f) Weaving group: It is to be organized by training of weaving skill and practicing products sale among women in the project area.

g) Handicraft group: It is to be organized through activities such as training of handicraft skill and practicing products sale among women in the project area.

h) Food processing group: It is to be organized training of food processing such as cheese and practicing sales of the products among women in the project area.

(4) Farmers' Organization for the Community Re-vitalization Center (CRC)

The organization for management of CRC is principally to be discussed and determined among the member communities. The way of their management system could be refereed to water users' associations. Each community will select a representative and is to participate to the management of the center with opinion of own community. Discussion results at the center will be informed to the community by the representative. In CRC, other group of committee may needed to manage activities of maintenance, technical and training.

6.4 Agricultural Infrastructure Development

6.4.1 Development Extent and Implementation Procedure

Fifty five (55) irrigation systems were identified in the Rio Keka basin through the inventory and confirmation surveys of existing irrigation systems. Out of which 32 existing irrigation systems locate in the Rio Keka river course and others are in the tributaries of Rio Keka. Whole existing irrigation systems related to the Rio Keka basin will be taken as the improvement targets of the existing irrigation system taking the equality among the communities and future water utilization into consideration. However, stage-wise improvement plan among the existing irrigation systems will be applied in view of the location of the objective irrigation system, required cost for improvement works and improvement effects.

Three stages such as short, middle and long terms are considered for implementation of the work. Since objective areas of the Study have been settled at around 8,400 ha, the existing irrigation systems located at the out of the objective areas will be categorized in the long term stage improvement. Concerning the irrigation systems located within the Study area, selection for the short term or middle term stages improvement is made with the following criteria;

- availability of water utilization during the dry season
- scale of the commanding irrigation area
- degree of the contribution for the improvement of farm management
- number of the related communities
- degree of the effects for water saving

Based on the above criteria, priority among the existing irrigation systems are evaluated by using matrix table as shown in Table 6.3.1. The five (5) irrigation systems are selected as the short term stage improvement systems and others are set up as the middle term stage improvement. Selected systems are shown in same Table. Summaries of the stage wise improvement systems are as follows;

Stage	Nos. of Irrigation Systems	Gross Irrigation area (ha)	Net Irrigation area (ha)
Short Term	5	1,979	1,789
Middle Term	27	2,102	1,683
Long Term	23	2,575	2,190
Total	55	6,656	5,662

Systems for short term stage (System No.)
2, 3, 9, 12, 27 5 systems

Systems for middle term stage (System No.)
1, 4, 5, 6, 7, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 28, 29, 30, 31, 32, 33 27 systems

Systems for long term stage (System No.)
34, 35, 35-1, 35-2, 36, 37, 39, 40, 41, 43, 46, 47, 49, 49-1, 50, 51 52, 53, 53-1, 56, 57, 58, 59 23 systems

6.4.2 Water Requirement

(1) Irrigation Water Requirement

Potential evapo-transpiration (ETo) is estimated by the modified Penman method. Meteorological data at Belen station are applied. Summaries are as follows;

Unit : mm/day

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
ETo	4.1	4.4	4.3	4.3	3.6	3.2	3.4	4.3	4.9	5.0	4.9	4.4

The crop coefficient varies with kind of crops, planting season and period of crop growth, the crop coefficient of the proposed crops are made referring to " Crop Water Requirement, FAO Irrigation and Drainage Paper No.24".

The effective rainfall is estimated on a monthly basis using the SCS method developed by the Department of Agriculture, US (USDA)

(2) Leakage Amount from the Canal System

Overall irrigation efficiency consists of conveyance and application efficiencies. Conveyance efficiencies will be assumed 70 % for unlined canal. Based on the survey results of leakage amount of existing canal system, it can be said that over 20 % of leakage water from the canal will conservatively be avoided through the canal lining and construction of concrete diversion structures. Therefore, conveyance efficiency of lined canal will be assumed at 90 %. Application efficiency at the field level is assumed at 60 % with the condition of furrow irrigation method. Thus, overall irrigation efficiencies is estimated at 42 % for unlined canal and 54 % for lined canal conditions.

Unit water requirement for major crops are estimated based on the above procedures and cropping calendar. Crop diversion water requirements of major crops are summarized as below.

Crops	Diversion Requirement (mm)	Maximum Water requirement (l/sec/ha)
Potato	594	0.56
Barley, Oats	506	0.47
Broad bean	947	0.64
Onion	557	0.64
Carrot	617	0.58
lettuce	594	0.70
Alfalfa	Annual 2,093, Nov-Apr 909	0.89

Based on the present land tenure and cultivated crops, a classification of farming type has been made through the analysis of present farm management in the Study area. Unit diversion water requirement of each farming type is estimated as follows to settle the

system capacity of the irrigation facilities.

Farming Pattern	Unit Diversion Requirement (mm/ha)	Maximum Water requirement (l/sec/ha)
Type A, (Upper basin)	653	0.53
Type B, (Middle basin)	749	0.54
Type C, (Middle basin)	724	0.55
Type D, (Lower basin)	820	0.57
Type E, (Lower Basin)	840	0.56
Type F, (Middle basin)	1,007	0.61

(3) Drainage Requirement

Drainage requirements in the Study area is estimated by the Rational method since the objective drainage areas ranges mainly less than 100 ha. The probable daily rainfall with return period of 5 years is employed for estimation. The runoff coefficient is assumed at 0.75 and time to evacuate the surplus rain water is assumed at 12 hours taking into consideration the present farm lot conditions such as extent, slope, etc. With these assumptions, drainage requirements are estimated at 6.42 l/sec/ha.

6.4.3 Irrigation Method

Present gravity irrigation method from the intake structure to the farm lots and furrow irrigation method in the farm lot basis will be followed in the improvement plan. Prevailing rotation intervals of irrigation water use is also taken in the improvement plan. To set the lining section of each canal, theoretical canal capacity is employed on the basis of the commanding area of rotation block, peak consumptive use of irrigation water of crops, etc. Considering the present water utilization at the farm lot basis, area of rotation block is taken at 2 ha. and irrigation hours in a day is set at 24 hours. With the estimated peak consumptive use of irrigation water of crops, canal capacity is estimated with the following equations;

Qmax = (2.5 l/sec) x (number of rotation block)
Number of rotation block = (total irrigation area) / (2 ha.)

6.4.4 Proposed Work

(1) Intake structure

Present lateral intake structure with training levee method is followed as the intake structures of canals in the improvement plan. Proposed intake structure consists of training levee and inlet portion. Training levee will be set within river section and at bank for inlet portion. River bed materials will be used to construct the training levee covering the gabion mattress on its slopes. Inlet portion will be designed with rectangular shape of reinforced concrete structures. Wing and cut-off walls will be provided at the beginning point of inlet portion. Because existing irrigation system has long water conduction portion located in the riverbed, most of the sand and pebbles flowing into the conduction portion pile up on the base of the conduction portion. With these consideration, sand sluice structures is not planed principally.

(2) Canals

Main and a part of secondary canals are designed as masonry lining to prevent much water losses from the canal reaches. Basically, no modification of existing canal route is planned in the design. Canal sections will be designed with the theoretical peak water requirement of commanding area, however, lining section of canal will be designed from 100 % to 80 % of the required canal sections depending on the canal capacity. Canal

length of each implementation stage are as follows;

Stage	Nos of Systems	Canal Length (km) Main	Secondary
Short Term	5	57.3	11.4
Middle Term	27	60.3	13.3
Long Term	23	59.1	10.0

(3) Related structures of canal

O & M road are designed to provide along main and secondary canals when no road is provided in the existing main and irrigation canals. Division structures from the main to secondary canals and from canals to each farm lots will be designed to avoid excess water use and losses at the division points. Gate will be equipped at the division points. Stuff-gauge is installed at the just down stream of the gate. H-Q curve is also provided for such point to measure the volume.of the divided flow. Crossing structures of canals and/or canal itself will be designed to cross the roads and streams.

(4) Reservoirs

To supplement the irrigation water, reservoir on the way of irrigation canals will be designed as much as possible. Basically, dam body for reservoir will be designed as the combined structure with road or canal bank. Fish cultivation is also planned in those proposed reservoirs. Through the field survey, following three (3) sites were confirmed as the possible site for reservoirs;

Irrigation System No.	Location	Dam Body Height (m)	Length (m)	Reservoir Capacity (m3)
9	Putuni	2.5	700	140,000
12	Pajchani Molino	2.5	300	60,000
16	Icrana	4.0	350	115,000

(5) O & M works

Proposed CRC (Community Re-vitalization Center) provides machinery and equipment for maintenance of roads and canal systems in the Study area. Those O & M equipment will fully be used to maintain canal systems well and to save labor for the maintenance work.

6.4.5 Theoretical Irrigation Area

Based on the available river flow and required diversion water requirement in the Study area, irrigation area increase by canal improvement is estimated theoretically with the condition that non-exceedance probability is 1 to 5 years. To express the effects of canal lining, change of conveyance loss of canal is considered. Overall irrigation efficiency in the calculation of diversion water requirement is taken at 0.42 for the "without" project condition and at 0.54 for the "with" project condition. Detailed estimated results and procedures are shown in Table 6.3.2 and Annex G. Summaries by basin-wise and implementation stage-wise are as follows.

	No. of Irrigation System	Total net Irrigation Area (ha)	Irrigable Area (ha) Without Improvement Rainy Season	Dry Season	With Improvement Rainy Season	Dry Season	Incremental Area Rainy Season	Dry Season
Lower Basin	3	998	224	23	288	30	64	7
Middle Basin	31	2,600	710	169	913	217	203	48
Upper Basin	21	2,064	1,065	407	1,174	523	109	116
Total	55	5,662	1,999	599	2,375	770	376	171

	No. of Irrigation System	Total net Irrigation Area (ha)	Irrigable Area (ha)					
			Without Improvement		With Improvement		Incremental Area	
			Rainy Season	Dry Season	Rainy Season	Dry Season	Rainy Season	Dry Season
Short Term	5	1,683	775.9	241.1	884.4	310.2	108.5	69.0
Middle Term	27	1,789	815.1	245.9	965.6	315.8	150.5	70.0
Long Term	23	2,190	408.0	112.0	525.0	144.0	117.0	32.0
Total	55	5,662	1,999.0	599.0	2,375.0	770.0	376.0	171.0

6.4.6 Water Management and O & M Plan

All existing irrigation systems in the Study area have been constructed by the gravity irrigation method from the water source to each farm lots. To use the irrigation water equally among the beneficiaries, rotational irrigation method is widely diffused in the existing systems. Since many of the existing irrigation systems have incoherence between the available water for irrigation and its commanding irrigation area, no theoretical irrigation water use on the basis of the crop water requirement is being carried out and irrigation water distribution by simplified time schedule among the concerned farmers is being prevailed. No change of prevailing water utilization method among the farmers and/or communities can be considered in the irrigation development plan of the Study taking into account the tradition and customary water right in. However, efficient and certain water distribution will be accelerated by the improved structures related to the canal.

In order to proceed smooth and effective operation and maintenance of the irrigation facilities improved, activation of water users group in the community level and water users' association in the basin level is essential. Both organizations has been established and well being functioned in the Study area. The approach of the water management organization in the irrigation development plan is as follows.

(1) Water users group

Water users group of existing irrigation system is organized by community basis. Alcalde Agua is the chief of the water users group and has responsible for all O &M works of commanding irrigation canal system. When the irrigation system is formed with several communities, consultation regarding the water management and O & M works is carried out among the Alcalde Agua related to the system. Judging from the present activities of these water users group, new organization for water management is not proposed in the irrigation development plan.

(2) Water users' association

There are two water user's associations at present in lower stream and upper stream of Rio Keka in the Study area. Lack of communication and social relation is occurred due to difference on water source for irrigation and socio-economy conditions in respective areas. Integrated water users' association in the Rio Keka basin is desirable to efficient water management for the basin as a whole, however, it should not be interfered by the project toward the unity of the associations. To distribute water reasonably among the beneficiaries, rural community has system with their own social sense. The situation will be changed depending on their necessity.

Though the situation of two water user's associations is admitted, it is recommended to have certain communication organ between two associations for development and effective water use of the Rio Keka basin.

6.5 Rural Infrastructure Development Plan

6.5.1 General

Based on the situation of the existing facilities, improvement level of the rural area and the target of improvement will be set up. The process of improvement is divided into three stages as short, middle and long term developments. The level of improvement will be raised gradually by the development stages. The urgent need for agricultural development will be implemented at the short term development stage. After establishment of the improved agricultural production and organized activities of farmers in the study area, the plan classified into the middle and the long term developments will be implemented

Basic infrastructure improvement is set up in order to promote the settlement of the inhabitants and to establish sustainable farming in the objective area.

6.5.2 Road

The road is the fundamental facility directly connected with productive activity and daily life. To create the economic sphere of Rio Keka basin centralized Achacachi city, construction of the road network within a basin and improvement of existing roads are also indispensable. Therefore the priority should be given to the trunk road improvement over the other infrastructure.

The selection of roads to be improved will be decided taking the three major views such as relativity with the agricultural activities, effectiveness for the road network and executionability into account. Factors for assessment are set up as follows;

1) Relativity with the agricultural activities
   - accessibility for farm land
   - convenient for collection and shipping of agricultural products
   - easiness of agricultural activities
2) Effectiveness for the road net work
   - numbers of related household (direct)
   - numbers of related household (indirect)
   - connectionability with other roads
   - accessibility to the public facilities
   - accessibility to the urban area
   - requirement of local habitants
3) Executionability
   - topographical features
   - extent of improvement in sub-base
   - extent of improvement on drainage facilities
   - necessity of related structures such as bridge
   - extent of enlargement of road width

With above assessment, road improvement plan at each development stage is set up as follows;

Stage	Short term		Middle term		Long term	
Facility	Route	km	Route	km	Route	km
Main road	2	56.8	-	-	-	-
Connection road	2	7.2	9	31.3	8	33.5
Village road / Farm Road	-	-	23	40.8	24	33.7
Related facility						
Bridge	1 places		-		-	
Submerged Bridge	6 places		6 places		2	
Culvert	81 places		91 places		91 places	

6.5.3 Community Re-vitalization Center

Agricultural extension center will be installed as a core facility for communication, agricultural and rural development in the area. The center is also function for operation and maintenance of the proposed rural infrastructures. Two levels of the center are considered to fulfill the objectives and covering the areas.

The core center (CRC : Community Re-vitalization Center) is to be installed in representing location of agro-ecological area in the Study area and consists of i) main building for training and management (including meeting room, training room, medical care room, space for storage and shipping of the products), ii) demonstration farm (demonstration plot for technology transfer of farm management) and iii) garage for O & M machinery. The sub-center (AC : Area Center) is to be installed to supplement the core center for covering the respective area and consists of i) main building for meeting and storage and shipping of the products, and ii) garage for O & M machinery.

Development of facility and equipment regarding the center is planned according to the steps as the short, middle and long terms considering necessary fund and the effect of the project activities. In the short term, accumulation of social and economical infrastructure, and improvement of the present agriculture and livestock in the project area are to be emphasized. Related priority facility and equipment with the development plan are O & M machinery for the infrastructure and its garage, and the demonstration plot for improvement and promotion of agriculture and livestock. Agricultural support concerning the substantial contents of activity and establishment of the center's organization will be started at the beginning of the project However, the activities as meeting and training are to be carried out by using the center's space and school in the area.

In the middle term, main building for the meeting, training and management, and necessary equipment which are going to increase the necessity according to progress of the activity, will be developed for fulfilling the center's facility and function. The facility development will be completed by fencing of the center in the long term.

The criteria for selection of the location of CRC and AC are considered as follows;

- representing areal natural, farming type and socio-economy
- areal center in geographically
- easy access in the area
- socio-economical center in the area
- land is available for facility
- community is willing to accept the facility

Based on the above criteria, following location and facilities is set up.

Agro-ecological area	Community	CRC		AC	
		Short	Middle	Short	Middle
Upper basin	Chachacomani	Garage & Plot	Main building	-	-
	Kerani	-	-	Garage	Main building
	Comata Baja	-	-	-	Main building & Garage
	Corpaputo	-	-	-	Main building & Garage
Middle basin	Cala Cala	Garage & Plot	Main building	-	-
	Putuni	-	-	Garage	Main building
	Jawir Laca	-	-	Garage	Main building
	Pongon Huyo	-	-	-	Main building & Garage
Lower basin	Belen	Garage & Plot	Main building	-	-

The following shows scale of facilities regarding the CRC, AC and MH.

(Unit: m^2)

Facility	CRC			AC			MH		
	Short	Middle	Long	Short	Middle	Long	Short	Middle	Long
Main Building									
Training room		129.6			24.3			-	-
Office		24.3			24.3			-	-
Practice room		48.6			48.6			-	-
Health room		24.3			-			-	-
Lodging room		43.2			-			-	-
Meeting room		43.2			-			48.6	48.6
Store room		43.2			24.3			24.3	24.3
Toilet		12.2			12.2			12.2	12.2
Electric room		12.2			12.2			-	-
Entrance, etc.		58.3			-			-	-
Garage	286	-		143	-			-	-
Demo. Plot	10,000	-		-	-			-	-

unit:place

	CRC			AC			MH		
	short	middle	long	short	middle	long	short	middle	long
Main building	-	3	-	-	6	-	-	5	10
Garage	3	-	-	3	3	-	-	-	-
Demonstration Plot	3	-	-	-	-	-	-	-	-

Equipment and facilities introduced in the CRC and AC are as follows;

Equipment	Short Term			Middle Term		
	Upper	Middle	Lower	Upper	Middle	Lower
O&M Machinery:						
Buldozer15t	1 set	1 set	1 set			
Back-hoe0.3m^3	1 set	1 set	1 set			
Dump track4t	1 set	1 set	1 set			
Tractor70ps	3 set	2 set	2 set			
Stone picker	1 set	1 set	1 set			
Pick-up 4WD)	1 set	1 set	1 set			
Motorbike(125cc)	5 sets	7sets	3 sets	4 sets	2sets	-
Equipment:						
Solar electric supply system	2 set	3 set	1 set	2 set	1 set	-
Water supply system				4 set	4 set	1 set
Wireless communication system	2 set	3 set	1 set	2 set	1 set	-
Meteorological apparatus	1 set	1 set	1 set			
Type writer				1 set	1 set	1 set
Rotary Mimeograph				1 set	1set	1 set
Artificial insemination tool	1sets	3 sets	2 sets			
Thermos tank for semen	2 sets	3sets	2 sets			
Castrating tool	8 sets	4 sets	4 sets			
Wool cutting scissors	8 sets	4 sets	4 sets			
TV & VTR				1 set	1 set	1 set
Training tables & chairs				600 sets	600 sets	300 sets

(4) Other Facilities

Facilities for school, medical care, drinking water and electricity supply are requested by inhabitants in the study area for their safe and comfortable life. Other development agencies such as FIS (Fundacion de Inversion Social), World Bank and NGOs are carried out to assist for those facilities. Therefore the effort of the inhabitants is expected for improvement step-by-step utilizing the fund of these development agencies. The necessary facilities and numbers are as follows;

unit: No. of community

Facility	Short term	Middle term	Long term
Education			
Primary	2	1	-
Medium level	1	2	3
Advanced level	-	1	2
Medical care	3	5	2
Water supply			
Manual pump	50	10	-
Water supply system	2	5	25
Electricity	3	6	15

6.6 Environmental Conservation Plan

6.6.1 Impacts on Environment by the Implementation of the Project

(1) Impacts on Environment by Proposed Facilities

It can be said that the proposed development plan has generally little influence on environment because the component of the plan is mainly rehabilitation of the existing facilities.

As regards with the bridge, location is selected considering the network on the trunk road. Construction of the bridge surely brings out benefit and convenience to people's life in the upper basin. Cross-sectional area of flow of the bridge was designed against the flood with probability of 200 years occurrence. 2 places of submerged bridge were selected by considering the network on the connecting road.

By constructing the canal during the dry season, a detour canal which may sometimes be needed in improvement of irrigation facilities, will not be necessary.

However, it is necessary both not to concentrate in a certain place for the collection of the constructing materials such as sand, gravel, and to prevent erosion in advance by properly protecting collection sites. A caution for not producing pollution from laborer's accommodations is also necessary.

(2) Impacts on Environment by Improvement of Farming

1) Grassland management

In this plan, it is assumed that the study area is classified into three basins, and that farm management is improved according to own characteristics on each basin. Extension of grassland, which is proposed for improving livestock in the middle and upper basins, is related to environmental issues. It is planned to introduce fodder or pasture into natural grassland where "Estipa" grows at present. "Estipa" is not suitable as the fodder crops. The grassland management is not only important as the fodder production but also as the effect to prevent soil erosion aggravated by bare land. The plan aims to raise the productivity of the livestock by newly introducing and expanding grass of a high additional value. The grassland is not disturbing existing natural ecosystem, but a farming system that the land deprivation is a little and the maintenance is comparatively easy. In natural grassland the livestock is accompanied according to an existing custom, therefore may not impose the problem on the environment, furthermore economic reason makes away from utilizing fertilizer and agricultural chemicals.

2) Appropriate use of chemical fertilizer and agricultural chemicals

The project has 2 objectives, that is, -Improvement of crops, -Increment of the

number of livestock. As a concrete strategy to achieve these objectives, it is thought to decrease the planted acreage of potato by an increasing the unit yield of potato, and consequently expand acreage of barley and oats. Especially in upper basin, it is planned that unused land change into cultivated land of barley and oats. For this to be achieved, an appropriate use of a chemical fertilizer and agricultural chemicals is planned. The current state of the use and the influence of the plan are considered as follows.

(a) Current state of chemical fertilizer use
According to the interview, a chemical fertilizer is used for potato, onion, carrot, and lettuce, etc. in the vicinity of the project area. A quantitative amount for fertilizer use is not investigated. The fertilizers used are as follows.

Urea	N:P:K=46:0:0
Chemical fertilizer (Compound F)	N:P:K=18:46:0

(b) Current state of agricultural chemicals use
Agricultural chemicals are merely used. In this matter, the Division of Agricultural Chemicals Fertilizer and Vegetable Hygiene of the SNAG made the standard of the use prohibition agricultural chemicals in 1990. Although there is a fact of aid from foreign countries in terms of a chemical fertilizer and agricultural chemicals, the accurate current status of it is not grasped.

(c) Impacts of introduction of chemical fertilizer and agricultural chemicals
By the soil survey executed in the study area, 1,265 ha has a shortage of phosphorus in the upper basin and 267 ha in the lower basin presents strong acid soil. It is said that the fodder with a shortage of phosphorus will become a nourishment malfunction for cow. In the improvement plan, use of a chemical fertilizer is planned to apply for the phosphorus deficient soils and the lime for strong acid soil. The farming guidance is planned in the CRC as a pivot by experienced persons. Therefore it is no problem as regards with the impacts on the environment because appropriate use of the fertilizer and agricultural chemicals is guided.

6.6.2 Environmental Conservation Plan

(1) Significance of Environmental Consideration in Agricultural Development

A basic policy of environmental conservation in an agricultural development is to promote sustainable development for improvement of the life of inhabitant and to collaborate for the harmonized development with an appropriate environment in the area. For this purpose, it is necessary to consider the sustainable development taking the balance between the project and the natural resource, peripheral inhabitant life and the existence base into account. Therefore, it is important to carry out the study including the monitoring plan not only forecast, evaluation and conservation measures for the negative environmental effects but also to pay attention the benefit brought by the project for the objective areas, regional environment harmonized with the development and improvement effects of regional environment.

