

BAY REGION AGRICULTURAL DEVELOPMENT PROJECT

649-0113

MOGADISHU, SOMALIA

FINAL EVALUATION

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DR. ROBERT W. DUELL, TEAM LEADER CONSULTANT RUTGERS UNIVERSITY

MR. RAY FOX, USAID, MOGADISHU, SOMALIA

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ACRONYMS AND ABBREVIATIONS

ADF	Africa Development Fund
AFMET	Agricultural Farm Management, Extension and Training
AID	Agency For International Development
BRADP	Bay Region Agricultural Development Project
BRS	Bonka Research Station
CGWDP	Comprehensive Groundwater Development Project
cm	Centimeter
DAP	Diammonium Phosphate
FEA	Field Extension Agent
GSDP	Government of the Somalia Democratic Republic
ha	Hectare
IFAD	International Fund For Agricultural Development
kg	Kilogram
m	Meter
MLFP	Ministry of Livestock, Forestry and Range
mm	Millimeter
MOA	Ministry of Agriculture
P	Phosphorus
PADU	Pilot Agricultural Development Unit
PMU	Project Management Unit
SAFGHAD	Semiarid Food Grain Research and Development Project
USAID	United States Agency For International Development

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EXECUTIVE SUMMARY

END OF CONTRACT EVALUATION OF THE
BAY REGION AGRICULTURAL DEVELOPMENT PROJECT, SOMALIA

May 31, 1988

1. The purpose of the project is to assist the GSDR in achieving self-sufficiency in food production. The obvious constraints are the dry climate and the low technical status of agricultural operations. The less obvious constraints are the low contents of phosphorous and nitrogen in local soils, the lack of potentially high yielding crops, and the difficulties in remediating the problems.

The project, quite rightly, proposed remediation by improving production of the nation's chief dryland grain crop, sorghum, and to deal simultaneously with related constraints in a logically holistic fashion, recognizing the need to develop professional, personnel, agricultural institutions, and community infrastructures, specifically water supply and roads.

2. The evaluation was undertaken at this time because the USAID Project Officer was packing to leave, and the end of the Wyoming contract was three months away. The purpose of the evaluation was to ascertain the extent to which the project had succeeded and to establish substantiation and recommendations pertinent to this and future efforts.

The team of evaluators was numerically less than prescribed, consisting of an agronomist, a local AID economist, and very briefly, a new member of the Planning Unit of the Ministry of Agriculture. The procedure was to visit the Bay Region headquarters which consists of the Bonka Station just out of the town of Baidoa and the Project Management Unit in Baidoa. The evaluation team visited the section leaders, noted their oral reports, saw their field work and supporting facilities, traveled the recently constructed roads and "Irish crossings" (stone and concrete passages across intermittent water ways), and inspected a well-site with troughs and community water facilities. Written reports were obtained from distant past and recent project related activities, the latter were both voluminous and illuminating, particularly from the soil and crop-related section leaders.

Questions were asked of all project-related persons encountered enroute and answers were freely and frankly given. Quantitative assessment of impact of the project/achievement of goals, however, was hampered by a general dearth of baseline information.

3. A two-volume Socioeconomic Baseline Study of the Bay Region was published by a four-man team of sociologists and anthropologists from the University of Wyoming in December 1964, but quantification of crop, soil and livestock data and pertinent market information could not be retrieved even by University of Wyoming personnel. Hence a revised effort was begun a year ago to develop appropriate baseline data via a weekly and a more extensive semiannual systematic questionnaires. These data were found to be appropriate and informative. Their collection, involving the Extension Service, should prove educational to all concerned and the interpreted data will lend guidance to project researchers, the Ministry of Planning, other Ministries, the Extension Service, AID, etc.

The disappointment of the late start of the project was compounded by the total lack of results including lack of written reports, from the largest section of the agricultural component, specifically, that dealing with sorghum improvement which was to be the prime impact. This deficiency appears to have been rectified by new leadership, and positive contributions can be expected to accrue from impacts by the Wyoming Contract personnel in collaboration with the Somali staff at Bonka.

The facilities, including land, buildings and equipment at Bonka, are impressive in extent and quality. They indicate potential, if activities continue at the present rate, and quality. This implies maintenance and growth including the application of advanced education and on-the-job training of Somali candidates.

A major assumption, previously held, was that low rainfall was a prime constraint to agricultural production. There is evidence that soil phosphorous, or phosphorous plus nitrogen, is also a constraint that may exceed that of moisture, in certain situations, depending on which is the most limiting factor. Pest control, including insects and diseases, is recognized as a constraint, but weed control and its drain on labor should be acknowledged as the greater concern in this category.

The labor constraint could be alleviated by wider adaptation of animal traction with appropriate equipment. The practicality of using animal power in the fields requires, in addition to implements and harnesses, quality forage and even grain feeding to provide energy for full realization of their work potential. Progress in forage research in the project is, unfortunately, limited to the introduction of leucaena and promising observations from several non-replicated plantings.

Research trials involving rows of leucaena as windbreaks in crop areas are herein recommended, as is initiation of replicated trials in comparison with other grass and legume forage species for grazing, green-chop and hay production for meat, milk and draft animals.

The release of a mung bean variety by the Legumes and Oil Grains section was noted as an early achievement. It has had widespread farmer acceptance and is a contribution to food production and quality. Actually, mung bean is presently a minor crop, and its selection may be viewed as a "lucky find". Little research data on its superiority are available. It does, however, contribute to morale-building, and should not be belittled in any way.

A more stimulating announcement of a soybean producing 2,150 kg/ha (approximating yields of the southeastern U.S.) was, unfortunately, not reproducible. Soybean yields have not exceeded 800 kg/ha in trials since then. Lack of proper inoculum was cited as an explanation. There is potential here that should be pursued.

The decision to void the range management study appears justifiable in view of the scope of work relative to the resources. However, a basically important aspect was thereby eliminated, namely that of monitoring the impact of livestock on the vegetative cover of the land. Brush, utilized as browse by all classes of livestock, dominates the nation. Overgrazing will eliminate desirable plant species; grasses and herbacious legumes are already insufficient. Installation of wells for livestock has led to desertification in other parts of Africa (especially the Sahel). Hence the impact of project wells and wars on vegetative cover should have been monitored. It would be advisable to start now.

The agreed-upon number of wells and appurtenances plus wars has reportedly been completed. Only one well was actually seen. It is hoped that GSDR will now maintain them.

The objectives of construction of an agreed-upon length of all weather roads as modified in the mid-term review have been met, and agricultural production has expanded into areas made more accessible by them. AID should make continuous efforts to remind GSDR of the importance of their maintenance.

Commitments to the veterinary Services appear to have been met. Commitments to long-term training have been exceeded. A base figure for short-term training was not found, but appears to be substantial. An evaluation of the efficiency is not presently possible. Time will tell.

4. A fine facility, well planned and furnished, has been developed at Bonka. Present research leadership is primarily in the hands of expatriates. The collaborative staff of Somalis is young and inexperienced; only a few have returned from an advanced degree as much as a year ago. There is concern that withdrawal of AID support at this stage of development would impair further progress and realization of goal-achievement. It is therefore recommended that support be continued at the present level for at least another two years and withdrawn, to be replaced by the GSDR, incrementally over the next five years.
5. The oldest and hardest lesson to learn relates to the diligence and time required to monitor the details of procurement and affect agreements so as to stay within the time frame of an agreement involving nations and multiple donors. This is merely a statement of understanding and obviously not a helpful lesson.

A prime concern with project design lies in the failure to develop a data base at the very beginning of the project.

A secondary concern involves the lack of a means of ensuring that training participants will return to work in Somalia in the capacity for which they have received training, advanced education and financial support to help their nation and their people. A 75% return is not acceptable.

