WATER AND SANITATION
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TRAINING WORKSHOP ON RAINWATER ROOF CATCHMENT, SAN JULIAN, BOLIVIA

WASH FIELD REPORT NO.163

JANUARY 1986

Prepared for
the USAID Mission in the Republic of Bolivia,
Activity No. 178

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Prepared for the USAID Mission in the Republic of Bolivia,
under WASH Activity No. 178

by

Oscar Larrea

March 1986

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APPENDICES

ACKNOWLEDGEMENTS

I should like to express my gratitude to those people who helped to ensure that the Workshop on Rainwater Catchment Systems was conducted to its fullest possible extent and in an effective manner. In particular, I would like to mention the major contributions made both at the pre-workshop stage and during the workshop itself by the Comprehensive Development Foundation (FIDES) and the Environmental Sanitation Directorate (DSA), in particular, Engineer Armando Molina, Executive Director of FIDES, and Engineer Gonzalo Rodas, DSA Regional Chief (Santa Cruz). Their support and coordination for the workshop's activities made it possible to achieve highly satisfactory results in the implementation of low-cost technologies in the rural areas of Bolivia, where rainwater is the most appropriate natural resource for satisfying these areas' most urgent requirements. To them and to their assistants, Hugo Moreno and Alberto Peña, my warmest thanks.

ABBREVIATIONS

CRAP	San Julián Regional Drinking Water Committee (Comité Regional de Agua Potable de San Julián)
DSA	Bureau of Environmental Sanitation (División de Saneamiento Ambiental) (Ministry of Health)
FCSJ	San Julián Peasants Federation (Federatión de Campesinos de San Julián)
FIDES	The Comprehensive Development Foundation (Fundación Integral de Desarrollo)

EXECUTIVE SUMMARY

USAID/Bolivia asked WASH to assist them in conducting a workshop on rainwater catchment. The workshop was held in the region of San Julián. Its aim was to train a group of ten community promoters from the Comprehensive Development Foundation (FIDES) and ten engineers from the Bureau of Environmental Sanitation (DSA). These 20 trainees would subsequently be training other rural officials as well as stimulating the interest and gaining the cooperation of other rural communities in using rainwater to meet their basic needs for potable water.

WASH asked Engineer Oscar Larrea to conduct the workshop with the assistance of two Bolivian coordinators, one from FIDES and the other from the DSA, and two assistants belonging to these organizations. The workshop was based on WASH Technical Report No. 27, A Workshop Design for Rainwater Roof Catchment Systems.

The workshop was held in San Julián from November 4 to 16, 1985. The agenda and timetable are included here as Appendix D. There was a total of 20 participants, and on the whole their performance was highly satisfactory.

Summary of the Report

Chapters 1 and 2 of this report describe the background to the workshop and the pre-workshop arrangements. Chapter 3 discusses the progress of the workshop in San Julián, and Chapter 4 contains a general evaluation. The conclusions are presented in Chapter 5.

The main conclusions are as follows:

- The WASH training guide for rainwater roof catchment systems is of high quality and has been designed in such a way that it may be adapted to the special needs of a particular workshop with only minor adjustments .

- The development of the workshop greatly benefited from the wholehearted collaboration and cooperation of the coordinators, who help daily with materials, equipment, and transportation and facilitated the presentation of theoretical subjects at the workshop. This collaboration needs to be emphasized and encouraged.

- In spite of the diverse backgrounds and activities of the participants involved, no snags or difficulties were encountered as far as the integration was concerned. Everybody showed proficiency, initiative, industriousness, a team spirit, and a willingness to learn.

- The workshop achieved its stated objectives and successfully trained 20 participants who are now in a position to share their knowledge with other officials and promoters and to initiate rainwater roof catchment programs in those regions in which they work.

Chapter 1

BACKGROUND TO THE PROJECT

1.1 The Planning Visit

Prompted by one of the recommendations contained in WASH Field Report No. 140, which investigated various alternatives for water supply in the San Julian colonization area in Bolivia, the Comprehensive Development Foundation (FIDES), a local private voluntary organization, made the decision to improve its training in rainwater catchment system construction so that it could promote projects in harvesting of rainfall for human consumption in San Julian communities. The rainwater would supplement the present daily supply, which is deficient both in quantity and quality on account of the low yield of existing wells and the poor quality of the water.

At the same time, the Environmental Sanitation Directorate (DSA) of the Ministry of Health and Social Security, on the basis of the same WASH field report, decided to train rural technicians (equivalent to sanitary inspectors) in the construction of rainwater harvesting systems. The rainwater would supplement the daily water supply (using low-cost options) in Bolivia's rural areas and in the Eastern Region in particular. It is the custom of rural communities in the eastern part of Bolivia to use rainwater to satisfy their basic needs.

The two groups decided to sponsor a training effort jointly and asked USAID/Bolivia for assistance. USAID/Bolivia asked in turn for WASH assistance in organizing the workshop. In September 1985, the WASH consultant made a preliminary visit to Bolivia to plan the workshop.

The planning visit resulted in institutional commitments which were to be met both prior to and during the workshop. These are enumerated in WASH Interim Report No. 178-1, the key elements are as follows:

ACTIVITIES PRIOR TO THE WORKSHOP	RESPONSIBILITY TO
1. Participants	
- Selecting and interviewing candidates	DSA/FIDES
- Arranging for transporting ten DSA technicians from their workplace to Santa Cruz and back again	DSA
- Arranging for transporting ten participants from Santa Cruz to San Julián and back again	FIDES
- Arranging for transporting ten FIDES promoters to the San Julián workshop site and back again	
2. Food and Lodging	
- Ensuring that the following personnel have suitable food and lodging:	

The WASH trainer	1	
General coordinators	2	
Training assistants	2	
FIDES participants	10	
DSA participants	10	
Drivers	3	FIDES

3. The Training Site

- Selecting suitable classrooms that can accommodate 25 people and are equipped with the following facilities:

  - A blackboard (and also a pointer)
  - A flipchart
  - Chalk and magic markers
  - An eraser for the blackboard
  - Tables and chairs
  - Suitable lighting and ventilation — FIDES/DSA

4. Training Materials

- Participant Reference Packets	25	
- Notebooks	25	
- Pencils with erasers	25	
- Pens	25	FIDES/DSA

5. Demonstration Systems

- Designing the systems that are to be constructed for demonstration purposes, including estimating materials and labor required. Planning budgets, arranging for the purchase and storage of materials, setting up timetables, and arranging for transportation — DSA
- Selecting two communities, one in the planned settlement of San Julián and the other at an unplanned settlement near the Brecha Casarabe — FIDES
- Identifying and selecting one dwelling with a sheet metal roof and another with a thatch or palm roof in each community for demonstration purposes — FIDES
- Selecting a location in the two dwellings for the construction of a cistern and receptacles for the storage of rainfall — DSA/FIDES
- Planning the construction in such a way that it can serve as a demonstration and example to the participants — DSA
- Identifying and hiring local personnel needed for the construction of demonstration systems, i.e., masons, solderers, plumbers, etc. — FIDES
- Reviewing the condition of the roofs selected and making repairs if necessary — DSA/FIDES
- Purchasing materials and tools needed for demonstration and transfer to the worksite — DSA/FIDES

