Development Project (dam and power generating plant have already been completed by a loan from the Italy and Argentina and the detailed design and construction work of the irrigation project will be started in 1990 by a loan from the Italian Government), covers the southern part and the downstream part of Santa Ana area. Like these projects, the Agricultural and Rural Development Project in Santa Ana is regarded as an indispensable project for the development of the southeastern region of Tarija city. The carrying-out of these projects is expected to make a great contribution to the well-balanced agricultural development in the surrounding area of Tarija city.

With the background described above, by developing the Santa Ana area as the model of agriculture and rural communities development in mountainous areas, the Bolivian government requested the Japanese government in February 1986 to carry out the feasibility study of Agricultural and Rural Development Project in Santa Ana. In response to this request, the Japan International Cooperation Agency (JICA) dispatched the preliminary study team in December 1988 and the "Scope of Work" of the project was signed by the Team and the Government of Bolivia. The study, both field investigation in Bolivia and home office work in Japan, were carried out twice once from July and once from November 1989.

1. 2 Objectives of the Study

Objectives of the study are to establish an agricultural development plan introducing the technical irrigation on the basis of water resources development for approximately 1,000 hectares of farmland and reclaimed land in the Santa Ana district of Tarija Department. In addition, rural development plan consisting of road improvement, water supply of domestic water, and soil conservation in the same district is to be established. In the project formulation, a development plan which basic concept can be applied not only for Santa Ana district but also for other regions should be established as a model of agricultural and rural development in the mountainous areas of Bolivia.

1. 3 Scope of the Study

The area to be studied is the area around Santa Ana located southeast of Tarija city, Tarija Department. The study area covers about 76 km² and includes with the watershed for the Nogal and the Temporal Rivers in the north, the Papa Chacra zone in the east, and the watershed for the San Pedro River in the west, and it is bordered by the Guadalquivir River in the south. From viewpoint of administrative boundaries, the study area is located in the Santa Ana District, Cercado Province, and consists of the "Santa Ana Nueva", "San Antonio", and "Santa Ana Vieja" Communities.

CHAPTER 2 GENERAL FEATURES OF BOLIVIA AND TARIJA

CHAPTER 2 GENERAL FEATURES OF BOLIVIA AND TARIJA DEPARTMENT

2.1 General

Bolivia is located in the middle of the South American Continent, south latitude $9^{\circ}38'$ to $22^{\circ}53'$ and west longitude $57^{\circ}26'$ to $69^{\circ}38'$. It is a landlocked country circled by five countries: Brazil, Paraguay, Argentina, Chile, and Peru. Bolivia is roughly divided into three areas on the basis of its altitude: the Andean highland area (3,500 to 4,000 m in altitude) in the west part, the Andean mid-slope (1,300 to 2,700 m), and the eastern plain (130 to 500 m). Approximately 60% of the total area of the country (1.09 million km^2), is occupied by the eastern plain area.

The country is divided into nine (9) administrative departments. La Paz, Potosi, and Oruro Departments are in the Andean highland area; Cochabamba, Chequisaca, and Tarija Departments are in the Andean mid-slope area; and Santa Cruz, Beni and Pando Departments are in the eastern plain area. The total population of Bolivia is estimated approximately 6.9 million (1988). Although the average annual growth rate of the population in the 1970's was 2.3%, the growth rate for the last five years (1981 - 1986) was 2.6% with a tendency to increase slightly. On the other hand, the ratio of urban to rural population is estimated at 44% to 56%. The growth rate of the urban districts in 1965 - 1980 was 2.9% but the growth rate for the last five years was 5.6%, which is nearly twice as high as the said 2.9%. In the major cities, such as La Paz (993,000), Santa Cruz (442,000) and Cochabamba (317,000), the average annual growth rate for the last 10 years (1978 - 1987) were as high as 3.5%, 5.4%, and 4.1%, respectively.

Major industries are the mining represented by tin and the agricultural. The agricultural production sector has an approximately 20% share (1988) of the GDP, employs approximately one million peoples, which is equivalent to 49% of the total work force (approximately 2.1 million), and plays an important role in the society and economy of the country.

