PN-ACM-752

MICRO IRRIGATION TRAINING NEEDS ASSESSMENT

P.O.511-O-00-01-00117-00

Submitted to: **USAID/Bolivia**

By

JORGE G. ZAMBRANA Q.

MAY, 2001
LA PAZ, BOLIVIA

A

CONTENTS

B

CONSULTANT'S TEAM:

Jorge G. Zambrana Q.	Design Engr. & Manager
Rainer H. Rothe	Irrigation Agronomist
CAT – PRONAR	Irrigation Training
Ingrid Tames Barrios	Secretary

La Paz, Bolivia, May, 2001

1. Introduction

The PL-480 Title II Program, implements activities of rural development in the food insecure valleys and highlands of Bolivia. The PL-480 Title II Program supports programs in the infantile maternal health areas, potable water and basic sanitation, school breakfasts and agricultural production (technology transfer, commercialization, improvement of local roads, and micro irrigation systems). The cooperating sponsors that USAID works with in the country are the Adventist Development and Relief Agency (ADRA), Project Concern International (PCI), Food for the Hungry (FHI) and CARE, which only recently has started to implement micro irrigation projects, the reason for which it was not included in the field visits.

Under the cooperating sponsors' Agricultural Productivity Program, micro-irrigation systems are either established or improved in areas where water resources and land characteristics are adequate. Efforts are directed at increased productivity, improved production technologies, and better market access in order to raise rural household incomes.

The present consultancy mission originates from the Food Security Unit(Who manages the PL-480 Title II Program) and the Economic Opportunities Strategic Objective Team, to obtain information on the experiences gained in the micro irrigation projects of this program through the previously mentioned cooperating sponsors. The purpose of the present report is to have an idea of the most relevant positive and negative aspects of the different projects visited as well as to recommend or to suggest aspects that should be included in the implementation of micro irrigation projects in the future Development Activities Proposal (DAP).

Likewise the team of consultants made an assessment of the training needs of those that implemented the micro irrigation projects and recommend the necessary and appropriate training of the technicians who are in charge of implementing the new projects.

In coordination with the Cooperating Sponsors under the PL-480 Title II Program, the team of consultants visited eight micro irrigation projects implemented in different areas within the country which represent 16% of the approximately 50 systems that have been constructed.

2. Objective of the Mission.

The objective is to conduct a training needs assessment of the cooperating sponsors PL-480 Title II Program to improve the planning and implementation of micro irrigation systems with the final objective being the design of specific training courses for their technical staff.

3. General description of the micro irrigation systems visited.

The different micro irrigation projects visited by the consultants together with the different cooperating sponsors' technicians are located in the Departments of Chuquisaca, Potosi and Cochabamba. According to the characteristics of the Andean region of Bolivia, these projects are found in different ecological zones and different agro–ecological regions.

3.1. Location

As has been previously indicated, the projects visited by the mission, are located in different parts of the country in the departments of Chuquisaca, Potosi and Cochabamba. These projects and their location are shown in table 3.1.

Table 3.1. Location of Projects Visited.

No	Name	Department	Province	Municipality	Cooperating Sponsor
1	Sacabamba North canal	Cochabamba	Esteban Arce	Sacabamba	PCI
2	Sacabamba South canal	Cochabamba	Esteban Arce	Sacabamba	PCI
3	Tambillo Linde	Cochabamba	Punata	Arani	PCI
4	K'uchu Muella	Cochabamba	Punata	Villa Barrientos	PCI
5	Abanico	Cochabamba	Tiraque	Tiraque	PCI
6	El Centro	Chuquisaca	South Cinti	Culpina	ADRA
7	Palca Pata	Chuquisaca	North Cinti	Inca Huasi	ADRA
8	Acequia Baja	Chuquisaca	North Cinti	San Lucas	ADRA
9	Sorocoto	Potosí	Chayanta	Ravelo	FHI

In general the accessibility to the micro irrigation projects visited by the consultancy, is via dirt roads that are in a reasonable condition. However, the roads from the community and to the construction sites are in a poor condition or do not exist and one has to get there by foot which is a big hindrance during construction and represents a difficulty for the communities to obtain a rapid and secure access to the markets.

3.2. Physical and economic aspects

The physical and economic characteristics of each project are defined according the number of families benefiting from the project and number of irrigated hectares. From these are obtained parameters for project investment such as the investment per hectare irrigated and per family benefiting from the project. A summary of these indicators are shown in table 3.2.

Table 3.2. Physical and economic indicators of the projects.

No	Name	Proposed Total Investment ($us)	Incremented Area (Has)	No. of Families Benefiting	$us/Ha	$us/fam
1	Sacabamba North and south canal	204,029,99	284	262	718	778
2	Tambillo Linde	26,503.13	98	120	270	221
3	K'uchu Muella	54,580.75	69	165	791	331
4	Abanico	205,062.41	82	662	2,500	310
5	El Centro	17,394.87	45	175	386	99
6	Palca Pata	6,296.28	20	42	314	150
7	Acequia Baja	42,582.25	50	82	852	519
8	Sorocoto	128,920.47	63	190	2,046	678

Source: own elaboration based on projects of the three cooperating sponsors.

From table 3.2, one can observe that the economic indicators of the different projects are very much below the parameters indicated by PRONAR[1] and FDC[2]. These are $us 2,500 per incremental Ha under irrigation and $us 4,500 per benefiting family. This is generally because the projects have been implemented on the basis of existing projects of great magnitude that were built by other entities and financers. In other words, partially completed projects. For example, the total implementation cost of the Sacabamba irrigation system was $us 1,673,489, - which gives a total incremental cost of $us 5,892 per Ha and $us 6,387 per benefiting family. In other cases, the water demand calculations were badly applied which gave unrealistic values of the incremental areas.

The amounts indicated in the table 3.2 represent the total budget for the construction of the civil works financed by USAID. The parameters, $us/Ha and $us/family are unrealistic because in 80% of the cases, the PL-480 Title II Program financed only part of a project of a larger magnitude.

In general, one can indicate that the contributions of each of the project participants in each project are those shown in table 3.3.

[1] PRONAR, Programa Nacional de Riego (National Irrigation Program)
[2] FDC, Fondo de Desarrollo Campesino (Peasant Development Fund)

Table 3.3. Contributions for project implementation.

No	Source	Non Qualified Labor	Local material	Equipment	Non Local material	Qualified labor	Supervision	Food for Work
1	Beneficiaries							
2	USAID							
3	Municipality							

From the previous table, one can conclude that the USAID cooperating sponsors have achieved the active participation of the municipalities and beneficiaries which is a highly positive factor for the implementation of micro irrigation projects in areas of poverty and food insecurity. Therefore, they archived the objectives proposed in the agricultural component of the PL-480 Title II Program.

Those projects that generate agricultural activity are able to increase, in certain way, the family incomes and reduce to a great percentage the temporary migration to different cities or countries in search of work to increase their incomes and to improve the quality of their lives.

4. Impacts achieved with the projects

In this context, it has been possible to observe the degree of agricultural diversification, the level of self-management of the systems built, the degree of sustainability of projects implemented and the degree of accessibility of the farmers to the market centers.

4.1. Degree of Crop Diversification.

80% of the micro irrigation projects visited have been constructed within the last one to two years. Consequently, it is too early to observe the degree of crop diversification at this early stage of implementation because the construction still has to be completed and the technical assistance stage has yet to be implemented.

However, in the older projects, crop diversification was noted where the areas under irrigation have been increased from rain fed conditions and small traditional systems . With a permanent source of water available for irrigation, it is possible to sow or plant crops earlier, therefore obtaining higher market prices for crop products. At the same time, it is possible to grow two crops a year (early dry season crops under irrigation and rain fed crops with supplementary irrigation).

In three micro irrigation projects visited, there is not enough water available to irrigate crops during the dry season. Here the systems were, or are being, constructed to improve the water distribution to the fields for supplementary irrigation during the rainy season to obtain higher yields as the annual rainfall is not sufficient.

The major crops grown under rain fed conditions in the systems visited, before project implementation, are potatoes, grains (wheat, barley, oats) and corn. These are generally cultivated between the months of September and March. With the introduction of irrigation water, crop production can be diversified to include legumes (broad, beans and peas), vegetables (onions, carrots) and fruit trees (peaches and apples) and sometimes forages (alfalfa).

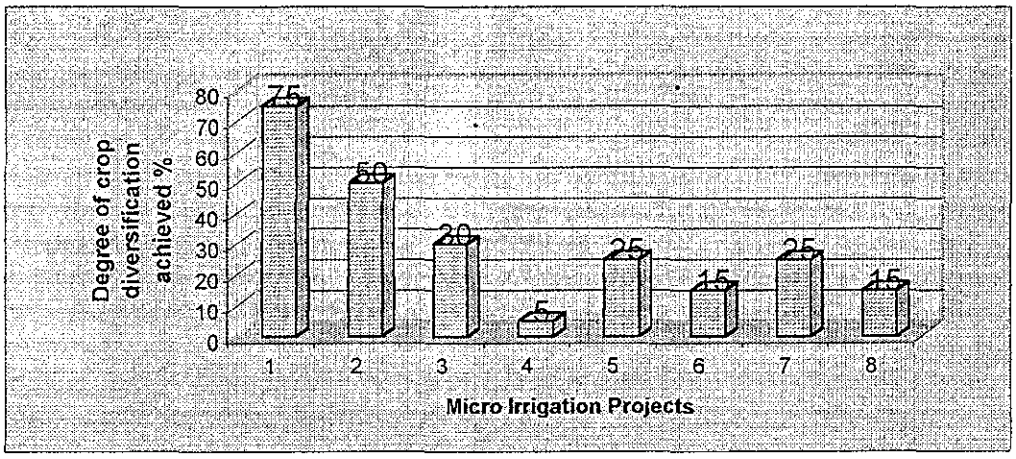
Irrigation water not only increases the crop diversification but makes it possible to have a better crop rotation, earlier planting dates to obtain better market prices and in most cases increase the cropping intensity.

It was also observed that the limited number of crops grown under rain fed conditions are basically grown for home consumption, some is kept for seed and very little for the market.

In 20% of the micro irrigation projects visited, crop diversification has been implemented with early planting, the introduction of new crops (legumes, vegetables, fruit trees) and have been able to obtain two crops a year from the same field. As indicated above, these projects are older in implementation and, through USAID's cooperating sponsors, have received technical assistance in the introduction of new crops as well as a revolving fund for inputs. It was understood that in the 80% of the newer projects, the cooperating sponsors have included technical assistance, revolving funds and market studies for crop diversification in their proposals for the second DAP. The consultants consider this to be of extreme importance in order to guarantee the sustainability of the projects.

Figure 4.1 indicates the consultants estimates of the degree of crop diversification of the eight micro irrigation projects visited.

Figure 4.1 Degree of Crop Diversification.



As can be seen from the figure above, the lower percentages represent micro irrigation projects recently completed, or have yet to be concluded. They also include projects where there is not sufficient water to irrigate during the dry season. The higher percentages represent projects that have been completed and technical assistance and a revolving fund for inputs has been implemented during the past two or three years.

4.2. Producer groups involved in the management of the system

The farmers belong to rural organizations which solicit financial help in order to implement different projects within the community. These organizations coordinate with different institutions which manage the financial resources in the best manner possible. They are in charge of soliciting financing for diverse projects that the community requires.

At the moment, and according to the visits made to the different micro irrigation systems, the consultants were able to observe that each system is very particular in water management. However, they possess similar qualities and conflicts during the elaboration of the project as well as in the stage of implementation. These are aspects that are considered important in all irrigation projects which are outlined in the following chapters of this document.

With the introduction of the popular participation, forgotten communities until then have been able to gain better access to benefits, elaborating and participating actively in their own Annual Operative Plan (POA). In this way, the municipality is in charge of prioritizing the project requested by the community to later on contact the different development institutions to obtain the financing needed.

4.2.1. Management of the irrigation systems

The irrigation systems visited are managed mainly by irrigation committees. These irrigation committees originate from within the communal organization which are the syndicates. They are the first contacts with the cooperating sponsors or other financing institutions.

All the projects that need to be financed have to be included in the annual operating plan (POA) of each municipality who is in charge of prioritizing each project and look for co-financing with development institutions that work in the area. The communal participation is an important part of all projects that are to be implemented.

Once the degree of institutional participation in the project has been defined (among the municipality, the cooperating sponsor and the benefiting community),an inter-institutional agreement is signed by all parties.

To be able to work in the project in an orderly and participative manner, each community forms a Works Committee (or Construction Committee) which generally consists of a president, a secretary of records and other positions that vary according to the degree of complexity or size of the system to be implemented. This organized works committee is mainly responsible for the follow up of the project and is in charge of controlling the community's contribution which is generally in local labor and provision of local materials (sand, gravel and stones).

In each stage of project implementation, the municipality or the cooperating sponsor takes charge of coordinating the work in a direct manner with the beneficiaries, so as to obtain clearly established contributions from each. During the construction process, the cooperating sponsor is in charge of giving advice to the committee and the community to conform and to strengthen the Irrigation Committee which is generally formed during the first phase by the same members of the Works Committee.