6. The goal of increased food production via identifying improved varieties of sorghum or introducing improved agronomic techniques such as seed treatment, or increasing production by using animal traction to till more land and control more weeds, or pest control, or using fertilizer has not been met. But the establishment of a functioning crop research station at Bonka is a major step toward attaining that goal. The adjunct project of road building probably has increased the area planted. The construction of wells and wars may have made life a bit easier now but, in the long term, we must be alert for evidence of overgrazing in their vicinity. Allowance of more time, two years, as has been proposed by World Bank funding, to retain expatriates, should suffice to see the recently-trained Somalis acquire the experience and confidence to continue operations so that Bonka will bear significant first fruits.

As a tax payer as well as a scientist, I believe that if anything that USAID does in Somalia is going to pay off, this agricultural component at Bonka will eventually, if given essential support for a few years more.

R. W. Duell

P.S.

I don't expect anyone to be fully satisfied with the outcome of the project at this point, nor in this report. Given the restrictions in time and manpower I believe we did a creditable job of evaluating the situation.

Final Evaluation

BAY REGION AGRICULTURAL DEVELOPMENT PROJECT (649-0113)

I. INTRODUCTION

The Bay Region Agricultural Development Project (BRADP) was a five year integrated multidonor rural development project. Project participants include USAID, the Africa Development Fund (ADF), the World Bank, the International Fund for Agricultural Development (IFAD) and the Government of the Somalia Democratic Republic (GSDR). Of the total project costs of US Dols 50.3 million USAID was to fund US Dols 15.6 million. Subsequently US Dols 500,000 were deobligated for use in the Livestock Marketing and Health Project which is also USAID funded. Therefore US Dols 15.1 million were provided by USAID to support BRADP activities. Of this US Dols 10.6 million was provided by BRADP activities, US Dols 3.6 million was provided by the Comprehensive Ground Water Development Project and US Dols 0.9 million by the Agricultural Extension, Training and Research Project.

II. PROJECT OBJECTIVES

The BRADP has three objectives.

1. Increase crop and livestock production in the region by increasing production on currently cultivated land and expanding cultivation into new lands.
2. Integrate extension operations to incorporate both crops and livestock interventions in a farming systems approach.
3. Establish a Project Management Unit (PMU) to increase development planning and implementation responsibilities at the regional level.

III. PROJECT COMPONENTS

To meet the above objectives the following components were incorporated into the project.

A. ADAPTIVE AND ONFARM RESEARCH (Partially USAID Funded): The Bonka Research Station (BRS) will be the center of this component. Activities will include varietal testing and screening; developing soil moisture conservation practices; selecting and improving farm tools and implements; promoting the use of animal power for land preparation, row planting and implement cultivation; the production of certified seed; and identifying appropriate crop and crop/pasture rotations that emphasize crops already known to farmers. When

promising improved technology has been identified BRS researchers in cooperation with field extension agents (FEA) and farmers will conduct trials on farmers fields.

B. SEED MULTIPLICATION (Partially USAID Funded): The existing seed farm near Bonka will be staffed and equipped to multiply identified improved seeds of sorghum, groundnuts, pulses and pasture seeds for general distribution to farmers. The farm will be equipped for mechanical production, harvesting, cleaning, treatment and storage of seeds.

C. WATER SUPPLY (Partially USAID Funded): The component will provide potable water in the region for both humans and livestock through (a) drilling and developing about 60 boreholes on the limestone plateau mainly in the crop producing areas, (b) an exploratory/production drilling program in the basement complex involving about 40 boreholes, 10 dug wells and four wars and (c) testing for the availability of water for irrigation in the limestone depression by drilling about six boreholes and two test wells.

D. ACCESS ROADS: All the roads in the Bay Region which provide access to areas where agricultural production is presently or potentially significant will be upgraded to an all weather status. About 350 kilometers of six meter wide low standard roads will be rehabilitated and about 210 kilometers of four meter wide feeder or access roads will be constructed. Also about 250 kilometers of tracks will be cleared.

E. REGIONAL VETERINARY SERVICE (Partially USAID Funded): This service will be strengthened by (1) staffing and equipping two mobile vaccination teams, each to cover two districts, (2) train and equip resident veterinary staff in the districts, (3) establish and stock 13 new dispensaries and stock 17 existing dispensaries at the village level and strengthen the headquarters of the veterinary service at Baidoa and provide laboratory facilities and equipment.

F. PILOT AGRICULTURAL DEVELOPMENT UNITS (PADU) (Never Implemented): Four PADUs will be established to organize farmers and pastoralists in the Bay Region in a way that they will be motivated to preserve the productive potential of crop producing areas and the rangelands. The PADUs will be located in areas that reflect differences within the region as to soils, rainfall and relative importance of crops and livestock as a source of family income. Each unit will accommodate about 750 families with 7,500 hectares of arable land for crop production and on-farm animal husbandry and about 55,000 hectares of rangeland to support off-farm livestock.

Demonstration trials in the cropped areas of the PADUS will focus on testing practices with the potential for preserving soil fertility, providing sufficient forage to maintain on-farm livestock on a year-round basis, conserving moisture in the soil and increasing productivity. An integrated rotation of crops and sown pasture will be introduced by the research staff. The Bonka Research Station staff will closely monitor the activity so as to generate sufficient farm management data to serve as a basis for planning a more intensive agricultural development program for the Bay Region and to provide the extension service with proven practices to extend to crop and livestock producers.

G. TECHNICAL ASSISTANCE AND TRAINING: Technical Assistance and Training both short and long-term will be provided to all the project components listed above.

H. FACILITIES CONSTRUCTION: Offices will be constructed for the PMU and the Research Station. Project staff housing will be constructed. A vehicle and equipment maintenance facility will be constructed. In addition facilities will be constructed on the Research Station to accommodate laboratories, seed processing equipment, machinery maintenance and storage. Veterinary clinics will be constructed some from the counterpart funded shilling budget.

I. PROJECT MANAGEMENT UNIT (PMU): The project will be implemented through the Ministry of Agriculture (MOA) by a multi-disciplinary PMU headed by the Somali Project Director and an internationally recruited Technical Manager and a Financial Controller. All MOA services as well as those from other ministries responsible for livestock, range, road construction/maintenance and water development will be incorporated into the PMU.

J. VEHICLES AND EQUIPMENT: Vehicles, equipment and spare parts will be purchased for the research station and seed farm, the PMU, the road construction and maintenance and the Regional Veterinary Service Components of the project.

K. BASELINE STUDIES: Baseline studies will be conducted to identify project area resources, possible areas of intervention to encourage development and for evaluating project progress.

IV. MID-TERM EVALUATION:

A World Bank sponsored mid-term project review (June 1984) noted the difficulties in getting project activities underway. All project components were behind schedule especially agricultural research which was three years behind and only then getting started. Road construction costs were significantly greater than those estimated during project design. Also the review noted that ground water suitable for human and livestock use was not as plentiful as had been expected. The following recommendations were made and accepted by all participating agencies.

A. WATER SUPPLY: Well drilling will be largely confined to the limestone plateau. If further exploratory drilling is successful in the limestone depression well drilling will continue there also.

B. ACCESS ROADS: Road construction will be reduced from 560 kilometers to 300 kilometers plus the originally proposed improved tracks in order to serve primarily crop producing areas except when otherwise economically justified.

