WATER PUMPING FOR IRRIGATION IN AFRICA: AN ANALYSIS OF PROJECT PROBLEMS AND ENERGY OPTIONS

Alan Borst, AFR/TR/SDP
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Executive Summary

Sub-Saharan African irrigation is receiving dramatically increased attention with the recent advent of severe droughts, a deepening food crisis, and increasing population growth. Indeed, both African governments and donors are taking a close look at irrigation as one of the viable solutions to the food crisis and the droughts.

Where surface water supplies are inadequate for irrigated agriculture, water pumping is necessary, and this requires energy. There are several different energy sources which may be harnessed to power the pumps -- although up to now the overwhelming choice of irrigation project designers has been diesel fuel, or electricity where available for the larger pumps. These are currently the most economic energy sources, although at specific sites this may not be the case. Most project designers and personnel have failed to implement experiments with alternative energy sources at the specific project sites. They need to explain in greater detail the rationale for their energy source selection, and either the results of their site specific experiments, or their reasons for not doing them. Furthermore, evaluation teams have often failed to sufficiently document the problems of these irrigation projects' water pumping components, which has made it very difficult for African irrigation project designers to learn from the experiences of these past projects.

The most serious problems encountered by African irrigation projects' water pumping components, based upon the case studies in this report, are:

a). Fluctuating levels of water sources, and the lack of appropriate technology to deal with them.

b). Deficient fuel system design, well construction, and inappropriate pump and engine selection.

c). Difficulties in the procurement and storage of the water pumps and related inputs, including fuel and spare parts.

d). The lack of trained personnel -- particularly diesel engine mechanics and competent administrators.

Foreword

Alan Borst is a summer intern from Michigan State University. He is majoring in International Relations with an emphasis in Developmental Economics at James Madison College and will graduate with a B.A. in June 1985. He is participating in James Madison's Field Experience program, which is directed by Carol Duane, Ph.d.

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Alan Borst
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Introduction

Sub-Saharan Africa is suffering from a "food crisis". Food production increased by an average annual rate of only 1.5% for the 1970's, down from 2.0% for the 1960's. Population, however, increased by an average annual rate of 2.7% in the 1970's, up from 2.5% in the 1960's.[1] Thus, per capita food production has been declining for the region. Indeed, from 1970 to 1979 population was growing faster than agriculture in 20 of 31 African countries for which data was available.[2]

The agricultural export sector has also been deteriorating for Sub-Saharan Africa. In the last two decades African agricultural exports have had zero growth in terms of volume, and have grown at only 1.8% a year in terms of value (constant prices) as modest gains in the 1960's were offset by equal losses in the 1970's.[3] World trade in those commodities which Africa exports, however, have grown at an average annual rate of 1.8% in volume, and 3.3% in value.[4]

Conversely, Sub-Saharan Africa is importing larger amounts of food, and receiving more food aid from a variety of sources. Imports of cereals have grown at an average annual rate of over 9.0% for the last 20 years, and that rate has been increasing.[5] Food aid for Africa almost doubled from 800,000 tons a year in the mid 1970's to about 1.5 million tons in 1980.[6]

Some African nations are starting to exhaust their supply of arable land. Nigeria, Rwanda, and Kenya are all facing such a "neo-Malthusian" situation, while many other African nations - with population growth rates of between 3.0% and 4.0% - are heading in that direction.[7] Furthermore, population pressure on a country's arable land tends to result in poor agricultural practices, such as over cultivation, which in turn leads to soil fertility problems, desertification, and soil erosion.[8] These factors, along with unpredictable rainfall and drought, are all contributing to the deterioration of Africa's arable lands.

The majority of Sub-Saharan African nations are facing declining per capita food production, agricultural exports, and foreign exchange reserves. Governments in these nations, along with international and national donor organizations, are examining alternative solutions to this regional agricultural crisis.

One of the possible solutions for many of these nations is irrigation, which up to now has only had a token role in African agriculture. Indeed, only 1.6% of world irrigation is located in Sub-Saharan Africa (see Figure 1). The food crisis, population pressure, and severe droughts have all dramatically increased interest in Sub-Saharan African irrigation.[9]

Gravity-fed irrigation from surface water sources is the most economic method, but surface water supplies are often not available.[10] Therefore, it is necessary for policy makers to examine the economics of pumping ground water for use in irrigation. The energy used for this method is far greater than for gravity fed irrigation, and it therefore has much higher costs.

Different energy sources, however, are available for irrigation pumping and each should be examined for their economic feasibility, and their suitability to Sub-Saharan African conditions. Such an examination, however, must be site specific, and is beyond the scope of this report.

The goal of this report is to examine eight AID African irrigation projects and analyze their pumping components. It will first examine the general advantages, disadvantages, and African resource potential of alternative energy sources which may be used for irrigation pumping. It will then review the specific projects to determine:

a). if any alternative energy sources were considered for driving the water pumps, and;

b). if any of the various energy options were actually tested at the project site

It will also review the different problems each projects' water pumping component encountered, according to the project evaluations, and some of the solutions which were proposed to deal with them. Finally, this paper will examine the lessons to be learned from these projects' water pumping experiences. Abstracts of the plans for each project are located in Annex I.

Figure 1. Sub-Saharan African Irrigated Perimeters - 1981

	Thousands of Hectares	% of World Irrigation
World	212,860	
Asia	134,179	63.0%
Sub-Saharan Africa	3,464	1.6%
Benin	20	
Botswana	3	
Burundi	5	
Cameroon	10	
Cape Verde	2	
Chad	4	
Ethiopia	60	
Gambia	32	
Ghana	23	
Guinea	13	
Ivory Coast	27	
Kenya	48	
Liberia	4	
Madagascar	480	
Malawi	11	
Mali	115	
Mauritania	9	
Mauritius	16	
Mozambique	68	
Namibia	8	
Niger	36	
Nigeria	30	
Reunion	5	
Rwanda	3	
Senegal	180	
Sierra Leone	7	
Somalia	165	
Sudan	1,850	
Swaziland	30	
Tanzania	66	
Togo	10	
Uganda	5	
Upper Volta	6	
Zaire	7	
Zambia	6	
Zimbabwe	100	

Source: F.A.O. Production Yearbook 1982 p. 57

Alternative Methods for Irrigation Pumping in Africa: Advantages and Disadvantages

The following is a discussion of alternative methods for irrigation pumping in Africa, which includes a brief assessment of their advantages, disadvantages, and Africa's resource potential for their various energy sources

The information contained in the following discussions of "advantages" and "disadvantages" of the various energy sources is based on the following sources:

Halcrow, Sir William and Partners. Small-Scale Solar-Powered Irrigation Pumping Systems Technical and Economic Review. London, England: Intermediate Technology Development Group Ltd.; September 1981. (Executed by the World Bank) (p. 13)

Smerdon, E.T.; Hiler, E.A. Energy in Irrigation in Developing Countries. Washington, D.C.: A.I.D.; December 1980. (A.I.D. Report PN-AAJ-628 a.) (p. 49-52, 59-60)

Food and Agricultural Organization. Energy for World Agriculture. Rome, Italy.: 1978 (p. 10-15)

1). Petroleum/Diesel Motors.

For information on proven oil reserves in Sub-Saharan Africa refer to Figure 2.

Advantages. This is a widely available and well developed technology which can produce high energy output on demand. Small diesel engines are portable, and have low initial capital investment costs per unit of output. They are also generally considered to be the most economic method for driving small water pumps.

Disadvantages. Petroleum/diesel fuel is a finite resource which is expensive. The small diesel and petrol engines have relatively short lives and suffer frequent breakdowns. They are difficult to maintain, and require spare parts and fuel which most Sub-Saharan African nations must import with precious foreign exchange.

Country	Proven reserves (billions of barrels)[a]	Estimated oil production (thousands of barrels a day)			
		1977	1978	1979	1980
Angola	1,200	171	147	144	150
Cameroon	200	—	12	34	57
Congo Republic	660	34	47	53	56
Gabon	450	223	210	196	145
Ghana	6	—	—	—	2
Ivory Coast	50	—	—	—	3
Nigeria	16,700	2,079	1,905	2,301	2,100
Zaïre	130	23	18	21	22
Total	19,396	2,530	2,339	2,749	2,535

a. As of January 1, 1981.
Sources. *Oil and Gas Journal* and other petroleum industry sources.

