Government of the Somali Democratic Republic
Water Development Agency

# COMPREHENSIVE GROUNDWATER DEVELOPMENT PROJECT
1979 - 1986

Final Evaluation
June 1986

USAID/SOMALIA

PIO/T No. 649-0104-3-20076

TAMS TIPPETTS-ABBETT-McCARTHY-STRATTON
ENGINEERS, ARCHITECTS AND PLANNERS

TAMS
TIPPETTS-ABBETT-McCARTHY-STRATTON
*ENGINEERS, ARCHITECTS AND PLANNERS*

PARTNERS
Raymond J. Hodge, P.E.
Austin E. Brant, Jr., P.E.
John E. Bardes, P.E.
Robert F. Heins, P.E.
Dana E. Low, P.E.
Eugene O'Brien, P.E.
Donald R. Peirce, R.A.
Patrick J. McAward, Jr., P.E.
Philip Perdichizzi, P.E.
Lyle H. Hixenbaugh, P.E.
Edward C. Regan, P.E.
Mario Asin, P.E.

ASSOCIATE PARTNERS
Ernest Jonas, P.E.
Albert T. Rosselli, P.E., AICP
Eric T. Dodge, P.E.
Anthony R. Dolcimascolo, P.E.
Daniel Remeta, R.A.
G. Barrie Heinzenknecht, P.P.

PRINCIPAL ASSOCIATES
Leonard Gersten, P.E.
Daniel J. Powell, P.E.
Michael T. Sobczak, AICP
John Buursink, Ph.D.
Eduardo A. San Martin, P.E.
Ernest J. Naples, R.A.

CONSULTANTS
Ronald W. Pulling, P.E.
Armando Balloffet, P.E.
Plinio P. Patrao, P.E.
Harry Ekizian, P.E.
Bernard Scheuer, P.E.

CONTROLLER
Francis A. Rohrer

July 8, 1986

Mr. William Darkins
Project Officer
USAID/Somalia
Mogadishu, Somalia

Dear Mr. Darkins:

Subject: Evaluation of the Comprehensive Groundwater Development Project 1979-1986

On the following pages is presented the final evaluation of the Comprehensive Groundwater Development Project. This evaluation has been undertaken pursuant to a work order issued under PIO/T No. 649-0104-3-20076 and constitutes a review of the Project's objectives, assumptions and inputs, plus an appraisal of performance and the degree to which the modified objectives of the Project have been met.

Overall, the Groundwater Project has been a qualified success and has benefited a total of perhaps 100,000 people. There have, however, been some significant shortfalls, stemming largely from the original Project assumptions and the "serial" manner in which procurement was carried out, and there are also a number of major concerns regarding continued benefits from the Project. These concerns are detailed in Part IV of this evaluation report.

The evaluation team consisted of the following people:

Allan C. Cremer - Team Leader/Planner,
William M. Turner - Senior Hydrogeologist,
Frank P. Araujo - Senior Sociologist,
Pia Chesnais - Sociologist.

THE TAMS BUILDING, 655 THIRD AVENUE, NEW YORK, N.Y. 10017 (212) 867-1777 CABLE: TAMSENG NEW YORK TELEX: ITT 422188/RCA 233055

The team wishes to express its thanks to you and other USAID staff members, as well as to the new Manager and Deputy Manager of WDA and the Team Leader of the LBII/RM Project Team, for the considerable assistance and cooperation that we have received in the course of the evaluation. We trust that you will find the evaluation to be both fair and useful for guiding further assistance to the WDA and for similar projects elsewhere.

Sincerely yours,

TIPPETTS-ABBETT-McCARTHY-STRATTON

Allan C. Cremer

Allan C. Cremer
Associate

COMPREHENSIVE GROUNDWATER DEVELOPMENT PROJECT

FINAL EVALUATION

TABLE OF CONTENTS


| | | Page |
|---|---|---|
| I. | The Project | |
| | Project Background | 1 |
| | Project Purposes | 1 |
| | Project Assumptions | 3 |
| II. | Review of Project Inputs | 8 |
| | USAID Inputs | 8 |
| | Somali Government Inputs | 12 |
| | Other Donor Inputs | 16 |
| III. | Review of Project Performance | 18 |
| | Institutional Support | 18 |
| | Data Collection & Utilization | 30 |
| | Local Community Participation | 36 |
| | Exploitation Programs | 42 |
| IV. | Conclusions and Recommendations | 48 |
| | Conclusions Regarding the Project | 48 |
| | Recommendations | 52 |
| Appendix A: | Geohydrological Issues | A-1 |
| Appendix B: | Evaluation of the Social Component | B-1 |

# I

# THE PROJECT

## PROJECT BACKGROUND

The scarcity of dependable water supplies for rural people and their livestock is perhaps the most serious restraint to improved public health, agricultural practices and livestock management in Somalia. To overcome this restraint AID decided, early in 1978, to assist in developing a competence within the Somali Water Development Agency (WDA) to plan and carry out groundwater and surface water development projects in the rural areas of the country. The Project Initiation Document (PID) for what became the Comprehensive Groundwater Development Project (CGDP), or more simply the Groundwater Project, was prepared in April 1978.

Originally the focus of the Groundwater Project was the WDA and its parent ministry, the Ministry of Minerals and Water Resources (MMWR). At the time, however, two large integrated rural development projects, jointly funded by USAID, IBRD and West Germany's GTZ, were also being started. Both of these projects, the Bay Region Agricultural Development Project (BRADP) and the Central Rangelands Development Project (CRDP), had a water development component. It was decided that, rather than dividing the water development effort among different projects, it would be better to focus this effort within the WDA and the Groundwater Project, which in turn would meet the water development needs of the two integrated rural development projects. Thus, the objectives of the Groundwater Project were split between increasing the institutional capacities of the WDA and developing groundwater (and some surface water) potentials in the Bay Region and the Central Rangelands.

The Project Paper (PP) for the Groundwater Project was completed in September 1979. This PP had been prepared during a six week period, largely by a contract team from the firm of CH2MHill. The PP reflected the changed project objectives

stemming from the decision to support the water development needs of BRADP and CRDP. It also established some of the key technical features of the Groundwater Project. The first of these was the recommendation not to rehabilitate the existing WDA rigs (most of which are of American manufacture) but to, instead, purchase three new rotary drilling rigs (plus two cable tool rigs that were later omitted). This may have reflected a concern that the water supply objectives of the BRADP and CRDP might not be met if older equipment were used. The second technical feature was apparent acceptance of the WDA's preference to use 8" casing for virtually all wells. (The list of equipment and supplies in the PP shows 8" casing only). WDA's reasons for not using smaller diameters were that if holes are not straight or casing is misaligned, pumps cannot be placed and that fishing is difficult in smaller diameter holes. Another reason for this relatively large diameter casing may have been a hope on the part of IBRD staff that sufficient groundwater reserves might be found at the base of the Baidoa escarpment to support irrigated agriculture. (False-color satellite imagery indicated relatively dense vegetation in the area.) This hope later proved illusory, as many small springs were found but no significant groundwater reserves.

## Equipment Procurement

In June 1980 the initial orders for drilling equipment, support vehicles, casing, screens and other commodities were placed. Procurement services contracts were used to write the specifications for these goods and materials and later to evaluate bids. As discussed later, this process resulted in the selection of inappropriate drilling equipment for the Project and support vehicles that may have a short useful life.

Technical Assistance Contract

In July 1981, a host country contract was signed between Louis Berger International Inc. (LBII) and the WDA. (At the same time LBII signed a subcontract with Roscoe Moss Co. for services directly connected with the drilling operations.) The LBII contract covered technical assistance and related services such as training, etc. It was for 3 years, initially, with a provision to extend it to as much as 6 years if conditions warranted.

The Terms of Reference for this contract set forth four major components of work:

1. Preliminary Data Collection Phase (including the design and undertaking of an exploratory drilling program of up to 40 wells).

2. Institutional Support for the WDA and the MMWR.

3. Exploitation Programs, including:
   - Provision of wells in the Bay Region and the Central Rangelands (including exploratory wells that could be used as producing wells);
   - Technical assistance to improve shallow well techniques;
   - Technical assistance in constructing surface water catchments.

4. On-going Data Collection Program.

PROJECT PURPOSES

The primary purposes of the Groundwater Project, as outlined in the Project Paper and the contract Terms of Reference can be summarized as follows:

- to develop a competence within the WDA to plan, carry out and evaluate the impact of groundwater and surface water programs throughout Somalia (this was to be done through a combination of technical assistance, commodity support and training - including classroom instruction and seminars, on-the-job training and participant training in the U.S.);

- to develop a data base on groundwater potentials in Somalia through the preparation of inventories of wells and other water sources throughout Somalia and a program of exploratory boreholes in the Bay Region and Central Rangelands;

- to complete some 140-150 producing wells, complete with pumps and civil works in the Bay Region and the Central Rangelands, and to develop surface water catchment reservoirs in these areas (the Central Rangelands PP notes that up to four reservoirs should be constructed). (In the affected areas, wells were to provide 10-15 l/cap/day for people and 20-30 l/head/day for livestock);

- to develop an on-going program of data collection and analysis for the purposes of expanding overall knowledge of the quantity and quality of Somalia's water resources, estimating levels of demand at various times of year, determining the most suitable locations for wells, determining patterns of usage and water user characteristics, and analyzing the impact of improved water supplies upon rural communities - both permanent and nomadic.

These purposes were modified somewhat during the first three years of LBII's services, though the contract scope was never changed to reflect these changed purposes. Only staffing levels were changed.

The first modification, which was quite a positive one, was to initiate a program for enlisting the active participation of local communities in planning, providing construction support and later managing well sites within their locality. Initially, this program also contained a component for selecting where to place wells but this function was largely taken over by the two integrated rural development projects, BRADP and CRDP, albeit the willingness of a community to support construction of a well remained a significant criterion in selecting well sites.

At the end of the first three years of LBII's contract a Project Paper Supplement (PPS) was prepared, which specifically addressed the need to modify the project's components and purposes to some extent. The following changes were made:

- Since the preliminary data collection phase was largely complete, the two data components were rolled into a single component called "Data Collection and Utilization".

- Increased emphasis was placed upon counterpart training - particularly hydrogeologists and mechanics -- and manuals for operation and maintenance were to be prepared.

- A Planning Department was to be established within the WDA and a cooperative effort begun in the area of data collection, processing and use, with the WDA and MMWR in collaboration with the UNDP. The intent of this change was to strengthen the entire data collection effort and, also, to begin to reorient the WDA towards more of a role as a planning, contracting and regulatory agency - as a precursor to the possible privatization of much of the actual work of drilling wells.

- The community participation concept was to be recognized as an integral part of the WDA's approach to the development of water resources and a regular program established within the Planning Department for monitoring and evaluating the operation, use and impact of well construction within rural communities.

- The realities of operating in Somalia were recognized by a pull back in the number of production wells actually to be developed during the course of the Groundwater Project. At the same time, the PPS endorsed what was evidently an earlier decision to scale back the development of surface water catchments to effectively zero -mainly because of the potential cost of such facilities. (All that remained were a series of seminars on the construction of reservoirs).

- A final change in purposes made by the PPS was to lay the groundwork for a study of privatization of much of the water resource development effort in Somalia. As noted above, this envisioned a substantial change in the role of the WDA - away from being an operating agency and towards being a planning, contracting and regulatory agency that would drill wells only in drought emergencies.

Later in the study, project purposes were further modified when it became evident that WDA could not (or would not) establish or staff a Planning Department within the timeframe of

the Groundwater Project. Thus, project purposes included only the preparation of a system for the monitoring and evaluation of well operations, for later use by the WDA, when the Planning Department became a reality.

PROJECT ASSUMPTIONS

As with any other project, the design of the Groundwater Project contained a number of assumptions, some of which later proved to be invalid and which had a clear impact on the effectiveness of the Project. Among the most important assumptions were the following:

- that the objectives of the WDA were the same as those of the project: namely to upgrade its skills and to drill a signficant number of rural wells. That the WDA might have other possible objectives, such as the acquisition of rigs for subsequent lease for hard currency and the acquisition of materials or fuel that could be used for other projects or purposes, appear not to have been considered.

- that the rehabilitation of the WDA's existing equipment (listed in the PP) would not be cost effective. Comparative costs of rehabilitation vs the purchase of new equipment were not looked at during the project preparation stage, though it is known that much of this equipment is old (see table in Appendix A).

- that the WDA's preference for using casing no smaller than 8" was appropriate for the wells to be drilled. (This initial assumption was questioned by LBII and both evaluation teams).

- that information on wells and other water sources throughout the country controlled by WDA and information on other aspects of the project, such as equipment inventories, materials stocks, counterpart funding, would be forthcoming from the WDA and available to the contractor.

- that there would be a free interchange of information between the Groundwater Project and the BRADP and CRDP.

- that the WDA would continue as an operating agency, responsible for the drilling of wells, so that the improved skills of its drilling staff would continue to be used in subsequent projects (this probably will be the case but it conflicts with the desire of USAID to privatize much of the groundwater development effort).

- that the skills within the WDA for planning and carrying out well-drilling were equally deficient at all levels. In fact, Somali well drilling crews do accomplish their work but perhaps not within the time frame established by AID planners, based upon back-home productivity. Somali well drillers have been drilling wells for over 50 years in Somalia and methods have been developed which may not be state of the art methods but which work in Somalia.

- that a major share of the water needs in the targeted regions (Bay Region and the Central Rangelands) could be met through the development of groundwater. (LBII , in its End of Project Report, shows that this early assumption is invalid. The firm estimates that only 23% of the Bay Region can be served by groundwater of suitable quality and also states that good quality groundwater is also hard to find in the Central Rangelands.). One result has been to deprive areas where suitable groundwater cannot be found of any help from this project.

- that the WDA would already have in place a system of continuing maintenance for the wells that are installed and an efficient system for the collection of fees for water use.

- that powered pumps with relatively high output would be appropriate whenever the well yield was sufficient to permit their use. Thus the only determinant of which type of pump to use was the yield of a particular well.

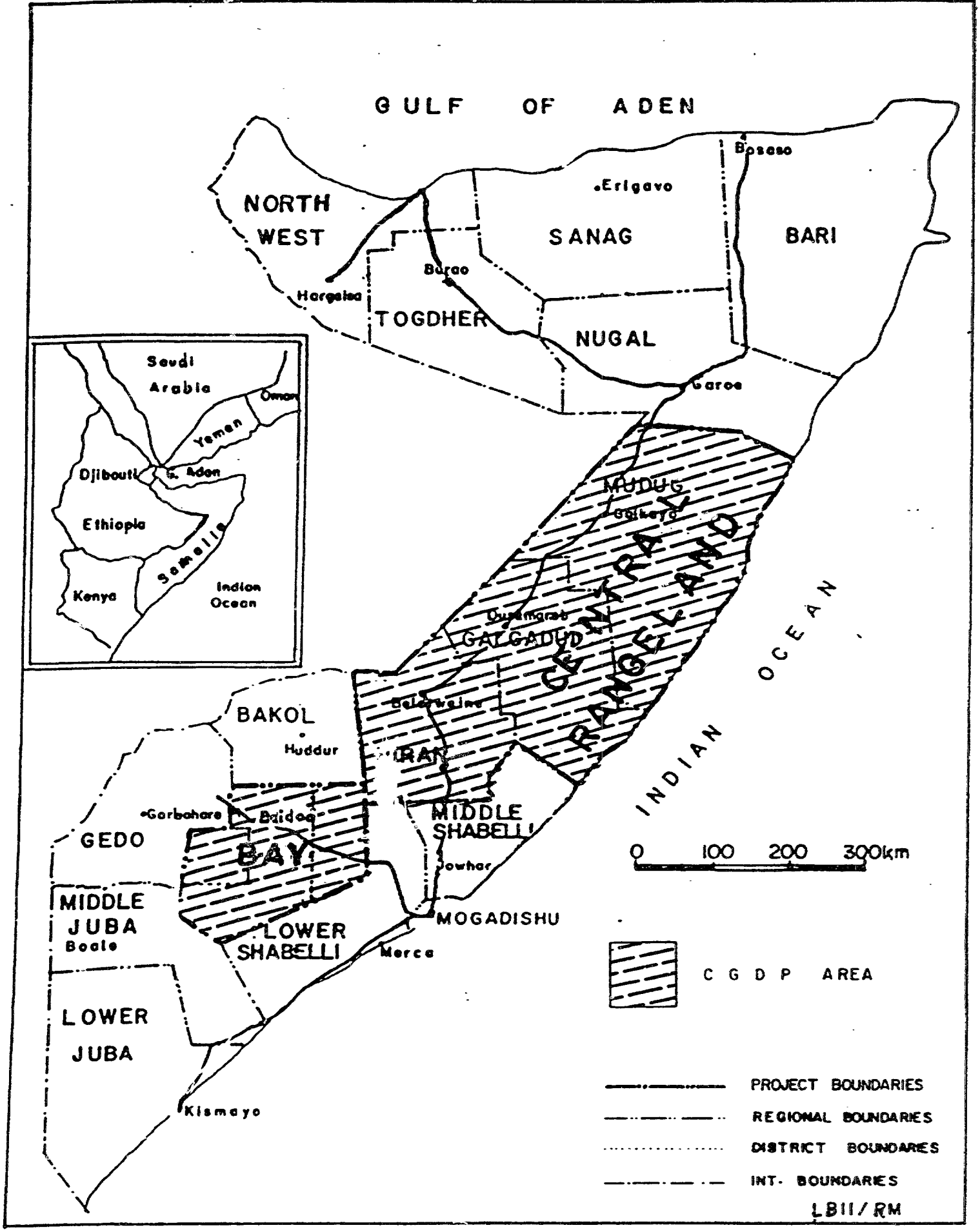



Figure 1 Bay, Hiran, Galgadud and Mudug Regions

# II

# REVIEW OF PROJECT INPUTS

## USAID INPUTS

For the Groundwater Project USAID has provided the following inputs:

### Technical Assistance

Through the LBII contract (and RMC subcontract) USAID has provided a total of approximately 54 person-years of technical assistance. A review of the original Contract and Amendments 6, 9, and 12, plus the contractor's End of Project Report indicates that this total is broken down roughly as follows:

| Position | Person Years |
|---|---|
| Team Leader (Water Resources Eng./Hydrogeologist) | 4.4 |
| Hydrogeologists | 9.3 |
| Chemist and assistant | 3.2 |
| Civil Engineer and Water Resources Planner | 2.5 |
| Specialists in Sociology, Economics, Data Base Management, Etc. | 3.4 |
| Privatization Study Team | 0.9 |
| Drillers | 12.4 |
| Mechanics, Electrician and Warehouse | 7.8 |
| Technicians | 5.1 |
| Expatriate Support Personnel | 5.1 |
| TOTAL | 54.1 |

The cost of this technical assistance was approximately $8.9 million over a five-year period. In addition, approximately So.Sh. 27 million at varying exchange rates have been provided by the Somali Government from counterpart funds for support of the LBII/RMC team.

Training

Much of the training provided by the Groundwater Project has been classroom instruction and seminars provided by or led by the technical assistance team. In addition, on-the-job training has been provided through the course of the exploratory and production well-drilling program. Local staff covered by in-country training has included hydrogeologists, chemists, drillers, pump installers, mechanics, civil works constructors, and those selected at various times for the WDA Planning Unit. (The proposed Planning Department has not been established.)

In addition to training in their specialties, the hydrogeologists and drillers were trained to implement the Tuulol (Village) Assessment and Participation Process (which preceded the Community Assessment and Participation Process (CAPP) developed later in the Groundwater Project). Training included lectures, discussions and visits to villages selected for well sites. Later, Somali members of the BRADP were trained in these same techniques by the Groundwater Project team, albeit their limited background meant that training remained at an introductory level. These people were later absorbed by another study team under BRADP, so they were not available to the Groundwater Project. As wells were completed, rudimentary training was provided to well operators in the affected communities but this was done mainly largely by the WDA staff because of language barriers.