(2) Correspondence to the Result of FA

FA was made as an initial environmental evaluation and examined by National Secretary of Natural Resources and Environment (M.D.S.M.A.). The result of examination of FA was category II indicating the necessity of EIA on the specific theme.

This plan was firstly categorized as the project of category II in all projects of SNAG. In this sense, it is recognized that M.D.S.M.A. has a special concern to this development plan. Explanation sheet was formulated in line with the content of the preparation standard for EIA and the request sheet was submitted to M.D.S.M.A for re-

examination of the category. As a result, the category of this project was changed from II to III. Formal examination certificate will be finally issued by M.D.S.M.A. after submitting the Draft Final Report of the study.

(3) Problems in Examination Result of FA

Necessary items of consideration for making a countermeasure on environmental conservation in the future are as follows;.

1) Social environment

An agreement with the local inhabitant is necessary for the formulation of development plan. In Bolivia, there is an example that the necessity of the adjustment is raised to execute the development scheme. It is PRIV (El proyecto de riego inter-valles) of the Tiraque and Punata areas in Cochabamba province. The project area is situated in above mean sea level of 3,200m, where water shortage was a problem since centuries. The farmer's organization developed through acquisition of water right, being formed by different interest groups such as Central Labor Relations Commission, lakes and marshes irrigation committee, regional group, and farmer organization. They took a joint action on the water management. This was a situation before the start of PRIV project. Under these condition, the project met a strong opposition form farmers at first stage. One of the reason was the irrigation project having stood on the developer side.

As for the details, it is explained in the book entitled "Dios da el agua Que hacen los proyectos?". As the title shows, farmers gave a doubt for the way of developer because they behaved to farmers as if they were God. This document tells that the plan was not explained well by the developer, farmers were left from the information even the where irrigation canal passed. Although the irrigation plan has been designed first by the engineer, a drastic modification was made for the present situation and existing irrigation systems of farmers. Finally, it is reported that the design of infrastructure was changed since the developer side esteemed existing water management system of farmers. PRIV can be thought as the model case for the development project. However, the experience of PRIV cannot be applied for the region where farmer's organization is still ill-developed .

2) Soil erosion

Soil erosion in the farm land and the pasture is one of the most serious problems in the environment control in Bolivia. Soil erosion is a problem from the colony age when settlers started agriculture. However, it is pointed out that the suitable soil conservation technology is lacked for the Bolivian farmers in comparison with the other tropical areas. With this reason, problems on soil erosion is turned seriously in Bolivia.

Terrazus (1973) introduced how the production yield decline due to the soil erosion is serious in the country by contrast with other countries. And he pointed out that the production capacity of land is very low compared with other countries. He also pointed out that 70% of the inhabitants are in the serious undernourishment condition due to the decrease the food production.

As for these things, it is suggested that the soil conservation countermeasure is important for the development of Bolivia. The area influenced by the soil erosion in the entire Bolivia is estimated at 35-41% and about 418,000 square km of the country. In the present time, remarkable soil erosion is not seen in the study area. But, as it has been stated, the study area is the area which has the possibility of the land devastation and the decline of the productivity due to the soil erosion from the viewpoint of the topography and the meteorology. Therefore, the examination is necessary in the formulation of the project.

3) Water quality conservation

(a) Water quality of drinking water
It turned out be clear that the well water is not suitable for drinking use upon the water quality investigation in phase I . Drinking water basically derives from the well water in the study area. However, many of wells dry up at the dry season continued from August to September, therefore, the establishment of drinking water supply system is desired as a part of the life environment improvement. This project does not include the drinking water supply plan but the project of drinking water supply system and sewage system development plan by FNDR (Fondo Nacional de Desarrollo Rural) has been in progress at Achacachi city.

In other communities, the project of drinking water supply system and sewage system development plan relating to PROSABAR (Programa Saneamiento Básico Rural) is under examination. Moreover, the well digging program by FIS (Fondo de Inversión Social), provision of latrine and the drinking water supply system by CARE of NGO etc. are in progress.

As such, there are movements relating to the development of drinking water supply and sewage systems from 3 directions, community, NGO, and the government. Direction is indicated for improving the life environment around the study area .

(b) Role of the project in water quality conservation of Titicaca Lake basin
The Titicaca Lake can not be recovered easily once polluted because there is only one outflow, Rio Desaguadero. The lake shows almost closed water system having 63 year's water stagnant. Therefore, a detailed and careful consideration is necessary for planning an agricultural development plan in rivers that flow into the Titicaca Lake.

However, the basin ratio which the Rio Keka occupies in the Titicaca Lake basin is small and basin rainfall is also few. Moreover, as already described in the example of Puno city, sewage due to a population increase is the biggest cause in water pollution. This plan is not intended to settle the new migrant, but aims at promotion of settling down the native inhabitants in the project area as it was, therefore, there would be no anxiety for the water quality. Although an use of agricultural chemicals and fertilizers together with the improvement of the agricultural management is thought to be slightly increased in the plan, influence to the river water can be minimized by the guidance of appropriate use.

(4) Mitigation of Environmental Impacts

1) Phase of Execution

(a) Air pollution
Air pollution caused by construction machine could be reduced by proper maintenance of them and by shortening the use time of a heavy machine. To prevent air pollution caused by the soil movement, the soil is moved in premeditation. When the excavated materials are piled up at the construction site, the height of piling is decided in consideration of peripheral humidity.

(b) Soil erosion
To prevent soil erosion at the stockyard, proper area and stock height will be designed.

(c) Erosion at borrow area for aggregate
The collection of aggregate is carried out intentionally so as not to be concentrated in one place and the collection place should be remedied after

collection so as not to cause soil erosion.

(d) Pollution from workers' camp
Environmental pollution by sewage and garbage from the workers' camp will be minimized with attention for scale and extent of the camp.

(e) Noise
To prevent the noise of machine, the utilization time of them will be minimized. Moreover, the number of the vehicles for the construction period is also minimized. Appropriate maintenance can reduce the noise of machine as well.

(f) Boundary modification
The improvement of canals will be carried out in the presence of farmers paying attention to boundary modification.

2) Phase of management

(a) Water quality deterioration
To prevent water quality deterioration by inadequate use of chemicals and the fertilizer, extension service by NGO's or reducing the amount of chemicals will be recommended .

(b) Alkalization and salinization of soil
The problem of alkalization and salinization of soil will be alleviated by proper guidance and assistance of NGOs.

(c) Soil erosion on farmland
Soil erosion on farmland will be alleviated by reducing the area of farm lot as possible according to traditional land use. By introducing less demanding species of grass systematically into natural grassland, desertification could be avoided.

(d) Social economy
The friction between inhabitants for the water supply will be alleviated by the reinforcement of the water users' association.

(e) The problem of O & M for intakes and canals
The problem such as decreases of intaking water amount due to blocking of intakes and canals will be solved by carrying out regular cleaning of intakes and canals by the maintenance organization of irrigation system.

(f) Management of water quality through fish culture
To prevent the water pollution of Rio Keka by the outflow from the reservoir which cultivated the fish, attention will be paid to the proper density of fish-raising, prevention of over-feeding, periodical dredging of the bottom of the reservoir, etc.

(g) Possible change of groundwater system
Possible change of groundwater system will be managed by irrigation at proper time.

(5) Monitoring Plan

Monitoring will be carried out for assessing the effectiveness of mitigating measures. It should be done over the entire life of the project. As was mentioned already, there is little anxiety concerning environmental impacts of the project that put stress on improvement of existing agricultural facilities. However, minimum monitor of water quality for preventing water pollution in the Titicaca Lake is desirable. Since regular monitoring on water quality scarcely executed around the Titicaca Lake, it is recommendable to refer following cases in order to make sustainable monitoring

technically and financially.

Water quality investigation results of the study (sampling point and analysis items, etc.), and
Monitor investigation results carried out by The Cultivation Examination Center of JICA in Tequina.

As for the responsible organization for the monitoring, Institute of Ecology of San Andres University is recommended in respects of analyzed facilities and manpower.

6.7 Summary of the Agricultural Development of Achacachi Area

Through the field and home office works, development plans of the study area were formulated as stated in the previous section. Salient features of the Agricultural Development of Achacachi Area are as follows;

(1) General Features

Objective area	:	8,370 ha
Objective communities	:	31 including Achacachi city
Total population	:	36,790
Total households	:	6,610 families
Farmland including grass land	:	6,584 ha
Existing irrigation system	:	55 (32) systems
Existing irrigation area	:	6,656 ha including out of study area

(2) Overall Infrastructure Development Plan :

Road Improvement		
Main Road	2 Routes,	56.8 km
Connection Road	19 Routes,	72.0 km
Farm Road	46 Routes,	74.5 km
Bridge		1 place
Submerged Bridge		14 places
Crossing Structures		272 places
Existing Irrigation System Improvement	56 systems,	6,656 ha
Intake Structures		55 places
Canal Improvement		211.4 km
Major Division Structures		356 places
Small Reservoir Development		3 places
Community Center Development		
Community Re-vitalization Center (CRC)		3 places
Main Building		3 places
Garage		3 places
Demonstration Farm		
Area Center (AC)		6 places
Main Building		6 places
Garage		6 places
Meeting Hall (MH)		15 places

Fig. 6.7.1 shows those development plan entire study area.

(3) Stage-wise Infrastructure Development Plan

Stage	Improvement Item	Quantities
Short Term Stage	Road Improvement	
	Main Road	2 Routes, 56.8 km
	Connection Road	2 Routes, 7.2 km
	Farm Road	-
	Bridge	1 place
	Submerged Bridge	6 places
	Crossing Structures	81 places
	Existing Irrigation System Improvement	5 systems, 1,979 ha
	Intake Structures	5 places
	Canal Improvement	68.7 km
	Major Division Structures	123 places
	Crossing Structure	36 places
	Small Reservoir Development	2 places
	Community Center Development	
	Garage	6 places

Typical structural drawings for the facilities on the short term stage development are shown in Fig. 6.7.2 to Fig. 6.7.9.

Middle Term Stage	Road Improvement	
	Main Road	-
	Connection Road	9 Routes, 31.3 km
	Farm Road	23 Routes, 40.8 km
	Bridge	-
	Submerged Bridge	6 places
	Crossing Structures	91 places
	Existing Irrigation System Improvement	27 systems, 2,102 ha
	Intake Structures	27 places
	Canal Improvement	73.6 km
	Major Division Structures	133 places
	Crossing Structures	181 places
	Small Reservoir Development	1 places
	Community Center Development	
	Main Building (CRC)	3 places
	Main Building (AC)	6 places
	Garage	3 places
	Meeting Hall	5 places
Long Term Stage	Road Improvement	
	Main Road	-
	Connection Road	8 Routes, 33.5 km
	Farm Road	24 Routes, 33.7 km
	Bridge	-
	Submerged Bridge	2 places
	Crossing Structures	91 places
	Existing Irrigation System Improvement	23 systems, 2,575 ha
	Intake Structures	23 places
	Canal Improvement	69.1 km
	Major Division Structures	123 places
	Crossing Structures	36 places
	Small Reservoir Development	-
	Community Center Development	
	Community Re-vitalization Center	-
	Area Center	-
	Meeting Hall	10 places

6.8 Meetings on the Study with Beneficiaries

For continuous and progressive development of the proposed project, purpose and contents of the project have to meet the demands of the beneficiaries. To fill these requirements, participation and collaboration of the beneficiaries to the Study is indispensable and the needs of the beneficiaries have to incorporate and reflect to the project formulation as much as possible. In this connection, a series of meetings

concerning the Study between the beneficiaries and the Study Team has been held during the course of the field works.

6.8.1 Explanation Meeting

Explanation of contents on the Inception Report and procedure of field investigation to the local government bodies and beneficiaries of the Study was carried out at Achacachi Municipality prior to the field survey of the Study.

(1) Meeting with the Local Governmental Bodies

Meeting was held on 15 November, 1996 with presence of concerned officials on the following organizations;

SNAG	Victor Lara Rodriguez
Prefectura	Samuel Tapia Soria, Julio Condori Quisbert Angel Tito Panama, Fernando Nava Villarroal
Achacachi Municipality	Juan Perez Luna, Vicente Ayala A, Fidel Quispe Costaneto, Dario Quinteros Francisco Gome Huallpa
Water Usersí Association	Alajembro Chura Morales
Omasuyos Province	Pedoro Lisme Chambilla
JICA Study Team	H. Terakado, T. Kawamura, T. Nibe M. Shibata, Y. Nishikawa, T. Hirano K, Sawada

Questions and answers

- Contents of the explanation were understood. We want to know the time and source of found to implement the presumed improvement works in the Study area. (Achacachi Municipality)

  Implementation of the presumed improvement works in the Study area depends entirely on the financing procedures of the Bolivian Government. Participation of the beneficiaries and real efficacious improvement plan presented in the explanation are to arrange the conditions for implementation of the presumed improvement works in the Study area. (Study Team)

  The Study carry out by Japanese Government without compensation. Project formulation to be able to raise the found for implementation of the presumed improvement works will be made through the field study. (SNAG)

- Residents in the Achacachi city consider that the presumed improvement works will be implemented by the grant aid of the Japanese Government. (Omasuyos Province)

  The Study includes to pursuit the possibility of utilization on such found. (Study Team)

- Is it possible to express the residents' opinion during the course of the field survey ? (Omasuyos Province)

  We expect such manner as explained. (Study Team)

- Is it possible to express the residents' idea for the improvement plan? (Omasuyos Province)

  We expect. (Study Team)

- We have interest the improvement plan derived from the Study results. Achacachi municipality has many problems to solve, therefore, we are

expected the close cooperation of Japanese Government from now on. (Mayor of Achacachi municipality)

- We are pleased that the presumed improvement plans include the rehabilitation of the existing irrigation system. To improve the regional economical conditions, improvement of many infrastructural components can be considered not only the irrigation system but also amelioration of farm management, promotion of inland fishery and so on. Provision of the community center is one of the residents' requirement and we wish its realization. (Water users' association)

(2) Meeting with the Beneficiaries in the Study Area

Explanation meeting of the Study for the beneficial communities in the Study area was held on 20 November, 1996. Because no traffic measures to Achacachi are available in the upper basin of the Study area, communities located in the middle and lower basins were only participated the meeting. Participants of the meeting are as follows;

SNAG	Victor Lara Rodriguez
Prefectura	Samuel Tapia Soria, Angel Tito Panama, Fernando Nava Villarroal
Achacachi Municipality	Vicente Ayala A,
Water Usersí Association	Alajembro Chura Morales
Omasuyos Province	Pedoro Lisme Chambilla
JICA Study Team	H. Terakado, T. Kawamura, T. Nibe M. Shibata, Y. Nishikawa, K. Sawada
Representatives of the beneficial community	13 communities of the Kanton Achacachi

The meeting was opened with a salutation of Mr. Victor Lara (SNAG), then, team leader introduced study team members to the beneficiaries. Continuously, team leader explained the basic approach of the Study and procedures of the field works during the stay in the site of the team. After the explanation, representatives of the beneficial communities were filled out a questionnaire prepared by the study team regarding the present situation of each community.

Explanation meeting for the communities located in the upper basin of the Study area was held on 28 November, 1996 at the office of the study team in Achacachi.

Prefectura	Samuel Tapia Soria, Angel Tito Panama, Fernando Nava Villarroal
Water Usersí Association	Alajembro Chura Morales German Flores Chambi
JICA Study Team	H. Terakado, T. Kawamura, T. Nibe M. Shibata, Y. Nishikawa, K. Sawada
Representatives of the beneficial community	17 communities including Kanton Achacachi

The meeting intended to communities which absent at former meeting in the upper basin of the Study area. 17 communities were participated including communities participated the former meeting.

The meeting was opened with a salutation of Mr. Samuel Tapia Soria (Prefectura), then, team leader introduced study team members to the beneficiaries. Continuously, team leader explained the basic approach of the Study and procedures of the field works during the stay in the site of the team. After the explanation, representatives of the beneficial communities were filled out a questionnaire prepared by the study team regarding the present situation of the each community.

6.8.2 Workshop

(1) Workshop concerning the results of Phase I Field works was held on 13 January, 1997, at the site office of the Study Team. Participants of the meeting are as follows;

SNAG	Edgar Tapia Carlos Villegas Sarmiento H. Chiga
Prefectura	Julio Condori Quisbert
Omasuyos Province	Pedro Lisme Chambilla
Los Andes Province	Pedro Mamani Flores
JICA Bolivia Office	M. Sekiguchi
JICA Study Team	T. Kawamura, T. Nibe, H. Okabe, S. Onoda M. Shibata, Y. Nishikawa, F. Onoda, S. Sai
Representatives of the beneficial community	30 communities

Through the field study, 31 communities including Achacachi municipality were identified as the beneficial communities in the Study area. Workshop was intended to explain the field survey results, basic development concept and plans of the Study for those communities. For the Workshop, representatives of 30 communities excluding Achacachi municipality were participated.

Workshop was opened with a salutation of Mr. Edgar Tapia (SNAG), then, study team members explained the present conditions of the Study area, development constraints and potentials, basic approach to the development plan, preliminary development plans. Discussions were carried out after completion of the explanation.

Questions and Answers

- Proposed development plans are final plan or not ? When does the Phase II study start ? (Omasuyos Province)

  Proposed development plans are the basic plans. After discussion with the concerned personnel and organs, final plans will be formulated. Phase II Study will be started coming May. (Study Team)

- To expand the agricultural products, how do you think the market ? (Representative of community)

  Details such as market, demand and supply will be studied during the Phase II Field Works. (Study Team)

- To make communication easily between the study team and the residents in the Study area, more interpreters of Aymara language will be indispensable during the field investigation of the Study. (Representative of community)

  Attention will be pay during the Phase II Field Works. (Study Team)

With a close salutation of governmental organization concerned, Workshop has been closed.

(2) Work Shop aiming at submission of the Phase I study results and to hear the opinion of each community on the proposed improvement plan for the representatives of beneficial communities was held on 20 May, 1997 at the Achacachi office of the study team. Participants of the Work Shop are as follows;

SNAG	Carlos Villegas Mitsuhiko Nakasone (JICA Expert)
Prefectura de La Paz	Julio Condori Angel Tito
Japanese Embassy	Eisaku Nomura
JICA Bolivia office	Naoki Yanase
Study Team	H. Terakado, T. Kawamura, T. Nibe, S. Sai, H. Okabe, Y. Nishikawa, F. Onoda
29 Beneficial Communities	Secretaria General and Alcalde de Agua of whole beneficial communities except Putni and Achacachi city

Order of the Work Shop is as follows;

i) Salutation (SNAG)
ii) Explanation of the contents on the Phase II Field Survey (Team Leader)
iii) Description of the proposed improvement works (Team Leader)
iv) Opinions of each community for the proposed plan (Representative of each community)
v) Questions and answers for the opinions
vi) Proposals for the management of Community Re-vitalization Center (CRC) (Team member)
vii) Salutation (SNAG)

After explanation of the Phase I study results and the proposed improvement plans of the study, hearing of the opinions for the proposed improvement plans was carried out on each community basis. Furthermore, study team proposed to hold the explanation meeting of the study with area-wise and following schedule.

May 26	AM	Chachacomani, Corpaputo, Berenguera
	PM	Kerani, Comata Alta, Comata Media, Comata Baha
May 27	AM	Pairumani, Icrana
	PM	Pajchani Molino, Pajchani Grande, Putuni
May 28	AM	Cala Cala, Barco Cala Cala, Pongon Huyo
	PM	Avichaca, Tipampa
May 29	AM	Suntia Comun, Suntia Grande, Suntia Chico, Jahuir Laca
	PM	Marca Masaya, Kajsina
May 30	AM	Arasaya Chico, Arasaya Kentuyo, Arasaya Patanivi, Cajon Pata
	PM	Belen, Barco Belen, Taramaya

Concerning the proposals of the study team for the management organization of Community Re-vitalization Center (CRC), opinions of each community will be asked in the further Work Shop.

(3) Explanation Meeting of the Study for the Beneficiaries

Based on the proposal stated in the Work Shop held on 20 May, area-wise explanation meetings on the study were held from 26 May to 30 May. Study team explained the major contents of the proposed works of the Study through the Aymaran interpreter to the beneficiaries. Major items explained to the beneficiaries are as follows;

- basic components of the study are the improvement works of existing irrigation system and road network, community re-vitalization center and agricultural supporting and assistance development,
- the proposed development works emphasize the measures to develop the Rio Keka basin as a whole,
- no dam construction is considered as the water source development,
- rehabilitation of the existing irrigation facilities is the major works on the irrigation development,

- whole proposed works will be executed by the stage-wise procedures.

The explanation was made on the basis of the general map on the proposed development works. Through the meeting, proposed development works were basically agreed by the beneficiaries.

(4) Work Shop aiming at submission of the Phase II study results and to explain the management procedure of CRC for the representatives of beneficial communities was held on 23 June, 1997 at the Achacachi office of the study team. Participants of the Work Shop are as follows;

SNAG	Ronald Bellot Paulino Luis, Juvenal Rojas Mitsuhiko Nakasone (JICA Expert)
Prefectura de La Paz	Samuel Tapia, Julio Condori Angel Tito, Sergio Oblitas
JICA Bolivia office	Akira Kumakura, Naoki Yanase
Study Team	H. Terakado, T. Kawamura, T. Nibe, H. Okabe, Y. Nishikawa, F. Onoda, K. Sawada
30 Beneficial Communities	Secretaria General and Alcalde de Agua of whole beneficial communities except Achacachi city

Order of the Work Shop is as follows;

i) Salutation (SNAG)
ii) Explanation of the proposed development plan based on the Phase II field works (Team Leader)
iii) Explanation of purpose and management procedure of Community Re-vitalization Center (CRC) (Counterpart personnel)
iv) Salutation (SNAG)

After explanation of the proposed development plans of the study area, explanation of purpose and management procedures of the CRC was carried out by the counterpart personnel. Prior to explanation, representatives of each community were divided into three groups, then, each group discussed and concluded the opinion regarding the role, activity and management procedures on the CRC. Based on the opinions of beneficiaries, proposed management procedures and activities of the study were thoroughly explained by the counterpart personnel.