C. AGRICULTURE: All agricultural activities will be combined into a single component. The changes proposed arise from the findings that except for seed treatment there are not yet any technical recommendations readily available that allow farmers to improve crop production and the range areas of the Bay Region. The findings that the absence of large tracts of land plus the difficulties inherent in changing local grazing methods and customs preclude allocating large range areas to any one group of farmers to establish the four PADUS in which to test integrated range and crop production trials. Consequently the focus of agricultural improvement will be toward applied research to develop and test technology and practical ways to improve technology. To accomplish this the following actions will be taken.

1. The technical assistance team at Bonka Research Station will be strengthened.
2. The seed farm will be an adjunct of the Research Station which has inadequate land while retaining only a small seed production program until improved varieties are identified.
3. Soil moisture conservation trials using both animal traction and small tractors and related implements, based on the principals and methods that have shown promise at Kurtum Waare and Sablaale, will be adapted to Bay Region conditions.
4. A program of on-farm trials will be conducted by the extension service with technical guidance from the Research Station.
5. Some of the operating costs of the plant protection service and the district agricultural offices will be project funded.

D. VETERINARY SERVICE: The Veterinary Service will consolidate already started operations. The epidemiological survey and expansion of the veterinary laboratory are not deemed necessary.

V. USAID FINANCED PROJECT COMPONENTS:

USAID provided much of the technical assistance, training, equipment and supplies for agricultural research, veterinary services and water supply development. The latter activity was funded under the Comprehensive Groundwater Development Project (649-0104) (CGWDP). The final evaluation of this project was conducted in 1986.

The technical assistance budget for agricultural research and seed multiplication was for five person years each for an extension specialist, agricultural research officer and a seed farm manager. For the range and livestock activity a range officer and a veterinarian were to be provided also for five years each.

Following the mid-term review recommendations, the research technical assistance team was strengthened to include an entomologist, a director of research, two agronomists, a farm superintendent and later an agricultural economist. Since the range component of the project was eliminated following evaluation the range officer position was never filled and the services of the veterinarian were discontinued after two two-year tours.

Of the \$10.7 million provided by USAID to the project 59 percent was used for technical assistance, 36 percent for commodities and four percent for participant training (Table 1). Technical assistance inputs provided a total of 27 person years. This included agronomists, an entomologist, an economist, a seed specialist and a farm superintendent for the agriculture research component. For the regional veterinary service component a veterinarian was provided (Table 2). Commodities provided were vehicles, farm machinery, laboratory equipment, computers, veterinary drugs and supplies and pump sets and well development commodities. Sixteen long-term and 11 short-term participants received training abroad (Table 3). In addition to the above inputs approximately So. Sh. 190 million have been provided to the project from counterpart funds generated from USAID funded programs.

VI. PROJECT IMPLEMENTATION:

The project began in 1980 and was scheduled for completion in 1985. However, it took longer than expected to get the project started and implementation was slower than expected. All project components were two to three years behind schedule at the time of the mid-term evaluation. This required that the project be extended for three more years if project targets were to be met. The construction of facilities was not completed until 1986 which finally made available adequate office space and other facilities for project administration, maintenance and research activities. The following narrative will be primarily confined to the project objectives and targets as recommended by the mid-term review and subsequently accepted by project participants.

A. AGRICULTURAL RESEARCH COMPONENT

This component constitutes the largest and most diverse group of professionals, both expatriate and Somali personnel funded principally by: USAID, World Bank and GSDR (eight ministries), along with IFAD and ADF.

The present scope and complexity of personnel are illustrated, in part, by Table 1. These workers are located at the Bonka Station and the Project Management Unit (PMU) in Baidoa. Efficient offices were provided there in 1986. Also provided are appropriate labs for soil research, crops, pest control, a library, computer facilities, seed processing, seed storage, field implements and equipment (ranging from a 10-row self propelled combine, and huge tractors to experimental - size row planters, hand tools and animal-draft implements), machine storage barns, fuel storage, vehicle repair shop and spare parts, meteorologic equipment, a permanent electrified boundary fence and personal computers.

TABLE 1

FINAL BUDGET OF USAID SUPPLIED FUNDS

	<u>U.S. \$ 1,000</u>	<u>Percent</u>
Technical Services and Studies	6,322	59.2
Commodities	3,886	36.4
Participants	435	4.1
Other	28	0.3
Total	10,671	100.0

TABLE 2

USAID FUNDED TECHNICAL ASSISTANCE

	<u>Person Years</u>
I. Agricultural Research Component	
A. Original Team	
Agronomist (Chief of Party)	2.0
Seed Specialist	2.0
General Services Specialist	2.0
B. Second Team	
Entomologist (Chief of Party)	3.2
Research Director/Sr. Agronomist	3.2
Soils Specialist	1.8
Agronomist/Computer Specialist	1.5
Farm Systems Economist	1.3
Farm Superintendent	3.2
II. Veterinary Services Component	
Veterinarian	4.5
III. Consultants	2.4
IV. Total	27.1

TABLE 3

USAID FUNDED PARTICIPANT TRAINING

	<u>Number of Participants</u>
<u>Long-term Training</u>	
Agronomy 1)	5
Seed Production	1
Crops 2)	1
Plant Pathology 2)	1
Veterinary Science	3
Range Management	2
Poultry Science 2)	1
Agricultural Economist	1
Vehicle and Engine Maintenance	1
Total	16
Short-term Training	11

Note: One participant, the vehicle and engine maintenance candidate, went for a two year non-degree training program. The poultry science participant received a B.S. degree. All other long-term participants were masters degree candidates.

1) Two agronomists did not return to Somalia.

2) Did not return to Somalia.

TABLE 4
PERSONNEL LIST
BAY REGION AGRICULTURAL PROJECT AT BONKA, BAIDOA

<u>Section</u>	<u>Expatriate</u>	<u>No. of Somali Personnel</u>
Personnel and Administration	-	3
Computer Training	Dr. Hedera Porter	-
Regional Ag. Coordinator	-	1
Regional Ag. Coordinator Asst.	-	1
District Officer	-	4
Clerk	-	5
Messenger	-	4
Driver	-	2
Sprayer	-	4
Watchman	-	5
Other	-	4
Farm Operations		
Farm Superintendent	Mr. Nels Anderson	-
Farm Manager	-	1
Asst. Farm Manager	-	2
Driver	-	5
Watchmen	-	3
Other	-	5
Plant Protection	Dr. Robert Lavigne	-
Researchers	-	5
Services-heads	-	2
Sprayers	-	7
Others	-	5
Sorghum Improvement		
Leaders	-	2
Researchers	-	8
Technician	-	1
Advisor	Dr. H. Porter	-
Agronomy	-	5

TABLE 4 (Continued)

PERSONNEL LIST
BAY REGION AGRICULTURAL PROJECT AT BONKA, BAIDOA

<u>Section</u>	<u>Expatriate</u>	<u>No. of Somali Personnel</u>
Grain & Legume Oil Crops	-	1
Reg. Officer	-	3
Technician	-	1
Forages	-	2
Soils Leader	Dr. P. Porter	2
Researchers	-	6
Dryland Cropping Systems	-	3
Advisor	Dr. G. Eagleton ¹⁾	-
Off. Station Leader	Dr. G. Eagleton	-
Researchers	-	2
Animal Traction Leader	Dr. G. Eagleton	-
Researcher	-	1
Collars	-	1
Equipment	-	1
Animal Care	-	1
Research Director	Dr. Grant Richardson	-
Farming Systems Analyst	Ms. Julie Howard	-
Total	7	Approx. 110 Some are on leave Some names appear twice. Ms. Howard staff was unlisted 15 were identified women, 4 as techn cians or better.

1) All expatriates, with the exception of Dr. Eagleton, were USAID funded.

All the above have been installed in and are functioning to conduct the mandated applied research at the Bonka Station and on cooperating farms in the four districts of the Bay Region.