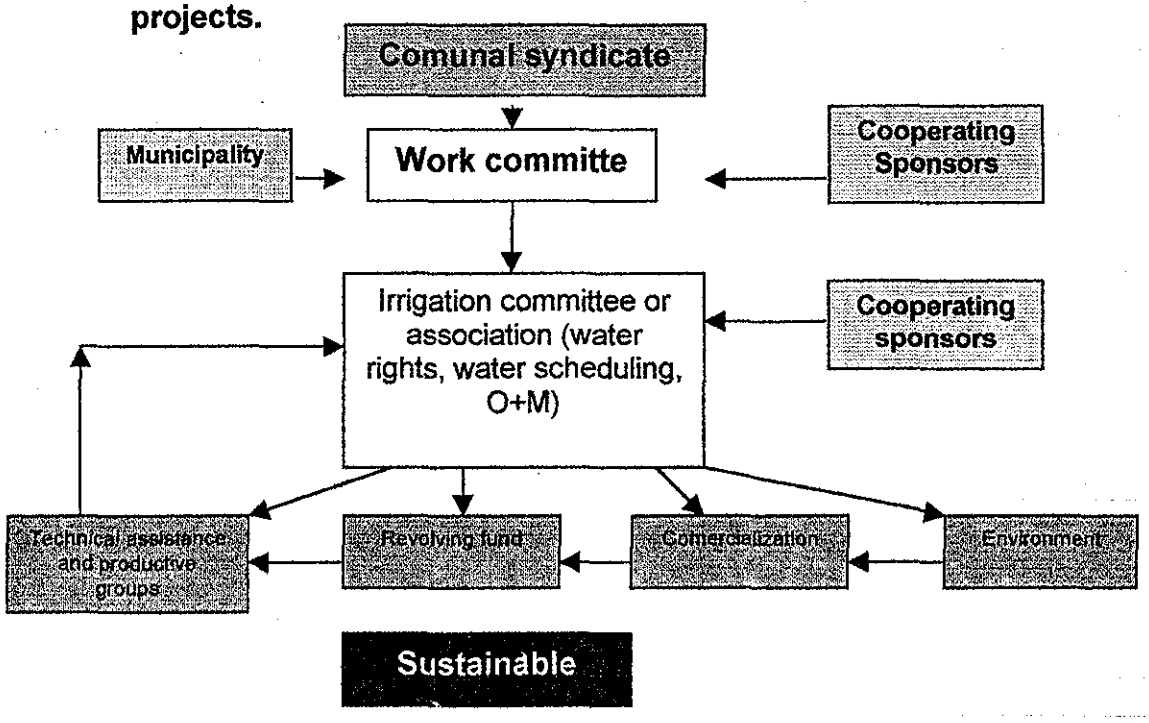
The Irrigation Committee is in charge of defining the water rights of each beneficiary. Usually this is allocated according to the number of labor days contributed during the construction phase and the size of the fields that he or she wants to irrigate. If a person has not participated with labor during the construction, then he can purchase his rights by paying the amount equivalent to the number of days worked defined by the Irrigation Committee. At the same time, the Irrigation Committee defines the schedule for each user and the obligations for the maintenance of the system. In these cases the cooperating sponsors usually support the Irrigation Committee during its organization economically and with technicians.

Once the irrigation system is in operation and with sufficient water to irrigate the crops, the irrigation committee begins to form sub-committees that will be responsible for the technical assistance, revolving funds, commercialization and in some cases the formation of producer groups.

Figure 4.2, illustrates the development process of the management capabilities of the Committees or Irrigation Associations before and during the implementation of the projects.

In making a general summary of all the projects visited by the mission, only one has reached the final stage of the process. Another project that was implemented in an existing irrigation system has not only arrived at its final stage but got much further than that outlined in the figure 4.2. The rest of the projects are in a transformation stage between the works and irrigation committees because they are still elaborating statutes and regulations on the use of water within the communities.

Figure 4.2. Formation process for the management of micro irrigation projects.



To achieve sustainability in these projects, it is highly recommended that the cooperating sponsors support these organizations until the end of the process. Otherwise, the implementation of micro irrigation projects will not be sustainable.

4.2.2. Communal participation

The communal participation in all the micro irrigation projects implemented through the PL–480 Title II Program is extremely important because without it a project could not be executed successfully .

The communal participation during the construction phase has been of great importance, not only in regard to the social impact but also on the economic aspects, which has led to 30% in contributions of non qualified manpower and the gathering and loading of local materials.

80% of the projects visited have the conventional model of irrigation committees. 10% of these projects have functioning irrigation associations, the remaining 10% have irrigation associations which are still not functioning.

Of the total of projects, one can conclude that only 15% of them have an irrigation committee which has been functioning for the last 5 years. 85% of the total are finalizing the construction and forming and consolidating the statutes and regulations of the irrigation committees.

It has been observed in the field that these irrigation committees were developed following the same process illustrated in figure 4.2. It was also noticed that there are variations between one system and another regarding water management and operation and maintenance. In general, the differences occur because each system captures the water in a different way and the existence of irrigation traditions are still respected in the communities. In other cases, the insertion of a technician has been important to assist the beneficiaries with their water management.

4.3. Degree of project sustainability.

The degree of a project sustainability is mainly based on the following aspects:

- ✓ The micro irrigation system has an association or a well consolidated irrigation committee and it is self managed.
- ✓ The project is functioning (water distribution, operation and maintenance).
- ✓ Correct use of water for irrigation.
- ✓ Have a defined market to sell agricultural produce and obtain price information of the main markets in the country.

- ✓ Increased agricultural production due to the availability of irrigation water, technical assistance to diversify agricultural production and the availability of a revolving fund or credit for the purchase of agricultural inputs.
- ✓ Access roads to the markets should be in good condition so that transport costs can be reduced.
- ✓ Implementation of practical soil conservation and forestation.
- ✓ Rely on groups of producers for the purchase of inputs for the community in bulk which represents savings in costs. Also these groups of farmers, at the same time, could channel the farm products to the market (i.e transportation, selection and cleaning of the products, to offer better quality).
- ✓ The presence of the cooperating sponsor is important until the end of the cycle to achieve the objectives noted previously.

According to the different visits made to the projects already implemented and currently in operation by the cooperating sponsors, one can say that 90% of the projects do not guarantee their current sustainability. However, of this percentage, it has been detected that approximately 80% can end up being sustainable as the cooperating sponsors are working in these areas. Of these, it is necessary to highlight that 5% will be sustainable in the short term, the rest in the medium and long term. The remaining 20% (of the 90%) do not seem to have any future because training does not exist, there is no O+M on behalf of the beneficiaries who are abandoning the irrigation infrastructure without any maintenance.

4.4. Accessibility of the system to farm-to-market roads.

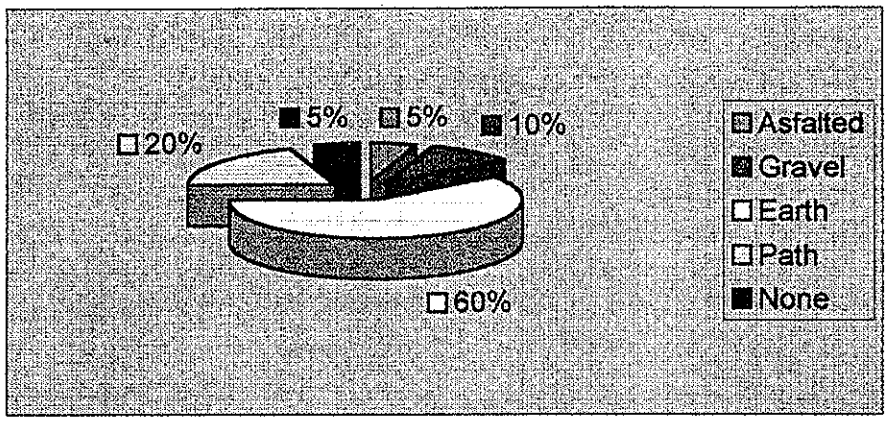
The accessibility of the beneficiaries from the field to the nearest big markets, located in the departmental capitals, can be passed through 90% of the year. During the rainy period, the communities become isolated, because they cannot cross rivers or canyons which affect normal traffic circulation considerably.

In a high percentage, projects exist where accessibility from the fields to the community is through animal tracks where the small holders transport their produce to the local school or market (if it has one) by the means of pack animals. The products are then bought by merchants and intermediaries who then transport the produce to the departmental markets. In the interviews with the farmers, it was detected that in very isolated cases the community nominates a group of people to be in charge of transporting the agricultural produce to the market in order to obtain larger revenues as the merchants and intermediaries are avoided.

Another very important aspect that was detected is that the price changes depending where the product is sold, whether it is in the field, or community, or in the local market (in the event of having one),or in the rural road. This in general can be significant and that is why group transportation of agricultural produce should be encouraged.

As mentioned in the previous paragraph, the importance of access roads to the community was verified. Figure 4.3 shows the types of roads that exist and are usually used for transporting products to the markets.

Figure 4.3. Types of existing roads for market access.



During the field visits to the different projects, the consultants estimated the distances and travel periods between the departmental capitals and the project sites. Figure 4.4 shows the distances between the community and the populated centers such as the municipal and provincial capitals. The figure also shows the distance traveled from the community to the nearest village.

Figure No 4.4.a. Distances between the community and the nearest village

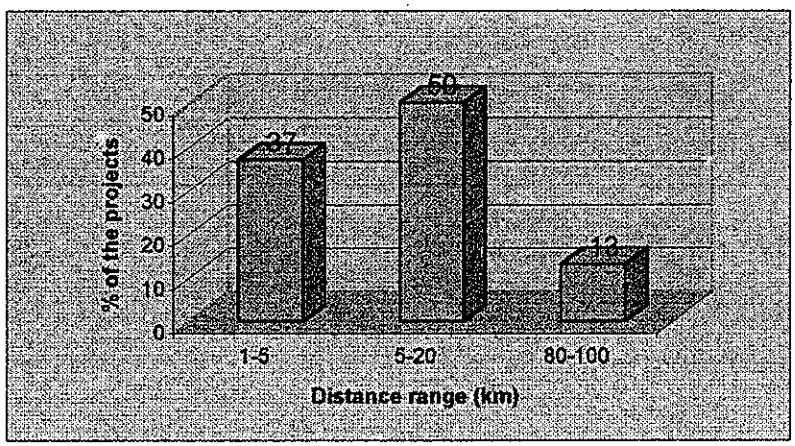
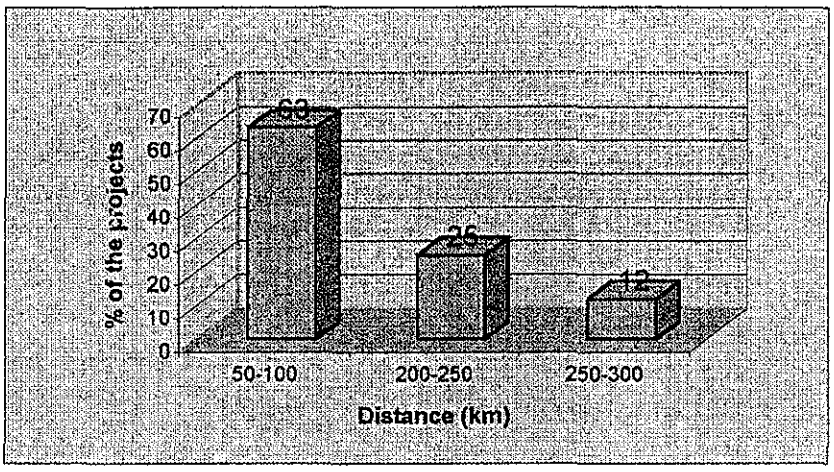


Figure No 4.4.b. Distances between the community and the nearest departmental capital



As a second conclusion and recommendation for the future PL-480 Title II Program micro irrigation projects to be implemented, is that they should be accompanied by a rural road improvement project. This would facilitate the transportation of materials for construction and, in the future, permit the transportation of agricultural produce to the markets.

5. Pre-Project Planning

The planning made before project implementation greatly influences the future sustainability of irrigation projects. Deficient planning usually leads to failure during implementation. For example, if good engineering design was made but the hydrological analysis was faulty or it simply was not done, the project could lead to a hydrological failure[3].

5.1. Policy, programming, and planning issues

5.1.1. Micro irrigation potential in food insecure areas

Micro irrigation projects implemented in the country have a great social and productive potential since they are mainly located in marginal areas and not serviced by the government.

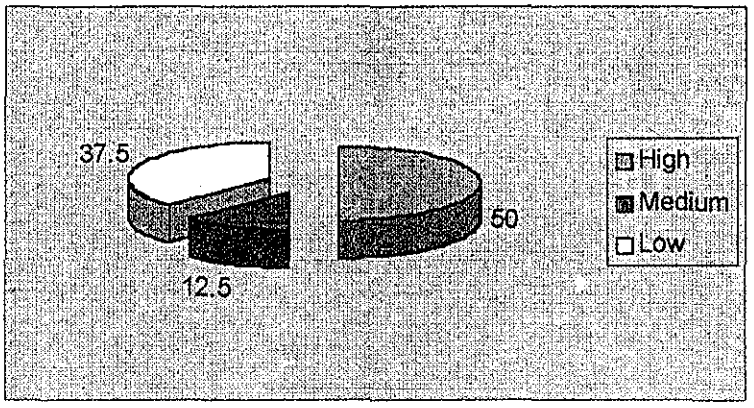
Projects have been implemented in high food insecurity areas, where agricultural production without a project is very low and is hardly sufficient for home consumption. For this reason, the heads of families migrate to the departmental capitals or other places in search of work in order to improve their family incomes.

Agricultural production without a project basically serves self-consumption and it is not diversified. Only potatoes, oca and other tuber crops are harvested which the family is forced to consume for the whole year. With an irrigation project, crop diversification can be achieved which not only covers the family basket but makes it possible to produce different crops that can be sold in the market or be exchanged for other non local products. In this way living standards can be improved in the communities.

During the visits made to the different micro irrigation projects, which are implemented by the three cooperating sponsors in three different departments, it was noted that the projects are implemented in high, medium and low food insecure areas. A summary of this data is shown in figure 5.1.

[3] A hydrological failure is understood to be when the runoff from the catchment area has been over or under estimated.

Figure 5.1. Percentage of projects located in different food insecurity areas



When implementing micro irrigation projects in the country, certain recommended minimum aspects should be kept in mind so that these projects will become sustainable. For this purpose, the comparative table 5.1 was elaborated to illustrate what is recommended for new sustainable projects and what was encountered in the field. An important aspect that should be taken into account for a project to be sustainable it is that it should be implemented in medium to high food insecurity areas. This is because the people in these areas have a great need for water because their livelihood comes from farming. Whereas, in other areas, people have greater economic opportunities because they can count on other forms of employment and thus farming becomes of less importance. Apart from that, the project should be the community's need and not that of other instances.

Table 5.1. Summary of aspects encountered and recommended in Pre-Project Planning

Recommended	Encountered
Organization. Availability of non qualified labor, local materials, interest in participating in the project.	It was observed in field that communal participation has not been what was expected in the projects. For example, in some projects the beneficiaries showed indifference in the construction of the irrigation infrastructure. This indifference can probably be attributed to a wrong focus of the project because they were located in areas of low food insecurity. Others have been implemented in places with an abundant quantity of water and therefore the community does not see the need to improve the irrigation system. As regards to the local materials for the construction of the irrigation works, no problems were detected, because the banks of local materials were located near to the construction sites and in abundant quantity. The number of work days proposed for the construction in 100% of the projects have exceeded the budget. This is due to poor construction planning and not considering such items as types of soil, working conditions and others.

