PD-AAL-671
621-0025/15

CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) – PART I

Report Symbol U-447

1. PROJECT TITLE

Margui-Wandala Water Supply Project

2. PROJECT NUMBER: 631-0025

3. MISSION/AID/W OFFICE: USAID/Cameroon

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY)

☒ REGULAR EVALUATION ☐ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES

A. First PRO-AG or Equivalent	B. Final Obligation Expected	C. Final Input Delivery
FY 10/79	FY 9/84	FY 9/84

6. ESTIMATED PROJECT FUNDING

A. Total $ _____

B. U.S. $ 1,460,000

7. PERIOD COVERED BY EVALUATION

From (month/yr.) February, 1980

To (month/yr.) June, 1982

Date of Evaluation Review: August, 1982

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
1. Decisions must be taken to resolve problems concerning well and gallery designs, pumps, and other problems identified in summary of PES.	CARE Project Delegate	October, 1982
2. A revised implementation schedule must be submitted to USAID/Cameroon for the period remaining in the project.	CARE Project Delegate CARE Project	October, 1982 C

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☐ Project Paper
- ☒ Implementation Plan e.g., CPI Network
- ☐ Other (Specify)
- ☐ Financial Plan
- ☐ PIO/T
- ☐ Logical Framework
- ☐ PIO/C
- ☐ Other (Specify)
- ☐ Project Agreement
- ☐ PIO/P

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☐ Continue Project Without Change
- B. ☐ Change Project Design and/or ☒ Change Implementation Plan
- C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

Claudio Fortunato, USAID/Cameroon Project Officer
Randal Thompson, USAID/Cameroon Evaluation Officer
William Edgar, CARE Project Delegate
Susan Greisen, CARE Health Specialist
Mayako Francois, Genie Rural
Baytore Rene, Community Development

12. Mission/AID/W Office Director Approval

Signature: Bernard D. Wilder

Typed Name: Bernard D. Wilder

Date: 9/4/82

13. Summary and Recommendations

The Margui-Wandala Water Supply Project is an OPG to CARE with the objective to rehabilitate or improve a number of existing water sources in the Margui-Wandala area in the North Province of Cameroon.

The project proposes to install pumps on 36 existing but poorly or non-functioning wells and on 56 newly installed infiltration galleries. The 92 thus improved water sources should serve an estimated population of 102,000 year round. In addition, the project proposes to design and implement a complementary health program to transfer hygenic water usage habits and waste practices to the target population.

The period of the grant is October 1, 1979-September 30, 1984.

The Project is being implemented by CARE under the direction of a project delegate, who is also a technical specialist in wells construction, and a health specialist. The host country counterparts include the Department of Genie Rural and Community Development of the Ministry of Agriculture.

An evaluation was conducted of the project from May through July, 1982, in accordance with Section J.2.b. of the Project Agreement. The evaluation found that as of the end of June, 1982, 30 pumps had been installed on a total of 20 sites. Five additional sites were under construction. Hence, in spite of the fact that the project had passed the half-way mark, less than one third of the target sites had been upgraded.

According to the REDSO/WA engineer, who participated in the evaluation from May 25-29, 1982, there are several problems with the wells and galleries which must be resolved before the project can be continued. The engineer visited a total of sixteen completed sites, and found several pumps in less than optimal working order. Moreover, he found that in general, wells and galleries were not dug deeply enough. Out of eight wells visited, four were dewaterd. In addition, two out of eight galleries observed were dewatered, and none had over three meters of surcharge. This means that the objective of the project to provide a year-round supply of water has not yet been achieved, and that the water sources must be deepened if this objective is to be achieved in the future. The engineer also noted some problems with the gallery design, and found that several of the water sources were supplying turbid water.

The health component of the project has evolved a methodology and approach suitable for the target population. The two segments of the health component include "animation," or the involvement of the target village in the construction of the water source, and "health education," or training of the target

population in water usage habits which will improve their health status. The evaluation found that the "animation" segment of the project has had a mixed success. In general, community involvement in the construction and maintenance of water sources has been less than desirable, but reports from the field claim that the degree of participation is improving. The health specialist reports a good deal of success in transferring new water usage habits. The technique of reaching the target population via the training of local leaders appears to be very suitable for the achievement of project objectives. An evaluation conducted in January, 1982 of the local leader seminars showed that all (100%) of the three villages whose leaders attended seminars, had integrated improved health activities into their daily lives.

There were several problems in obtaining the GURC contribution to the health component. Early on in the project implementation, the decision was made to coordinate the health activities of the Margui-Wandala Water Supply Project with those of the Mandara Mountains Water Resources Project (631-0012). A coordinating committee formed under the auspices of the Ministry of Economic Affairs and Planning, was established in the target zone to direct the water resources' project activities. Unfortunately, this committee was lacking in its provision of the host country contribution for fuel, per diem, and other costs. Finally, the USAID project officer decided to end the link between the two project activities; support was obtained as intended by the Ministry of Agriculture. Counterpart funds were finally forthcoming from MINAGRI and the project activities could proceed more smoothly.

The higher level objectives of the project, namely increasing the productive activities of the target population, improving income and general well-being, and reducing migration, were not evaluated at this time due to the fact that the project outputs were not yet adequately achieved. These higher level objectives will be evaluated in the final evaluation.

Recommendations:

The REDSO/WA Engineer recommends in his technical evaluation to continue with the project, inspite of the technical problems experienced to date. He asserts that the technical problems are to be expected in such a project and that the project has made strides in dealing with and solving the problems.

The health component has been receptive to its environment and has successfully evolved an educational approach conducive to the dissemination of health objectives. The original target of 102,000 beneficiaries appears to be highly improbable. Only approximately 2000 families or 10,000 beneficiaries have been served to date even though about one fourth of the anticipated water sources have been constructed.

It is the general recommendation of the individuals who participated in this evaluation that the second half of the project should be funded, that more realistic targets be set, and that the following specific recommendations should be implemented within a strict time frame:

1. Numerical criteria for minimum depth of wells and galleries must be established and all existing sites must be brought up to that criteria as soon as possible.

2. In order to achieve criteria for minimum depth of wells and galleries, it will be sometimes necessary to drill and blast rocks. Project must gear-up for these activities by training, hiring technical specialists, procurement, transport, storage, and by obtaining the necessary licenses and permits.

3. Alternative gallery designs should be investigated and tried with the objective of eliminating horizontal suction pipes and excessive cost and construction.

4. Look for an alternative, more durable, piston-type suction pump that might be locally available.

5. Get a technical representative from Moyno to come to project and diagnose existing problems with pumps drives, stators, rotors, and installations, and give a hand on training in installation techniques.

6. Implement program for data collection and analysis for sites operation. Monthly water levels in wells and galleries should be measured and recorded. A person should go to each site three or four times a year at representative times in the wet and dry season and document how many people use the source, how much water is taken, and how far they come.

7. Hire a project administrator. The CARE delegate, acting as technical director, has too many responsibilities overseeing the technical aspects of the project and cannot handle administrative problems.

8. Project should re-assess its animation strategy to determine whether community participation can be enhanced.

9. Health education component should continue as currently practiced. Local leader strategy seems to be effective.

10. In view of the above, a revised implementation schedule must be submitted by CARE and approved by GURC and AID.

14. Evaluation Methodology

This evaluation was conducted collaboratively by USAID, the Government of Cameroon, and CARE. The purpose of the evaluation was to assess whether the project was being implemented as envisioned and whether project objectives were being achieved in the water source and health components. The project officer and evaluation officer drafted scope of work which was then discussed and finalized in Maroua with the CARE and GURC project responsibles. (See Appendix A). A work plan was written and assignments made to each party to complete specific sections of the evaluation. (See Appendix B). Each party submitted a report which addressed the issues which were assigned to them. In addition, a REDSO/WA engineer came to the project site from May 25-29, 1982 to assess the quality of the wells. Finally, the Project Evaluation Summary was written in USAID/Yaounde..

The Project Agreements between AID and CARE and between CARE and GURC. served as the basis of the evaluation. The actual project implementation was compared with the implementation schedule and differences were explained on the basis of design or managment problems. The outputs of the project as stated in the Project Agreement were assessed to determine whether they had been or would be achieved. Purpose level objectives were reviewed in order to verify the design logic of the project and to determine whether necessary steps were being taken to assure that project purpose also would be achieved.

Finally, evaluation findings were carefully reviewed by the USAID/Yaounde project officer to determine whether adequate progress had been made in the project to warrant continuation of the project and disbursement of the second tranche of funds.

Participants in the Evaluation included:

Susan Greisen, CARE, Health Specialist
William Edgar, CARE, Project Director, Well Specialist
Claudio Fortunato, USAID/Cameroon Project Officer
Randal Thompson, USAID/Cameroon Evaluation Officer
Dan Jenkins, USAID/REDSO/WA Engineer.
Niayako, Francois, Genie Rural
Baytere, Rene, Community Development

15. Inputs

A. Commodities and Equipment

There were delays encountered in the procurement of project commodities and equipment which had a negative effect on the timely construction of wells. The 1981/1982 season was the first year in which the construction teams could fully utilize the equipment and hence "gear up" for their construction/renovation activities.