The importance of maintaining continued support is dramatically illustrated by the bad example of deteriorating facilities (and therefore function) on the other side of the road from Bonka, namely the extension service, known as AFMET.

There is concern among the expatriates about continuity of research and services after Sept. 1988 when the project is scheduled to terminate.

There have been changes of personnel and continual upgrading of professional capacity as Somalis return from long-term educational training. A return rate of only 69 percent is appalling. Hopefully this will be rectified by measures recently taken to assure return to this research station. There should be Somalis with graduate level training plus two years of on-the-job training in every significant position of each section before expatriate departure. Adequate funding of operations and maintenance after expatriate departure may still be a factor for further consideration.

1. SORGHUM IMPROVEMENT SECTION

As documented in Table 2, sorghum is by far the most widely grown crop in the Bay Region. It is also the highest yielding rain-fed grain crop in Somalia. It was expected that, before the project was completed, one or more exceptionally productive varieties of sorghum would be released from the several seasons of trials, so as to appreciably enhance food and feed production, but this may not happen.

The Sorghum Improvement Section was the largest at the Bonka Station during the first years of the project. As noted in the end-of-term report of the previous Director of Research, this largest program of the agricultural component was the least productive. This was attributed to inefficiencies and lack of dedication by the leader of the section. No end-of-term report of that leader was seen by the reviewers, but the explanation by the Director of Research seems plausible, and was corroborated by interviews with present personnel.

The terminal report of the Director of Research also stresses the potential impact that a break-through of a superior sorghum would have after being seed-increased at the "100 hectare farm" (soon to be increased by 50 ha in anticipation of crop releases through these research efforts). This report, plus interviews with others, indicate that the previous Director of Research was a man of vision, energy and hope for positive contributions from the research and extension activities via the efforts of personnel of the agricultural component. His hopes, specific to sorghum varieties, were that hybrids adapted to the Bay Region would be the solution to higher and more dependable production in Somalia as they have been in other parts of the world.

TABLE 5

PERCENT OF CULTIVATED LAND PLANTED TO CROPS AND
CROP MIXTURES FOUND IN THE DISTRICTS OF
BAY REGION, GU 1987

<u>Crop or Crop Mixture</u>	<u>Baidoa*</u>	<u>B/Hakaba*</u>	<u>Q/Dhere*</u>	<u>Dinsor*</u>
Sorghum sole	39.2	69.0	55.4	90.0
Sorghum Cowpea	44.4	22.1	32.0	7.4
Sorghum/Mung bean	1.0	.0	.0	.1
Mung bean/Cowpea	.8	.0	.0	.0
Mung bean**	.1	.1	.1	.0
Cowpea**	.1	.4	.0	1.0
Groundnut**	.9	.2	.2	.1
Sesame**	.0	.3	.0	1.0
Maize**	8.0	.0	10.0	.2
Sole crops	48.2	70.1	65.7	92.1
Intercropped	51.6	29.9	34.3	7.9

*Baidoa district: n = 28

*B/Hakaba district: n = 33

*Q/Dhere district: n = 32

*Dinsor district: n = 28

** Also occur in mixtures; more data are available in Farming Systems Section Report of Deyr 1987, Tables 3.9.10, also 11, and 12

Selected sorghum hybrids frequently outyield other varieties and locally grown sorghum. Presently, insufficient data are available, and yields are too variable to predict for certain that the added cost of continued resupply of hybrids will be economic in the Bay Region, but this has been demonstrated many times in many parts of the world. Exceptions are unknown.

Currently, sorghum variety trials (including hybrids) are being conducted in an efficient, discriminating manner with fewer personnel, on less land, but with greater assurance of selecting the most appropriate varieties for both the Gu (longer rainy season), and the Deyr (shorter rainy season). Trials are now being replicated 3 or 4 times to assure that statistically significant differences between means of varieties will be obtained under "normal" circumstances. Varieties are segregated into: short term, preliminary screening; elite trials, after inferior entries are discarded; advanced trials at the Bonka station; and off-station testing, on various farms throughout the Bay Region.

Presently, however, all plots on-station are sprayed to control stem borer. In elite or advanced testing a split plot of no borer control should be employed. In the event that borer control is not economical it may be necessary to discard overly susceptible varieties.

Future progress in this section appears likely to be excellent.

Agronomic variables such as seed treatment effects on seedling emergence, spray for borer control, effects of tilling to incorporate stems for borer control, effects of stem removal from fields on rainfall infiltration and nutrient recycling, and also crop rotation for borer control are being studied in an effort to enhance sorghum production.

2. SOIL IMPROVEMENT SECTION

Best prospects for crop production occur when all constraints are lifted in a complete management package, as advocated in the philosophy of the Green Revolution. Previously, low rainfall was viewed as a prime constraint, or limiting factor for sorghum production in the Bay area. Differences in rainfall between the Gu and the Deyr seasons are still recognized, but the constraint of low phosphorus availability is now being viewed as being very important; sometimes as most important. Liebig's "Law of the Minimum" applies here; i.e., the barrel will fill only to the height of the shortest stave. If moisture is limiting, adding more phosphorus won't help.

The clay soils of the Bonka Station have been characterized (P.M. Porter et al., Sept. 1987, paper presented at Addis Ababa, Ethiopia) as brown to dark brown vertisols. The expandable montmorillonite clay-dominant soils reworks the soil surface so that it does not crust as it dries, but remains soft and is easily worked for planting and weed control. Drying cracks may be 2 m deep, but rapid swelling after wetting limits infiltration. Moisture holding capacity is large, but not all of the moisture is plant-available.

Cation exchange capacity is high, organic matter and conductivity (salt content) are low. Calcium content is high and sodium low. Phosphorus and zinc are low. Soil pH is commonly about 8, but iron does not seem deficient. Phosphate fixation capacity is high. Potassium is high and sulphur is moderately low. Chemical analyses of soils of the region and single element deletion tests in these soils confirm that N and P are the prime limiting nutrient elements. Nitrogen fertilization usually enhances P uptake and plant growth. Hence, diammonium phosphate (DAP) would appear advisable, particularly if applied to minimize soil contact thereby avoiding fixation. It must also be applied at a depth where there will be moist soil (under an eventually dry surface) in proximity to the seed, where plant roots will reach the local concentration of P, yet not be injured by the concentration of ammonium ions. This can be done mechanically as "band placement", or a hand-applied equivalent operation.

This classical agronomic theory was supported in several field trials, particularly with sorghum. Certain data suggest that farmer fields in the Bay Region may not be as P deficient as those of the Bonka Station. Sufficient data are not available to ascertain the economic feasibility of this sort of chemical fertilization, even though research with very low rates of banded DAP elicited positive responses from sorghum. Adequate moisture is still a necessity, but this treatment may save crops in a marginal moisture situation. It may also greatly increase yields in good moisture situations.

Moderate rates of goat and cow manure application each increased sorghum yields in research trials, but camel manure did not. Yields of a crop following the one that received the manure initially are being evaluated. Residual nutrients from either fertilizer or manure applications might enhance yields and hence economic feasibility.

3. LEGUMES AND OIL GRAINS SECTION

This research included varieties of cowpea, mungbean, peanuts (groundnuts) and soybeans, all of which are edible legumes, and all but the last are grown in the Bay Region, on a very limited basis. Safflower, a non-legume oil crop is also grown locally. Oil is press-extracted locally from peanuts, safflower and sesame and could be extracted from soybeans also if locally adapted varieties were available. Cultivars of these species (except sesame) are being tested at Bonka by an all Somali team.

From 70 mung bean varieties tested thus far, one particularly early maturing variety called 'Filsan' was released, and found favorable acceptance by local farmers.