Table 6.4.1 Selection of the Priority Irrigation System

No.	Water Source	Related Community	Related Farmers	Net Irrigation Area (ha)	Commanding area Large>small	Dry season use>no	Agri. Improve much>ordinary	Nos of related communities	Effectiveness of water saving	Total	Evaluation
1	Rio Keka	Barco Belen	20	215	3	1	5	1	5	15	
2	Rio Keka	Belen	140	571	5	1	5	3	5	19	3
3	Rio Keka	Taramaya	220	212	3	1	5	3	5	17	3
4	Rio Keka	Haurilaca	25	515	5	1	3	3	3	15	
5	Rio Keka	Haurilaca, Suntia Comun	20	146	1	1	5	3	3	13	
6	Rio Keka	Suntia Grande	30	8	1	1	3	3	1	9	
7	Rio Keka	Sumtia Comun	25	32	1	1	3	1	1	7	
9	Rio Keka	Putuni, Pajchani Grande	287	430	5	3	5	5	5	23	1
10	Rio Keka	Putuni	Included in (9)	7	1	5	3	1	3	13	
11	Rio Keka	Pajchani Molino	89	14	1	5	3	1	1	11	
12	Rio Keka	Pajchani Molino	Included in (11)	19	1	5	5	3	3	17	5
13	Rio Keka	Cala Cala	Included in (11)	43	1	1	1	3	1	7	
14	Rio Keka	Cala Cala	Included in (11)	54	1	1	1	1	1	5	
15	Rio Keka	Icrana	32	75	1	1	3	1	1	7	
16	Rio Keka	Icrana	65	48	1	1	3	1	1	7	
17	Rio Keka	Pungunuyu	142	26	1	1	1	1	1	5	
18	Rio Keka	Payrumani	125	5	1	1	3	1	1	7	
19	Rio Keka	Payrumani	30	6	1	1	3	1	1	7	
20	Rio Keka	Pungunuyu	Included in (17)	156	3	1	1	3	3	11	
21	Rio Keka	Payrumani	42	111	3	1	1	3	3	11	
22	Rio Keka	Payrumani	20	9	1	1	3	1	1	7	
23	Rio Keka	Coromata Media	-	6	1	1	3	1	1	7	
24	Rio Keka	Berenguera	-	11	1	1	1	1	1	5	
25	Rio Keka	Berenguera	60	26	1	1	1	1	1	5	
26	Rio Keka	Berenguera	25	3	1	1	1	1	1	5	
27	Rio Keka	Coromata Media, Baja	170	451	5	5	3	3	5	21	2
28	Rio Keka	Chachacomani	Included in (26)	3	1	5	1	1	1	9	
29	Rio Keka	Chachacomani	Included in (26)	16	1	5	1	1	1	9	
30	Rio Keka	Chachacomani	Included in (26)	32	1	5	1	1	1	9	
31	Rio Keka	Berenguera	20	77	1	5	1	1	1	9	
32	Rio Keka	Chachacomani	-	40	1	1	1	1	1	5	
33	Rio Keka	Berenguera	160	105	3	5	1	1	1	11	
				3472							

Table 6.4.2 Comparison of Irrigation Area by "with" and "without" Improvement Conditions

Serial No.	Irrigation System No.	Water source	Related Community	Related Farmers	Irrigation Area (ha)		Location of system in stream reach			Implementation Stage			Irrigation Area (ha)				Incremental Irrigation Area (ha)	
													W/O Improvement		W/ Improvement			
					Gloss	Net	Lower	Middle	Upper	Short	Middle	Long	Rainy	Dry	Rainy	Dry	Rainy	Dry
1	1	Rio Keka	Barco Belen	20	253	215	0				0		48.3	5.0	62.0	6.5	13.8	1.5
2	2	Rio Keka	Belen	140	672	571	0			0			128.2	13.2	164.8	17.2	36.6	4.0
3	3	Rio Keka	Taramaya	220	249	212	0			0			47.6	4.9	61.2	6.4	13.6	1.5
4	4	Rio Keka	Haurilaca	25	606	515		0			0		185.0	44.1	237.9	56.5	52.9	12.5
5	5	Rio Keka	Haulaca, Suntia Comun	20	172	146		0			0		52.5	12.5	67.4	16.0	15.0	3.5
6	6	Rio Keka	Suntia Grande	30	9	8		0			0		2.9	0.7	3.7	0.9	0.8	0.2
7	7	Rio Keka	Suntia Comun	25	38	32		0			0		11.5	2.7	14.8	3.5	3.3	0.8
8	9	Rio Keka	Pututi, Pajchani Grande	287	506	430		0		0			154.5	36.8	198.6	47.2	44.1	10.4
9	10	Rio Keka	Pututi	Included in (9)	8	7		0			0		2.5	0.6	3.2	0.8	0.7	0.2
10	11	Rio Keka	Pajchani Molino	89	16	14		0			0		5.0	1.2	6.5	1.5	1.4	0.3
11	12	Rio Keka	Pajchani Molino	Included in (11)	22	19		0		0			6.8	1.6	8.8	2.1	2.0	0.5
12	13	Drainage water of No.14	Cala Cala	Included in (11)	50	43		0			0		15.4	3.7	19.9	4.7	4.4	1.0
13	14	Rio Keka	Cala Cala	Included in (11)	63	54		0			0		19.4	4.6	24.9	5.9	5.5	1.3
14	15	Rio Keka	Icrana	32	88	75		0			0		26.9	6.4	34.6	8.2	7.7	1.8
15	16	Rio Keka	Icrana	65	56	48		0			0		17.2	4.1	22.2	5.3	4.9	1.2
16	17	Rio Keka	Pungunuyu	142	31	26		0			0		9.3	2.2	12.0	2.9	2.7	0.6
17	18	Rio Keka	Payrumani	125	6	5		0			0		1.8	0.4	2.3	0.5	0.5	0.1
18	19	Rio Keka	Payrumani	30	7	6		0			0		2.2	0.5	2.8	0.7	0.6	0.1
19	20	Rio Keka	Pungunuyu	Included in (17)	184	156		0			0		56.0	13.3	72.1	17.1	16.0	3.8
20	21	Rio Keka	Payrumani	42	131	111		0			0		39.9	9.5	51.3	12.2	11.4	2.7
21	22	Rio Keka	Payrumani	20	10	9			0		0		8.8	3.7	9.0	4.7	0.2	1.1
22	23	Rio Keka	Coromata Media	-	7	6			0		0		5.8	2.5	6.0	3.2	0.2	0.7
23	24	Rio Keka	Berenguera	-	13	11			0		0		10.7	4.5	11.0	5.8	0.3	1.3
24	25	Rio Keka	Berenguera	60	31	26			0		0		25.3	10.6	26.0	13.7	0.7	3.0
25	26	Rio Keka	Berenguera	25	3	3			0		0		2.9	1.2	3.0	1.6	0.1	0.4
26	27	Rio Keka	Coromata Media, Baja	170	530	451			0	0			438.8	184.7	451.0	237.4	12.2	52.7
27	28	Rio Keka	Cormata Alta	Included in (26)	3	3			0		0		2.9	1.2	3.0	1.6	0.1	0.4
28	29	Rio Keka	Cormata Alta	Included in (26)	19	16			0		0		15.6	6.6	16.0	8.4	0.4	1.9
29	30	Rio Keka	Cormata Alta	Included in (26)	38	32			0		0		31.1	13.1	32.0	16.8	0.9	3.7
30	31	Rio Keka Khara Pampa	Coromata Alta	90	90	77			0		0		74.9	31.5	77.0	40.5	2.1	9.0
31	32	Rio Keka Khara Pampa	Coromata Alta	13	47	40			0		0		38.9	16.4	40.0	21.1	1.1	4.7
32	33	Rio Keka Khara Pampa	Kerani	27	123	105			0		0		102.2	43.0	105.0	55.3	2.8	12.3
33	34	Rio Corpa Jahuira	Berenguera	20	113	96			0			0	41.7	9.9	53.6	12.6	11.9	2.6
34	35	Rio Corpa Jahuira	Chachacomani	-	5	4			0			0	1.7	0.4	2.2	0.5	0.5	0.1
35	35-1	Rio Corpa Jahuira	Coromata Alta	-	39	33			0			0	14.3	3.4	18.4	4.3	4.1	0.9
36	35-2	Rio Corpa Jahuira	Chachacomani	-	5	4			0			0	1.7	0.4	2.2	0.5	0.5	0.1
37	36	Rio Corpa Jahuira	Berenguera	160	9	8			0			0	3.5	0.8	4.5	1.0	1.0	0.2
38	37	Rio Chiar Jokho	Suntia Grande	-	56	48		0				0	5.4	1.3	6.9	1.6	1.5	0.4
39	39	Rio Chiar Jokho	Suntia Grande, Chico	160	78	66		0				0	7.4	1.8	9.5	2.3	2.1	0.5
40	40	Rio Chiar Jokho	Avichaca	Included in (39)	275	234		0				0	26.1	6.2	33.6	8.0	7.5	1.8
41	41	Rio Chiar Jokho	Cala Cala	70	113	96		0				0	10.7	2.5	13.8	3.3	3.1	0.7
42	43	Rio Chiar Jokho	Cala Cala	Included in (39)	19	16		0				0	1.8	0.4	2.3	0.5	0.5	0.1
43	46	Rio Chiar Jokho	Cala Cala	Included in (39)	175	149		0				0	16.6	4.0	21.4	5.1	4.8	1.2
44	47	Rio Chiar Jokho	Pongunuyu, Barco Cala Cala	221	163	139		0				0	15.5	3.7	20.0	4.8	4.5	1.1
45	49	Rio Chiar Jokho	Pungunuyu	50	8	7		0				0	0.8	0.2	1.0	0.2	0.2	0.1
46	49-1	Rio Wila Wilani	Pungunuyu		44	37		0				0	4.1	1.0	5.3	1.3	1.2	0.3
47	50	Rio Chiar Jokho	Pungunuyu	3	8	7		0				0	0.8	0.2	1.0	0.2	0.2	0.1
48	51	Rio Chiar Jokho	Pungunuyu	4	16	14		0				0	1.6	0.4	2.0	0.5	0.4	0.1
49	52	Rio Chiar Jokho	Pungunuyu	70	53	45		0				0	5.0	1.2	6.5	1.5	1.4	0.3
50	53	Rio Chiar Jokho	Pungunuyu	40	25	21		0				0	2.3	0.6	3.0	0.7	0.7	0.2
51	53-1	Rio Chiar Jokho	Pungunuyu	-	31	26		0				0	2.9	0.7	3.7	0.9	0.8	0.2
52	56	Rio Jallpa	Corpaputo	350	450	383			0			0	109.3	32.6	140.3	41.9	31.0	9.3
53	57	Rio Jallpa	Corpaputo	250	130	111			0			0	31.7	9.4	40.7	12.1	9.0	2.7
54	58	Rio Kellhuani	Chachacomani	-	520	442			0			0	70.5	21.2	91.0	27.4	20.5	6.2
55	59	Rio Kellhuani	Chachacomani	80	240	204			0			0	32.5	9.8	42.0	12.6	9.5	2.8
		Total		3,175	6,656	5,662							1,999.0	599.0	2,375.0	770.0	376.0	171.0

Note : Numbers of related farmers are employed the survey results of local consultants
Irrigation area was calmated by the aero-photo and topographic map compiled by the study team.

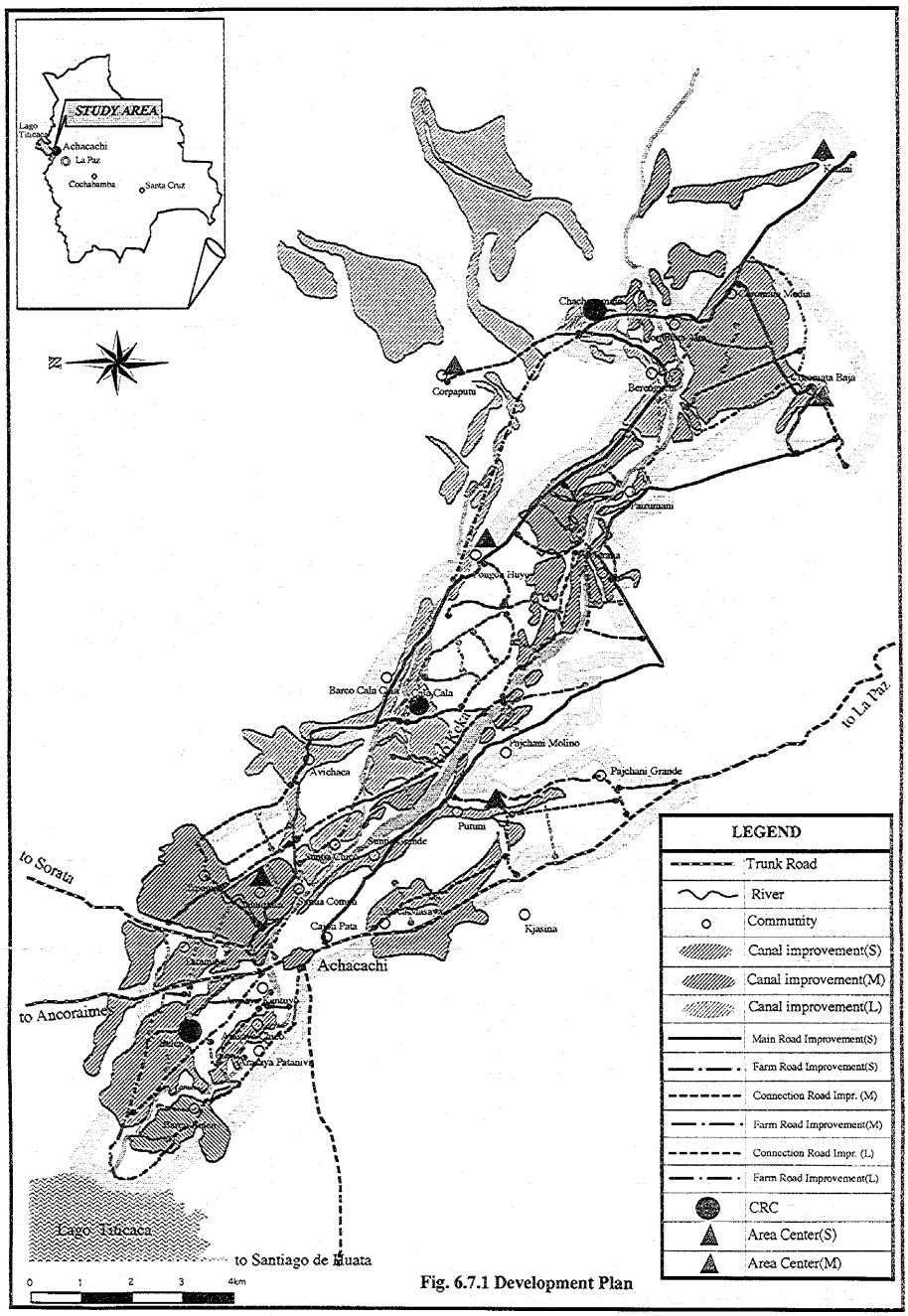
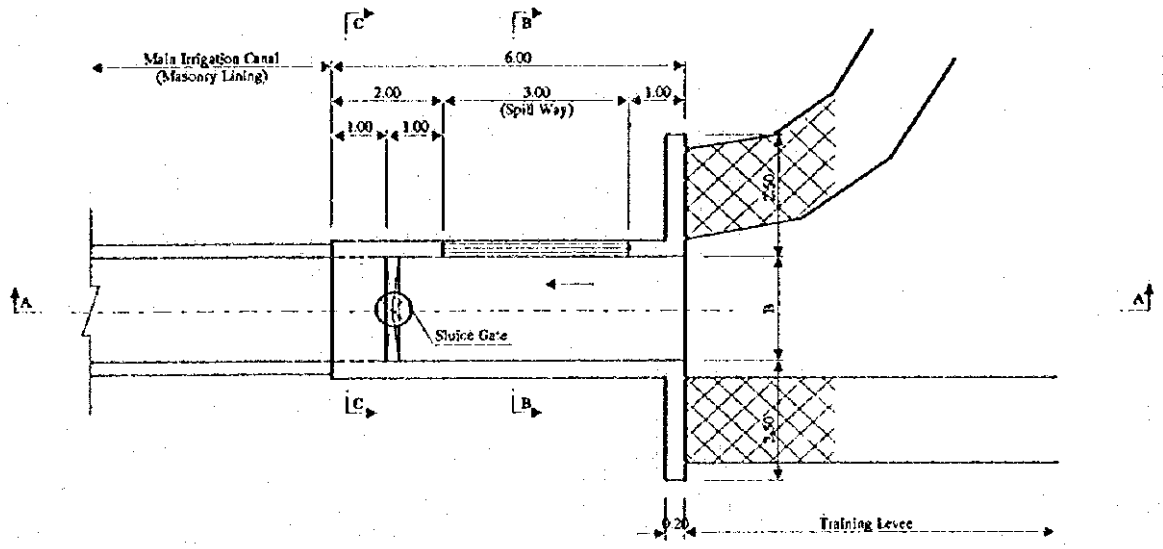
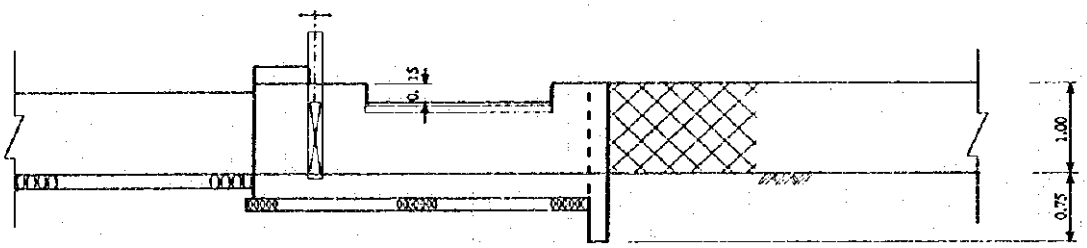


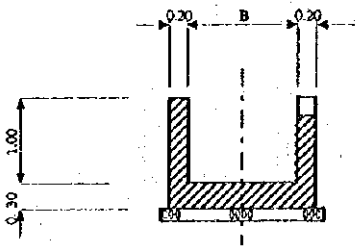
Fig. 6.7.1 Development Plan



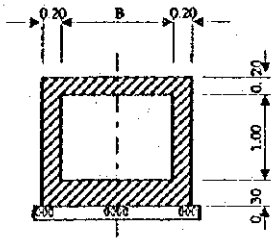
PLAN



SECTION A - A



SECTION B - B

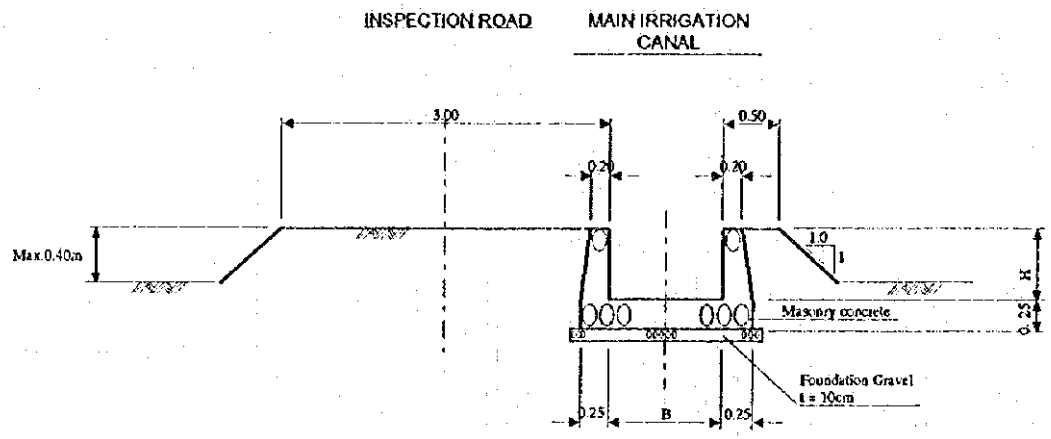


SECTION C - C

DIMENSION

	B	Canal No.
TYPE - I	0.50	7,13,19,21,22,23,24,25,26,28,32,37,39,45,49-1,50,51,52,53,59
TYPE - II	0.75	4,5,14,29,30,31,34,35-1,35-2,36,53-1
TYPE - III	1.00	1,3,10,11,12,16,17,18,20,35,49,57,58
TYPE - IV	1.25	2,40,43,
TYPE - V	1.50	9,15,27,33,41,46,55

Fig. 6.7.2 Intake



DIMENSION

Canal No.	B	H
1	1.00	0.55
2	0.85	0.70
3	0.65	0.40
4	0.50	0.40
5	0.55	0.45
6	0.40	0.40
7	0.40	0.50
9	0.65	0.85
10	0.45	0.65
11	0.40	0.65
12	0.65	0.65
13	0.40	0.30
14	0.35	0.50
15	0.35	0.70
16	0.50	0.60

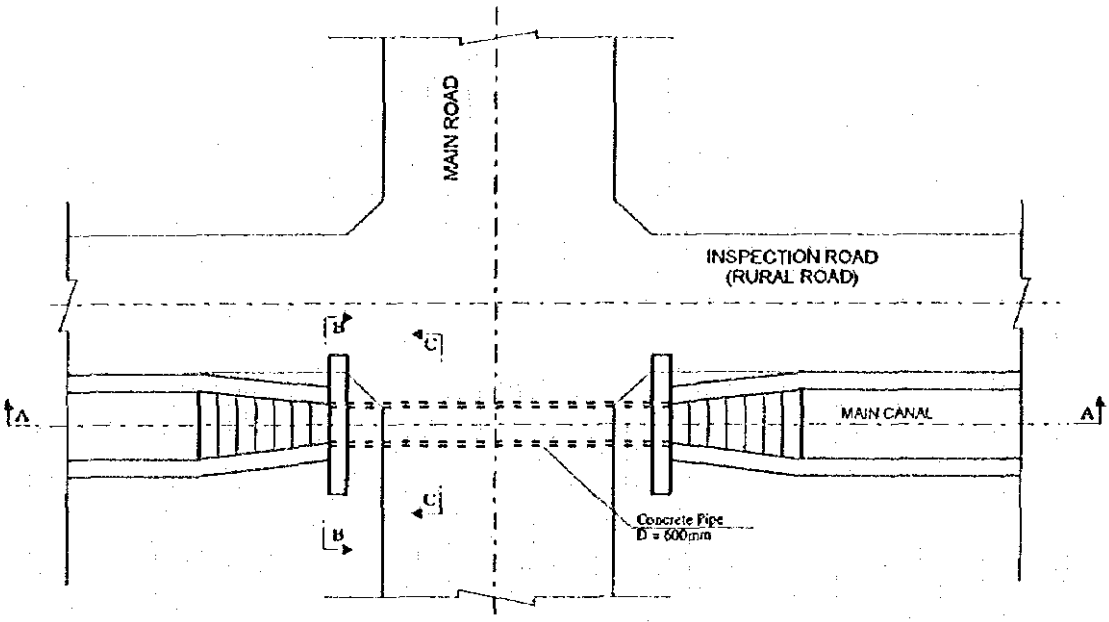
Canal No.	B	H
17	0.40	0.65
18	0.45	0.55
19	0.35	0.40
20	0.35	0.55
21	0.40	0.40
22	0.50	0.40
23	0.50	0.40
24	0.30	0.40
25	0.35	0.35
26	0.30	0.40
27	0.65	0.95
28	0.30	0.40
29	0.35	0.45
30	0.45	0.50
31	0.40	0.45

Canal No.	B	H
32	0.35	0.40
33	0.60	0.90
34	0.30	0.50
35	0.30	0.55
35-1	0.30	0.50
35-2	0.30	0.50
36	0.45	0.45
37	0.35	0.30
39	0.50	0.35
40	0.40	0.70
41	0.40	0.80
43	0.30	0.50
45	0.35	0.45
46	0.45	0.70
47	0.40	0.65

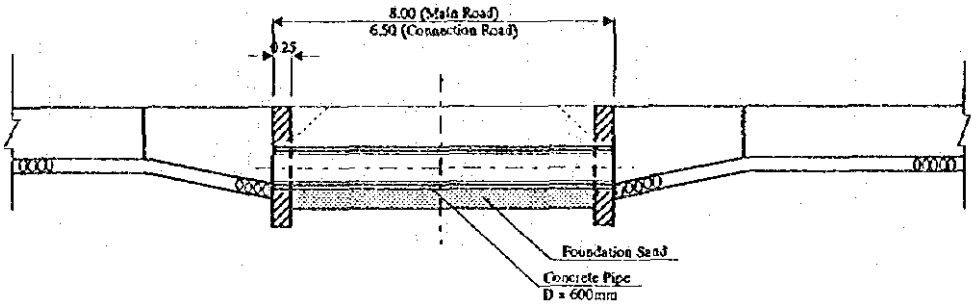
Canal No.	B	H
49	0.35	0.55
49-1	0.40	0.40
50	0.40	0.30
51	0.50	0.40
52	0.30	0.35
53	0.35	0.40
53-1	0.35	0.45
56	0.40	0.60
57	0.40	0.55
58	0.40	0.55
59	0.30	0.40

Note : The numerical values of the standard section for each canal are indicated by the item "DIMENSION".