B. Myno Pump

According to the project paper, CARE was to test several types of pumps on the upgraded water sources and select the one which would be the most suitable for the target region. Instead, CARE unilaterally selected the Myno pump. CARE asserted that the pump is very adaptable, durable, is made to assure continual lubrication of pivoting parts, and is as serviceable as other pumps.

The REDSO/WA engineer who conducted the technical evaluation concluded that the Myno pumps used in the project "are probably as durable as any other." (See Appendix D for an indepth analysis of the pump). He found, however, that a large percentage of the pumps were not completely functional. He thought that the problems stemmed mostly from improper assembly and installation in the field, not from any inherent fault of the pump design.

The engineer does assert that other pumps may be more appropriate and efficient for lifts encountered in the galleries, however. He recommends investigating the availability of a durable piston-type suction pump in Cameroon.

The engineer also points out that while the Myno pump is considered as durable or more durable than most, it requires special tools, knowledge, and parts to repair. Villagers cannot be expected to maintain and repair the pump. It is therefore vital to provide an efficient repair and maintenance service with spare parts, tools, transport and personnel capable of maintaining all the systems in the area. If replacement pumps and parts are not available, the project will die out after CARE's activity ends.

C. Technical Assistance

CARE has provided a project delegate and a health education specialist to implement the project out of Mokolo in North Cameroon. The first project delegate arrived in April, 1980 and left in June, 1982, to be replaced by the current delegate. The health education specialist position has changed hands several times. The current specialist has been on board since February, 1981.

The evaluation found no serious problems in the quantity, quality, or timeliness of the technical assistance inputs. Although the changes in individuals caused some problems of transition, these changes did not seriously interfere with project implementation. The major problem identified in project technical assistance to date is the fact that the project delegate could not handle both

the administrative and technical aspects of the project himself. He was inexperienced in administration and was pressured by technical difficulties. The evaluation team concluded that CARE should hire an administrator for the project, and that the project delegate should handle primarily the technical aspects of the project.

D. Host Country Counterparts

The Community Development and Génie Rural Departments of the Ministry of Agriculture are participating in the project implementation. The Community Development department provides agents who participate in the animation and health education aspects of the project. A representative of Génie Rural is responsible for maintenance.

A Coordination Committee was formed to direct and monitor the activities of the Mandara Mountains Water Resources Project (631-0012), also funded by AID, whose objective was to construct dams in the target area and also to train beneficiaries in improved water usage habits. The Coordination Committee also took on the responsibility to monitor the Margui-Wandala Water Supply Project. The Coordination Committee is composed of the Department Prefect, the Provincial Development Agent (Local Project Coordinator), Departmental Chief of Preventive Health, the Departmental Agricultural Delegate, the Section Chief of Rural Engineering, the Chief of the Department of Mines and Energy, the Section Chief of Community Development and the Section Chief of Social Affairs.

However, this Coordination Committee failed as a viable implementation body in the sense that it failed to provide adequate funds and commitment to keep project activities functioning smoothly. Sufficient fuel, per diem, and other expenses were not supplied to the Community Development agents. As a consequence, visits of animators were limited, and the project implementation was severely delayed.

Finally, the USAID/Project Officer decided that Mandara Mountains Water Resources Project monies could no longer be used to fund health activities of the Margui-Wandala Project. The USAID/Project Officer's action caused a funding commitment to be made for the Margui-Wandala Project by the Ministry of Agriculture who had the responsibility to provide the funding in the first place. Once this commitment was obtained, the project implementation could proceed with less impediments.

The CARE health specialist reports that it was very difficult to obtain full-time commitment from the Community Development Department for the implementation of the project. Health activities were emphasized between October, 1980 and October, 1981, yet the Chief of Community Development could only contribute 10-20 percent of his time to community development activities. The remainder of his time went toward his other delegated role as the Director of SCCODPED. In order to keep the health activities from ceasing, the health specialist at times fulfilled the responsibilities of Chief of Community Development. She assured that community development workers were paid, that their motorcycles were repaired, and had gasoline, etc. Time spent maintaining Community Development in functioning capacity left little time for health planning and activities, and had a negative effect on project implementation. Once a new Community Development Chief was named, cooperation between CARE and the Community Development Department substantially improved so that the two parties

are now working in close unison.

The CARE project delegate also reported that the initial relationship with the Community Development Department had a negative impact on the planning and preparation of villages for the work needed to construct each site. It was not until December of 1981 that the proper procedures began to be used in selecting a site which satisfied both the animation and technical criteria. It was not until after December, 1981 that the work at the sites really began and the animators started to gain skill in judging which villages would be promising from a "work participation" point of view.

Valuable time and energy was also taken up between May, 1980 and December, 1980 to construct the warehouse/garage. This was supposed to be furnished by the Ministry of Agriculture but no appropriate building was found in Mokolo for the purpose.

E. International Volunteers

Peace Corps Volunteer commitments to health education activities at the design and origin of the project were at 100%. During the last year, however, commitments have fallen near 40% to 60% among the three volunteers involved in the health activities. This caused a lack of field supervision for the Community Development workers which is crucial for proper program implementation. Due to this factor, it often took longer for successful results to occur. For example, village participation decreased due to the lack of proper Community Development animation. Had the actual percentage commitment of the Peace Corps been known at the beginning of the project design, the structural organization would have been planned differently, placing less emphasis on Peace Corps involvement and possibly increasing estimated time to achieve certain goals. These considerations have now been incorporated into the present plan.

F. Community Involvement

According to the CARE strategy, the communities targeted for water sources play a crucial role in the project. The well construction, health education process begins when a village sends a request to CARE for a well. Once selected, a village must provide labor to assist in construction activities and also to disseminate health knowledge. In the early months of the project, community participation was lacking. Villagers simply wanted a water source with no commitment to nor involvement in the process. This is the model followed by Génie Rural. However, CARE began implementing a questionnaire to potential target villages to assess their willingness to participate. This questionnaire has greatly improved the role villagers have played.

17. Project Activities and Outputs

Activities: The project proceeds by a repetition of the following basic scenario.

The well construction, health education process begins when a village sends a request to CARE for a well. The Community Development agents visit the potential village and implement a questionnaire to determine whether the village possesses the type of qualities indicative of a successful venture. The questionnaire investigates the village's past history of community involvement, presence of water sources, etc.

The questionnaires are examined by CARE. If the village fulfills criteria then CARE performs a prospection site to determine whether a water source can be provided, and, if so, what the appropriate design and strategy would be. If CARE decides that a water source is technically feasible, then the Community Development agents go back into the village and inform the villagers what they must provide. Each village must provide labor (six volunteers per day), lodging and food for the well workers for two to four months, depending on how long the well will take, gravel and sand, as well as other miscellaneous things. The villagers sign a contract agreeing to their commitments. CARE then sends in a construction team composed of CARE employees who have been trained by CARE in well construction. There are seven construction teams employed by the project, six of which construct new sites, the other of which deepens wells and maintains them. Consequently, up to six new sites are worked simultaneously. Once the construction team is on board, village animation and health education commence. The Community Development agents encourage the villagers to appoint local leaders who will serve as well guardians and assist in the dissemination of new health practices. The villagers elect volunteers to provide labor, a well guardian (who also hopefully will participate in construction) and volunteers who will teach health. CARE attempts to encourage the enlistment of at least one volunteer who speaks French and who can read and write. In addition, at least one woman must be represented. The woman must be recruited in order to successfully disseminate new health practices to women, since the local culture prohibits men from directly speaking to unknown women. All but one of the villages serviced to date have provided a female volunteer.

After the volunteers, leaders, and well guardians are selected, training commences in the various skills necessary to implement and sustain the project. A two-day seminar for local leaders inculcates improved water usage habits and establishes role models for the community to emulate. Well guardians are also trained. One teacher seminar in health education is held in schools in the target site area. Supplies, flipcharts, etc. are given to establish a school-student health committee to organize student participation in improving health and water usage habits.

A follow-up evaluation is made of C.D. agents to determine their effectiveness in training the target population. Moreover, an evaluation is made of target trainees to determine whether their water usage habits have improved. The condition of the wells is also periodically surveyed.

Wells are to be maintained by the villagers with the help of the Community Development agents. Well guardians are to take care of routine maintenance.

Villagers are to inform Community Development agents when there is a problem which villages themselves cannot handle.

Currently, though, it is a representative of Genie Rural who handles well maintenance for CARE. Although the Community Development Department has a technical division which should be capable of such a task, this division is not functional in the project area. Consequently, it may in actuality be Genie Rural who maintains the wells in the future. Genie Rural is geared-up to construct wells in the Northern Province and does so by using dynamite for blasting through rock, etc., to create adequate depth. However, Genie Rural's approach differs sharply from that of CARE's, since they do not elicit village participation in the construction nor maintenance of water sources. They merely provide the water source exclusive of education in water usage.

The technique used by CARE for building the water sources is described in Appendix D.

Construction Output:

The anticipated output of the construction component of the project was 92 improved wells and infiltration gallaries, providing 50 liters of water per family per day all year round. To date, 30 pumps have been installed on a total of 20 sites, servicing approximately 2000 families. Since several of the water sources were dewatered, a year-round water supply has not yet been established at all sites. No definite data is yet available on the amount of water per family per site which has been provided by new or improved sites.