In comparison with 25 cultivars from ICRISAT, the local type of peanut proved best.

In one trial a soybean entry produced 2150 kg/ha; a very respectable yield. Subsequently yields have not exceeded 800 kg/ha. Specific rhizobia bacteria are needed for soybeans and this may be limiting production of this otherwise high-potential crop. The other legumes mentioned above are promiscuous; i.e., nodulation occurs with various local common rhizobia.

Safflower has been yielding well at Bonka and is being seed-increased on the 100 ha farm. Spacing trials have just been initiated to determine optimum population per unit area.

4. PLANT PROTECTION SECTION (Entomology)

Insects of major crops are dealt with in two modes, research and service. Resistant varieties are of prime concern and are sought through crop trials conducted by others and also in farmer's fields. Obtaining borer-resistant sorghum appears unlikely, for these insects are not host-specific, and may survive in other large stemmed grasses as well as in sorghum. The absence of sorghum from an area does seem to reduce the incidence of borers in subsequent crops. Crop rotation with non-grass crops such as legumes and certain oil-seed crops would deprive stalk borers of habitats essential to their survival until the next suitable crops are available. Four months is the critical survival duration for the pupae in this environment. Beyond that, they desiccate.

Similarly, removal of sorghum stems following grain harvest deprives borers of habitat for the diapause pupae to survive. Stems are sometimes removed by farmers, partially or completely, from some fields or parts of fields. All fields are gleaned by grazing cattle following grain harvest. Stems may also be tilled into the soil thus depriving borers of habitat.

Problems arising from these strategies relate to the fact that although the sorghum leaves are nutritious, the stems are much less beneficial to livestock. Also, farmers presently lack means to till the soil sufficiently to properly incorporate the stems of sorghum or maize into the soil so as to appreciably reduce the borer population that may attack the next crop of those species.

Loss of production from early borer attack, inducing "dead head" (by consuming the apical meristem that generates the seed head) is reduced by preferential hand thinning of afflicted seedlings. This, however, necessitates the use of more seed at planting, and more labor. The thinning operation consumes time during the critical weed control period.

The service aspect of this section involves maintaining surveillance of crop insects, reporting on massive outbreaks of crickets and such, supplying poison baits and spraying farmers' fields on a demonstration basis.

5. ANIMAL TRACTION (AND FORAGES) SECTION¹⁾

This is the youngest section of the Bay Region Agricultural Development Project. Originally the project called for the inclusion of a forage aspect. This would be logical because working animals require quality forage, and indeed should also have grain to provide energy for full working efficiency. Only preliminary efforts with two species, leucaena (Leucaena leucocephala) and alfalfa (Medicago Sativa) have been made to date. No data were seen relating to the alfalfa work.

Leucaena is a drought tolerant woody legume whose foliage provides an abundance of high quality feed readily consumed by all classes of livestock. It retains green foliage 11 months without rain at one location in Somalia. It requires no inoculation and has been started from scarified seed (which it produces abundantly the second year) at several locations in the Bay Region. It must be protected from grazing in the seedling stage and even after it matures, goats strip its bark and regrowth must come from buds at the soil surface. It will produce firewood if not cut or grazed during a season. It is used in alley cropping to provide nitrogen to associated crops, but it does deplete soil moisture. It should be used as windbreak to reduce evapotranspiration in a modified (5 m wide rows) alley crop system with sorghum or other crops sown between. Other forages such as sweet clover, alfalfa, stylosanthes, elephant grass, Brachiaria spp., buffel grass and Andropogon gayanus should be considered.

Animal traction has been long advocated, but not readily adopted anywhere in Somalia, probably because of the prevalence of nomadism. People are now using animal traction more and more frequently particularly in the form of donkey carts wherever there are roads throughout the Bay Region and elsewhere in Somalia. Conditions seem more appropriate than ever to succeed in introducing animal traction for crop-farming.

Aside from efforts of this section, animal traction is being demonstrated by the Extension Service in the Bonka area, and by the Off Station (on farm) work supported by the World Bank.

Camels, bulls, heifers, cows and donkeys have been used successfully in Somalia (on a very limited basis) and more frequently elsewhere for draft purposes in crop farming. The first two classes of livestock are better suited for heavy work including soil tillage, but they are export commodities. Also, no-till, or minimum tillage may suffice for some cropping systems in the Bay Region.

Weeds are a serious constraint in any cropping system. They compete for both nutrients and moisture thereby reducing crop production and contributing to the 1 of 3 Deyr crops failure (short rainy season), and 1 of 4 Gu crops failure (long rainy season). Weeds also harbor pests, diseases, and insects, they impede harvesting, contaminate the harvest and perpetuate themselves all too efficiently. The area cropped by a farmer is limited to the area he can weed, even though half of the

1) The technical assistance to this section was not provided by USAID.

farmers of the Bay Region hire help for weeding. Laborers use a hoe called a yambo. Its blade width is approximately 10 cm and its handle is from 50 to 125 cm long, and they are relatively light weight. In the non crusting, low density montmorillonite clay of the Region, a blade width of 15 to 20 cm would be more efficient.

It was estimated by trials in the region that one man and a cow pulling a cultivator in a sorghum field of the Region could weed an area equal to that of four people using yambo. This estimate would appear to be conservative if the cultivator was a good design and the animal was in good condition, properly harnessed, and well trained.

6. FARM OPERATION SECTION FOR RESEARCH AND SEED INCREASE AT BONKA

The project constructed facilities at the Bonka Research Station make possible proper operation and maintenance of equipment for tillage, planting, weeding, control of insects, and plant diseases, seed processing, transportation, research and seed increase efforts for the entire project. The need for seed increase, however, thus far has not come close to the potential of the farm. An estimated 2 ha of the newly released Filsan is being increased to be given away, another 2 ha of safflower, and several ha of sorghum of no particular variety are grown.

Although the farm appears quite uniform and level, a land plane was employed and the fields are large and in good form for either research or seed increase. Evidence of gullies developed from recent heavy rains indicate that hill and sheet erosion have also occurred. Signs of the latter were obliterated by plowing and harrowing, but the need for shallow terracing and grass water-ways is apparent to safeguard the land.

Prior problems with crop losses and irregularities in research plot yields because of pilfering and foraging by passing herds have been greatly alleviated by the construction of a permanent perimeter fence consisting of steel posts and multistrand barbed wire and smooth high voltage wire. Small animals are easily dissuaded by this fence, but camels are less affected by the electric shock, hence the need for the barbed wire. A high-tensile-strength wire suspension fence with heavy duty corner posts, widely spaced, intermediate posts, and frequent light weight spanners might have been more appropriate for land as level as that at the Bonka Station.

An efficient planting system has been developed, particularly for large scale operations such as seed increase. The "100 hectare" farm is essentially fully plantable but the plan is to expand into an additional 50 ha. This is ambitious, particularly in view of the fact that there is not that much strikingly superior material to be increased in the near future. Filsan mung bean is the only release of the project thus far.

The planting system is based on clean plowing, row planting with diammonium phosphate for sorghum, maize and safflower but triple superphosphate for legumes. Both types of fertilizer are banded beneath and alongside the rows of seed.

Planting has been standardized as follows:

- Sorghum - 75 cm rows, 57,000 plants/ha, 5-7 cm deep with press wheels.
- Legumes - 50 cm rows, 120,000 plants/ha, 4-6 cm deep with press wheels.
- Safflower - 7 row beds, 18 cm between rows, 50 cm between beds, The proper plant density for this region is being researched.

Experimentation with deep tillage designed to increase infiltration and moisture retention/root penetration has recently been initiated. This will continue with heavy tractors and chisel plows. A subsoiler should be procured for this purpose.