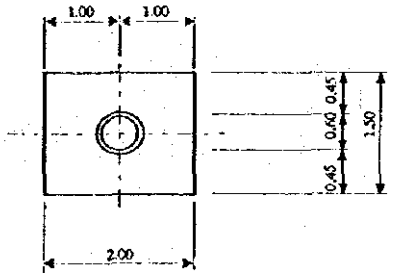
Fig. 6.7.3 Typical Section of Main Irrigation Canal



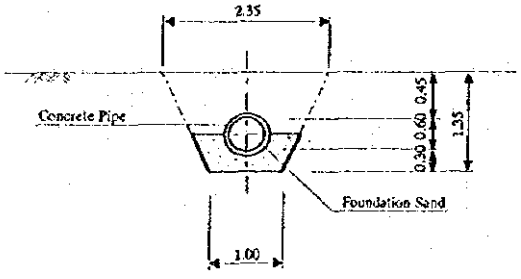
PLAN



SECTION A - A

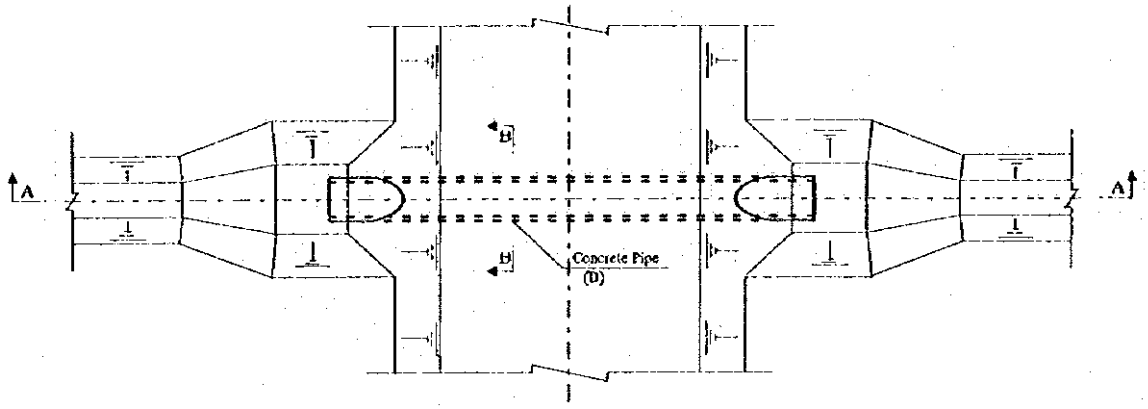


SECTION B - B



SECTION C - C

Fig. 6.7.4 Road Crossing (Type-I)



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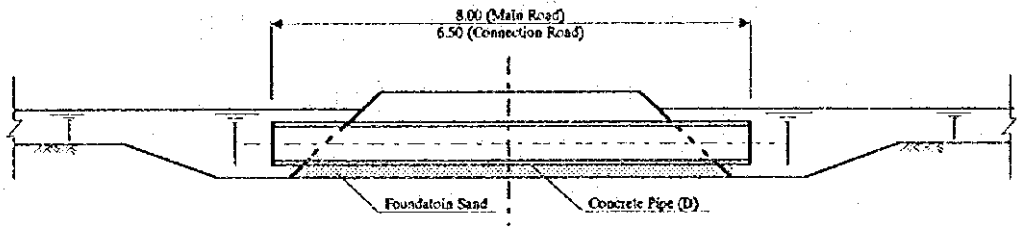
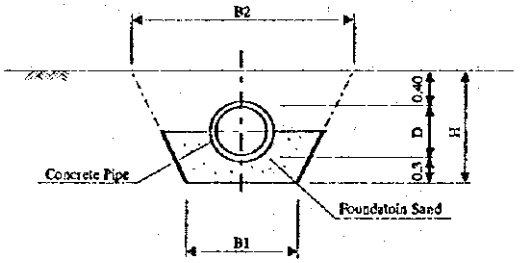


SECTION A - A

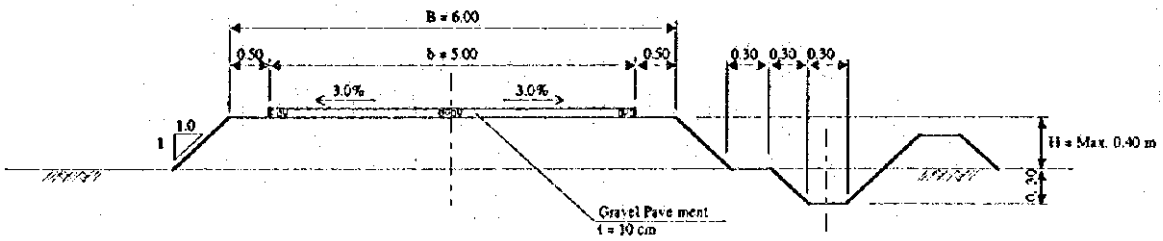


SECTION B - B

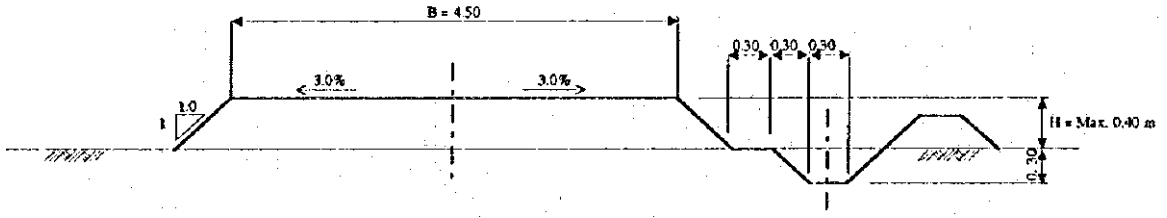
DIMENSION

	D	H	B1	B2
Type-1	1,000 mm	1.70	1.40	3.10
Type-2	600 mm	1.30	1.00	2.30
Type-3	300 mm	1.00	0.70	1.70

Fig. 6.7.5 Road Crossing (Type-II)

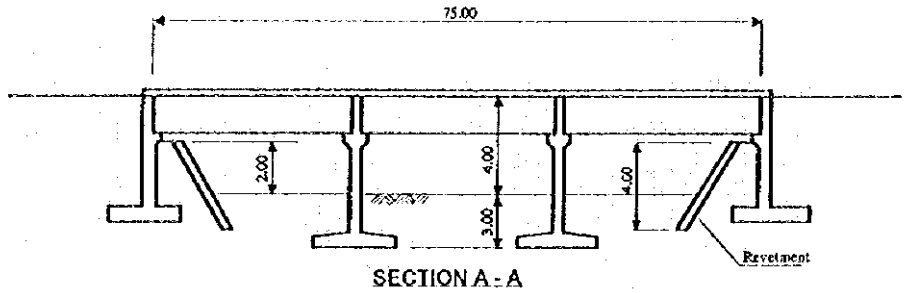


TYPICAL CROSS SECTION OF MAIN ROAD

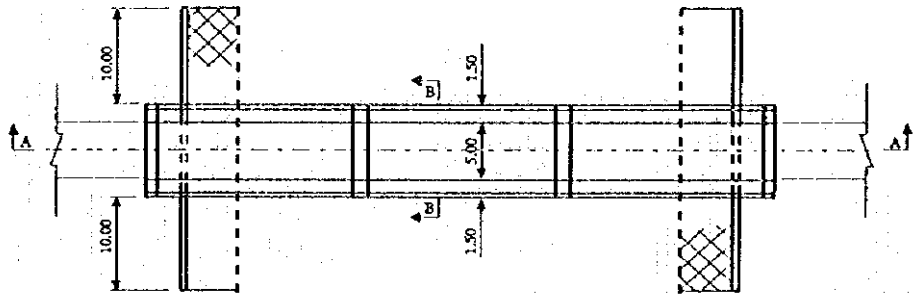


TYPICAL CROSS SECTION OF CONNECTION AND RURAL ROAD

Fig. 6.7.6 Typical Section of Road



SECTION A - A



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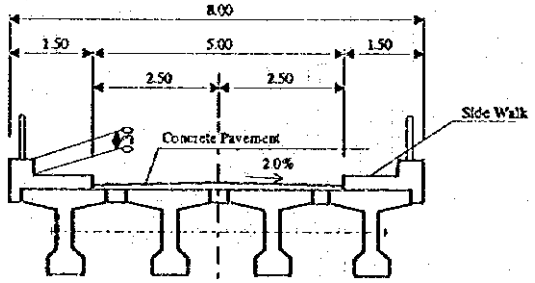


SECTION B - B

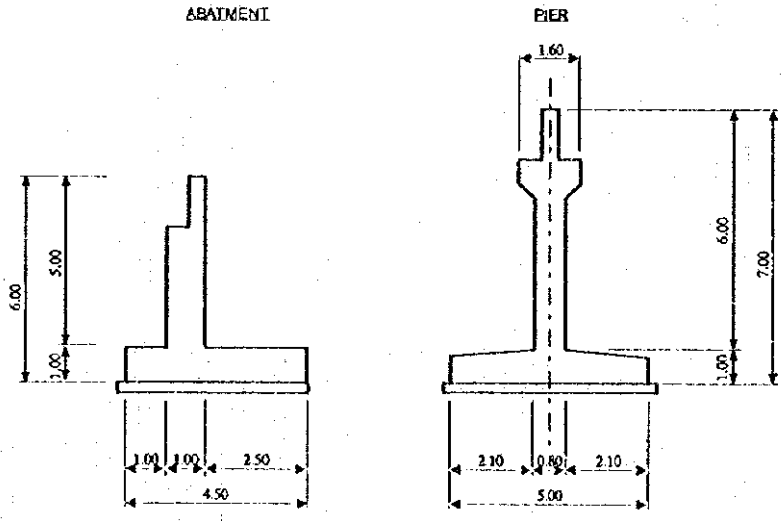
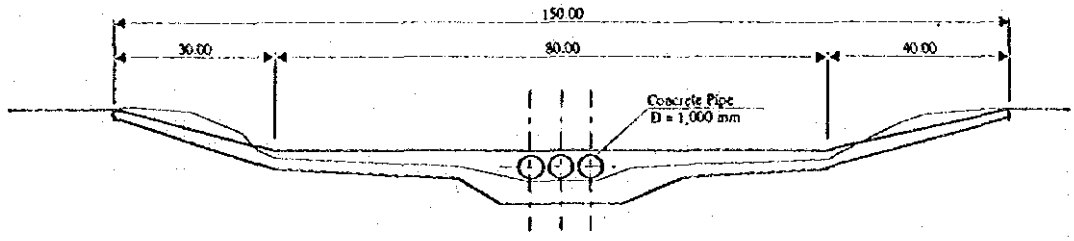
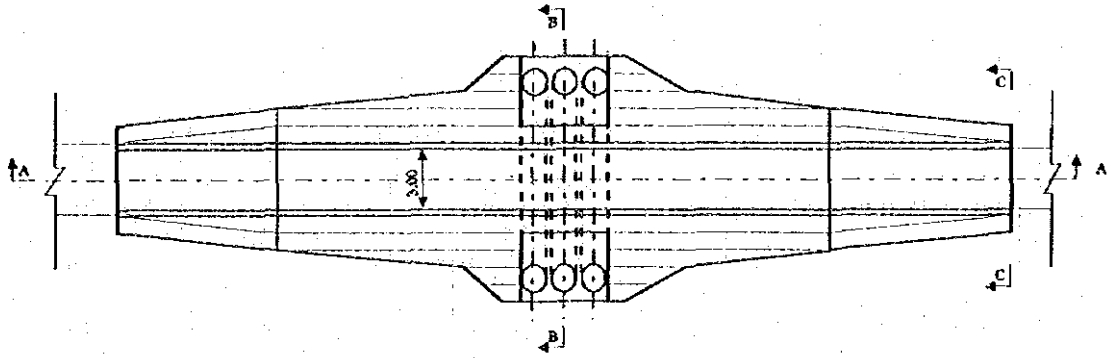


Fig. 6.7.7 BRIDGE (Type I)
(COROMATA ALTA - Rio KEKA, CP - 2)



SECTION A - A



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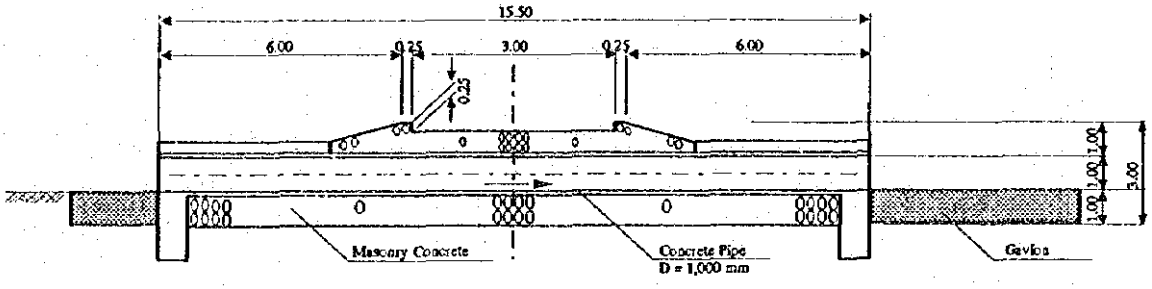

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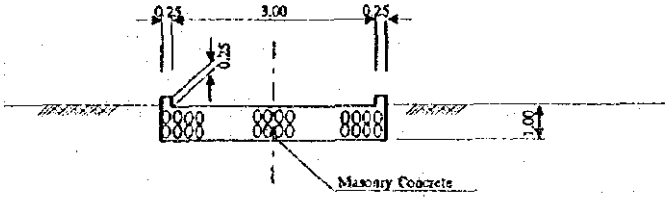