6. Transportation

In addition to the transport arrangements specified in item 1, it will be necessary to make provision for the following means of transport:

- Transporting the principal trainer, coordinators, and one assistant trainer from La Paz to San Julián, via Santa Cruz, and back again.	DSA
- Transporting one coordinator and one assistant trainer from Santa Cruz to San Julián and back again.	FIDES
- One jeep, with four-wheel drive and room for four passengers. This should stay in San Julián throughout the entire workshop and is to serve as transportation for the trainers and coordinators	
- Two vehicles, each having room for 12 people, intended for the day-to-day transport of the participants throughout the entire workshop	
- Fuel and lubricant needed for running the vehicles.	FIDES

7. Motivating the Community

- Making contact with community leaders and organizations in the settlements chosen for workshop demonstration activities, explaining the purpose of these operations, and securing their participation and cooperation with local materials and unskilled labor	FIDES
- Gaining the acceptance of the owners of the households that have been selected for the construction of the demonstration systems	FIDES

8. Rainfall Data

- Obtaining consolidated rainfall data for the San Julián region	DSA/FIDES

It was decided that the workshop's preliminary activities would take place from September 30 to October 31 and that the workshop itself would be held November 4-19, 1985.

1.2 Goals of the Workshop

As a consequence of the above commitments, USAID/Bolivia requested the assistance of WASH to conduct the actual workshop. The workshop was to be aimed at satisfying the basic water needs of the rural population in regions where groundwater or surface water is both deficient and difficult to obtain or where the capital maintenance costs of other systems are very high in relation to the average annual income of the villagers. (See Appendix A for the Scope of Work of the consultancy.)

The workshop's goals may be summarized as follows:

a. Train a group of ten rural FIDES promoters who are working in villages in the region of San Julián, Department of Santa Cruz.

b. Train ten sanitary technicians from the Regional Environmental Sanitation Directorate of Santa Cruz and La Paz who work in regions that are deficient in groundwater and surface water resources for supplying low-income, subsistence-economy rural communities.

c. Introduce low-cost technologies which may be used at a national level as part of the Basic Rural Sanitation Program.

Specific objectives include the following:

a. Provide the participants with basic know-how regarding suitable methods and techniques for harvesting rainfall from roofs, storing it in locally built tanks and receptacles, and using it for drinking and preparing food.

b. Give the participants an opportunity to make direct contact with the rural community to enlist its support for (and contribution to) programs of this kind.

c. Encourage the direct construction of communal and household demonstration systems which enable the participants to apply simple construction methods with the aid of suitable, low-cost technology and to use their imagination in solving the problems involved in supplying water to rural communities.

d. Provide the participants with techniques for arousing the interest of the communities concerned and ensuring that they play their part in rainfall catchment.

e. Provide the participants with the requisite know-how so that they will be able to share their knowledge with other technical officers and community promoters in their corresponding regions and in other areas of the country.

WASH drew up a plan of action for the workshop under Activity 178 and asked Engineer Oscar Larrea to carry it out. The workshop was held in San Julián November 4-16, 1985.

Chapter 2

PRELIMINARY ACTIVITIES

2.1 Back-Up Personnel

In accordance with the program of the pre-workshop activities described in WASH Interim Report No. 178-1 and summarized in Chapter 1, DSA and FIDES appointed the individuals who were to collaborate with the WASH consultant in the preparation, implementation, and evaluation of the workshop. (See Appendix B for a list of trainers.)

Four individuals made up the back-up team:

- Engineer Armando Molina, Executive Director of FIDES, co-trainer responsible for logistics coordination and the provision of facilities for the workshop's theoretical and practical sessions, food and lodging for the participants, transportation, and materials and workshop equipment.

- Engineer Gonzalo Rodas, DSA Regional Chief, Santa Cruz, co-trainer responsible for coordinating the transportation of participating technicians, supplying materials, and supervising and building the communal demonstration tank.

- Sr. Hugo Moreno, DSA Assistant, Santa Cruz, assistant trainer responsible for the general coordination of DSA personnel and the community's activities with regard to the construction of catchment systems and their operation and maintenance.

- Sr. Alberto Peña, a FIDES Community Communicator/Promoter, assistant trainer responsible for the general coordination of the workshop with the communities chosen for practical demonstration purposes and for the technical-cum-practical sessions involving the construction of models and their subsequent implementation within the communities.

In addition, the administrative and logistic personnel at the FIDES San Julián camp provided invaluable support for all of the activities in the workshop.

Pre-workshop activities were more comprehensive than initially anticipated.

2.2 Participants

Pre-workshop activities relating to the workshop participants were performed in accordance with the commitments made during the planning visit.

FIDES, in conjunction with the communities of San Julián and the Peasants' Association, identified and selected ten community promoters, all of whom are also leading farmers in their respective communities.

For its part, the DSA selected ten technicians with several years of experience who had worked in rural areas of Santa Cruz. Those selected were judged capable of applying the skills learned in the workshop and of training other DSA technicians at the national level.

Appendix B of this report gives a complete list of the participants.

2.3 Selecting the Communities

In conjunction with the DSA (Santa Cruz) and the San Julián Regional Drinking Water Committee, FIDES selected two communities for the field demonstrations and the construction of model tanks for rainfall catchment. The communities chosen were San Andrés and Settlement No. 11. Later, however, Settlement 11 was replaced by the community of Los Angeles on account of the latter's superior location and the greater degree of acceptance of the training program.

San Andrés is a community of some 350 inhabitants located approximately 6 kilometers to the south of the FIDES outpost, which was the workshop's headquarters. It is a dispersed community with some density around the schoolhouse. The houses have roofs made of thatch, baked clay, or corrugated sheet metal, known locally as "calamina." The thatched roofs are generally badly damaged because of the effects of the weather and the region's hostile environment. This is a characteristic feature of San Julián.

Los Angeles shows a higher degree of development than San Andrés. It is situated some five kilometers to the northeast of the FIDES outpost. Agriculture and small-scale stockbreeding are the mainstay of this community's economy. It has some 400 inhabitants and a primary school with a larger capacity than the one at San Andrés. It is less dispersed than the first community.

2.4 Food and Lodging

FIDES revamped its outpost at San Julián to provide food, lodging, and laundry facilities for the trainers, participants, and support personnel. Four houses at the camp were made available; one for the trainers and three for the participants. Each house had all the basic amenities such as drinking water, lighting, and bathrooms, which helped to make the camp an agreeable and comfortable place to stay.

2.5 Training Site

The training room was enlarged by FIDES within the camp so as to accommodate 40 students, with sufficient lighting and ventilation, two blackboards, a flipchart, and chairs for the participants.