From May 25-29, 1982, REDSO/WA hydraulic engineer, Dan Jenkins, visited Cameroon to conduct site visits to the CARE wells, in order to assess their quality and the quantity of water which they provide for their target users. (See Appendix D for his complete report).

Jenkins visited sixteen completed sites and took measurement of discharge, specific displacement of pump (cycles per liter), well or gallery depth and amount of water, and force required to turn pump. He also identified specific problems and made general observations. Discharge and displacements were measured by time and cycles to fill a 12 liter bucket at a comfortable pumping speed. Table 17a shows his general observations as to the sixteen sites as well his technical measurements.

As can be seen in Table 17a, Jenkins found many pumps in poor working order. 10 pumps out of a total of 25 pumps had defects which generated less than optimal performance. Several of the water sources had turbid water and some of them were dewatered.

In his assessment of system capacity, Jenkins concluded that sites with limited system capacities were common. Jenkins characterizes system capacity or the effectiveness or amount of utilization of the systems as determined by (1) inhabitants within range of the source; (2) the discharge capacity of the pumps; and (3) the yield of the well or gallery. Jenkins identified sites limited by one or more of these factors. According to Jenkins, the capacity should never be a limiting factor; this characteristic depends upon how deep the well or gallery

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TABLE 17a

SUMMARY OF ENGINEER'S FINDINGS

Village	No. of wells/pumps	Condition for wells/pump/water
Mayo Kabba	2 wells with one pump each	1st well dewatered after pumping 10 liters 2nd well had 20 cm of stored water above the in let
Palva	1 pump on a dug well	Knocking and binding in the shaft or rotor/ requires excessive work in turn
Hina Winde	Well with one pump	Pump has bad foot value and looses prime/pump drive somewhat rough and hard to turn. Pumping nearly dewatered
Gawar Winde	Well with one pump	Has never dewatered/deepest well visited (16 meters) and had 2 meters of stored water. Pump starts rough.
Mouhour	Infiltration gallery with one pump	Pump not working/pumped water was turbid.
Vitte	Infiltration gallery with 2 pumps	Pumps operated normally and gallery had 3 meters of stored water/water is turbid.
Bhoumzou	Infiltration gallery with two pumps	Was dewatered/water is turbid
Kosselore	Infiltration gallery with two pumps	Was dewatered/water is turbid
Tourou	2 infiltration galleries with 3	Galleries had about 1.5 meters of stored water. One pump had bad foot value and lost prime One pump has a bind in the rotor and is hard to turn. One pump has broken or disconnected shaft. Water is turbid.

Village	No. of wells/pumps	Condition for wells/pump/water
Djingliya	Well with two pumps	4 meters of stored water. One pump starts rough and binds. Other pump has defective rotor.
Maak	Infiltration gallery with two pumps	Both pumps operated smoothly and the gallery had 2 meters of stored water. Water is turbid.
Morala	Well with one pump	Pump operates smoothly but has less than normal specific displacement, due to lost prime and bad foot value.
Talmade	Well with one pump	Pump works smoothly with normal discharge and specific displacement.

impact of this water on their health and quality of life. CARE has recently procured water meters. These meters will be placed at each site for a duration of two or three weeks during typical times of the two seasons; total consumption is thus obtained. In addition, a survey has been developed to find out how many families use the pump, and this combined with the meter reading results, will afford the quantity used per family. Unfortunately, no base-line data was collected prior to the upgrading of sites, so that no pre and post comparisons can be made. The CARE project proposal insisted that such baseline data would be collected; the lack of such data indicates a serious flaw in the implementation.

Health Component Output

The health education component (HEED) is composed of two distinct elements: "animation" and "health education." Animation, or the process of making a community aware of the importance of a clean, adequate water supply, is designed to arouse community involvement in the building, maintenance, and proper use of improved year-round water sources. Health education is the process of informing the users of improved water sources about proper water usage habits and of changing user attitudes and behavior toward water.

Animation is closely linked to the construction phase of the project; it is the key to the commencement of construction which cannot be implemented successfully unless the benefitting communities have been motivated to and are willing to participate in construction.

The activities involved in the health education component are described in detail in Appendix E. This Appendix also includes summary data on the seminars given to date, the number of individuals trained, and statistics on results to date.

The health component functions with the following individuals: government officials, community development supervisors, community development agents, and at the community level, with local leaders, teachers, and CARE well workers. The strategy for inculcating improved health practices is for the community development agents to make periodic visits to the target villages, and also for the local leaders and teachers to serve as role models for the community. Toward this goal, seminars are given for local leaders and teachers. Table 17b in Appendix E shows the seminars given to date.

CARE reports a high rate of success in its local leader seminars. In January, 1982, CARE conducted an evaluation of the impact of local leader seminars on changing the health habits of the local population. CARE had anticipated that only 25% of the villages with leaders attending seminars would actually show an increase or an improvement in health related activities after the first four months. Of the three villages trained, CARE found all (100%) had integrated improved health activities into their daily lives. Some examples of the changes included: (1) construction and utilization of new latrines; (2) old latrines improved and properly maintained; (3) weekly health education lessons given by the local leaders; (4) regular inspections of village sanitation by the local leaders; (5) increased frequency of cleaning water storage vessels with soap; and (6) rotation of a well guardian by a CARE well site to keep the area clean and to guard it from animals.

No data is yet available on the success of the teacher seminars since they have only recently begun. The ambition for involving teachers is, of course, to include water usage training for students in school. It is hoped that the students will organize school health committees to monitor water and sanitation habits at the schools.

The major outputs of the health component were to be:

(1) A health education curriculum for Community Development agents, international volunteers, and communities. This output has been successfully accomplished. As indicated above, an evaluation of the efficacy of this curriculum has shown it to be positive.

(2) Completed and distributed hygiene manual.

The health specialist found several appropriate health manuals already available in the project area. As a consequence, she has decided to employ them rather than to creating new ones which would add little, if anything, new to the existing ones. Hence, a new hygiene manual is no longer a project output. Existing manuals have been employed by the project and distributed.

In conclusion, the health component has kept pace with the water source activities, but like those activities, it is behind schedule. As indicated in the input section, the major reasons for delays in this activity include procurement delays by Government of Cameroon in providing manpower and financial commitments, and inadequate participation by villagers and Peace Corps Volunteers.

18. Purpose: Not pertinent at this time.

19. Goal: Not pertinent at this time.

20. Beneficiaries: The direct beneficiaries of this project are the numerous families in the Margui-Wandala region of Northern Cameroon who in general have an inadequate supply of clean water provided all year. These families are primarily subsistance farmers.

21. Unplanned Effects: None.

APPENDIX A

SCOPE OF WORK FOR THE EVALUATION OF MARGUI-WANDALA WATER RESOURCES PROJECT (631-0025)

The Margui-Wandala Water Resource Project is an OPG to Care with the objective to rehabilitate or improve the number of existing water sources in the Margui-Wandala area in the North Cameroon Province.

The project will install pumps on 36 existing but poorly or non functioning wells and in newly installed infiltration gallaries. The thus improved water sources will serve an estimated population of 102,000. In addition, the project will design and implement a complementary health program to transfer hygenic water usage habits and waste disposal practices to the target population.

The period of the grant is October 1, 1979 - September 30, 1984, and will have been in effect approximately 2 1/2 years at the time of this mid-project evaluation. The purpose of this evaluation is to:

1) Satisfy the C.P. of the OPG, Section J.2. b.
2) Review the implementation process to date and determine whether it has proceeded as scheduled and, if not, determine the cause or causes of divergence;
3) Review the project design logic to determine whether project activities will likely lead to project purpose;
4) Determine whether the project is affecting the target population.

As a direct result of more water being made available and easily accessible, answers to the following questions will be sought:

a. Is fifty (50) liters of water per day per family being supplied? Has the quality of life improved?
b. What productive activities are being undertaken for the well-being of the family?
c. Has migration to the neighbouring country of Nigeria reduced?

Specifically, the following project components and issues will be examined:

1) Upgrading of Water Sources

a) determine whether procurement of necessary commodities and equipment has proceeded as planned;

b) determine whether communities are (1) being sensitized to the benefits of improved water supply systems and (2) are cooperating with volunteer labor during construction;

c) determine why CARE has selected the pump it is employing and what advantages the pump has over others;

d) determine how many water sources have been upgraded, and whether the plan for future upgrading is realistic;

e) determine whether all wells upgraded to date have been deepened and have been furnished with two pumps;

f) determine whether there has been a financial saving on selecting the infiltration galleries instead of constructing spring boxes and related structures which have been deemed unnecessary for lack of springs.

g) determine whether villagers have been trained in minor maintenance of their water source facility;

h) determine whether a permanent maintenance crew has been trained;

i) determine whether a routine maintenance procedure manual is being written.

2) Health Education Component

a) determine whether a hygiene education curriculum for the hygiene education workers has been developed;

b) determine whether training for C.D. and International Volunteer Hygiene education workers has been completed;

c) determine whether C.D. agents and International Volunteers have commenced collecting baseline data on water procurement and usage habits;

d) determine whether education process in selected villages has commenced and whether agents are teaching the following subjects:

1) water usage; personal, domestic.
2) water handling and storage.
3) waste disposal: human, animal, and domestic.

e) determine whether the hygiene manual is being developed.

f) determine whether intended beneficiaries have been reached by the training component, the numbers reached to date.

g) whether the plan formulated to educate the target population and measure the impact of the teaching of appropriate health practices is leading to intended results.