Manuals were prepared by the Technical Assistance team for the following specialties:

---

[1]Tuulos are settlements that are more or less permanent and somewhat analogous to villages. Buulos (which are referred to later in this report) are smaller settlements for which the term hamlet has been considered as an equivalent term, but this is a rather poor analogy.

1. Hydrogeology
2. Pump Testing
3. Water Quality
4. Downhole Geophysical Logging
5. Well Drilling Operations and Preventive Maintenance
6. Evaluation, Rehabilitation or Abandonment of Water Sources
7. Pump Rig Operation and Well Maintenance
8. Light Vehicle Preventive Maintenance
9. Warehouse Procedure

Manuals intended for skilled workers, as opposed to professional employees, were translated into Somali.

In the first phase of the Groundwater Project, i.e., prior to 1984, eight staff members from the WDA (4 chemists, 2 hydrogeologists and 2 geophysicists) were selected as participants in the two-month U.S Geological Survey program of water resource studies, held in Colorado. Also, 2 hydrogeochemists and 2 hydrogeologists were selected for degree programs at the University of Arizona.

Commodities

Approximately $8.4 million worth of drilling equipment, support vehicles and materials were provided to WDA under the Groundwater Project. In the early phases of the Project, support vehicles, spare parts, casing and screens were provided also by BRADP and CRDP. Replacements for these items have been ordered through the Groundwater Project, however, and the cost of these replacements are included in the $8.4 million figure.

Review of the listing of PIO/C's indicates the following approximate breakdown for commodities provided under the Groundwater Project. The breakdown is only approximate, since some of the 47 PIO/C's included several categories of commodities and a detailed study of individual PIO/C's was not made. Also, some PIO/C's are still pending, so only estimated costs are shown in the listing.

| | |
|---|---|
| TH60 drill rigs, spare parts, casing and screens | $2,860,000 |
| GMC support vehicles, spare parts, etc. | 2,000,000* |
| GMC geophysical logging vehicles | 240,000 |
| Spare parts (unclassified as to purpose) | 1,450,000 |
| Gen'l supplies (inc. pumps & civil works mat'l) | 630,000 |
| Windmills | 75,000 |
| Spare parts for one of WDA's Failing rigs | 185,000 |
| Household furnishings, etc. | 370,000 |
| Laboratory equipment | 30,000 |
| Satellite navigation equipment | 20,000 |
| Computer hardware/software | 15,000 |
| Diesel fuel | 170,000 |
| | $8,045,000 |
| Misc. supplies through LBII contract | 375,000 |
| | $8,420,000 |

* Includes $260,000 in spare parts provided through LBII contract

Under the Project Agreement, fuel was to be provided by the Somali Government, using counterpart funds for local purchase. Because of continuing problems of fuel supply, however, it was necessary on two occasions to make special offshore purchases of fuel. These are reflected in the above tabulation.

As noted earlier, procurement of most of the above commodities was initiated in June 1980, well before the contractor for the Groundwater Project itself was selected. Specifications and bid evaluations were based largely upon the PP, plus short trips to Mogadishu by procurement services contractors. The three rotary rigs selected as a result of the bid evaluation process were Ingersoll-Rand TH-60's, which later proved to be a poor choice, particularly for cased wells as large as 8". The bid evaluation does appear to have been straightforward but, at the time, some correspondence noted that the WDA intended to standardize on the TH-60 rigs (even though they had none in their inventory at the time). This process is discussed in detail in Appendix A.

In the case of support vehicles, AID was in a difficult situation since the Foreign Assistance Act normally requires that equipment and supplies be of U.S. origin. At the same time, no capability exists in Somalia for servicing or maintaining U.S.

vehicles. Except for the drill rig carriers, GMC vehicles were procured for the Groundwater Project, which was probably no worse than any other U.S. manufacturer from a maintenance standpoint, albeit the specification of automatic transmissions compounded the difficulty. It is very unlikely that any of these vehicles will outlive the project itself by more than a few months. Inasmuch as the IBRD was involved in allied projects (BRADP and CRDP), which supported some equipment to the Project, an approach that might have been explored would have been the funding, by the IBRD, of support vehicles from Italy or Japan (which could have been maintained). A final shortcoming was that, while the rigs were provided with flotation tires, the support vehicles had no off-road capabilities. This meant that during the wet seasons, drilling operations could not be sustained in certain areas because of the lack of accessibility.

Local Currency Support

Local currency support came from counterpart funds generated by CIP and PL480 imports. These funds can thus be considered as a USAID input. Since, however, they are jointly administered by USAID and the Somali Ministry of Finance through the latter's Domestic Development Department, they are discussed below under the Somali Government inputs.

SOMALI GOVERNMENT INPUTS

WDA Staff

Somali staff for the Groundwater Project was provided by the WDA, primarily from its staff resources though, in some cases, it was necessary to recruit qualified people from outside the WDA. The former Deputy General Manager of the WDA (who was named Project Manager for the Groundwater Project and served in that capacity until a few months ago) stated that project personnel were drawn from the WDA's roster of permanent personnel, were selected on the basis of past experience (particularly with

rotary rigs) and came mainly from the Bay Region. Neither USAID nor the contractor had any control over the process whereby personnel were selected. Many of the Project staff members met by the evaluation team seemed quite competent but evidently some unqualified people and others who performed unsatisfactorily were also nominated to the Project. Some project personnel, indeed, were part-time people and several were recently discharged by the WDA's new Deputy General Manager.

As noted earlier, some staff members of the BRADP were supposed to have worked with WDA personnel in the follow-up phases of the CAPP. After receiving some training from the Groundwater Project U.S. staff, they were, however, not available for the project. Also, some of the vehicles provided by BRADP and CRDP had drivers from those projects assigned to them. This apparently proved to be a source of vexation for the LBII staff since they had even less control over those drivers than they did over the WDA's drivers.

Support Facilities

The WDA provided the Groundwater Project with office space, yard and warehouse areas, in addition to some housing accomodations for expatriate Project staff, for which an imputed rental value appears to have been included in LBII's contract.

Local Fund Support

All local funds for the Groundwater Project came from counterpart funds generated by CIP and PL480. These funds were included in the Somali Government's Development Budget for each calendar year and were allocated in accordance with a Local Currency Budget process that began with requests prepared each year by the project managers of the various development projects (of which the Groundwater Project is one). These requests were used to make up the Annual Program Budget Plan, prepared by USAID's Program Office and signed by the USAID Director and the Minister of Finance. Allocations under the Budget Plan were then

approved by Generated Shillings Proceeds Committee and advances were normally made on a quarterly basis. The amounts budgeted ranged from So. Sh. 3.4 million in 1982 to So. Sh. 49.9 million in 1986 as project activities increased and the Somali Shilling was successively devalued. The dollar equivalent remained in the range of $0.8 million each year.

In the case of the Groundwater Project this budget was used for the following types of expenditures:

Operating Costs

- Topping off salaries of WDA staff assigned to the Project
- Per diems, fuel and vehicle maintenance
- Office supplies

Local Capital Costs

- Payments to local contractors on presentation of invoices (Civil works contracts are to be let shortly for a number of wells but these will be paid for by BRADP. It is not clear that any local contract payments were made by the Groundwater Project).

Because of the extremely low salaries paid by all government agencies, including WDA, the device of providing "top-off" salary supplements and adequate per diems to local Project personnel was probably necessary. The Groundwater Project, however, affected only one department within the WDA, albeit the largest one, and only a portion of that department. The topping off of salaries for less than 10% of the WDA's 1,780 employees seemed to increase the degree to which the Groundwater Project, as a large-scale project with a separate project management structure and staff, tended to be isolated by the remainder of the organization. Jealousies may have been fostered by the fact that the Project had its own special priorities and the new skills obtained by project personnel could be considered a threat by other members of the organization. Discussions in the Baidoa regional office seemed to indicate that this has occurred. The Project staff was considered apart and the Regional Director

evinced no interest in the Project. Indeed, he noted at one point that his pump maintenance crew had received no training from the Project and "had more experience than the Project people anyway."

While money was budgeted for fuel (both diesel oil and gasoline) the problem of actually getting fuel for the Project, and then making sure that it wasn't diverted, proved to be the most vexatious problem of all for the LBII staff. Somalia is chronically short of fuel and a very active black market exists. The WDA's former Project Manager stated that often an allocation of 40,000 liters would be requested from the Government Petroleum Agency and only 4-5,000 liters would be delivered, which was not enough to mobilize the rigs. Neither USAID nor LBII had any direct control over fuel allocations and deliveries and it is quite possible that larger allocations were made, which did not reach the Project.

The down time caused by inadequate fuel supplies can properly be laid at the foot of the Somali Government, for short term planning and improper allocation of ephemeral supplies. But given the fact that the WDA's requirement is a small portion of the national total and that managing supplies is accorded little priority by Somali officials, the Project design might have recognized this in advance and provided for the tank farm to stockpile fuel. Indeed at least one local Danish/Somali drilling firm (Kampihl) has its own storage tanks in the harbor area for its fuel supplies. If it was not possible to acquire fuel dependably through Somali channels, alternative means of supply might have been built into the Project. Twice, fuel was purchased from Mobil Oil Corporation in Djibouti, and it is also possible that arrangements could have been made with the Navy to obtain U.S.-sourced fuel.

OTHER DONOR INPUTS

The Groundwater Project received no inputs from other donors, but did relate to other projects with funding from other donors.

Integrated Rural Development Projects

Firstly, the Project provided support to and had to be meshed with the two large integrated rural development projects mentioned earlier, the BRADP and CRDP. Both these projects have received the major share of their funding from the IBRD, though USAID has alo provided substantial support to both and GTZ is funding certain activities within these projects.

Small Urban Water Supply Systems

Secondly, under a separate agreement, GTZ has provided technical assistance to the WDA during the past six to seven years, including some advisory services on administrative systems. The Terms of Reference for LBII's contract mention this assistance but fail to note that it has been primarily in connection with the operation of a number of small urban water systems, for which GTZ has provided DM 70 million in financing. Nevertheless, under this assistance, a revenue collection system has been developed that is in use in four urban centers. These four urban systems are understood to be recovering their operating expenses from revenues.

As a part of the work on small urban water supply systems, GTZ has also funded a review of WDA's current capacity to operate, maintain and repair water wells and distribution systems in small urban centers and rural areas. A major finding of this review, completed earlier this year, is that the WDA has little capacity for (or interest in) operation, maintenance and repair. Therefore, the review concludes that effective operation and maintenance will require a basic change in the origanizational structure and recommends that these responsibilities be

separated from other responsibilities of the WDA. Three options are presented for making this separation but any recommendation as to the best option is deferred until a further study is undertaken. That study is not, as yet, funded. The recommendations of this review of WDA's operating and maintenance capacity are discussed further in the section below an LBII's study of private sector participation.

GTZ is also very concerned about low salaries and a multifold increase in salaries is one of the conditions they have said must be met before any agreement to finance the next phase of their urban water systems program will be signed.

National Water Data Center

As discussed below, there is an abundance of geological and hydrological information extant in Somalia, as in most African countries. The information is scattered among government repositories, private agencies and assistance organizations. It has never been gathered and compiled and placed into easily retrievable or useable formats. Furthermore, it will be necessary to continue the data acquisition and processing activities to ensure that proper future planning activities can be carried out.

Therefore, the UNDP/FAO is providing assistance for a National Water Data Center that will be located within the MMWR. This effort was to have been started earlier, so that an interface with the WDA's Planning Unit could be developed. It is only now beginning (as is any real start on a Planning Unit in WDA), so the development of the respective responsibilities of these two units will not be directly affected by the Groundwater Project. The National Water Data Center will, however, draw heavily upon the data base work that has been done under the Groundwater Project and will build upon the material developed by LBII.

# III

# REVIEW OF PROJECT PERFORMANCE

The following review generally follows the order of the major components of the Groundwater Project, as they have been realigned in the Project Paper Supplement:

- Institutional Support,
- Data Collection and Utilization,
- Exploitation.

A separate section, however, has been provided on Local Community Participation, since this has been an important element of the Project.

## INSTITUTIONAL SUPPORT

The institutional support component of the Groundwater Project included the following elements:

1. Improvement of WDA's hydrogeological data collection system.

2. Commodity support (discussed above), logistic improvements and assistance in preparing equipment lists and specifications.

3. Improvement in planning and scheduling the use of equipment.

4. Collection of data on actual costs of well construction and estimates of maintenance and operating costs. Assistance to WDA in accounting and reviewing fee structures.

5. Social analysis (see Community Participation below).

6. Development of water utilization models for allocating costs, adjusting water charges and judging priorities for well sites.

7. Environmental analysis (this was a relatively minor input to the Groundwater Project, since the BRADP and CRADP each had substantial environmental inputs.

8. Provision of on-the-job training for counterparts.

9. Conduct of seminars in topics related to water resource development.

10. Provision of technical support for the WDA Planning Department (new department).

11. Investigation of potentials for private sector participation in the development of Somalia's water resources.

Hydrogeological Data System

The Groundwater Project has been staffed by competent personnel particularly in the last two years of the project. It is likely that all hydrogeological data from the project, with the possible exception of pump test data, have been properly collected. Specific aspects of the actual data collection effort are discussed in a later section.

Improvements in Logistics and Planning/Scheduling Equipment

With respect to the next two elements, improvements in logistic systems and in the planning, scheduling and use of equipment, assistance in these areas was provided throughout the course of the Project and expatriate personnel were specifically devoted to this work. LBII's End of Project Report, however, makes little reference to this aspect of the technical assistance, other than to discuss the difficulties encountered in maintaining the rigs in the field. Almost nothing is said about improving the WDA's logistics systems. Inventory controls, supplies, transport and workshops (other than to discuss on-the-job training of mechanics, etc.) Under its earlier managers, the WDA was not forthcoming with information about available equipment and supplies or the status of funds. One has the impression that there were no improvements; that most of the time of the expatriate logistics personnel was devoted simply to getting the equipment and supplies needed for drilling the Project's wells out to the field and seeing that equipment was

maintained. There was little incentive for the WDA to document its supply status. LBII was to have developed an inventory of WDA equipment and supplies, building on a partial equipment list included in the PP. LBII personnel said they were unable to obtain a more detailed list or further information on equipment or supplies (yet, from the new Deputy General Manager of the WDA, the evaluation team obtained a full list of drilling rigs for the asking).

Under the former managers, the WDA was essentially run with no attention, either by accident or design, to the physical resources of the department. This has led to the continued poor functioning of the department. When, for example, an urgent request for well repair is received from a community, no one can locate operable equipment to solve the emergency or identify the type of pumping equipment in the well (which may need to be replaced or for which the spare parts should be taken along by a maintenance crew.)

The original purpose of the Planning Unit, and the purpose which remains uppermost in the mind of the new General Manager of the WDA, was to plan for future water development and equipment maintenance activities, based upon a sound knowledge of equipment and material resources available within the WDA. The fate of this Planning Unit is discussed below.

## Collection of Data on Actual Costs

The Groundwater Project included two substantial efforts to tabulate and analyze the costs of well construction, maintenance and operation. Both efforts, one for Phase I of the Project and the other for the entire Project, were done in a professional manner and provide a good picture of costs. The contractor's reports, however, make no mention of active assistance to the WDA in its accounting systems and fee structure, and no reference to the revenue systems developed for four urban centers by a GTZ consultant. Once again, the contractor found the WDA to be less than forthcoming when it came to the status of

local project funds and evidently showed little interest in systems of accountability. (See discussion below, under Community Participation, regarding the flow of revenues from Project wells.)

Water Utilization Models

Estimates of possible demand were made early in the project, building on a system developed by Hunting Technical Services for BRADP. Later in the project, water utilization studies have been carried out and solid data collected for at least one community (Maleel). This information has been used in connection with the costing studies but, because of the lack of good baseline socioeconomic data, no effort has been made to quantify benefits or allocate costs to specific beneficiaries. Regarding priorities for well sites, the Groundwater Project staff was aware of the criteria used to select well sites and information obtained during the early community participation studies, on the degree of local commitment, was used in the selection of sites. After the exploratory phase, however, the selection of communities in which to drill wells has been made by the BRADP and CRDP. The Groundwater Project and WDA have had a very limited role in this selection. Only later were the WDA's hydrogeologists, together with tuulo/buulo water committees, involved in selecting the specific location within a community. This process of site selection by BRADP and CRADP was not related in any way to the normal procedures of the WDA and MMWR, under which the locations of wells are determined by a National Water Committee on the basis of information from the Regional Governors (through the Ministry of Interior) and hydrogeological input from the MMWR. The National Water Committee meets only once a year (unless there are special circumstances) and the procedures are admittedly cumbersome, so location of the Groundwater Project wells required a different procedure. The fact that normal procedures were simply forgotten, rather than an attempt being

made to adopt them to Project needs may, however, have served to further isolate the Project in the eyes of many in the WDA.

On-the-Job Training and Conduct of Seminars

On-the-job training of counterpart personnel appears to have been one of the major benefits of the Groundwater Project. Altogether, some 132 members of the WDA's staff received training of one type or another. The expatriate Project Team provided such training to the WDA's hydrogeologists, chemists, planning staff, geophysicists, well drillers, pump installers and equipment maintenance mechanics. It is clear from reading project documents and from detailed discussions with the LBII team leader and WDA officials that every effort was made to supplement the technical skills of WDA employees and that virtually no stone was left unturned. The manuals prepared for the project have been reviewed and seem to be quite appropriate. Most have been translated into Somali - which is essential at the skilled worker level and desirable even at the professional level.

On-the-job training has in many instances been preceded by both classroom instruction and seminars. Much of this was done early in the project before the drilling equipment had arrived.

Participant Training

Also, there has been a participant training program, consisting of (1) a U.S. Geological Survey two-month course for eight participants and (2) degree programs for four individuals. At least one of the participants in the USGS short course, a geophysical well logger, did not wish to return to Somalia and instead travelled to Saudi Arabia. Later, he and possibly others did return to the Project. It is felt that the skills of those course participants may not have been greatly enhanced but, of those who returned to the Project, they seemed to take their work more seriously.

Regarding the participants in the degree programs, the evaluation team was told that two hydrogeologists and two hydrogeochemists attended the University of Arizona under the project, but that only one had returned to the WDA. This information was incomplete and misleading. The team has identified the two hydrogeochemists studying in the Department of Soil and Water at the University of Arizona. Both would have been accepted by the University on the strength of their academic credentials and both have been good students. The first earned his M.S. in Soil and Water Science and returned to Somalia in January 1986. The second student will complete his degree this summer. He is not quite as strong as the first but has overcome any difficulties. Neither student carried out projects specifically related to the hydrogeochemical specialty for which they were chosen and their skills are likely to be of greater value to irrigation projects than to water development projects. They will still, however, be of value to Somalia.

The evaluation team has also identified the two Somalis sent to study hydrogeology. One is still at the University of Arizona and is reportedly an energetic and intelligent student, now working on his dissertation, who has a 3.0+ grade point average. His AID support has been terminated but he was offered and accepted a Teaching Assistantship to continue his studies. The second hydrogeologist was unable to obtain adequate grades for admission to the Master's degree program and hung on at the University of Arizona for several years. He was scheduled to depart in December 1985 but, because of the birth of a child, he said he had to wait. In March 1986, he passed through Washington with a ticket provided by AID, which he evidently traded for a ticket to Saudi Arabia. No one spoken to by the evaluation team could recommend this individual. He was regarded by all as untrustworthy.

The team spoke to USDA personnel who handle programming and administration of foreign students regarding their experience with foreign students supported by AID. The method of selection

of foreign students varies widely-from political appointments to students who are intelligent and indeed qualified. They have experienced outstanding students and those who are undesirable.