2.2 National Economy and Agriculture

2.2.1 Present Condition of Economy and Role of Agriculture

(1) Growth of GDP

The GDP of Bolivia had maintained the average annual growth rate of 5% from the 1960's to the second half of the 1970's, but the cumulative rate of change from 1981 through 1988 dropped to -8.4%. The major causes by which the growth rate dropped is thought to be an activity in

the production of the mining and agricultural industries sectors, which are the basic industries of the country. In particular, the growth rate of the agricultural production sector, which played the most important role in the GDP, had maintained 2% per year from 1970 through 1981, but it turned to a negative growth in 1982, a 22% negative growth in 1983 versus 1982, and the share in the GDP dropped to less than 16%. The serious flooding by the rivers in the eastern plain area, which is a leading agricultural production area in the country, and the unfavorable weather condition (dryness) that continued afterwards causing damage to agricultural produce, are pointed out as the reasons for the decreased agricultural production.

However, the growth rate of the agricultural production sector in the last five years (1984-1988) compared to each previous year is plus 2.5% per year on the average, and the share in the GDP is as high as 23% (1988). The recent increase of the agricultural production sector have favorably affected the national economy, and the growth rate of the GDP in 1987 and 1988 were 2.5% compared to each previous year. Thus, the national economy is showing a trend of recovery.

The gross domestic production, the gross production per capita, and the distribution rate of GDP in last seven years are shown in Table A.1 of Annex A.

(2) Condition of import and export

The major export goods of Bolivia are mining products mainly represented by tin, petroleum, and natural gas. These account for more than 80% of the total export amount. Natural gas is the most important export goods and accounts for 60% (1988) share in the total export amount. All of these export goods, however, are subject to price fluctuations affected by the international market, and both production and export are unstable. Although agricultural and forestry products such as timber, coffee, and sugar have been exported, they have small shares.

On the other hand, the major import goods are capital goods and intermediate goods for production such as machinery and transport equipment, which account for 85% share in the total import amount. The main features of import are that there is very little import of materials and equipment relating to agricultural production, which negatively affects the improvement of agricultural productivity in the country. Moreover the import of foods, including wheat as a main item, shows a trend of increase, and that oils and fats, soybeans, and dairy products, added to wheat, have an 80% share in the total foods import amount. For this reason, the government provided the policy in 1982 to exempt import duties on materials and equipment for agricultural production and to prohibit import of fruit and vegetables.

The import and export condition of last five years is shown in

Table A.2 and A.3 of Annex A.

(3) Prices, wages and condition of employment

The average annual increase rate of the consumer price index for the period 1975 through 1981 was approximately 18%. However, it exceeded 200% from 1982, and an 8,200% price increase rate was recorded in 1985 as compared with the previous year. Among all, the steep rise of food prices was the most remarkable, and a 1,200% increase was recorded in 1984 as compared with the previous year, which is regarded as the most significant cause for the high inflation. As the result of execution of the new economic policy in 1985, however, the high inflation was decreased to 66% in 1986, 10.7% in 1987, and 20.9% in 1988. Since the steep rise of prices lowered actual wages to such a significant degree, the government has instituted a legal minimum wage system since 1985. The current legal minimum wage is B.S. 70.4/month (March, 1989).

The estimated labor population in the country is 2.1 million (1989, according to the Ministry of Labor) which is equivalent to approximately 30% of the total population. Out of the 2.1 million labor population, approximately 49% is employed in an agricultural production sector. The number of unemployed laborers was approximately 147,000 at the end of 1988. The increase of the unemployment rate in urban areas was 13 - 15% per year on the average by the first half of the 1980's, but the rate has increased to 22% in the last three years (1986 - 1988). This increase is said to be attributable to the population flow from rural to urban districts in recent years.

2.2.2 Trend of Agricultural Production

(1) Land use and land holding

Agricultural lands of about 8,770 thousand ha, which is equivalent to 8% of the total area of the country, are distributed throughout the country at present. An area of cultivated lands is only 1,270 thousand ha, which is equivalent to 15% of the total agricultural land. The other 85% is non-cultivated land. The total area of the agricultural land including non-cultivated land has increased at the rate of approximately 2% per year on the average in the period 1975 through 1980. The greater part of this increased area is a conversion from forest area into farm land.