Coffee and refreshments were offered during the rest periods between sessions.

2.6 Transportation

Three vehicles with sufficient capacity to transport the trainers, participants, and laborers to the worksite were available throughout the entire workshop. These same vehicles served to transport personnel from Santa Cruz to San Julián and back.

2.7 Teaching Materials

DSA prepared 20 copies of the Participant Reference Packet that was required by the workshop. Other material such as chalk and magic markers were supplied by FIDES.

2.8 Construction Materials

Material for the practice and demonstration sessions for the systems in question were provided by FIDES and DSA as requested by the lead trainer.

Chapter 3

THE DEVELOPMENT OF THE WORKSHOP

3.1 Checklist and Timetable

Prior to the start of the workshop, a schedule of activities was prepared which included the checklist in the WASH training guide, the construction of systems at the camp, and the construction and installation of communal and household systems within the communities selected for demonstration purposes.

Since the participants were able to assimilate the material easily, a number of theoretical sessions were speeded up in favor of theoretical/practical construction activities and contacts with the community. (The timetable and agenda for the workshop can be found in Appendices C and D of this report.)

3.2 Division of Responsibilities

3.2.1 Training

All members of the training staff were assigned specific responsibilities. The WASH lead trainer provided the overall coordination of the workshop; the FIDES and DSA co-trainers took responsibility for their specific sessions. All the trainers and assistants participated on a joint basis in the sessions involving analysis, general discussion, and conclusions.

3.2.2 Logistics Coordination

All matters concerning the supply of construction materials, transportation, the hiring of local personnel for construction, dealings with community leaders, mechanical workshop facilities and tools, etc. were the responsibility of the FIDES co-trainer with the collaboration of the DSA co-trainer.

3.2.3 Coordination of Demonstration Activities

The planning and supervision of demonstration activities in rural communities was the responsibility of the co-trainer from DSA with the collaboration of FIDES personnel.

3.3 Execution of the Program

3.3.1 Schedule of Activities

The workshop began at 8:00 a.m. on November 4 with an opening ceremony led by the Executive Director of FIDES. This led directly into Session 1 of the WASH training guide, during which there was an opportunity to determine the skills and abilities of each one of the 23 participants, as well as to assess the speed at which they could assimilate theoretical concepts.

The original format of the workshop (which followed the training guide) was adjusted so as to include practical work during the mornings instead of during the high temperatures of the afternoons.

On the afternoon of the second day of the workshop, the preparation of materials for small family size tanks began, and the tanks were constructed on the afternoons of Days 3 and 4. The construction of charcoal filters and automatic roof washers took place on Days 5 and 6 during the afternoons. The afternoons on Days 7 and 8 were given over to the construction of metal and bamboo guttering at the machine workshop available at the camp. These activities were carried out in their entirety by the participants. (To adapt the schedule to the particular circumstances of this workshop, a decision was made to hold Session 17 (Making and Connecting Gutters) on Day 8 instead of on Day 11. This had a highly positive influence in maintaining continuity in the practical activities.)

At the same time, a communal brick tank with a capacity of 5 cubic meters was constructed at the San Andrés village schoolhouse and a complete rainfall collection system was planned (with supervision) for two selected communities, namely Los Angeles and San Andres. This particular planning exercise gave the participants (divided into groups of 10) a chance to apply systematically what they had learned and to plan a complete rainwater catchment system for communal and household tanks.

The afternoon on Day 9 and a major portion of Day 10 were given over to completing the construction of gutters and downpipes and the curing of sand and cement jars. The remainder of Day 10 and all of Day 11 were devoted to the installation of catchment systems, using metal and bamboo gutters (bamboo is known locally as "tacuara"), filters, roofwashers, and cement/sand jars for roofs made of tiles, corrugated sheet metal, and thatch. Three complete systems were constructed in this fashion.

Appendix E contains a number of photographs illustrating the work of the trainees.

3.3.2 The Three Demonstration Systems

At the San Andrés schoolhouse, with its roofing of red baked clay tiles, smooth sheet metal gutters were installed and fastened to the roof with iron hooks. The downpipes discharge into an automatic roofwasher consisting of a suitably prepared 200-liter drum connected to a brick masonry tank with a concrete cover and a capacity of 5 cubic meters. This component was not finished, and therefore the complete system was not placed into standard service. Even so, on the afternoon of Day 11 a torrential rain fell over the area, and this provided a test for the system of gutters, downpipes, and roofwashers; as it turned out, they functioned perfectly.

A household system was installed with bamboo gutters and downpipes on a private house with a sheet metal roof in the village. In addition, the participants constructed a small-scale automatic roofwasher consisting of a metal drum cut in half; it discharges into a sand/cement jar. This system also

functioned perfectly during the rainfall on Day 11, and on the following day some members of the community were given a chance to draw rainwater on the occasion of the delivery of the system to its users.

In Los Angeles, a house with a thatched roof was chosen. It was situated on the main road and was readily visible from many different locations. The used for this house consisted of bamboo gutters and downpipes, as well as a small-scale automatic roofwasher made from a metal drum cut in half which discharged into a sand/cement jar. It was not possible to test this system as it did not rain during the period.

The morning of Day 12 a ceremony was held to deliver the systems to the communities. This was performed by DSA and FIDES representatives. At the same time, each of the groups of participants that had taken part in the construction and installation of the systems gave the recipient community a description of the systems and recommendations for its operation and maintenance. In addition to the systems installed within the communities, the groups constructed a wood filter to be used with toasted rice husks and a 200-liter drum-based metal household tank with an internal coating of cement slurry.

It should be stressed that each one of the demonstration systems was devised, designed, sized, built and installed by the participants on the basis of the theoretical know-how which they had acquired. Of course their work was carried out under the supervision of the trainers.

For all of the construction sessions, participants were divided into groups of ten people (five DSA technicians and five FIDES community promoters). Each one of these groups chose a leader who provided general coordination for the group. The group was further subdivided into smaller groups with specific work assignments determined by the group. This practice gave the workshop greater dynamism, and both the productivity and the progress exceeded our initial expectations.

3.3.3 Costs of the Models

The 5 cubic meter tank in San Andrés was constructed with the aid of a hired mason and an assistant furnished by the community, which also supplied bricks and sand. The estimated cost of this tank is approximately US $400. It will benefit a school population of some 45 pupils, two teachers, and the neighboring population estimated at 30 people. The unit cost of construction is US $80 per cubic meter of water to be stored, and US $5.20 per person benefited. The community's contribution was estimated at approximately 20 percent of the cost.

With respect to household tanks, all of the materials were supplied by FIDES and DSA. The estimated cost of each system was US $15 to benefit a family of five, i.e., US $3.00 per person.