Figure 2 Proven Sub-Saharan African Oil Reserves

2). Human Labor

Advantages. Many African nations have a large number of unemployed and under employed laborers. These laborers could be flexibly deployed at a low investment cost.

Disadvantages. For some African nations, however, there may not be that much surplus labor, and the opportunity cost of hiring labor may be significant. Furthermore, laborers can only pump a very low level of water - "one person can only pump enough water to irrigate at most one-half hectare when the lift is not more than two meters. One liter of diesel fuel can pump about as much water as one man working for 5 days or an ox working one day."[11]

3). Draught Animals

Advantages. Its an available energy source for many African nations with a medium investment cost, and it is a power source which can be flexibly deplored.

Disadvantages. Animals entail a high feeding cost, requiring extra food production, and can only pump limited amounts of water. Furthermore, trypanosomiasis has virtually precluded the use of one-third of the African continent for many draught animals.[12] "Poor nutrition, lack of dry season fodder, disease, and high mortality rates" are all problems which have plagued African animal traction programs in recent years.[13]

4). Centralized Rural Electrification

Advantages. Once the transmission lines are installed, the farmer's can purchase the electric pumps for a relatively low investment cost. Electric pumps are both reliable and efficient, assuming the supply of electricity is steady. It is considered to be the most economic and efficient energy source for driving large pumps.

Disadvantages. There is a high system investment cost. Generating and distribution costs may also be high, depending on the energy source. A sparse consumer population and high fluctuation in demand often raise the cost of rural electric systems in Sub-Saharan Africa. Finally, extended power failures could cause widespread damage to crops.

5). Hydropower

Potential in Africa. Hydropower potential in Africa is estimated to be 223 gigawatts, and only 2% of this potential has been exploited to date.[14] The potential for small-scale hydroelectric power has only been touched, and could benefit from closer engineering and economic analysis. Indeed, it is estimated that Zaire has over 1,000 suitable sites for small-scale hydropower.[15] Most countries in Sub-Saharan Africa, however have simply not investigated their hydropower potentials. One of the first small-scale hydropower projects ever attempted in Africa - the Yandohun project in Liberia - was only implemented in 1980.[16] The National Rural Electric Cooperative Association (NRECA), through a AID contract, in currently conducting resource assessments, feasibility studies, and technical and economic analyses regarding small-scale hydropower in Sub-Saharan Africa.

Advantages. Hydropower is a long life, low maintenance, pollution free and fuel free power source if proper site conditions are available.

Disadvantages. High initial construction costs and relatively rare site conditions limit potential benefits. Damming the water may have negative environmental effects, and may cause rapid silting and back water sedimentation.

6). Biomass

Potential in Africa. A small number of African countries with surplus production of molasses or sugar can consider the substitution of alcohol for gasoline. These countries include Kenya, Malawi, Mauritius, Sudan, Swaziland, Tanzania, Zambia and Zimbabwe.[17]

There are currently 18 African nations with one or more institutions engaged in biomass experiments or demonstrations.[18] The Ivory Coast and Botswana are constructing cattle dung digesters, while Uganda is experimenting with fruit residues.[19] South Africa is implementing a program of biomass irrigation pumps with disappointing results to date.[20] A recent field assessment of renewable energy technologies in Africa by the AID Africa Bureau found that the biomass powered water pumps that they observed were all prototypes in the experimentation stage. It concluded that "anaerobic digesters . . . may hold promise for the provision of power for irrigation pumping," but that they were "inherently complex and capital intensive."[21] Biomass technologies require further experimentation and development before their potential role in African irrigation pumping can be properly assessed.

Advantages. Biomass allows small engines to operate in rural areas without dependence on petroleum. It is a renewable energy source which can produce fertilizer as a by product. The waste can also be reprocessed into cattle feed, which solves many problems of waste disposal and of related environmental pollution. The technologies of gasification and methane production in particular are suitable for developing countries. Indeed, the Phillipines, India, China, and other nations have used them for years.

Disadvantages. Biomass fuels are generally low grade, and their impact on engines is largely unknown. Large scale collection of agricultural and animal waste can be costly. The digester requires high inputs of labor and water, and has a high investment cost. The storage of biomass material can be expensive, and provision must be made for spare parts and maintenance. Some of the biomass technologies, such as plant seed oils hold a lot of promise, but are in early stages of development. Fuel from grains, or other food crops has a very high opportunity cost, and the impact of biomass energy programs on food prices and availability must be carefully evaluated for the many arid, food-deficient countries of Sub-Saharan Africa.

7). Solar Power

For information on African solar resources refer to Figures 3 and 4.

Advantages. The sun is almost always available in areas where irrigation is needed. Furthermore, there is a natural correlation between energy availability and irrigation needs because solar radiation dries the soil, and hence the less energy the sun puts out, the more moisture the soil retains. Photovoltaic (PV) cells have long life and low maintenance when properly installed and supported. Solar energy is renewable, non-polluting, safe, and free of fuel costs.

Disadvantages. There are technical difficulties in using it on a large scale -- conversion and collection techniques must be improved to reduce the size of the cells. Furthermore, solar PV cells have serious limits on their energy output, and are often only strong enough to serve as a complimentary source of energy. It is an immature and complex technology with extremely high investment costs.

8). Wind Energy

Potential in Africa. Wind energy resources in Africa have not been carefully measured. Large areas have no data measuring systems at all. The most common device that does exist in Africa, the counter cup totalizer, can provide only a rough indication of the wind energy potential as it records the mean speed--which can be difficult to correlate to available energy. Still, a number of areas have been identified as potential regions of good wind power availability, including the Senegal/Mauritania coasts and nearby islands, the northern part of the the Sahelian region of West Africa, the Rift Valley/Lakes region of East Africa, the coastal areas of East Africa, and parts of South Africa. Other regions may also have wind potential but have not been properly surveyed. Much of the interior of the continent has fairly low winds.

(Excerpted from "Wind Energy Activities in Africa" by Alan Wyatt and Sam Baldwin 1982 p. 2-4.)

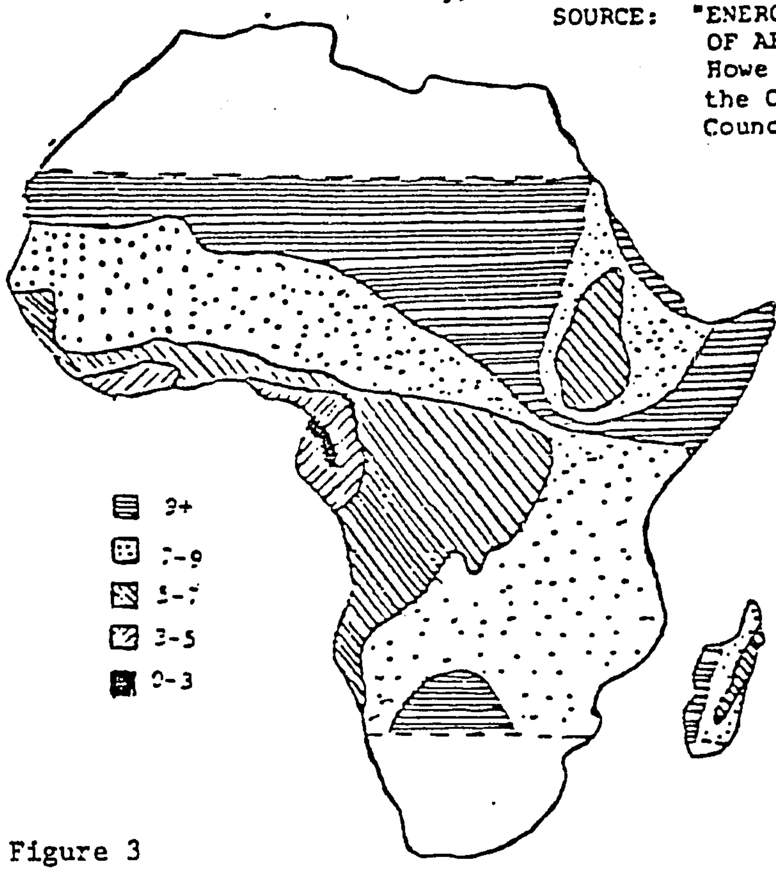
For more information on Africa's wind resources refer to Figure 5.