The scale of land holding per farm household differs at each area. In the Andean highland and Andean mid-slope areas, farm households with less than 20 ha account for more than 91%, while in the eastern plain area farm households with 50 - 75 ha are most typical and account for more than 25% share. In the Andean highland and Andean mid-slope areas, according to the limitation of the existing farmland area and the

concentration of the number of farm households and farming laborers, a trend which fractionization of farm lands are progressing is shown. To prevent such a trend, the Bolivian government has set the farmland fractionization limit depending on the scale of land holding in each area based on the Agrarian Reform of 1952. According to its reform, the land fractionization limit is 3 - 4 ha to small-scale farm household located in an irrigated area of the gorge and a grape cultivation area in Andean highland and Andean mid-slope areas. (Diagnostico y Programa, MACA, 1982 - 1984)

The condition of land holding by scale and the details of land fractionization based on the Agricultural Land Act are shown in Table A.4 and A.5 of Annex A, respectively.

(2) Production and demand of main agricultural products

The main agricultural produce in Bolivia are grain crops such as rice, maize, and wheat and root crops such as potatoes. The greater part of the produce are for the domestic market and farmers' consumption. For export crops, sugar cane, cotton, and coffee beans are mainly produced. The progress of harvest area, production volume and yield for main crops is as follows.

Crop	Year	1980			1985			1987		
		A	P.V	H.V	A	P.V	H.V	A	P.V	H.V
Rice		66	95	1.4	119	184	1.5	90	126	1.4
Maize		293	383	1.3	349	554	1.5	329	543	1.5
Wheat		100	60	0.6	100	74	0.7	110	81	0.7
Potato		168	786	4.6	163	768	4.7	125	598	4.8
Sugar cane		67	2,822	41	78	3,151	40	70	2,730	36
Soy bean		37	47	-	61	83	-	70	112	-
Cotton		24	7	0.3	10	14	1.0	10	17	0.3
Coffee beans		22	16	0.7	28	23	0.8	28	25	0.9

Unit: A : Harvest area 1,000 ha,
P.V: Production volume 1,000 t
H.V: Yield t/ha

Source: Estudio de Prognostico Agropecuario, 1985
Banco Central, Memoria, 1988

Among the main crops, the traditional crops such as rice, wheat, maize, potato, cotton, and sugar cane show a trend of level or decreased in production. In contrast, however, coffee beans and soybeans are showing a sharp increase, supported by the government's promotion policy; the growth was 6 times in harvest area and 8 times in production volume versus the records in 1976. Taking the total agricultural production including fruit and vegetables added to the main crops mentioned above, the annual change is great; with approximately 6.7 million tons in 1982 as the peak, the last five years' annual average increase or decrease rate was 10 - 15%. Irrespective of increase or decrease of cultivated area, the changes mentioned above are attributable mainly to the

instability of the yield per ha.

The condition of main agricultural production by area are shown in Table A.6 of Annex A.

Except for wheat, the production of the basic foods such as rice, maize, and potato can nearly satisfy the total domestic demand. Due to the unstable supply capacity of such basic foods, however, a part of demand may depend on import in some years. More than 90% of wheat demand, in particular, must depend on import. The average import volume of wheat per year during the last five years (1982 -1986) was 300,000 tons, and it tends to increase year by year. The import increase is said to be attributable to the decrease of the domestic production due to discouragement of farmers' will because of suppressing wheat producer's price and to the increase of its consumption per capita.

(3) Agricultural productivity and irrigated agriculture

Comparing the yield per ha in Bolivia with that of surrounding Andean group countries, Bolivia's yields of each main crops are lower. (See Table A.7 of Annex) This is because the greater part of main crops production depend on small-scale farmers with self-supply agriculture occupying 62% of the total farm households. Besides, mentioned below, the low labor productivity, lack of production materials and equipment, and poor production infrastructure including irrigation facilities as a major item are causing the poor yield in Bolivia.

- The annual number of laborers engaged in agriculture is approximately 1.1 million per 1.16 million ha of total cultivated area (Diagnostico y Programa, 1982 - 1984, MACA). Farming manpower of approximately one labor per hectare is required.
- The quantity of chemical fertilizer used per hectare is 4.2 kg on the average, which is equivalent to 1/20 - 1/40 of other Andean group countries. The using rate of tractors is one per 100 - 500 ha in the said countries, while it is one per 4,500 ha in Bolivia.
- The irrigated area is only 100,000 ha, which is equivalent to 12% of the total cultivated area. The greater part of these are located in the eastern plain area, thus having a heavy location deviation.