Municipality. Pre disposition to support the project, it should be included in the Annual Operating Plan (POA) and the Municipality Development Plan (PDM). The technical and administrative capacity should be continuously supported. Counterpart contributions for the implementation of the project should be planned.	All the municipalities were predisposed to implement projects; therefore they are or were included in the POA and in the Municipal Development Plan (PDM). However, 90% of the municipalities do not have the technical and administrative capacity which causes delays regarding programmed payments committed for the projects. In 50% of the projects, the continuos change of mayors were the reason for delays in project implementation. In most of the cases, 80 to a 100% more time was required for implementation.
Hydrological Studies Availability of hydrological data, water availability calculations , water quality analysis for irrigation , estimates of the irrigable area.	Bolivia does not have a complete database regarding hydrological data, however these can be extrapolated or simply assumed from the nearest meteorological station to the project area. This important aspect was not been taken into account in 40% of the projects and has led to the hydrological failure of the projects. 25% of the projects have carried out a water analysis for irrigation, 25% have used analysis made for other projects, the rest (50%) do not have any water analysis which represents a danger for the area under irrigation. 63% of the projects have an estimate of the irrigated area (water balance). However, inside this group, 50% of these estimates are not well done and thus unreal values are used that can lead to a collapse of the project or they use of erroneous values relating to costs/ha. In many of these cases the availability of water does not correspond to the area irrigated. In many of these cases the proposed cropping pattern under irrigation is different from the one that is used in the water balance calculations..
Number of Beneficiaries.	This indicator coincides with that planned even though during the implementation of the construction, communal participation came with different kinds of conflicts.
Number of Hectares.	50% of the projects have enough water available for irrigation which coincides with their proposals The rest only have enough water for supplementary irrigation during the rainy season.
Soil Characteristics. Classification and aptitude of the soils for irrigation.	50% of the projects under took a soil classification for aptitude for irrigation. Inside this group, 20% carried out this analysis specifically for the project. The rest took data from other areas or it was simply based on existing information. The main reason for not undertaking a soil classification is, without a doubt, economic and the expense is not justified in relatively small micro irrigation projects.
Cropping Patterns. Without and With Project, production costs With and Without Project.	Cropping patterns in the With and Without Project situations as well as the production costs of these were found in 50% of the projects and, in the other ones, this aspect was completely forgotten. The degree of crop diversification in the proposed cropping pattern is necessary to calculate or estimate the water demand and consequently to make an adequate design of the civil works.
Water Demand. Calculation of the water demand in the Without and With Project situations.	These calculations were found in 50% of the projects and in 80% of these not well elaborated. This is because the proposed cropping pattern did not correspond to the one used in the calculations. At the same time, the situation without the project was not included. Others incorporated unrealistic factors in their water demand calculations. The proposed cropping patterns in the project proposals texts usually do not coincide with the water balance calculations presented. In many cases the water balance calculations were not done for the without project situation thus making it impossible to estimate the incremental area under irrigation.

Engineering. Topography, infrastructure design and detailed planes, metric computations, cost calculations and technical specifications.	63% of the implemented projects used an appropriate topography and had detailed plans of the proposed infrastructure. However, 70% of these do not have plans of the general location of the irrigation infrastructure. The engineering of the projects has been adequate and the metric computations done in a detailed manner therefore being able to obtain a general budget that is not far removed from reality. 63% of the projects have technical specifications. The rest of the projects do not have detailed plans but simple diagrams of infrastructure and neither do they have technical specifications.
Cost/Benefit Analysis. With and Without Project	50% of the projects visited have this information which is positive i.e the C/B ratio is greater than 1..
Environmental Impact Analysis of environmental impact, correction measures.	Only 13% of the projects have been granted an environmental certificate approved by the vice environment ministry. The other 13% have an environment baseline certificate in which corrective measures are included. The rest of the projects do not have any environmental impact studies and are not implementing any protective measures. This is probably because they are small projects which do not damage the environment. Never-the less, the cooperating sponsors in charge of implementing the projects, consider it necessary to implement soil conservation and reforestation practices in a second phase.
Water Rights. **Existing traditional systems, detect problems and conflicts.**	In general, traditional water rights have been respected within the communities and neighboring communities which include water rights above and below the water source. For this reason no inter-communal conflicts were detected regarding the water source. In 70% of the projects no conflicts were detected basically because small traditional irrigation systems are involved. The rest of the projects are new medium to large sized ones and thus no problem exists in the use of water for irrigation.

5.1.2. Micro irrigation and its fit within the DAP approach.

After visiting eight of the micro irrigation projects implemented during the first DAP, one can say that highly positive aspects, which in some form alleviates poverty in food insecure areas, were observed.

However, in most of the projects visited, there were delays in their implementation which were caused by implementation problems. Once projects have been identified and, working together with the municipalities, who in many cases had not included the projects within their POAs, meant that one had to wait until the following year. Once the projects are approved by the government, the municipality could count on financial resources. Upon POA approval, an agreement is signed between the project beneficiaries, the municipalities and the cooperating sponsors to implement the project according to the proportions agreed upon previously. This whole process can take up to one and a half to two years. Another factor that also further delays the process is that there are continuous changes of mayors both during project planning and implementation of the irrigation works.

As indicated in the previous paragraph, positive and negative impacts of the projects cannot be measured at the moment because construction is still going on and in other cases, training of beneficiaries is still being implemented. Other projects have planned their institutional strengthening and committee training for a second phase. If these projects are followed through into a second DAP and if the next projects could be implemented within the first and second years, project impacts could then be evaluated.

5.1.3. The present water laws and Title II

The government elaborated a water law proposal to be revised in parliament for it's approval. However, the small holder farmers (campesinos) had a lot of doubts about it and, under their pressure, the proposed water law was cancelled in September, 2000. As part of an agreement signed at that time, the parliament promised to revise all the relevant information and laws concerned with water. In reality this process is still continuing and the details are still unknown.

In this opportunity (Sept., 2000), a committee was nominated by the Vice Ministry of Agriculture and Livestock to elaborate a new document for a new water regulation on the use of water for irrigation. To date (May 2001), a new draft water regulation exists and is still confidential. Never-the-lees, the consultants were authorized to indicate that this proposed regulation over the use of water for irrigation is based on three central points which are:

- ✓ National registration of irrigation systems.
- ✓ Norming procedures and processes for the elaboration and execution of irrigation projects.
- ✓ Under take a follow up of the management of all irrigation systems.

Of the three points indicated previously, one can indicate that, fundamentally, the idea is that all irrigation systems within the country are registered. This registry is free of charge both for traditional and new irrigation systems and is necessary for any improvements or the implementation of new projects. The benefiting communities have to register their water for irrigation in the departmental prefectures.

However, there still are some points to be solved and are still in the process of discussion. One of these points is the property rights of the irrigation infrastructure which are partially or wholly financed by the government either through loans or donations. Some large irrigation systems and traditional systems are managed differently where the government condones some for a period of 30 to 40 years and others are directly transferred to the beneficiaries. As indicated above, this process still has to be solved.

After revising the relevant information, the consultants conclude that there should not be any problem with the Title II projects. The only requisite for now, is to

register the water for irrigation purposes which should be undertaken by the community. The registration is free of charge and it should be emphasized that the government will not charge for the use of water for irrigation purposes and only want the water to be registered.

5.1.4. Moving environmental considerations to the field

During project planning, environmental aspects should be considered such as the fragility of the soils to be irrigated, soil fertility (crop rotation), slopes, erosion gulleys, existing degree of forestation and the correct use of pesticides and chemical fertilizers.

For the construction of the irrigation infrastructure (canals and water off takes) and their location, the type of soil and its susceptibility to erosion as well as possible land slides should be considered. For this one should foresee the planting of trees along the length of the canal, infiltration ditches and other preventative and soil conservation measures. These especially should be considered in the upper catchment areas and the main irrigation canals.

In order to implement these soil conservation practices during the construction stage, it is very important to make the beneficiaries aware of these activities of forestation and soil conservation before hand. On the other hand, the implementing cooperating sponsors should have the economic means and technical personnel in the area in order to implement these practices contemplated in the project.

Only 25 % of the micro irrigation projects visited were implementing soil conservation practices within the area. The other 75% were not implementing this concept because, in some cases, it was not included in their budgets or that the construction work has only recently been completed and conservation measures will be passed on to a later implementation stage such as the next DAP.

None of the projects visited are implementing catchment area management which in most cases are completely unprotected. The responsible technicians of each cooperating sponsor informed the mission that this is another aspect to be included in a second project phase.

To summarize, soil conservation and catchment management within the Title II irrigation projects should be taken into account in the implementation of future projects.

5.2. Economics of micro irrigation.

The micro irrigation projects implemented by Title II represent a great social and economic potential in the benefiting communities. However, there is still a long way to go before they are sustainable.

5.2.1. Place of economics in food insecurity programs.

When analyzing this aspect during the revision of documents and projects executed by the different cooperating sponsors, one finds that not much attention was paid to the parameters used by other financiers (FDC, PRONAR; BID) because these projects are donations and not loans. However, as noted in table 3.2, the parameters commonly used such as cost/ Ha and cost/family are relatively low compared to by those used by the financiers mentioned above. This is probably because 100% of the projects visited were financed where existing infrastructure and already been financed from a another source. This probably explains the lower investment cost indicated above. However, one should take into account that the benefit/ family is not equal for all as the name suggests; one family could not benefit in the same manner as another family who has more water rights. This difference and uneven family benefits requires another form of analysis.

In order to obtain a realistic parameter of the costs per family and the costs/ha increased under irrigation, the correct water demand and the sustainable technology as well as the technical and social benefits should be considered when implementing or improving part of an irrigation system.

In areas of extreme poverty, where aid is most required, and the investment is high, the economic indicators could pass the established limits because the cost of transporting materials and maintaining technicians in the field is more expensive. It is these projects which really need help and have a greater chance of becoming sustainable than those which are situated close to urban areas and have other economic aspirations.

5.2.2. Applying economic and financial analysis to micro irrigation

The application of economic and financial analyses is important for all kinds of projects. However, projects exist where there is no return and the benefit cost ratio is outside the permitted range. These parameters are considered less important when the objective of the project is to help poverty areas with communities which have a higher food insecurity.

Economic and financial analyses of micro irrigation projects are fundamental for establishing whether or not a project will have a beneficial economic impact.

However, it should not be used as the only selection criteria. In the case of micro irrigation projects being implemented by PL-480 Title II Program, not only is a benefit obtained from agricultural production but also various social benefits (e.g. improved organization in the system management, operation and maintenance, marketing, higher family incomes and improved living standards, etc) which are priorities in this program. Thus one should not only evaluate the returns on investment but also the possible social benefits.

Of the projects visited by the consultants, 60% would need to incorporate economic and financial analysis (because they find themselves in low food insecure areas). The rest do not require one. 80% of those projects which require this type of analysis, did include them in their project files but with unrealistic amounts. They should have taken the costs of the existing infrastructure, financed by others, into account as well as the technical assistance costs. .

5.2.3. Food for work and micro irrigation

In this aspect, the consultants detected certain positive and negative aspects concerning food for work. For a better understanding, the details of which are shown in table 5.2.

Table 5.2. Positive and negative aspects of using food for work

Positive aspects	Negative aspects
It avoids the temporary migration of the small holder farmers who seek work in the cities in order to increase their family incomes. This usually occurs in the dry season which, at the same time, is the best period to construct the micro irrigation projects. It is during this period that food for work should be used, so that the people stay in their communities in order to work in the micro irrigation projects.	Food for work can create certain dependencies within the community and in many cases, the people refuse to work unless they are given food.
Food for work can also be efficiently used in the implementation of soil conservation practices and improving rural roads.	

In order to avoid creating dependencies on food for work, a good work plan has to the made and the cooperating sponsors should explain to the communities that the food for work is only temporary. That is, that it will only be provided during the dry season in the region which is when the small holder farmer stops his farming activities and seeks other activities for subsistence which is the reason for temporary migration.

In conclusion, food for work should only be used in poverty stricken and highly food-insecure areas. It should not be used in areas where there is sufficient water,

a more advanced and diversified agricultural production and the farm families already have a certain degree of food security. In these cases, food for work is highly negative not only for project development but for the communal development itself. In such cases, the consultants have come to the conclusion that the best way to avoid these problems would be to sell the donated food on the market. These funds could then be used to purchase inputs and non-local materials, pay for necessary skilled labor and contract specialized technicians for training the farmers.

90% of the projects visited used food for work during implementation and 25% of these created dependencies within the communities as indicated above.

6. Adequacy of implementation arrangements for construction of the system

Of all the projects visited by the consultants, one can conclude that 90% had an adequate preparation prior to construction. 10% of these did not justify an adequate technical solution and other better alternatives had to be selected with the help of the project beneficiaries. This was caused by not analyzing different alternatives during the planning stage of the project.

6.1. Role of user groups

Once a project implementation agreement is signed between the municipalities, the cooperating sponsor and the beneficiaries, the communal organizations elect a works committee, which in many cases originates from the pro-project committee. The work committee then coordinates directly with the cooperating sponsor to determine the numbers of man days required to implement construction activities. At the same time, and together with the person responsible for the execution or supervision of the works, the quantity and quality of the local materials required for constructing the irrigation infrastructure is verified.

Of the projects visited, one can come to the conclusion that 63% of these did not have problems regarding the beneficiaries' roles during project preparation. 37% of these had problems of temporary migration and the people (beneficiaries) did not want to work in the project unless they were given food or were paid; even though the project was for their benefit.

6.2. Contracting

According to the documentation revised and the projects visited, only one contracted a construction company. This company the experience in constructing hydraulic works and similar projects where the communities participated in providing unskilled labor and local materials. In 63% of the projects, the agencies contracted external supervision (construction engineers) during construction of the irrigation infrastructure. This aspect resulted to the highly positive for the projects.

6.3. Local government support

Once the general budget of the project has been defined, the contributions of the cooperating sponsors, municipalities and beneficiaries are decided upon. The municipal contribution varies between 7% and 62% of the total construction cost of the irrigation infrastructure. As indicated previously, this percentage varies

according to the degree of municipality involvement in the implementation of different projects.

The municipality contribution usually consist of non local material, transportation equipment to carry local material to the construction site, contracting skilled labor and supervising the project.

This contribution is usually deposited in the cooperating sponsors bank account for a better management of the funds. However, as there are problems of municipal continuity, these deposits were not made at the right time which caused continual delays in project implementation.