Advantages. Wind is a non-polluting energy source which has traditionally been used for pumping water in isolated, rural areas. Wind-powered water pumping is a mature technology with low maintenance and zero fuel costs. Wind-powered pumps are durable, reliable, and simple to operate. Wind conversion technology and spare parts can both be built in Africa - Kenya, Zimbabwe, and Tanzania all currently manufacture windmills.[22]

Disadvantages. Variations in energy output are significant according to the duration and force of the wind. Storage of electricity to compensate for this variation is expensive. Wind energy, like solar energy, has only the strength to be a complimentary energy source in many situations - depending on the sign of land to be irrigated, the meters of lift required for pumping, etc. Finally, windmills have high initial capital investment costs.

Mean Annual Sunshine

(Hours/Day)



SOURCE: "ENERGY FOR THE VILLAGES OF AFRICA" by James Howe and the Staff of the Overseas Development Council 1977 p. 115

Figure 3

DEVELOPING COUNTRIES WHOSE SOLAR CLIMATES INDICATE POSSIBLE APPLICABILITY OF PHOTOVOLTAICS

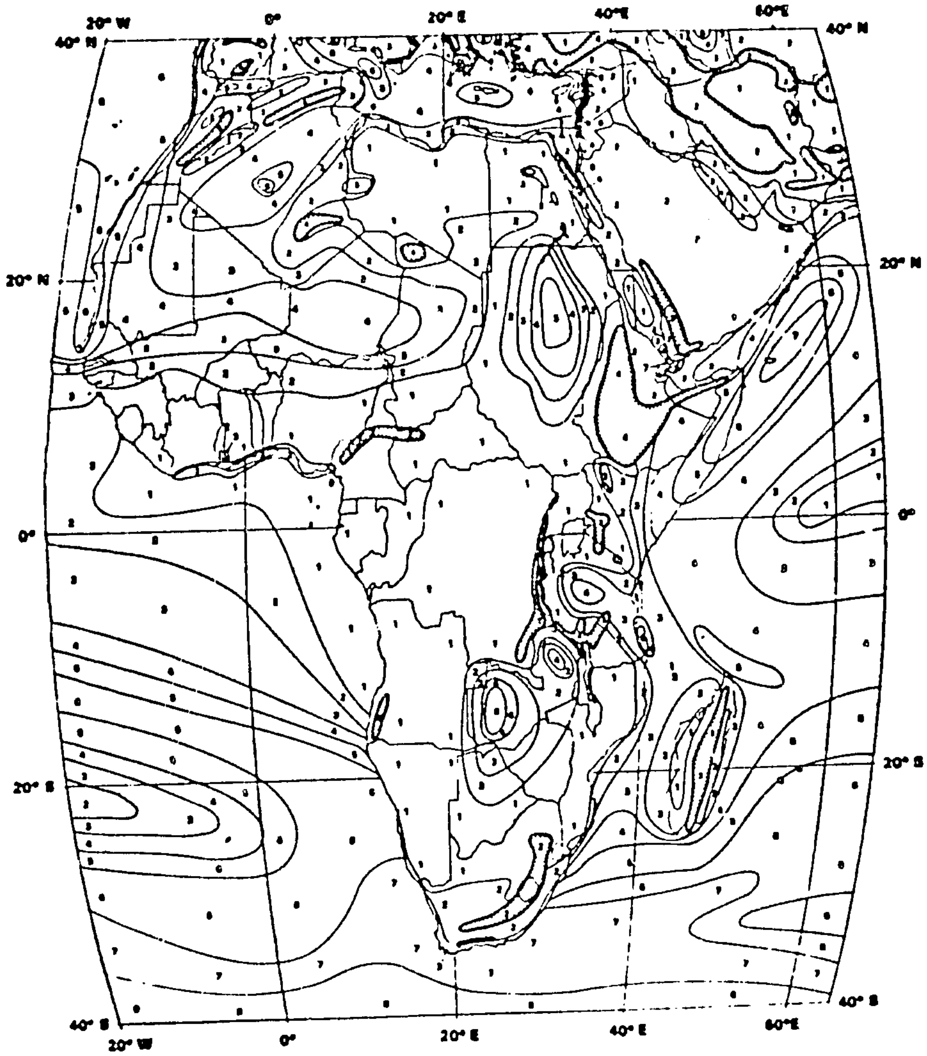
A*	B*		C*	
AFRICA				
Mauretania	Ivory Coast		Sierra Leone	
Mali	Togo	North	Liberia	
Niger	Dahomey		Togo	
Chad	Nigeria		Dahomey	South
Sudan	Kenya		Nigeria	
Egypt	Somalia		Gabon	
Senegal	Central Africa Empire		Congo	
Gambia	Tanzania			
Upper Volta	Mozambique			
Botswana	Swaziland			
Southwest Africa				
Zambia				
Madagascar				
Tunisia				
Morocco				
Malawi				
Lesotho				

SOURCE: "PHOTOVOLTAICS AND THE LESS DEVELOPED COUNTRIES" by U.S.A.I.D. 1977 p. 9

A = Highly Desirable
B = Desirable
C = Desirable for Certain Applications (Application where power need is intermittent or seasonal)

Figure 4

AFRICA - WIND ENERGY RESOURCE



CLASSES OF WIND ENERGY FLUX (WEF)

WIND ENERGY CLASS	10 m (33 ft) WEF W/m²	10 m (33 ft) SPEED m/s	10 m (33 ft) SPEED mph	50 m (164 ft) WEF W/m²	50 m (164 ft) SPEED m/s	50 m (164 ft) SPEED mph
-	0	0	0	0	0	0
1	100	4.4	9.8	200	5.6	12.5
2	150	5.1	11.5	300	6.4	14.3
3	200	5.6	12.5	400	7.0	15.7
4	250	6.0	13.4	500	7.5	16.8
5	300	6.4	14.3	600	8.0	17.9
6	400	7.0	15.7	800	8.8	19.7
7	800	8.8	19.7	1600	10.1	22.6
8	1200	10.1	22.6	2400	12.7	28.4
9	1600	11.1	24.9	3200	14.0	31.3
10	>1600	>11.1	>24.9	>3200	>14.0	>31.3

Figure 5

SOURCE: "WIND ENERGY ACTIVITIES IN AFRICA" by Alan Wyatt February 1982 p. 2

Reviews of eight AID African Irrigation Projects and Their Pumping Components

The following reviews of selected A.I.D. irrigation projects' pumping components are based upon examinations of the of the microfiche project files in AFR/PD/IPS -- Room 2485 NS. They are also based upon documents gathered from the microfiche project files of PPC/CDIE/DI -- Room 3659 NS.

The projects to be reviewed are:

1). 650-0026 Wadi Halfa Community Development - Sudan

Subproject 2. Youth Training
Subproject 3. Irrigation

2). 688-0226 SONADER/Africare Small Irrigated Perimeters - Mauritania

3). 664-0312.3 Small Holder Irrigation - Tunisia

4). 655-0003 Tarrafal Water Resources - Cape Verde

5). 608-0127 Doukkala Irrigation - Morocco

6). 685-0208 Bakel Crop Production - Senegal.

7). 688-0213 Action Ble - Mali

8). 688-0206 Action Riz-Sorgho - Mali

650-0026 Sudan - Wadi Halfa Community Development

Project 650-0026 used pumps, but did not specify which type of pumps, nor what energy source they used.

One of the problems of the Wadi Halfa project's pumping component was the fluctuating level of its water source--Lake Nasser. The level of the lake is controlled by the operation of the Aswan dam, and the lake level is often very low.[23] Indeed, in 1981 an (IVS) International Voluntary Services agronomist started a 5-feddan experimental irrigated farm for local youth training, but it had to be abandoned because the lake had receeded too far for the pumps to effectively draw water in for irrigation.[24] In response, I.V.S. is providing a suction pump with much greater pumping capacity for the next experimental farm.