3.3.4 Additional Activities

As part of the field work, a visit was organized to the National Institute of Colonization's meteorological station in San Julián, located approximately five kilometers away from the FIDES outpost. The person in charge of the

station gave us a detailed explanation of how the pluviometer and pluviograph worked. He also explained the readout and interpretation of data and showed trainees the records from recent years.

Chapter 4

GENERAL ASSESSMENT

4.1 Results of the Workshop

An analysis of the pre-workshop skill assessment forms does not provide a sound and reliable starting point for a quantitative assessment of the workshop, because the majority of the responses were erratic and occasionally contradictory. This can be accounted for by the fact that the form contains a number of questions (e.g., 1, 4, 5, 6, 7, 8) which refer specifically to topics which were going to be addressed at the workshop. The participants ran into difficulties when filling out the form. The questions should also have been answered as a post-test when the training was finished and the participants were in a better position to understand and answer the questionnaire.

SUMMARY OF THE PRE-WORKSHOP SKILL ASSESSMENT FORMS

Skill Area	No Experience	Some Skill	Adequate Competency
1. Identify the technical feasibility of a rainwater catchment project	80%	20%	0%
2. Social and community assessment	10%	40%	50%
3. Local resource inventory	30%	30%	40%
4. Choose an appropriate combination of technologies	80%	20%	0%
5. Designing a system	85%	15%	0%
6. Ordering/gathering material and organizing the construction	50%	50%	0%
7. Construction skills	30%	60%	10%
8. Monitoring and maintenance	70%	30%	0%

Some of the participants answered the questions on the basis of their personal experience in projects of another type. Nonetheless, since the questions on the form are specific about expertise in rainwater catchment and harvesting, the positive answers found on the form were not always valid.

The evaluation form, prepared at the workshop's conclusion, contains specific responses which make it possible to quantify the results.

On this basis, the following summary table has been prepared:

SUMMARY TABLE ON GOAL ATTAINMENT
(in presents)

	Low				High
ITEM	1	2	3	4	5
Session 1	-	-	-	50	50
Session 2	-	-	-	60	40
Session 3	-	-	5	55	40
Session 4	-	-	5	50	45
Session 5	-	-	-	40	60
Session 6	-	-	-	45	55
Session 7	-	-	15	60	25
Session 8	-	-	-	20	80
Session 9	-	-	5	65	30
Session 10	-	-	5	40	55
Session 11	-	-	5	70	25
Session 12	(not shown)				
Session 13	-	-	15	50	35
Session 14	-	-	5	60	35
Session 15	-	-	5	25	70
Session 16	-	-	5	25	70
Session 17	-	-	5	40	55
Session 18	-	-	5	35	60

The low degree of attainment in Sessions 7 and 13 can be explained. Three promoters had limited mathematical ability and found it difficult to follow these sessions. Throughout the workshop, the trainers informally evaluated the results and found a performance of greater than 85 percent for the following parameters:

- Punctuality
- Interest in the theoretical presentations
- Participation in discussions and teamwork
- Skill in theoretical and practical work
- Initiative
- Communicating with the target communities
- Team spirit, cooperativeness
- General progress
- Discipline

Generally speaking, the workshop results were highly satisfactory. All twenty participants completed the training and were awarded a certificate. (See Appendix F for sample.)

4.2 Coordination and Back-up Personnel

Logistics coordination ran smoothly, thanks to the interest shown by the Executive Director of FIDES who, in addition to his role as co-trainer, was also responsible for presenting sessions on pluviosity, obtaining and processing data on rainfall, and making use of this information in rainwater roof catchment projects for the rural community. He also took part

in general discussions and the analysis of topics presented on a daily basis and in practical and demonstration activities. His know-how and expertise in San Julián were invaluable in dealings with the representatives and directors of the San Julián Regional Drinking Water Committee, the Federation of Peasants, and the leaders of the communities selected for field work.

In carrying out these activities, he enjoyed the on-going cooperation of the assistant trainer appointed by FIDES, who was also responsible for the presentation of topics connected with community social assessment.

The DSA's Regional Chief in Santa Cruz was responsible for coordinating the construction of a communal tank and providing certain additional materials for the construction sessions. He also presented workshop topics on construction materials, lists of materials, and construction calculations and procedures. He had the support of the assistant trainer appointed by DSA, who (in his capacity as health educator) was responsible for the general coordination of the groups during the theoretical and practical sessions.

The commendable degree of cooperation and collaboration achieved between the coordinators and the assistant training personnel made the lead trainer's work much easier. It also meant that the workshop could be conducted in a harmonious atmosphere, within the time provided and with 100 percent goal attainment. Their support for all the activities involved was effective, wholehearted, and enthusiastic.

4.3 Training Site

The theoretical and theoretical/practical sessions were held at the FIDES camp in San Julián, which has spacious classroom facilities equipped with blackboards, flipcharts, chairs, etc.; moreover, it also has a machine shop with all the equipment and resources necessary for construction practice. The participants had access to all the space and facilities for their studies and practical tasks. The sand and cement jars, the metal or bamboo gutters and downpipes, and the filters and automatic roofwashers were all made in their entirety at the camp and subsequently transferred to the communities to be installed.

4.4 Logistics

Some delay was experienced in the construction of the communal tank built at the San Andrés schoolhouse. There was also a slight delay in obtaining suitable bamboo for the construction of gutters and downpipes. These problems were promptly solved by the coordinators and the delay was made up in the second week of the workshop.

No problems were encountered in the other logistics operations; the coordination here was excellent.

4.5 Response from the Communities

Once the installation of the household tanks at San Andrés and Los Angeles had been completed, the community gathered to observe the tanks for themselves.

There is a widespread conviction that the systems are straightforward, economical, and easy for communities to build by themselves using local materials. Similarly, certain of the San Julián community promoters who took part in the workshop reported that the communities in which they work and reside are ready and willing to build these tanks to relieve their current shortage of water for drinking and cooking. In addition, plans are underway in the community of Los Angeles to construct a communal tank by making use of a sizeable area of thatched roofing on the village schoolhouse.

The communities selected for demonstration purposes were very supportive and gave their approval to the workshop activities.

4.6 Training Methodology

The workshop was conducted on the basis of the methodology proposed by the training guide, WASH Technical Report No. 27, which proved to be satisfactory. The minor changes introduced into the workshop were instrumental in keeping up its dynamism and bringing out the best in the participants; for example, a theoretical session on a given topic would be followed by practical construction activities at the camp. In this way, the participants were in a position to implement on short notice the theoretical know-how which they had heard in class.

During the workshop trainers and the participants alike made a number of suggestions for the training guide based on their experience and observations, namely:

- The theoretical sessions should be conducted by topic or module so that it is easier for trainers to acquire a mastery of the problem concerned. For example, the instructions on guttering to be found in Sessions 10 and 17 could perhaps be closer together. This change was tried out at the workshop with encouraging results. It should be noted that the special circumstances surrounding this workshop dictated the change involved in presenting Session 17 instead of Session 15, which was switched to the day before the participants made their recommendations concerning the operation and maintenance of the systems that had been installed in the communities.