Among all the conditions, the improvement of irrigation facilities is indispensable for increased farm income through improved productivity considering the meteorological distinct characteristics of rainy and dry seasons in Bolivia. The improvement of irrigation facilities, therefore, is the most urgent issue required for promoting domestic agricultural production. The breakdown of the irrigated areas approximately 100,000 ha in Bolivia is shown in Table A.8 of Annex A, out

of which approximately 30% is under the control of the governmental authorities, while the other 70% is under farmers with the traditional and conventional irrigation method. Irrigable area is estimated approximately at one million ha, and the greater part of its area are distributed in the Andean mid-slope and the eastern plain areas. Particularly, in the Andean mid-slope area, since the population density per cultivated area is high, the improvement of irrigation facilities should be carried out with the highest priority in view of the social and economic aspects.

2.3 Administrative Organization of Bolivia

Out of the domestic administrative organization, the Ministry of Planning and Coordination will plan and formulate main economic and social development plans, such as the national development plan, regional development plans, etc. In addition, the ministry determines priority of development plans presented by various ministries and agencies.

The competent authority for agricultural policy such as domestic agriculture development and production support, on the other hand, is the Ministry of Farmers, Agriculture and Stockbreeding (MACA). The MACA formulates plans for agricultural policy, agricultural investigation and research, agricultural product marketing, improvement of farmland, settlement, irrigation and drainage, and natural resource development on the national level. For such purposes, the following organizations are formed as the execution and support organizations for the MACA. (organization chart of MACA is shown in Fig. A.1 of Annex)

- Bolivian Research Institute of Agriculture and Stockbreeding (IBTA)
- Bolivian Agricultural Bank (BAB)
- Forest Development Corporation (CDF)
- State and Social Development Agency (SNDC)
- Agricultural Land Restoration Agency (CNRA)

Separately from the central administrative organization, the Regional Development Corporation (La Corporacion Regional de Desarrollo) is established in each department. Each Regional Development Corporation established in 1978 under Bolivian Government Law, although different in organization and system to some degree depending on the department, consists of a board of directors, president, and various development departments and agencies. The president of the corporation is nominated by the president of the Government of Bolivia. Under the instruction of the Ministry of Planning and Coordination, the Regional Development Corporation determines development plans, policies, and strategic ideas of its department, and also takes charge of the following as its main activities.

- Investigation, planning and approval for regional development
- Development and utilization of natural resources, and promotion of industrialization
- Contract and administration of construction works
- Cooperation in joint projects with foreign organizations

The Corporation is established as an incorporation, and for its sources depends on revenue from the companies owned and operated, and on financial support from the government as well as loans and aid from foreign organizations.

2. 4 Role of Agriculture in the National Development Plan

2.4.1 Fundamental Objective of the Development Plan

The national development plan of Bolivia, "Economic and Social Development Plan 1989 - 2000 (Estrategia de Desarrollo Economico y Social)", was determined in 1989 by the Ministry of Planning and Coordination based on the Emergency Economic Reconstruction Plan designated in 1985 and the Long-term Plan designated in 1981.

The final completion specified by the development plan is intended for the year 2000, and the plan consists of various items such as mining, energy (petroleum, natural gas), electricity, agriculture, industry, education, labor, social security, city and housing. The basic objectives of the development plan, which includes all the said items, are as follows.

- Restoration and activation of the domestic economy, and increase of domestic investment and stabilization and maintenance of prices in order to achieve this purposes
- Improvement of productivity
- Diversification and expansion of export on mining, energy, and agricultural productions sectors
- Stable supply of basic foods to domestic markets
- Increase of opportunity for employment
- Improvement of public services through improved education, medical treatment, water supply and sewer, and housing
- Correction of regional difference and increase of limit on local administrative organizations

A total investment of approximately US\$ 6.2 billion is expected during the planned period. Approximately 80% of the said amount is dependent on foreign investments, including financial aid from overseas. The breakdown of the investment amount by item is shown below. Overall, energy sector has the largest share at 31%. Looking at the share of the GDP at the completion of the development plan, however, agricultural production sector has the largest share in the production field at 18%.