3) Development Administration

a) determine whether CARE, MINAGRI, and USAID cooperating villages, International Volunteers have lived up to their commitments and have provided what they agreed to; if not, to determine why commitments

were not honored, and what impact on the project this has had.

b) determine whether the relationship between CARE, MINAGRI, and USAID has operated in a fashion conducive to a positive implementation process.

c) determine whether the monitoring responsibilities of USAID toward the project have been in keeping with those expected for an OPG.

4) Financial Management - determine whether the financial management of the project has been in accordance with the anticipated budget and the principles of sound fiscal management and AID regulations.

The evaluation will be conducted by a review of files, site visits to the water sources and villages where health education has begun. Interviews will be conducted of health workers, target beneficiaries and maintenance teams to determine the quality of health and maintenance training. An engineer will examine the systems used for improving the water sources for quality and efficiency.

The evaluation team will consist of the USAID Project Officer, who is also the General Engineering Officer, the USAID Evaluation Officer, a representative from the USAID controller's office, and representative from CARE and MINAGRI (Genie Rural and Community Development).

Evaluation Schedule:

March, 1982	Final scope of work will be written and work plan made.
May-April, 1982	Site visits and preliminary results summarized. Further site visits will be scheduled if preliminary results warrant it.
June, 1982	PES will be completed by the team and presented to Mission and GURC officials before final submission to AID/W.

Issues	Information Required to Address Issues	Source of Information	Method of Obtaining Information	Person who will obtain Information	Date of Obtaining it
4a 50 litres/ jour	N°. of litres of water collected/ family/day	representative sample of water wells	-water meter -survey	Community Development Agents	21 April- 5 May 1982
4b,c,d will be addressed later	re-discuss at a later date			C. Fortunato will discuss with CARE/ Yaounde	19 April 1982 (CARE/Mokolo)
Upgrading of water sources					
1a	arrival schedule	CARE warehouse document	visit ware-house	CARE	31 April, 1982
1b Community involvement	N°. of people participating in construction	site attendance sheets	compiling information on sheets	CARE	May 30, 1982
1c Pump	-adaptability -durability -Initial cost -case of installation		-references -experience	CARE will write technical aid memoire	April 31, 1982
1d no.of sources upgrading	no. of wells which have been upgraded	site completion report		CARE	May 30, 1982
future plan	no. of wells which will be upgraded in future	Report attached		CARE	
1e -pumps/site -deepening of wells	no. of pumps -depth of well	guide explaining how many pumps/site prospection reports		CARE/	May 30, 1982

APPENDIX B

1f financial savings	-reason for selecting adopted method		report	CARE	May 30, 1982
1g were villagers trained in minor maintenance			report	CARE	May 30, 1982
1h maintenance crew	-skills of maintenance -person		report	CARE	May 30, 1982
1i maintenance procedure manual			draft copy will be submitted to AID.	CARE	May 30, 1982
2. Health		-lesson plans			
2a curriculum -lesson plans -on-the-job training -follow-up		monthly reports -Barbara's report		CARE	
2b -ongoing training					
2c -determine whether		files		CARE AID+	May 10, 1982
2d				CARE AID +	May 10, 1982
		-site files		AID x	May 10, 1982
		-seminar programs			

2e manuals				AID x	
2f	No. reached to date	animateurs	review	CARE	May
2g	-no. of villages visited -no. of visits/ village -subjects being discussed	animateurs	review dossiers of animateurs interview animateurs	CARE	May 30, 1982
Development Administration					
3a Lived up to	-agreement with CARE/MINAGRI and CARE & USAID -Peace Corps & CARE -concerned villagers			x CARE x MINAGRI	May 30, 1982 May 30, 1982
3b	"			"	"
3c	-whether AID monitoring has been sufficient, adequate			CARE/ AID	May 30, 1982
4a Financial Management				requested from CARE by C. Fortunato	May 30, 1982
AID rules vis-à-vis PVO's financial management				R. Thompson	April 15, 1982

APPENDIX C:

Key Project Milestones

February, 1980:	OPG signed between USAID and CARE
April, 1980:	CARE project delegate arrived in Mokolo to commence implementation. First well construction began on April 18. Construction on project warehouse and garage began.
May, 1980:	CARE Health Education Specialist Linda Lankenau arrived and developed first plan for implementing the Health Education component of Margui-Wandala, Mandara Mountains, and World Bank dam projects.
	First regional health education committee formed and construction of second well commenced.
June, 1980:	Collaborative meeting held between provincial chiefs of service for health education, social affairs, community development, rural engineering, and CARE, and CDF representatives took place. All were familiarized with responsibilities and potential for collaboration.
July, 1980:	First meeting of newly formed management committee for Margui-Wandala and Mandara Mountains projects.
	: Installation of the first Myno pump. : Health education sub-committee formed in Mora.
September, 1980:	Integrated Health Education Seminar held. Enhanced teaching capabilities of the animators and helped unify project responsibles.
	Linda Lankenau departed; Barbara Ormond became new temporary health specialist.
December, 1980:	Ormond held seminar for primary school teachers in Mokolo area in order to explain the role of health education in the school system.
January, 1981:	Ormond held seminars continuing training of the animators of the Health Education component in Méri, Mora, and Mokolo; seminars introduced a method of lesson planning and different animation techniques.
February, 1981:	Susan Greisen arrived as Project Health Specialist, Ormond departed. Greisen reoriented health education component to include less formal training for the animators. Individuals needs and problems were to be dealt with on a day to day basis in an informal manner followed by practical application in the villages.

: Project warehouse and garage completed.

April, 1981: Well construction workshop held for construction teams of CARE and Genie Rural. Goal was to facilitate dissemination of health education through the well workers to the population.

: Global health education budget was presented to the Prefet for approval.

December, 1981: Prospecting sites in Mawak, Kouyapé, Nguetchewé, Mandaka

: Work 80% completed in Tourou, 82% in Kossehore, 77% in Rhoumzou and 66% in Mouhour.

January, 1982: Construction activities targetted for Vitté, Moraka, Tala-Mada, and Bala

: Six construction teams functioning

: Seventh team hired to handle well deepening, retrofitting of modifications, difficult maintenance.

: "Comité de Gestion" would no longer finance seminars involving CARE well sites, but would continue funding the perdiem, gasoline, and motorcycle repair for the animators unit June 30, 1982.

: Work continue slowly in Tourou A,B,C, Kosselhore and Rhoumzou. Serious lack of involvement by villagers.

: New sites at Moraka, Tala Mada, Mardaka, and Vitté started.

: Already constructed well at Gawar Windé deepened.

: Retrofitting of standard intake for infiltration gallery at Mouhour nearly completed.

: "Comité de Gestion" reinstated proposed funds for per diem, gasoline, and motorcycle repair for animators. However, these funds were still unavailable.

: Progress made with local leader seminars evaluated by CARE and animators. Results showed that all (100%) of the three villages whose leaders had attended seminars, had integrated improved health activities into their daily lives.

: Animators trained in the purpose and method of completing health education evaluation questionnaires.

February, 1982: Local leader seminar held in Méri, involving five villages surrounding dam sites.

March, 1982: Moraka, Mawak, Bala, Mandaka, and Gadala sites under construction.

: Prospection visit made to Katamsa to determine feasibility of installing an infiltration gallery and plan its placement.

: First infiltration gallery constructed at Mouhour is functioning; coliform count found to be 4, within range of 0-10 used as objective.

: Decision made to cease all health education funding from the Manadara Mountains Dams Project; health education activities for this project were halted until contract bids for construction underway. Health activities for Margui-Wandala project would continue with funding from the Ministry of Agriculture.

: Local leader seminar held in Hira for well site villages of Mouldar, Palva, Hira Windé, and Mayo Kaba.

April, 1982: Scope-of-work for mid-project evaluation reviewed in Maroua.

: Following sites completed as of end of April, 1982: Hira Windé, Palva, Mayo Kabba A, Mayo Kabba B, Mouldar, Cawar Windé, Mouhour, Djingliya, Tourou A, Tourou B, Kosse Lone, Rhoumzou, Vitté, Mardaka, Mawak, Tala Mada, Moraka, and Katamsa A. Total sites = 18; total pumps = 28; estimated beneficiary population = 13,500.

: Sites under construction include: Mawak, Bala, Mada, Mandaka, Katamsa A, Gadala.

May, 1982: Donation of tennis shoes were distributed to those who have collaborated closely with CARE and CD.

: Three well guardian training sessions were held: Local leaders at each village have chosen a guardian and one assistant who will be responsible to keep well clean and do minor repairs.

: REDSO/WA engineer visited project sites.

: General agreement that wells and galleries should be dug deeper.

: Mawak site completed.

: Seminar for school teachers held.

June, 1982: Bill Edgar, CARE project director left, and was replaced by Mike Godfrey.

: Delegate of Agriculture toured CARE office and project area. Site visit made to Tourou.