Another problem encountered was with the design of the boreholes . Preliminary studies by the Sudanese government had asserted that no casings would be necessary because the lake was in direct contact with sandstone.[25] The preliminary analysis was incorrect, and resulted in a delay for subproject 3, the inland irrigation scheme.[26]

The project is still active, though AID's final year of funding was FY81. Total AID funding to the Wadi Halfa project amounted to $518,000. Only 2 of 5 subprojects, however, had irrigation components - subproject 2, youth training on the experimental irrigated farm, and subproject 3, the inland irrigation scheme.

It was planned that a windmill powered pump would be used for at least one of the five boreholes to be drilled for subproject 3.[27] This was to be done to test the efficiency of windmill powered pumps in the Wadi Halfa area - but no mention was made of it in the project evaluations. No economic analysis was available in the project file.

682-0226 Mauritania - Small Irrigated Perimeters

Project 6820226 used SLENZI motor pumps, which were found to be unadaptable to the environment.[28] The pumps suffered from serious and frequent breakdowns, and the pump batteries were often deficient.[29]

The pumping component of 682-0226 had many serious problems which negatively affected the entire project. There was not a sufficient system for stocking spare parts and providing needed maintenance.[30] An Africare technical advisor attempted to teach SONADER mechanics and pump operators through on-the-job training and technical advice, with little emphasis on formal training. The training was insufficient, however, which contributed to the project's record of poor pump maintenance.[31]

There are currently not enough irrigated perimeters in the Gouraye sector to support a private supplier and mechanic who could service the pumps.[32] If more perimeters are constructed in this sector, however, such a private venture could become economically feasible.[33]

The fluctuation of the Senegal river caused further problems for the project. The pumps used at Gouraye were not floating, and thus when the water level seriously declined the pumps could not provide sufficient water.[34] Trenches were dug to alleviate the problem, but the volume of water only permitted the pumps to operate for about 30 minutes.[35] In Diaguily I plans for irrigation were abandoned because of this problem.[36] In order for some of the abandoned perimeters to have been irrigated more than 150 meters of extra piping would have been required, and it was not available.[37]

The unreliability of the pumps slowed down the adoption rate of new technology by the farmers. Indeed, pumping problems were the major cause of hesitation among the farmers.[38]

The project had to be extended 9 months to address deficiencies in the provisions of spare parts, equipment, and maintenance for pumps.[39]

The project's funding was finally terminated after $457,000 had been invested by AID.[40]

No alternative energy sources for the water pumping component appear to have been considered.

664-312.3 Tunisia Small Holder Irrigation

Project 664-0312.3 is using Johnson deep-well electric pumps for the three irrigation perimeters.[41]. In addition, 323 existing shallow wells and 17 new ones are being equipped with diesel or electric driven pumps[42].

The civil works for the perimeters were almost complete at the time of the evaluation in March 1983, but the Johnson pumps were not yet installed[43]. This delay occurred because Tunisian customs failed to clear the Johnson pumps until January 1983, even though they arrived in Tunis in April 1982[44]. Thus, customs clearance was cited in the evaluation as one of the main implementation problems for the irrigated perimeters.

Another problem encountered with the pumping component of this project was the lack of training among the farmers, technicians, and personnel of supporting government agencies. The evaluation noted that "the in-country time spent on individual consultant assignments was too short and co-ordination was apparently inadequate"[45]. Thus, the expatriate technical consultants should have more contact with the Tunisians.

Furthermore, when some of the Tunisian technicians were flown to the U.S. they observed irrigation practices, but were not trained[46]. Such training trips "should be specifically designed as an intensive and practical short course covering irrigation problems "such as pump operation and maintenance.[47]

The evaluation noted that the perimeters appeared to lack a detailed operational and management program relating to, among other things, pump maintenance.[48]. It recommended that such programs be created.

The project is still active, with A.I.D. contributing $4,400,000 in loans and $400,000 in grants to the Tunisian government[49].

No alternative energy sources appear to have been considered for the pumping component of this irrigation project.

No economic analysis of the costs and benefits of alternative irrigation approaches was done for 664-0312.3. But this was because no systematic data was being collected. The evaluation team recommended "that a systematic program of data collection and analysis to appraise costs and benefits from alternative investments in irrigation systems "should be established.[50].

655-0003 Cape Verde - Tarrafal: Irrigation Investigations and Training

The Tarrafal irrigation project was concerned with investigation and training, rather than the construction of actual perimeters. Nevertheless, there was a brief examination of the role of water pumping and wells.

The mid-term special evaluation of project 655-0003 recommended that the government of Cape Verde (GOV) should be certain to train field technicians on the operation and maintenance of diesel and electrical pumps.[51]

Furthermore, the report asserts that the GOCV should carefully observe the drilled test wells to determine where reliable levels of sustained pumping can be established without aquifer deterioration (i.e. without draining the water table.)[52]

Concerning construction of the wells and the installation of the pumps, the report recognizes that flooding could be a problem. It asserts that the new masonry walls built around some of the wells are too low to protect against flooding, and recommends that the wells themselves be raised - especially if turbine pumps are to be installed.[53]

The evaluation also recommends that the masonry caps should be removed from the wells, and that steel caps should be put in their place to make the wells more secure.[54]

The project funding was completed in FY 1983 after a total investment of $3,217,000.[55]

The project evaluation team recommended that a windmill be installed to determine if it could effectively pumps water.[56]. No such determination, however, was written into the final project report.

No economic analysis was done in either the project evaluation summary (mid-term special evaluation) or the final project report. However, economic studies of both "traditional and alternative irrigation systems in terms of efficiency. water use, operation and maintenance costs, and management "were done.[57]

608-0127 Morocco - Doukkala Sprinkler Irrigation.

Project 608-0127 will consist of 4 pumping stations, each driven by electric motors.[58]. Each station will be fitted with underground conduits and hydrants. The 4 sectors of the Doukkala area, totaling 15,400 hectares, will be irrigated by a large sprinkler system.

The project was delayed for a few months because the low bidder defaulted on the delivery contract for sprinkler heads, which in turn required a new contract to be negotiated with the second lowest bidder.[59].

The most serious implementation delays, however, were in the "Americianizing" of the project materials and designs. The project engineering components were originally designed and specified by a French engineering firm (SCET). However, when A.I.D. contracting and equipment became involved, major modifications were required.[60]. The evaluation team concluded that" where AID funds and U.S. equipment are involved, U.S. engineering and contracting concepts should be involved from the earliest possible moment.[61].

The Doukkala project is continuing as planned. AID has contributed $13,000,000 to the total project costs of $94,000,000.[62]. No economic analysis was performed in the evaluation, and no alternative energy sources for the pumps were mentioned.

685-0208 Senegal - Bakel Irrigated Perimeters

Lister HR-2 (2 cylinder) and HR-3 (3 cylinder) diesel engines were used exclusively throughout the Bakel irrigation project. [63]. However, there were different types of pumps used with these engines, and with different results. The evaluation team found the 5 Marlo pumps to be both inefficient and unreliable, and advised that they "be retired from service".[64] Conversely, they found the Deloule pump used with the HR-3 engines to be the best combination.[65] 50 pumping plants using various combinations of Lister engines and pumps were operating at the time of the evaluation in January 1982.[66] These plants were installed on small fiberglass and metal rafts to draw water from either the Senegal river, or from swamps.