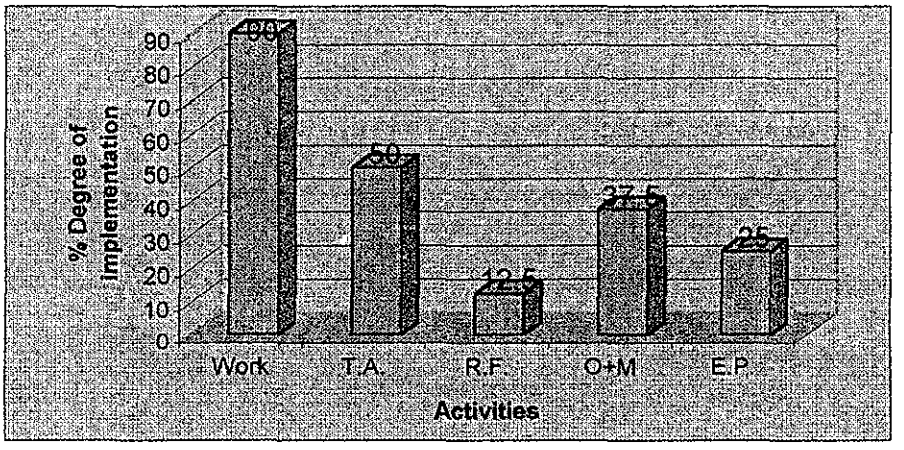
7. Assessment of project implementation

In order to assess the projects implemented in different parts of the country, the consultants visited eight micro irrigation systems (16% of the total being implemented) in the departments of Chuquisaca, Potosi and Cochabamba. This was to get a general idea of the total amount of projects being implemented by the different cooperating sponsors.

7.1. Following plans

USAID Bolivia's cooperating sponsors planned different activities within their micro irrigation projects so that they would be sustainable in the future. These activities include civil engineering works, Operation and Maintenance (O+M), Technical Assistance (T.A.), Revolving Funds (R.F.) and Environmental Protection (E.P.) amongst the most important. According to figure 7.1, one can observe that not all projects have fully implemented these activities. As indicated in the previous chapter, many of these projects do not have the properties of becoming sustainable.

Figure 7.1 Degree of activity implementation in the micro irrigation projects



Never the less, one should take into account that some projects have only recently been constructed and the other activities are programmed for a second phase.

7.2. Timeliness of execution

During the field visits, the consultants were able to observe that a high percentage of the projects' implementation periods suffered alterations. In some cases the extended periods of execution were not serious but in others greatly over extended. For example, projects were planned to take up to three months but were completed after a year or more. In general, the reason for this was the discontinuity

in the municipalities where the authorities were continually changed or simply were not present in the area. This caused delays in planned payments and consequently the projects were delayed.

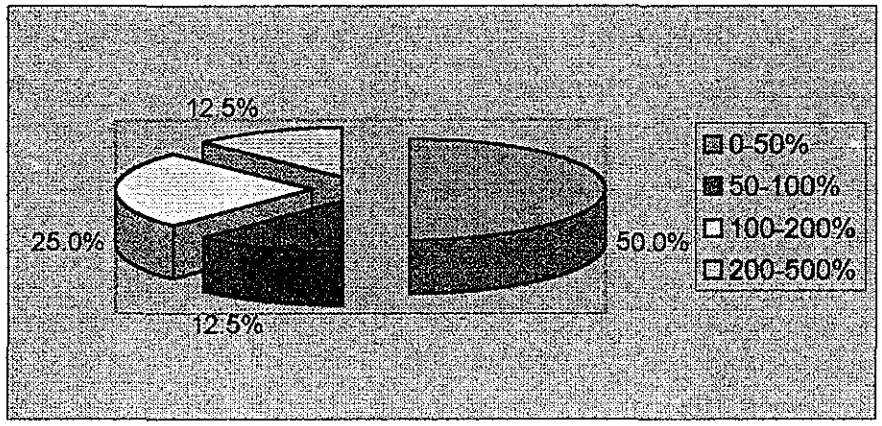
Another factor that delayed the construction process were in areas where traditional irrigation exists and the farmers wanted to irrigate their fields. Thus, while irrigation was going on, the construction work was held up or moved to another site.

According to conversations held with the cooperating sponsors' technicians and some mayors while visiting the micro irrigation projects, the willingness to work in some communities did not exist because of other interests. Therefore a 100% communal participation was not present thus causing delays in project implementation.

Other projects were delayed because of problems with the ownership of farm plots where irrigation infrastructure was planned to be built. Here the plot owners would not permit any construction on their land. Thus, here again, construction delays were caused while independent intermediaries solved these communal conflicts.

In figure 7.2., one can observe the degree of delays occurred in the different micro irrigation projects visited. This information was obtained from the project documents and interviews in the field

Figure 7.2. Degree of micro irrigation implementation delays



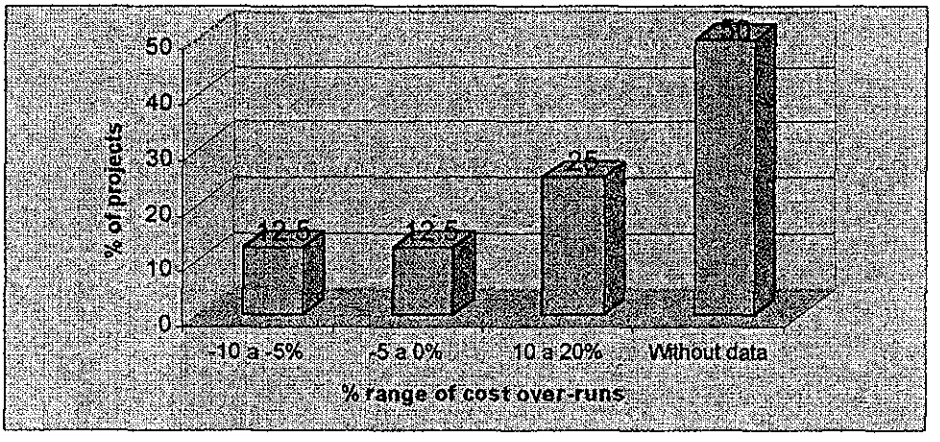
7.3. Cost over-runs

Information provided by the different cooperating sponsors concerning the initial investment cost prior to project implementation were reviewed. At the some time documents about the termination of projects were examined to determine whether there were any cost over-runs. Many of the cooperating sponsors could not provide the consultants with the relevant documentation but with several verbal requests, the final figures were provided by some of them. With the data available one could

estimate the percentages of the initial (planned) projects cost versus the real project cost. These are shown in figure 7.3.

It should be noted that of the information provided, only 50% of the projects showed any clarity as regards to amounts invested or not invested and where project budgets indicate very different values to those actually executed. These values do not coincide with the agreements signed by the there principal contributors of the project. It is also not clear why these variations exist. Although it is not within the scope of this consultancy to investigate the accounts of each project some idea about the planned and executed costs was obtained from about 50% of the projects visited.

Figure 7.3. Degree of cost over runs



Of all the projects visited, the cost of technical personnel, use of vehicles, housing and other administrative expenses were not considered in the project implementation cost. These costs should be included in each project's budget which should include the operation and maintenance of offices and living quarters for the technicians during the construction and post construction phase of the project, salaries of permanent and eventual staff, vehicle costs (motorcycles, pick ups) and other equipment, fuel and oil required during the implementation of the project. In most of the cases, these budgets represent up 50% to 100% more of the construction cost.

7.4. Adequacy of planning versus current system construction

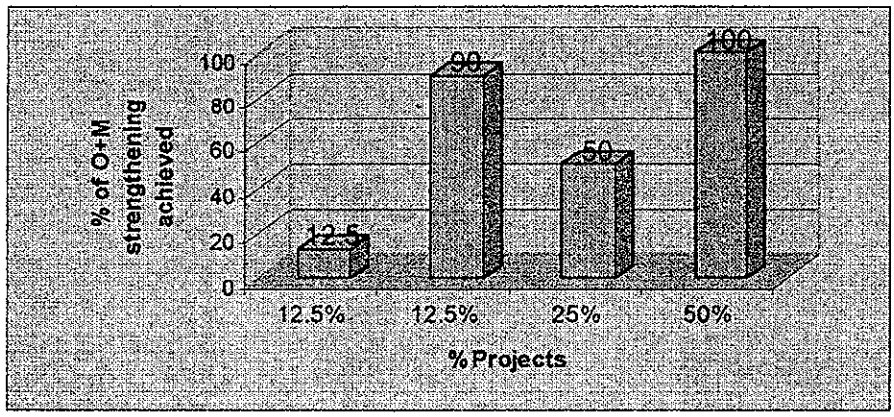
In regards to irrigation infrastructure, only 63% of the projects visited maintained their original idea or conception of the project which were conceptualized with the beneficiaries. The remaining 37% had to make substantial changes in the irrigation infrastructure which occurred during construction. This is because the beneficiaries disagreed with the original plans and consequently changes had to be made, for example in different structures or canal alignments.

8 Assessment of institutional strengthening

8.1. Capacity to do Operation and Maintenance of water user groups

During the field visits performed by the consultants, one was able to detect that in 50% of the micro irrigation systems, irrigation traditions were already established which includes the operation and maintenance of their systems. For this reason institutional strengthening was not necessary. Of the 50% of these projects, 25% have an irrigation tradition but the operation and maintenance is not sufficient. Therefore the technicians responsible for each project foresee training in this aspect. This is especially considered for the projects which have recently been constructed. Referring to that indicated above, the beneficiaries find themselves in different degrees of ability to undertake the operation and maintenance activities themselves. This is illustrated in figure 8.1.

Figures 8.1. Degree of O+M strengthening achieved.



According to the information provided by the different cooperating sponsors institutional strengthening of the recently formed irrigation associations and/or committees will continue into the next DAP.

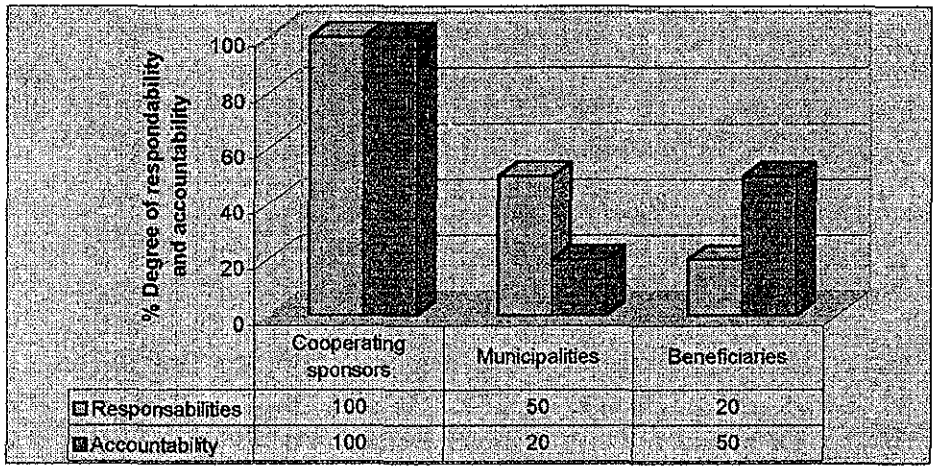
8.2. Institutional responsibilities and accountability

Within the micro irrigation projects visited, different degrees of responsibility exist between the different parties involved in a project. In general the municipalities are responsible for paying for the rent of equipment, skilled labor and help in transporting local materials. The beneficiaries normally collect and load local material and provide unskilled labor which is used in the construction of the irrigation infrastructure. Generally the cooperating sponsors contribute with inputs or non local material, supervision, and in reality are the ones responsible for administrating the project as the municipalities deposit their contributions into the cooperating sponsors' bank accounts every one or there months or simply according to the agreements made between the two parties. In this way the

cooperating sponsors is responsible for all the receipts and payments for the project. With their field technicians, they coordinate directly with the community's works committee as for as local support is concerned. Here they control the number of man days required for the construction as well as the quantity of local materials. In some projects however, this role was undertake by the municipality and the cooperating sponsors only provided the inputs and cash resources for the construction. In areas where irrigation is a tradition and the beneficiaries are well organized, this method of project implementation is successful. However, in areas where a clearly established committee does not exist and there is no defined regulation of procedures, bad experiences were gained by investing in areas where the sustainability of a project is not guaranteed.

Figure 8.2 illustrates the degree of responsibility and accountability of the three institutions involved in the implementation of the project.

Figures 8.2. Degree of responsibility and accountability



In the figure above, high responsibility is qualified with a 100, medium to regular with 50 and low with 20 over 150 points.

The responsibilities of each institution involved are stipulated in a document that are part of the project. This document is an agreement signed between the beneficiaries, the municipalities and the cooperating sponsors. This document also clearly indicates the method of payments detailed by quantities per item and generally in a percentage.

Nevertheless, some items are part of the strengthening of the Irrigation Committee or Association, such as training in management, operation and maintenance of the system and others mentioned previously, which do not form part of the current agreement and will be performed in a second phase of a project. In 90% of the cases the cooperating sponsors plan to do just such in a possible next DAP..

9. Marketing activities

The marketing activities of each micro irrigation project is based on the diversification of crop production under irrigation which was described in section 4.1. With water for irrigation one can sow o plant earlier in order to obtain higher prices in the market when there is a shortage of the product. Besides that, two crops can be grown in the same field in one year which automatically increases the produce for home consumption and for sale in the market. According to the different interviews held with the cooperating sponsors technicians, market studies are being undertaken in 75% of the implemented projects. Adding to this, the principal limiting factor in 50% of the projects is the deficient and scarce network of rural roads to bring agricultural produce to the market. In order to alleviate this problem, the cooperating sponsors are implementing rural road improvement projects.

Using the experience of some irrigation systems implemented in the country the cooperating sponsors are trying to form groups within the communities to be in charge of the marketing the farm produce in the principal departmental capitals. In this way, they hope to avoid the current intermediaries who purchase their agricultural produce at very low prices.

Some of the cooperating sponsors are implementing an interesting method of providing the small holder farmers with market price information via local radio stations. Prices of inputs and agricultural products are given from the principal markets in Cochabamba, La Paz, Santa Cruz, Sucre, Tarija and Potosi, and most of the members of the communities listen to this news on their radios.

It is recommended that marketing specialist are contracted in order to assist the cooperating sponsors with their marketing studies. For example, an analysis should be undertaken to see what the demand for different agricultural products are in the different departmental capitals and during which periods. The aim of these studies is to obtain better prices in the markets and offer the consumers a diverse range of better quality agricultural products.

10. Assessment of training requirements

After revising the information of each micro irrigation project and visiting them in the field, the consultants were able to detect certain details and general aspects which are described in the following sectors.