This is because the most significant interest is placed on the development and the effective utilization of recyclable resources in Bolivia under the determination of each development plan. It is pointed out that the future basic structure of the Bolivian economy is affected by the behavior of agricultural production.

Year Item	1989-2000 Amount		Investment Dom. Over.		Share of GDP 1989-2000 (%)
	(US\$ thou.)	(%)	(%)	(%)	
Energy	1,927	31.1	23.5	76.5	9.2
Electricity	790	12.7	22.8	77.2	1.8
Mining	158	2.5	20.7	79.3	9.7
Agriculture	757	12.2	18.8	81.2	17.8
Industry	105	1.7	10.1	89.9	12.2
Subtotal	3,737	60.3	21.9	78.1	50.7
Telecommunication and transport	1,389	22.4	20.5	79.5	7.1
City improvement	234	3.8	9.0	91.0	42.2
Health and medical	137	2.2	9.0	91.0	
Water supply and sewer systems	397	6.4	15.7	84.3	
Education	133	2.2	34.7	65.3	
Others	173	2.8	22.2	77.8	49.3
Subtotal	2,463	39.7	19.5	81.5	
Grand total	6,200	100.0	21.0	79.0	100.0

Source: Estrategia de Desarrollo Economico y Social 1989 - 2000
MPC, 1989

2.4.2 Agricultural Development Policy

For agricultural production sector in the national development plan, three items, "Stable Supply of Food", "Increase of Substitute Agricultural Products for Import", and "Increase of Agricultural Products for Export", are taken up as the objectives of development. In order to realize the objectives, the necessity of structural improvement of the following items as the domestic agricultural development policy is emphasized.

- Improvement of cropping intensity and extension of cultivated area per household through improved irrigation facilities in Andean high-land and Andean mid-slope areas
- Promotion of the settlement policy for effective utilization of land resources
- Utilization of family labor and introduce of suitable techniques
- Improvement and expansion of agricultural producers' organizations

Through the carrying out of the policy mentioned above, the following extension of cultivated area and produce are expected.

- Extending cultivated areas from present 1.0 - 1.2 million ha to 2.0 million ha during the planned period.
- Increasing a 56% of gross agricultural production, and a 76% of gross production value
- Setting 5.4% annual growth rate of gross agricultural production value during the planned period
- Expanding export of agricultural products from US\$ 77 million to US\$ 518 million

For the crops to be increased in the planned period, maize, wheat, rice, barley, beef, and milk are designated. By means of increasing production of these crops, it will be planned to terminate the food support (KR) from overseas by 1993. The production increase plan of main agricultural produce is shown in Table A.9 of Annex A. For the development investment fields with a high priority out of the total investment amount of US\$ 757 million in the agricultural production sector, the following six items are counted:

- (1) improvement of marketing and distribution system,
- (2) development of optimum technique and technical transfer,
- (3) improvement of irrigation facilities,
- (4) agricultural finance,
- (5) improvement of farm road, and
- (6) rearing of talent.

More than 60% of the total investment amount in the plan is allocated to regional agricultural development plans, and the investment amount for Tarija Department has the largest share (13%) among the investment amount for agricultural sector in the departments, as shown in Table A.10 of Annex A.

2.5 General Features of Tarija Department

2.5.1 General

(1) Natural conditions

Tarija Department is located between south latitude 20°50' to 22°50' and west longitude 62°15' to 65°20'. Its southern side borders Argentina, and its eastern side borders Paraguay, respectively. The total area of the department is 37,623 km². Topographically, the department is divided into three areas: the mountain area located along the periphery of the department, the gorge area located from the central part to the west, and the plain area in the east. The mountain area covers 47% of the total department area. The annual mean precipitation is 400 to 2,000 mm. Although the distribution of rainfall differs depending on the topographical conditions, the rainfall is concentrated in all the areas during the rainy season from October to April. The annual mean

temperature is 9.5°C in the mountain area, 18°C in the gorge area, and 22°C in the plain area. In the department, in addition to Pilcomayo River, one of the leading rivers in Bolivia, there are many medium and small tributaries such as Piraya River, Camblaya River, San Juan de Oro River, etc., forming major sources of water supply.