There were serious problems encountered with the floating pumps stations, despite the assertion in the project paper that such set-ups had "been tested for two years in the Bakel area and (were) operating satisfactorily."[67] Indeed, the existing float systems were found to be grossly inadequate,: and reports indicated that four to five floats per year were tipping over and drowning the engines.[68]

Another problem with the floats was that most were listing at various angles. This was damaging the diesel engines by adversely affecting their lubricating systems and loading the shafts and bearings unevenly.[69] The evaluation team estimated that inadequate floats were" responsible for increasing maintenance and repairs by at least 25% project wise, and at the same time reducing engine life by a like amount."[70]

The report observes that the floats "are" breaking up because of the small support area for the pump, the vibration of the engine, and collision with floating debris."[71] It recommends the use of wider timbers to better support the weight of the pump, heavier plywood put together with marine glue to frame the fiberglass," and rubber mounting pads to help absorb the shock of the engine.[72]

The fueling systems are also a problem area for the project. Fuel is currently brought in 200 liter drums brought by boat or truck. The fuel is poured in open buckets and carried to the floats, resulting in considerable contamination with dirt and water. According to evaluation team estimates," a 25% reduction in engine life and a 25% increase in maintenance costs."[73] The evaluation recommends that 2000 liter storage tanks should be built for each pumping plant to "provide a safety margin against fuel delivery interruptions."[74] Furthermore, either closed containers or hoses should be used to carry the fuel to the engines.[75]

The evaluation reports that the pumping plants maintenance programs were "casual at best",[76] Indeed, the project mechanics were overburdened by minor repairs and problems caused by improper maintenance.[77] The SAED (Senegalese Ministry of Agriculture) chief mechanic was very capable, but he had both insufficient help and tools to keep up with pumping maintenance and repair for the project.[78] The report concludes that the farmer operators and SAED mechanics must be trained about "routine preventative maintenance practices, minor repairs and service; record keeping; plus principles of diesel engines, centrifugal pumps, and water lifting.[79]

The project has been active since FY 77 at a total cost $7,209,000.[80]

Alternative energy sources for water pumping were to be tested under this project. Indeed, AID and the Government of France each funded $625,000 to firms in their countries - Thermo-Electron and SOFRETES respectively - to construct a solar thermal pump facility.[81] It was to replace diesel pumps on one of the perimeters as an experiment.

The evaluation team, however, found many problems with the solar facility. Its potential to irrigate land is considered to be about the same as a standard floating 2-cylinder diesel pumping plant.[82] The solar facility is materials intensive, requiring large amounts of glass, aluminum, and copy, and thus its cost "tends to rise as fast or faster than energy costs."[83] Furthermore, the facility will be expensive to operate in terms of: "salaries and expenses for expatriate technicians; cleaning, repair, and maintenance of the collectors; and maintenance of the machinery."[84] They recommended that the solar thermal facility be terminated as soon as possible.[85] Four months after the evaluation was published Thermo Electron wrote a project status report. The report noted that the solar station was 33 months behind schedule.[86]

Furthermore, it noted that when the current estimated completion cost was added to past expenditures the total unplanned cost overrun would be $737,002.[87]

688-0213 Mali - Action Ble

The Action Ble project is using low head 4HP diesel engines with a lift of 5-15 meters.[88] The pumps are expected to irrigate 4 hectares a piece, with one farmer per hectare.[89]

The project has had many serious problems in its brief history. Indeed, AID suspended project funding in 1981 due to serious administrative deficiencies in the Action Ble organization.[90] The parastatal organization was supposed to establish a revolving credit fund "to provide participating farmers with credit for financing the purchase of irrigation pumps."[91] The money that was supposed to be put into the fund, however, was spent on operating expenses contrary to the project agreement.[92]

The organization, without mission approval, "shipped 425 pumps from secure storage in Bamako, the capital of Mali, to the project site at Dire."[93] 277 pumps were found by an auditing team lying in an open field without adequate security or storage--several were damaged by weather.[94]

Action Ble has not formulated a policy on the issue of delinquent borrowers, nor have they determined what to charge farmers for pumps and fuel.[95] Action Ble was negligent in providing necessary inputs, such as diesel fuel, and "farmers (have) in turn lost confidence" in the organization.[96] AID funds were suspended until all these administrative policies were resolved.

In April 1982 W. DeRafols, a consultant, wrote an economic analysis of Action Ble. He listed a series of major project constraints, of which the following had a negative impact on the pumping component:[97]

1) The lack of roads to the project site at Dire makes transportation of diesel fuel supplies, spare parts, and other pumping inputs very difficult.

2) Even if the inputs could be easily transported, Action Ble lacks proper storage facilities for them. A pumping station for fuel needs to be constructed.

3) The farmers need mechanics to service the pumps. Action Ble currently has an insufficient number.

4) Assigning only one pump to 4 farmers creates arguments and other complications.

5) The farmers need to be trained more about the skills of irrigation. The untrained farmers tend to pump excess water, wasting fuel and raising operation costs.

6) The lack of a proper agricultural credit program prevents most farmers from purchasing inputs in advance, mainly fuel. This is a long standing problem with Action Ble.

DeRafols concluded that, in light of these and other constraints, "most of the farmers do not have a positive return" in project Action Ble.[98]

The project is on-going, with a total projected cost of $2,066,000.

Animal power, in the form of "flow pumps", (See Figure 6) was to be tested as an alternative energy source for pumping in this project.[99] Furthermore, both solar pumps and animal pumps were economically assessed in comparison to diesel pumps.[100] But these alternative pumps appear to have been ignored in the post project paper documentation.

688-0206 Mali - Action Riz-Sorgho

Action Riz-Sorgho's design team initially rejected the use of small motor pumps for the project (project paper appendix A). They believed that insubmersible dikes would be the key to both assuring and increasing rice production. An AID evaluation in April 1981 asserted that this approach was "inherently wrong" and that the design team had a "lack of understanding of farming practices and exigencies in the Niger River corridor".[101]

The Action Riz-Sorgho (ARS) staff has been handling the pumps they do have very poorly. The evaluation reports that "over half of the ARS motor pumps are lying idle and non-operational," and the "supply rooms (are) in disarray."[102] Furthermore, ARS staff are "(failing) to respond to farmers requests for ... pumping services."[103]

The ARS project staff and management, the evaluation concludes, are neither "technically trained (nor) focused enough to meet the needs of the agricultural situation.[104] The projects personnel fail "to give priority to technical needs - engineering and logistics are generally downgraded within the projects managerial framework.[105]

There was also a problem with the ARS personnels' attitudes and communications regarding the farmers. Many farm villagers, despite the presence of a ARS extension agent in their village, did not even know pumping services were offered.[106] ARS staff often "stated the need to 'oblige' or even force farmers to follow ARS instruction."[107]

The ARS office at Tacherane, which in principle was supposed to serve approximately 500 farmers, had only two 6HP pumps, and one was broken.[108] The ARS office at Gargouna had three 4-5HP pumps, but only one was rented out, because one was broken, and the other one was "too heavy to move."[109]

The evaluation recommends that the Action Riz-Sorgho administration should be "revamped and redefined".[110] They assert that local cooperative stores, as opposed to the ARS staff, should handle the pumps and related equipment.[111] The increased use of diesel-fueled water pumps in encouraged to decrease the risk and increase the yield and income of farmers participating in Action Riz-Sorgho.[112]

The project is still active, with a projected total cost of $4,285,000.[113]

An animal-driven "flow pump" was scheduled to be tested in this project as an alternative to the motor pumps. The evaluation team, however, observed that ARS personnel were unable "to install or to conduct a test program" on an animal-powered flow pump."[114] Furthermore, an ox-drawn water lifting device, the Noria (See Figure 7), was supposed to be tested for irrigation potential. At the time of the April 1981 evaluation, however, the Noria had not been tested.[115]