10.1. During the planning phase

During the preparation of a project, one has to clearly define the roles of the different institutions who are going to implement the project. These should be clearly defined for before, during and after project implementation. Both economic aspects (budgets for the irrigation structure) and the post implementation phase of the project should be considered. Referring to this aspects, one should take into account that indicated in section 5.1.3 in which the new water regulation proposal contemplates amongst its most important points is the "establishment of procedures to norm and regulate the process of elaborating and executing irrigation projects".

In planning new irrigation projects, a five year duration should be contemplated in order to achieve their sustainability. Shorter project durations cannot guarantee the sustainability. This minimum period is based on experiences gained in other irrigation projects implemented in the country where the time needed for constructing the irrigation infrastructure and the follow up of a project (Operation and Maintenance, technical assistance, revolving funds and environmental protection) requires a minimum of five years and maximum of 10 years. In cases where the cooperating sponsors intervention period has terminated (conclusion of a DAP), which is before gaining project sustainability, then they should leave trained personnel within the municipalities or other institutions so that the project can obtain its sustainability.

As indicated in the sections above, total project budgets should not only include the investment cost of the irrigation infrastructure but also the expenditures incurred before, during and after total project implementation for the period the cooperating sponsors feel necessary and sufficient for a sustainable project.

In the project identification and elaboration stage, a clear idea of the potential markets is necessary to elaborate the new cropping patterns and calendars in the situations with and without the project. This is done so that the future impact of project implementation can be assessed.

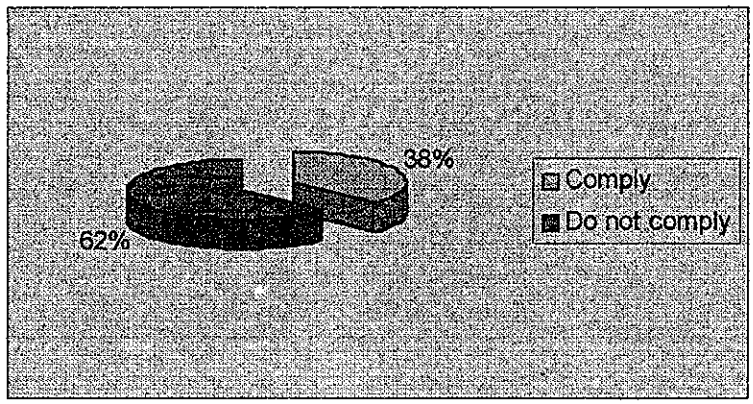
Taking the new cropping patterns into account, an appropriate adequate design of the irrigation infrastructure required can be made. The design should also include the most appropriate method of irrigating which in turn depends on the types of crops to be grown and soils in the area. During this planning stage it should be

clearly established, together with the beneficiaries, what type of water off take should be constructed. This is also the case with canal alignment and proposed irrigation structures so that they are easy to operate and maintain. This stage is very important so as to avoid delays during construction.

During the project preparation stage the field staff should have a sound knowledge of the benefiting community's culture and customs. On the basis of this knowledge, the future organization of the irrigation associations or committees can be formed for both the construction and operational stage of the system. Other important aspects to be considered during the planning stage are technical assistance, revolving funds for inputs and environmental protection measures. Together with this information a detailed project implementation plan should be elaborated to include construction, O+M, technical assistance, introduction of a revolving fund and environmental protection measures.

Figure 10.1, shows the general deficiencies encountered in irrigation project planning of the projects visited according to the minimum requirements indicated in table 5.1.

Figure 10.1. Percentage of the projects which comply with the planning requirements



After revising the information provided and conducting interviews with the cooperating sponsors' technicians, it is necessary to conduct training courses in project planning procedures. Recommended topics are outlined in section 10.4 below.

10.2. During implementation

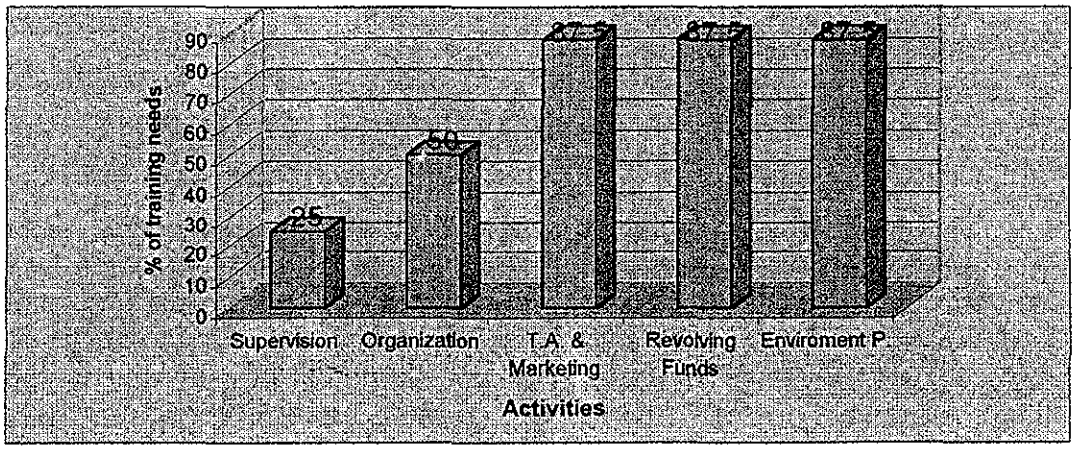
The following aspects were detected during the construction of the irrigation infrastructure:

- As regards to the supervision during construction, some technicians are not sufficiently trained to carry out this task. Sometimes technicians are asked

to perform this task when it is not his field of specialty. E.g.. an agronomist supervising construction work.

- In some cases the coordination between the communal organization and the cooperating sponsors is not sufficient. The recently formed works and irrigation committees require constant help and advise from the cooperating sponsors regarding infrastructure construction and operation and maintenance of the system.
- Market studies should be a priority in order to carry out a purposeful technical assistance on behalf of the cooperating sponsors. The technical assistance should help the project beneficiaries in the introduction of the new cropping pattern under irrigation. Here field trials and demonstration plots as well as farmers field days are highly recommended.
- The cooperating sponsors should assist the irrigation associations or committees in the creation and self management of a revolving fund in order to purchase adequate and appropriate inputs in bulk. These funds should not come from USAID sources but should come from the beneficiary contributions themselves other wise recuperating problems in the future will occur.
- Environmental protection is another important aspect which the cooperating sponsors should consider in micro irrigation project implementation. Here the project beneficiaries should be made aware of the necessity to implement soil conservation and reforestation measures in order to avoid soil erosion hazards.

Figure 10.2. Percentage of training needs for project implementation.



After revising relevant project documents and field trips to the different micro irrigation projects, the consultants come to the conclusion shown in figure 10.2. This figure illustrates the deficits encountered in the different micro irrigation projects visited as regards to the different activities that are necessary to implement. It is also a reflection of the training needs that may be required in order to aid proper and complete project implementation. In this case, the most important topics are technical assistance (including marketing), revolving fund management and environmental protection measures.

10.3. Post implementation phase

After construction of the irrigation infrastructure has been completed, it is recommended that the cooperating sponsors implement a follow up project. This should include training the water users in the operation and maintenance of the system. Continue with the technical assistance especially for the introduction of the new cropping pattern under irrigation, assist the beneficiaries in establishing a revolving fund for inputs, continue assisting in the different marketing aspects and continue implementing soil conservation and reforestation practices. These activities are all necessary in order to obtain a sustainable micro irrigation project.

Only 50% of the projects visited are implementing all the activities indicated in the previous paragraph. This is mainly because these activities were not included in the project plan or that construction is still under way and have not been implemented yet. Another factor could be that the staff who prepared the projects were not aware of the importance of these activities.

As regards to the introduction of revolving funds for the purchase of agricultural inputs, it is important to indicate here that the capital for this fund should come from the proper beneficiary contributions and not from the cooperating sponsors. However, the cooperating sponsors should train the beneficiaries on how to manage these funds.

10.4. Suggestions for specific training.

After assessing the different micro irrigation projects visited and consulting the technicians in the field, one found that certain skills were lacking in project planning and elaboration, implementation and post implementation. For this reason the consultants designed a basic training course for the cooperating sponsors' technicians. The idea of the course is to bring all the technicians to the same standard with the intention of obtaining uniform micro irrigation projects in the future. The course is designed for professional civil engineers, agronomists and sociologist who are presently implementing micro irrigation projects and provide them with basic know how on how to design and implement micro irrigation projects.

Table 10.1 presents the contents of this course, which is planned for a six day duration with nine of the most important subjects that the consultants feel are necessary. During the field visits and interviews with the field technicians, the following topics for training were noted as necessary.

a) Irrigation management, operation and maintenance.

b) Environmental protection.

c) Management of revolving funds for inputs.

d) Marketing.

e) Cropping patterns and water demand calculations.

f) Communication and training of water users.

g) Financial and economic analysis of micro irrigation projects.

h) Design of irrigation projects.

i) Participative planning of micro irrigation projects.

j) Design of irrigation infrastructure.

k) Visits to the Punata and Tiraque irrigation systems.

Of this list, the consultants selected seven of most important subjects. These are shown in the table below together with their contents.

Table 10.1. Basic Training Course for irrigation.

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Morning	Introduction to the situation and problems of irrigation in Bolivia.	Subject 1.cont. Subject 2. Technical assistance as a service to accompaniment.	Field Work (whole day) Diagnosing an irrigation system with group work	Subject 5: "Hydrological Balance and water demand calculations"	Subject 6: "Economic, financial and social evaluation of irrigation systems"	Presentation of group work
Afternoon	Subject 1. "Peasant Management of irrigation systems".	Subject 3: "Guidelines for the formulation of irrigation projects". Subject 4: "Types of irrigation infrastructure. Unitary costs".		Subject 5. cont.	Subject 7: "Environment and irrigation systems".	Course evaluation.

Course costs: 350 $us/Person, which includes board and lodging, instructors fees, course material and software.

Table 10.2 shows the minimum contents of each of the seven subjects recommended by the consultants for the basic training course on irrigation.

Table 10.2. Minimum contents of the subjects in the basic irrigation training course.

Subject	Contents
1. Introduction to the situation and problems of irrigation in Bolivia.	Area under irrigation, location and size of systems, number of beneficiaries, areas still with irrigation potential, problems encountered, irrigation project concepts.
2. Peasant management of irrigation systems.	Peasant agriculture and management of their irrigation systems, institutional aspects of irrigation in Bolivia, operation and maintenance of irrigation systems
3. Technical assistance as a service to accompaniment	Experience in technical assistance in the past in irrigation projects and at the professional an institutional level. Recommendations for technical assistance in peasant irrigation systems.
4. Types of irrigation infrastructures. Unitary costs.	Different types of hydraulic structures used in irrigation, calculations of their unitary costs.
5. Hydrological balance and water demand calculations.	Hydrological balance calculations, water supply, cropping patterns and calendars in the with and without project situations, water management, field irrigation methods, crop water requirements, irrigation efficiencies, incremented area under irrigation.
Field Work: Diagnosing and irrigation system. (whole day)	Using the knowledge gained in the two previous days gather relevant information in the field necessary for irrigation designs.
6. Economic, financial and social evaluations of irrigation systems.	Yields with and without project, prices, total agricultural production with and without project, total investment economic parameters and social benefits of irrigation projects.
7. Environment and irrigation systems..	Legal aspects, environmental base line certification, water management and environment, soil conservation practices, forestry, crop rotation, correct pesticide use.

The basic training course shown in the table above is to bring all the technicians up to the same level in planning and implementing micro irrigation projects. However, should some of these technicians want to deepen their knowledge in certain subjects, the consultants revised information from public and private institutions who provide training in irrigation. The National Irrigation Program (PRONAR) has the most wide experience in this field and its Technical Assistance Component (CAT-PRONAR) has highly trained and experienced staff. Thus, this institution is recommended for specific training courses, which are of a longer duration than the basic course indicated above.

PRONAR provides training in different aspects concerned with irrigation and the most important of which concerning irrigation planning, implementation and post implementation are:

a) Small holder irrigation management.

b) Design of small hydraulic structure for irrigation.
c) Operation and maintenance of irrigation systems.
d) Focal points in technical assistance in irrigation and rural development projects.

Table 10.3 shows the contents, duration and costs of each of these courses. The price includes board(food) and lodging, course materials, software, instructor fees and local transport.

Table 10.3 Courses offered by PRONAR

No	Title	Contents	Duration	Cost ($us/person)
1	Small holder irrigation management.	Develop solid skills about the management of peasant irrigation systems, peasant agriculture and institutional aspects concerned with irrigation in Bolivia so that the professionals can carry out adequate and coherent assistance of peasant irrigation systems.	10 months divided into four cycles with obligatory and non obligatory presence	1,150.00
2	Design of small hydraulic structures for irrigation.	Develop conceptualized technical capacities for the engineering design of hydraulic structures for irrigation which are coherent with the social and cultural environment, the geographic and agro-ecological diversity in the country.	5 days	200
3	Operation and maintenance of irrigation systems	Provide conceptual elements and methods for diagnosing the management of irrigation systems and for the preparation and execution of projects for technical assistance in operation and maintenance of irrigation systems under peasant management.	5 days	200
4	Focal points in technical assistance in irrigation and rural development.	Reflect on and exchange experiences collectively and horizontally over different focal points in technical assistance which are implemented in irrigation projects and rural development programs. Collectively compare this to professional and institutional practices that permits the improvement of technical assistance services in peasant communities and in particular in peasant irrigation systems.	3 days	60

As regards to catchment area management, soil conservation and forestation, the Integrated Catchment Area Management Program (PROMIC[4]) in Cochabamba is the institution that has the technical capacity to provide training in these activities. It has well trained personnel in these areas. However, unlike PRONAR, they do not

[4] PROMIC, Programa de Manejo Integral de Cuencas

have specifically programmed courses but these two institutions usually coordinate with each other in order to provide specific courses related to environmental protection such as:

- Mechanical and agronomic techniques
- Crop management
- Crop rotation and diversification
- Agro-forestry concepts
- Sprinkler irrigation
- Integrated management of catchment areas
- Soil conservation
- Others, according to specific requirements.

These courses can be complementary to the ones shown in table 10.3. The costs per person of these courses can be defined according to the number of students and the contents of a specifically prepared course.