According to the first LBII team leader for the Groundwater Project, the main criterion for selecting the students who attend the University of Arizona was that they pass the TOEFL test administered in Somalia by the USIS. (It was indicated that one of the hydrogeochemists sent to the University of Arizona was not a WDA employee and pulled some strings to be selected.) Both hydrogeologists were found to be seriously deficient in the practical aspects of hydrogeology, having had no practical field experience. It isn't clear whether the students sent to the University of Arizona had received training from the Groundwater Project team, though the former team leader indicated that they had. If so, then the training was inadequate in that it provided the trainees with few, if any, field skills.

Comments On Training

Comments on the training component are as follows:

- The classroom training program was highly ambitious. Successful completion of the hydrogeology curriculum would earn the matriculant a degree in the U.S. Though the materials are competently prepared, one can only wonder at the success of the instructors in imparting 1/10 of the knowledge they sought to impart, given the time available and language barriers. Undoubtedly, some knowledge was imparted and that was more than WDA staff members had at the beginning.

- Given the diversity of equipment owned and operated by WDA, it would have been useful to have included programs on the maintenance and operation of other types of equipment, such as the 4 Failing rigs or the other Ingersoll-Rand rigs (possibly 4) of the WDA. (In some instances, the rigs may be functional, or nearly so, while others require rehabilitation and new carrier vehicles.)

- The course dealing with aerial photo interpretation was apparently a failure because of the lack of stereo-photography at a proper scale. The course did use aerial photography but it was apparently

large single photographs which cannot be used. LBII has indicated that stereo coverage was to be provided by WDA but they did not have the required stereo pairs. The MMWR does have a number of stereo pairs in its library, including recent sets by Hunting Technical Services. The extent of coverage and whether it includes Bay Region or Central Rangelands could not be determined, so LBII may very well be right. On the other hand, the librarian said he believes this coverage exists. Without aerial stereo-photography, it is not possible to apply photogeologic fracture trace methods to the location of wells. The fracture trace methods are highly successful throughout West Africa and other countries where they have been used, though large areas in the Central Rangelands are covered by acotian sands, which would make positive identification difficult.

- There is some concern on the part of the LBII team leader that upon termination of the project, inadequate pay will cause many of the trainees to leave for other more lucrative occupations. The evaluation team shares this concern and others, including GTZ above have been pressing the Government to improve WDA salaries in order to retain qualified staff members.

- The new WDA management, however, has a demonstrated commitment to retain personnel who were trained by the project. Of the people selected for the one month USGS short course in the United States, at least four are personally known to the new Deputy General Manager of WDA and are presently employed by WDA. There is the danger that a major push by lending agencies for privatization of many of WDA's functions and thus for a reduction in staffing could undercut this commitment - particularly as it might apply at the lower, operating levels.

- A major shortcoming of the project, created at the planning stage, was to confine the effort to direct training of well drillers and other WDA employees, rather than training trainers, who would then carry out the local training on a long term and continuous basis. Upon completion of the training component of the project, it is finished and there has been no capability developed to have that training continue on the local level. The WDA is currently establishing a training unit, though an alternative exists for mechanics, etc. in the Industrial Vocations Training Center supported by GTZ.

Technical Support for New Planning Department

Establishment of a Planning Department within the WDA was foreseen in the PPS and technical assistance to this Department was to be provided. The stated objective for this department was to integrate social, technical and maintenance plans in order to select sites and optimize the use of the WDA's resources. Four functions were set forth:

| | |
|---|---|
| Planning: | coordination of information and development of drilling programs and schedules, plus schedules for maintenance of wells and equipment. |
| Economic Analysis: | models for the costing of rural water supplies, monitoring of revenue flows and determination of benefits |
| Sociological Evaluation: | continuation of community participation, design of new evaluation procedures and help to communities in their maintenance responsibilities |
| Policy Studies: | community responsibilities, pricing and revenue collection |

It should be noted that these functions do not include the function of preparing capital budgets for the WDA and submitting budget requirements to the Ministry of Planning. The fact that capital budgeting was not included may have reduced the relevance of a Planning Department for the managers of the WDA. Subsequently, this part of the Groundwater Project, indeed, became a series of major setbacks for the LBII/RM team. Since a new department requires a Presidential decree, which takes a while, the department became a Planning Unit. Staffing needs were set out but the WDA assigned only one qualified professional and he later left. It may well be that the former managers of the WDA really did not want a functioning Planning Unit able to keep track of the status of both equipment and supplies. There may have been a desire to keep others in the dark regarding

materials available to the WDA, so as to be able to sell or lease supplies or equipment to private drillers and others, without a record. In any event, the Planning Unit now has only one staff member, a chemist, albeit the new WDA management is currently considering four candidates to take over the Unit.

Because of the difficulties encountered, the functions of the unit were cut back to the production of specific products that could be developed largely by the expatriate team. These products included:

| | |
|---|---|
| Planning: | development of project data base<br>Technical monitoring system<br>Computerized mapping system<br>(referred to earlier) |
| Economic Analysis: | costing model (referred to earlier) |
| Socio-Economic Evaluation: | "packaged" system for monitoring and evaluation |
| Policy Studies: | discussion of options |

In addition, the LBII team prepared a set of recommendations regarding phased development of the Planning Unit and a proposed program of technical assistance. This program, totalling 120 person months, is far too rich in light of the interest shown to date.

The major accomplishments of the Planning Unit effort have been in the area of data collection and use, and in the development of the socio-economic monitoring and evaluation system. The results of this work are, however, very likely to be lost if it is not picked up through the UNDP/FAO program of assistance to the National Water Data Center in MMWR.

Study of Private Sector Participation

The PPS also included a proposal for a study of the potentials for private sector participation in water resource development. In response a special team from LBII and RM produced a substantial study that included projections of demand; estimates of the respective capacities of the public and private sectors to develop, operate and maintain rural water supplies; and financial pro-formas for the pricing of private sector inputs.

With a view towards meeting future demand, ten policy options were developed, ranging from no change to total privatization, and these were analyzed in terms of their impact on government agencies, private firms, community organizations and foreign donors. Three major conclusions resulted from this analysis:

- If national water supply and per capita consumption goals are to be met, the public sector alone cannot do the job;

- The Government of Somalia should, with donor assistance, stimulate growth of the private sector in the water resource development industry;

- Foreign donors should engage in a joint effort to shift well drilling and water supply facility construction from foreign firms to Somali firms and to develop the capabilities and resources of local firms over a 10-year period.

In line with these conclusions, the study offered a three-part program that was reviewed by Somali government officials, USAID and others. Following this review, a modified ten-year program was prepared, comprising actions, technical assistance and institutional elements. This program incorporated three of the ten policy options as three phases, moving further towards privatization of the water development industry over the ten-year period. The action components, for example, would start with contract well maintenance, move to a water-security role for private

drillers in the next phase and end with expanded contract well-drilling by private firms and a re-orientation of WDA's role.

The study is impressive in terms of the volume of data developed and the care of the analyses. Nevertheless, it's conclusions are rather optimistic, the process foreseen seems too "pat", and the recommendations for massive technical assistance are out of proportion to the interest shown so far by the Government and the direction in which it wants to move. The authors of the report state that the draft program was reviewed with government officials and that, while they expressed a reluctance to change WDA's role in drilling wells and constructing water supply facilities in the near term, a shifting of this role to the private sector could be considered in the future if the private sector demonstrates its capabilities. This could be a case of telling people what they want to hear. Most recently, the WDA's management has expressed interest in the WDA itself doing well drilling under contract (to foreign firms or donors) and it is likely that, even with recent changes, the importance of a planning and regulatory role is not fully appreciated. Moreover, there is no current incentive for the WDA to give up the cash flows that direct well-drilling and the operation of existing wells provide. It is likely that a program of privatization will be slow going and will be resisted by various groups within WDA and MMWR. The commitment of major resources to a program of broad technical assistance should be held in abeyance until the Government's commitment to an expanded private sector in water development is much more clearly established.

## DATA COLLECTION AND UTILIZATION

As revised in the PPS, the Data Collection and Utilization component of the Groundwater project included the elements included originally in the Preliminary Data Collection Phase, plus the Planning Unit functions discussed above, and a cooperative data collection and processing effort between the WDA and the MMWR, with assistance from UNDP/FAO.

The original data collection work included:

### Phase I

#### Collate Materials and Data on Existing Geophysics and Hydrology

As far as can be determined, publications which were available on the hydrology of the Bay Region and Central Rangelands have been collected and are in the Project Office. There is no evidence that computerized searches of on-line data bases, such as GEOREF, were ever carried out. These types of searches should be carried out prior to contractor staff leaving the United States. Such searches from team experience require a very short time to uncover every reference to any published work on the geology or hydrology or water resources of any country. One Evaluation Team member was able to obtain an extensive bibliography on the geology of Cyprus in 10 minutes.

Members of the Evaluation Team visited the library of the Ministry of Minerals and Water Resources and find it to be rather extensive and moderately well organized. There exists a rather good collection of materials dealing with the geology and hydrology of Somalia. It is our impression from talking with the librarian that LBII and RM personnel made use of this library.

## Establish Standard Forms for Recording Well Data

Well data are presented in LBII's End of Project Report in a systematic way but the reporting format is not identified as the set of standard forms that LBII has proposed for adoption. Apart from this report, each well has its own file but papers in the file are loose and not clipped into the file jacket. Also, many of the data in the files are in pencil, which will fade with time and the data will become illegible.

## Establish Method to Number and Cross Reference Wells

The project instituted a well numbering system not unlike that used in some states in the United States. The well numbers begin with either "BR" or "CR" for the Bay Region and Central Rangelands area respectively. (It might have been better to have divided the latter into separate letter prefixes for each of the three regions in the Central Rangelands.) Wells drilled by the project are numbered consecutively in ascending order. This numbering system should also be extended to other wells and boreholes in the four regions. Furthermore, each well should have locational information, besides a unique number. This information has been tabulated for the project wells, utilizing a grid system with kilometers north and east of a zero point, rather than longitude and latitude but the information has not been fully integrated into the permanent data base as yet.

## Inventory of Existing Wells in the Project Priority Area Including the Bay, Hiran, Galgadud and Mudug Regions

This effort was only accomplished for project wells. No inventory was made in the early days of the project of other wells, which have been completed by the WDA in the past or which have been inventoried by other donor-funded projects in the past.

Such wells, however, exist. The UNDP in 1972 carried out a survey of groundwater resources and estimated there to be 260 springs, 17,000 hand dug wells, 18,000 uars, and 10,000 burkeds in Somalia. Moreover, in 1976 the Italian firm, Idrotechnico,

submitted a report which inventoried all of the known hand dug wells in the Bur Akaba region. These wells are not in the project inventory of wells.

Finally, LBII's study of Private Sector Participation in Somalia's Water Resources Development Industry indicates that there are some 360 WDA wells in rural and semi-urban areas and there are another 130 which are out of service. These wells are apparently known but are not included in a well inventory.

The preparation of a well inventory was a clear requirement of the TOR. In the early years of the project, before the arrival of project equipment, there was ample time available for the compilation of this data base. The Evaluation Team has reviewed reports prepared by earlier projects, has visited wells drilled by WDA and is disappointed that none of the wells inventoried in the earlier projects has been included in a common well inventory covering earlier wells and the present project. This inventory would include such information as: a) location, b) depth, c) depth to water, d) well diameter, e) kind of well, f) use of well, g) owner of well, h) yield of well, i) chemical quality of water, j) number of people and livestock served by the well, if it was available. Evidently a decision was made not to "repeat" any inventories made earlier. A consequence of this decision is that there is no common repository of well data and the Project's data base does not extend beyond the Bay Region and Central Rangelands.

## Update Central Well Data File and Prepare Hydrogeological Maps

As far as can be determined, the central well data file for the Bay Region contains information only on the Project wells, since there was no staff for entering data from other sources. The hydrogeological maps prepared by the Project for the area are based almost entirely upon these wells and there is no reference to earlier studies or reports. Maps for the Central

Rangelands Area, including the regions of Galgadud, Hiran and Mudug, are based largely upon work carried out by others during the 1970's.

Determine Localities In Project Priority Areas Requiring Improved Domestic and Livestock Water, and Identify Additional Data Needs

This aspect of the project seems to have gone off well. As noted earlier, the process of determining well sites was largely in the hands of BRADP and CRDP staffs, though the Groundwater Project provided input to the process through the Community Participation Process and hydrogeological assessments.

Design Exploratory Drilling Program to be Done Through Existing Resources of MMWR or with Project Resources

The initial exploration well program in the Bay Region was delayed until project equipment arrived. The exploratory program was designed as intended, but it was not carried out using WDA equipment as originally set forth in the PP and contract documents, evidently because the WDA, at the time was unwilling to make its equipment available to the project.

Phase II

Drill 40 Exploratory Holes

Twenty five exploratory wells were drilled in the Bay Region. (Of these wells, those which encountered good quality water were completed as water wells.) The purpose of this program was to further define the hydrogeology of the Bay Region as a guide for the production drilling phase. With the completion of 25 boreholes, plus available information on the geology of the area, sufficient information was available to allow the production phase to begin in the Bay Region. A report on the results of this program was prepared by LBII in 1983.

Establish Geophysical Logging Program

The project purchased two geophysical logging trucks: one for the Bay Region and another for the Central Rangelands. They served the project purposes well and logging was done for most wells. Indeed, it was done for instruction even when it was not needed for well data. Potential problems with the GMC trucks have been discussed earlier.

Establish Wells and Aquifer Testing Program and Monitor Wells

Numerous wells were tested for various periods of time by project hydrogeologists. It seems, however, that data were commonly collected by local staff and the form used originally led to the contrivance of test data in some cases and, therefore, unreliable results. The problem form was changed and better quality data were obtained. The analyses of pump test data presented in the Project reports are inconsistent and incorrect analyses were occasionally made, which reflected a lack of understanding of well hydraulics. Thus, some of the data on transmissivities and pumping rates are unreliable. Also the recovery curves for some wells are indicative of wells that were not adequately developed.

It is recognized, however,that this may have been a consequence of the fact that analyses were often made by trainees and there may not have been time to go back and re-do them correctly.

Though monitoring data have been obtained, the team observed that they were not separately filed as monitoring data. Such data are only on file for particular wells.

## Groundwater Chemistry and Analytical Capabilities

The Groundwater Project added considerably to the analytical capabilities of the WDA and the contractor's End of Project Report indicates that staff training took place. The analyses of water reviewed seemed quite good. Cation/anion balances have been used to determine the acceptability of an analysis and this is sound procedure.

In preparing maps of water quality in the Central Rangelands area, the Stiff Diagrams give no numerical indication as to water quality. Trends in water quality cannot easily be discerned. The plotting of groundwater chemistry on the maps in the End of Project Report needs to be revised, in order to specifically relate changes in water quality to the direction of groundwater flow, if the maps are to be useful for groundwater exploration in the future. The chemical data cannot be contoured if the direction of groundwater and possible anomalies, such as higher transmissivities in certain areas are ignored.

## Collate all Data and Prepare Reports and Maps

The contract Terms of Reference specified that data processing and map preparation be carried out by local staff as a training exercise. This has generally been done in the case of map preparation, but little data processing has been done by WDA staff. Appendices to LBII's End of Project report contain substantial information in the form of maps, borehole logs and chemical analyses, but it is only a fraction of the data developed by the Project. The fear is that many data will be lost.

LBII has developed the framework for a data base covering the hydrogeology of the areas, plus other items of concern such as the density and variation of demand, tuulo/buulo profiles,[1] etc. Unfortunately, most of the data have not been entered because of the lack of a staff to undertake this work and little motivation on the part of WDA personnel.

---

[1]See earlier footnote on tuulos and buulos.

## Data Collection in Later Phases

### WDA Planning Unit

The fortunes of the WDA Planning Unit have been discussed in the preceding section on institutional support.

### Cooperative Data Collection Effort by WDA and MMWR

The PPS foresaw the establishment of a National Water Data Center within the MMWR during the course of the Groundwater Project and envisioned a cooperative data collection effort between WDA, with support from the LBII team, and MMWR, with support from the UNDP/FAO.

The National Water Data Center is only now just beginning and the UNDP advisor has only recently arrived. He has no staff and has not yet received more than token support. It is expected, however, that he will take over the LBII data base facilities within the WDA office complex. His first task will be to establish a network for collecting data through the WDA's regional offices; then if the WDA or MMWR comes through with staff, as they now say they will, he can devote some attention to using the LBII materials as a base for a larger effort. Ultimately, the NWDC is intended to collect relevant data from a range of sources, then standardize their format and make the resulting information available to Somali planners and various donors.

## LOCAL COMMUNITY PARTICIPATION

As originally developed, the Groundwater Project had a social component but it was relatively small and was largely devoted to preparing social profiles of the communities to receive water. Specific guidelines for securing the backing and cooperation of local communities were not considered.

In its Inception Report, LBII presented a reevaluation of the Project's social component and outlined an approach to involve rural residents in a collaborative effort to work with

WDA in the selection, construction, operation and maintenance of Project wells. The approach was termed the Tuulo (Village) Assessment and Participation Program. Subsequently, as certain modifications were made and it was recognized that each well would serve from 7 to 10 villages, the approach became the Community Assessment and Participation Program (CAPP).

This program organizes water development at the community level into four stages of technical activities and village participation. These are as follows:

- community orientation and assessment,
- drilling of boreholes,
- construction of civil works and pump installation,
- operation and maintenance.

Incorporated into these stages are: information on local attitudes and conditions; labor and materials for construction; and and the payment of users' fees, and enforcement of operating rules. The stages are discussed as follows:

Community Assessment Stage

The objectives of this stage are to determine the extent of local interest in a well and to form a Water Committee to look after the community's interest, if such a committee does not already exist, and to arrange for representation of the several villages. Meetings are set up with village and local government personnel that are coordinated by a community participation organizer (initially from LBII), a WDA employee, and extension staff (from BRADP or other units).

Drilling Stage

The objectives are to make the necessary preparations for drilling the borehole and installing a pump. The community participates in selecting the drilling site, electing the local personnel who will oversee the pump, nominating candidates for well operator training, repairing roads to the construction site, and providing support (food, etc.) for the drilling crews.

Civil Construction Stage

The objective is to complete the water supply system civil works. The local residents generally contribute labor and provide food for the workers. The WDA staff meets with the local leaders to devise a water management system plan and the well operators are trained.

Operation and Management Stage

The objective here is the operation and management of the water distribution system. The responsibility is shared between the WDA and the community Water Committee, according to the plan agreed upon. The procurement of fuel, oil and other operating parts may be carried out by the local community and, in theory, these items are normally purchased from the WDA. In practice, they are often in short supply.

Originally, CAPP was intended to be applied to all Groundwater Project wells and, indeed, to be a procedure that WDA would expand to others. Lack of staff and lack of support from WDA and BRADP led to the overall effort being curtailed, even though the approach had been praised by the mid-term evaluation team. Nevertheless, the Groundwater Project has succeeded in establishing the CAPP process in twelve communities in the Bay Region. It was also initiated in 8 to 12 other communities but activities were discontinued as the quantity or quality of water were not adequate for a producing well.

In the Central Rangelands, the situation has been quite different. The NRA and CRDP operate an education and extension program which seeks to organize Range and Livestock Associations (RLAS) within the deegan areas. These RLA's will participate in the drilling and construction along the lines of the water committees in the Bay Region, and the NRA and CRDP will provide the necessary institutional support to sustain this participation.

The RLA program is complex and problematic. The operation and maintenance of diesel pumps within a geographical area as isolated as the deegan of the Central Rangelands and by people

who are basically pastoralists will require a great deal of input from the NRA and CRDP. It is questionable whether they have the capacity.