FLOW PUMP

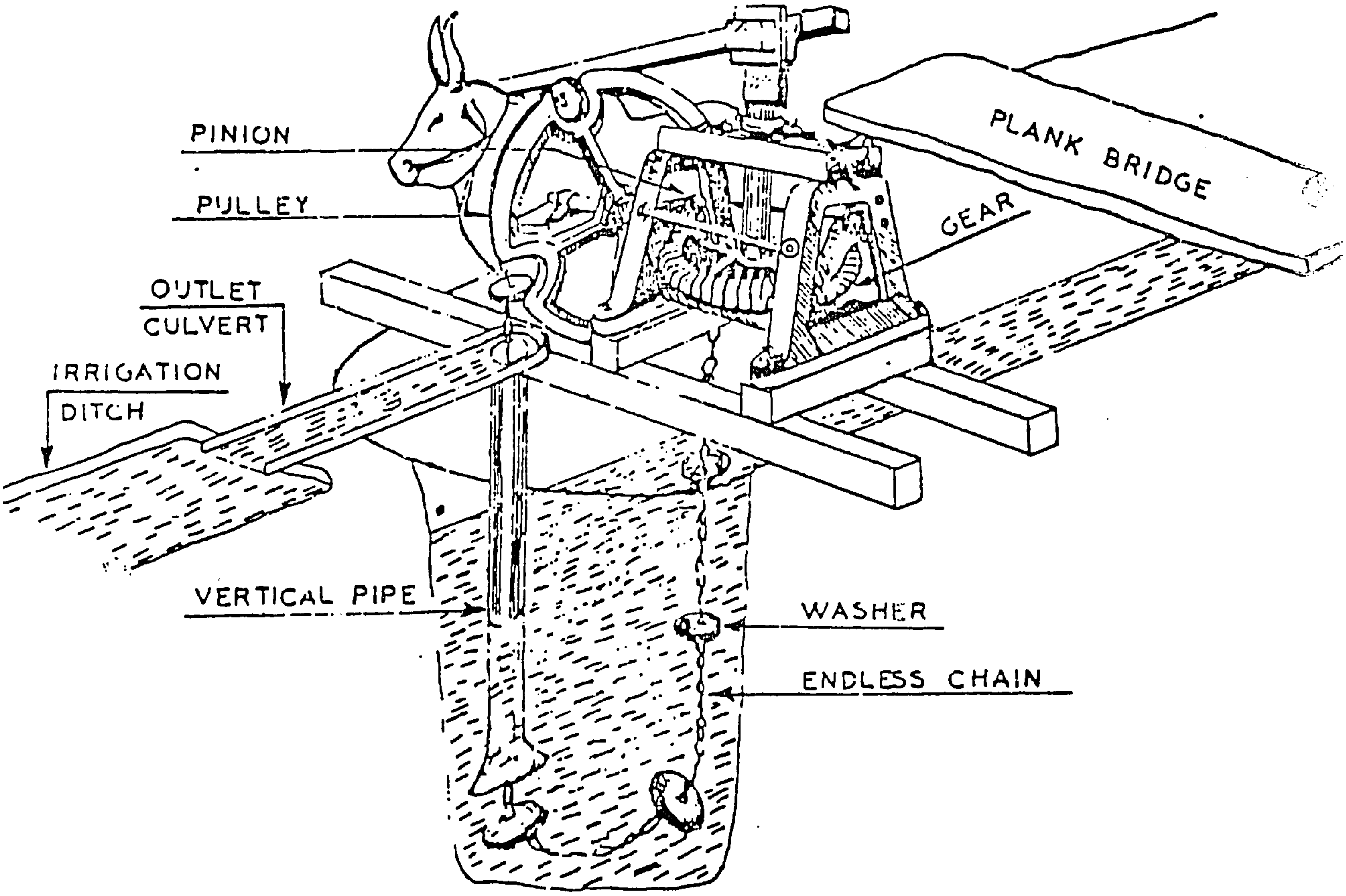


Figure 6

SKETCH OF A NORIA

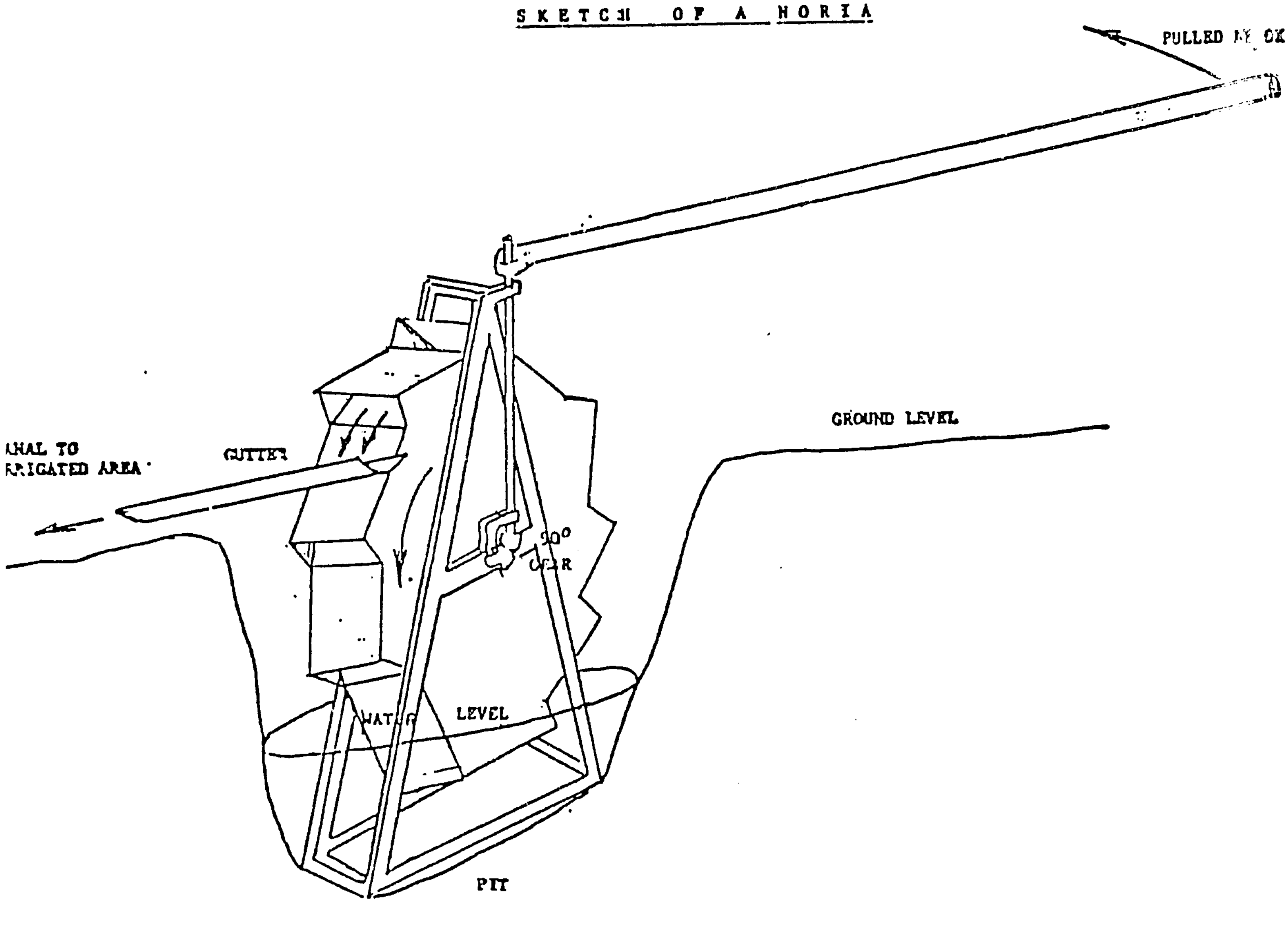


Figure 7

Conclusions

1). Africa has great wind, solar, biomass, and hydropower resources. Site specific experiments, however, are necessary to determine their technical and economic feasibility for driving water pumps. Conversely, Sub-Saharan Africa has few proven reserves of oil.

2). The price of oil, a finite resource, will inevitably rise as it becomes more scarce. The price of renewable energy technologies, however, will start to fall as demand for them increases and as they are developed over time.

3). Irrigation water pumping will be necessary for arid and semi-arid areas where surface water supplies are inadequate. Furthermore, as oil prices increase, alternative energy sources will have to be harnessed for the purpose of water pumping.

4). AID has had relatively few irrigation projects in Sub-Saharan Africa. Those that have been implemented have had many serious problems with, among other things, their water pumping components. These problems for six Sub-Saharan and two North African AID irrigation projects are summarized at the end of this section.

5). AID has almost exclusively used diesel and gasoline driven water pumps for their African irrigation projects. Furthermore, they have rarely experimented with pumps driven by alternative fuels. As Figure 8 illustrates, only five of eight irrigation projects reviewed appear to have considered such experiments*--and none of the experiments have actually been implemented.