Another very useful and practical method of training, which the consultants recommend, is that the cooperating sponsors' technicians carry out exchange visits among their micro irrigation projects. During these visits, ideas and experiences can be exchanged and discussed. Communal leaders should also be taken along on these exchange visits so that they too can obtain ideas and experiences from other community leaders. These exchange visits would greatly enhance PL-480 Title II's efforts in micro irrigation project implementation. Also recommended are field visits to irrigation systems that already have a long history of implementation. Two good examples of these are the Tiraque and Punata irrigation systems in the department of Cochabamba. Both systems have their own associations that manage the operation and maintenance, technical assistance and revolving funds for inputs by themselves. Cooperating sponsors' technicians could learn a great deal from the experiences gained by these two associations.

11. Conclusions

In a general manner one can arrive at the following conclusions:

- Eight micro irrigation projects were visited in the departments of Cochabamba, Chuquisaca and Potosi.
- The investment per Ha and per family are below the established parameters recommended by FDC and PRONAR ($us 2,500/Ha and $us 4,500/ amily) mainly because they are partially implemented projects and do not include the total costs.
- 80% of the projects visited are still in the construction phase or only have recently been completed and therefore it is too early to observe much crop diversification.
- In the majority of the projects visited, the cooperating sponsors are still forming and advising the irrigation committees on how to manage and operate their systems.
- On the average, a 30% contribution has been obtained from communal participation in the implementation of the micro irrigation projects.
- 80% of the projects have a chance of becoming sustainable only if the cooperating sponsors continue to provide support in the medium and long term (3 to 5 years).
- Future micro irrigation projects to be implemented should, if necessary, be accompanied by a rural road improvement project in order to have a better access to the markets.
- Micro irrigation projects have a good potential for alleviating poverty in food insecure areas. However, they should only be implemented in areas of medium to high food insecurity.
- Detailed and complete project planning is essential for micro project implementation.
- The implementation of micro irrigation projects fits in well with the DAP approach in order to alleviate poverty in highly food insecure areas.
- Problems with water laws and regulations in preparation will not pose a problem in the implementation of micro irrigation projects. The only requisite, however, is their registration.

- Only 25 % of the projects visited are presently implementing soil conservation and forestation measures. The rest have planned to do so in a second phase of project implementation.
- In areas of extreme poverty, the investment costs of micro project implementation could be high but this should not be the only selection criteria as other social benefits, which are more important, can be obtained.
- Economic and financial analyses are essential to all micro irrigation projects but they should not be the only selection criteria for implementation.
- Food for work should only be used in areas of high food insecurity for the implementation of soil conservation practices and rural road improvement. The use of food for work in other areas of lesser food insecurity causes dependencies within the communities.
- 63% of the projects visited did not have problems with the beneficiaries as regards to project preparation.
- Only one of the projects visited contracted a construction company and the others engineers to supervise the construction.
- Local government support from the municipalities as far as the contribution for project implementation is concerned, varied between 7 and 62 % of the implementation cost.
- In general, not all the activities planned for project implementation have been completed in order to obtain sustainable projects. These include technical assistance, the introduction of a revolving fund, operation and maintenance and environmental protection measures.
- Most of the projects visited had suffered delays in their implementation which was mainly caused by discontinuity in the municipalities, farmers working in agricultural activities while construction was going on, poor beneficiary participation and various other conflicts.
- As regards to cost over-runs, 50% of the projects showed any clarity as regards to amounts planned to be invested and actually spent. The other 50% of the projects cost over-runs ranged between –10% to +20% of their proposed budgets.
- Only 37% of the projects had to make substantial changes in irrigation infrastructure and canal alignments which deviated from their original plans.
- In 63% of the projects, the irrigation committees are almost ready to carry out operation and maintenance activities by themselves. The rest still require help from the cooperating sponsors in this aspect.

- The beneficiaries, municipalities and the cooperating sponsors demonstrated responsibility and accountability in project implementation of all the projects visited.
- Market studies of different agricultural produce should be included as part of each project implementation. Also important is the improvement of rural roads for better market access.
- Micro irrigation project beneficiaries should be involved right from the beginning in the planning phase of the project.
- 62% of the projects visited have not completed with all the requisites for proper planning considered necessary by the consultants.
- During project implementation, not only the construction activities but also technical assistance, revolving funds and environmental protection should also be undertaken .
- Certain skills are lacking as regards to project planning and implementation on behalf of the field technicians. Thus a basic irrigation training course was elaborated with he aim of bringing all the relevant cooperating sponsors' technicians to the same level and provide them with the basic knowledge on how to design and implement micro irrigation projects.
- For further and more specialized training, the consultants recommend the courses offered by PRONAR.

12. Recommendations.

With all the aspects indicated in the preceding chapters, the following recommendations are made:

- ✓ In order for a project to be sustainable, it should be situated in areas of medium to high food insecurity. The project should be a communal necessity and not that of other instances.
- ✓ Beneficiary participation is very important for the project's success and sustainability. The beneficiaries have to feel that they are the owners of the project and not just its laborers. In some of the micro irrigation projects visited, one gains the impression that the beneficiaries are doing a favor to USAID's cooperating sponsors by working in the improvement of their irrigation system and they are not aware that the infrastructure is for their own benefit. In this point, the cooperating sponsors, through their technicians in the field, play an important role because they are the ones who have to be explicit with the beneficiaries and get them involved with the project. They should also make the beneficiaries feel that the project is theirs. Under this situation the small holder farmers will work for their own benefit and become conscious that the work is for themselves and neither for the cooperating sponsors nor the municipalities.
- ✓ Project planning should be undertaken jointly with the beneficiaries and it should be carried out in the field and not behind a desk. The minimum period required for a good integrated planning is estimated to be, for a medium sized project, six months. During this period, designs for the infrastructure, canal alignments, operation and maintenance plans, technical assistance, creation and management of a revolving fund and environmental protection measures should be elaborated.
- ✓ If the new water regulations are approved in parliament, then it is recommended that the new PL-480 Title II program's micro irrigation projects be registered.
- ✓ In order to solve some of the problems mentioned earlier, training of the technicians according to their professions and fields of work with in their institutions is recommended in the subjects indicated in section 10.4 of this document.
- ✓ In order to obtain uniform projects that contain the minimal recommended aspects, it is suggested that USAID's cooperating sponsors use the guidelines for the formulation of micro irrigation projects which were prepared by the consultants and are presented in Appendix 4. These are

based on the official guidelines used by the Peasant Development Fund (FDC).

- ✓ Future micro irrigation projects that are to be implement by PL-480 Title II program should be accompanied with a rural road improvement project. This would not only facilitate transporting construction material for the irrigation infrastructure but also the transportation of agricultural products to the markets in the future.
- ✓ It is recommended to make a) an economic and financial and b) social analysis of those micro irrigation projects to be implemented in the future.
- ✓ Each micro irrigation project should have a file with the following contents:
  - The project profile
  - The final project design according to the guidelines attached.
  - The instruction book in which the whole construction process is recorded including conflicts, modifications, changes in instructions etc
  - Documentation regarding changes in instructions.
  - Minutes or records of the beginning and conclusion of the project.
  - The final construction period of the construction work.
  - Reduced plans of the project and those actually executed (as built).
  - Various items that the executing entity considers necessary to include within the project file.

-Each micro irrigation project to be implemented should fill in an environmental impact form especially if they are new projects. In the case of improvement projects, a base line environmental form should be filled out.

-The micro irrigation projects should count on the beneficiaries participation in the planning phase and this consists of the following aspects:

- The project should be requested by the community and not by outsiders.
- It should already be included in the Annual Operating Plans (POAs) so that one does not have to wait until the following year when the community and the municipality decide to include the project in the next POA. This avoids delays in project implementation.

- The design of the irrigation system should be with beneficiary involvement right from the start and they should feel that they are the owners of the project.

- The future operation and maintenance of the project should be discussed and analyzed with the beneficiaries. Items such as water rights, irrigation scheduling, contributions that have to be made (man-days and money) and their organization.

- The new cropping pattern should be defined jointly with the beneficiaries. Their ideas are generally very sound and reasonable as they have knowledge of their own environment and potential markets for their farm produce.

- As with the above, the necessary input requirements (seed, planting material, organic and chemical fertilizer, pesticides, equipment and tools) should be defined jointly.

- Discuss and define the possibilities of introducing a revolving fund for the purchase of adequate and appropriate inputs in bulk. This fund should be managed by the beneficiaries themselves and the capital should come from their own contributions and not from USAID resources.

- Environmental aspects within the irrigated area should be analyzed with the beneficiaries and preventative measures defined.

- Important aspects of rural road improvement should also be defined.

- A detailed work plan with all the activities mentioned above should then be elaborated jointly so as to avoid delays during implementation.

REFERENCES

Proyecto de micro riego Sorocoto
FHI, Bolivia, 1995

File de cierre de proyecto Sorocoto
Oscar Montes, FHI 2001.

Carpeta Challaque, Canal Norte
PCI

Construcción de la red parcelaria de distribución y drenaje del sector sur del sistema de riego Chiara Qhochi

Presupuesto de la contratación de la red parcelaria de distribución y drenaje del sector norte.
CIPCA, 1998

Micro riego Sacabamba, Sur
PCI

Proyecto a diseño final Canal Sur Chiara Qhochi
Jorge G. Zambrana Q., 1998

Proyecto a diseño final Sección de riego Tacachi, K'uchu Muela
Hermogenes Espinoza, 1999

Proyecto de micro riego k'uchu muela
PCI

Proyecto de riego, Sección de riego Tacachi, K'uchu muela
CORDECO, 1991

Perfil del Proyecto de riego para el Abanico de Tiraque
H.A.M.Tiraque, 1999

Proyecto de riego a diseño final para el Abanico de Tiraque
H.A.M.Tiraque, 1999

Carpeta Proyecto de micro riego Tambillo Linde
PCI

Carpeta de resumen cuatro proyectos de micro riego
Ramiro Suarez, PCI, 2001.

Mejoramiento del sistema de riego Palca Pata
ADRA, Regional Camargo, programa de infraestructura, H.A.M. Incahuasi

Sistema de riego Acequia Baja
ADRA, Regional Camargo, H.A.M. San Lucas, 1999

Perfil del proyecto de riego El Centro
H.A.M.Culpina, Chuquisaca, 1998

File Ejecución presupuestaria de proyectos
Johnny Velásquez G., 2001.

La política de compensación en el subsector riego
Reflexiones sobre el tema
Eberhard Gooll
PRONAR, 2001.

Bolivia Title II Mid term Evaluation
USAID

Formulario de inventariación de sistemas de riego
PRONAR

Bibliografía varia
Cursos de Capacitación CAT – PRONAR, 2001

Guía de Formulación de proyectos
Fondo de Desarrollo Campesino, 2000

APPENDIXES

APPENDIX 1.
WORK PLAN

TENTATIVE WORK PLAN FOR
MICRO-IRRIGATION ASSESSMENT
P.O.511-O-00-01-00117-00

Week	Day	Date	Location	Activities
One	Monday	April, 23 rd	USAID, La Paz	Meetings with EOSOT Training Specialist, IR2 Team Leader and Food Security Representative. Submit voucher form 1034 to USAID/Bolivia controller duly signed by the EOSOT Activity 1. Manager. Review documents. 2. Initiate visits and interviews with Cooperating Sponsors (FHI, CARE, PCI, and ADRA).
	Tuesday	April, 24 th	USAID, La Paz	Review and analyze relevant documents such as available studies, evaluations and reports concerning Title II irrigation activities.
	Wednesday	April, 25 th	USAID, La Paz	Prepare Work Plan and draft outline for the final report, lists of tasks to be carried out and a time line for the completion of tasks. Discuss the above with the EOSOT IR2 Team for its approval. Return trip to Cochabamba.
	Thursday	April, 26 th	PCI, Cbba	1. Meeting with Project Concern International (PCI) to coordinate activities for the following days.. 2. Review PCI relevant documents. 3. Prepare for field trips commencing the following week.
	Friday	April, 27 th	Cochabamba	Leave Cochabamba Hrs: 06:30 in PCI vehicle. Arrive Sacabamba Hrs: 9:00 Together with members of PCI, visit the "Sacabamba" Irrigation Project, interview water users and project beneficiaries. Collect relevant data for the evaluation mission. From HRS: 10:00 to 14:00 Lunch in Sacabamba between HRS:14:00 to HRS: 15:00 Leave Sacabamba Hrs: 15:30 and arrive in Cochabamba Hrs: 18:00 Over night stay in Cochabamba
	Saturday	April, 28 th	Cochabamba	Leave Cochabamba, at Hrs: 06:30 in PCI vehicle Arrive Tambillo Linde HRS: 8:30 Visit Tambillo linde irrigation system until Hrs: 12:30 Luch in Tiraque 12:30 a 13:30 Hrs. 14:00 Visit the K'uchu Muela irrigation system until HRS: 18:00 Leave Punata Hrs: 18:30 Arrive in Cochabamba Hrs: 19:30 Over night stay in Cochabamba
Two	Sunday	April, 29 th	Cochabamba	Rest.
	Monday	April, 30 th	Cochabamba	Leave Cochabamba Hrs: 06:30 in PCI vehicle to Tiraque.