: Parawai and Mokong sites completed.

: Bala, Gadala, Katamsa, Mada, Mouldar sites under construction.

: Mokolo hosted a local leader seminar for 20 village leaders from Mawak, Katamsa, and Mokong.

: Parts and repairs obtained for project motorcycles and mobylettes. Regular supply of gasoline has been obtained.

APPENDIX D

TECHNICAL EVALUATION

MARGUI-WANDALA WATER SUPPLY PROJECT (631-0025)
USAID/CAMEROON
TECHNICAL EVALUATION
DAN JENKINS, HYDROLIC ENGINEER, REDSO/WA
JUNE 1, 1982

SUMMARY

The subject project is funded by AID, managed by CARE in Mokolo, and assisted by Peace Corps. The objectives of the project are to upgrade and install manual pumps on 36 existing but poorly or non-functioning wells, to provide infiltration galleries with manual pumps in 56 sites with water near the ground surface, and to implement a training program in basic hygiene to the users. This paper is a mid-project technical evaluation of the wells, galleries and pumps installed to date. The evaluation was conducted between May 24 and 31, 1982.

The project was found to have encountered various technical problems and difficulties in the initial phase. In spite of these difficulties an impressive amount of work was accomplished. There is no question as to the need or usefulness of the project. The recommendation is to make technical modifications or additions to rectify past problems and proceed based on the knowledge gained in the initial phase.

TRIP REPORT

May 25 - 26 Project documents were reviewed and discussed with Claudio Fortunato, engineer, AID/Yaound6.

May 27 - 29 Discussions were held with Bill Edgar, Project Manager, CARE regarding technical issues and problems. A meeting was held with Lankesse Laurent, Chief de Section, Genie Rural, Mokolo, to discuss their parallel rural water program and how the two efforts interact and augment each other. 16 completed sites were visited and measurements were made of discharge, specific displacement of pump (cycles per liter), well or gallery depth and amount of water, force

required to turn pumps, specific problems, and general observations. Discharge and displacement were measured by time and cycles to fill a 12 liter bucket at a comfortable pumping speed.

DESCRIPTION OF THE INSTALLATIONS

Wells: Wells are dug and cased with pre-cast re-inforced concrete rings and capped with a cast slab. The slab has a man-hole with a cast slab cover that can be removed for access as well as for drawing water with buckets if pumps fail. The slab also has anchor bolts and mounting plates for one or two pumps.

Infiltration Galleries: Pits are dug into the water table in ravines, gullies or floodways, cased with pre-cast concrete rings, and capped about 0.5 M above natural grade. Pumps are placed on a concrete slab outside of the floodway 2-3 meters above and 50-100 meters away from the infiltration galleries. Pumps are connected to the gallery sump with 3 cm steel pipe risers with foot valve in the gallery and ABS plastic pipe buried about 30 cm below natural grade between the gallery and pump.

Pumps: Pumps used on both the wells and galleries are manually driven progressive cavity types manufactured by Robbins and Myers under the trade name of "Moyno". Power is transmitted from a double-arm crank through 90° bevel gears in the head to a vertical drive shaft in the drop pipe to the rotor or pumping element. In the case of the wells, the rotor and stator are submerged in the stored water in the bottom of the well and are at or above atmospheric pressure. The pump rotor and stator on the infiltration galleries are above the static water level and therefore below atmospheric pressure. The pumps are steady flow and positive displacement under the design head ranges. All applications use single stage rotor and stator.

THE SITES

Mandaka: An infiltration gallery is installed in a drainage course in a hilly area with sand, clay and gravel overburden. Pump bases are installed on each side of the ravine with one pump installed and the other being installed. The gallery

MISSING PAGE
NO. _____

Vitte: This infiltration gallery has two pumps and was in operation 3 months. The pumps operated normally and the gallery had 3 meters of stored water. It may have been recharged from recent rains. It is in an area of scattered households. Water is turbid.

Rhoumzou: This infiltration gallery has two pumps and was de-watered at our visit. It is in an area of scattered home-sites and in a relatively wide floodway. Water is turbid.

Kossehone: This infiltration gallery has two pumps and was de-watered during our observation. It is in a rural area with scattered homesites. Water is turbid.

Tourou: There are two infiltration galleries about 100 meters apart on a ravine with a narrow floodway between steep, rocky sides. The galleries have three pumps each. There is a small village on the ridge several hundred meters above the galleries. The galleries have been in operation four months. The galleries had about 1.5 meters of stored water. One pump had a bad foot valve and lost prime. One pump has a bind in the rotor and is extremely hard to turn. One pump has a broken or disconnected shaft. The water is turbid.

Djingliya: This well has two pumps and about 4 meter of stored water. One pump starts rough and seems to bind slightly, but has normal discharge and specific displacement. The other pump appears to have a defective rotor and/or stator indicated by very low specific displacement. The well is in a steep mountainous area with scattered homesites just downstream from a small reservoir thought to augment recharge.

Mawak: This infiltration gallery is adjacent to a village on a dry stream bed in the plains near the toe of some hills. Both pumps operated smoothly and the gallery had 2 meters of stored water. It is not apparent that there is significantly more water or less rock in the streambed than on the banks and the gallery would probably be as effective if moved to the pump site. Water is turbid.

Moraka: This well with one pump is in a flat plain area several kilometers from hills or rock outcrop. The site is in a village and is apparently heavily used. The pump has

been in operation for one month. The pump operates smoothly but had less than normal specific displacement; possibly due to lost prime and bad foot valve.

Talamada: Also in a village in the plains, this well with one pump has been heavily used for 3 months. The pump works smoothly with normal discharge and specific displacement.

SUMMARY OF DATA

SITE	INSTALLATION	DEPTH	SURCHARGE	PUMP	DISCHARGE	SPECIFIC DISPLACEMENT	FORCE TO TURN	PERIOD OF OPERATION
Mayo Kabba (A)	Well	9 m	0.0 m	A	(Dewatered)	-	-	14 mo
Mayo Kabba (B)	Well	8 m	0.2 m	A	18 l/min	4.5 c/l	5 Kg	14 mo
Palva	Well	6 m	0.4 m	A	18 l/min	4.3 c/l	8-12 Kg	12 mo
Hina Winde	Well	9 m	0.1 m	A	16 l/min	4.7 c/l	8-10 Kg	12 mo
Gawar Winde	Well	16 m	2.0 m	A	18 l/min	4.6 c/l	6-10 Kg	10 mo
Djingliya	Well	12 m	4.0 m	A	16 l/min	4.7 c/l	5-12 Kg	-
Noraka	Well	15 m	3.0 m	B	7 l/min	10.7 c/l	4-8 Kg	-
				A	14 l/min	5.3 c/l	6 Kg	1 mo
Yalamada	Well	9 m	1.5 m	A	16 l/min	4.4 c/l	4 Kg	3 mo
Mandaka	Gallery	4 m	0.7 m	A	18 l/min	4.5 c/l	4 Kg	2 mo
Mouhour	Gallery	3 m	1.5 m	A	8 l/min	10.5 c/l	-	2 mo
Vitte	Gallery	6 m	3.0 m	A	16 l/min	4.4 c/l	5 Kg	3 mo
				B	16 l/min	4.4 c/l	5 Kg	3 mo
Rhoumzou	Gallery	4 m	0.0 m	A	(Dewatered)	-	-	2 mo
				B	(Dewatered)	-	-	2 mo
Fossehane	Gallery	3 m	0.0	A	(Dewatered)	-	-	2 mo
				B	(Dewatered)	-	-	2 mo
Tourou (A)	Gallery	3 m	1.3 m	A	16 l/min	4.3 c/l	8 Kg	3 mo
				B	16 l/min	4.5 c/l	8 Kg	3 mo
				C	10 l/min	4.3 c/l	15 Kg	3 mo

SITE	INSTALLATION	DEPTH	SURCHARGE	PUMP	DISCHARGE	SPECIFIC DISPLACEMENT	FORCE TO TURN	PERIOD OF OPERATION
Tourou (B)	Gallery	3 m	1.5 m	A	13 l/min	4.5 c/l	8-12 Kg	3 mo
				B	0.0 (Disconnected Drive shaft)			
				C	12 l/min	5.0 c/l	12 Kg	3 mo
Mawak	Gallery	4 m	2.0 m	A	16 l/min	4.3 c/l	7 Kg	2 mo
				B	16 l/min	4.5 c/l	4 Kg	2 mo

DISCUSSION OF DATA

Well or gallery depth is the vertical distance from the ground surface to the bottom of the well. This gives an indication of how high water must be lifted and how deep one must excavate to find water in the specific area. Surcharge is the depth the drop pipe inlet is below the water surface. The surcharge is an indication of the safety factor the well or gallery has to prevent becoming de-watered due to excessive pumping and/or natural fluctuations in groundwater levels. Discharge is the rate water can be pumped without excessive effort for a short duration, expressed in liters per minute. Normal pumping rates in the lift ranges encountered are 14 - 20 liters per minute. Reduced pumping rates indicate a problem with the pump, pipeline, or well capacity. Specific Displacement is the number of cycles or cranks of the pump handle to produce a given volume of water, expressed in cycles per liter. Since the pump is positive displacement, this valve should remain relatively constant in a given lift range if the system is functioning properly. Specific capacity is reduced somewhat with increase in lift. In the lift ranges encountered in the project installations (less than 20 meters) the specific displacement should be between 4.2 - 4.6 c/l. Values greater than this indicate malfunctioning rotor/stator, air leak in a suction line for galleries or a de-watered well or gallery. If a check valve is faulty and the system looses prime, specific discharge will be excessive until flow commences, and then should be normal. This is due to the cycles that are necessary to fill the drop pipe and/or suction line before flow starts.