SECTION C - C

Fig. 6.7.8 Submerged Bridge

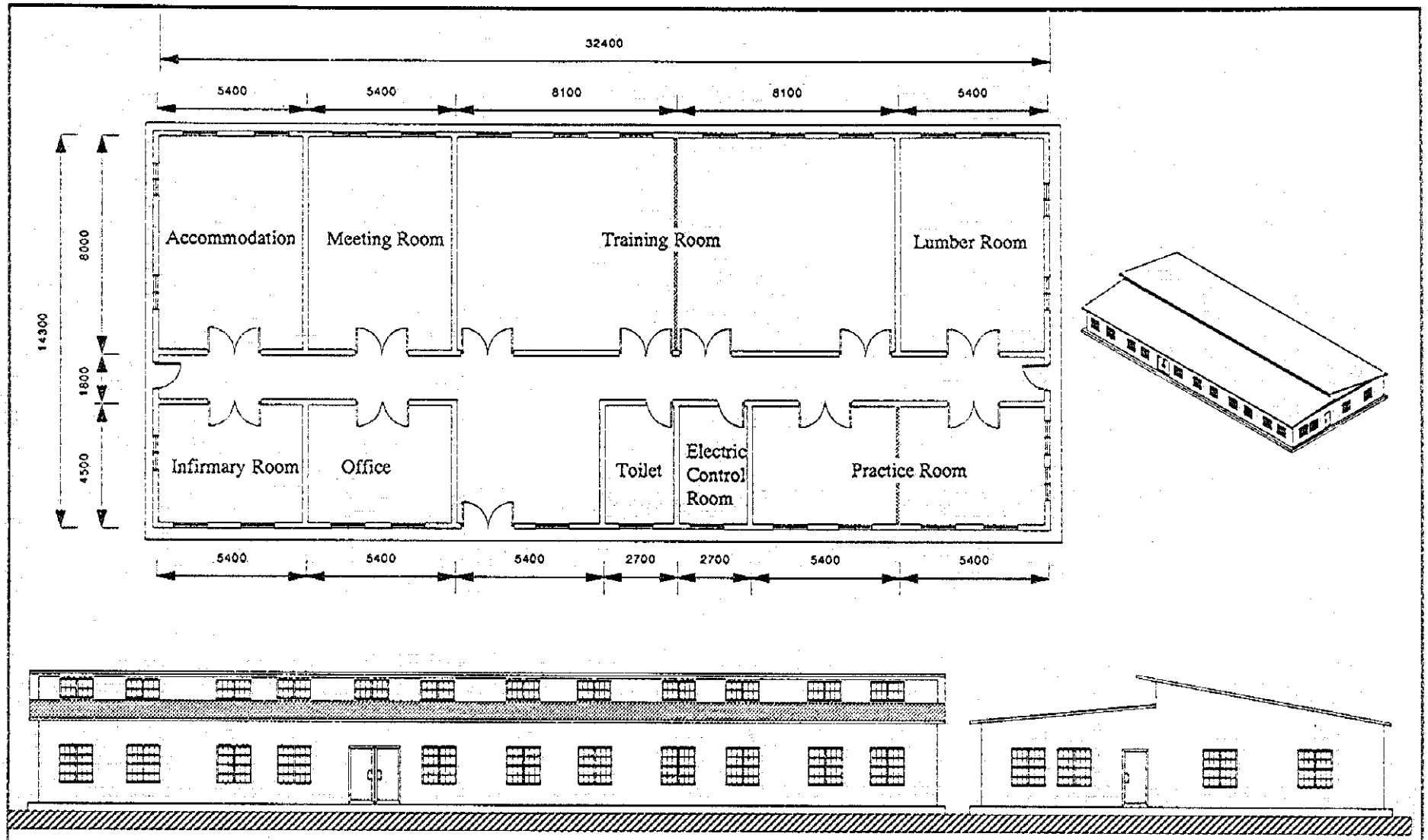

Fig. 6.7.9 Plan of CRC

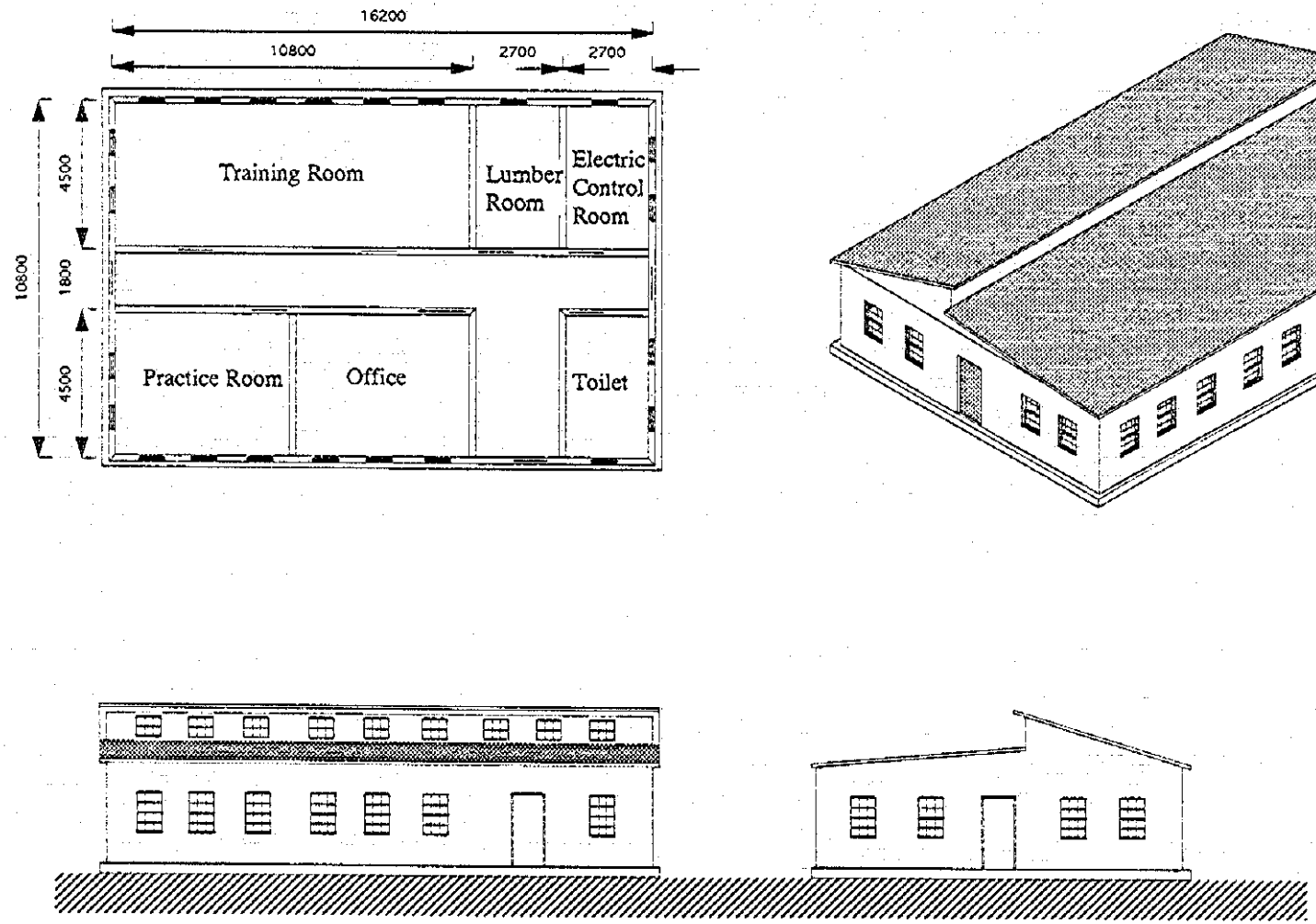

Fig. 6.7.10 Plan of AC

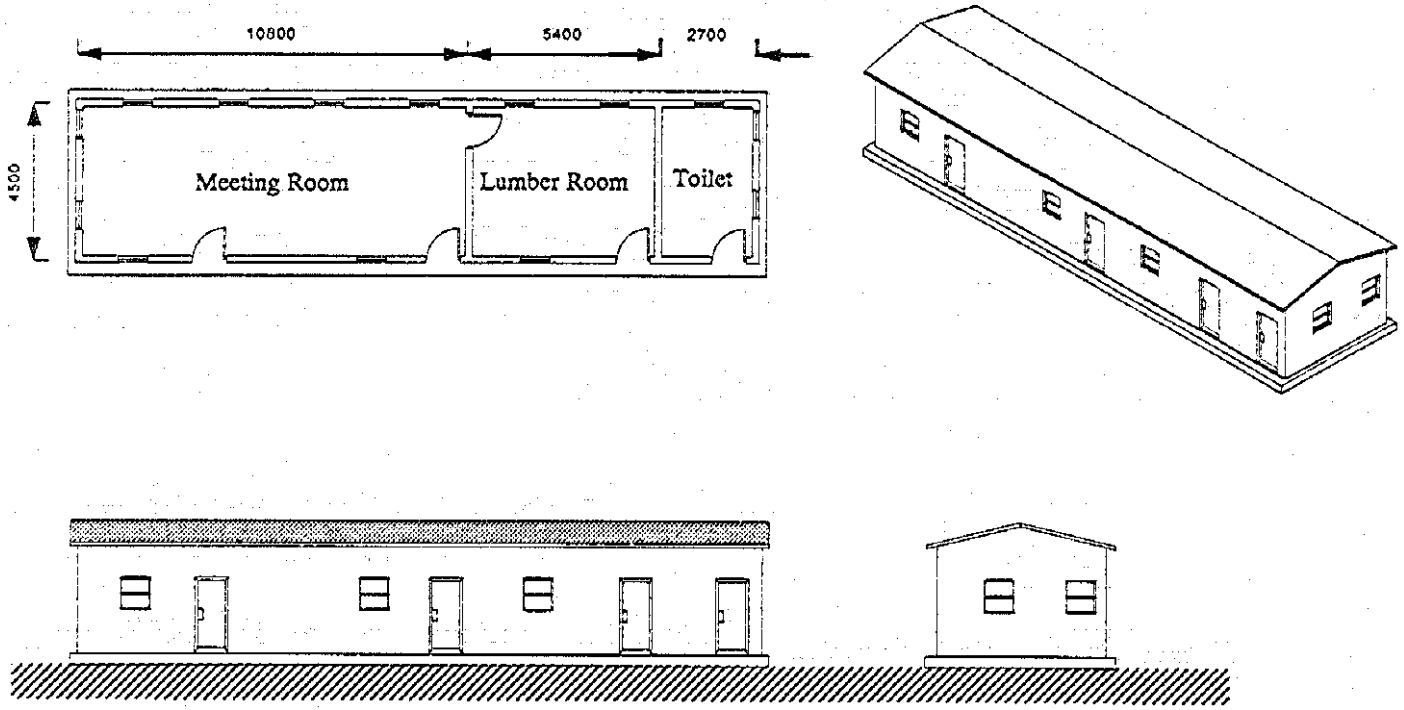

Fig. 6.7.11 Plan of MH

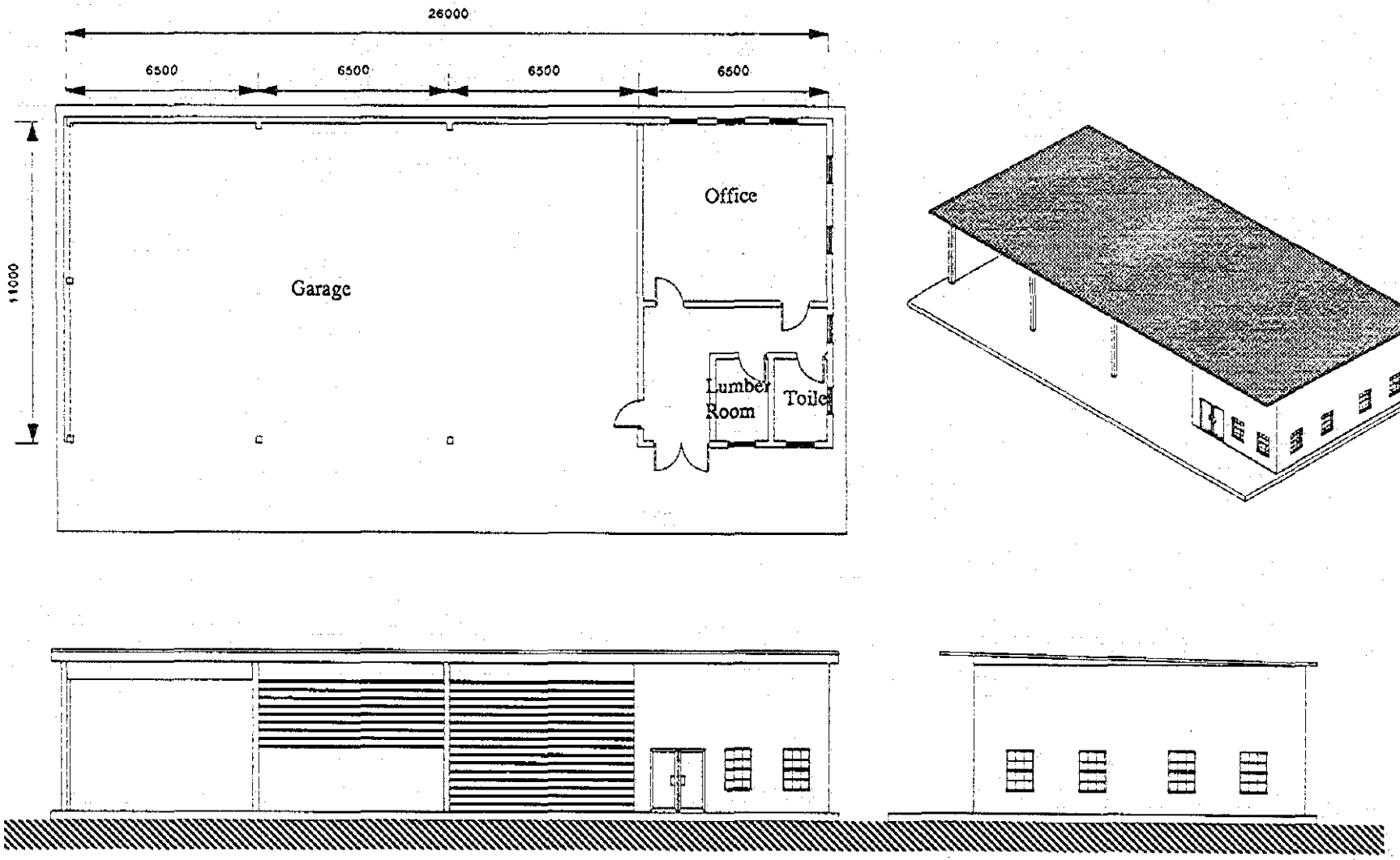

Fig. 6.7.12 Plan of Garage for CRC

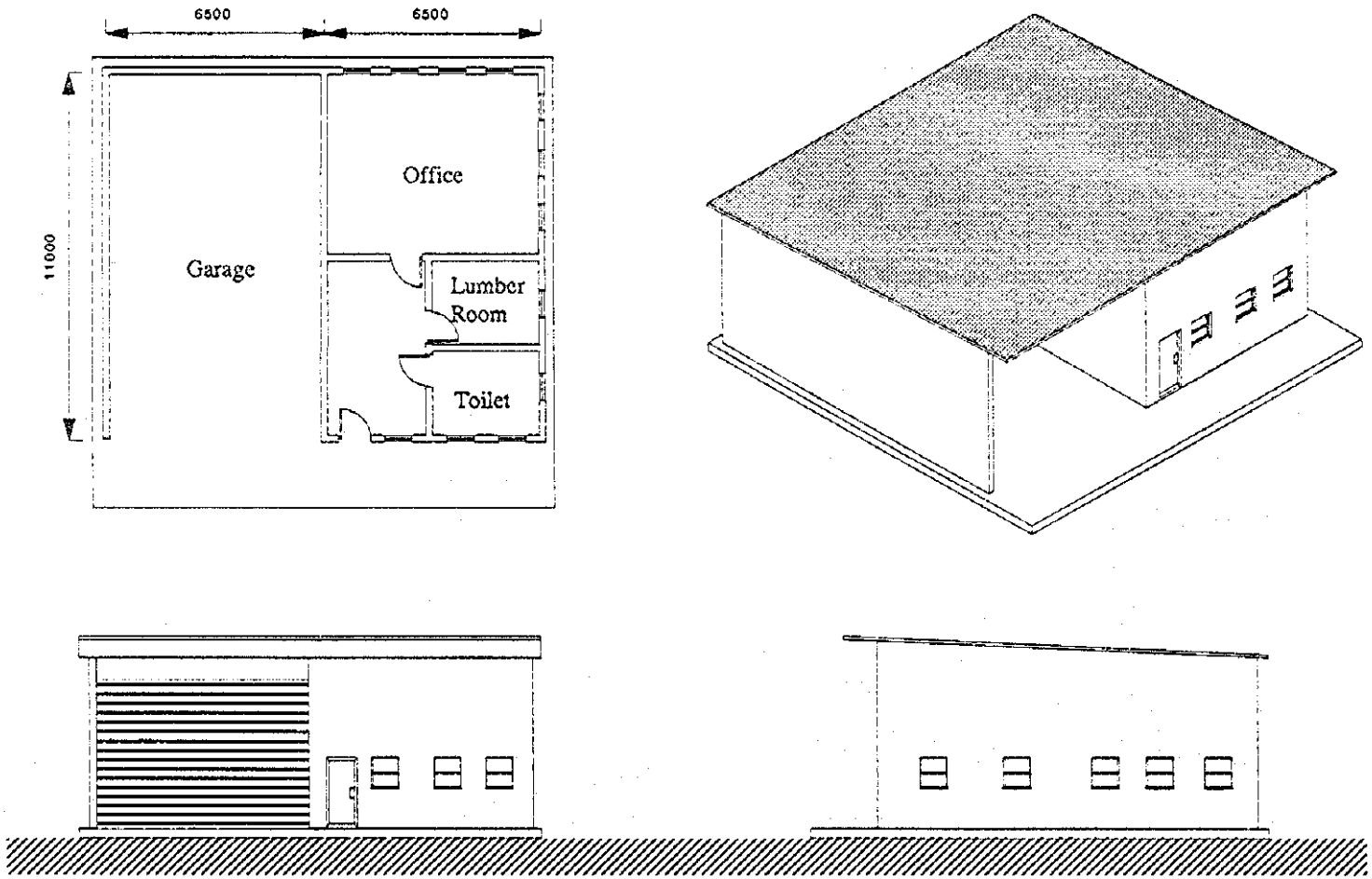

Fig. 6.7.13 Plan of Garage for AC

CHAPTER 7

ESTIMATION OF CONSTRUCTION COST

CHAPTER 7 ESTIMATION OF CONSTRUCTION COST

7.1 Basic Conditions of Cost Estimation

Construction costs are estimated at the price level as of June 1997 taking into consideration the updated costs of labor, construction materials and equipment. Civil engineering works will be executed by contractors on a contract basis. The machinery and equipment required for construction works will be provided by the contractor. Accordingly, the required expenses on construction machinery and equipment will be estimated depreciation cost basis. Basic conditions and assumptions of cost estimate are as follows;

i) Proportion between local and foreign currencies are assumed as local portion : foreign portion 3.5 : 6.5. Local portions of costs are consisted of labor, materials such as sand, gravel, stone and timber, and the remaining covered by foreign costs.
ii) Construction materials are assumed to be transported from La Paz to the respective sites.
iii) Working ratio and work capabilities of equipment are estimated based on the prevailing conditions in the Study area.
iv) Land acquisition cost is estimated at US$ 1,000 / ha for residential areas and at US$ 500 / ha for other areas.
v) Overhead and profit of contractors are assumed at 20 % of the direct cost in the unit price.
vi) Engineering and administration costs are assumed at 12 % of direct construction cost.
vii) Physical contingency is assumed at 10 % of the direct construction cost.
viii) Exchange rate is applied at US$ 1.0 = Bs 5.22.

Major costs of labor and construction materials for the estimation are summarized in Annex L.

7.2 Quantities of the Works

Construction of civil works is broadly divided into three (3) categories, agricultural infrastructure, rural infrastructure and agricultural support service facilities. Construction volume of the major works is as follows;

Short Term Development

Item	Quantity	Unit	Excavation (m^3)	Embankment (m^3)	Concrete (m^3)
Agricultural Infrastructure					
Main Irrigation Canal	57.3	km	19,000	33,000	25,000
Secondary Irrigation Canal	11.4	km	2,300	-	2,800
Rural Infrastructure					
Main Road	56.8	km	17,000	45,500	2,300
Connection Road	7.2	km	1,100	4,600	5,000
Agricultural Support Service					
CRC	3	Nos	-	-	-

Middle Term Development

Item	Quantity	Unit	Excavation (m^3)	Embankment (m^3)	Concrete (m^3)
Agricultural Infrastructure					
Main Irrigation Canal	60.3	km	17,000	59,000	22,000
Secondary Irrigation Canal	13.3	km	3,000	-	3,600
Rural Infrastructure					
Connection Road	31.3	km	4,000	18,000	5,600
Farm Road	40.8	km	6,000	26,000	-
Agricultural Support Service	1	L.S.	-	-	-

Long Term Development

Item	Quantity	Unit	Excavation (m^3)	Embankment (m^3)	Concrete (m^3)
Agricultural Infrastructure					
Main Irrigation Canal	59.1	km	15,000	55,000	18,500
Secondary Irrigation Canal	10.0	km	2,200	-	2,700
Rural Infrastructure					
Connection Road	33.5	km	5,000	22,000	1,000
Farm Road	33.7	km	5,000	22,000	-
Agricultural Support Service	1	L.S.	-	-	-

7.3 Construction Cost

Total construction cost for the short, middle and long term stages is estimated at about US$ 22.4 million as shown below. Details are presented in Table 7.3.1.

Unit : US$ 1,000

Description	L/C	F/C	Total
1 Construction Cost			
Preparatory Works	103.5	229.4	332.9
Agricultural Infrastructure Development	2,659.6	6,202.4	8,862.0
Rural Infrastructure Development	1,674.3	3,833.0	5,507.3
Agricultural Support Service Facilities	837.5	1,436.8	2,274.3
2 Land Acquisition	45.0	0.0	45.0
3 Engineering and Administration	731.5	1,620.3	2,351.8
4 Purchasing of O & M Machinery	448.2	832.4	1,280.6
5 Physical Contingencies	527.5	1,170.2	1,697.7
Grand Total	7,027.1	15,324.5	22,351.6

Construction cost of each development term is summarized below.

Short Term Development — Unit : US$ 1,000

Description	L/C	F/C	Total
1 Construction Cost			
Preparatory Works	39.1	88.2	127.3
Agricultural Infrastructure Development	883.1	2,059.3	2,942.4
Rural Infrastructure Development	962.9	2,153.8	3,116.7
Agricultural Support Service Facilities	106.5	198.3	304.8
2 Land Acquisition	15.0	0.0	15.0
3 Engineering and Administration	239.0	540.0	779.0
4 Purchasing of O & M Machinery	442.1	821.1	1,263.2
5 Physical Contingencies	199.2	450.0	649.2
Grand Total	2,886.9	6,310.7	9,197.6

Middle Term Development — Unit : US$ 1,000

Description	L/C	F/C	Total
1 Construction Cost			
Preparatory Works	38.9	83.8	122.7
Agricultural Infrastructure Development	1,006.8	2,347.2	3,354.0
Rural Infrastructure Development	468.0	1,091.2	1,559.2
Agricultural Support Service Facilities	469.6	753.0	1,222.6
2 Land Acquisition	15.0	0.0	15.0
3 Engineering and Administration	297.5	641.3	938.8
4 Purchasing of O & M Machinery	6.1	11.3	17.4
5 Physical Contingencies	198.3	427.5	625.8
Grand Total	2,500.2	5,355.3	7,855.5

Long Term Development			Unit : US$ 1,000
Description	L/C	F/C	Total
1 Construction Cost			
Preparatory Works	25.5	57.4	82.9
Agricultural Infrastructure Development	769.7	1,795.9	2,565.6
Rural Infrastructure Development	243.4	588.0	831.4
Agricultural Support Service Facilities	261.4	485.5	746.9
2 Land Acquisition	15.0	0.0	15.0
3 Engineering and Administration	195.0	439.0	634.0
4 Purchasing of O & M Machinery	0.0	0.0	0.0
5 Physical Contingencies	130.0	292.7	422.7
Grand Total	1,640.0	3,658.5	5,298.5

7.4 Other Cost

Other cost related to the project cost is the land acquisition cost, purchasing cost of O & M equipment and physical contingencies.

7.4.1 Land Acquisition Cost

Land acquisition cost for road is estimated at in each development term. Total cost is estimated at US$ 45,000 by local currency.

7.4.2 Engineering and Administration Cost

The engineering cost including topographic and geological surveys consists of costs for detailed design and construction supervision. The administration costs are the preparation of offices, procurement of office supplies and miscellaneous expenses required for the project implementation. Total cost is estimated at US$ 2,352,000 which consists of US$ 779,000 for short term stage, US$ 939,000 for middle term stage and at US$ 634,000 for long term stage.

7.4.3 Purchasing Cost of O & M Equipment

Purchasing cost of O & M equipment is estimated at US$ 1,280,600. Necessary number of O & M equipment is estimated based on the assumptions of O & M work quantities and workable days. Main O & M works are assumed to be grading and compacting works of roads, clearing of canals, etc., and the equipment such as bulldozer, backhoe and tracks are provided. Furthermore, vehicles and motorbikes are provided to carry out the operation and activities of CRC. Cost of spare parts is estimated at 10 % of purchasing cost.

7.4.4 Physical Contingency

The physical contingency allowance for all facilities is estimated at US$ 1,698,000 for short, middle and long term stages.

7.5 O & M Cost

O & M cost of consists of administration expenses and maintenance cost for irrigation, roads and community center facilities. The administration expenses estimated at Bs 186,000 (US$ 35,600) per annual for short term stage and at Bs 222,000 (US$ 42,500) per annual for middle and long term stages, on the basis of structural condition of the CRC and AC. Administration cost consists of salaries of O & M staff and operation costs such as fuel of vehicles. Maintenance cost of the facilities is estimated at Bs 66,850 (US$ 12,800) for short term stage, at Bs 916,700 (US$ 17,600) for middle term stage and at Bs 133,600 (US$ 25,600) for long term stage. Details are shown in

Table 7.5.1.

7.6 Replacement Cost

Replacement cost of agricultural and rural infrastructure is estimated at US$ 1,801,000 for short term stage, US$ 301,000 for middle term stage and US$ 271,000 for long term stage.

Table 7.3.1 (1) The Project Cost

Description	Local Currency	Foreign Currency	Total
1 Construction Cost			
(1) Preparatory Work	103.5	229.4	332.9
(2) Short Term			
a) Agricultural Infrastructure Development Works	883.1	2,059.3	2,942.4
b) Rural Infrastructure Development Works	962.9	2,153.8	3,116.7
c) Agriculture Support Services Development Works	106.5	198.3	304.8
sub-total	1,952.5	4,411.4	6,363.9
(3) Middle Term			
a) Agricultural Infrastructure Development Works	1,006.8	2,347.2	3,354.0
b) Rural Infrastructure Development Works	468.0	1,091.2	1,559.2
c) Agriculture Support Services Development Works	469.6	753.0	1,222.6
sub-total	1,944.4	4,191.4	6,135.8
(4) Long Term			
a) Agricultural Infrastructure Development Works	769.7	1,795.9	2,565.6
b) Rural Infrastructure Development Works	243.4	588.0	831.4
c) Agriculture Support Services Development Works	261.4	485.5	746.9
sub-total	1,274.5	2,869.4	4,143.9
2 Total { (1) to (4) }	5,274.9	11,701.6	16,976.5
3 Land Acquisition Cost	45.0	0.0	45.0
4 Engineering and Administration Cost {2.x12%}	731.5	1,620.3	2,351.8
5 Purchasing Cost (O&M Machinery)	448.2	832.4	1,280.6
6 Physical Contingencies{2.x10%}	527.5	1,170.2	1,697.7
Grand Totaal	7,027.1	15,324.5	22,351.6

Table 7.3.1 (2) The Project Cost (Short Term)

Unit:x1,000US$

Description	Unit	Quantity	I/C	F/C	Total	Remarks
1 Construction Cost						
(1) Preparatory Work	L.S.	1.0	39.1	88.2	127.3	
(2) Agricultural Infrastructure Development Works						
a) Intake Structure						
Intake Body	L.S.	1.0	4.2	9.8	14.0	
Training Levee	L.S.	1.0	2.9	6.8	9.7	
(Sub-Total)			7.1	16.6	23.7	
b) Main Irrigation Canal						
Canal	km	57.3	702.1	1,638.2	2,340.3	
Turnout	nos	123.0	15.9	37.1	53.0	
Crossing Structures	nos	36.0	12.5	29.1	41.6	
(Sub-Total)			730.5	1,704.4	2,434.9	
c) Secondary Irrigation Canal						
Canal	km	11.4	73.3	171.1	244.4	
(Sub-Total)			73.3	171.1	244.4	
d) Reservoir	nos	2.0	72.2	167.2	239.4	
(Sub-Total)			72.2	167.2	239.4	
Total (2) {a) to d)}			883.1	2,059.3	2,942.4	
(3) Rural Infrastructure Development Works						
a) Main Road Development						
Road	km	56.8	294.9	685.0	979.9	
Crossing Structures	nos	81.0	14.7	34.2	48.9	
Bridge	nos	4.0	502.2	1,082.0	1,584.2	
(Sub-Total)			811.8	1,801.2	2,613.0	
b) Connection Road Development						
Road	km	7.2	16.3	38.0	54.3	
Crossing Structures	nos	9.0	1.1	2.6	3.7	
Bridge	nos	3.0	133.7	312.0	445.7	
(Sub-Total)			151.1	352.6	503.7	
Total (3) {a) to b)}			962.9	2,153.8	3,116.7	
(4) Agriculture Support Services Development Works						
a) Main Garage						
Garage	nos	3.0	30.0	55.8	85.8	
Related Facilities	L.S.	3.0	42.3	78.9	121.2	
(Sub-Total)			72.3	134.7	207.0	
b) Sub Garage						
Garage	nos	3.0	15.0	27.9	42.9	
Related Facilities	L.S.	3.0	19.2	35.7	54.9	
(Sub-Total)			34.2	63.6	97.8	
Total (4) {a) to b)}			106.5	198.3	304.8	
(5) Total Construction Cost {(1) to (4)}			1,991.6	4,499.6	6,491.2	
2 Land Acquisition Cost	L.S.	1.0	15.0	0.0	15.0	A=30ha
3 Engineering and Administration Cost {(5)x12%}	L.S.	1.0	239.0	540.0	779.0	
4 Purchasing Cost (O&M Machinery)	L.S.	1.0	442.1	821.1	1,263.2	
5 Physical Contingencies{(5)x10%}	L.S.	1.0	199.2	450.0	649.2	
Grand Total			2,886.9	6,310.7	9,197.6	

Table 7.3.1 (3) The Project Cost (Middle Term)