				Together with the PCI members visit the 3 irrigation systems within the Abanico area. Over night stay in Cochabamba
	Tuesday	May, 1 st	Cochabamba Camargo	Review and process all the data collected in the previous days field trips. Flight from Cochabamba to Tarija at 1450, arriving at 15:50 Hrs. Leave Tarija at 16:00 Hrs with ADRA vehile to arrive in Camargo at 21:00 Hrs. Over night stay in Camargo
	Wednesday	May, 2 nd	Camargo	Leave Camargo at Hrs: 06:30-with ADRA vehicle to Culpina. Arrive in Culpina at Hrs: 08.30 Arrive in the "El Centro" community Hrs: 9:00 Visit the reservoir and the "El Centro" irrigation system. Meeting with the irrigation association until Hrs: 18:00 Return to Camargo at Hrs: 18:30 Over night stay in Camargo.
	Thursday	May, 3 rd	Camargo	Leave Culpina at Hrs: 7:30 Arrive in Incahuasi at Hrs: 8:00 Visit the "Palca Pata" irrigation system between Hrs: 8:30 and 16.00 Return to Camargo between HRS: 16:30 – 19:00 Over night stay in Camargo
	Friday	May, 4 th	Carmargo	Leave Camargo at Hrs: 06:30 Arrive in San Lucas Community at Hrs: 9:30 Visit the "Asequia Baja" irrigation system between Hrs: 10:00 to 14:30 Lunch in San lucas between Hrs: 15:00 and 16:30 Leave San Lucas at Hrs: 16:30- with ADRA vehicle. Arrive in Potosí at HRS: 21:30 Over night stay in Potosí
	Saturday	May, 5 th	Potosí Sucre	Travel from Potosí to Sucre
Three	Sunday	May, 6 th	Sucre	Review and process all the data collected in the previous days field trips. Meeting with Food for the Hungry (FHI) members to plan the following two days activities. Rest. Over night stay in Sucre
	Monday	May, 7 th	Sucre, Sorojchi Sorocoto	Leave Sucre at Hrs: 06:30 Arrive in Sorocoto Community at Hrs: 9:30 Together with FHI members visit the "Sorocoto Irrigation Project". Interviews and data collection. Over night stay in Sorojchi
	Tuesday	May, 8 th	Sucre, Sorojchi,Tomoyo	Together with FHI members visit the "Tomoyo" Irrigation Project. Interviews and data collection. Meeting with FHI and review relevant

				documents.
	Wednesday	May, 9 th	Sucre Cochabamba	Return trip to Cochabamba.
	Thursday	May, 10 th	Cochabamba	Interviews with members of the National Irrigation Program (PRONAR) about irrigation training possibilities.
	Friday	May, 11 th	Cochabamba	Mission team analyzes, reflects on and puts in order all the information gathered on the field trips.
	Saturday	May, 12 th	Cochabamba	Same as the previous day and commencement of draft report writing.
Four	Sunday	May, 13 th	Cochabamba	Same as the previous day. Rest.
	Monday	May, 14 th	Cochabamba	Deal with further aspects of irrigation training with PRONAR. Continuation of draft report writing.
	Tuesday	May, 15 th	Cochabamba	Continuation of draft report writing.
	Wednesday	May, 16 th	Cochabamba La Paz	Revision and correction of draft report. Travel from Cochabamba to La Paz.
	Thursday	May, 17 th	La Paz	Submit the preliminary draft report to USAID and Cooperating Sponsors with all conclusions and recommendations.
	Friday	May, 18 th	La Paz Cochabamba	Preparation of the briefing workshop planned for Monday May 22 nd. Meeting whit USAID staff to the discuss draft report. Hrs 15:00 Return trip to Cochabamba
	Saturday	May, 19 th	Cochabamba	Correction draft report Preparation of briefing work shop.
Five	Sunday	May, 20 th	Cochabamba La Paz	Same as the previous day. Dispatch corrected draft report to USAID in La paz.
	Monday	May, 21 st	Cochabamba- La Paz	Preparation of briefing work shop. Return trip to La Paz.
	Tuesday	May, 22 nd	La Paz Cochabamba	Half day briefing workshop to relevant USAID staff and the Cooperating Sponsors to solicit feedback as well as to receive comments and suggestions to be included in the final report. Meeting whit USAID staff to discuss results of work shop. Return Trip to Cochabamba.
	Wednesday	May, 23 rd	Cochabamba	Final report writing and editing.
	Thursday	May, 24 th	Cochabamba La Paz	Same as previous day. Terminate Final report writing. Return trip to La Paz.
	Friday	May, 25 th	La Paz Cochabamba	Deliverance of the Final Report to USAID in three hard copies and one electronic copy in WORD and EXCEL for Windows 2000. Return trip to Cochabamba.

APPENDIX 2.

TERMS OF REFERENCE

For the firm fixed price mentioned in item 17.I, the contractor will provide the services in accordance with the following statement of work.

ARTICLE I - STATEMENT OF WORK

A. BACKGROUND

The Mission's PL-480 Title II Program implements rural development activities in food insecure areas of Bolivia's valleys and altiplano regions. Title II supports programs in the areas of mother-child health, water and sanitation, school breakfasts, and agricultural productivity (i.e. technology transfer, marketing, road improvement and micro-irrigation systems). The following cooperating sponsors are responsible for implementing the program: Food for the Hungry (FHI), CARE/Bolivia, Project Concern International (PCI) and the Adventist Development and Relief Agency (ADRA).

Under the cooperating sponsors' Agricultural Productivity Program, micro-irrigation systems are either established or improved in areas where water resources and land characteristics are adequate. Efforts are directed at increased productivity, improved production technologies, and better market access in order to raise rural household incomes.

B. TITLE

Training Needs Assessment of Title II Agricultural Productivity Program.

C. OBJECTIVE

The objective is to conduct a training needs assessment of Title II cooperating sponsor's to improve the planning and implementation of micro-irrigation systems with the final objective being the design of specific training courses for their technical staff.

D. SCOPE OF WORK

The Contractor will carryout the following tasks:

1) Gather available information concerning Title II assisted micro-irrigation systems and projects;

2) Select several micro-irrigation projects representative of the universe of systems under the PL-480 Title II Program using the following parameters:

- Size of systems (i.e. number of beneficiaries and hectares irrigated);
- Degree of crop diversification;
- Types of producer groups involved in the management of the system (i.e. water users associations, cooperatives, producer associations);
- Apparent degree of sustainability;
- Accessibility (remoteness) of the system to farm-to-market roads.

3) Review the pre-project planning carried out by cooperating sponsors including but not limited to adequacy of water resources calculations, engineering, environmental impact assessments, economic cost benefit analyses, estimates of number of producers and hectares to benefit from irrigation. Also assess other basic aspects considered in the planning phase including soil characteristics, water rights, land tenure, degree of community organization, irrigation traditions, etc.;

4) Review adequacy of implementation arrangements (i.e. role of user groups, contracting, food-for-work, local government support) for construction of systems;

5) Assess implementation of projects in regard to following plans, timeliness of execution, cost over-runs, adequacy of planning versus actual system construction;

6) Assess institutional strengthening of water user groups to have capacity to operate and maintain systems;

7) Assess crop diversification as a result of irrigation and marketing activities of cooperating sponsors;

8) Assess cooperating sponsors' assistance to water user groups in the areas of water scheduling and conflict resolution;

9) Recommend specific training (i.e. topics, methods, level of effort, evaluation criteria, etc.) for those areas of micro-irrigation system planning and execution that require improvements.

APPENDIX 3.

GUIDELINES FOR IRRIGATION PROJECT FORMULATION

1. RESUMEN

Se debe preparar un resumen de todo el proyecto, con extensión máximo de dos hojas. Debe incluir la ubicación, una breve descripción del proyecto, sus objetivos, los beneficiarios, costo de ejecución y evaluación económica. Este resumen incluye además la ficha técnica del proyecto.

2. ASPECTOS GENERALES

2.1. Ubicación

Dar la ubicación política (sección municipal, provincia, Departamento) y geográfica (longitud y latitud9 del sitio de obra o en su defecto de la comunidad (es) beneficiaria (s) y de la zona de riego. Describir el camino de acceso, calidad de la vía, distancias y tiempos de recorrido desde la capital de departamento y desde el pueblo más próximo. Incluir mapas de ubicación.

2.2. Antecedentes y justificación del proyecto

Indicar que el proyecto se ha preparado en coordinación con los beneficiarios interesados y con el Municipio de la zona.

2.3. Situación actual

2.4. Objetivos y metas del proyecto

1) Objetivo: el beneficio que generará el proyecto, es decir el riego de una extensión de terreno y el número de familias beneficiarias, con el consiguiente mejoramiento de las condiciones de vida de los campesinos.

2) Meta: Las construcciones que comprende el proyecto, por ejemplo un reservorio o atajado de tantos m^3 de capacidad, sus características principales, tantos metros de canales de aducción, conducción, revestidos, tipo de sección, obras de arte, para el riego de tantas hectáreas.

2.5. Conclusiones del estudio

3. DESCRIPCIÓN GENERAL DEL AREA DE PROYECTO

3.1. Aspectos climáticos

Precipitación y temperatura media anual. Temperaturas máximas extremas. Descripción de su ocurrencia durante el año.

3.2. Aspectos edafológicos

Describir brevemente las pendientes, pedregosidad de los suelos del área de riego y, en lo posible, su profundidad y nivel freático. Indicar que la existencia de cultivos demuestra su aptitud para la producción agrícola.

3.3. Aspectos socio – económicos

Como indica la guía.

3.4. Aspectos productivos

Citar los principales cultivos que se producen en la zona del proyecto y sus porcentajes con respecto a la producción total. Situación actual del área beneficiada con respecto a la disponibilidad de riego.

3.5. Descripción del sistema de riego actual y derechos de agua

4. BALANCE HÍDRICO

5. INGENIERIA DEL PROYECTO

5.1. Planteamiento de las obras

Describir técnicamente las obras propuestas, por ejemplo, el reservorio, canales, obras de arte como desarenador y vertedero de excedencias, etc. Y demás características técnicas.

5.2. Diseño de las obras

Descripción de las obras proyectadas

Se debe dar la descripción técnica detallada de las obras, con todas sus dimensiones. Se deben presentar como parte del texto los dibujos generales de las obras principales y hacer referencia a los planos adjuntos, en los cuales deben presentarse todos los detalles del diseño.

Cálculos hidráulicos y estructurales

Se debe presentar la descripción detallada de todos los cálculos realizados para el diseño de las obras componentes del proyecto, por ejemplo, la estabilidad de los taludes, obra de toma y vertedor de excedencia, así como de los canales.

5.3. Previsiones logísticas notables

5.4. Previsiones para la operación y mantenimiento

5.5. Previsiones para asesoramiento en Desarrollo Agrícola

5.6. Estrategia de ejecución

Se debe indicar, la modalidad de la ejecución (administración delegada), entidades responsables, proceso constructivo de las obras, requerimiento de equipo y materiales, herramientas y personal. Presentar en anexo el cronograma de ejecución (PERT)

6. PRESUPUESTO Y ESTRUCTURA FINANCIERA

6.1. Información básica para el presupuesto

- Se deben obtener cómputos métricos de todas las obras componentes del proyecto.
- Preparar análisis de precios unitarios de todos los ítemes considerados en el proyecto, según formato PRONAR, en las cuales se encuentra desagregado el aporte comunal.
- Obtener el costo total del proyecto y el desglosado según aportes, multiplicando los cómputos métricos por los precios unitarios general y desglosados.

  El aporte comunal obtenido, correspondiente a un mínimo de 15% para proyectos de riego y 10% para proyectos de atajados.

- Preparar cuadro de la estructura financiera del proyecto (aporte USAID, aporte comunal, y si existiera aporte del municipio y ONG)

  No se debe preparar la estructura de costos por partidas (materiales, equipo, mano de obra)

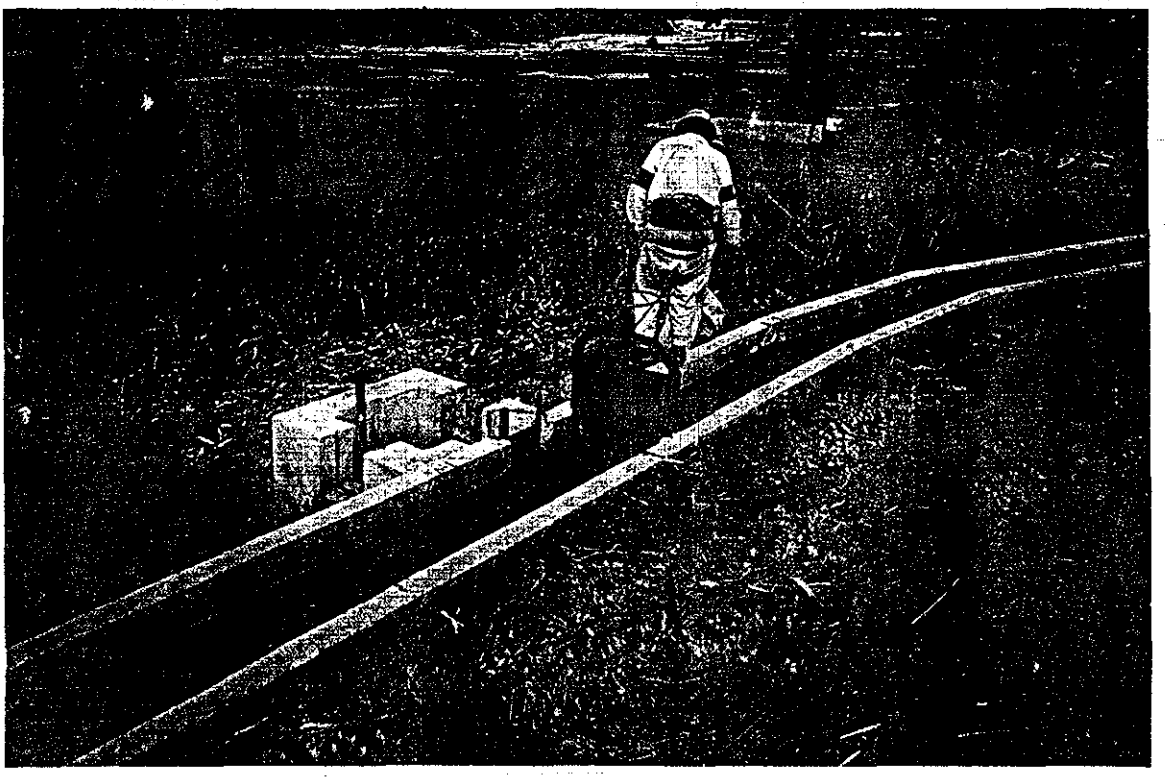
7. EVALUACIÓN DEL PROYECTO

8. ANEXOS

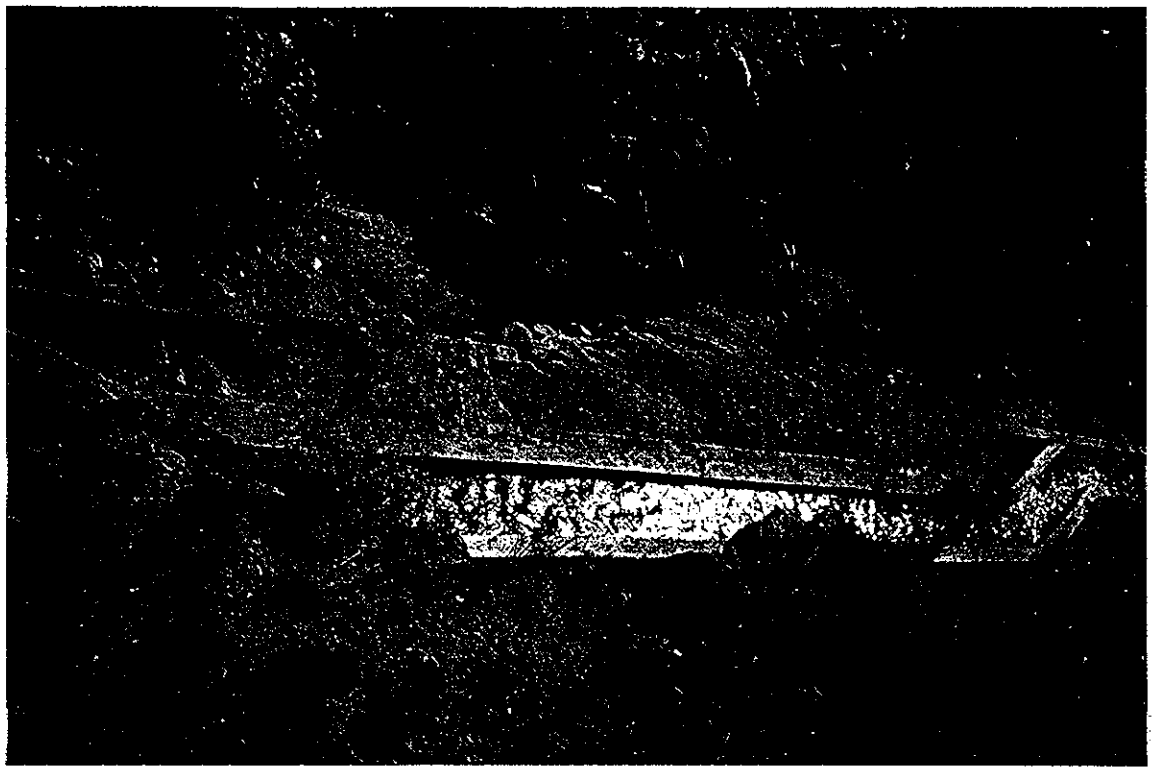
APPENDIX 4.