*This determination is based upon examination of the eight project's files--mainly project papers and evaluations--hence energy alternatives <u>may</u> have indeed been considered for all. No results for such experiments, however, were reported in the evaluations.

Figure 8

PROJECTS THAT EXAMINED ALTERNATIVE ENERGY SOURCES FOR IRRIGATION PUMPING

	Considered Experiment	Initiated Experiment	Completed Experiment
650-0026	Windmill	---	---
688-0226	---	---	---
664-0312.3	---	---	---
655-0003	Windmill	---	---
608-0127	---	---	---
685-0208	Solar Thermal Pumping faci lity	Construction is 33 months behind schedule/cost overruns a serious problem	Termination of experiment has been recommended
688-0213	Flow-pump (see fig. 6)	---	---
688-0206	Flow-pump, Noria (see fig. 7)	--- ---	--- ---

A. <u>Engineering Problems</u>

Wadi Halfa

1. Fluctuation of Lake Nasser's water level.

2. Engineering feasibility study's incorrect analysis of sandstone boreholes.

SONADER/Africare Small Irrigated Perimeter

3. SLENZI motor pumps are deficient.

4. Fluctuation of Senegal River

Tarrafal Water Resources

5. Wells were built too low to protect pump engines from flooding

6. Masonry well caps insufficient protection, should be replaced by steel caps.

Doukkala Irrigation

7. The "Americanizing" of French engineering design and specification.

Bakel Perimeters

8. Inefficient selection and pairing of pumps and engines.

9. Deficient float design for water pumping stations.

10. Deficient fueling systems for water pumping engines.

11. Solar pumping station experiment is too materials intensive, and dependent on expatriate technicians.

Action Riz-Sorgho

12. Project design team erred in rejecting use of small motor pumps.

B. Administrative/Political Problems

SONADER/Africare Small Irrigated Perimeters

1. System of stocking spare parts and providing maintenance is insufficient.

Tunisia Small-Holder Irrigation

2. Customs problems delayed delivery of the Johnson pumps, and the entire project, for 8 months.

3. There was no detailed operational and management program for the project.

Doukkala Irrigation

4. Project was delayed when low bidder defaulted on contract.

Bakel Perimeters

5. No detailed maintenance program.

Action Ble

6. Administrative deficiencies resulted in a suspension of funds. These deficiencies included:

a). failure to establish a revolving credit fund for farmers to purchase pumps and inputs.

b). commodity abuse, e.g. 277 pumps left lying in a field.

c). failure to formulate policies on rates to charge farmers for pump rental and other inputs.

7. Logistical problems - very isolated region with no good roads.

8. Storage problems - pumping station for fuel, and shelter for pumps.

Action Riz-Sorgho

9. ARS personnel have failed to care for pumps - half their pumps are non-operational.

10. ARS personnel are reported to be unqualified - and they have down graded technical, logistical, and engineering matters in their managerial framework.

C. Training/Manpower Problems

SONADER/Africare Small Irrigated Perimeters.

1. On-the-job training and technical advice was insufficient in this project to train the SONADER mechanics.

Tunisia Small-Holder Irrigation

2. Expatriate technical consultants were in Tunisia for too short a time, and they failed to provide sufficient training for the farmers, technicians, and personnel of Tunisian government agencies.

3. Tunisian mechanics were flown to the U.S. where they observed irrigation practices, but were not trained.

Tarrafal Water Resources.

4. Field technicians need to be trained about the operation and maintenance of diesel and electric pumps.

Bakel Irrigated Perimeters

5. Farmer operators and Senegalese Ministry of Agriculture (SAED) mechanics need more training.

Action Ble

6. More mechanics are needed to service pumps.

7. Farmers need to be trained more about the skills of irrigation, as they are pumping excess water and wasting fuel at the present.

Action Riz-Sorgho

8. The ARS staff was found to have insufficient technical training to meet the projects agricultural needs.

D. Economic Problems

SONADER/Africare Small Irrigated Perimeters

1. There were not enough perimeters in the area to support a private mechanic for servicing pumps.

Bakel Perimeters (Solar Experiment)

2. The solar thermal pumping facility has no hope of ever becoming economically competitive with diesel.

E. Social Problems

SONADER/Africare Small Irrigated Perimeters

1. Farmers came to distrust pumps because of their unreliability.

Action Ble

2. When each pump was assigned to four farmers it created arguments and other complications.

Action Riz-Sorgho

3. The ARS staff failed to notify farmers about pumping services which were offered. They also forced farmers to follow ARS instructions, which created hostility among the farmers.

Recommendations

1). A.I.D. African irrigation projects should continue to be designed with diesel-powered water pumps because, for the present time, they are the most economical method of water pumping. However, experimentation with alternative energy sources for water pumping should continue because their price will continue to fall while the price of gasoline and diesel fuel will inevitably rise.

2). Such experiments, however, should be less ambitious and more realistic than some of the previously documented ones. Project Action Ble, for instance, planned to test 105 animal-driven flow pumps, and yet no such tests have been documented. Project Action Riz-Sorgho planned to test both flow pumps and an ox-drawn water lifting wheel known as the "Noria." An evaluation team noted that the project personnel were unable to either install or to conduct the tests. More care should be taken in designing experiments to insure their practicality.

3). The personnel who conduct such experiments should take more care in documenting their results. In many of the projects that were examined in this report experiments with alternative energy sources for water pumping were considered in the project paper or in other planning documents, but the results of such experiments, or the reasons for their cancellation, were no where to be found. The proposed installations of windmills for driving water pumps in the Tarrafal Water Resources project and the Wadi Halfa Community Development project are two examples. Such experiments were to test the windmills' feasibility at the sites of the two projects, but no mention of such experiments were made in later documentation. It is very important to document the results of such experiments, or the reasons for their rejection, so that future African irrigation project designers may learn and benefit from them.

4). The designers of future African irrigation projects should be more explicit about which exact type of water pumping equipment is being proposed for project use, and the evaluation teams should be more explicit about which types of such equipment are performing satisfactorily, and which are not. Such information is critical for the planning of future African irrigation projects as planners may select, from past documentation, which pump/engine combinations are optimal and which ones should be avoided. In the Bakel evaluation of

Janurary 1982, for example, the Lister HR-2 and HR-3 diesel engines and the Deloule pumps are cited as the best combination while the Marlo pumps were found to be the most inefficient and unreliable. In contrast to this well documented and very useful information the Wadi Halfa and Doukkala evaluations did not mention which types of pumps were being used, and the November 1982 evaluation of the Mauritania Small Irrigated Perimeters project which condemned SLENZI motor pumps for their unreliability did not specify which fuel they used.

5). Regarding engineering project problems, and relating to the above recommendation, there must be better technical water pumping information written into project documentation -- from the planning stage to the final project evaluation. Specific areas of concern for engineers involved with African irrigation projects include:

a). The problem of fluctuating water levels in rivers and lakes, and the issue of how to best pump water from them. The floating pumping stations of Bakel and Mauritania Small Irrigated Perimeters are one possible solution, but putting pumps on rails which go into the water is another one (mentioned in the Janurary 1982 Bakel evaluation.) Another possible solution is to place the pumps on platforms connected to pulleys and beams which go over the river and are lowered or raised according to need by people on shore (mentioned in the Project Evaluation Summary for Wadi Halfa.) Studies of this problem are currently being undertaken in Africa.

b). The problem of conforming with foreign engineering designs and specifications in areas where A.I.D. is entering a project. This is particularly a problem with the French is Francophonic Africa as their engineering designs are radically different.

c). Other construction problems such as fuel system design, well construction, and pump and engine selection and installation.

6). Regarding administrative and political problems with African irrigation projects, personnel weakness was the major constraint. Administrative deficiencies have created critical problems with Projects Action Ble and Action Riz-Sorgho, and have plagued all other projects covered in this report to one degree or another. Specific areas of weakness include the project personnels' failure to properly use project funds or commodities (including pumping equipment and the funds to buy them), the failure to establish adequate systems of maintainance and spare parts for the pumps, and the failure to formulate necessary policies on rates to charge farmers for pump rental and other inputs. One of the prime concerns of planners designing African irrigation projects should be to ensure the project is staffed with sufficiently trained personnel. This is also a political problem in the sense that the governments of the African countries where the projects are being implemented share expenses, appoint personnel -- as in the case of Project Action Ble and the Government of Mali -- and eventually are supposed to assume responsibilitly for the projects. These governments must have the political will and administrative ability to run the projects if they are to succeed.