Thus, it is not clear how the CAPP, which was designed for the Bay Region, would be adapted to the Central Rangelands. There are more sources of conflict and the local conditions within these districts vary considerably. It will require further investigation to determine precisely how community support or participation can be obtained.

The last stage of the CAPP would be implemented from the WDA side through the Monitoring and Evaluation System (MES) that was developed for the WDA's Planning Unit - as described earlier under Institutional Support.

In evaluating the CAPP, together with the MES, two questions may be asked:

1. Has community participation, in itself, been of value?

2. Has contact with the villagers uncovered features of the Groundwater Project that may not have been intended and should be revised?

The answer to the first question has generally been positive. A dialogue was started between WDA and the communities in which wells were drilled, and those communities where the process was undertaken had much higher rates of participation than those where it was not donel. Furthermore, there is a potential in the first set of communities for better care of the wells--if the WDA does not undo it, as discussed below.

The system that was developed is much too complex, however, and needs to be simplified in terms of the information sought and the uses to which it is put. Related to this is the

---

[1]There was an unconfirmed report of a few villages that didn't want wells in their communities either because they felt it would result in an influx of neighboring people fetching water or because the owner of an alternative water source was able to prevent the development of a competing source.

fact that solid baseline information on the socioeconomic profiles of the communities was never really obtained. Forms were developed but they were only half filled out and the original data from the villages are currently in a state of disarray. Some, no doubt, have already been lost.

The Monitoring and Evaluation System (MES) that is intended to complete the CAPP cycle is also much too complex for WDA staff to handle, though the LBII team in this case did its work much more carefully. A series of four forms for baseline surveys, eight forms for monitoring and four forms for evaluation are proposed, in a situation where WDA staff will become impatient with one form. Considerable simplification is needed in order to obtain a few items of indispensable information.

Regarding the second question, LBII's End of Project Report and two field visits by the Evaluation Team (in which a structured set of questions was asked) revealed a number of interesting aspects of the Groundwater Project.

- Members of the Water Committees are generally also members of the Village Committees, which existed long before the Groundwater Project. Water Committees are clearly dominated by those living in the village where the well is located but other villages are also represented.

- In its reports, LBII notes that the CAPP team took pains to point out that water might not be found. Yet, except for Bur Akaba (where the CAPP was not used), Committee members said they were never told that water might not be found. Indeed, drillers assured them that water would definitely be found.

- In addition to supporting well construction (access roads, civil works, etc.) through labor, both voluntary and paid, it was common practice for villages to make cash payments to the drillers when water was found. These payments ranged from 10,000 to 30,000 So.Sh. Thus, it appears that a form of incentive pay already exists. (These payments may also have been the reason why one village was incensed with the pump test team who later determined that the yield was insufficient for even a hand pump.)

- Committee members were led to believe that the wells would belong to the villages when they were completed, so they feel that they have been "taken", when all the revenues, beyond what is needed to buy fuel and spare parts from WDA, leave the village.

- In fact very little can be learned about what does happen to surplus revenues from the well. Studies by LBII personnel indicate that during the dry season these are substantial, yet in one village the well operator and Water Committee members agreed that there was little, if any , surplus. In another, where the Committee and the well operator were at odds, the well operator said he used it to "buy milk."

  Theoretically, fuel consumption should be an indicator of the revenues generated but few records are kept and it is reasonable to assume that only a fraction of the funds collected ever reach the WDA's account in Mogadishu.

- Committee members were supposed to nominate the well operator for approval by WDA. In fact, the well operator normally is picked by the WDA's civil works chief and the choice is ratified by the Committee. In one case, the Committee objected and was overruled. The well operator is paid 500 So.Sh./month by the WDA and has anywhere from one to five assistants to collect fees during peak periods in the dry season.

- Well operators are given rudimentary training in how to start and stop the engine and add fuel. Some have learned how to change filters. When asked if they would like to have received more training in the workings of the pump and how to maintain it, all the operators replied yes. They do not wish to depend upon the WDA for repairs (though one village that said they had three breakdowns also said the WDA came the same day to repair the pump). The WDA says it is considering an extended training program for the operators.

- Official prices are a sometime thing. LBII's staff indicates that towards the end of the dry season prices at the wells go up. Also, well operators and Committee members said they paid from 7,000 to 10,000 So.Sh. for a 200 l. drum of fuel from WDA. At official prices it would be 4,400 So.Sh.

- Fuel consumption rates reported by well operators varied from 2.4 to 2.7 l/hour. In its cost model, LBII used a figure of 1.77 l/hour for the Lister diesel that is used, so it may well be that well operators have learned to adjust downward the number of operating hours they report.

- In the town of Bur Akaba, several wells were drilled without the use of the CAPP process. Only one of these was successful and fitted with a hand pump (the others were saline). It is within the WDA compound, where it is used by less than 200 of the several thousand and local people and nomads in the town; other people felt that it was sort of a private well. In terms of impact, this well was a complete miss. The water situation in Bur Akaba is very poor, though more surface water catchments or infiltration galleries are a possibility. As it is, the Project yielded virtually no benefit to this substantial town - no alternatives were available.

## EXPLOITATION PROGRAMS

### Drilling Program

The major share of the Groundwater Project effort in recent years has been devoted to the actual process of drilling and completing the production wells themselves, in both the Bay Region and Central Rangelands. This process started in early 1983, with the completion of the Bay Region exploratory program. Indeed, there was no real break between the two phases, since the exploratory program had been held up until Project equipment arrived. Drilling in the Central Rangelands didn't start until several months later and the selection of sites considered to have some potential was done on the basis of data from previous studies and criteria developed by the CRDP.

The number of wells actually completed fell well below the original Groundwater Project targets for a variety of reasons that were outside the control of the LBII/RM team. Indeed, that team probably did as good a job as possible under the circumstances. The number of producing wells envisioned in the contract Terms of Reference, including those drilled in the

exploratory phase, was between 140 and 150, which were to be completed in a six year period. Of this total, at least 32, plus a portion of 35-50 wells unspecified as to location, were to have been in the Central Rangelands. Only 60 to 70 wells were specifically designated for the Bay Region. (One other region, the Lower Shabelle, is mentioned in the TOR but never seems to have been considered in the Project as it evolved.)

The number of producing wells actually completed within a four year period has been 50 in the Bay Region and 11 in the Central Rangelands. Civil works for a number of these wells have not yet been completed and 24 still await pumps. Project targets have been scaled back over the years, yet the general feeling is that a good deal has been accomplished, particularly during the last two years. When the shorter period of actual drilling operations is taken into consideration, the annual rate of completion has been about 65% of what was originally targeted (15 per year instead of 24).

Reasons for this lower productivity are numerous. The problems with fuel have already been discussed. Timely clearance of equipment and supplies was another source of delay, resulting in down time. WDA was responsible for the clearance of these items and delays of several months have been encountered, often for capricious reasons having little to do with the project itself.[1] Normal customs clearance time at Mogadishu Port is reported by commercial sources to be one week. It has been the experience of the Danish drilling firm PIHL that equipment and supplies ordered in the United States are delivered to the job site in about 5 weeks.

It was noted that the two TH-60 rigs in Baidoa have 2045 and 2185 hours respectively on their engines. This means that each has worked only about 530 hours each year they have

---

[1]Recently, clearance of supplies was held up because the Government wanted a list of the landlords of the expatriate team members and USAID could not accede to what appeared to be an improper demand.

been in Somalia, or less than two hours a day, including travel time. Thus, they have been idle much of the time because of logistic problems.

Another reason for low productivity is that, while is that the TH-60 rig is capable of high production rates when drilling with its air hammer (putting down 6-inch diameter boreholes to be equipped with 4-inch diameter casing, as are most wells with hand pumps), this productivity is sharply reduced when the rig must be used to drill 10" holes or larger for setting 8" casing. With the larger hole, the uphole air velocity is not sufficient to remove cuttings and water from the hole - particularly when smaller diameter drill pipe is used. (The TH 60's presently have 3-1/2" drill pipe but 4-1/2" would have been better.) It is noted that later in the Project, drillers were putting down 6" diameter uncased holes and getting better drilling rates.

That the TH-60 drilling rigs were not the optimum choice for Somalia was nicely demonstrated by the Project team when it showed that a properly operated cable tool drilling rig could drill and complete a well as quickly as a TH-60. Inasmuch as a cable tool rig costs about $90,000, five cable tool rigs could have been purchased for the price of one TH-60. Even operating at their normal slower rate, the project would have had 10-15 cable tool rigs, which require very little material support, and less manpower and maintenance than the TH-60's. Each one is capable of one well in say two months, which would have resulted in 90 wells per year or more than 360 wells for the four years the project had its equipment. It is an observation of the evaluation team that cable tool drilling should be extensively used in Somalia.

Another factor in the relatively low production rates, with equipment potentially capable of high production rates, may be related to cultural differences in perceptions of time and concerns about job security. Certainly, low salary levels do not encourage high productivity. Furthermore, to utilize the

TH-60 rig as it is intended would mean that a hole could be completed before a work camp is set up. Thus, there could be fewer jobs for those casual laborers who spend their time establishing and servicing camps.

Evidently the rate of dry holes and poor quality water in the Bay Region was not significantly higher than what was expected once the exploratory phase was completed. A possible exception was in the limestone depression area that was mentioned earlier . This, therefore, was not a major reason for the relatively low number of production wells completed. It is unfortunate, however, that water quality was not more consistently evaluated as the wells were being drilled. Had further efforts to determine specific conductance been made each morning prior to drilling, for example, a greater understanding of water quality variation with depth would have been achieved and could have been important in well completion. (If it is determined that water quality is good near the water table but deteriorates with depth, the deeper water could be shut off and only shallow water used.) By carrying out this procedure in more cases, wells which have been counted as failures by the Project may conceivably have been converted to successful wells. The LBII team leader is aware of this problem. His suggestions to carry out measurement of conductance as wells were drilled, using the right equipment available to the geohydrologists, were not always followed and in other cases loss of circulation meant there were no samples to measure.

LBII/RM personnel recognized the quality stratification of groundwater and the interim evaluation team correctly recognized the problem of the "upconing" of poor quality water into shallower, better quality water if pumping rates were high. That team pointed out that upconing was already occurring in the new well fields supplying Baidoa and suggested that "skimming wells" be constructed to overcome this problem. To the credit of the project, this suggestion was not carried out. It is a highly technical solution to the problems which generally requires

larger diameter boreholes. A more appropriate solution would have been to suggest that the productive capacity of the well be reduced. Low capacity hand pumps, for example, could be used rather than higher capacity diesel-powered pumps.

Because of low productivity, only 11 wells capable of producing water of adequate quality were drilled in the Central Rangelands and, to date, only 7 of these have pumps and civil works. Expatriate staff and USAID officers responsible for the CRDP are not overly distraught by this turn of events, however, since the areas around some of the completed wells in the Central Rangelands have suffered significant environmental degradation. In such cases, some previously nomadic groups have settled near the wells and enclosed adjacent grazing areas, leaving only narrow aisles, and the area immediately around the wells, for others to gain access with their animals. As a result, these access routes and other areas outside the enclosures have been almost completely denuded. Before many more wells are drilled, most observers believe that further studies should be undertaken of potential settlement patterns and alternative water point systems, such as clusters of low production wells, widely spaced within each cluster. This could, indeed, provide a further reason for using the TH-60 in the manner for which it is best suited - putting down a large number of small diameter wells.

Shallow Well and Surface Water Development Program

As noted earlier, these programs - with the exception of some classroom instruction and seminars on surface water development - were ultimately dropped from the Groundwater Project.

At the completion of the interim project evaluation, the recommendation was made to include development of improved uars and cisterns and the construction of hand dug wells in the fresh water areas of the basement complex in the next phase of the Project.The Project staff made similar suggestions. Despite

these recommendations, no effort was ever mounted to respond to these recommendations. The result, as noted earlier, has been to leave significant areas of the Bay Region, including the Bur Akaba area, with no benefit from the Groundwater Project.

# IV
# CONCLUSIONS AND RECOMMENDATIONS

## CONCLUSIONS REGARDING THE PROJECT

Overall, the Comprehensive Groundwater Development Project may be considered as modestly successful, in terms of the achievement of its objectives and the underlying validity of those objectives. A number of producing wells were completed; more than 100,000 rural dwellers, plus their livestock, have benefited from the Project; and about 130 staff members of the Somali Water Development Agency (WDA) have received some form of training. The requirements of the contract Terms of Reference have been largely carried out in a sound and professional manner. The LBII/RM staff could have done little more under the circumstances and should be commended for their efforts.

On the other hand, for reasons detailed earlier, the Groundwater Project fell well short of its original targets for the number of producing wells; total costs per well were unacceptably high; and there have been few improvements in the institutional capacity of the WDA as a result of the project.

That the Groundwater Project would achieve only a portion of its objectives was foreordained by certain determinations made at the outset and actions taken before the prime consultant was selected. The PP determined: (1) that the WDA's professional capabilities and staff skills needed substantial improvement if it was to develop groundwater resources in Somalia; (2) that two large integrated agricultural development projects, BRADP and CRDP, required water supplies and (3) in light of these needs, the acquisition of new equipment would be preferable to the rehabilitation of existing equipment. The WDA's own perception may well have been that it already had years of well-drilling experience and what was needed was a program of equipment rehabilitation, standardization, maintenance, and material support. The

possibility cannot be dismissed that the WDA also perceived that acquisition of additional equipment and materials would enable it to generate income through their lease or sale to others for hard currency.

Even though there appeared to be considerable divergence between USAID's perception of appropriate objectives and the likely objectives of the WDA, in one key area the preferences of the WDA were accepted and in another the WDA's former managers may have played a key role. This refers to the acceptance of 8" casing and screen for all wells and the later selection of a highly sophisticated rotary drilling rig that was not well suited to drilling wells large enough to accommodate 8" casing. This mismatch has been noted by LBII/RM and two evaluation teams; it greatly diminished the rate at which wells could be drilled and completed and was a major factor in the high cost of the wells.

The NPV of average total costs per well in the Bay Region was $114,950 and in the Central Rangelands was $198,400, excluding technical assistance and training. Assuming 12 cu.m/hr. for 8 hrs/day for 240 days/year (which is on the high side) and 81 So.Sh/U.S. dollar, this translated to a cost of 61 So.Sh/cu.m and 105 So.Sh/cu.m, respectively (in contrast to the Government's official price of 18 So.Sh/cu.m.). These are not reasonable costs, as was well-recognized by LBII, which correctly noted that two ways in which the cost per well might have been reduced to reasonable levels would have been to sharply increase productivity with the same equipment or to have instead rehabilitated some of the WDA's 20-odd operable rigs.

The cost to rehabilitate wells, using private contractors, as proposed by LBII has been estimated at $5,185 per well--which would be much more cost effective, if in fact the work could actually be done for this price. Rehabilitation of wells could be an attractive program, provided that costs are close to the estimated value and a large amount of technical assistance is not required.

With regard to benefits, these have not been quantified by LBII, largely because needed baseline data on end-user characteristics, usage rates, willingness to pay, local health conditions and local livestock production were not obtained. (Detailed data on end-user characteristics and usage rates were obtained in one community.) Nevertheless, benefits of the Groundwater Project have been real for the people (and their animals) who live in the communities where producing wells have been completed. These benefits are listed in the End of Project Report of LBII, as well as an earlier economic study, as follows:

- Improved access to year-round, high-quality water at existing levels;
- Increased quality of water;
- Reliable water supplies in times of drought;
- More human resources are available for productive economic activities (particularly women who may spend up to 8 hours a day in the dry season getting water);
- Reduced livestock losses;
- Stabilization of agro-pastoral and sedentary populations--which means more production of food crops;
- Increased ability of the government to provide social services;
- Increased accessibility to pasture during the dry seasons;
- Improved level of public health.

The last named benefit, improved public health, may be illusory, since most rural dwellers continue to use surface water supplies, which are free but which may also be polluted, during most of the year. The use of well water occurs mainly during the extended dry season (or Jilaal) with less use during the shorter dry season (or Hagai).

Because of the recent change in the two top positions at the WDA it is possible to be somewhat more optimistic about continuing benefits from the Groundwater Project. The new General Manager and Deputy General Manager are both technically qualified and seem committed to using personnel trained by the Project and to improving the functioning of the WDA. Nevertheless, there are still several areas of concern:

- The capability of the WDA's regional offices to maintain and repair the wells that have been installed is marginal at best. Well maintenance, as opposed to equipment maintenance, was not really addressed by the Groundwater Project. (One manual on well maintenance was produced and the private sector study has proposed the use of contracts for well maintenance.) Villagers expressed a desire not to be dependent upon the WDA for well maintenance and a GTZ-sponsored study stated that WDA had little interest in maintenance.

  One aspect of the Groundwater Project that has not been mentioned so far, but which the Evaluation Team finds most worrisome, is that the practice of constructing relatively large wells with power driven pumps that produce perhaps 11.5 cu.m/hour, has had a significant effect upon settlement patterns. People have tended to move closer to the wells and have added to the population of existing villages (such population data as LBII has managed to obtain, indicate increases of 5 to 21 percent in the population of communities where wells are located, within 12-24 months after wells are installed) or established new villages near the wells. The practice, therefore, carries relatively high risks of severe dislocation if a well should fail for any reason. A lower-risk alternative would be the drilling of a larger number of wells with low production rates, most of which would probably have hand pumps.

- The fact that villagers must pay for water, while virtually none of the money collected remains in the community and no one seems to know just where it goes, will continue to have a very corrosive effect upon relationships between the WDA and the local residents. A much better accounting needs to be given to villagers and their representatives. Better yet, would be to have the local community retain all receipts from water sales, from which they would pay for fuel and repairs, <u>plus</u> a fixed

annual amount for amortization of the well and civil works. (This fixed amount would have to be based upon something other than the extraordinarily high cost of the Project wells).

- The ability of the WDA to continue to maintain equipment and vehicles obtained under the Project, once the present stocks of spare parts are exhausted or major units, such as transmissions, start to go, is a large question mark .

- Whether the WDA recognizes the importance of, and has a sustained interest in; maintaining an adequate data base--covering socioeconomic data, geohydrological data and equipment inventories--for the purpose of planning, budgeting and scheduling future water resource development activities is not known. Many of the data obtained in the course of the Groundwater Project are still in the form of rough notes, which have not yet been incorporated into a permanent data base or system of files. If trained personnel are not made available for the work of tabulating and storing these data (either as a part of the UNDP/FAO effort or outside of it) they will, for the most part, be lost.

RECOMMENDATIONS

Two sets of recommendations are made: the first set refers to what might be done differently for future projects that are similar in nature to the Groundwater Project; the second set are specific recommendations regarding follow-on work in Somalia to assure that the benefits of the Groundwater Project will not be lost.

Recommendations Regarding Future
Implementation of Similar Projects

1. The design of similar projects in the future should more deeply involve long-term AID people, familiar with specific conditions in the host country and aware of the larger framework, as a support to any short-term consultants retained to prepare the PP and procurement

documents. In the case of the Somali Groundwater Project, it probably would have been wise to have had a direct-hire advisor, with a background in well-drilling techniques, equipment and water resources development, working with WDA for about a year. Such a person would have had the time to find out the actual condition of the WDA's equipment and assess the real priorities of the WDA's former management. These are things that a short-term consultant or a PSC simply could not do.

2. It would make sense in the future to work more closely with other donors in order to specifically address the dual problems of non-standardization and equipment that cannot be maintained within a country such as Somalia. For well-drilling equipment, the U.S. is the most appropriate source, and standardization upon the equipment of two to three U.S. manufacturers makes sense. For support vehicles, however, it would have been far batter to have permitted standardization upon Japanese or Italian vehicles similar to those already widely used. Of necessity, these would have to be funded by multi-lateral donor agencies or bi-lateral programs of other countries.

   An alternative might be to require U.S. bidders to establish an in-country maintenance capability. This may, however, merely result in a set of unresponsive bids or requests for waivers.