Presently, soil penetration is such that a 4 mm diameter steel rod can easily be inserted to at least 75 cm.

Resupply of diesel fuel presents occasional problems. Relief is planned via increasing storage capacity through buried tanks. Lack of replacement parts has disabled the largest tractor. A shipment of fertilizer did not arrive in time for one planting season. Inoculum was not available for this season's planting of soybeans.

These types of difficulties arise in spite of a keen awareness for the need to plan ahead.

7. FARMING SYSTEMS SECTION

This activity was mentioned in the original plan but was not executed at the outset. A two-volume report entitled Socioeconomic Baseline Study of the Bay Region was made by a four-man team from the University of Wyoming plus Somali cooperators, and is dated December 1984. This report dealt extensively with sociological and anthropological aspects and did not quantify crops parameters sufficiently as to constitute a base-line from which to measure progress and the impact of the project.

Only in the past year was an effort begun to obtain such essential crop and livestock data through continuous systematic surveys of the farming operations involved, marketing practices, personal preferences for crops and varieties of crops, differences among the districts of the Region in terms of area planted, seasonal labor supply, and year-to-year variations in yields, acceptance of new recommendations, etc. These data are admittedly short-term thus far, and hence of limited use for the assessment of impact and accomplishments of the project such as the release of Filsan or the use of seed treatment chemicals. Both of these recommendations were favorably received, according to the survey. Quantification, however, is still limited.

Survey forms currently being used appear quite detailed, and data contained in the 14 pages of the semiannual survey questionnaire have been computerized, and over time print outs should show trends attributable to project objectives and interactions with seasons, rainfall, market price, cost, area of specific crops, numbers of each class of livestock, in total or in each district of the region, etc. Comparisons may be made with the earlier report of 1984, but the more quantifiable data indicating project impact is yet to come.

The need for training and close supervision of survey takers was quite evident, as was the instilling of diligence and perseverance into young Somali extension agents working in the 4 districts. The detailed format and strategy for data accumulation, compilation and analyses of the 14 page survey to be conducted have been worked out. The twice yearly survey will be increasingly appreciated as a source of baseline information with the passage of time. The format of the questionnaire should be upgraded periodically as critical review will indicate and interests vary.

Excerpts from the first survey include:

- a. Reports by farmers on Filsan mung bean regarding quality characteristics: shelling, cooking, taste, yield, earlier selling price, and pest resistance are all overwhelmingly positive.
- b. Crop and livestock problems can be documented and sometimes quantified.
- c. Land tenure forms indicated that 2/3 of the land was inherited. Corrected estimates of land holding indicate an average of 8 ha/farmer. 94% want more land. Walk 38 minutes to their farm.
- d. Farmers, particularly on sloping land, practice bunding to allay water erosion and increase water retention.
- e. Only 1 farmer did not plant by hand (using a yambo) in random hills, he used animals to open a furrow.
- f. For most crops 1/2 of the farmers save their own seed. They plant 10 seeds/hill, thin out seedlings including those showing dead-heart of sorghum, leaving 4 or 5/hill.
- g. They try to weed each field two times, but their fields are so extensive in comparison with the labor available, that 11 percent of the land is not weeded at all. Wild lettuce was the worst weed by far on essentially every farm.
- h. When interviewed, farmers expressed more concern over insects and diseases than they did over weeds. However, weeds are probably a more serious threat to yields than are insects and diseases.

- i. Predator damage: 31% of survey farmers said that warthogs were the most serious problem, 23% porcupines, and 37% birds including wild guinea fowl (beautiful blue-gray birds that are delicious to eat). They also attributed some crop damage to domestic animals.
- j. Sorghum is stored unthreshed in bakaars (clay pits). Rats and insects are problems. The extent has yet to be specified.
- k. Several times sorghum varieties (about 7) were introduced. Wyoming agronomists introduced varieties in 60's, and FAO in 70's. 20% of the farmers had tried introduced varieties.
- l. Almost 1/2 of the farmers interviewed had used seed-treatment chemicals in the past season and farmers on average said that they would be willing to pay So.Sh. 25 for a 90 gram packet.
- m. They do not use pesticides in Bakaars. They do not know the potential damages of certain pesticides. Farmers have never used inorganic fertilizer.
- n. 84% of the farmers penned animals at night in their villages rather than in fields, where manure is needed. Only 4% had used the manure on cropland.
- o. Half knew that manure was good for crops.
- p. 16% had experienced tractor-clearing.
- q. 8% had used animal traction in past, but only 3% in '87, even though 30% had observed the use of animal traction.
- r. 93% use animals to transport material. Donkeys commonly pull carts in town. Farmers use camels to carry loads, but men do not ride camels; only pregnant women and little children and the very aged may ride without shame.
- s. In recent years AFMET (Extension) and BRADP (includes Wyoming) used sorghum stalk removal for insect and disease control as well as stored feed. 59% of the farmers participate in this form of pest control.
- t. Market data for various crops are being accumulated in a format that facilitates computer processing to develop a quantifiable baseline in time.
- u. Cowpea yield data are more difficult to obtain because cowpeas are picked periodically by women and children. 32% of the farmers who grew cowpeas sold some in the market.

- v. Labor records are more difficult to obtain than crop data. But it is quite clear that the most critical shortage occurs during weeding. This justifies increasing efforts to encourage the use of animal traction for cultivation to control weeds.
- w. Land clearing (from brush in the Bay Region) is the least frequent, but most expensive agricultural operation. Weeding is the next most expensive per operation, but it is the most frequent. This is followed by harvesting, and lastly, planting costs, both of which are normally once per crop.
- x. Extensive data are now available in this recent survey about livestock. Cattle are the most commonly owned and were the most frequently sold during the survey period probably because of the Der 1986 - Jilaal 1987 drought. Goats are second most commonly owned livestock. 46% owned camels, 17.7% sheep, and 12% owned donkeys.
- y. Weekly market price data will help to determine need for storage facilities and in determining the importance of agricultural diversification.
- z. White maize, cowpeas, and mung beans are more available in the Baidoa area of the Bay Region.

Much of the data included in the present evaluation were taken, in part, from the survey reports of this section.

8. OFF SITE (ON FARM) AGRONOMIC/ANIMAL TRACTION TRIALS 1)

These activities, sponsored by the World Bank in collaboration with the Somali Extension Service, entail crop species and fertilizer use on farms throughout the Bay Region. These trials are in concert with project efforts and the animal traction/training demonstrations of the Extension Service. The one trial site visited by the evaluation team and accompanying researchers was on a farm that had been extensively cleared by bulldozers and was free of bush. A grass, approximately one meter tall, dominated perhaps 100 ha that could be seen from our vantage point. This appeared to be a wild type of Sudan grass (Sorghum bicolor). Stems of this grass are fine enough to prohibit oviposition by stem borers, and soft enough at the wet-seed-stage to be quite digestible to livestock. This could be harvested (even with a sickle or sythe) and cured to produce hay of far greater nutritional value than sorghum stover.

1) The technical assistance to this section was not USAID funded..

9. CONCLUSIONS It is understandable that research of rangeland management was eliminated from the scope of the project at mid-term, but it is unfortunate that rangeland survey data were not obtained. Species identification and occurrence data are needed to determine trends in livestock carrying capacity, particularly as impacted by improved or new roads and wells or wars (watering holes). This would also facilitate decision making regarding the development of a forage program, expansion of crop farming, livestock production and dryland farming versus irrigated land development. The latter area appears to be limited by river volume to about half the irrigable land between the two major continuously-flowing rivers of Somalia.