Unit:x1,000US$

Description	Unit	Quantity	I/C	F/C	Total	Remarks
1 Construction Cost						
(1) Preparatory Work	L.S.	1.0	38.9	83.8	122.7	
(2) Agricultural Infrastructure Development Works						
a) Intake Structure						
Intake Body	L.S.	1.0	25.4	59.3	84.7	
Training Levee	L.S.	1.0	16.2	37.7	53.9	
(Sub-Total)			41.6	97.0	138.6	
b) Main Irrigation Canal						
Canal	km	60.3	730.1	1,703.6	2,433.7	
Turnout	nos	134.0	14.9	34.7	49.6	
Crossing Structures	nos	48.0	16.9	39.4	56.3	
(Sub-Total)			761.9	1,777.7	2,539.6	
c) Secondary Irrigation Canal						
Canal	km	13.3	95.0	221.7	316.7	
(Sub-Total)			95.0	221.7	316.7	
d) Reservoir	nos	1.0	108.3	250.8	359.1	
(Sub-Total)			108.3	250.8	359.1	
Total (2) {a) to c)}			1,006.8	2,347.2	3,354.0	
(3) Rural Infrastructure Development Works						
a) Connection Road Development						
Road	km	31.3	63.1	146.8	209.9	
Crossing Structures	nos	39.0	4.4	10.2	14.6	
Bridge	nos	6.0	300.8	702.0	1,002.8	
(Sub-Total)			368.3	859.0	1,227.3	
b) Farm Road Development						
Road	km	40.8	92.4	215.1	307.5	
Crossing Structures	nos	50.0	7.3	17.1	24.4	
Bridge	nos	0.0	0.0	0.0	0.0	
(Sub-Total)			99.7	232.2	331.9	
Total (3) {a) to b)}			468.0	1,091.2	1,559.2	
(4) Agriculture Support Services Development Works						
a) Community Revitalization Center(CRC)						
Building	nos	3.0	104.1	193.2	297.3	
Related Facilities	L.S.	3.0	96.0	59.4	155.4	
(Sub-Total)			200.1	252.6	452.7	
b) Area Center (AC)						
Building	nos	6.0	110.4	204.6	315.0	
Related Facilities	L.S.	6.0	82.2	153.0	235.2	
(Sub-Total)			192.6	357.6	550.2	
c) Meeting Hall (MH)						
Building	nos	5.0	52.5	97.5	150.0	
Related Facilities	L.S.	3.0	24.4	45.3	69.7	
(Sub-Total)			76.9	142.8	219.7	
Total (4) {a) to c)}			469.6	753.0	1,222.6	
(5) Total Construction Cost			1,983.3	4,275.2	6,258.5	
2 Land Acquisition Cost	L.S.	1.0	15.0	0.0	15.0	A=30ha
3 Engineering and Administration Cost {(5)x15%}	L.S.	1.0	297.5	641.3	938.8	
4 Purchasing Cost (O&M Machinery)	L.S.	0.0	6.1	11.3	17.4	
5 Physical Contingencies{(5)x10%}	L.S.	1.0	198.3	427.5	625.8	
Grand Total			2,500.2	5,355.3	7,855.5	

Table 7.3.1 (4) The Project Cost (Long Term)

Unit:x1,000US$

Description	Unit	Quantity	I/C	F/C	Total	Remarks
1 Construction Cost						
(1) Preparatory Work	L.S.	1.0	25.5	57.4	82.9	
(2) Agricultural Infrastructure Development Works						
a) Intake Structure						
Intake Body	L.S.	1.0	22.5	52.4	74.9	
Training Levee	L.S.	1.0	14.3	33.4	47.7	
(Sub-Total)			36.8	85.8	122.6	
b) Main Irrigation Canal						
Canal	km	59.1	640.0	1,493.3	2,133.3	
Turnout	nos	101.0	11.3	26.3	37.6	
Crossing Structures	nos	29.0	10.2	23.8	34.0	
(Sub-Total)			661.5	1,543.4	2,204.9	
c) Secondary Irrigation Canal						
Canal	km	10.0	71.4	166.7	238.1	
(Sub-Total)			71.4	166.7	238.1	
Total (2) {a) to c)}			769.7	1,795.9	2,565.6	
(3) Rural Infrastructure Development Works						
a) Connection Road Development						
Road	km	33.5	75.9	176.6	252.5	
Crossing Structures	nos	31.0	3.3	7.7	11.0	
Bridge	nos	2.0	80.9	209.6	290.5	
(Sub-Total)			160.1	393.9	554.0	
b) Farm Road Development						
Road	km	33.7	76.3	177.7	254.0	
Crossing Structures	nos	60.0	7.0	16.4	23.4	
Bridge	nos	0.0	0.0	0.0	0.0	
(Sub-Total)			83.3	194.1	277.4	
Total (3) {a) to b)}			243.4	588.0	831.4	
(4) Agriculture Support Services Development Works						
a) Area Center (AC)						
Building	nos	0.0	0.0	0.0	0.0	
Related Facilities	L.S.	0.0	0.0	0.0	0.0	
(Sub-Total)			0.0	0.0	0.0	
b) Meeting Hall (MH)						
Building	nos	10.0	178.5	331.5	510.0	
Related Facilities	L.S.	1.0	82.9	154.0	236.9	
(Sub-Total)			261.4	485.5	746.9	
Total (4) {a) to b)}			261.4	485.5	746.9	
(5) Total Construction Cost			1,300.0	2,926.8	4,226.8	
2 Land Acquisition Cost	L.S.	1.0	15.0	0.0	15.0	A=30ha
3 Engineering and Administration Cost {(5)x15%}	L.S.	1.0	195.0	439.0	634.0	
4 Purchasing Cost (O&M Machinery)	L.S.	0.0	0.0	0.0	0.0	
5 Physical Contingencies{(5)x10%}	L.S.	1.0	130.0	292.7	422.7	
Grand Total			1,640.0	3,658.5	5,298.5	

Table 7.5.1 Annual O & M Cost

Description		Quantity			Unit	Unit Price (Bs)	Cost (Bs)		
		Short Term	Middle Term	Long Term			Short Term	Middle Term	Long Term
Administration Expenses									
Salaries									
Staff	CRC	72	72	72	M/M	600	43,200	43,200	43,200
	AC	36	72	72	M/M	600	21,600	43,200	43,200
Temporary Staff	CRC	124	124	124	M/M	600	74,400	74,400	74,400
	AC	12	24	24	M/M	600	7,200	14,400	14,400
Sub-Total							146,400	175,200	175,200
Operation Cost									
Motor Bike	CRC	5,400	5,400	5,400	Lit.	2	10,800	10,800	10,800
	AC	3,600	7,200	7,200	Lit.	2	7,200	14,400	14,400
Pickup Truck	CRC	10,800	10,800	10,800	Lit.	2	21,600	21,600	21,600
Sub-Total							39,600	46,800	46,800
Maintenance Cost									
CRC		(3)	3	3	Nos	L.S.	7,600	7,600	7,600
AC		(3)	6	6	Nos	L.S.	3,350	6,700	6,700
MH		-	5	10	Nos	L.S.	-	1,470	2,940
Irrigation Facilities		68.7			km	L.S.	23,900	26,900	31,000
Road Facilities		64.0	96.5	168.4	km	L.S.	32,000	49,000	85,400
Sub Total							66,850	91,670	133,640
Total							252,850	313,670	355,640

CHAPTER 8

IMPLEMENTATION PROGRAM

CHAPTER 8 IMPLEMENTATION PROGRAM

8.1 Organization of the Project Implementation

In Bolivia, Ministerio de Hacienda coordinates the financing from a foreign country of a project and the participation of authorities concerned to carry out the project at national level. The executing agency of the project will be the Department of La Paz under the supervision of Ministro de Agricultula, Ganadería y Desarrollo Rural. Dirección Desarrollo Económico, which is one of the departments in governmental organization of Department of La Paz, will give the administrative and technical support.

After termination of construction works, all the facilities will be handed over to the "Coordination Organ" which will be established in Achacachi city and organized by the Department of La Paz. The "Coordination Organ" will be supported by the concerned municipal governments and organizations related to the project. Organization of the project implementation is shown in Fig. 8.1.1.

8.2 Project Implementation

8.2.1 Implementation Schedule

The project will be implemented with three stages, short, middle and long term stages. Each stage is assumed by 5 years and consists of detailed design, preparation of tender documents and tender procedure for one year, and construction period of one and half years as shown in Fig 8.2.1.

(1) Detailed Design

The detailed topographic and geological survey will be carried out prior to commencement of the detailed design on the proposed agricultural and rural infrastructure development. Detailed design will be executed taking into account the survey results. Tender documents of the project will also be prepared during the detailed design stage together with the construction cost estimation of the project.

(2) Contract

The contractor will be employed through international competitive bidding. The machinery and equipment required for the construction works are to be prepared by the contractor. The construction materials are to be procured from domestic and/or international market under the responsibility of the contractor.

(3) Construction works

Construction works will start in the second year after commencement of the each stage. Construction period will be one year and half for each component of the project in the short term stage. In case of middle and long term stages, construction period of agricultural support facilities will take place for 8 months though other components take place for a one and half year.

8.2.2 Construction Planning

(1) General

Major works executed by the project are ; canal lining of existing irrigation canal, construction of diversion facilities of canals and small reservoirs along the canal, existing road improvement including gravel pavement, construction of new bridges, construction of Community Re-vitalization Center and Area Center.

(2) Basic Consideration

The construction of the major works will be completed within about one and half year including the preparation period. Construction of bridges will mainly be carried out during the dray season. Other works will be carried out all the year round.

The construction works are planned to be carried out in one shift with net working hour of 8.0 hr. per day and 25 days per month in the dry season (May to October) and 20 days per month in the rainy season (November to April).

Preceding the construction works, temporary roads will be provided as the preparation works for transporting necessary machinery, heavy equipment and materials. Those temporary road must be gathered with the projected roads in the improvement works as much as possible.

Sand and gravel, which are material for concrete and road pavement, are gathered from Rio Keka and stored in stockyard provided near the construction site. Basically, concrete made by the portable mixer at the site is used for the canal lining work. Concrete made by the simplified concrete plant will be used for the bridge construction.

(3) Canal Lining

The canal lining works will be carried out each irrigation system basis. Work volume is 5 irrigation systems with total canal length of 68.7 km in the short term stage, 27 irrigation systems with total canal length of 73.6 km in the middle term stage and 23 irrigation systems with total canal length of 69.1km in the long term stage. Concrete containing 60% of stone is used for lining. When roads along the canal are not available, O & M road must be constructed prior to carry out the lining work. Major quantities are as follows;

Stage	Lining Length	Excavation (m^3)	Embankment (m^3)	Concrete (m^3)
Short Term	68.7 km	21,000	33,000	27,000
Middle Term	73.6 km	20,000	59,000	25,000
Long Term	69.1 km	17,000	55,000	21,000

(4) Small Reservoir

Reservoirs will be constructed at the site where the irrigation canal crosses the wet land and/or small valley. Canal bank is used as the dam body of the small reservoir. The central part of the embankment on the canal bank will be filled up and compacted with cohesive soil. Embankment and compaction will be carried out by bulldozer, for a thickness of 30 cm per one lift and compaction of 4 times each. Major quantities of the dam body are as follows;

Irrigation System No.	Location	Dam Body Height (m)	Dam Body Length (m)	Embankment Volume (m3)
9	Putuni	2.5	700	7,000
12	Pajchani Molino	2.5	300	3,000
16	Icrana	4.0	350	6,500

(5) Road Improvement

Road improvement works will broadly be divided into three construction sections. Those divisions will be from Kerani to Chachacomani, right and left banks of Rio Keka for the short term stage. Three basin divisions, such as lower, middle and upper basin, will be made for the middle and long term stages. The works include leveling of road surface, gravel pavement, construction of crossing structures. Work

quantities of major work are as follows.

Stage	Lining Length	Excavation (m^3)	Embankment (m^3)
Short Term	64.0 km	18,000	50,000
Middle Term	72.1 km	10,000	44,000
Long Term	67.2 km	10,000	43,000

(6) Bridge

15 bridges were planned in the project area to cross the Rio Keka and its tributaries in connection with the road improvement works. Out of which, 3 are constructed in the short term stage, 6 in the middle term stage and 11 in the long term stage. One post-tension pre-stress concrete bridge will be constructed at Cormata Alta during the short term stage and others are the submerged bridge (Bateon) made by the concrete containing 60% of stone. All bridge works will be planned during the dry season. Required concrete volume is around 7,000 m^3 in the short term stage, 6,000 m^3 in the middle term stage and 1,000 m^3 in the long term stage.

(7) CRC and AC

The construction works of CRC include building and its related facilities such as water supply, electrification, model farm and green house. As the source of water supply, deep well equipped with electric pump will be dug by the contractor near the CRC and AC. Solar battery is the power source on the electrical facilities of the CRC and AC. Numbers and scale of the CRC are as follows.

Stage	Structure	Nos	Scale
Middle Term	CRC	3	440m^2
	AC	6	116m^2

8.3 Operation and Maintenance

8.3.1 O & M Bodies

Because existing irrigation systems are being well operated and maintained by the water user's group consisting communities and/or farmers related to the system, basic unit of operation and maintenance for the irrigation systems rehabilitated has already been set up in the project area. On the other hand, maintenance of existing roads is being carried out periodically as the communal work with participation of the community members. Those communal work system can also be considered as the basic unit of maintenance for the roads improved. With these present situation, O & M body of the project set up at the each community. No organization specified for the O & M works of the implemented facilities is proposed in the project.

To execute the O & M works efficiently and substantially, machinery useful for the O & M works will be provided at the CRC established by the project in the upper, middle and lower basins. Management of the CRC will be executed by the Committee consisting the representatives of community related to the CRC. Utilization of O & M machinery for the maintenance works will be made with the mutual consent of the Committee.

Therefore, O & M of implemented facilities will be executed by each community as a basic unit under the decision of the Committee of CRC. In accordance with the policy of the government of Bolivia, implemented project facilities has to transfer from the executing agency to the beneficial farmers as soon as possible. Committee of the CRC. will succeed the implemented facilities from the executing agency after the management of CRC is started along the right lines.

8.3.2 O & M Works

Following works can be required as the major periodical O & M works of the implemented facilities.

Irrigation System
- Construction of training levee at intake structure
- Canal clearing
- Repair of lining and gate

Roads
- Leveling and clearing of road surface
- Clearing of side ditch
- Repair of crossing structure
- Inspection of bridge and minor repair

CRC, AC and MH
- Inspection and minor repair of roof, wall, floor of the building
- Inspection of water supply system
- Inspection of solar power system

Those works will be made by mutual consent among the communities composing the CRC.

Monitoring related to the water management (amount of diversion water, gate operation, water leakage from the canal, etc.) of the irrigation canal will be carried out using the measuring device equipped at the each division structure. Those monitoring results will be utilized equitable water distribution among the beneficiaries, maintenance of the facilities of canal system, etc.

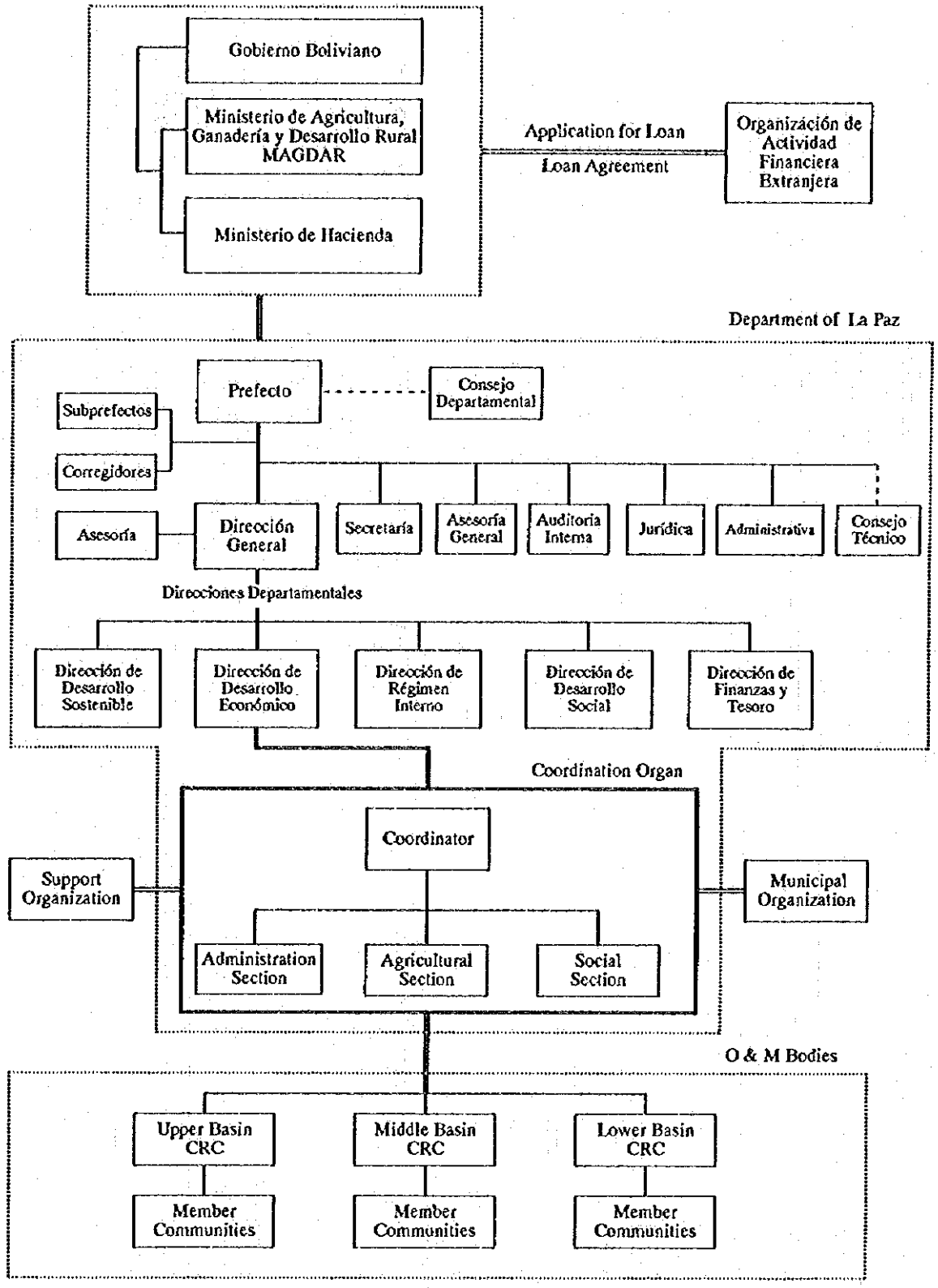

Fig. 8.1.1 Organization of the Project Execution

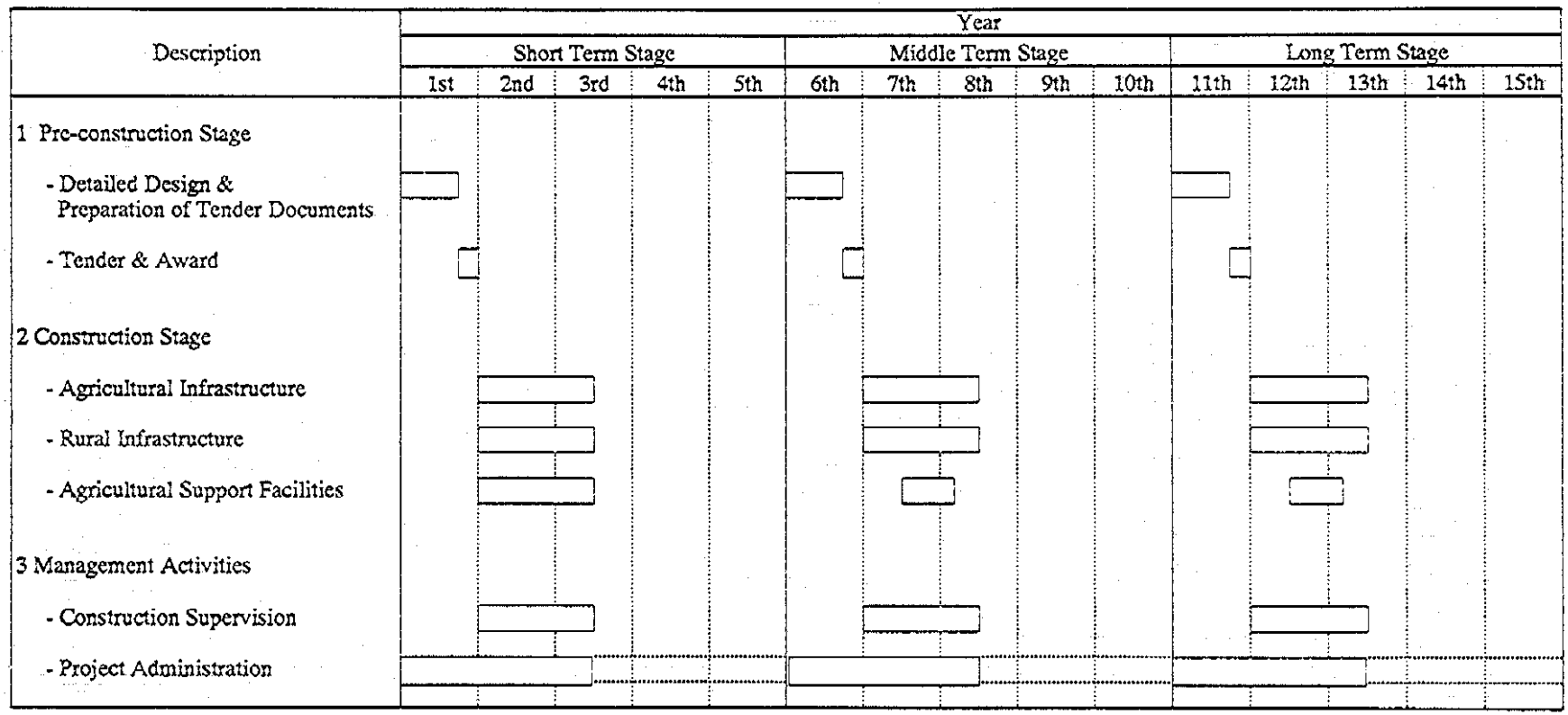

Fig. 8.2.1 Implementation Schedule

CHAPTER 9

PROJECT IMPACT AND EVALUATION

CHAPTER 9 PROJECT IMPACT AND EVALUATION

9.1 Project Impact

Among the overall project impacts which are supposed to be derived by implementation of the project proposed in this feasibility study, quantitatively calculable financial benefits are enumerated in 9.2.

Overall project impact on the farm household economy should come from the effect of improvement on the production basis of agriculture by increasing in intensification and efficiency of land use. It would spill away to every aspect of the family life not only in terms of cash inflow but also quality of life. More money inflow with the same amount of time allocation to the activity in the field may be expected. The quantity and quality of auto-consumption may be improved. Time saved by reduction of maintenance work of irrigation canal may be utilized to the communal work for running the centers in various activities. The betterment of roads and provision of new bridges should lower the amount of time required for tours for sale and exchange, and should increase the frequency of outing within the study area and beyond, which should increase and intensify the social communication networks, whereas maintenance and repair works of roads and bridges should surely increase.

9.2 Project Appraisal

This project appraisal only deals with the short term development plan of the three term project proposal for the development of the Rio Keka basin. It deals with financial, economic, and community aspects of the project. Comparison of the "with " situation and "without" situation of the discounted flows of benefit and cost will be made.

9.2.1 Basic Assumption

Tangible benefits derived from the implementation of the project are primarily expressed in the form of incremental volume of agro-produce, the annual unit volume of which drastically fluctuates, and the seasonal and annual price of which fluctuates drastically too, whereas the data sources are poor and mostly limited in terms of both time and space, i.e., about one year time span, and the study area and its surroundings. In order to place the project in a wider setting so that it would be comparable with other similar projects within the same context of "Altiplano," it would like to use more generic sources of information on the prices of agro-produce when it take a global view of the project.