3. Future groundwater project designs should consider not only quantitative needs and a "groundwater development program" to satisfy those quantitative needs but also, as a part of the design compare alternative approaches to well drilling in terms of project objectives, the types of equipment best suited to each approach and the impact of each approach on settlement patterns, future

maintenance needs and organizational structure. Outline procurement specifications should be a product of this process. Also, the project design should explicitly consider what to do in cases where groundwater of suitable quality can't be found and, later, the project should retain the exploitation of alternative sources as a major element.

4. Future project designs might include guidance to a mission on what courses of action are possible when a clearly uncooperative approach is adopted by a recipient agency, yet where there may be political considerations involved. In the case of the Groundwater Project, there were numerous occasions when the work was delayed by problems of supplies (some that were beyond the control of the WDA and others that weren't) or when key staff was not made available for agreed assignments. Actions appropriate to the circumstances should have been taken but may not have been in the absence of clear guidelines.

5. The idea of involving individual communities in the development and operation of wells should be included in all future rural groundwater development projects. Indeed, the concept should be incorporated into the project design from the outset and the contractor directed to explore the alternative of local control and operation of wells and what it would require in the way of centralized support functions.

## Recommendations or Follow-on Actions for the Somali Groundwater Project

1. Make further assistance to the WDA contingent upon regularizing the flow of funds from sales of water in the rural communities and providing some accounting for these funds. One possible model is the system developed already, through GTZ, for small urban water systems; another would be to use the approach suggested in the prior section on conclusions.

2. Give serious consideration to a program for rehabilitating the operating rigs of the WDA and providing continued support for maintenance of the new TH-60 rigs and GMC support vehicles. Also, speak with other donors about a possible program for the maintenance of other support vehicles, so that a balanced fleet results.

3. Work with the WDA's new managers to develop a modest program of support for the WDA Planning Unit. The program would be responsive to the expressed needs of the WDA but would also involve a clear set of reciprocal obligations. One of the Planning Unit's initial tasks would be to work with the National Water Data Center to ensure that data from the Groundwater Project is either properly entered into the computerized data base for the WDA or placed in permanent files where they are easily retrieved.

   The work of the WDA Planning Unit should go beyond equipment scheduling, the later monitoring and evaluation of well-drilling programs and policy studies; it should also include planning for capital budgeting and necessary inputs to the Ministry of Planning.

4. Modify the proposed technical assistance program for private sector participation in water resource development so that it is consistent with what the new managers of the WDA perceive to be the real needs of the Agency and scale it down so that the effort is proportional to the interest the WDA shows in the whole concept of privatization. There may be a need to go slowly until it is clear that recently trained drillers and others won't be displaced (they may leave of their own volition in order to secure better-paying jobs) and the staff of the WDA have a much better idea of what role the Agency will play as it moves away from direct drilling activities.

5. Whether it is done directly or through local contractors, move ahead with a program of support for well maintenance (depending upon funds availability, this may be linked to a program of well surveys and well rehabilitation, as proposed by LBII).

6. Finally, no matter what programs are finally adopted, USAID should maintain a dialogue with the WDA and also maintain contacts with other donor agencies that have been rendering assistance to the WDA.

# APPENDIX A

## GEOHYDROLOGICAL ISSUES

### Geology of the Area

Somalia, as a whole, forms a kind of plateau sloping down towards the Indian Ocean in a NW-SW direction. The altitude along the southern frontiers ranges from 300 to 500 metres. An arc of mountains (the Ougai and the Medjourtine Ranges) borders the Gulf of Aden, with peaks between 1,700 and 2,200 metres.

The two major rivers, the Shabelle and the Jubba, rise in the Harar plateau of Ethiopia and cross the southern part of Somalia. Their course disappears in a sort of inland delta, an elongated playa 5 to 40 km from the coast.

The basement rock units are predominantly gneiss and schist with granodiorite intrusions. They crop out at the land surface in the mountains in the northern part of the country and in the locality of Bur Akaba in the Bay Region (one of the two project areas between the Shabelle and the Jubba Rivers. Northwest of this basement complex is a limestone plateau that is part of a marine Jurassic trench that extends into northeast Kenya. The central part of the country is occupied by a syncline comprised of Jurassic gypsiferous sandstone, oolitic limestone and shaly limestone. Sandstones comparable to the circum-Nubian Shield Sandstones were deposited during the Lower Cretaceous, followed by Cretaceous marl and limestone of marine origin. These were followed conformably by Eocene limestone.

In the Bay Region, the limestone plateau, west of the Baidoa escarpment, is a major zone of ground water recharge. Following recharge, the ground water appears to move primarily to the northwest and the southeast. Water moving to the northwest probably discharges in the vicinity of the Jubba River. Water migrating to the southeast has no known discharge zone, unless there is a major fault zone separating the sedimentary rock from the Precambrian Bur Akaba region which also acts as a major conduit for ground water movement away from the area.

Ground water quality in the Bay Region is best in the vicinity of the recharge zone but deteriorates in the direction of ground water movement because of evapotranspiration from the water table. Thus, poorer quality water can be expected as the Jubba river is approached and as the Bur Akaba area is approached. In the Bur Akaba area itself, ground water primarily occurs in broad sand-filled paleo-drainage channels as well as in fractures within the basement rock.

The Central Rangelands area from the Shabelli River in the the southwest to the Nogal Valley in the northeast consists mainly of aquifers in sandstone, limestone, and gypsum-anhydrite. Aquifers in unconsolidated material are of local significance, as in the dune belt along the coast of the Indian Ocean and alluvium in dry river beds.

No perennial surface drainage occurs northeast of the Shabelle River. Numerous wadis, however, show that the central Rangelands area is part of a drainage system with flow directed southeastward. The low precipitation of the area, ranging from 100 mm/yr in the north to about 200 mm/yr in the south, may partially infiltrate the karstified limestone and gypsum anhydrites. Groundwater flow near the surface follows the southeast direction. A deeper large-scale regional groundwater flow occurs from recharge areas in the Ogaden desert. This confined aquifer has static water levels of 100 to 150 meters below the surface along the border of Ethiopia and Somalia, and is presumed to be present in the area southeast of Ceel Bur.

The upper water-table aquifer systems show a direct relation to the chemical composition of the outcrops and are highly mineralized. Groundwater from the deeper aquifer, probably consisting of the Auradu Limestone, is of lower mineralization and is characteristically undersaturated in sulfates. The coastal dune belt has groundwater of high sodium content which rapidly diminishes in concentration inland.

## GEOLOGICAL STUDIES

Geological knowledge of Somalia is extensive. Much of the geology of Somalia is known through studies carried out by the British in northern Somalia and the Italians in the southern part of the country. In addition, from 1949 through 1979, extensive geological studies were carried out by oil companies. These studies included extensive seismic geophysical surveys. A total of 51 oil exploration holes were drilled during this period of time. The areas selected for exploration drilling were in the northern coastal basin bordering the Gulf of Aden, the Somalia Indian Ocean coastal basin and the Mandera Trough, which probably extends into neighboring Ethiopia and Kenya.

From 1978 through 1984, Atlantic Richfield carried out oil exploration activities in an on-shore block of land in central Somalia and drilled three wildcat wells. At present, Elf Aquitaine has a 3,340 square kilometre offshore permit north of Mogadishu. Last year Esso won eight offshore blocks, covering 48,000 square kilometres along the central southern coast near the Bur Akaba uplift. All of this intense oil exploration activity has generated a significant amount of information which is directly applicable to ground water exploration.

## PRIOR TECHNICAL ASSISTANCE

A significant amount of technical assistance has been provided to Somali citizens through bilateral and multilateral assistance projects, oil and gas exploration, and through other private companies. In the early 1970's, the Food and Agricultural Organization of the United Nations provided technical assistance in ground water development as part of agricultural projects. USAID provided technical assistance in the training of drilling technicians for the water supply of Mogadishu. Also, the Soviet Union provided technical assistance. In fact, many Somalis have received technical degrees from Soviet Universities and speak Russian rather better than English. Technical assistance was also provided by oil companies who employed local workers more recently by the Danish contractor PIHL & Sons who

constructed 26 production wells for the Mogadishu Water Supply System under IBRD Contract Number 4.

A United Nations project on mining and groundwater undertaken in the late 1960's, covered the El Bur and Kismayo areas. The second phase of the project, undertaken in late 1969, provided for the organization of a hydrogeological section within the MAR, preparation of hydrogeological mapping, a preliminary inventory of ground-water resources and detailed investigations in selected zones.

WATER DEVELOPMENT ADMINISTRATION EQUIPMENT

At the time the Comprehensive Groundwater Development Project was planned, the Water Development Administration (WDA) owned and operated about 28 different pieces of drilling equipment including either 1 or 4 Ingersoll Rand rigs, 5 Speedstar rigs and 4 Failing rigs, all of American manufacture. Speedstar was made by a division of Koehring Co. that was sold and went out of business in 1985. Spare parts may still be available from liquidators, however. Table 1 is a list of all the drilling rigs owned by the WDA as of March 1986.

WDA is an earner of foreign exchange for the Somali government. It apparently accomplishes this function in two ways: (1) It leases its equipment for hard currency to foreign funded projects (at present, a BOMAG 750 drilling rig is on lease to Wild Drilling Company of Mogadishu.); and (2) it sells its materials and stores for hard currency to any buyers and many local contractors rely upon WDA for casing and other supplies.

WDA is able to accomplish this because its heavy equipment and materials are supplied by donor countries. Having obtained equipment and materials on concessionary terms or through grants, and with only a rudimentary inventory of supplies, the WDA can dispose of it for hard currency or for an equivalent Somali Shilling price.

TABLE 1

WDA DRILLING RIGS
(Excluding Project Rigs)

| Make and Model | Bought | Origin | Serial | Location | Condition |
|---|---|---|---|---|---|
| Ingersoll-Rand | ? | USA | RX/42 | Salahley | Unk* |
| Ingersoll-Rand | ? | USA | RX/44 | Burco | Unk* |
| Ingersoll-Rand | ? | USA | RX/46 | Cada Kibir | Unk* |
| Ingersoll-Rand | 1975 | USA | RX/22 | Muuri | Out of Servi |
| Speedstar (Rotary) | ? | USA | RX/24 | Banadir | Unk |
| Speedstar (Rotary) | ? | USA | RX/30 | Lasconod | Unk |
| Speedstar (Rotary) | 1975 | USA | RX/32 | Kismayo | Operable |
| Speedstar (Rotary) | 1978 | USA | RX/34 | Afgoye | Operable |
| Speedstar (Rotary) | 1978 | USA | RX/36 | Dh./Mareeb | Operable |
| Failing JED-A | 1975 | USA | RX/28 | Banadir | Operable |
| Failing JED-A | 1975 | USA | RX/26 | ? | Out of Servi |
| Failing F1500 | 1968** | USA | RX/14 | ? | Old |
| Failing F2500 | 1960** | USA | RX/6 | Magadishu | Old. Needs new carrier |
| URB 3 AM (Rotary) | 1966 | USSR | RX/2 | Hidda | Lacks spares |
| URB 3 AM (Rotary) | 1966 | USSR | RX/4 | Galkayo | Lacks spares |
| URB 3 AM (Rotary) | 1973 | USSR | RX/38 | Qodqod | Lacks spares |
| URB 3 AM (Rotary) | 1973 | USSR | RX/40 | Mora Ari | Lacks spares |
| Bomag | ? | W.Ger. | RD/25 | Cambar Sare | Operable |
| Bomag 750 | ? | W.Ger. | RXR/48 | Leased to Wild | Drilling Co. |
| Dando (Cable Tool) | ? | U.K. | RD/27B | B. Hawo | Unk |
| Dando (Cable Tool) | ? | U.K | RD/29 | Lasconod | Unk |
| Dando (Cable Tool) | ? | U.K. | RD/31 | Mashruca | Operable |

(Plus another 6 rigs of U.S., British or Soviet origin shown as being in poor condition)

---

* These are recent acquisitions and there is the possibility that they could be the Groundwater Project rigs. They are shown, however, with Benz or Toyata carriers and their locations do not agree with the known locations of the project rigs.

**This is the year rig was bought, Failing Co's records show shipment dates of 1960 and 1954, respectively.

Best Available Copy

Following completion of the Groundwater Project and the assumption by the WDA of total control over project supplies, it is likely that some of these supplies may find their way to other drillers in country. This is not altogether undesirable because it contributes to the privatization of the water well drilling industry in a very practical and very simple manner without the introduction of three layers of bureaucracy as proposed by the LBII study on the privitization of the Somali water well drilling industry.

In spite of the WDA's role as an earner of foreign exchange, the Agency is often crippled by the lack of foreign exchange for the purchase of necessary spare parts for rigs, heavy equipment and vehicles and well construction materials.

An example of this is a Failing 2500 Holemaster which sits unused in front of the LBII/RM project office. The rig requires repair and also a new carrier but it will give another 20 years of service. The manufacturer has complete manuals on the rigs and they could be rehabilitated in a month. The same is likely true with the other American equipment with the possible exception of the Speedstar rigs because the firm is out of business.

Other drilling equipment exists in Somalia. In addition to the equipment owned by the WDA (Table 1) and other Government entities there were about 15 other drilling rigs in Somalia owned by private companies, at the time the initial project paper was prepared.

Private well drillers generally carry out project work for private parties and bilateral or multilateral development projects which have a foreign exchange component which enables them to purchase materials and supplies. In some instances, private contractors use the WDA as a source of equipment an supplies. As long as WDA is paid in hard currency, they act as a supplier of equipment and material. Most Somali drilling contractors purchase supplies from Europe, when time allows, and many of them have expatriate mechanics and drillers. Wild Drilling Company, a West

German Firm, is currently leasing a BOMAG 750 drilling unit from WDA and has used it to complete 4 wells in the Jubba and Shabelle areas in connection with an agricultural development project. Another European firm, PIHL & Sons of Denmark is has been active in Somalia since 1980, operating two Failing rigs which they acquired in 1982. PIHL and Sons carried out Contract Number 4 on the Mogadishu Water Supply System, funded by the IBRD, which involved the drilling of about 40 exploratory wells and 26 production wells each cased with 10-inch casing to a depth of about 210 metres. PIHL used expatriate Danish and English drillers and mechanics as well as Somali helpers and mechanics. It is understood that the PIHL equipment is now stacked and for sale.

Private Somali or joint venture drilling companies that own equipment are listed at the end of this Appendix.

NEW EQUIPMENT PROVIDED BY THE PROJECT

Since some information on the equipment owned by WDA was known prior to the project, the evaluation team believes that WDA would have been better served if a contract was let to rebuild and rehabilitate the older drilling equipment and to remount the equipment on new carrier vehicles, where necessary. It is estimated that the cost of rehabilitating a drilling rig may be from 15 to 50 percent of the cost of a new rig. By rehabilitating existing equipment, funds would have been available to purchase additional equipment and supplies if needed.

Ingersoll-Rand TH-60 Well-Drilling Rigs

Furthermore, poor technical advice was given when the Ingersoll Rand TH-60 rig was selected as the appropriate rig for the Groundwater Project. The decision to use 8" casing was made much earlier and is reflected in the list of project equipment included in the PP. Eight-inch cased wells should have called for a TH-4 rig instead of the TH-60 rigs, if air-hammer or air-rotary Ingersoll Rand Equipment was to be purchased. Failure to compare well design with equipment specifications led to the purchase of inadequate equipment. The performance of this equipment and the

number of wells drilled caused the expectations of the project to be scaled down. This was perhaps the most critical flaw in the Groundwater Project. The well-drilling equipment purchased for the Project is capable of high production rates when drilling with its air-hammer constructing 6-inch diameter boreholes to be equipped with 4-inch diameter casing (as are most wells with hand pumps).

Further evidence that selection of the TH-60 drilling rigs was faulty has been provided by the LBII/RM crews, who showed that a properly operated cable tool drilling rig could drill and complete a well as quickly as a TH-60 under Somali conditions. Inasmuch as a cable tool rig costs about $90,000, the price of one TH-60 could have purchased 5 cable tool rigs. Even operating at their normal slower rate, the project would have had 15 cable tool rigs, which require little material support and less manpower and maintenance than the TH-60's. Each would be capable of, say, one well every two months--which would result in 90 wells per year, or more than 360 wells for the four years the project actually had equipment. It is apparent that cable-tool drilling is commonly carried out in Somalia-and it is a recommendation of the evaluation team that cable tool drilling be more extensively used. One of the evaluation team members has made the same recommendation some years ago to OFDA for water supply in Uganda following the departure of Idi Amin.

LBII's personnel, the interim project evaluation team and the current evaluation team have all pointed out the unsuitability of the TH-60 drilling equipment for the project. The current evaluation team reviewed the procurement files for the drilling equipment. This file revealed that no particular equipment was specified originally. Subsequent to the issuance of tender documents by a PSC, the then General Manager of the WDA orally communicated to AID that he had decided that the WDA would standardize around the TH-60. He requested that the tender documents be modified so that the TH-60 could qualify and was asked to put this in writing, which he later did. Consequently, a minor modification

was made in the tender specifications and the bids were evaluated by a PSC (Chemonics), with some participation by the General Manager of the WDA.

According to the first LBII team leader, Ingersoll-Rand made at least one representation in the form of a memo that they intended to open up a distributorship in Somalia and would be able to service the TH-60's and its supporting equipment. For whatever reason, this never happened and the rationale for this apparent commitment can only be surmised.

The order was placed with Ingersoll Rand SA (IRSA) of Switzerland, which then placed the order with Ingersoll Rand in the United States and captured any profit on the transaction outside of the United States, IRSA may have been a DISC; but, this is not known. It is known that since the middle of 1985, IRSA has not been a factor in foreign orders for Ingersoll Rand equipment. This is understandable if IRSA was a DISC, since the tax advantages to DISCs, were largely removed in recent tax legislation.

Wind Baron Windmills

The project selected various pumping plants for the project. Inasmuch as there is nearly continuous wind in Somalia during the dry months, two windmills were purchased from Wind Baron Corporation in Arizona. If they work, windmills are a desirable solution to the pumping problem because there is no need to purchase and transport diesel fuel. The major drawback to windmills is the need to replace leathers in the pump periodically and the need for lubrication of the moving parts. It is to the credit of the project, that they looked into windmills. The first Wind Baron was set up at the Bonkay Experimental Farm near Baidoa. The well was of low capacity, as determined from a test of the well, and it was determined to be suitable for the Wind Baron.

After about 9 months of operation, the fan shaft failed at the point where it enters the hub of the fan. Initial inspection of the shear suggested that the windmill was not well maintained and that the gears in the gear box had frozen and the shaft torqued off while the fan was rotating at a high rate of speed.

The heavy gage metal of the catwalk atop the tower was badly damaged by the fan as it broke off. Discussions with the Wind Baron Corporation, however, suggest that the shaft and fan hub were not effectively annealed subsequent to welding the hub to the shaft. The Wind Baron shaft and hub assembly were apparently part of a lot of 50 and of that lot they have had the same problem with another windmill sold to a buyer in Canada. It may still be true that lack of proper lubrication contributed to the destruction of the Wind Baron, since both the shoulder block bearings on the shaft and the grease labyrinth seals require greasing at six month intervals. It is not known whether any lubrication was carried out, albeit the windmill was checked regularly by an expatriate team member.

To evaluate the Wind Baron and windmills in general, one member of the evaluation team contacted members of the Water Operations and Maintenance Department of the Navajo Tribe and the Navajo tribe operates Wind Baron windmills as well as many other makes including Aeromotor. According to those responsible for windmill maintenance, the Wind Barons operate for several years and then begin to have serious problems. One of the most serious problems is twisted towers caused by gusts of wind against the large surface area of the fan. Though the fan is designed to shift out of high velocity winds, the shifting mechanism cannot respond rapidly enough to high velocity gusts.