The Sorghum Improvement Section should better be known as the sorghum selection effort. Breeding should not be an important goal, but the selection from available varieties of higher yielding, better adapted sorghum should achieve the stated project goals more quickly. Many nations of the world are now beneficiaries of selected hybrid sorghum. The agronomic superiority of selected commercial hybrids has been widely demonstrated, but data to test the logistics or economic feasibility of this tactic for Somalia are still lacking.

Similarly, soil improvement via the use of phosphatic fertilizers, with or without nitrogenous fertilizers, is of concern. Data are needed to determine if the demonstrated yield and quality increases are of sufficient magnitude and duration to justify their recommendation in the present or future economic framework. Clearly the best package of agronomic practices is one which minimizes the most constraints.

The enhancement of legume and oilseed grain production will have to occur through variety selection of presently grown crops but new species should be included in expanded efforts in concert with soil improvement practices and further attention to plant protection measures in the field and in storage. Increased areas of these crops diversify the agricultural base and facilitate crop rotation opportunities. Oil extraction techniques and facilities as well as consumer preferences and product marketing have been addressed by project activities.

Crop diversification and selection of varieties with superior insect and disease resistance facilitates plant protection, in that reliance on insecticides and fungicides should be diminished to the extent of being used only in exceptional instances, such as unanticipated outbreak. The use of seed treatment chemicals constitutes an exception. Their widespread routine use is commonly regarded as a worthy investment, cheap insurance, and only objectionable when ingested.

Weed control is a prime constraint in crop production around the world, and rightfully should have been included in the project, perhaps as a part of plant protection activities. Passive recognition has been made of weeds and weeding in project reports, but actively seeking innovations via research was not a focus.

Several signs indicate that the time is right for overcoming the lack of application of animal traction in Somalia as a means of increasing crop production. This is most promising as a means of alleviating the constraint of weeding on the area of crops planted and harvested. Spin-offs will include the manufacture of animal drawn implements and harnesses, the increased value of trained animals, increased demand for quality forage, fodder and grain (essential for working animals) or the release of people for the pursuit of more rewarding work or the luxury of leisure and a better standard of living.

Critical to the essential research conducted and services rendered to attain the project goals is the proper development of facilities and their maintenance plus that of land and equipment attained for project activities. An impressive amount of planning went into the Bonka Station to form an environment conducive to the conduct of research, seed-increase and on-the-job training of young Somali senior staff and scientists. The investment by multiple donors was appreciable and should not be allowed to deteriorate prematurely as has happened at the nearby Extension Service facility. The pay-off of the investment lies in continued operations when research break-throughs are expected in the form of new and better crops that will be increased and released to the farmers who will employ more efficient agronomic practices to further enhance crop production and quality.

Present farming systems surveys, only a year old, are providing better baseline data particularly pertinent to the goals of the project. Previous baseline studies were not sufficiently specific, nor quantitative concerning crop production. Unfortunately, the present survey has not yet accumulated sufficient data to assess the contribution of project activities to date. Survey data do, however, indicate directions that research should take, needs that should be met and the likelihood that recommendations may be followed.

B. VETERINARY SERVICES: The purpose of this component was to strengthen the veterinary services of the Bay Region. The mid-term review recommended that this activity be continued. However, the services of an expatriate veterinarian were to be reduced from five years to four and that the epidemiological survey and expansion of the veterinary laboratory were not deemed necessary. The project paper proposed that two mobile vaccination teams be established to vaccinate cattle and that rural dispensaries be built throughout the region.

Three mobile vaccination teams have been equipped with vehicles, camping gear, kerosene fueled freezers and portable corrals. Since the mobile teams began their operations they have vaccinated, on the average, about 242,000 cattle per year. Fourteen dispensaries were built (seven with PL-480 counterpart funds) by the project and two European Economic Community built dispensaries were taken over by the Veterinary Service. These plus those established in each of the district veterinary office and one in Baidoa makes a total of 20 dispensaries in the region. Since

these dispensaries opened their doors they have treated annually an average of 553,000 animals for various diseases. All of the dispensaries have not been staffed because of a shortage of veterinary assistants. A proposal has been made to select someone from the local community and give them special training to staff the more remote dispensaries. However, the Ministry of Livestock, Forestry and Range (MLFR) does not agree to this. They maintain that only veterinary assistants are capable of filling these positions. The feasibility of using locally hired and trained dispensers should be thoroughly investigated.

When project funding terminates it is imperative that user fees be established that cover total costs so that adequate amounts of drugs and vaccines can be maintained in the region.

C. ACCESS ROADS: The cost of constructing roads in the Bay Region proved to be more costly than what was budgeted in the Project Paper. Therefore, the mid-term review recommended only 300 kilometers of roads instead of 500 kilometers be constructed. The amount of track to be improved was maintained. The revised budget has been met and the quality of roads constructed is adequate. To accommodate the passage of rain water from one side of the road to the other the roadbed at these spots was lowered to original grade. Some of these areas were paved with rip-rap and some with concrete and still others are yet to be constructed. A contract has been let to complete construction at these spots and repair some of those that have been washed out by heavy rains. The project is still constructing tracks but this activity should be completed by the time the project ends.

The Bay Region now has an adequate road system to serve the agricultural producing areas. However, a program of routine maintenance must be adopted if these gravel surfaced roads are to remain useful.

D. WATER SUPPLY: The Project Paper proposed that water availability be increased in the Bay Region through the drilling of 100 boreholes, 10 hand dug well and four wars. Sixty of the boreholes were to be drilled on the limestone plateau and the remaining in the basement complex. However, the drilling experience of the Comprehensive Ground Water Development Project in the basement complex indicated that there was no hydrogeological basis on which to select sites where drilling had a reasonable chance of success. Thus subsequent drilling was to occur only on the limestone plateau.

Approximately 100 boreholes have been drilled. Forty of these were unusable. Of the producing wells 50 were drilled by the CGWDP. Some of the wells have hand pumps, some are engine driven and one is wind driven. Nine wars have been constructed and 21 rehabilitated. Considering that the basement complex appears not to have suitable aquifers the project has basically met its targets in this component. However, some of the pump sets that were installed had weak engine supports and failed in operation. Earlier models from the same manufacturer were built with heavier frames and did not have this problem.

The constant wind during the dry season in the Bay Region should be suitable for wind driven pumps. The one that was installed at Baidoa for research purposes operated for only nine months. The fan shaft sheared and has not been repaired. A program should be introduced for testing the feasibility of using wind driven pumps especially on medium yielding wells.

All these water sources need a viable maintenance program if they are to remain productive. If WDA retains the responsibility for operation and maintenance a user fee to cover all costs must be initiated. An administrative structure must be put in place that sees to it that the fees are used for the purposes for which they were collected. Another possibility, and probably a more viable one, is to give operation and maintenance responsibilities to the community using the water source.

E. TRAINING: USAID funded 16 advanced degree candidates and 11 short-term trainees. Of the long-term trainees five did not return to Somalia. Thus, the return rate including the only one still in training is 69 percent for long-term participants, which is above the average for all USAID funded projects in Somalia. The project paper proposed 26 student years of long-term training or 13 participants (two years for each MS degree). Not considering the four that failed to return the USAID supported training was two degrees above that what was originally planned. In addition to the above training the World Bank funded 26 trainees and SAFGRAD one.

VII. CONCLUSIONS AND RECOMMENDATIONS

The difficulties of coordinating and implementing a multidonor integrated rural development project are well known. This project did not prove to be an exception. Most project components were two to three years late getting started requiring that the project be extended three years.

The project as originally designed seriously underestimated the cost of road building. This required that the road construction target be reduced from 500 kilometers to 300 kilometers and confined to serving current and potential crop producing areas only. Even though significantly reduced the roads that were constructed should stimulate agricultural production and the area under cultivation assuming appropriate policies are in place. There are now indications that the area cultivated has already increased along these roads.