- Constructing the sand/cement tanks can be made easier by using the hessian sacking in a vertical direction and by winding a thread from this same sacking around the mould, which makes it easier to apply the sand/cement mortar. The volume of the tank remains the same and the strength of the walls is also unchanged.

4.7 Goal Attainment

The training guide provided the basic ingredients for the workshop. The participants were able to acquire the basic theoretical know-how, apply this in construction tasks, gain hands-on experience in construction technologies, and, last but not least, collaborate with the communities to install and operate the systems, and instruct people in how to maintain them.

The stated objectives were duly achieved at the San Julián workshop, as the following analysis will show.

1. Plan and develop a rainwater roof catchment project.

   The participants learned decision-making methods and planning methods and applied their knowledge in the execution of specific projects for communal and household use. At the same time, they carried out planning and selected one community per group and applied their newly-acquired skills in designing the most appropriate rainwater catchment system for the community as a whole. They conducted a resource inventory, motivated the community, and made estimates of the materials required, the cost, construction time, financing, and other related areas. This exercise made it possible to clarify the inter-relationships that exist between various entities in prudent and judicious planning.

2. Determine the feasibility of a rooftop catchment program in light of local rainfall patterns.

   The technical presentations on obtaining and interpreting pluviometric data to determine the roof yield were illustrated with the aid of tangible examples as well as an observation visit to the National Institute of Colonization's meteorological station. Furthermore, the planning exercise included a calculation of the yield for selected roofs.

   We estimate that 10 percent of the participants did not have a sufficient grounding in mathematics to gain a mastery of this particular item within the workshop's time frame.

3. Assess a community's willingness and ability to support a rooftop catchment system.

   Because the participants were technicians and community promoters in the San Julián area they were in an ideal position to attain this goal swiftly. Their everyday work requires these skills. The workshop simply provided them with guiding principles for their dealings with the community.

4. Conduct an inventory of local skills, materials, and techniques which can be used in rooftop catchment.

   The comments on the previous goal apply to this goal as well. During the workshop, however, considerable emphasis was placed on determining when the labor force in a community would be available and under what conditions. This limiting factor is intimately tied to those periods during which crops are sown, planted, harvested, etc.

5. Choose the most appropriate technologies for tank and gutter construction.

This was one of the most stimulating and rewarding portions of the workshop. The participants received training with respect to alternative solutions and the decision-making process.

All possible alternatives applicable to San Julián and to other rural areas in Bolivia were presented. Once the most appropriate technology had been chosen, its suitability in practice was verified, its advantages and disadvantages were analyzed, and there was a critical analysis of the various technologies and their potential at the local level.

6. Calculate an optimum size for storage tank.

   To attain this goal participants must make a major effort of subjective interpretation and accept certain basic principles. In addition they must have relatively complex mathematical knowledge.

   For this reason, 15 percent of the participants failed to acquire a thorough grasp of the optimization methodology. It may be that greater effort and individual study were required of them.

7. Mix and prepare cement and mortar.

   To a greater or lesser extent, all the participants were familiar with construction materials and knew how to use them. Even so, the workshop provided additional know-how regarding the construction of household sand/cement jars in a very "dry" mix, with only a little binding material.

   The construction of the communal tank in San Andrés, using brick masonry reinforced with chicken wire and iron rods, posed relatively few problems as 85 percent of the participants are involved in this type of construction as a part of their normal activities.

8. Design and plan a rainwater catchment system using all of the steps and procedures necessary for detailing and ordering construction materials.

   At the start of the workshop, 50 percent of the participants had some skill in making out lists and orders for materials intended for projects that had already been designed. However, none of the participants had any experience in the design and planning of rainwater catchment systems.

   In the course of the workshop, the participants methodically learned the theoretical and engineering principles of construction. This enabled them to make decisions about the most appropriate systems, to design the specific system to be used, and plan the construction, including estimating materials and labor and devising a work plan and timetable.

Once again, 15 percent of the participants failed to acquire a thorough grasp of the design and planning processes, probably owing to the difficulties which they faced in handling certain types of mathematical data.

9. Design and construct a roof catchment and filtration system for thatch roofs.

   This topic aroused the keenest interest among the participants. On the basis of the theoretical sessions, they designed and constructed two sand/cement jars, a metal drum tank lined with cement slurry, two automatic metal roofwashers, one charcoal filter in a metal container and another in wood, as well as bamboo gutters and downpipes for two complete systems. This was one of the most pleasing aspects of the workshop.

10. Manage the ordering of material and labor necessary for constructing a rainwater roof catchment system.

    Because of a time lag in local procurement of materials and specialized labor (masons), trainees had no practical experience in this area. Training was only theoretical. The participants were given examples pertaining to the topic in addition to a conceptual grounding.

    At the same time, 50 percent of the participants already had some familiarity with ordering materials and labor.

11. Build a small household storage tank and a large cistern tank.

    The number of storage tanks and cisterns built is given in item 9 above. Trainees also obtained some experience in the use of local clay jars of small capacity as household tanks.

12. Develop strategies for involving communities in the construction of the system.

    This goal was fully attained with the aid of sociograms and practical activity within the communities. The basic instruction and activity conducted by the participants made this part of the training both agreeable and straightforward.

13. Develop a monitoring and maintenance plan for the system which the community can use and implement.

    The basic guidelines of Session 15, held the day prior to the delivery of the systems to the community, provided the participants with the grounding they needed in order to prepare verbal and written recommendations in an effective manner. They also prepared a maintenance plan with an inspection program which was explained to the community during a session held on the final day of the workshop.

14. Construct, connect, and hang gutters for the system.

Participant group 1 constructed, welded, and installed all the gutters, downpipes, roofwashers, and other components for the communal tank constructed in San Andrés. They learned techniques for cutting sheet metal, soldering with tin, constructing support hooks, etc.

Group 2 constructed sand/cement jars, bamboo gutters, brackets, joints, weatherproofing, charcoal filters, etc. for small household tanks.

The frequent exchange of views among participants and the comparing of notes between groups meant that everybody was able to benefit from this particular exercise.

15. Develop action plans for promoting rainwater roof catchment in their project areas.

    The comprehensive planning exercise conducted by the groups of participants contains a session on organizing rural communities and strategies for securing their participation.

To sum up, the goal attainment surpassed our initial expectations for the workshop.

Chapter 5

CONCLUSIONS

5.1 Findings

The training guide (WASH Technical Report No. 27) is of high quality, has been designed in a methodical fashion, and lends itself to being adapted to the special needs and circumstances of each workshop. It encompasses all of the issues involved in theoretical and practical training and the construction of demonstration systems in regions such as San Julián.

The collaboration that was established between the coordinators and their auxiliary personnel was excellent, as evidenced by the superlative logistics coordination and the cooperation between the participating institutions. The expertise, enthusiasm, trust, and professional competence of the coordinators and auxiliary personnel contributed a great deal to the workshop.