There is no problem as far as the supply of spare parts for the Wind Barons. An alternative has, in the past, been Aeromotor windmills, but Aeromotor spare parts are now a problem, as the units are no longer manufactured in the United States. Spare parts come from FIASA in Argentina. It is the experience of the Navajo Tribe that cost of maintenance of Aeromotor windmills is high and the pumping rate low.

The Navajo Tribe is about to place its first order for hydraulic windmills which are very heavy duty units capable of pumping approximately 130 litres per minute in a 13 to 16 kilometer wind and able to withstand gusts up to 120 miles per hour.

## Likely Future Problems

### 1. Life Span of GMC Support Vehicles

Aid is required to purchase American equipment as a matter of law or regulation and is barred from purchasing from all 941 countries. As a result the Groundwater Project purchased a large number of GMC vehicles. These vehicles cannot be serviced in Somalia and local mechanics are unfamiliar with their service requirements. Spare parts are not available on the open market. Consequently, shortly after the termination of the project, the vehicles will be trashed the moment they need repair. The vehicles have automatic transmissions which are pleasant to drive over the rough roads of Somalia but which cannot be repaired. Driving in the hot climate and dusty roads of Somalia will result in eventual failure of the transmissions.

### 2. Failure of TH-60 Rigs

a) The TH-60 is a sophisticated rig. The engine, a Detroit Diesel 8V92TA, is a constant speed engine that runs flat out when drilling. One of the engines observed in Baidoa is covered with grease; it probably has leaking head gaskets and needs replacements. Major overhauls of both these power plants will be required, well before 12,000 hours of operation. The two rigs now have 2045 and 2185 hours on their engines. Each rig carries a 6-month warranty and they are clearly beyond their warranty period. There is no service for Detroit Diesel engines in Somalia; the nearest service is in Saudi Arabia. The nearest service for the International Harvester 5000 Paymaster carriers is either through International Harvester Overseas Company in Brussels, Belgium or through Lima Limited, the International Harvester distributer in Nairobi. In the event of servicing, either mechanics will have to be brought in or the engines removed and shipped to the nearest Detroit Service center. During this time, the rigs will be out of service unless spare engines are purchased. The engines will cost about $36,000 delivered by air in Somalia.

(b) The last hydraulic leveling jack hydraulic seal was installed on the TH-60's in Baidoa during week of May 11, 1986. Other jacks are developing leaks.

(c) The maintenance foreman will run out of additional spare parts.

(d) There is no steam cleaning equipment with which to clean the rigs on weekly basis.

DATA ANALYSIS

Well and Aquifer Testing Program

Numerous aquifer performance tests (APT's) were carried out by project hydrogeologist using project wells. It seems, however, that data were commonly collected by local personnel left at the site by the expatriate project hydrogeologist to collect data. The type of form used led to the contrivance of data in some cases and, therefore, unreliable test data. The data form was subsequently rectified and better quality data was obtained.

The APT data presented in LBII's End of Project Report is unconvincingly analysed and in some cases incorrectly analysed. Results given in Volume 5 of the End of Project Report, and results given in Table 4.1 of Volume 2 of the Phase I Final Report of March 1985 do not match as far as transmissivities and pumping rates. For example, the Sarman Dheere well has a transmissivity of 2,092 or 400 square meters per day depending on which report one chooses to believe. No type curves of any type are drawn on any of the plots of drawdown vs. time data. In the analyses of water-level recovery data, afterflow data are sometimes analysed. Afterflow data cannot be analysed.

In the case of the Quralow well the data are not analysable using the Jabob straight-line method. The methods of Hurr or Sternberg would probably have been more appropriate.

In the case of the Hareero Jiifo well, it is likely that the data analysed to obtain transmissivity were collected before casing unloading effects had passed and that the transmissivity is actually much higher than determined. Furthermore, the recovery data plot as a classic recovery curve for an inefficient well.

Could it be that the well was drilled with mud rotary methods and not adequately developed?

Recovery data from the Hobishole well show a classic case of recovery in an inefficient well also. The afterflow data have been incorrectly analysed. Data after a t/t' ratio of about 3 should have been analysed, as should drawdown data after about 100 minutes. It is likely in the case of this well, also, that casing unloading effects had not passed and that early drawdown data were incorrectly analysed.

The conclusion drawn is that, if local hydrogeologists were operating under the supervision of project hydrogeologists, their training was faulty; they were not trained in the wide variety of analytical methods necessary to adequately analyse pump test data collected under diverse hydrogeological conditions. The selection of analytical methods for analysis of APT data requires a thorough understanding of well hydraulics.

## Well Monitoring Program

Project personnel monitored water levels in selected wells and confirmed that recharge to the water table takes place within a short time of rainfall events. The rise in the water level may be 5 meters or more, indicating an effective planar recharge mechanism in the areas where the rapid rise in water levels was observed.

Though monitoring data were obtained, the team did not observe that they were on file as monitoring data except that they may be in the file for a particular well. No data base was observed for water level data.

## Groundwater Chemistry and Analytical Capabilities

The project did add considerably to the analytical capabilities of the WDA and it is understood staff training took place. The chemical analyses of water reviewed seemed quite good. Cation/anion balances which are used to determine the acceptability of an analyses have been calculated. This is sound procedure.

There are some problems in the reporting of the chemical data. Some of the chemical data given in the LBII/RM Phase I Final Report report have been reported under two different collection dates even though the analyses are identical. The chemical analysis of the Bonkay 3 well is an example.

In preparing maps of water quality, in the Central Rangelands area, the Stiff Diagrams for both the drilled and hand dug wells give no numerical indication as to water quality; they only convey a qualitative sense of water quality. Furthermore, there is no key which would relate the water source to the water quality. The way in which water data are plotted is commonly a matter of the personal choice of the hydrogeologist, but the plotting of groundwater chemistry should be done with specific reference to groundwater level contours and should be consistent with the direction of flow and reflect local anomalies, where they exist.

## COMPARISON WITH OTHER PROJECTS

### Tunisia

In Tunisa, AID is supporting the Central Tunisian Development Authority (CTDA) and has provided it with a TH-60 for provision of rural water supply to dispersed tribal population. The rig is operated by the Regie des Sondage for the CTDA, but it is under the control of the Service Hydraulique. Inflexible well construction methods are used and the rig is being misused in the construction of boreholes up to 17-inches in diameter by air rotary methods. Boreholes of this dimension destroy the rig and require three months to drill. One of the members of this evaluation team recommended purchasing an air hammer. The air hammer was purchased but was unused for at least one year (and may still be unused) because it was realized that with the air hammer a small diameter well, as envisioned in the PP, could be completed before the camp was set up - thereby putting camp support personnel out of work.

Water well construction rates and well costs are totally unacceptable in this project. Furthermore, there has been no attempt by USAID/Tunisia to strengthen the technical skills of the CTDA and other agencies or to compile data bases.

Burkina Faso

The objective of the Burkina Faso project was to construct up to 500 rural water supply points in the western part of Burkina Faso. AID purchased an Ingersoll Rand TH-60 for this project as well. The rig was moderately well maintained under the supervision of an expatriate mechanic and the rig was well supplied with spare parts. It was operated entirely by local drillers and well sites were located by an expatriate hydrogeologist working with a Burkinabe hydrogeologist trained in Mali. The project was under the supervision of DIMPEX, a contractor with no experience in water well construction. The contractor was working with the Service Hydraulique of the Government of Burkina Faso.

Despite the fact the drilling rig was out of service for about 8 months, because the main 8V92TA Detroit Diesel engine had trouble and had to be removed for repair, the project managed to construct nearly 500 wells during the five years of the project. The TH-60 observed in operation near Bobo Diolasso was drilling a well every two days to a depth of about 100 meters.

Despite the high production rate, DIMPEX received one of the most scathing mid-term evaluations ever given a water supply contractor, primarily for poor project organization and administration. Some of the criticism was likely justified but other criticism had to do with factors beyond the control of the contractor.

The great success of the project in terms of water supply systems installed, has been due to the competence and dedication of the Bobo Diolasso General Manager of the Service Hydraulique and his staff. It is also due to the clear organizational structure of the Service Hydraulique--with a drilling brigade, a well

completion and pump testing brigade, and a hand-dug well construction brigade. It is also due to the easy supply of fuel and material through Abidjan and the importance placed upon the project by the Government of Burkina Faso. The project was successful not because of the AID-funded contractor.

Zaire

The Zaire project is presently in its very early stages. It is a water supply project funded through church agencies in Zaire and involves, hand dug wells, gravity flow systems, infiltration galleries and other labor intensive approaches. Drilled wells were also planned and one of the members of this evaluation team was called upon to specify the drilling equipment. It was his conclusion that the drilled wells component should be dropped, because it would require a shift from labor intensive methods to capital intensive methods, which could lead to the use of the equipment for political purposes or as a source of illicit gain through the black market sale of materials and supplies. Government officials naturally have had no interest in the labor intensive methods, since these methods generate no capital. As a consequence, it is suspected that the project will do well.

DRILLING COMPANIES REGISTERED IN SOMALIA

Fratelli Murri Company
Box 418 Mogadishu
Paolu Murri Director
Garauldo Giorgio, General Manager
Tel 20293 Tlx 711

Juba Enterprises
Box 549, Magadishu
Tel 22238

National Drilling Company
Box 59, Mogadishu
Abdulla Mohamed Ahmed
Tel. 20460 (o)
20982 (h)

Horn of Africa Drilling
Box 931, Mogadishu
Ahmed Hashi Jama ("PeeWee")

Somali Drilling Company
Box 391, Hargeisa
Ahmed Yasir Omar Hashi, Manager
Tel. 2573

Kampihl
Box 2993, Mogadishu
Mr. Per Wengler, Admin and Financial Officer
Tel. 81983

Somali German Drilling and Windmill
Box 449, Hargeisa
Abdulkarin Ahmed Julaid, General Manager
Tel. 2888

# APPENDIX B

## EVALUATION OF THE SOCIAL COMPONENT

### INTRODUCTION

Evaluating programs or projects from an anthropological or sociological perspective differs little from any other AID evaluation procedure; the social component is often well integrated with other aspects of the program and as such, difficult to measure objectively or quantitatively. However, it has been shown again and again that, when social factors are ignored in program planning, the results are frequently negative and many of these programs fail or do not meet their objectives (cf. Casley and Lury 1982: 20-45). Basically the approach used here examines the objectives adopted prior to the project's undertaking, the assumptions underlying these objectives and the performance of the program.

In the Study at hand, the evaluation is directed to the performance of the LBII sociological team's work in the CGDP Groundwater Project: the focus is on the success (or lack thereof) of the Project team in integrating the support and participation of local communities into the groundwater development strategy. The results of these analyses of the performance of the Project, as shown in the main report, demonstrate that the reception of the program by these rural communities was quite mixed. Many of the areas of resistance to the WDA's intervention demonstrate inadequate groundwork and naive assumptions on the part of the WDA and LBII. There is also evidence that the previous managers of the WDA gave little more than "lip service" to the social component of the Groundwater Project and were content to allow the idea of a monitoring unit to wither on the vine, completely unsupported.

An apathetic attitude toward the social component is observed in other cooperating projects--notably the BRADP. Following the training of six field assistants in the United States, the three who returned were essentially dismissed. The result speak for themselves: at the present there is not a Somali who has been formally trained in the social sciences at work with any of the agencies involved with this study.

## SOCIAL ANALYSIS

Ideally, social analysis precedes any technical inputs, such as modification of the social infrastructure. These studies should be undertaken by an anthropologist or sociologist trained in interviewing techniques and data analysis in order to determine which aspects of the programs will be acceptable and which will not. General demographic aspects, along with cultural and economic features must be determined and given to the members of the team who have the responsibility for making the technical improvements.

### Social Analysis Background

The need to understand the social organization of local communities in rural water development projects was addressed in the original Project Paper (PP) of the Groundwater Project in 1979. In this document, the need to identify patterns of local leadership and initiate actions to encourage participation in the Project was noted and provision made for carrying out social analysis of rural communities. However, specific guidelines for securing the cooperation of local residents were not given nor were funds provided to establish a working relationship between the Project and the local populace. In fact, the social aspects of the project constituted only 1.8% of the total man months originally allotted.

This time was used for "social investigations", carried out by the LBII's first social scientist, Dr. Paula Roark. The socioeconomic report (Roark 1982) was a brief survey of the Bay

Region, which focused on four steps, termed the "Socioeconomic Data System (SEDS)" and comprised the following: data collection, field research, site selection procedures and evaluation program. This study was disappointing in several respects; it was a hasty survey which provided neither a complete data base for any one village nor a balanced overview of the Bay Region. It presented a confusing picture of agropastoralism in the Bay Region. Much of Roark's work focused on educational aspects, using a comparative approach with her earlier work in Upper Volta. The social organization of villages was treated quickly--with little consideration given to the organization of power and the relationships among various social units such as the WDA and others.

Data were, however, provided that allowed the design of the Tuulo (Village) Assessment and Participation Process (TVAPP) as a strategy for incorporating the local community into the well drilling program. This strategy was outlined in LBII's Inception Report for the project.

The notions of tuulo and buulo are introduced. The term tuulo may be glossed as a 'village'. The term buulo is glossed as a 'hamlet', and is seen to refer to a small residential unit linked to several others of similar size. It should be mentioned that this is a peculiar use of the term and is apparently characteristic only of the Bay region. In most other parts of Somalia, the term buulo is the generic term for a village or rural residential area. The difference between the buulo and tuulo patterns of residence is essentially one of size and is not really important. The other notion introduced is an extended political district termed a beel which has been glossed as a 'county'.

The TVAPP was basically a series of visits and interviews with the residents of rural communities in which project personnel explained the various steps involved in receiving a well and secured the involvement of the residents--who then provided food, labor for road construction, etc., as well as later paying fees for the water services.

The program was used in twelve villages in the Bay Region, using the assistance of personnel from the Bay Region Agricultural Development Project (BRADP) personnel. The initial reports of the TVAPP's utility were favorable and its reception by the local communities also seemed to be quite good.

The TVAPP was assessed by an LBII anthropologist, Dr. R. Shwartz, and by a USAID evaluation team which concluded that the strategy was essentially sound and reception by local residents had been largely favorable. The approach was recommended for additional support and guidelines were provided for its modification on an expanded scale. However, because of a lack of support from USAID, the Water Development Agency (WDA) and from the University of Wyoming sociological team working with the BRADP, the newer version of the TVAPP, the Community Assessment and Participation Program (CAPP) has only been briefly implemented. The lack of support may, in fact, have stemmed from an overly elaborate program having been proposed by LBII.

The Central Range area is markedly different from the Bay region. It is more arid and less populous. there are a greater number of pastoralists who herd their animals within a given range area termed a deegan. This area is usually under the authority of an extended kinship group who control the water and feed resources. The deegan are usually traditional areas and as such, are not registered under a single individual. the notion of family among transhumant pastoralists is quite fluid and varies from region to region in size and composition (cf. Lewis, 1961, 1969).

## Purposes of CAPP

The only purpose of the TVAPP and its later version, the CAPP, was to secure the cooperation and involvement of local communities in the process of obtaining groundwater resources. The Groundwater Project Paper Supplement (PPS) gave considerable support to the participation program and its personnel needs. The WDA was to be provided with the means of improving their capacity

to carry out these participation programs. The WDA agreed to "pursue solutions to the problems of hiring and retaining qualified individuals..." and to... "promote and facilitate community participation..." A new Planning Unit was called for and this entity was to include a full-time Somali sociologist and four sociological field assistants.

The work program for the sociological team included:

- Convening community meetings and training villages to sustain local participation in data collection, maintenance and operations, etc.

- Supporting village water committees to promote greater community participation in maintaining the water supply.

- Establish linkages between local residents and the social service agencies.

The WDA did not meet the requirement of the agreed-to covenant and did not hire a full-time sociologist or assistants. At the present time there is only one individual in the planning unit; he has no formal sociological training.

Assumptions Regarding Social Aspects

There were several assumptions made about the project. One, it was assumed that the WDA would obtain sufficient support from the Somali Government to permit the project to meet its objectives. It appears from the performance of the WDA in satisfying agreements involving the social component and others, that it may have simply been unable to work through the maze of bureaucratic pitfalls that prevented it from expediting imports of materials, obtaining fuel and supplies, and retaining the trained personnel needed to comply with the conditions stipulated in the project agreements. The WDA hardly stands alone in being incapacitated by an unwieldy and inefficient governmental system.

Another assumption was that, by training the WDA staff in the various technical aspects of the project activities, the staff would be incorporated into a continuing system to provide

services for the development of rural water resources. Unfortunately, turnovers in personnel, wage disincentives and organizational problems have jeopardized the results of training efforts.

In modifying the extent of local participation in project activities, it was assumed that the WDA would be able to obtain the personnel adequately trained to carry out the objectives. Also, it was assumed that the WDA personnel working within the local offices would be willing participants in these community efforts. Such was not the case.

It was also assumed that support from other institutions, e.g., the BRADP, the CRDP, etc., would be in place. These institutions have played a key role in the implementation of Groundwater Project activities. However, the extent to which other public sector institutions, e.g., the Ministry of Public Health, have responded is not known and only a minor effort was made to involve them.

Both USAID and the Consultant modified purposes and assumptions during the course of the project. In the case of the social component, much more emphasis was given in the PPS (1984) to community participation than was originally given in the PP (1979). It appears that LBII responded responsibly in the Inception Report (1981) by pointing out the necessity for greater community involvement.

## Other Social Considerations

There are three sources of groundwater in both the Bay and Central Rangeland regions: surface catchments, hand-dug wells and drilled wells. In the Bay region, almost every rural settlement, either tuulo or buulo, has and maintains a uar or water storage reservoir. These are usually owned by the community and are under the direction of a water committee who elect or appoint an overseer of the water; this individual is called an aawu, and his duties are to regulate the use of the water. (In

the Central rangelands where water is much scarcer than in the Bay region, the aawu may have the authority to use force to protect the water resources.)

The uar is constructed and maintained by the members of the community, who enjoy equal shares (or share proportionate to their input of labor) to the water contained in it. Water is generally held to be a gift from God and as such, the members of the community share and have comparable rights to it. Hence, the community labor efforts in maintaining the uar can be seen as a community tax. The uar, however, is a structure that stands on land that belongs to an individual; this may have some effect upon usage.

Communities often have reciprocal agreements with other nearby villages so that in times of scarcity, they can share the resources. Transhumants and itinerants who pass through the area on a regular basis may also share and provide labor or may pay a fee for the water use. Fighting or contaminating the water at the uar can provoke fines, imposed and collected by the aawu.

Water from the uars in the Central Rangelands is often fiercely protected and since there are rarely the same kind of reciprocal agreements among nomadic pastoralists regarding labor exchanges, water charges are often exacted from the uar users.

Wells are quite a different matter. A well is owned by an individual and the water is seen to be his to do with as he wishes. Hand dug wells are not as common as uars and there are considerably fewer problems in regulating their resources among members of the community.

Drilled wells are often reported by members of the communities as belonging to the government. Therefore, the community usually feels little obligation for their operation and maintenance. This attitude can be modified, however, as shown clearly in the reports by the LBII social scientists, where a significant difference between upkeep by villages who have gone through the TVAPP (and CAPP) procedures and those who have not is reported.

## CAPP APPROACH: THE MODEL AND ITS ASSUMPTIONS

It was assumed that the Groundwater Project would secure the cooperation of local communities in its well drilling, operating, and maintenance efforts. Water is always in high demand in an arid region and much of the thrust of the social investigations was directed at how to integrate and train rural residents in the use of the new wells.