PHOTOGRAPHS

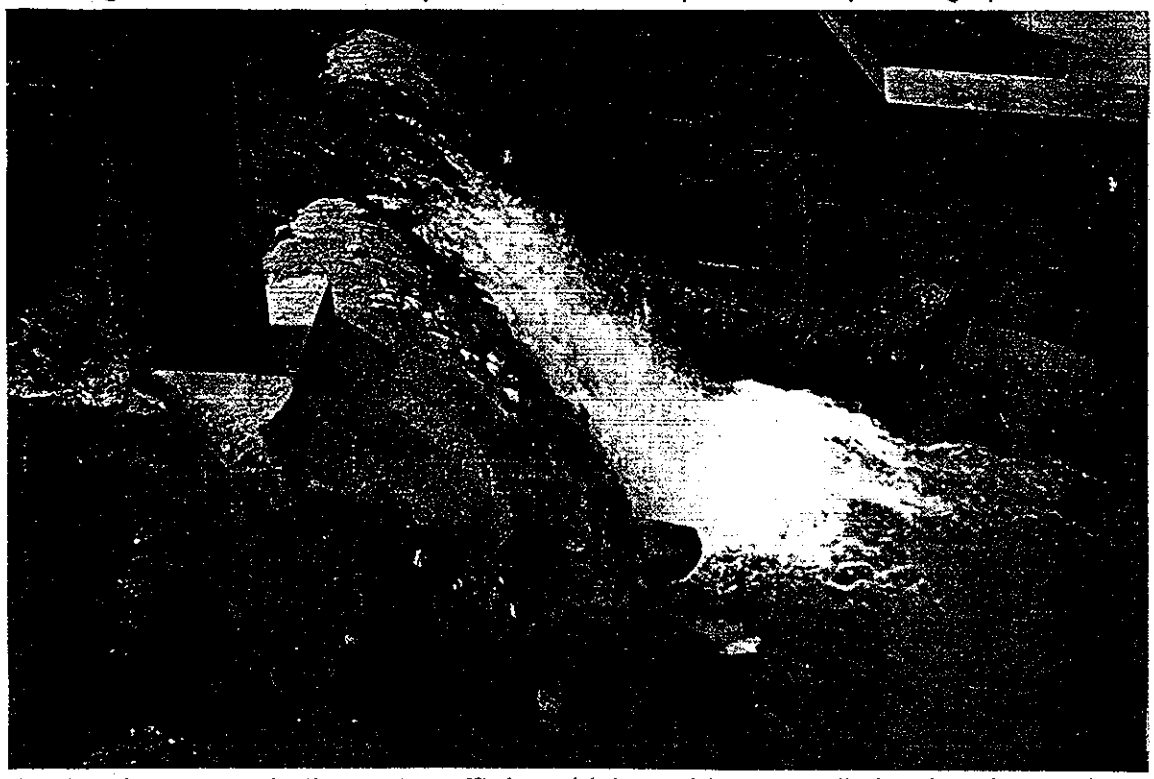
The correct method of distributing water discharges from the main to the secondary canals



Another correct form of distributing water from the main canal



Here we can observe the responsibility gained by the irrigation committee where the damaged main canal was repaired with the help of the cooperating sponsor.



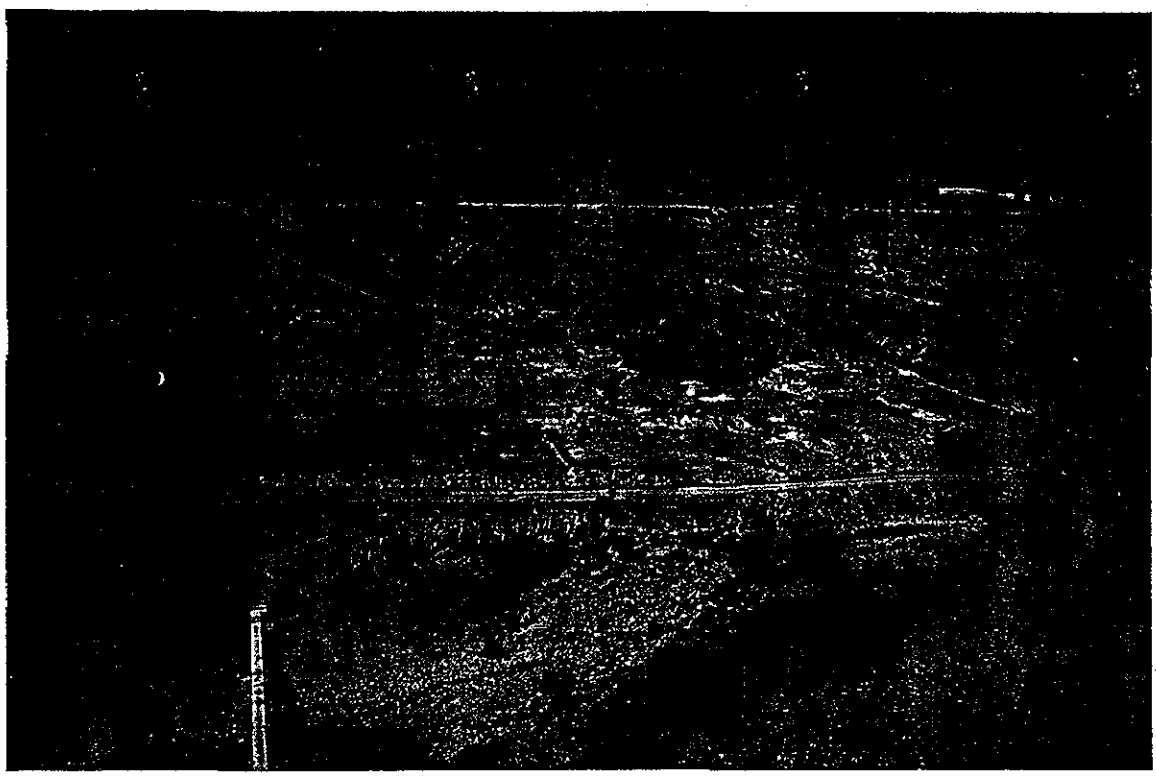
Lack of maintenance in the water offtake which could eventually lead to the total collapse of the structure.

Poorly designed structure, all the sediments have been deposited into the canal. Here the irrigation committee is not interested in operation and maintenance.

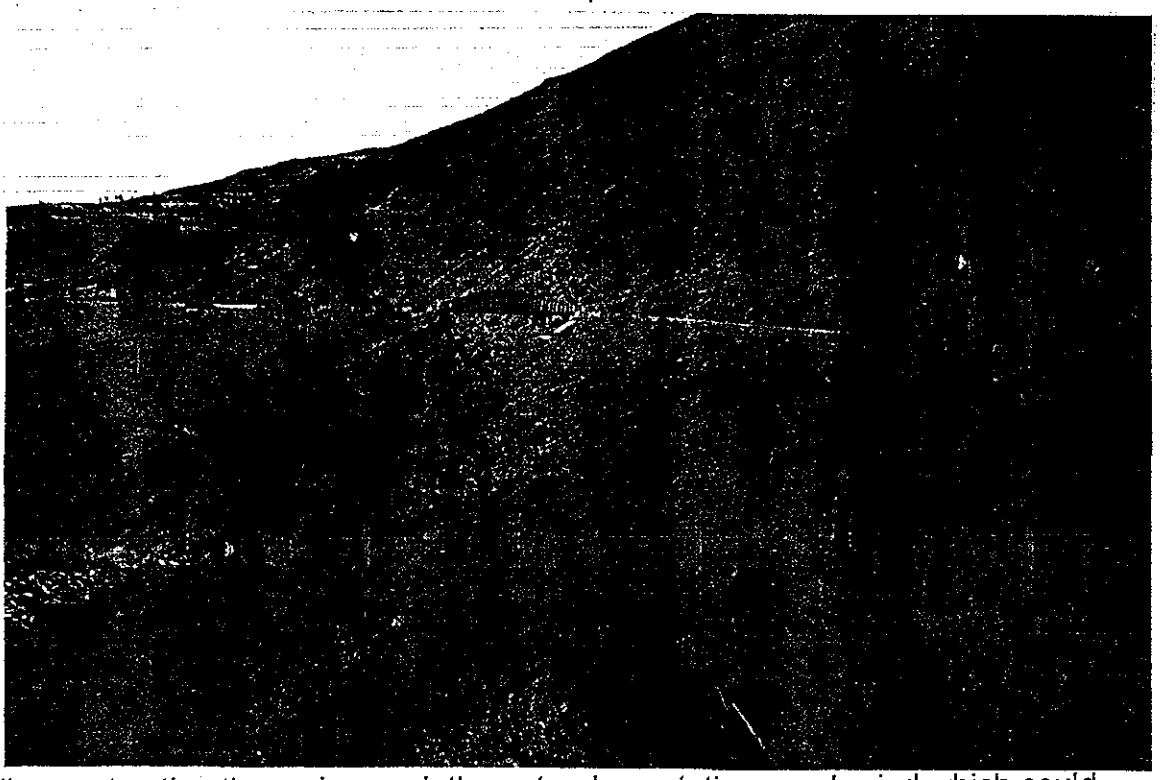
Sedimentation tanks were not considered in the design.

Incomplete structure, the water gates are missing which leads to poor operation of the system.

Here the lack of maintenance can be observed in the water offtake. So much time has passed that the structure has become unusable.

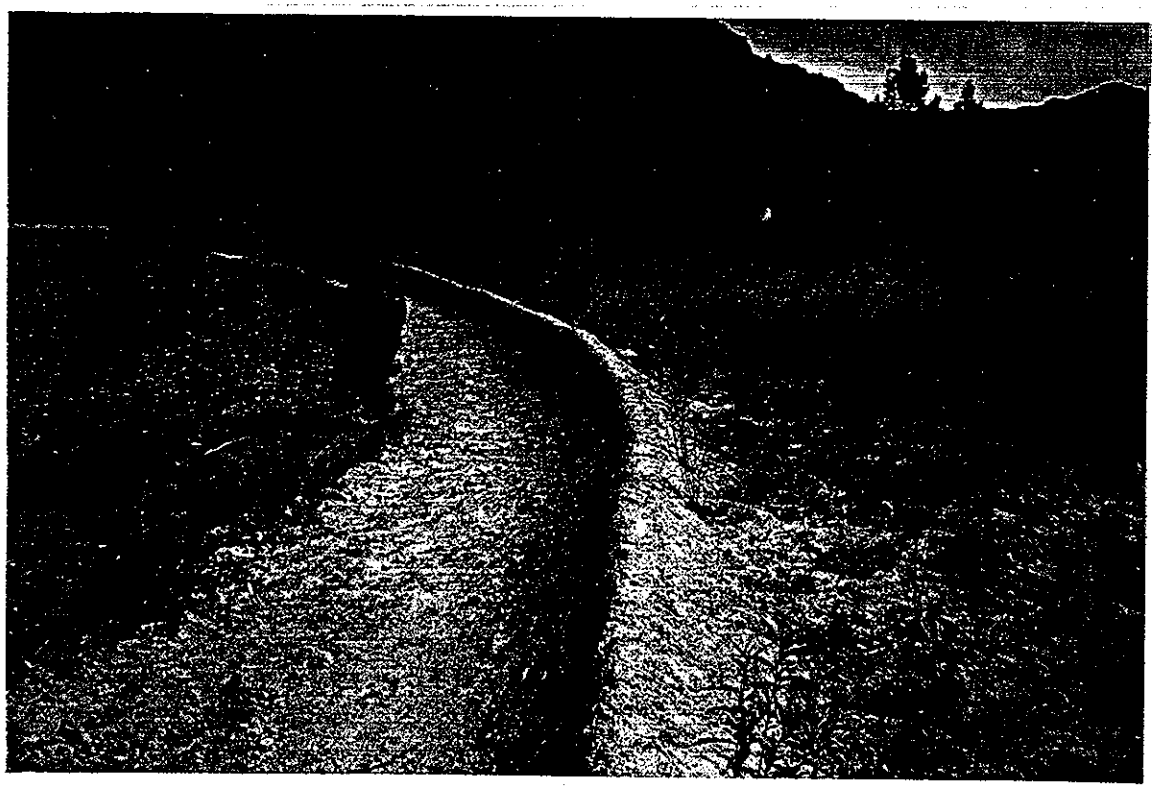


This irrigated area has suffered substantial soil erosion. All projects should therefore include budgets to implement soil conservation practices to prevent further soil erosion problems.



While constructing the main canal, the natural vegetation was buried which could lead to serious erosion hazards. Soil conservation and forestation measures should be undertaken.

Slow formation terraces have been constructed in order to recuperate land in an irrigated area using stones.



Contour line infiltration ditch constructed in an irrigated area to avoid soil erosion.