The Farmers Development Fund (FDC) is one of the most appropriate institutions that could provide us with such information stored in the data base that have been accumulated for many years. The study team have contacted it and got data on prices, and got acquainted with its guidelines on project appraisal so that all the assumption to be made will follow the guidelines advised by the FDC.

The methodology introduced by the FDC described in the guidelines on appraisal of project is supported by analysis of long standing on the projects carried out in Bolivia. The idea behind it is that all the benefits of proper investment in the agriculture sector will be eventually reflected to quantitative increase of produce resulted from the increase of productivity or/and of enlargement of cultivated land to certain extent.

The project consists of three major components;

1) Rehabilitation and improvement of irrigation canals,
2) Rehabilitation and improvement of existing road network with provision of new bridges for vehicles, and

3) Provision of necessary equipment for each CRC and AC.

Benefits will be attributed to the corresponding investment separately, then to estimate the three NPVs and IRRs each. Further detailed explanation is given in Annex N. The FDC's assumption is given in Table 9.2.1.

It is assumed that the financial benefits are equivalent to the economic benefits. Those rates used to change financial prices to economic prices are as follows:

1) Standard Conversion Factor = 0.9615*
2) Shadow Wage for Unskilled Labour = 1.00*
3) Transfer Item:

		L/C	F/C	
Tax rate	=	7.7%:	7.0%	Roads & Bridges**
	=	5.3%:	5.4%	Irrigation**
	=	7.6%:	7.6%	CRC & AC**

* Source: World Bank, * *Source: Cost Estimator

9.2.2 Financial Benefit and Cost

(1) Benefits

Quantitatively calculable financial benefits which are supposed to be derived by implementation of the projects proposed in this feasibility study may be identified as follows:

1) An increase of irrigation area as well as total cultivated area by improving irrigation canals.
2) An increase of cultivated area and reduction of transport cost by improving the roads along the Rio Keka and building of new bridges for vehicles to connect the both banks of the river.
3) Reduction of waste if community centers are used as after-harvest processing places.
4) Intensification of agriculture may be expected if the project is accompanied by an additional program of technical assistance on production method with fund for initial investment on agricultural inputs.
5) Intensification of livestock raising may be expected if the project is accompanied by an additional program of technical assistance on breeding method with fund for initial investment.
6) Reduction of degree of wind erosion on surface soil and reduction of fuel cost may be expected if forestration program is accompanied by an additional funding for initial investment.

The FDC's assumption is given in Table 9.2.2.

(2) Investment Costs

Estimates of financial and economic capital costs for improvement of various infrastructures in three sub-projects are given in the corresponding tables of 9.2.3, 9.2.4, and 9.2.5.

9.2.3 Financial Analysis

This analysis is conducted from the standpoint of an average family household economy. Contribution to the investment by beneficiaries, one percent of the total value of investment is assumed to be paid in the form of renunciation of the income opportunity outside the own land-based economic activities. Residual book value of the investment on

the infrastructure at the end of the project life is reimbursed in the book to the individual household economy of the beneficiaries at the rate of one percent. The number of beneficiaries for three sub-projects is estimated in Table 9.2.6.

(1) Sub-Project 1: Roads and Bridges

Table 9.2.7 gives the process of estimation of Financial Net Present Value at 12 percent, opportunity cost of capital (NPVf) and Financial Internal Rate of Return (IRRf). It is assumed that a direct benefit will be derived from a decrease of transport costs and indirect benefit will be derived from a slow and gradual increase of cultivated land up to equivalent of the area of 'barbecho' (=0.62 ha/ family) in the tenth year of the project by an influence of better transport.

A windfall benefit is assumed as an external benefit in the transport sector, which is a direct benefit derived from a decrease of transport costs.

The NPVf of Sub-Project 1 is estimated at US$ 2,098 and its IRRf is estimated at 981 percent.

(2) Sub-Project 2: Irrigation Canals

Table 9.2.8 gives the process of estimation of Financial Net Present Value at 12 percent, opportunity cost of capital (NPVf) and Financial Internal Rate of Return (IRRf). It is assumed that a direct benefit would be derived from a increase of new irrigation water, and its effects are twofold.

The first is in terms of area, in which gradual and simultaneous increase of irrigation area and total cultivated area would take place in five years. At the sixth year total cultivated land would reach maximum at 3.87 hectare which would include the area equivalent to 'barbecho' (=0.62 ha/ family), and newly irrigated area would cover 36 percent of the total cultivated area. It is assumed that potatoes and broad beans would be grown in the newly irrigated land, and potatoes would cover 75 percent of the field. The second is in terms of productivity of the two produce; the increases are assumed to be 17 percent and 173 percent respectively.

The NPVf of Sub-Project 2 is estimated at US$ 1,965 and its IRRf is estimated at 77 percent.

(3) Sub-Project 3: CRCs and ACs

Table 9.2.9 gives the process of estimation of Financial Net Present Value at 12 percent, opportunity cost of capital (NPVf) and Financial Internal Rate of Return (IRRf). It is assumed that a direct benefit would be derived from a decrease of post-harvest waste. It would take place in five years. At the sixth year an amount of waste of each produce would reach an assumed minimum level.

The NPVf of Sub-Project 3 is estimated at US$ 211 and its IRRf is estimated at 1,176 percent.

(4) Total Project

To get NPVf and IRRf of the total beneficiaries, the individual cash flows of benefit and cost of the each sub-project are multiplied by corresponding number of beneficiaries, then the flows of the three sub-projects are added up to get the NPVc and IRRc. NPVc of the total project is equivalent to the sum of NPVc of the three sub-projects.

The NPVc of total project is estimated at US$ 8.8 mil. and its IRRc is estimated at 352 percent. The process of estimating the NPVc and IRRc of the total project is given in Table 9.2.10.

9.2.4 Economic and Community Analysis

It is assumed that the economic value of the incremental benefits in an average individual household would be equal to the financial value. The cash flow of net benefit of the each sub-project is multiplied by the corresponding number of beneficiaries to get the NPVc and IRRc of each sub-project. Therefore, NPVc is equivalent to the NPVf multiplied by the corresponding number of beneficiaries and the IRRc is equivalent to IRRf.

To get NPVc and IRRc of the each sub-project, its cash flow of the net benefit is subtracted by that of economic prices of investment costs and maintenance costs of the corresponding sub-project. Economic prices of the maintenance costs are set at 95 percent of the financial price.

Coefficient of Impact for Distribution (CID) is equivalent to the value given by NPVc / NPVc. Therefore, when a value of NPVc is negative, i.e., IRRc of the cash flow is less than 12 percent, the value of CID will become negative and meaningless.

(1) Sub-Project 1: Roads and Bridges

Table 9.2.3 gives the process of estimation of Economic and Community Net Present Values at 12 percent, opportunity cost of capital (NPVc and NPVc), Economic Internal Rate of Return (IRRc), and CID.

The investment costs for maintenance machinery are included in this sub-project, though they are assumed to be kept in the CRCs and to be used for future community-projects. The investment is scheduled at the second year of the project.

The NPVc of Sub-Project 1 is estimated at US$ 2.27 mil., its IRRc is estimated at 20 percent, and its CID is estimated at 297 percent.

(2) Sub-Project 2: Irrigation Canals

Table 9.2.4 gives the process of estimation of Economic and Community Net Present Value at 12 percent, opportunity cost of capital (NPVc and NPVc), Economic Internal Rate of Return (IRRc), and CID.

The NPVc of Sub-Project 2 is estimated at US$ -2.4 mil., its IRRc is estimated at -1.6 percent.

(3) Sub-Project 3: CRCs and ACs

Table 9.2.5 gives the process of estimation of Economic and Community Net Present Value at 12 percent, opportunity cost of capital (NPVc and NPVc), Economic Internal Rate of Return (IRRc), and CID.

The NPVc of Sub-Project 3 is estimated at US$ 0.67 mil. and its IRRc is estimated at 37.5 percent. CID is also estimated at 154%.

(4) Total Project

The NPVc of total project is estimated at US$ -0.04 mil. and its IRRc is estimated at 11.9 percent.

The process of estimating the NPVe and IRRe of the total project is given in Table 9.2.10.

9.2.5 Sensitivity Analysis

Sensitivity analysis is carried out on the total project by economic prices. The IRRs of three cases in the context of cost and benefit variations are chosen, estimated and compared; the first is of the case one, in which the benefit would be ten percent less than the value estimated in the economic analysis, the second is of the case two, in which the cost would be ten percent more than the value estimated (physical contingency of ten percent is included in the cost estimate.), and the third is of the case three, in which the case one and the case two are combined. The process is given in table 9.2.11, and the result is found in a matrix shown below.

	base	-10%	< benefit>
base	11.9%	10.0%	
+10%	10.1%	8.3%	
<cost>			

As a rough rule of thumb, each ten percent fluctuation in both benefit and cost is translated into two percent change in the value of IRRe.

9.3 Other Development Impact

By the project implementation, following socio-economical impacts are expected in addition to the benefit estimated by financial and economical evaluation. The effect of the Project implementation will be borne by following condition;

- Improvement of irrigation facility and intensive land use
- Expansion of irrigable area
- Promotion of crop diversification and increase of its marketability
- Activation of agriculture by improvement of irrigation facility and intensive land use, and improvement of farming technique
- Promotion of socio-economical interchange by improvement of roads
- Activation of the area by the Community Re-vitalization Center as a core organ
- Creation of employment opportunity
- Formulation of sustainable agriculture system considering environment

Expected socio-economical impacts and effects by the project implementation are as follows;

(1) Suitable Supply and Diversification of Agricultural Products

The project implementation is expected to contribute to be self-support economically in the area by stable supply of agricultural products as vegetable and animal products as well as increase stable supply of major crops for self-supply. And also organizations for marketing and for quality improvement of the products are expected through supplying their products to markets and establishing a planned crop production system.

(2) Increase of Employment Opportunity

Employment opportunity will be created for skilled worker and unskilled workers who will be recruited from farmers in and around the Project area during the construction. Employed farmers who will learn a technique through the construction works will contribute on management and maintenance of the constructed irrigation

system and roads. Activated agricultural production in the area will create job as well. Increment of farm works according to intensive use of irrigation system and land is expected to increase the demand of labor for no-farming inhabitants in the area. Setting up the Community Re-vitalization Center is thought that will create job and promote an employment for management and maintenance, and operation of equipment of the center. These created job opportunity will prevent a population movement to cities as La Paz. It will slow down the concentration of the population in the large cities and contribute to well balanced development of the country.

(3) Increase of an Intention for Working

The Project implementation will give a feeling of satisfaction on raised living standard as the result of production increase by in comparison with the present low productivity. This will raise a farmer's intention to increase the productivity and accelerate development of the area.

(4) Activate a Socio-economical Activity

Traffic condition in the area will be largely improved by construction of roads and bridges. Established road network will increase interchange of human and material not only within the area but also with outside of the area and it will activate a socio-economic activity. The Community Re-vitalization Center will function as a core of development and activation of the area by an integrative interchange in the entire project area.

(5) Development of Regional Economy

Farmer's income level will raise with increase of agricultural products. It increases a purchase power and contribute to regional economy and to stable national economy of Bolivia.

(6) Improvement of Human Resource

Establishment of the Community Re-vitalization Center is expected to be a base of manpower development by conducting social education and technical training such as agriculture technique, living technique, operation and maintenance of various machinery, environment, etc. And it will contribute to the future development in rural area as well as the nation. Women's participation to an activity of the center will improve their social status.

(7) Effect to Environment

Establishment of farming system and other useful technique utilizing resource of the area and considering the effect to ecology will contribute to the natural conservation and reduce an influence to environment. Environmental education at the center will clarify the relation of agriculture and environment to the people, and promote practical environment conservation.

9.4 Justification

The objective of the project implementation is to realize comfortable rural society by ridding from the present poverty or its reducing and the precondition of the project for development is to harmonize with the nature.

Based on those objectives and the preconditions in the development project, agricultural production is increased and the infrastructure of the production is improved. The result of increase of farmer's income will affect not only to household economy but

also to improvement of quality of the life and the present poverty will be reduced at least. The improvement of the basic condition of the life in the community as the place for living will also fulfill their settlement condition.

At the same time, socio-economical exchange starting from human communication through the activity of farmer's production in the area will be activated in entire area. The method of development as well as on agricultural technique are considered for reducing influence on the environment and the ecology and minimizing influence on the natural environment.

In view of economic aspects, implementation of the proposed development plan (short term stage) can be evaluated at 11.9 % with the index of economic internal rate of return (EIRR). As for the financial point of view, effects to the farmers' economy can be estimated at 45% to 63% of incremental surplus compared with the present situation.

With these stand points, the implementation of the Project is justified.

Table 9.2.1 Standard Farming Type (Traditional Agriculture)

Cultivation	Area ha		Area	ha
Barley (green)	0.94	28.9%	Fallow land	0.62
Potato	0.92	28.3%	Rest land	1.27
Quinua	0.59	18.2%	B: Cultivation area	5.14
Barley (grain)	0.54	16.6%	Intensity of cultivation	
Bean (green)	0.26	8.0%	A/B=	63.2%
A: Cultivation area	3.25	100.0%		

Cultivation 1994S	Rend. tm/has	Produc tm	Price US$/t	Price cost US$/ha
Barley (green)	2.40	2.26	70	55.49
Potato	4.70	4.32	150	423.52
Quinua	0.50	0.30	350	73.00
Barley (grain)	0.90	0.49	100	70.49
Bean (green)	1.10	0.29	190	186.50

Caractaristic: Rainfed, traction animal, without technical asistance

Working of outside farm 60 Members of Laborer

3 Laborers price:US$

Cultivation 1996S	Rend. tm/has	Produc tm	Price US$/t	Price Bs./tm	Price* Bs/t	Production cost US$/ha
Barley (green)	2.40	2.26	77	403		61.04
Potato	4.70	4.32	165	865	867	465.87
Quinua	0.50	0.30	385	2017	1,714	80.30
Barley (grain)	0.90	0.49	110	576	481	77.54
Bean (green)	1.10	0.29	209	1095	650	205.15

Caractaristic: Rainfed, traction animal, without technical asistance

Working of outside farm 60 Members of Laborer 1.1 ='96/94

3 Laborers price:US$

* Average in Market of La Paz,1995/2 =Price Ex-farm

(for comparison)

Table 9.2.2 Origin of Benefit (FDC)

Type	External Change	Internal Change	Change & External Benefit
Farm Road	Reduction of transportation cost Reduction of economical loss Improvement of economical margin	Expansion of cultivation area	B: Transportation Sector (windfall) C: Maintenance and repairing
Bridge	Reduction of transportation cost Reduction of economical loss Improvement of economical margin		B: Transportation Sector (windfall) C: Maintenance and repairing
Irrigation		Expansion of cultivation area Increment of Ave. yield by irrigation Increment of Ave. yield by technical asistance Change of the productive structure	C: Maintenance and repairing
Market	Reduction of transportation cost Reduction of economical loss		B: Consumption Loss of transportation Sector (Intermediary)
Small Basin		Expansion of Ave. cultivation area by recovering soil erosion Increment of Ave. yield by protection of soil Increment of Ave. yield by technical asistance Production of secondary crop (leña)	B: ecosystem and life in general

Table 9.2.3 Economic and Social Analysis (Rural Infrastructure Improvement) : Roads with Bridges

Unit= 1000US$

	Beneficiary	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
B:net.increm	3417	-97	473	979	1,012	1,045	1,079	1,112	1,145	1,178	1,257	1,257	1,257	1,257	1,257	1,257	6,746	NPVc
B:external*	* Extraordinary earnings of the sector transport, equivalent to the costs of transport truck paid by the beneficiaries in the tract of the improvement road or construct																	
B: Total		-97	473	979	1,012	1,045	1,079	1,112	1,145	1,178	1,257	1,257	1,257	1,257	1,257	1,257		
Investment	contribute 1: 79%	1,905	1,879															
	contribute 2: 20%	482	476															
	contribute 3: 1%	48																
Maintenance**			34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2		
Residual																-1185	297%	CID
TTL ECONOMIC COST*3		2,387	2,389	34	34	34	34	34	34	34	34	34	34	34	34	-1,151	20%	IRRc
B-C: NET INCREMENT		-2,483	-1,916	944	978	1,011	1,044	1,078	1,111	1,144	1,223	1,223	1,223	1,223	1,223	2,408	2,273	NPVc

*Calculated in the financed benefit

** Financial Cost*0.95 (-tax) *3 -contribute 3

Inv/family:$	Resid/fam:$*	Financial			Economical			CP-1	25.2
15.1	3.8	L/C	F/C	TTL	L/C	F/C	TTL	CP-2	31.6
Preliminary works (PW) TTL		39.1	88.2	127.3				CC-5	3.1
PW: Road&Bridge,	49.0%	19.1	43.2	62.3				CC-6	6.9
Road&Bridge		962.9	2153.8	3116.7				CC-7	4.1
S: SUB-TOTAL		982.0	2197.0	3179.0				TTL: km	70.9
Land Price*		15.0	0.0	15.0	*exclusive of economical analysis				
Machinery**		442.1	821.1	1263.2	**they stay in CRCs				
Engin. & Admin.: S*12%		117.8	263.6	381.5	Tax*1	Tax*1			
Physical Conting.: S*10%		98.2	219.7	317.9	92.4%	93.1%			
GRAND TOTAL		1655.2	3501.4	5156.6	1529.2	3260.3	4789.5		
*1: Transfer Rate: TR		Unit price/km		72.7	*3	SCF*2			
*2: Standard Conversion Factor						96.2%			

*3: TR<SCF, then adopted costs without imposing

Table 9.2.4 Economic and Social Analysis (Rural Infrastructure Improvement) : Irrigation Canals

Unit= 1000US$

	Beneficiary*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Bnet.increment	517	-84	1	52	101	151	247	247	247	247	247	247	247	247	247	252	1,015	NPVc
Economic Costs	Contribute 1: 79%	1,825	913															
	Contribute 2: 20%	462	231															
	Contribute 3: 1%	35																
	Maintenance**		25.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0		
	Residual															-858	-	CID
	TOTAL*3	2,288	1,169	50	50	50	50	50	50	50	50	50	50	50	50	-808	-1.6%	IRRe
B-C: NET INCREMENT		-2,371	-1,168	2	51	101	197	197	197	197	197	197	197	197	197	1,060	-2,428	NPVe

*126 families have 100 percent of the benefits, but the remainder of 906 families have only 50 percent of the benefits. ** Financial Costs*0.95 (-tax) *3-contribute 3

Inv/fam: cost fin.	Residual/fam	Financial			Economical			Family	Rainfall:R	Dry:D	L+S
70.8	10.1	L/C	F/C	TTL	L/C	F/C	TTL	No.	ha	ha	ha
Preliminary Works (PW) TTL		39.1	88.2	127.3				140	36.6	4	40.6
Pw:Irrigation/TTL=	46.2%	18.1	40.8	58.9				220	13.6	1.5	15.1
Irrigation		883.1	2059.3	2942.4				287	44.1	10.4	54.5
S: SUB-TOTAL		901.2	2100.1	3001.3				89	2	0.5	2.5
Engin. & Admin.: S*12%		108.1	252.0	360.2	Tax*1	Tax*1		170	12.2	52.7	64.9
Physical Conting.: S*10%		90.1	210.0	300.1	94.7%	94.7%		906	108.5	69.1	177.6
GRAND TOTAL		1099.4	2562.1	3661.5	1040.8	2425.2	3466.0		No. of family=		128
*1: Transfer Rate: TR		Unit price/km		63.9	*3	SCF*2			ha: Avr.		0.20
*2: Standard Conversion Factor						96.2%					

*3: TR<SCF, then adopted costs without imposing

Longitude of canales km

Canal			Canal		
2-1	3.7		12-0	4.4	4.4
2-2	3.2		27-1	5.8	
2-3	3.5		27-2	2.2	
2-4	2.5	12.9	27-3	3.4	
3-0	3.4	3.4	27-4	3.5	14.9
9-1	5.3			Total	57.3
9-2	6.3				
9-3	4.8				
9-4	5.3	21.7			

Table 9.2.5 Economic and Social Analysis (Rural Infrastructure Improvement) : CRCs and ACs

Unit= 1,000US$

	Beneficiary	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
B:net.increment	4,987	-4	20	102	159	189	197	197	197	197	197	197	197	197	197	198	1,035 NPVc
Costos Economicos	contribute 1: 79%	174	87														
	contribute 2: 20%	44	22														
	contribute 3: 1%	3															
	Maintenance*		5.2	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	
	Residual															-82	154% CID
	TOTAL**	218	114	10	10	10	10	10	10	10	10	10	10	10	10	-71	37.5% IRRe
B-C: NET INCREMENT		-221	-94	92	148	179	186	186	186	186	186	186	186	186	186	269	672 NPVe

* Financial Costs*0.95 (-tax) **-contribute 3

Inv/fam: cost fin.	Residual	Financial			Economical		
0.76	0.19	L/C	F/C	TTL	L/C	F/C	TTL
Preliminary Works (PW) TTL		39.1	88.2	127.3			
PW:CRC&/TTL=	4.8%	1.9	4.2	6.1			
CRC & AC		106.5	198.3	304.8			
S: SUB-TOTAL		108.4	202.5	310.9			
Engin. & Admin.: S*12%		13.0	24.3	37.3	Tax*1	Tax*1	
Physical Conting.: S*10%		10.8	20.3	31.1	86.9%	86.9%	
GRAND TOTAL		132.2	247.1	379.3	115.0	214.8	329.8
					*3	SCF*2	
						96.2%	

*1: Transfer Rate:TR

*2: Standard Conversion Factor

*3: TR<SCF, then adopted costs without imposing

Table 9.2.6 Numbers of Beneficiaries in each Project Component

	Total	Area		CRC	Irrigation	Road
1) Chachacomani	630	6	1%	630		630
2) Corpaputu	250	9	4%	250		250
3) Berenguela	40	40	100%	40		40
4) Kerani	420	103	25%	420		420
5) Coromata A.	70	70	100%	70		70
6) Coromata M.	138	138	100%	138		138
7) Coromata B.	200	89	45%	200	170	200
8) Pairumani	160	117	73%	160		160
9) Icrana	34	22	65%	34		34
10) Pajchani M.	80	80	100%	80	89	80
11) Pajchani G.	90	90	100%	90		39
12) Putuni	39	39	100%	39	287	
13) Calacala	240	240	100%	240		240
14) Barco C.	14	14	100%	14		14
15) Pongon Huyo	380	93	24%	380		380
16) Avichaca	300	206	69%	300		300
17) Tipampa	123	56	46%	123		123
18) Suntia C.	22	22	100%	22		22
19) Suntia G.	65	65	100%	65		65
20) Suntia Chico	30	30	100%	30		30
21) Jahuir Laca	150	150	100%	150		150
22) Marca Masaya	145	64	44%	145		
23) Kjasina	200	22	11%	200		
24) Arasaya C.	80	78	98%	80		
25) Arasaya K.	40	40	100%	40		
26) Arasaya P.	40	40	100%	40		
27) Cajon Pata	32	32	100%	32		32
28) Belen	500	500	100%	500	140	
29) Barco Belen	125	125	100%	125		
30) Taramaya	350	196	56%	350	220	
Total	**4,987**	**2,776**	**56%**	**4,987**	**906**	**3417**