### Framework for the CAPP

The initial description of the social organization of the rural communities made in Roark and the selection of the tuulo as the social unit upon which to focus was presented in Farah, Sartana and Roark (1983). The TVAPP program was aimed at involving local communities in the planning, construction and maintenance of wells and at using the same community resources to monitor and maintain records on the water use. Tuulo leaders were to be involved in Groundwater Project well construction activities through a series of three meetings in which it would be arranged for the community to provide services and goods to the drilling crews. The participation responsibilities for the tuulo were as follows:

1. Community assessment for information
2. Labor support for the actual installation of the boreholes
3. Local payment for the construction of the distribution system, and partial payment of recurring costs
4. Community management of the new water point through cooperation with the existing, locally selected, water management committees.

In Schwarz (1983), the TVAPP was changed to incorporate a more elaborate scheme of involvement and participation, and the focus was shifted from the tuulo (or village) level to a larger

community level. The three visits by WDA and Groundwater Project personnel was extended to a series of visits and involvement procedures.

The CAPP is given below. This program organizes water development at the community level into four stages of technical activities and village participation (See Figure). These are as follows:

- community orientation and assessment,
- drilling of boreholes,
- construction of civil works and pump installation,
- operation and maintenance.

Incorporated into these stages are information on local conditions, labor and materials for construction, the payment of users; fees, and the enforcement of management rules. The stages are as follows:

Community Assessment Stage

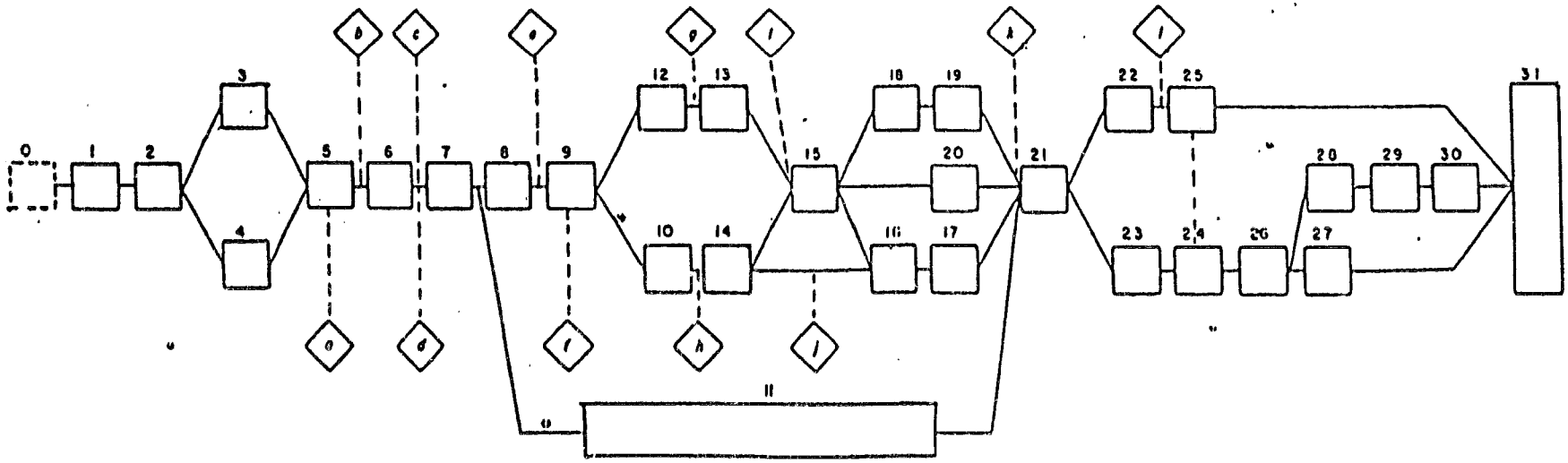
The objectives of this stage are to determine the extent of interest and to form a committee, if one does not already exist, to coordinate local participation. Meetings are programmed among village and local government personnel and coordinated by the community participation organizer, assisted by a WDA employee and other extension staff.

Drilling Stage

The objective is to make the necessary preparations for the borehole and pump installation. The community is to participate in selecting (or helping to select) the drilling site, electing local personnel to oversee the pump, nominating candidates for well operator training, and repairing roads or the construction site.

Construction Stage

The objective is to complete the water supply system. The local residents contribute labor and provide food for the workers. The WDA staff meets with the local leaders to devise a water management system plan and well operators are trained.



THE COMMUNITY ASSESSMENT AND PARTICIPATION PROGRAM (CAPP)

| COMMUNITY ORIENTATION AND ASSESSMENT STAGE | DRILLING STAGE | CONSTRUCTION STAGE | OPERATIONS AND MAINTENANCE STAGE | |
|---|---|---|---|---|
| Duration: 4-6 weeks | 8-16 weeks | 4-25 weeks | 52-61 weeks | Continuous |
| 0. Site Selection | 7. Third Community Meeting (Select of Drilling Site) | 15. Construction of Water distribution system begins | 27. Well Operation and Maintenance | |
| 1. Community Organization Meeting Organized | 8. Drill Site Prepared | 16. Pump Installed | 28. Project Monitoring (First year) | 29. Annual Joint Project Evaluation |
| 2. Community Orientation Meeting | 9. Well Drilled | 17. Pump Operators Trained | 29. Project Assessment Meetings | 29. Preparation of Annual Work Plan |
| 3. Socioeconomic Background Survey | 10. Pump Test | 18. Sixth Community Meeting (Water Management Plan) | 30. Well Operations and Maintenance | 30. Implementation of Annual Work Plan |
| 4. Joint Village Assessments | 11. Monitor Construction Activities (UL data) | 19. WDA Approval of Community Management Plan | 31. Evaluation Plans Developed | 31. Periodic Impact Evaluations |
| 5. Project Zone Baseline Profile | 12. Fourth Community Meeting | 20. Construction of Distribution System completed | 32. End of Year Impact Evaluation | |
| 6. Second Community Meeting | 13. Fifth Community Meeting | 21. Inauguration of Community Water System | | |
| Waiting Periods 1-13 weeks | 14. Preparation of Borehole | | | |

* This Plan focuses on community participation and evaluation. It is NOT a detailed plan for all technical and construction activities.

COMPLEMENTARY EVENTS ◇

a) Share findings with WDA technical staff.
b) Advise village of visit.
c) Determine when drill rig is available.
d) Waiting period 1 - 43 weeks.
e) Drill rig to site.
f) Test water quality.
g) Well committee and community meeting.
h) Construction materials to site.
i) Construction materials to site.
j) Pump to site.
k) Inauguration ceremony organized.
l) Health, education and other development activities organized.

Network Plan: CGDP Integrated Approach to Construction, Community Participation, Monitoring and Evaluation.

scientists did not direct any attention to how the various aspects and elements of the WDA interact and how the WDA related to the rural communities.

There are always several social factors at work in any large organization, and these should have been clarified. The Project was not well integrated within the WDA. There were different kinds of people in the agency who were suddenly working together, i.e., expatriate and WDA project personnel and other WDA personnel. Were there conflicts? Was a strategy evolved for dealing with potential problems? Also, what about the interests of WDA personnel and those of the rural communities? Somali Government personnel are horribly underpaid and very vulnerable to petty corruption. How were these problems dealt with?

b. Training

Training appears to have been carried out in basically, two ways. One was a series of formal training sessions, ranging from classroom instruction to seminars and the preparation of training manuals. The consultants were very active in this area, and much of the project effort was spent in formal training. The other way was on-the-job training, wherein individuals were taught by working in the actual task of drilling wells, repairing equipment or collecting data. It has been argued that one reason for the very high cost of individual wells was the emphasis placed on training during actual field operations, with a consequent drop in production rates and the use of additional procedures that would otherwise not have been carried out.

The social component of the Project included several formal and informal training sessions relating to the project's goals. Unfortunately, it is difficult to assess the immediate results, because there are no trained sociologists or field assistants in the WDA at this time, other than the chemist who has worked closely with the LBII social scientists and who is, functionally, a good field assistant.

c. Commodities

The principle commodity or physical resource that has been provided to the WDA under the social component has been a set of two computers and the training of personnel in their use. These are both personal computers, which seem adequate for their intended use by the WDA Planning Unit.

d. Direct Support

Direct support, in terms of operating costs for the social component of the Project, appears to have been quite adequate for the work that was carried out, though the more extensive program proposed by the Consultant was never approved or funded.

2. Somali Government Inputs

a. WDA Staff

The WDA has not been able to provide any of the other personnel requested or agreed to in previous project documents. The only member of the Planning Unit of the WDA is the chemist who worked with the LBII social scientists.

b. Support Facilities

The social component is housed in the Planning Unit facilities located in the WDA's central offices in Mogadishu. There are no special facilities required or provided in the outlying regions.

c. Staff from Bay Region Agricultural Development Project

For the social component, BRADP provided three enumerators, who had been working with the socioeconomic unit of the University of Wyoming's team. These enumerators were utilized as field assistants for a short time only and were then released. The loss of these trained people appears due to a lack of inter-

a very useful strategy if there were adequately trained personnel within the Planning Unit of the WDA.

No alternative to the CAPP was allowed for. The LBII social scientists proceeded with the understanding that the personnel and support necessary to implement this program would be forthcoming. One can hardly fault them for the inability of the WDA or the Somali Government to respond to their agreements, although, given the past performance of the WDA and other Somali institutions in these areas and given the absence in the country of trained social scientists necessary to carry out the program, it was overly optimistic on the part of USAID and the consultant to expect that they would be provided.

PROJECT IMPACT

Impact of the Groundwater Project on village lifeways is difficult to assess with any degree of precision. There is a lack of quantifiable data and the Project is still too recent to show any long-term effects. However, field visits to several villages show that the benefit of having water available is being enjoyed by a greater number of people in the Project areas.

Field visits were made to some seven villages in two trips. The Evaluation Team leader was present on both occasions. During the first field trip, the team was able to concentrate on the role of the WDA, its internal organization and the functional capacity of WDA's Baidoa regional office. The second field trip extended visits to four villages in the Bay Region where wells had been drilled by the Groundwater Project, with the view to observe how wells were functioning (albeit the field visits took place during the Gu or major rainy season), the support services given by the WDA, and the effectiveness of the CAPP.

Field visits were made only to villages in the Bay region. Inasmuch as the bulk of the Groundwater Project efforts have been expended in the Bay Region, it seemed reasonable to select field sites in that locale. Since visits were during the major rainy season, the availability of surface water was near

its peak and most wells were not in use. During the second visit, which concentrated on interviews with local water committees and village well operators, the procedures for water distribution and fee collection could be observed. Also, since visits took place during Ramadan, the pattern of water use was quite different than normal.

During the first visit, it was observed that the overwhelming majority of individuals drawing water from wells or surface sources were women. Water was generally transported incontainers carried on their backs. The donkey carts with tanks and other means of transporting water observed on other occasions, or in different regions of the country, were not observed. Several women reported that since the wells were drilled, their time spent in carrying water had been reduced considerably. One woman in particular reported that she used to spend four hours ever other day in fetching water and the time had been reduced to one hour. The shorter distance also permitted her to transport more water at a single time, which meant she could keep her household cleaner as well as increasing the overall amount of water consumed.

During the second visit, it was learned that members of the Water Committees are generally drawn from the existing village committees. Each Water Committee appears to be dominated by members from the village in which the well is located, though in most cases members of other villages using the well were also committee members.

Committee members generally reported that they were consulted on the location of the well prior to its drilling. Where the TVAPP procedures were followed ,however, committee members claimed they were not informed of the possibility that water may not be found. Indeed, they stated that the WDA's drillers told them that water would definitely be found. This was in direct conflict with the guidelines provided in the CAPP strategy

which required that communities be informed of the possibility of failure in order that they may decide whether to participate in the drilling program or not.

It was reported that villages participated in the well drilling and civil works construction by preparing roads, hiring and providing labor, food and other services to the drilling and construction crews. In the second visit, one village reported that its people also gave Sh. 30,000 to the drilling crew. Evidently, it is common to provide cash amounts of Somali Sh. 10,000 - 30,000 to the drilling crews.

Project guidelines provide for the nomination of well operators by the local water committee. In practice, however, it was reported that the civil works construction crew selected the operator from each village and this selection would then be confirmed by the Water Committee. In the village of Sarman Dheer the Water Committee vetoed the WDA choice for well operator, who also acts as fee collector, and were overruled by the WDA. It should be noted that people in Sarman Dheer voiced the most complaints about the disposal of water fees.

Information on well use was generally impressionistic, since the only records kept by village well operators that were observed were listings of people who are charged by the month for drawing water from the well. Well operators at the village sites were either unable or unwilling to give accurate estimates of well usage. While well operators were trained to keep records as part of their normal instruction in operation procedures, it appears that this practice has been impossible to enforce. Once project employee reported that the only way they were able to get a well operator to keep water records was to pay him an additional sum.

Well operators were trained in operation procedures during the period of civil works construction. These individuals reported having had three months on-site training in operation but none in repairs. All expressed interest in learning how to

effect minor repairs. These villages are located at some distance from Baidoa and one said he was attempting minor repairs on his own. The WDA suggested that it was possible to set up a program in the future, in which groups of well operators would be brought to Mogadishu for individual training in basic pump repairs.

Although the well operators are responsible for fee collection, they also hire others to assist in this task. One village reported that the fee collectors.were members of a well operator's family. Water charges are supposed to be standard at all wells, yet charges are considered high by the local population who use uar's during the dry season. Some of the villages collected monies on a per use basis while others established monthly accounts at a set fee for frequent users. Some well operators reported keeping no records of fees collected.

Part of the money collected from water fees goes to paying for fuel from the WDA. The reported prices varies from Somali Sh. 7,000 to 10,000 for 200 L of diesel fuel, which is considerably above the established government rates. Fuel was usually received the same day requested, albeit, in the event of regional shortages, a wait of three or four days was not unusual. A 200 L barrel of fuel usually lasts a week or two during the dry season, the period of peak use. Sarman Dheer reported operating the pump for abut 8 hours daily, using around 2 L of fuel per hour; Taflow operated 6 hours daily using 2.7 L per hour; and Hareero Jiifo 11 hours daily using 2.3 L per hour. Pumps were not run during the hottest part of the day and the water tanks were normally filled during the night. During the rainy season, the tank is filled only occasionally for those few who need water. The WDA reports that the rest of the money goes to it, though well operators reported keeping the remainder for their own use ("milk money"). In the absence of records it is impossible to determine the amounts of income from the wells.

# ANNEX

## CORRESPONDENCE BETWEEN UNIVERSITY OF WYOMING SOCIOLOGY DEPARTMENT AND PROJECT PERSONNEL

Bay Region Rural Development Project
Socio-Economic Study
P.O. Box 3315
Merica Hall, Rm. 320
University of Wyoming
Laramie, Wyoming 82071
307-766-4821

June 2, 1986

Dr. Frank Araujo
11 Dartmouth Place
Davis, CA 95616

Dear Frank,

Enclosed are the things I have with regard to Louis Berger and Ron Schwartz's request for supporting data from the Socioeconomic Baseline Study.

The first item is a letter from Roy Lock. He seemed to know what he was doing, and I wrote back almost immediately with a copy of the household survey and codebook, so he could indicate what data (variables) he wanted. I think I also indicated that I could pull the data off our CYBR to put a file on a set of PC disks compatible with their IBM-PC-XT, but that I hadn't done that at the time and might need a little time. I didn't hear back from Lock.

The second item is a letter from Levine, received in early August. He mentions Schwartz' interest in information. I responded with a 8/13 letter, the third item enclosed.

I didn't hear anything after that, until late February the next year. (UW - Julien's office received the telex on 2/17. I got it over a week later!) It responds to my letter to Levine six months earlier. The next day I received Ron's letter, enclosed, and contacted our Office of Research and talked to Roger Wilmot about Berger's request. He informed me that the work would have to be contracted through UW, and they would first need more formal authorization from Berger. Ron's word wasn't good enough to allow me/UW to proceed.

The telex sent from here on 2/27 requests this more binding authorization to do the work and be paid for it - through UW's Contracts and Grants Office (c/o Roger Wilmot). That's the last correspondence we had on the matter.

I am also enclosing Ron's draft of the information he was seeking. This is a cleaned-up version that was sent in February 1986 with Ron's letter to me. I had received a ~~hand~~ rough draft with Levine's letter the previous August, and that's refered to in my letter of 8/13 to Levine, on which I had estimated the time and cost of doing the work.

Hope this helps to clear the air. Really, I would have loved to help Ron out, and could have used the money. But, by late February his work was nearly due and I assumed there wasn't time, given my schedule that wouldn't let me get to it till Spring Break (April 7), as I indicated in my 2/27 telex. I wish we could have worked out the details in early fall, and there would have been no problem getting the work done.

Scott

Roy Lock/Louis Berger Int'l, Inc.,
American Embassy Mogadishu,
Agency for International Development,
Washington DC 20523.

Prof. Garth Massey,
Dept. of Sociology,
University of Wyoming,
Laramie, Wyoming.

Date: April 21, 1985.

Dear Professor Massey,

I have just started a one-year contract in Somalia with Louis Berger Int'l on the Comprehensive Groundwater Development Project. My specific task is to help establish a Planning Unit for the Water Development Agency. Part of this work involves setting up a computerised database of hydrogeological and socio-economic data for the whole country. Some concentration of effort will obviously go into collecting data on the GCDP area of operations, which, as you know, includes the Bay region.

I am therefore most interested in - and most grateful for - the work your team has done in producing the Socioeconomic Baseline Study of the Bay Region. I look forward to its final approval (or whatever is holding it up) so that I may have my own copy and not keep having to bother USAID to "borrow" theirs.

The report has proved very useful to me, as a newcomer to Somalia, in understanding something of the Bay region and how the system works. In terms of setting up a database here at WDA, however, I really need access to your raw data - or some of it, at least.

I understand that Mike Martin is here for five months at Baidoa, and has "some of the data" with him for use on his Osborne computer. I have not yet been able to contact him, but intend to do so as soon as possible. I also understand - from Bernie Kolp - that since his concern is mainly in agricultural economics, he may not have what I need. I am still anxious to meet him, and hope that we can be of some help to each other.

The equipment we have here at WDA consists of an Osborne (which is really the property of LBII) and a COMPAQ. This is to be supplemented in August by an IBM PC-XT (256K) + 384K. The COMPAQ is fully IBM compatible and we are using DBASE III and SYMPHONY software. On order is the PC version of SPSS, which, you say, was the package used for most of the analysis at Wyoming. What I would eventually like is for you to send me selected portions of this data on diskette.

Initially, could you please let me have an idea of what data is held in what form, so that I may be selective in what I request: and, indeed, if you are willing and able to provide me with the data in the form I can use.

I look forward to hearing from you, and thank you in advance for any help you might be able to offer.

Yours sincerely,

Roy Lock

Roy J. Lock.

Replied w/? what parts needed - indeed his whole collection

THE UNIVERSITY OF WYOMING
DEPARTMENT OF SOCIOLOGY
UNIVERSITY STATION, BOX 3293
LARAMIE, WYOMING 82071

August 13, 1985

Robert Levine, Chief of Party
Wyoming Team
USAID/Mogadishu
Department of State
Washington, DC 20523

Dear Bob,

I Received your letter and materials from Ron Schwartz this week. Thanks for your kind remarks about the Baseline Study Report. Of course, I'd be interested in your observations in the months ahead, as you come to find out that things may be different than we have written. I hope the report is useful in planning your own work.

As Ron has probably told you, we spent about ten days together in Baidoa on a previous consultancy, Ron living with Sheila and I at the AID guesthouse in Baidoa andtraveling together to some villages. Ron also worked with our team of interviewers for a few days, learning about water in the region.

I would be happy to help Ron with the information he is seeking, but his list of questions and the things he'd like to do with the data require quite alot of time and work. As you know, the data set we collected in the Bay Region belongs to AID as well as the University of Wyoming. I have offered to make the raw data available to USAID-in whatever form they'd like it, but so far I've had no takers.