Force to Turn Crank can be measured with a spring scale hooked on one handle and pulled at right angles to the crank. Force is expressed in kilograms. Part of the force is necessary to overcome mechanical friction between the rotor and stator. Most of the remaining force is to overcome the water pressure differential across the pump. According to Robbins and Meyers literature, it should not take more than about 5 kg to overcome mechanical friction between the rotor and stator, and an additional 0.2 kg per meter of lift. If the force required to turn the pump is much more than this there is probably some excessive binding in the drive train or between the stator and rotor.

PROJECT EVALUATION

System Capacity: The effectiveness or amount of utilization of the systems in question is limited by one of the three following factors: a) inhabitants within range of the source, b) the discharge capacity of the pumps, or c) the yield of the well or gallery. The command area of the source is determined by alternative sources in the area and how far people are willing or able to carry water. A source limited by inhabitants in the effective command area is indicated by sporadic use. The capacity of the pumps is a factor of lift, efficiency and the available person-power. Limited pump capacity is indicated by people queing during all or part of the day, some receiving less water than they would like or deciding to use an alternative source. Limited well or gallery capacity occurs when the source is pumped at a rate greater than the groundwater yield, and is indicated by de-watering of the well or gallery during periods of excessive use and/or natural reductions of the water table.

Sites limited by each of the three factors were encountered in the evaluation. In many cases it is justifiable to install a facility in a site limited by inhabitants in the command area. Perhaps the area is sparsely populated but there is no alternative source. Pump capacity is fixed by the laws of physics and available person-power. If pump capacity is limiting, it is possible to add pumps on the well or gallery or install additional wells or galleries within the same command area. Well or gallery capacity at a given site is determined to a large extent by the depth to which it is dug. It is the writer's opinion that well or gallery yield should never be the limiting factor for source utilization. This means the well or gallery should be dug to a depth sufficient to yield water at a rate exceeding the pump capacity during times of extreme drought and water table drawdown. It is absolutely critical that the well or gallery yield at the pump capacity at this time, as alternative sources will probably be dry. The well or gallery should be built with a considerable safety factor for drought periods, or abandoned. Few if any of the finished wells or galleries are deep enough to assure adequate yield in excessive drought.

One of the stated objectives of the project is to "provide 50 l/day/family to a population of 102,000 from 92 sources.

Assuming each source is functioning at the upper limit of the pump capacity, with an average of two pumps, each delivery 16 l/min for 8 hours a day, this would provide 50 liters per day for 28,000 families. However, due to limitations of families in command areas, malfunctioning and broken pumps, and de-watered sources, this figure is somewhat unreasonable. One thing is for certain; if each source yields to pump capacity, and at least one pump is always functioning, each source will be well utilized and completely justifiable. Perhaps the expectations of the number of families served in the project design is somewhat optimistic.

Pumps: The Moyno pumps used in the project are probably as durable as any other. The small number of pumps and short time of operation preclude a definitive analysis of pump durability or comparison of other models. It is assumed assessment of other projects using the Moyno pump for long periods has been done and forms the basis for its selection.

Of the 25 pumps visited, one was inoperative due to a break or disconnection in the drive, two had low specific displacement at least one of which was thought to be due to excessive wear and/or improper mating of rotor and stator, one had extremely drag in the rotor, and about seven had excessive drag in the rotor and/or drive chain and seemed to bind and turn rougly. It is possible that many or all of the problems encountered with the pumps were due to improper assembly and installation in the field.

Physical characteristics of the Moyno pump (constant drag friction between rotor and stator) make it mechanically inefficient for low lifts (0 - 5 meters) and moderately efficient for lifts of 10 - 40 meters. For lifts over 40 meters two stages must be used. At the lower lifts, discharge is limited by how fast one can comfortably turn the crank (70 - 80 rpm) as opposed to the power one can produce. This is not a primary factor in pump selection, as an average container can be filled in a minute or so, and unless there is excessive queing a more efficient pump would be of little consequence.

The Moyno pumps on the infiltration galleries are working in a suction mode since the rotor-stator is elevated above the free surface in the gallery. There is no apparent theoretical reason why the pump should not be operated with moderate suction, but there are some practical reasons which were observed that indicate another type of pump may prove more satisfactory. First, with the small static head on the drop pipe foot valves and turbidity of the water, there will be invariable problems with leaks and a de-watered suction line. The rotor must be turned dry for enough cycles to fill as much as 100 meters of pipe between the gallery and pump. Repeated operation of the rotor without water may cause excessive wear and failure.

The greatest advantage of the Moyno Pump is durability for moderate to high lifts. There are other pumps such as the Battelle which are much cheaper, easier to repair and install and more efficient in the lifts encountered in the galleries. If there is a durable piston-type suction pump available in Cameroon, it may be advisable to try them on the galleries.

Finally, the Moyno pump is considered as durable or more durable than most, but when it fails, repair requires special tools, knowledge, and parts. Villagers cannot be expected to maintain and repair the Moyno pump. Therefore it is vital to provide an efficient repair and maintenance service, with spare parts, tools, transport and personnel capable of maintaining all the systems in the area. It may be advisable or necessary to initiate some private sector involvement in the area for procurement and repair. If replacement pumps and parts are not available the project will die out after CARE's activity ends.

The Wells: The wells are well constructed with the exception of one major problem; few, if any, are deep enough. Of the 8 wells visited, four were essentially de-watered. CARE is well aware of this problem and is planning on deepening wells where necessary. Considering the short time the project has been going, initial problems in equipment procurement and operation, and lack of hydrologic data in the area, growing pains are to be expected. However, in future planning some criteria should be set down to be reasonably sure wells will never be de-watered. If this goal cannot be achieved on a particular site, it is probably not advisable to install a pump. A possible approach to determining minimum well depth would be to estimate probable natural groundwater fluctuation

by plotting data from nearby wells on probability paper, estimate specific yield of the wells under construction by pump tests, and add the calculated drawdown to the estimated maximum natural fluctuation and safety factor to determine the minimum static water depth.

Dug wells have several distinct advantages over drilled wells. During times of pump failure or maintenance water can be drawn with a rope and bucket. Dug wells are labor intensive, giving the users a chance to participate in construction and resulting sense of ownership and responsibility. Dug wells require less costly and sophisticated construction equipment to procure, operate and maintain.

Drilled wells offer advantages too. They can be constructed much faster and perhaps cheaper. They usually produce much better yield and less risk of drying up because of the ease of going deeper than dug wells. They usually produce water of better quality due to less chance of contamination through casing and slab.

Infiltration Galleries: The primary difficulty encountered with the galleries is the same as the wells; they aren't deep enough. Of the 8 galleries visited, two were de-watered and none had over 3 meters of surcharge. If the gallery is in a steep watercourse with shallow overburden, it may be necessary to drill or blast through the fractured rock layer to assure the gallery captures the groundwater moving past during the dry season. Even so, it may be found that yield is less than pump capacity in some locations.

There are some inherent problems with the gallery design. A chronic problem is anticipated with leaking foot valves and small leaks in the hose connecting the gallery to pumps causing loss of prime and/or entrainment of air in the suction line. The present design has three distinct advantages: 1) The gallery can be opened and tapped with a bucket if pump fails. 2) The gallery can be located in the center of the floodway, which many times provides the maximum yield with minimum excavation. 3) The pumps can be located on high ground out of the floodway for accessibility during times of surface runoff. This design is obviously necessary at the two galleries at Tourou due to the narrow, shallow overburden on steep rock banks and large amounts of surface discharge in rate and duration. At other sites, particularly Mawak, which is in the

plain area, it appeared that a dug well on the bank of the floodway might serve just as well as the gallery. In sites not precluded by rock banks, a better design may be to place the gallery on the floodway bank with pumps directly on top, and if needed put a backfilled perforated pipe extended under the floodway to increase yield by gravity inflow. For galleries on smaller drainage areas it is felt that pumps could be put on top of the galleries and in the center of the floodways. Accessibility due to surface water shouldn't be hampered more than a few hours after heavy rains, when pump use would be little, if any.

Water Quality Testing: The project is beginning a program for testing water quality using chloroform count and disinfecting with chlorine if needed. This information will provide a good idea of the sanitary effectiveness of the designs used for wells and galleries and possibly suggest modifications. The quality of water being supplied is such an improvement over alternative sources, and there is so much potential for contamination between source and use that rigorous testing and high standards are deemed unnecessary.

RECOMMENDATIONS:

1. Do not judge the project harshly on the problems encountered in the initial phases. This project has tremendous need for the stated objectives. Look at past problems as guides for modifying the future activities and surge ahead. A tremendous amount of work has been accomplished in a short time during the start-up phase, and many valuable lessons and information have been learned.