In spite of the fact that the two groups of trainees had totally different jobs, there was no obstacle to their complete integration -- much to the benefit of the workshop. It is our belief that this arrangement was highly advantageous for both sides; it is a twofold benefit which can only facilitate future joint projects.

All of the participants displayed proficiency, interest, initiative, team spirit, cooperativeness, industriousness, an organizational sense, and a tactful approach toward the rural community.

The Santa Cruz workshop achieved its objectives, within the time provided and with commendable efficiency.

5.2 Recommendations

We recommend that DSA and FIDES draw up a program for the construction of rainwater catchment systems (both household and communal) for all the communities in the region of San Julián. The FIDES community promoters would be responsible for conducting a community resource inventory, making a choice between the various possible rainwater catchment systems, and organizing the communities so that they could construct and maintain these systems. The DSA engineers would be responsible for designing the most appropriate systems, estimating the materials and labor required, and furnishing technical assistance during construction.

DSA and FIDES should assume joint responsibility for the monitoring and maintenance of the rainwater catchment systems, and they should provide technical assistance and ongoing promotion within the communities, as well as instruction and public health information.

DSA engineers should organize similar workshops on rainwater roof catchment systems for other engineers and community promoters. The aim should be to encourage the construction of rainwater catchment systems in other areas.

APPENDIX A

Scope of Work

ACT 178

Scope of Work

Bolivia: Rainwater Catchment Workshop

USAID/Bolivia has requested WASH to conduct a workshop on rainwater catchment to be held in the San Julian area. This workshop results from recommendations made by a WASH consultant in WASH Field Report No. 140. The overall purpose of the workshop is to (1) train a group of individuals from FIDES and DSA who can train others in both institutions and promote an interest and collaboration in rural communities in rainwater catchment, and (2) initiate the use of low cost solutions that could be applied at the national level as part of the National Plan for Rural Sanitation. The workshop should be organized along the lines recommended in a planning visit to Bolivia by a WASH consultant under ACT 178.

Responsibilities

1. Review progress on the pre-planning tasks established during the planning visit.

2. Respond to any additional needs that have arisen.

3. Make sure that there are enough participant reference packets for the participants.

4. Plan and conduct a staff training session with the Bolivian co-trainers from FIDES and DSA to prepare for the workshop.

5. Conduct the workshop with 2 co-trainers and 2 assistant trainers following the workshop guidelines in WASH Technical Report No. 27, A Workshop Design for Rainwater Harvesting.

6. Evaluate the general success of the workshop, including the acceptance of the community of the training program, the contribution of the coordinator and assistant trainers, the success of the logistic arrangements, the achievement of the workshop objectives, value of the training methodology, and appropriateness of the training site.

7. Write a final report which you should leave in draft with USAID/Bolivia before departing.

Training

The workshop will take place in San Julian from November 4-19, 1985. The complete timetable is as follows:

October 28 - Review of workshop plans with USAID/Bolivia
October 29 - Travel to Santa Cruz
October 30-31 - Review of pre-workshop activities with FIDES and DSA
November 1 - Travel to San Julian. Review of local arrangements for the workshop
November 4-19 - Workshop
November 20 - Travel to Santa Cruz. Evaluation of workshop with FIDES and DSA
November 21 - Travel to La Paz
November 22 - Evaluation of workshop with USAID/Bolivia

Personnel

WASH will provide the primary consultant, an engineer familiar with rainwater catchment and capable of delivering a workshop. He will work with two Bolivian co-trainers from FIDES and DSA and two assistant trainers from the San Julian area.

APPENDIX B

List of Trainers and Participants

LISTA DE INSTRUCTORES Y PARTICIPANTES

NOMBRES	PROCEDENCIA	CARGO
Ing. Oscar Larrea	Ecuador - WASH	Instructor Principal
Ing. Armando Molina	Santa Cruz-FIDES	Co-Instructor
Ing. Gonzalo Rodas	Santa Cruz-DSA	Co-Instructor
Tec.Alberto Peña	Santa Cruz-FIDES	Instructor Auxiliar
Tec. Hugo Moreno	Santa Cruz-DSA	Instructor Auxiliar
PARTICIANTES:		
Edwin Alba C.	Santa Cruz	Supervisor-Técnico
Elmer Barba L.	Santa Cruz	Técnico de Saneamiento
Eusebio Carrasco C.	Vallegrande	Técnico de Saneamiento
Jorge Sejas F.	La Guardia	Técnico de Saneamiento
Jorge Ticona C.	Portachuelo	Técnico de Saneamiento
Juan Carlos Lara	San José de Chiquitos	Técnico de Saneamiento
Rolando Ortiz O.	Warnes	Técnico de Saneamiento
Ricardo Pedraza A.	Camiri	Técnico de Saneamiento
Ricardo Pomacosi C.	La Paz	Técnico de Saneamiento
Luis Melgar D.	Montero	Técnico de Saneamiento
Arturo Arancibia	Santa Cruz	Chofer Promotor
Silvestre Alejandro L.	Núcleo 26	Promotor
Héctor Apaza M.	Central 1-Núcleo 4	Promotor
Benedicto Córdova	Central 2-Núcleo 4	Promotor
Casiano Flores M.	Villa Arancibia	Promotor
Juan Quispe P.	Central 3-Núcleo 23	Promotor
José Fernández	Central 7-Núcleo 67	Promotor
René Huasasi	Central 10	Promotor
Eusebio Colque	Central 4-Núcleo 32	Promotor
Antonio Monzón	Central 1	Promotor

APPENDIX C

Timetable

TIMETABLE

October 25 -- Journey from Quito to La Paz

October 26 -- Saturday

October 27 -- Sunday

October 28 -- Interviews with USAID and D.S.A. officials

October 29 -- Journey to Santa Cruz -- Planning the workshop agenda

October 30 -- A review of the preliminary activities with FIDES and DSA

November 1 -- (Blank)

November 2 -- Trip to San Julián. Review of the arrangements for the Workshop.

November 3 -- Sunday

Nov. 4-16 -- Workshop

November 17 -- Sunday

November 18 -- Journey to Santa Cruz

Nov. 19-20 -- Evaluation of the Workshop with FIDES and D.S.A. Draft Report.

November 21 -- Journey from Santa Cruz to La Paz.

November 22 -- Interview with officials from USAID/Bolivia; Delivery of a copy of the Report; Journey from La Paz to Lima.

November 23 -- Journey from Lima to Quito.