I think it makes the most sense for me to offer to do whatever additional (beyond the Baseline Study Report) analysis AID, World Bank or whoever desires, on a consulting basis. I estimate that I'd need about ten working days to do everything Ron is requesting, with computer time costing about $600 and an indirect cost rate of 39%, since I'd be using campus facilities.

If USAID has other things they'd like me to do, in the way of analysis, that can be arranged in the same way. If they will tell me what they want done, I can give them a cost estimate and they can send me a contract to do the work.

By the way, this doesn't apply to you or to others on the Wyoming Team. If there are things you'd like to see from the data, let me know and I'll do what I can to get you the information.

The six young Somali's who have been in the Applied Social Research Program here will return to Somalia at the end of this month. I expect most of them to return to Baidoa, and one will return to NMEF at the Ministry of Planning. They've had a good year, and an especially good summer in their courses on project design and evaluation. I'll miss them, but not the incredible amount of time the Program has taken from my other work.

I'll be writing a proposal for continued social research to accompany the technical assistance in the Bay Project, at Warsame's request last spring, and may be in Baidoa around or after Christmas for a few weeks. Basically, Warsame wants someone to direct and evaluate the work of the Monitering and Evaluation team of BRADP (the young men who have been at UW for social research training this past year). It's a good opportunity to conduct some long-term research, and with the work that's already been done it's a good opportunity to really have some information that can be useful.

Mike Martin stopped by my office yesterday. Sounds like he had a very successful tour in the Bay Region. His Plan B hearing is Friday, and I'm looking forward to that.

I hope all of you are making the adjustments to life in Baidoa well. You've gone over at a good time, weather-wise. Mike said the Gu rains were plentiful, so in addition to the good harvests of the previous two seasons things should be in pretty good shape.

Give my regards to the people on the project. Was good to hear from you.

Best regards,

Garth

Garth Massey
Associate Professor

CLEAR (Y/N/R)
Y
COMMAND

DW CID LRME

DW CID LRME
D
732 GULHOTEL SM1

RECEIVED FEB 17 1986

MSGE NOO. 81
ATTN: G MASSEY
FROM: R. SCHWARZ
DATE: FEB 17, 1986

AA. LOUIS BERGER INTERNATIONAL, INC.. CGDP WOULD LIKE TO CONTRACT WITH #YOU TO PROVIDE DATA FROM THE BAJ G M SOCIOECONOMIC ST UDY. YOU INDICATED IN YOUR AUGUST 13. 1985 LETTER TO DR. LEVINE THAT YOU WOULD NEED ABOUT 10 DAYS OF YOUR TIME. USD 600 IN COMPUTER COSTS AND A 39 PERCENT INDIRECT COST FEE TO PROVIDE DATA SPECIFIED IN THE DOCUMENT PREPARED BY DR. SCHWARZ: DATA REQUEST FROM STUMING STUDY.

B. WE ARE ESTIMAGTING AT 4500 FOR THIS WORK WITH FOLLOWING CONDITIONS:
(1) THE WORK IS PRESENTED IN THE FORMAT OUTLINED IN THE SCHWARZ DOCUMENT. INCLUDING ANSWERS TO QUESTIONS WHEN POSSIBLE.
(2) THE WORK IS COMPLETED AND DISPATCHED TO:
LOUIS BERGER INTERNATIONAL
P O BOX 2954
MOGADISHU, SOMALIA.

VIA DHL COURIER SERVICE NO LATER THAN MARCH 10, 1986.
(3) YOU PRESENT US WITH AN ITEMIZED BILL WHICH INDICATES COSTS OF PROFESSIONAL SERVICES, COMPUTER TIME. SUPPLIES MAILING AND OTHER DIRECT EXPENDITURES.

CC. A COPY OF THIS TELEX AND SCHWARZ DOCUMENT TO BE SENT TO YOU VIA DHL.
DD. PLEASE ADVISE ASAP YOUR ACCEPTANCE/REJECTION OF OFFER.

REGARDS
R. SCHWARZ

DW CID LRME

COPY FROM TELEX I OR IY (TWX) DIA1L00 FROM EASYLINK USE /WUW.
1504 FEB/17/1986

COMMAND

Best Available Copy

Glad to have gotten a copy of your final report. It pulls a lot of information together and you've obviously generated a large data base others will be able to use.

We obviously have other needs for the data which is why I wrote up the ~~the~~ request.. I was told before leaving Somalia in late August that AID wanted to follow up ~~and~~ & that I shouldn't pursue it independantly. I've been in Africa & France for the past few months and expected to have the ~~data~~ when I returned here.- I understand the work involved and have done what I can to get funds released to pay you. - ~~The data~~ We can make immediate use of the information to provide baseline files and ~~and~~ realistic monitoring/evaluation strategy for WDA/BRADP staff.

I hope you can fullfill the request and that we will get a chance to make use of the data you collected. - I'd also appreciate copies of additional reports/articles you have produced on the Bay Region.- ~~Be~~

Best wishes to Sheila and the Glascocks. —

Abrazos,

Ron S.

(Could you post the enclosed letter

999732+
UW CID LRME

0037195 EST 1502 FEB/27/1986
X
732 GULHOTEL SM
U CID LRME
FEBRUARY 27, 1986
LARAMIE, WYOMING USA

#455

ATTN: RON SCHWARTZ, LBI
FROM: G. MASSEY
DATE: FEB. 27, 1986
RE: REQUEST FOR ANALYSIS OF BASELINE STUDY DATA

PRIOR COMMITMENTS REQUIRE AN APRIL 7 (POSTMARKED) DEADLINE, RATHER THAN MARCH 10.

BEFORE PROCEEDING, LBI MUST SEND AUTHORIZING LETTER OF AGREEMENT TO ROGER WILMOT, RESEARCH OFFICE, U. OF WYOMING, LARAMIE, WY 82071 TO ASSURE PAYMENT. LETTER SHOULD CONTAIN TERMS OF FEB. 17 TELEX AND REVISED COMPLETION DATE.

BEST REGARDS,
DR. MASSEY
SOCIOLOGY DEPT.
UNIVERSITY OF WYOMING

732 GULHOTEL SM....
001.9 MINS

COMMAND

Best Available Copy

# DATA REQUEST FROM WYOMING STUDY

Data on villages in the Bay Region is needed to organize and implement an evaluation of water development projects and to establish a monitoring system. In view of the fact AID will soon conduct a water resource survey which could lead to additional Bay Region Projects, data on all villages surveyed would be welcomed. For items where this is not possible, then data at the beel and/or ecological zone level would be appreciated.

It would be useful to have detailed data for the villages with WDA wells (see appendix "A"). In addition, we request Wyoming's assistance in the selection of villages and beels without WDA wells in each ecological zone which could be used as control groups, and baseline data for each of these. The lists below follow the general organization of data in the socioeconomic Baseline Survey. Since many topics are discussed in several sections of the report, the format below shows some redundancy.

We recognize that Wyoming may not have all data requested and that village level data is available for only a limited number of items.

## IDENTIFICATION DATA

1.0. Beel

2.0. Tuulo

3.0. Buulo (village)

4.0. Date survey completed

5.0. Ecological Zone:

- 5.1. High cropping
- 5.2. Potential
- 5.3. Low cropping.

NOTE: Sketch maps of villages in each zone showing land use, settlement patterns, roads, water resources, schools etc. would be useful (1 or 2 for each zone).

6.0. Social Mapping Indicator (section: 2.3.2.)*

6.1. Dooy

6.2. Jabaay

6.3. Dhoybey

6.4. Jirr

6.5. Moolimad

6.6. Bay

6.7. Buur

6.8. Etc.

7.0. Water Resources (section 2.3.3.)

The methods section (1.3. and 1.8.) and the statistical information in sections 2.3.3.b and 2.3.3.c indicate that water resource data was collected in all 80 sample villages. The Planning Unit could make immediate use of this data particularly if it is provided for each village or beel. The chart below is based on our analysis of data which you would have collected in the field. Please view it at as suggestive and we would welcome the village level data in any format convenient to you. In addition, we would like to have the detailed results - quantitative data at the village or beel level - of your water point survey.

---

- *Section numbers in parentheses refer to sections in the SE Baseline study unless otherwise noted.

CHART 1. VILLAGE LEVEL WATER DATA

| Source | Distance from village | Seasonal availability | | | | Uses | | |
|---|---|---|---|---|---|---|---|---|
| | | Gu | Hagaa | Dayr | Jilaal | Domestic | Sheep, goats, | Cattle Camels |
| WDA Diesel Pump well<br>1.<br>2. | | | | | | | | |
| WDA Hand pump well.<br>1.<br>2. | | | | | | | | |
| Hand Dug wells*<br>1.<br>2.<br>3.<br>4.<br>5.<br>6.<br>7. | | | | | | | | |
| Waro<br>1.<br>2.<br>3. | | | | | | | | |
| Spring<br>1.<br>2.<br>3. | | | | | | | | |
| Other<br>1.<br>2. | | | | | | | | |

*If well has a hand-pump indicate with (HP).

Any additional comments on water issues in each village - supply problems, water quality, WDA management etc. - would be welcomed along with quantitative and descriptive information on water use at each site.

8.0. POPULATION (2.4.2.)

The summary Tables 1 and 2 are extremely useful. If possible we would like village or beel level data for those in the sample, particularly those villages listed in Appendix A and those you recommend for the control group.

9.0. MIGRATION (2.6.)

Migration data (Table 20 and 21 formats) for Appendix A and control villages. Migration data aggregated for beels and/or ecological zones.

10.0. VILLAGE SERVICES (2.7.2.)

An important item for WDA since infrastructure and service are important indicators linked to the availability of water resources. We would like infrastructure data on all villages/beels in the sample organized if possible, into a table similar to that in Table 24, (P. 146).

11.0. VILLAGE ORGANIZATION (2.7.3. - 2.7.5.)

This is an item we could use some help with. Your sections indicate a variety of positions and committees which could be used on a checklist. We need data for the sample villages and the names of committees and/or positions which could be added to the list.

## VILLAGE LEVEL CHECKLIST

| Positions | | Organizations | |
|---|---|---|---|
| Guddoomiye | _____ | Guddi-Sare | _____ |
| Nabadoon | _____ | Guddi-Hoosaad | _____ |
| Samadoon | _____ | Akhyaarta | _____ |
| | | Women's Committe | _____ |
| Other Positions (Development Related) | | Water Committee | _____ |
| _____ | | War | _____ |
| _____ | | Wells | _____ |
| _____ | | | _____ |
| _____ | | Others | |
| | | _____ | |
| | | _____ | |
| | | _____ | |

12.0. SCHOOLS AND LITERACY (2.8.)

Data from socioeconomic study broken down by villages or beels but not by age cohort. (Reference - Tables 24, 25 and 26).

13.0. HEALTH (2.9.)

13.1. Epidemiology

Village and/or beel level data on the frequency and distribution of diseases (2.9.1., 2.9.2.) and disease demographics (2.9.3.).

13.2. Health Infrastructure/Utilization

It is difficult to tell from the report how much village/beel level information you have on this topic. Village/beel level information useful to the Planning Unit includes:

Primary Health Center in Village/beel? Yes No

Distance to closest one _____

Pharmacy: in village: Yes No

Distance to closest one _____

Trained midwife resident in village: Yes No

Store in village which sells western medicines: Yes No

14.0. DIVISION OF LABOR (3.1., Table 28)

Data from table 28 by beel, ecological zone and for the villages in appendix A and control villages.

14.1. Women's Activities (Section 3.2.)

Quantitative data on time allocation for women's activities. Our interest would be to have this data from villages with no permanent year round water source and from others which do. Any information which would indicate the amount of time women and others spend on water gathering (per week/month/season/-year) would be particularly useful.

Identification of villages or beels where women required 3 days to get water during the Jilaal season?. Your report notes 2 days travel and one day wait to get water for some women during the Jilaal season. Estimates of number (or percentage) of women involved in these trips and the number they made last year (or during a "normal" year)?. What are the womens' views/ mens' views/ Wyoming staff views/ on how the addition of a permanent well would (did?) affect the activities of men and women?.

15.0. WAGE AND BUSINESS EMPLOYMENT (3.4.)

Answer for: Beels in the sample (statistical summary) and for Appendix A and control villages if possible.

15.1. Wage labor

| | On Farm | | Non Farm | |
|---|---|---|---|---|
| | Males | Females | Males | Females |
| 1. Persons working full time for wages | | | | |
| 2. " " part " " | | | | |
| 3. Persons working for wages outside of village | | | | |

5.2. Business/Trading

| | Part time | | Full time | |
|---|---|---|---|---|
| | Males | Females | Males | Females |
| 1. Number of shopkeepers | | | | |
| 2. Number of traders | | | | |

15.3. Number of residents who own businesses located outside of the village:

Males_____ Females_____

16.0. Farming and CROP Production (4.0)

Needed: Production data for Appendix A and control villages. Summaries of production data by beel and ecological zones. We realize quantitative data on this will not be complete for all crops but we would like summaries of available information to get some idea of the volume of production for major crops, land use, farm size, numbers of farms and technology for each ecological zone and, if possible, beels, ~~and~~ Appendix A and control villages.

16.1. Crops Grown in the Bay Region (Sections 4.1. - 4.6.)

For each crop: (Break up sorghum data into the major varieties).

(i) Crop

(ii) Percentage of goys cultivating each crop (in sample villages, beels, ecological zones).

(iii) Average yield/hectare data for major crops. You present data on sorghum yields (Table 33) and if you have it we would like similar data on other major crops and the yield data broken down for beels and ecological zones.

(v) The number and percentage of goys involved in irrigated agriculture (4.1.7);

(vi) The average area of irrigated land cultivated by each goy (for those goys involved in this activity).

(vii) Types of crops grown on irrigated land and the percentage of "farms" in which they are cultivated.

16.2. Agricultural Technology

Percentage of goys in each beel and ecological zone which use the technology/modern inputs listed below:

(i) Animal traction _____

(ii) Chemical Fertilizer _____

(iii) Pesticides _____

(iv) Improved seed varieties _____

(v) Milling Machines _____

(vi) Medical supplies/ drugs, related to animal health _____

(vii) Others (List): _____

_____

16.3. Land Sales (4.2.3.)

Any quantitative information you have about the frequency of sales and land values in different villages, beels and ecological zones.

16.4. Loaned and Rented Land (4.2.6.)

(i) The percentage of qoys with hoorsi arrangements in each beel and ecological zone.

(ii) The percentage of qoys renting land (doongad) in each beel and ecological zone.

16.5. Amount of Land Under Cultivation (4.2.7)

You estimate that an average qoy (5.84 persons) cultivates 1.93 hectares. The questions we have are:

(i) We assume the 1.93 ha. figure refers to the amount of land actually cultivated in a single year by an average family. Is this correct?_____

(ii) What is your estimate of the area of cultivable land controlled by a Qoys that is left fallow each year?

(iii) Are the figures cited in the answers to (a) and (b) the same in each cropping zone?_____. If there are differences:

(iv) Could you estimate these for each ecological zone for an average family.

LAND USE DURING A YEAR

| Zone | Average Size of Qoy | Under Cultivation | Fallow | Total |
|---|---|---|---|---|
| High Cropping | | | | |
| Potential | | | | |
| Low Cropping | | | | |

16.6. Number of "farms" per qoy. (4.2.7) Beel level data and if possible, Village level data for Appendix A and Control Villages.

(i) Farms in the sample villages, beels and ecological zones:

Number and percentage of Families with 0 Farms? _____

Number and percentage of Families with 1 Farm ? _____

Number and percentage of Families with 2 Farms? _____

Number and percentage of Families with 3 Farms? _____

Number and percentage of Families with 4 or more Farms? _____

(ii) Farms in other villages (Data for sample villages, beels and ecological)

| Number and percentage of families with: | Number | % |
|---|---|---|
| 1 Farm in another village? | | |
| 2 Farms in another village? | | |
| 3 or more farms in another village? | | |

11. Farm ownership by women (4.29) Beel level and for Appendix A and control villages.

17.0. AVAILABILITY OF LABOR (4.3)

Data from Table 31 for villages in Appendix "A" and control villages and/or by beel.

18.0. CROP YIELDS (4.5)

Harvest data (Table 33) for Appendix A and control villages and/or by beel or ecological zone.

Obstacles to increased production (4.6)

Is water scarcity a problem in all villages or is this cited less frequently in villages with WDA and/or wars with permanent water supply?

Does your data allow you to rank the importance of the obstacles, from the perspective of the populations for:

- The region as a whole?
- Within each ecological zone
- Among beels?

If this information is available, the Planning Unit could make use of it

19.0. CROP PROBLEMS

Variations in type and severity of problems by beel or ecological zone.

20.0. ROADS AND TRANSPORTATION (4.6.4.) (for all villages for at least appendix A and control villages).

| Village | No Passable road | Distance to dry season road | Distance to main road | Distance to Baidoa | Regular Bus/Truck Service Daily/Weekly |
|---|---|---|---|---|---|
| 1. | | | | | |
| 2. | | | | | |
| 3. | | | | | |
| 4. | | | | | |
| Etc. | | | | | |

21.0. HERDING AND LIVESTOCK PRODUCTION (5.0)

Again, while we would like this data for WDA Project villages, it does not appear that this data is available. For our purposes tables 36, 37, 39, and 40 organized by beels would be sufficient. The breakdown into age cohorts is not necessary.

22.0. WATERING REQUIREMENTS (5.3.3)

Additional quantitative data on this would be useful. Data on ~~actual~~ seasonal watering behavior for different animals .

23.0. COMMERCIAL ACTIVITIES (6.0.)
MARKETING AND MONETIZATION (6.1)

Would like to have Wyoming suggestions for key indicators to measure and monitor the monetization of village economies. We expect that improvements in water supply will provide time, particularly for women, to engage in small scale production and marketing. For example, using your study as baseline: the purchase and sale of mats, ropes and haans would indicate change along with the sale of animals. Which items might be key indicators?

## 24.0. SALE OF ANIMALS

Beel, and/or ecological zone data. We are interested in establishing rough norms for volume of sales for villages, beels and ecological zones.

### 24.1. Marketing Sorghum (6.2.)

Beel level data - Categories listed are suggestive and base on an interpretation of text material (V. 2. P. 160).

| | Marketing Pattern (for Sorghum) | | | |
|---|---|---|---|---|
| Name of Beel | Never Marketed | Rarely | Regularly by some households | Regularly by most households |
| 1. | | | | |
| 2. | | | | |
| etc. | | | | |

### 24.2. Marketing of other Crops (6.3.)/Irrigation

Village/beel level data (Yes / No)

| Beel | Crops Marketed | | | Irrigated Crop Production |
|---|---|---|---|---|
| | Peanuts | Cowpeas | Maize | |
| 1. | | | | |
| 2. | | | | |
| etc. | | | | |

24.3. Other Products Marketed (6.4.2.)

Beel level data

| Beel | Number of Items marketed | | Percent of Qoys Marketing | |
|---|---|---|---|---|
| | Male | Female | 1 or 2 items | more than 2 items |
| 1. | | | | |
| 2. | | | | |
| 3. | | | | |
| etc. | | | | |

25.0. LIVESTOCK SALES (6.7.3.)

Beel level data for table 52.

25.1. Changing Husbandry Techniques (6.8.)

Your data suggests delayed breeding and castration may be viewed (with some qualifications) as indicators of more market-oriented strategies. Would these be reasonable questions to ask in group meetings or would you suggest another approach?

25.2. Traders (6.9.1.)

Estimate of the number of livestock traders in the region?

26.0. PROJECT IMPLEMENTATION RECOMMENDATIONS

26.1. Environmental Issues

Do you have any evidence to suggest that increased water resources might lead to increased herd size and possibly contribute to environmental degradation (anything to question the findings in the Hunting report)?