Table 9.2.7 Financial Anlysis (Roads and Bridges)

	Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Area:ha: without	Barley (green)	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94		
	Potato	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92		
	Quinua	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59		
	Barley (grain)	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54		
	Bean (green)	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26		
Prodt/ha: with &without	Barley (green)	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40		
	Potato	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70		
	Quinua	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50		
	Barley (grain)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90		
	Bean (green)	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10		
Prodt: without	Barley (green)	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26		
	Potato	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32		
	Quinua	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30		
	Barley (grain)	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49		
	Bean (green)	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29		
Area: ha:with +Fallow land	Barley (green)	1.12	0.94	0.96	0.98	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.12	1.12	1.12	1.12	1.12		
	Potato	1.10	0.92	0.94	0.96	0.98	1.00	1.02	1.04	1.06	1.08	1.10	1.10	1.10	1.10	1.10	1.10		
	Quinua	0.70	0.59	0.60	0.61	0.63	0.64	0.65	0.66	0.68	0.69	0.70	0.70	0.70	0.70	0.70	0.70		
	Barley (grain)	0.64	0.54	0.55	0.56	0.57	0.58	0.60	0.61	0.62	0.63	0.64	0.64	0.64	0.64	0.64	0.64		
	Bean (green)	0.31	0.26	0.27	0.27	0.28	0.28	0.29	0.29	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.31		
Product: with	Barley (green)	2.69	2.26	2.30	2.35	2.40	2.45	2.50	2.54	2.59	2.64	2.69	2.69	2.69	2.69	2.69	2.69		
	Potato	5.17	4.32	4.42	4.51	4.61	4.70	4.79	4.89	4.98	5.08	5.17	5.17	5.17	5.17	5.17	5.17		
		0.35	0.30	0.30	0.31	0.31	0.32	0.33	0.33	0.34	0.34	0.35	0.35	0.35	0.35	0.35	0.35		
	Barley (grain)	0.58	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.58	0.58	0.58	0.58	0.58		
	Bean (green)	0.34	0.29	0.29	0.30	0.30	0.31	0.32	0.32	0.33	0.33	0.34	0.34	0.34	0.34	0.34	0.34		
Income:US$: without	Barley (green)	77	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174		
	Potato	165	713	713	713	713	713	713	713	713	713	713	713	713	713	713	713		
		385	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114		
	Barley (grain)	110	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53		
	Bean (green)	209	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60		
	Total	$/t	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114		
Except $3.3/day		60	198	198	198	198	198	198	198	198	198	198	198	198	198	198	198		
without: Income Total			1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312		
Expenditures$ without	Barley (green)	61.0	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57		
		465.9	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429		
	Quinua	80.3	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47		
	Barley (grain)	77.5	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42		
	Bean (green)	205.2	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53		
		$/ha	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629		
Transportation of B:100%	Barley (green)	4.07	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92		
	Potato	4.07	176	176	176	176	176	176	176	176	176	176	176	176	176	176	176		
		4.07	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12		
	Barley (grain)	4.07	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20		
	Bean (green)	4.07	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12		
	Total	$/km	311	311	311	311	311	311	311	311	311	311	311	311	311	311	311		
without: TTL Costs			940	940	940	940	940	940	940	940	940	940	940	940	940	940	940		
without: B-C			372	372	372	372	372	372	372	372	372	372	372	372	372	372	372		
Income:US$: with	Barley (green)	77	174	177	181	185	188	192	196	200	203	207	207	207	207	207	207		
	Potato	165	713	729	744	760	776	791	807	822	838	853	853	853	853	853	853		
	Quinua	385	114	116	118	121	123	125	128	130	132	135	135	135	135	135	135		
	Barley (grain)	110	53	55	56	57	58	59	60	61	62	63	63	63	63	63	63		
	Bean (green)	209	60	61	62	64	65	66	67	69	70	71	71	71	71	71	71		
	Total	$/t	1,114	1,138	1,162	1,186	1,210	1,234	1,258	1,282	1,305	1,329	1,329	1,329	1,329	1,329	1,329		
Except $3.3/day		60	182.9	198	198	198	198	198	198	198	198	198	198	198	198	198	198		
Residual																	3.8		
ING TTL			1,297	1,336	1,360	1,384	1,408	1,432	1,456	1,480	1,503	1,527	1,527	1,527	1,527	1,527	1,527		
Investment		15.1	0																
Work Increament			13	13	13	13	13	13	13	13	13	0	0	0	0	0	0		
Expenditures$ with	Barley (green)	61.0	57	59	60	61	62	63	65	66	67	68	68	68	68	68	68		
	Potato	465.9	429	438	447	457	466	475	485	494	503	512	512	512	512	512	512		
	Quinua	80.3	47	48	49	50	51	52	53	54	55	56	56	56	56	56	56		
	Barley (grain)	77.5	42	43	41	44	45	46	47	48	49	50	50	50	50	50	50		
	Bean (green)	205.2	53	54	56	57	58	59	60	61	62	64	64	64	64	64	64		
with: TTL Expenditure		$/ha	629	642	656	669	683	696	710	723	737	750	750	750	750	750	750		
Transporter Truck	Barley (green)	0.41	92	9	10	10	10	10	10	11	11	11	11	11	11	11	11		
	Potato	0.41	176	18	18	19	19	20	20	20	21	21	21	21	21	21	21		
	Quinua	0.41	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
	Barley (grain)	0.41	20	2	2	2	2	2	2	2	2	2	2	2	2	2	2		
	Bean (green)	0.41	12	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
	Total	$/km	311	32	32	33	34	34	35	36	36	37	37	37	37	37	37		
with: Total Costs			953	687	701	715	730	744	758	772	786	787	787	787	787	787	787		
with: B-C			344	649	659	668	678	688	698	707	717	740	740	740	740	740	740	NPV	IRR
Benefit Increment			-28	277	286	296	306	316	325	335	345	368	368	368	368	368	368	2,098	581%

Table 9.2.8 Financial Analysis (Irrigation Canals)

	year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Arable without	Barley (green)	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
	Potato	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Quinua	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	Barley (grain)	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
	Bean (green)	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
Reactfac without	Barley (green)	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
	Potato	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70
	Quinua	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	Barley (grain)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	Bean (green)	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Product without	Barley (green)	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26
	Potato	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32
	Quinua	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
	Barley (grain)	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
	Bean (green)	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Arable with +Fallow land	Barley (green)	0.72	0.94	0.90	0.85	0.81	0.76	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	Potato	0.70	0.92	0.88	0.83	0.79	0.74	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
	Quinua	0.45	0.59	0.56	0.53	0.51	0.48	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	Barley (grain)	0.41	0.54	0.51	0.49	0.46	0.44	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
	Bean (green)	0.20	0.26	0.25	0.24	0.22	0.21	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
		2.48	3.25	3.10	2.94	2.79	2.63	2.48	2.48	2.48	2.48	2.48	2.48	2.48	2.48	2.48	2.48
	Potato75%	1.04	0.00	0.21	0.42	0.63	0.83	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
	Bean (green)	0.35	0.00	0.07	0.14	0.21	0.28	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
	Irrigated land	1.39	0.00	0.28	0.56	0.83	1.11	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39
	TOTAL	3.87	3.25	3.57	3.50	3.62	3.75	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87	3.87
Reactfac with	Barley (green)	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
	Potato	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70
	Quinua	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
	Barley (grain)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
	Bean (green)	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
	Potato	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50	5.50
	Bean (green)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Product with	Barley (green)	1.73	2.26	2.15	2.04	1.94	1.83	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73
	Potato	3.29	4.32	4.12	3.91	3.70	3.50	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29	3.29
	Quinua	0.23	0.30	0.28	0.27	0.25	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
	Barley (grain)	0.37	0.49	0.46	0.44	0.42	0.39	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
	Bean (green)	0.22	0.29	0.27	0.26	0.25	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
	Potato	5.73	0.00	1.15	2.29	3.44	4.59	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73	5.73
	Bean (green)	1.04	0.00	0.21	0.42	0.63	0.83	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04
	TTL:Potato	9.02	4.32	5.26	6.20	7.14	8.08	9.02	9.02	9.02	9.02	9.02	9.02	9.02	9.02	9.02	9.02
	TTL:Bean	1.26	0.29	0.48	0.68	0.87	1.07	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26
Income/US$: without	Barley (green)	77	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174
	Potato	165	713	713	713	713	713	713	713	713	713	713	713	713	713	713	713
	Quinua	385	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114
	Barley (grain)	110	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
	Bean (green)	209	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	Total	$/t	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114	1,114
without Except $3.3		60	198	198	198	198	198	198	198	198	198	198	198	198	198	198	198
without Income TTL		day	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312	1,312
Expenditures$ without	Barley (green)	61	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
	Potato	466	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429
	Quinua	80	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47
	Barley (grain)	78	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
	Bean (green)	205	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53
without Expenditure TTL		$/ha	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629
without B-C		683	683	683	683	683	683	683	683	683	683	683	683	683	683	683	683
Income/US$: with	Barley (green)	77	174	166	157	149	141	133	133	133	133	133	133	133	133	133	133
	Potato	165	713	869	1,024	1,179	1,334	1,489	1,489	1,489	1,489	1,489	1,489	1,489	1,489	1,489	1,489
	Quinua	385	114	108	103	97	92	87	87	87	87	87	87	87	87	87	87
	Barley (grain)	110	53	51	48	46	43	41	41	41	41	41	41	41	41	41	41
	Bean (green)	209	60	101	141	182	223	264	264	264	264	264	264	264	264	264	264
	Total	$/t	1,114	1,294	1,474	1,653	1,833	2,013	2,013	2,013	2,013	2,013	2,013	2,013	2,013	2,013	2,013
with	Except $3.3	60	127	198	198	198	198	198	198	198	198	198	198	198	198	198	198
Residual																	10
with Income Total			1,241	1,492	1,672	1,851	2,031	2,211	2,211	2,211	2,211	2,211	2,211	2,211	2,211	2,211	2,221
Investment		71	0														
Capital Workforce			91	91	91	91	91	0	0	0	0	0	0	0	0	0	0
Expenditures$ with	Barley (green)	61.0	57	55	52	49	47	44	44	44	44	44	44	44	44	44	44
	Potato	465.9	429	408	388	367	347	326	326	326	326	326	326	326	326	326	326
	Quinua	80.3	47	45	43	41	38	36	36	36	36	36	36	36	36	36	36
	Barley (grain)	77.5	42	40	38	36	34	32	32	32	32	32	32	32	32	32	32
	Bean (green)	205.2	53	51	48	46	43	41	41	41	41	41	41	41	41	41	41
	Potato:Irrigation	452.5	0	94	189	283	377	472	472	472	472	472	472	472	472	472	472
	Bean:Irrigation	284.0	0	20	39	59	79	99	99	99	99	99	99	99	99	99	99
	O&M: 0%	$/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	with: Expenditure TTL		720	804	888	972	1,057	1,049	1,049	1,049	1,049	1,049	1,049	1,049	1,049	1,049	1,049
with Exp TTL B-C with		1031	521	688	783	879	975	1,162	1,162	1,162	1,162	1,162	1,162	1,162	1,162	1,172	NPV	IRR

Table 9.2.9 Financial Analysis (CRCs and ACs)

	Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Arable: with&without	Barley (grain)	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	
	Potato	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
	Quinua	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	
	Barley (grain)	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	
	Bean (green)	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	
Rural:No with&without	Barley (green)	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	
	Potato	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	
	Quinua	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	
	Barley (grain)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
	Bean (green)	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	
Prodc with&without	Barley (green)	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	
	Potato	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	
	Quinua	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
	Barley (grain)	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	Family
	Bean (green)	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	4.7
Self-consumption kg/capita/day	Barley (green)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Potato	0.28	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
	Quinua	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	Barley (grain)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Bean (green)	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Loan:% without	Barley (green)	10.0%	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	/year
	Potato	19.0%	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	
	Quinua	16.0%	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
	Barley (grain)	15.4%	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
	Bean (green)	26.0%	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
Commercialit without	Barley (green)		2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	
	Potato		3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	3.02	
	Quinua		0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	
	Barley (grain)		0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	
	Bean (green)		0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	
Loan:% with	Barley (green)	8.0%	0.23	0.22	0.20	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	SY
	Potato	15.2%	0.82	0.79	0.74	0.69	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	
	Quinua	12.8%	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	
	Barley (grain)	12.3%	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
	Bean (green)	20.8%	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
Commercialit with	Barley (green)		2.03	2.04	2.05	2.07	2.07	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	2.08	
	Potato		3.02	3.05	3.11	3.15	3.18	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	3.19	
	Quinua		0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
	Barley (grain)		0.41	0.41	0.42	0.42	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	
	Bean (green)		0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	
withouthousehold Self-consumption	Barley (green)	77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.1
	Potato	165	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	
	Quinua	385	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	
	Barley (grain)	110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Bean (green)	209	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	
without Income Farm	Barley (green)	77	22.67	22.67	22.67	22.67	22.67	22.67	22.67	22.67	22.67	22.67	22.67	22.67	22.67	22.67	22.67	14.5%
	Potato	165	99.73	99.73	99.73	99.73	99.73	99.73	99.73	99.73	99.73	99.73	99.73	99.73	99.73	99.73	99.73	20.0%
	Quinua	385	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	12.88	14.5%
	Barley (grain)	110	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56	6.56	14.5%
	Bean (green)	209	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	20.5%
without Income Market	Barley (green)	79.2	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	137.5	85.5%
	Potato	167	404.2	404.2	404.2	404.2	404.2	404.2	404.2	404.2	404.2	404.2	404.2	404.2	404.2	404.2	404.2	80.0%
	Quinua	387	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	76.4	85.5%
	Barley (grain)	112	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	85.5%
	Bean (green)	211	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	79.5%
without Income Total		$/t	930	930	930	930	930	930	930	930	930	930	930	930	930	930	930	*Consumer
Except $3 /day		60	198	198	198	198	198	198	198	198	198	198	198	198	198	198	198	37.5%
without Income Total			1,128	1,128	1,128	1,128	1,128	1,128	1,128	1,128	1,128	1,128	1,128	1,128	1,128	1,128	1,128	*Intermediary
																		63.5%
Expenditure& without	Barley (green)	61.0	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	
	Potato	465.9	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	
	Quinua	80.3	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	
	Barley (grain)	77.5	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	
	Bean (green)	205.2	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	
without Expenditure Total		$/ha	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	1.1
without B-C			499	499	499	499	499	499	499	499	499	499	499	499	499	499	499	
withhousehold Self-consumption	Barley (green)	77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Potato	165	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	79.26	
	Quinua	385	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	6.60	
	Barley (grain)	110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Bean (green)	209	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	7.17	
with Income Farm	Barley (green)	77	22.67	22.77	22.93	23.08	23.15	23.17	23.17	23.17	23.17	23.17	23.17	23.17	23.17	23.17	23.17	14.5%
	Potato	165	99.73	100.61	102.55	104.1	104.9	105.2	105.2	105.2	105.2	105.2	105.2	105.2	105.2	105.2	105.2	20.0%
	Quinua	385	12.88	12.98	13.15	13.30	13.38	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	14.5%
	Barley (grain)	110	6.56	6.61	6.68	6.75	6.79	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	6.80	14.5%
	Bean (green)	209	7.60	7.73	7.93	8.11	8.21	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	8.23	20.5%
with Income Market	Barley (green)	79.2	137.5	138.1	139.1	140.0	140.4	140.5	140.5	140.5	140.5	140.5	140.5	140.5	140.5	140.5	140.5	85.5%
	Potato	167	404.2	406.6	415.7	422.0	425.4	426.2	426.2	426.2	426.2	426.2	426.2	426.2	426.2	426.2	426.2	80.0%
	Quinua	387	76.4	77.0	78.0	78.9	79.4	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	79.5	85.5%
	Barley (grain)	112	39.4	39.7	40.2	40.6	40.8	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	40.9	85.5%
	Bean (green)	211	29.8	30.3	31.1	31.8	32.2	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	32.3	79.5%
with Income Total		$/t	930	938	950	962	968	969	969	969	969	969	969	969	969	969	969	
with Except $3 /day		60	197.2	198	198	198	198	198	198	198	198	198	198	198	198	198	198	
Residual																		0.2
Income Total			1,127	1,136	1,148	1,160	1,166	1,167	1,167	1,167	1,167	1,167	1,167	1,167	1,167	1,167	1,167	
Investment		0.8	0															
Expenditure& with	Barley (green)	61.0	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	
	Potato	465.9	429	429	429	429	429	429	429	429	429	429	429	429	429	429	429	
	Quinua	80.3	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	
	Barley (grain)	77.5	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	
	Bean (green)	205.2	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	
with Expenditure Total		$/ha	629	629	629	629	629	629	629	629	629	629	629	629	629	629	629	
with B-C			532	498	507	520	531	537	539	539	539	539	539	539	539	539	539	NPV	IRR
Benefit Increment				-1	8	20	32	38	39	39	39	39	39	39	39	39	40	211	11%%

Table 9.2.10 Economic and Community Analysis (Short Term Development Plan)

unit: 1000US$

		Beneficiary*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	NPVc	
Benefit (Economic)	Road & Bridge	3,417	-97	473	979	1,012	1,045	1,079	1,112	1,145	1,178	1,257	1,257	1,257	1,257	1,257	1,257	6,746	
	Irrigation	517	-84	1	52	101	151	247	247	247	247	247	247	247	247	247	252	1,015	
	CRC & AC	4,987	-4	20	102	159	189	197	197	197	197	197	197	197	197	197	198	1,035	IRRc
	Total	8,921	-183	495	1,136	1,276	1,390	1,528	1,563	1,597	1,631	1,711	1,712	1,713	1,714	1,715	1,722	8,841	352%
Benefit (Cost)	Road & Bridge		2,387	2,389	34	34	34	34	34	34	34	34	34	34	34	34	-1,151		
	Irrigation		2,288	1,169	50	50	50	50	50	50	50	50	50	50	50	50	-808		
	CRC & AC		218	114	10	10	10	10	10	10	10	10	10	10	10	10	-71		
	Maintenance		0	64	95	95	95	95	95	95	95	95	95	95	95	95	95		
	Total		4,892	3,736	189	189	189	189	189	189	189	189	189	189	189	189	-1,936		
	Contribute 1	79%	3,904	2,879															
	Contribute 2	20%	988	729														-	CID
	Contribute 3	1%	86	0														11.9%	IRRe
B-C: NET INCREMENT			-5,075	-3,241	946	1,087	1,201	1,339	1,373	1,408	1,442	1,521	1,522	1,523	1,524	1,525	3,657	-37	NPVe

* Beneficialios of first, secound projects are also the benefit of third

Table 9.2.11 Sensitivity Analysis (Short Term Development Plan) : Economic Prices

unit: 1000US$

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Total Benefits		-10%	-202	446	1,022	1,148	1,251	1,375	1,406	1,437	1,468	1,540	1,540	1,541	1,542	1,543	1,550		
Total Costs		10%	5,381	4,110	208	208	208	208	208	208	208	208	208	208	208	208	-1,742	IRRe	
B-C: case 1	B: -10%		-5,094	-3,290	833	959	1,062	1,186	1,217	1,248	1,279	1,350	1,351	1,352	1,353	1,354	3,485	10.0%	Caso 1
B-C: case 2	C: +10%		-5,564	-3,615	927	1,068	1,182	1,320	1,354	1,389	1,423	1,502	1,503	1,504	1,505	1,506	3,464	10.1%	Caso 2
B-C: case 3	B: -10%; C: +10%		-5,583	-3,664	814	940	1,043	1,167	1,198	1,229	1,260	1,331	1,332	1,333	1,334	1,335	3,292	8.3%	Caso 3

CHAPTER 10

CONCLUSION AND RECOMMENDATION

CHAPTER 10 CONCLUSION AND RECOMMENDATION

10.1 Conclusion

To formulate the rural and agricultural development plan in the objective areas, study on the present situation, facing problem and development potential has been carried out, as the conclusion, following was obtained.

(1) People in the project area are performed on a mixed farming of traditional animal raising and self-sustaining crop cultivation. The purposes of the project are improvement of farm economy and fulfillment of their settlement conditions by promoting agricultural production in the area, and activation of the areal economy and encourage farmers for settling. The concepts of development are improvement of farming and agricultural infrastructure, establishment of agricultural support system for agricultural promotion in the area and improvement of social infrastructure in order to establish an economical area and comfortable rural society in the entire Keka river basin.

(2) The plan for improvement of facility is proposed as follow.

Item	Unit	Short Term Plan	Middle Term Plan	Long Term Plan
Agricultural Infrastructure				
Main Canal	km	57.3	60.3	59.1
Secondary Canal	km	11.4	13.3	10.0
Rural Infrastructure				
Main Road	km	56.8	-	-
Connection Road	km	7.2	31.3	33.5
Farm Road	km	-	40.8	33.7
Agricultural Support Services				
CRC	No.	(3)	3	-
AC	No.	(3)	6	-
MH	No.	-	5	10

(3) Total investment for above works is estimated US$ 22,352,000, US$ 9,198,000 for the short term plan, US$ 7,856,000 for the middle term plan and US$ 5,298,000 for the long term plan respectively. Required period of works is proposed as 2.5 years including the period of the detail design.

(4) The internal rate of return of the project will be 11.9% from the required cost and the anticipated benefit. The project is to be applied in the area where is severe natural and socio-economical condition. Improved irrigation facilities and effectively utilized land, increased irrigable area, diversified marketable crop production, activated agriculture, accelerated socio-economical relation by road improvement, activated with CRC as a core of the area, created job opportunity are expected as socio-economical effects.

10.2 Recommendation

(1) The project is benefited directly to the inhabitants of the area and will give social and economical impact to the nation and the region by the implementation of development in Altiplano. It is recommended that the government of Bolivia would prepare necessary procedure for early implementation of the project based on the results of F/S study.

(2) The facility plan and the cost of the project studied in the F/S study should be reviewed at the stage of the detail design for more precise. It is required additional topographic and geological surveys for the detailed design.

(3) The project implementation body is La Paz department under the supervision of Ministro de Agricultula, Ganadería y Desarrollo Rural. Establishment of Coordination

Organ of the project implementation is recommended at the Dirección Desarrollo Económico, which is one of the departments in governmental organization of Department of La Paz for effective management. Coordination Organ will coordinate the project with the government of Bolivia during the beginning of the project till the end of the construction works and work for supporting the operation of CRC after the construction works.

(4) The activity of the farmers in CRC is an essential in achievement of the project objectives. The recommendation on management and activity regarding CRC is as follows.

- On management of CRC, establishment of a management committee which will be organized by representatives of the member communities. The committee will arrange, under assistance of Coordination Organ, O & M works of the facilities and plan and conduct supporting programs on agriculture and livelihood of member farmers.

- On operation and activity of CRC, utilization of financial support by the administrative system of the law of "Paticipacion Popular" is planned. The corporation of the municipalities of Achacachi, Batallas and FDC is essential and it is recommended that Coordination Organ establish a close cooperative relation with those organizations.

- On the activity of CRC regarding technical matter, support by research institutes, universities and NGOs are planned. It is recommended to Coordination Organ to establish close cooperative relation with those institutions.

ATTACHMENT