APPENDIX D

Workshop Agenda and Timetable
San Julian Workshop -- Timetable of Activities

DAY AND DATE	PERIOD	TOPIC	INSTRUCTORS
Monday, Nov. 4	Morning	Opening	Eng. Molina
		Session 1: Introduction to the Workshop (I)	Eng. Larrea
		Session 2: Developing a Project	Eng. Larrea
		Session 3: Initial technical Assessment	Eng. Molina
	Afternoon	Session 3: contd.	Eng. Larrea
		Visit to the Pluviometric Station	All
Tuesday, Nov. 5	Morning	Session 4: Community Social Assessment	Sr. Peña
		Session 5: Resource Inventory	Eng. Larrea
	Afternoon	Community Inventory	All
		Preparing Tank Materials	Eng. Molina Eng. Larrea
Wednesday, Nov. 6	Morning	Session 6: Choosing the most Appropriate Technology.	Eng. Larrea Eng. Rodas
	Afternoon	Constructing Household Tanks	All
		Communal Tank Construction Visit	All
Thursday, Nov. 7	Morning	Session 7: Sizing the Tank	Eng. Larrea
		Session 8: Household Storage Tanks	Eng. Larrea
	Afternoon	Constructing Household Tanks	All
Friday, Nov. 8	Morning	Session 9: Designing the System	Eng. Larrea Eng. Rodas
		Session 10: Thatch Roof Catchment	Eng. Larrea
	Afternoon	Constructing Household Tanks	All
		Constructing Roofwashers	All
Saturday, Nov. 9	Morning	Session 11: Planning and Management of the Construction Operations	Eng. Rodas Sr. Moreno
		Session 12: Mid-point Evaluation/Feedback (for the Workshop)	All
	Afternoon	Constructing filters	All

DAY AND DATE	PERIOD	TOPIC	INSTRUCTORS
Monday, Nov. 11	Morning	Session 14: Community Participation	Sr. Moreno/Sr. Peña
	Afternoon	Session 13: Construction of the (Communal) Tank.	All
Tuesday, Nov. 12	Morning	Session 17: Resource Inventory	Eng. Larrea
	Afternoon	Session 13: Construction of the Tank.	All
		Construction of Filters and Gutters	All
Wednesday, Nov. 13	Morning	Session 16: Critiquing and Refining the System Design.	Eng. Larrea Eng. Molina Eng. Rodas
	Afternoon	Completion of the Household Tanks	All
		Session 13: Construction of the Tank	All
Thursday, Nov. 14	Morning	Session 15: Monitoring and Maintenance	Eng. Larrea
		Installation of Household Tanks	Group 2
		Construction of Metal Gutters	Group 1
	Afternoon	Construction of the Communal Tank	All
Friday, Nov. 15		Construction of Household Tanks	All
		Construction of the Communal Tank	All
Saturday, Nov. 16	Morning	Delivery of the Systems to the Communities	All
	Afternoon	Session 18: Applications of the Workshop	All
		Session 19: Workshop Evaluation	All
		Closing Ceremony	Eng. Molina Eng. Rodas

(The number for each Session refers to the Training Guide, WASH Technical Report No. 27)

APPENDIX E

Photographs

Foto 1. Pequeña tinaja de cemento-arena (Relleno de arena).
Photo 1. Small sand/cement jar (filled with sand).

Foto 2. Curado exterior de la tinaja de cemento-arena.
Photo 2. External curing of the sand/cement jar.

Foto 3. Tinaja pequeña familiar, de cemento-arena (Relleno de cáscara de arroz).
Photo 3. Small family-size sand/cement jar (filled with paddy husk).

Foto 4. Grupo de participantes instalando canales de bambú, filtro de carbón y tinaja semienterrada.
Photo 4. A group of participants installing bamboo gutters, a charcoal filter and a semi-buried jar.

Foto 5. Sistema de filtro de carbón y tinaja semienterrada.
Photo 5. Charcoal filter/semi-buried jar system.

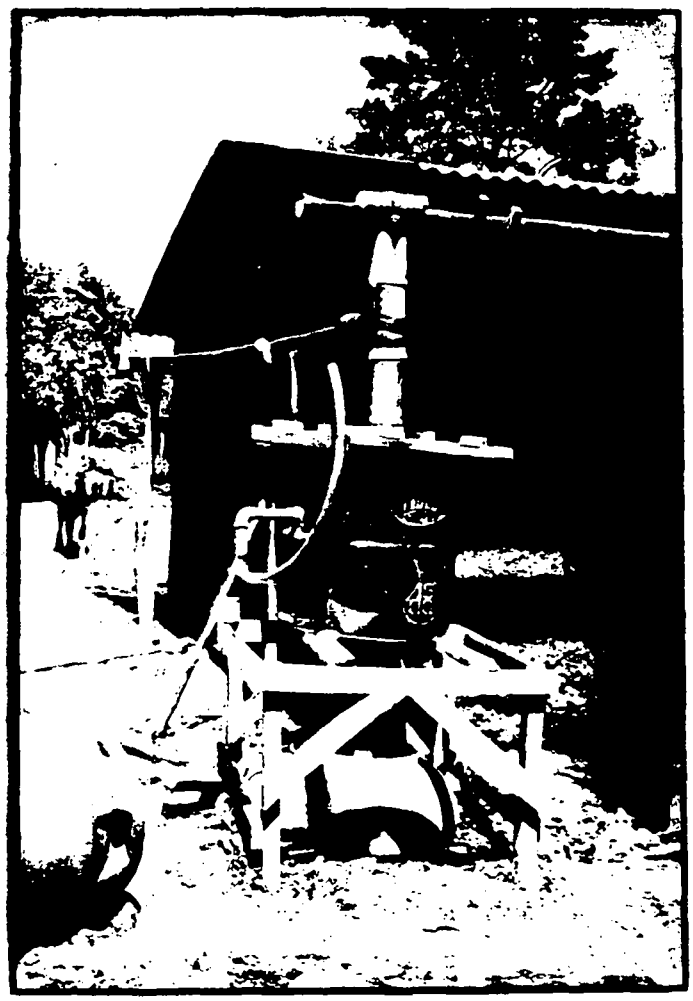

Foto 6. Lavatechos automático y tinaja semienterrada.
Photo 6. Automatic roofwasher and a semi-buried jar.