Well drilling also proved to be more costly than expected. Also, a suitable aquifer was not located in the basement complex and only a few wells were developed in this area. To compensate for this, to some extent, more wells than were planned were constructed and 21 rehabilitated. The number of producing wells on the limestone plateau are about what was planned.

The modest veterinary inputs into the project have resulted in a regional wide low cost dispensary system and inoculation program. However, it has been difficult to staff the more remote dispensaries. The MLFR should seriously consider training locally hired individuals to fill these positions. User fees must be introduced so that drugs and vaccines will continue to be available in sufficient quantities following the termination of project funding.

The agricultural research component was under designed. Technical assistance was to be provided by two agronomists (one each from two different donors) a seed farm manager and an extension officer. An agricultural research program requires a full complement of researchers if appropriate improved technology is to be forthcoming in a reasonable amount of time. Following the mid-term review this team was significantly strengthened. There are now three agronomists (research director, soils agronomist and sorghum improvement agronomist), one entomologist, an agricultural economist, a dryland cropping system advisor and a farm superintendent. This multi-disciplinary team has established a sound research program. The program if continued will result in improved technology being identified and developed for extension to farmers. To date only seed treatment and an improved variety of mung bean, a minor crop, are the only innovations developed by the research activity that are currently being accepted by farmers. Intensive sorghum trials are under way but widely adapted improved sorghum varieties have yet to be identified. This is not surprising since the current Gu crop is the beginning of only the third year of meaningful research on the potential of sorghum varieties. Since sorghum is the main crop in the Bay Region the project has not resulted in a measurable increase in production per hectare.

Cultural practices such as plant population, row spacing, water conservation, fertilizer use (chemical and organic), animal draft power, cultivator weeding and other plant protection measures are being researched. The dearth of available soil phosphorous to plants has been identified as a major constraint to increased yields. If future trials on the research station and on farmers fields show that fertilizers are a viable option for farmers in the Bay Region a fertilizer distribution system will need to be established. Animal draft power has the potential to relieve the labor constraints experienced by farmers during soil preparation/planting and weeding times. For this to be a viable option a feed production program needs to be incorporated into the farm enterprise so that the draft animals are in good condition when field work begins with the onset of the Gu rains. Forage production research needs to be incorporated into the program at Bonka.

To date there has not been sufficient overlap time of returned M.S. degree candidates with their expatriate counterparts. If the research program is to remain viable and results meaningful expatriates will have to remain at the research station for several more years.

A "Socio-economic Baseline Study of the Bay Region" was completed December 1984. Funds for this activity were provided for in the Project Paper. The purpose of the study was to provide the PMU with an information base adequate for the design of project components and the evaluation of activities through the life of the project. However, most of the information gathered was sociological and little economic and quantitative data are presented in the two volume report. As a result the report has proved to be of limited use for project management and evaluation purposes. In the future USAID should approve survey questionnaires to enhance the likelihood that baseline studies will provide the data and other information that are needed.

The project was originally designed to include four Pilot Agricultural Development Units in areas reflecting differences within the region as to soils, rainfall and relative importance of crops and livestock as a source of family income. Each unit was to accommodate about 750 families with 7,500 hectares for crop production and on-farm animal husbandry and about 55,000 hectares of rangeland to support off-farm livestock. At the time of the mid-term evaluation it was decided to drop the PADU component from the project because of the absence of large tracts of land and the difficulties inherent in changing local grazing methods and customs precluded allocating large range areas to any one group of farmers. This, very likely, was the right decision. Range improvement and long-term range utilization should be a project in its own right. However, research work on integrating livestock and crop production enterprises should have remained in the project because animal draft power has the potential to relieve labor shortages which occur certain times of the year. There may be a place for forage production in the rotations now being researched. Draft animals require proper nutrition if they are to be a viable source of traction.

ANNEX

STATEMENT OF WORK

A. Analyze the original project design and any substantive, documented modifications to that design to assess the adequacy of the original project concept in addressing the development constraints as originally identified. In particular:

1. Were stated outputs necessary and sufficient to achieve stated outputs?
2. Were stated outputs necessary and sufficient to achieve the stated purpose?
3. Did the stated purpose lead logically to achievement of the stated goal?
4. Was the original design articulated in a logical, practical and implementable way?
5. Were the roles and responsibilities of the various project participants (i.e., different GSDR entities, USAID, Contractor and other donors) adequately defined and outlined?

B. Assess the project's implementation and relative success in achieving objectives as designed. To the extent that implementation and relative success have not followed original design, document reasons for divergences and analyze the impact of divergences on overall project outcome. Information and analysis presented should include but not necessarily be limited to:

1. Has the project achieved its originally stated objectives? If not, why not? And if not, what achievements have been attained with what development significance?
2. Factors (including various project components) inter-related to enhance or inhibit project success?
3. How have the various project participants (i.e., GSDR entities, USAID, Contractor and other donors) contributed to project achievements (or lack of achievements)? Have the participants contributed to the project's implementation as planned? (In particular, have planned inputs been provided in a timely and appropriate manner?)
4. In general, what has been the overall impact of the project? In particular, what has been the project's impact on agricultural production? What is the projected longer-term impact of the agricultural research on agricultural production in Somalia?

C. Document key lessons learned from this project, both regarding design and implementation, that can be applied to other development projects. Provide conclusions and recommendations which USAID can use to improve other development activities. In particular, close inspection should be made of the agricultural research recommendations developed by the University of Wyoming and the Bonka Research Station. Evaluation recommendations should be made as to the future direction this research should take and its utility/applicability to future and current USAID projects.

3. Evaluation documentation and reporting: The findings and analysis resulting from Para 2 above will be presented in a concise, focused report to the USAID. The main body of the report will concentrate on overall project achievements, i.e., on the integration of the parts into the whole and the resultant impacts. Technical annexes for greater detail on specific components or aspects of the project may be included as necessary, but the report itself will discuss individual project components only as they relate to overall project progress and impact. The draft report will be modified, if/as necessary, to clarify points, correct inaccuracies and/or inconsistencies, and enhance the presentation of findings, based on discussions with USAID staff. The final report, while reflecting appropriate USAID inputs, represents the evaluation team's opinion and cannot be substantively changed by AID.

4. Roles and Responsibilities: To undertake this evaluation, USAID requires a four to five person team composed of the following: A USAID Agricultural Economist, a REDSO Project Development Officer, an Agronomist, a Ministry of National Planning Rural Sociologist and a Ministry of Agriculture Economist.

This team will work together collaboratively under the general direction of the team leader to fulfill the statement of work and prepare the evaluation report. The team will determine the division of labor to achieve its tasks internally based on the backgrounds and skills of the various team members. The team also will establish its evaluation procedures and schedule within the parameters established by USAID. These parameters include:

- A. The team will all be present and working cooperatively for no less than three weeks beginning in May 1988;
- B. The team (individually and/or as a whole) will review relevant project and other background documents, interview appropriate project participants (including selected beneficiaries) and visit major field sites in order to gather information and form evaluation opinions;
- C. The team will discuss its findings internally and reach a team consensus regarding evaluation findings;

D. No less than five days prior to the end of the evaluation period, the team will present a draft report to USAID and debrief selected USAID and Government of Somalia staff on the major findings and conclusions on the team;

E. Based on the debriefing discussion and on written comments on the draft report, the team leader, with the assistance of the full team, will submit a final evaluation report prior to departure from Somalia.

The team leader will report to the USAID project manager and will be referred to the evaluation officer on matters of evaluation procedure. Selection of documents, interviews, sites to be visited, etc. should be determined jointly by the team and the USAID and the GSDR project managers.