2. Form some numerical criteria for minimum depth of wells and galleries and bring all existing sites up to that criteria as top priority work.

3. Gear up for rock drilling and blasting. This may entail training, hiring technical specialists, procurement, transport, storage and obtaining necessary licenses and permits. However, it will be necessary for successful construction of wells and galleries in many sites.

4. Investigate and try alternative gallery designs with the objective of eliminating horizontal suction pipes and excessive cost and construction.

5. Look for an alternative piston-type suction pump that is durable and locally available or easy to introduce or manufacture for trial on the galleries. Perhaps there is no such suitable pump available in Cameroon.

6 Get a technical representative from Moyno to come to the project and diagnose existing problems with pump drives, stators, rotors and installation, and give hands-on training in installation techniques.

7. Consider the possibility of expanding the project to give parrallel capability for drilled wells. This would entail a considerable increase in funds, technical capability, management, and coordination with Genie Rural and may be beyond the scope or capabilities of the project. It may also be considered as a separate project.

8. Divide project responsibilities between a management/ administrator and technical director. There is too much work over too broad an area in these two sectors to be handled by one person.

9. Be sure Bill Edgar, the departing project manager, is replaced with someone having equivalent field experience in design and construction of dug wells and galleries. It is worth noting that Bill Slocum, AID Liaison Officer for North Cameroon, has had a great amount of first-hand experience in this type of work and could probably be relied on to provide technical suggestions and information and evaluate or suggest potential candidates for technical positions.

10. Implement a program for data collection and analysis for sites operation. Monthly water levels in wells and galleries should be measured and recorded. A person should go to each site three or four times a year at representative times in the wet and dry season and document how many people use the source, how much water is taken, and how far they come. This could provide valuable data for planning location and capacity for future sites. Other sources for groundwater and water use data such as Genie Rural should be investigated.

11. Investigate feasability and means of initiating private or public sector procurement of pumps and parts and maintenance facilities.

T A B L E 1

Sites Completed as of April 30, 1982

Site	Length of Construction	% Village *Participation	Increase in Depth	Number of Pumps
Hina Winde	93 days	80%	6,00 m	1
Palva	25 days	75%	2,00 m	1
Mayo Kabba A	94 days	85%	9,00 m	1
Mayo Kabba B	59 days	95%	12,00 m	1
Mouldar	75 days	90%	8,00 m	1
Gawar Windé	34 days	25%	14,77 m	1
Mouhour	69 days	72%	3,50 m	1
Djingliya	25 days	69%	13,00 m	2
Tourou A	42 days	45%	2,20 m	3
Tourou B	42 days	52%	2,30 m	3
Kossehone	50 days	62%	2,39 m	2
Rhoumzou	52 days	16%	3,50 m	2
Vitte	34 days	111%	6,00 m	2
Mandaka	60 days	3%	4,25 m	2
Mawak	60 days	88%	3,00 m	2
Talla Mada	42 days	75%	8,30 m	1
Moraka	54 days	48%	14,00 m	1
Katamsa	14 days	148%	1,50 m	1

* 100% participation is based on 6 village volunteers per work day at the site.

APPENDIX E

Health Education Component of the Margui-Wandala Water Supply Project

The health education component (HEED) is composed of two distinct elements: "animation" and "health education." Animation is designed to arouse community involvement in the building, maintenance, and proper use of improved year-round water sources. Health education is the process of informing the users of improved water sources about proper water usage habits and of changing user attitudes and behavior toward water.

The HEED component receives its inputs from the following groups: the government officials, community development (CD) supervisors, CD agents, and at the community level, from local leaders, teachers, and CARE well workers.

Government officials are brought into the implementation process via bi-monthly meetings of the Coordinating Committee. During the meetings, a verbal monthly report of activities is presented along with a report of progress, problems, and future plans. Meetings are held with government heads at the regional, provincial, and ministry level when necessary to maintain a flow of communication.

Community Development Supervisors (Peace Corps Volunteers) function as intermediate planners, coordinators, and supervisors of the CD agents and guide the implementation phase in the field.

Community Development Agents play a critical key role in program implementation. They are divided into two and three person teams to make their work more effective. The teams make village visits before CARE well teams arrive to solicit village cooperation, to see that local materials are gathered and to discuss various aspects of health in relation to water. They continue their visits during the well construction phase to assist CARE well workers with any difficulties in village cooperation and to discuss the concept of "local leaders" to help their community. The villagers are encouraged to set up meetings to choose the leaders who will represent their community. The CD agents also must make contact with primary school teachers in the area to discuss integrating health education in their schools, and with CARE well workers to reinforce their role as a role model to villagers. After the wells are completed and leaders and teachers have been trained, follow-up visits are made by the C.D. agents to aid further implementation.

Besides conducting these village visits in several local languages, the C.D. agents also play a major role in local leader and well workers' seminars. All seminars must be presented in the local language and at a level that the participants can understand.

Monthly lessons are provided for the CD agents to present new concepts and methods of application in the villages or reviewing and revising old techniques.

Community Level

Local leaders: The local leaders share the role of being charge agents in the villages along with the CD agents. They are chosen by the villagers and attend a two day leader seminar where basic health principles and demonstrations and their role in the village are presented. These leaders carry back to their villages newly learned information and ideas that they are encouraged to share with their community. The already existing respect and influence they have in the village facilitates this transfer of knowledge.

Teachers: Primary school students are a motivated group of children who are familar with education techniques and can have an influence on family health practices. One-time seminars are held for teachers surrounding the project sites. Follow-up visits will be made by the C.D. agents to assist the teachers in integrating health education in their schools.

Well Workers: The CARE well workers are the technicians assisting the villagers in the construction of their wells. These workers often live from two to three months in the villages. The workers are encouraged to see themselves as role models in the villages; they are guided in proper water usage habits and then use these habits in the village, thus encouraging others to follow suit.

Program Goals

The goal of the health component of the project is to transfer hygenic knowledge to the population at the water site villages. This goal is to be accomplished by two closely interlinked methods:

Firstly, the CD agents must work effectively at the water site villages. The following indicators measure the success of the CD agents:

(1) Number of villages with CARE wells animation completed. Completion of each CARE well depends heavily on the collaboration between the CD agents and the villagers. Explaining the benefits of having a CARE well, what work will be involved by the villagers, and encouraging village participation are all crucial factors contributing to the completion of a well site.

(2) Percentage of water site villages with local leaders attending seminars. The number of villages who have leaders participating in local leader seminars rests solely on the CD agents. Again it is their explanation to the villagers of what is a local leader, why is a local leader important, and encouraging the villagers to choose among themselves the leaders