(2) Social and economic conditions

Administratively, Tarija department consists of the six provinces (Provincias) and is moreover divided into 175 districts. Under the unit of district, communities (Comunidad) are formed with villages, and a governor (Corregidor) is nominated by the central government to control each community. In Tarija department, from the viewpoint of social and economic characteristics based on the topography and natural conditions, the provinces are classified into five sub-regions I - V.

Province	Capital	District	Sub-region
(1) Cercado	Sella Cercado	25	I
(2) Arce	Padcaya	26	IV
	Bermejo		
(3) Gran Chaco	Yacuiba		IV
	Carapari	39	IV
	Villa Montes		III
(4) Aviles	Uriondo	22	V
(5) Mendez	San Lorenzo	30	I
(6) O'Connor	Entre Rios	33	II

The total population of the department is estimated to be approximately 294,000 (1988), of which 47% is in urban areas and 53% in rural areas. The average annual growth rate of population in the past 15 years (1950 - 1976) was 2.3%, but it increased to 3.5% in the last eight years (1980 - 1988), exceeding the average annual growth rate of the country. The 68,000 population of Tarija City, which is the capital of the department, is equivalent to 23% of the total population of the department, and the growth rate in the said period was 4.5%, which was higher than that of the total department. The total population of the department in year 2000 is expected to reach at 530,000, and the economically active population is also expected to increase at the rate of 4.9% per year (approximately 7,000 peoples) in the period 1988 through 2000 along with the total population increase. (Plan de Desarrollo Economico y Social del Departamento para el Quinquenio, 1988 - 1992, CODETAR.) Population increase of major cities and provincials and forecast up to year 2000 are shown in Table A.11, A.12 and A.13 of Annex A.

Agriculture is a main industry, having a 25% share of the gross production amount of the department, and accounts for 50% (36,000 laborers) out of the total labor population (72,000). However, the share of the agricultural production sector in the total production amount, which peaked at 27% in the first half of 1980's, is decreasing year by year, and the labor attraction power (employment power) in its sector

shows a decreasing trend also. Consequently, the population of rural areas decreased from 60% to 53% in the last ten years, resulting in an accelerated population out-flow from rural to urban areas, and causing increased unemployment rate in urban areas.

2.5.2 Condition of Agricultural Production

(1) Land use

Agricultural lands of about 1,100 thousand ha, which is equivalent to 30% of the total area of the department, are distributed throughout the department. An area of cultivated areas is only 140 thousand ha, which is equivalent to 13% of the total cultivable areas. The remaining areas is the non-cultivated areas consisting the natural grass land. In view of the topographical and meteorological conditions as the agricultural area, the department can be divided into three areas: the mountain area with the cool weather (Altiplano), mid-mountain area with semi-arid (Valle Central) and tropical plain with high temperature and humidity (Chaco tropico). Administratively stated above, mid-mountain areas belong to Sub-Region I, mountain areas belonging to Sub-Region II and tropical plain areas belonging to Sub-Region III, IV and V.

The progress of the total cultivated areas can be estimated about 83 thousand ha (1985 to 1987 in average) and annual cropping intensity against the present cultivated areas is accounted less than 60%. It is pointed out that the these low cropping intensity and the land use ratio are derived from a chronic irrigation water shortage through the year at the mountain and mid-mountain areas which cultivated areas are concentrated and the existence of non-cultivated areas due to soil erosion. The present land use in Tarija Department is as follows:

Item	Area (1,000ha)	Ratio(%)	Description
Farm land	140.8	3.8	including fallow lands
Pasture	968.4	25.7	
Forest	2,646.4	70.3	
River	5.3	0.2	including lakes and reservoirs
Others	1.4	-	roads and houses
Total	3,763.3	100.0	

(2) Number of farm households and scale of farm management

The total number of farm households in Tarija Department is approximately 19,300, out of which approximately 60% is small-scale farmer possessing an average of 4 ha or less. More than 70% of these small-scale farmers are distributed in Cercado and Mendez Provinces belonging to Sub-region I. The farm household distribution by a scale (land holding area) in each sub-region is shown below.