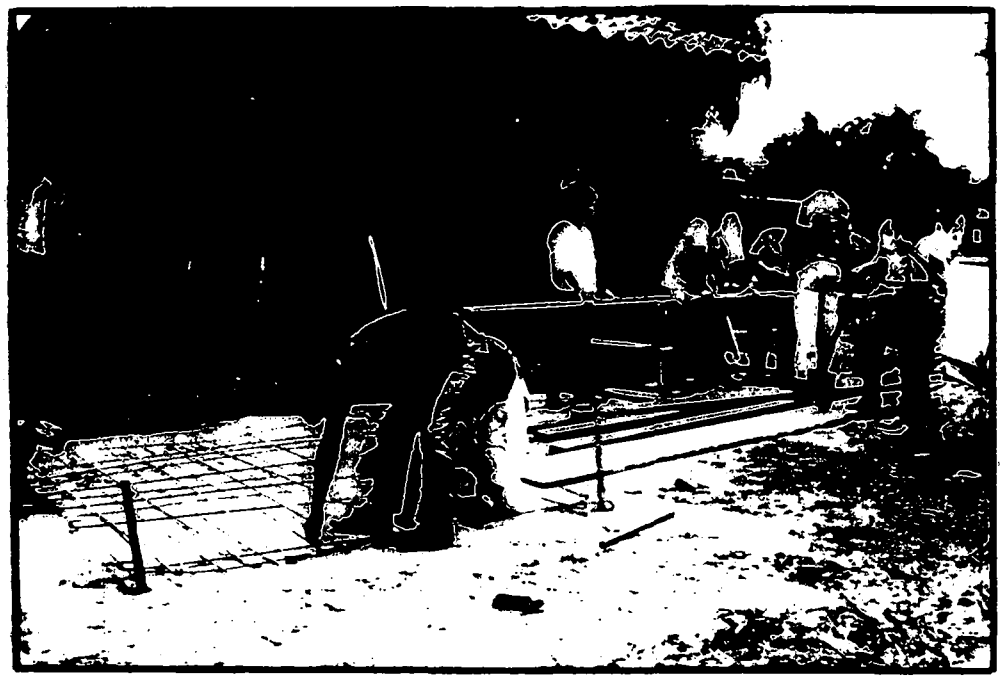

Foto 7. Participantes preparando material para la cubierta del tanque comunal de San Andrés.

Photo 7. Participants preparing material for the cover for the San Andrés communal tank.

Foto 8. Pequeño tanque comunal (sin terminar), bajantes metálicos y lavatechos automático para cubierta de teja.

Photo 8. Small communal tank (unfinished), metal downpipes and an automatic roofwasher for a thatch roof.

Photo 9. The community gathered at a session prior to the delivery of the system and was given recommendations on its operation and maintenance.

Foto 9. Comunidad reunida en sesión previa a la entrega del sistema y recomendaciones sobre operación y mantenimiento.

Foto 10. Uno de los participantes explica las partes del sistema y hace recomendaciones sobre funcionamiento y 0 y
Photo 10. One of the participants explains the system's components and makes recommendations on its operation, running and maintenance.

Photo 11. The Community listens to one of the participants making recommendations on the operation and maintenance of a system involving bamboo gutters.

Foto 11. La comunidad escucha las recomendaciones de un participante sobre operación y mantenimiento de un sistema con canales de bambú.

Foto 12. Grupo de participantes e instructores junto a un sistema familiar con canales de bambú ya terminado.
Photo 12. A group of participants and trainers standing beside a completed household system involving bamboo gutters.

Photo 13. Closing session of the workshop at San Julián. Part of the FIDES camp can be seen in the background.

Foto 13. Sesión de clausura del Taller en San Julián. Al fondo parte del campamento de FIDES.

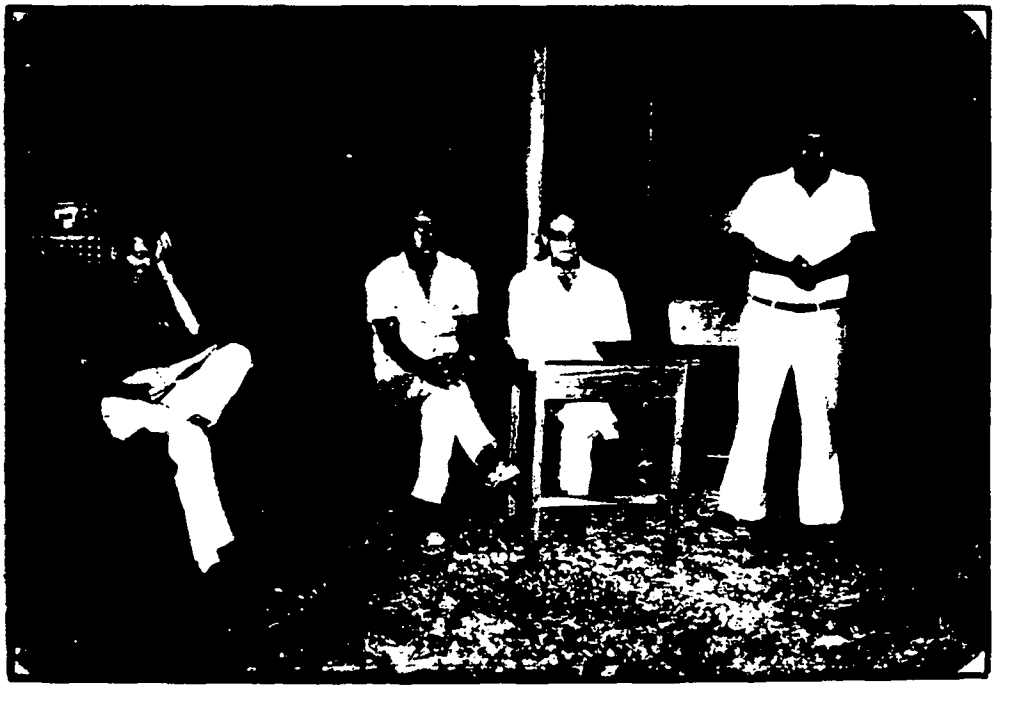

Foto 14. Sesión de clausura del Taller en San Julián. De izquierda a derecha: Asistente DSA, Director-Ejecutivo FIDES, Instructor WASH y Jefe Regional DSA, Santa Cruz.
Photo 14. Closing session of the workshop at San Julián. From left to right: a DSA assistant, the FIDES Executive Director, the WASH Trainer and the DSA Regional Chief (Santa Cruz).

APPENDIX F

Sample Certificate

FUNDACION INTEGRAL DE DESARROLLO - FIDES

DIRECCION SANEAMIENTO AMBIENTAL - D.S.A.

C E R T I F I C A D O

El Señor: .....

.....

Ha participado en el TALLER DE APROVECHAMIENTO DE AGUA DE LLUVIAS. Propiciado por A.I.D., organizado por FIDES y la DSA - Santa Cruz y dictado por el PROYECTO WASH a cargo del Consultor Ing. OSCAR LARREA V., del 4 al 16 de Noviembre.

San Julián, noviembre 1985.

Ing. Armando Molina F.
DIRECTOR EJECUTIVO-FIDES

Ing. Gonzalo Roda C.
JEFE REGIONAL - D.S.A.

APPENDIX G

Key Individuals Contacted

Sr. Gerry Bower	Jefe, HHR, USAID/Bolivia
Arq. Rafael Indaburu	Gerente de Proyecto, USAID/Bolivia
Ing. José Zuleta	Director, D.S.A.
Ing. Raúl Bascón	Asesor, D.S.A.
Ing. Armando Molina	Director-Ejecutivo FIDES
Ing. Gonzalo Rodas	Jefe Regional, D.S.A., Sta. Cruz
Sr. Alberto Peña	Promotor FIDES
Sr. Hugo Moreno	Educador D.S.A., Sta. Cruz