DIAGRAM 1

Phased - Level Approach

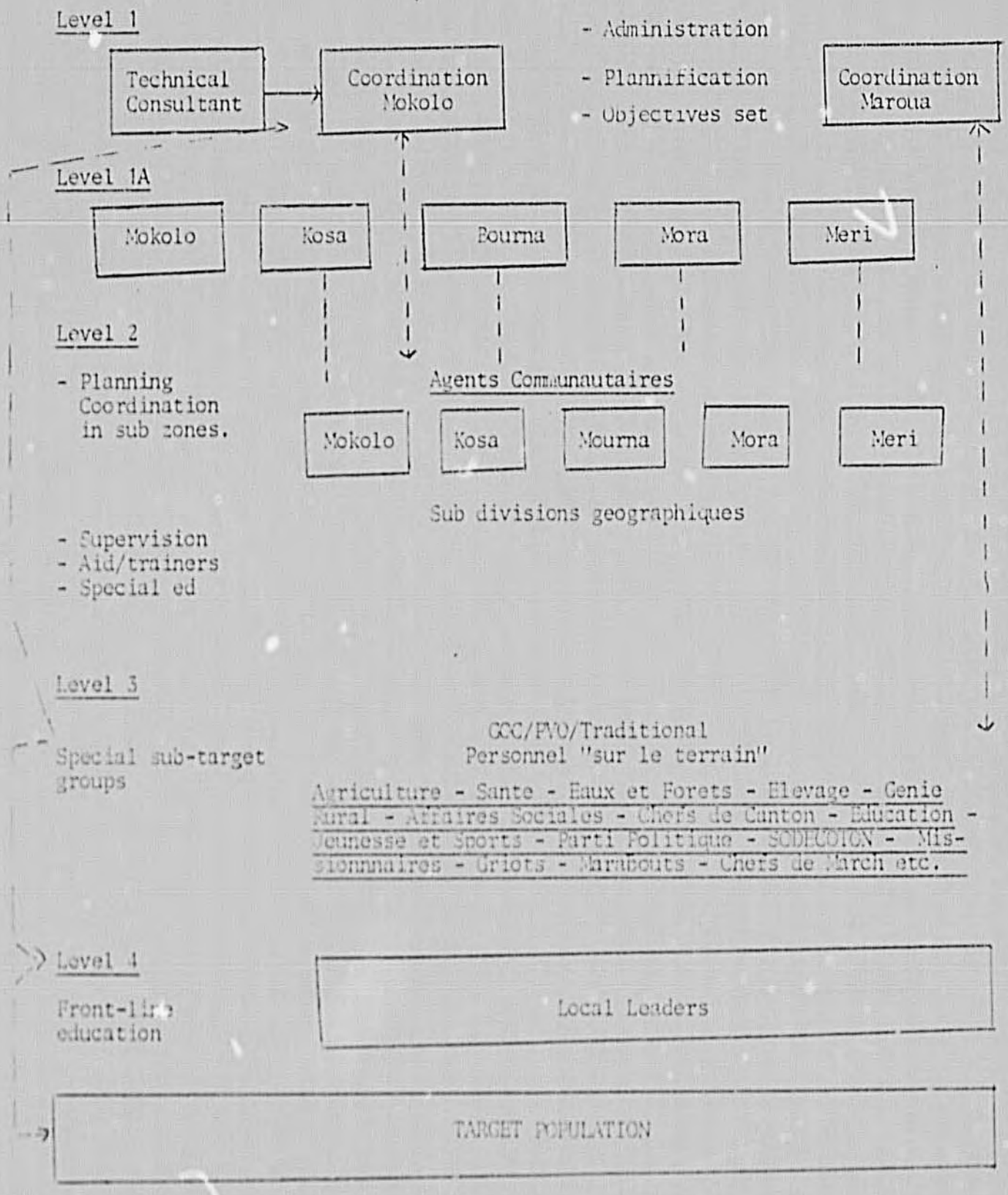
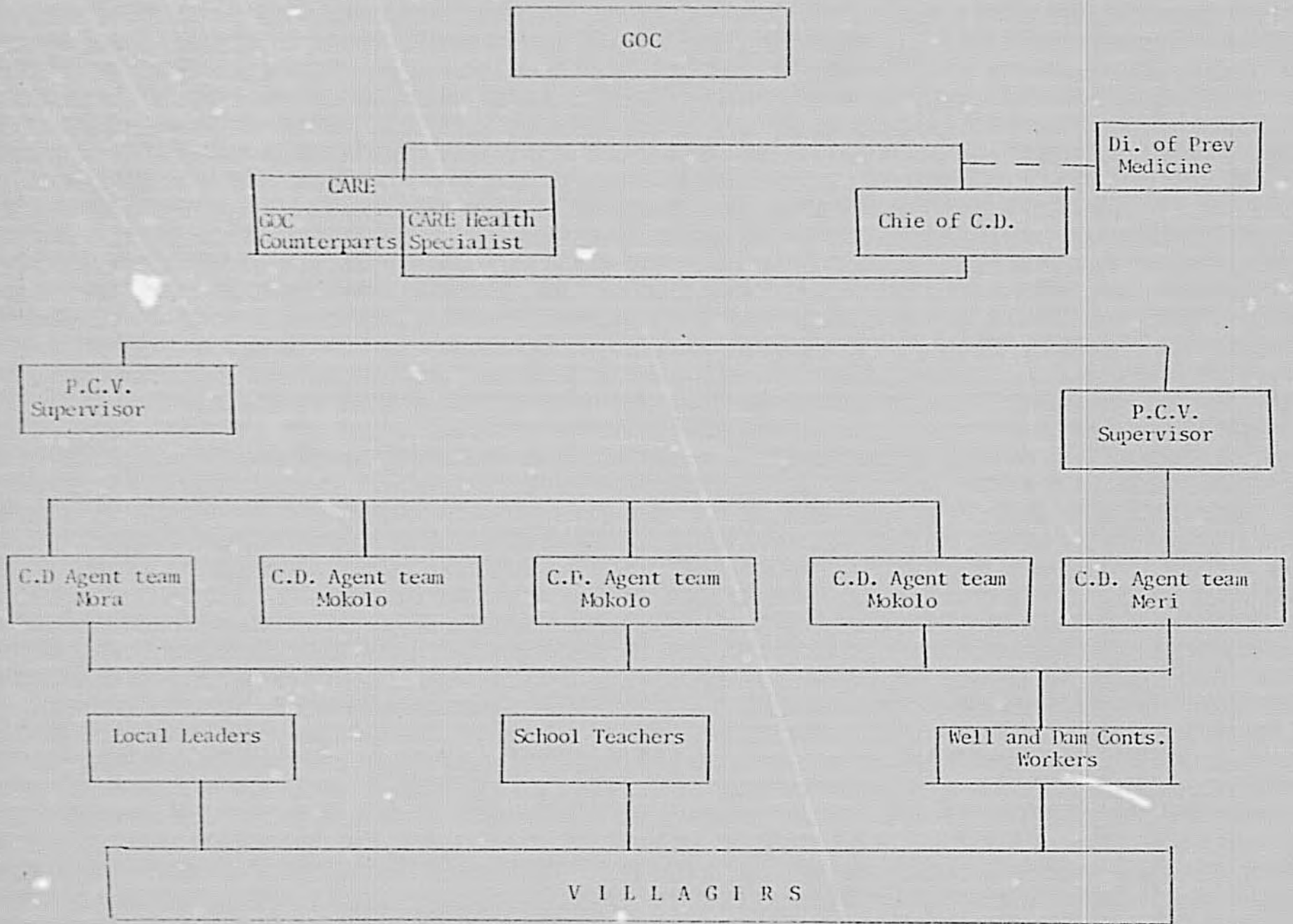


DIAGRAM 2

IMPLEMENTATION FLOW CHART



they want to represent their community at the seminar.

(3) Percentage of water site villages with teachers attending seminars. It is the CD agents who make the teacher contacts in the villages and encourage them to send representatives from their schools to attend the seminar.

(4) Percentage of CD agent teams making a minimum of two village visits per week.

Secondly, the goal can be reached if the trained leaders transfer basic health practices to their villages. This can be measured by the following indicator:

Percentage of villages with trained local leaders showing an increase in health related activities. This is shown by the baseline data questionnaire given to the leaders before the seminar and every four months after to determine any behavioral changes or new health activities.

The questionnaires form a part of the site files, which serve to document the site intervention. Site files also include reports of all village visits, a list of the local leaders, dates of local leader seminars, and other relevant documents.

Diagrams 1 and 2 visually represent the organization of the health component, which has been explained above. The phased-level approach, shown in Diagram 1, was an approach which evolved out of early project experience. Originally, the CD agents were to be the only transmitters of improved health practices. However, experience proved that there were an inadequate number of CD agents to cover the target population, and further more, that adequate frequency of contact was not possible to establish new role models and actually reinforce new water usage behavior. Consequently, the reliance on local leader participation was established. In January, 1982, CARE and the animators evaluated actual progress made with the local leaders seminars. They had anticipated that only 25% of the villages with leaders attending seminars would actually show an increase or an improvement in health related activities after the first four months. Of the three villages trained they found all (100%) had integrated improved health activities into their daily lives. Some examples of the changes included: (1) construction and utilization of new latrines; (2) old latrines improved and properly maintained; (3) weekly health education lessons given by the local leaders; (4) regular inspections of village sanitation by the local leaders; (5) increased frequency of cleaning water storage vessels and now cleaning them with soap; and (6) rotation of a well guardian by a CARE well site to keep the area clean and to guard it from animals.

The following Table 17b shows the number of seminars held as of May 7, 1982. As can be seen, ten seminars had been held as of that date with a total of 195 participants. All the villages who had been the target of construction activities were involved in the seminars; hence the health component has kept pace with the construction activities, but, as with these construction activities, it is behind the schedule as presented in the project design.

TABLE 17b

SEMINARS HELD TO DATE MAY 7, 1982

Types of Seminars - Villages Involved	Number Trained	Date Held
1. Primary School Teachers Doulek, Mokolo, Wandai, Mandaka, Magoumaz, Mora, Mokola, Ndilang.	26	Dec. 17 & 18, 1980
2. CARE Well Workers Workshops *	14	April 7, 1981
3. G.R. Well Workers Workshop *	13	May 4, 1981
4. Local Leader Seminar Mouhour, Garwar Windé, Gadala	16	Oct. 12 & 13, 1981
5. CARE and G.R. Well Workers Workshop *	17	Nov. 27, 1981
6. Local Leader Seminar Tourou	20	Jan. 19 & 20, 1982
7. Local Leader Seminar Dalbaye, Cassa, Goli, Dalkalak, Welé	17	Feb. 21 & 22, 1982
8. Local Leader Seminar Hina Windé, Palva, Mayo Kabba, Mouldar	25	March 30 & 31, 82
9. Local Leader Seminar Mandaka, Kossehone, Vitté, Rhoumzou	25	April 19 & 20, 82
10. Primary School Teachers Seminar Hina, Gawar, Gadala, Kossehone, Tourou, Rhoumzou, Muda, Kouyapé, Mokong, Djingliya, Tokembéré, Mandaka, Mayo Kabba, Hina Windé	22	May 3 & 4, 1982
Grand Total 10 Seminars	195 Participants	

* Training of Government and Private employees who have a substantial influence on good health with the involved villages.

TABLE 17c

STATISTICS TO DATE FOR THE
MARGUI-WANDALA WATER RESOURCES PROJECT (631-0025)

1.	Number of wells completed:		20
2.	Population served:		2,000 families
3.	Number of well guardians trained:		20
4.	Number of Primary School Teachers trained:		48
5.	Number of Local Leaders trained:		123
6.	Number of well workers trained:		44
7.	Number of Animators:		12
		AS	1
		CD	6
		HH	2
		JS	3