7). Regarding training and manpower problems the most significant one was the general lack of competent diesel pump mechanics, although as noted above there are many manpower weaknesses. A.I.D.'s efforts in these projects to train the farmers, mechanics, and government personnel of the African countries have generally been insufficient to meet project needs. Formal and intensive training needs to be emphasized. In the Tunisian irrigation project Tunisian mechanics were flown to the U.S. where they "observed" irrigation practices, but they recieved no formal training. In the Mauritania Small Irrigated Perimeters project the on-the-job training and technical advice that was offered was again insufficient. Indeed, the unreliability of the pumps and the lack of trained mechanics to deal with them was cited as one of the main problems of the project. In Project Action Ble the failure to properly train the farmers about the "discipline" of irrigation resulted in poor water and energy management, as both fuel and water were wasted.

8). Regarding economic problems with the African irrigation projects the private sector cannot always be counted on to support mechanics, spare parts suppliers, and other necessary investments, especially in the beginning years of the project. The project must be at a large enough scale to support such investments before the public sector can back away from them. In the Mauritania Small Irrigated Perimeter project there were not enough perimeters to support a private diesel mechanic.

9). Regarding social problems, more attention should be paid to the social implications of project plans. Social problems can be a serious constraint to an irrigation project's success, as was the case with Project Action Riz-Sorgho when the ARS personnel started coercing farmers to follow instructions, and alienating them. This clearly hindered the project and discouraged farmer participation. In Project Action Ble each pump was assigned to four farmers, which resulted in arguments over who got to use the pump and when. Projects should be designed to encourage local farmer participation and to disturb local social patterns and customs as little as possible.

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86). Thermo Electron Corporation, Solar Thermal Water Pumping System for Bakel, Senegal (Waltham, Massachusetts: 27 April 1982), p.1.

87). Thermo Electron, Bakel, p.2

88). See Abstract for Action Ble in Annex I.

89). Ibid.

90). A.I.D., Major Implementation Problems Confront Action Ble (Washington, D.C.: 24 September 1981), cover page.

91). A.I.D., Major Implementation Problems, p.ii.

92). Ibid.

93). A.I.D., Major Implementation Problems, p.iii, 14, 15.

94). Ibid.

95). A.I.D., Major Implementation Problems, p. 3.

96). Ibid.

97). W. De Rafols, Economic Analysis of Project Action Ble - Dire (Washington, D.C.: A.I.D., April 1982), p. 30-32.

98). De Rafols, Economic Analysis, p. 32.

99). See Abstract for Action Ble in Annex I.

100). A.I.D., Action Ble Project Paper (Washington, D.C.: 26 April 1978), Annex VI, VIII.

101). A.I.D., Action Riz-Sorgho Project Evaluation (Washington, D.C.: April 1981, p. 8.

102). A.I.D., ARS Project Evaluation, p. 13.

103). Ibid.

104). Ibid.

105). Ibid.

106). Ibid.

107). Ibid.

108). A.I.D., ARS Project Evaluation, Annex B p.

109). Ibid.

110). A.I.D., ARS Project Evaluation, p. 13.4.

111). A.I.D., ARS Project Evaluation, p. 32.

112). A.I.D., ARS Project Evaluation, p. 35.

113). See Abstract for ARS in Annex I.

114). A.I.D., ARS Project Evaluation, p. 13.

115). A.I.D., ARS Project Evaluation, Annex B p. 8.

Annex I. Project Abstracts

The following pages are project abstracts from Development Information (PPC/CDIE/DI) computer system (Rm. 3659 NS.) They summarize the project plans, and not the results. Nevertheless, they do provide a concise description of the irrigation projects which are reviewed in this paper.

AFR/TR/SDP, Alan Borst:SL:9/7/84:4342P

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6500026 Sudan
WADI HALFA COMMUNITY DEVEL:YOUTH TRAIN
FY 78 - 82 Status: A Total LOP Cost (x000): $ 518
Loan or Grant / Appropriation Code / LOP Cost: G / FN / 518
Subproject: 02

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<<< DEVELOPMENT PROBLEM >>>

THE LAKESHORE AREA OF WADI HALFA HAS NEVER BEEN CULTIVATED. THE WADI HALFA COMMUNITY NEEDS TO IMPLEMENT AN INTEGRATED AGRICULTURAL TESTING PROGRAM, INCLUDING IRRIGATION, FERTILIZER AND SEED TESTING, AND ON-THE-JOB TRAINING FOR YOUTHS IF THE AREA IS TO BECOME ECONOMICALLY SELF-SUFFICIENT.

<<< STRATEGY >>>

FIVE YEAR OPERATIONAL PROGRAM GRANT TO INTERNATIONAL VOLUNTARY SERVICES(IVS) WILL FINANCE TECHNICAL AND ADVISORY ASSISTANCE AND EQUIPMENT TO SUDAN'S WADI HALFA COMMUNITY TO DEVELOPAN INTEGRATED AGRICULTURAL TESTING PROGRAM INCLUDING YOUTH TRAINING.

<<< LOGICAL FRAMEWORK >>>

GOAL: TO IMPROVE ECONOMIC AND SOCIAL CONDITIONS CONTRIBUTING TO THE OVERALL DEVELOPMENT OF SUDAN. SUB-GOAL: TO CREATE CONDITIONS WHICH WILL ACCELERATE THE DEVELOPMENT AND RECONSTRUCTION OF WADI HALFA.

PURPOSE: TO ENHANCE THE ECONOMIC AND SOCIAL WELL-BEING OF PRESENT AND FUTURE WADI HALFA AREA POPULATION BY STIMULATING AGRICULTURAL DEVELOPMENT THROUGH IRRIGATION SYSTEMS DEVELOPMENT, CROP TRIALS, AND YOUTH AGRICULTURAL VOCATIONAL TRAINING; AND IMPROVING HEALTH/NUTRITION AND SANITATION CONDITIONS.

OUTPUTS: 1)LAKESHORE IRRIGATION SYSTEM; 2)INLAND BORELAND PUMP IRRIGATION SYSTEM; 3)YOUTH AGRICULTURAL VOCATIONAL TRAINING FARM PROGRAMME; 4)CROP TRAIL DATA IN FOODCROP, FRUIT, AND FODDER PRODUCTION; 5)EXPANDED POTABLE MUNICIPAL WATER SYSTEM; 6)SANITATION FACILITIES; 7)NUTRITION EDUCATION AND PRE-SCHOOL CHILD FEEDING PROGRAMME.

INPUTS: INTERNATIONAL VOLUNTARY SERVICE(IVS) AND OTHER DONOR CONTRIBUTIONS: 1)SIX IVS/CATHOLIC RELIEF SERVICES(CRS) TECHNICIANS AND STAFF; 2)COMMODITIES: PUMPS, CEMENT, HOSE, PIPE, DRILLING RIG, HANDTOOLS, FITTING.ETC, THREE FOUR-WHEEL DRIVE VEHICLES, ONE FIVE-TON LORRY, ONE 12KVA GENERATOR, OFFICE SUPPLIES AND EQUIPMENT, HOUSEHOLD FURNITURE, FUEL TRANSPORT AND TRANSPORATION COSTS; 3)TRAINING: SEMINARS, WORKSHOPS, OJT, VISUAL AIDS. HOST CONTRIBUTION: 1)600MM TECHNICIANS STAFF AND SKILLED LABOUR, 2)COMMODITIES: FUEL, SPARE PARTS, WATER SUPPLY

<<< ABSTRACT >>>

OPERATIONAL PROGRAM GRANT TO INTERNATIONAL VOLUNTARY SERVICES(IVS) WILL SUPPORT A SIX-PART COMMUNITY DEVELOPMENT PROJECT IN WADI HALFA, SUDAN. UNDER THE SECOND SUBACTIVITY, IVS TECHNICAL AND ADVISORY ASSISTANCE WILL BE USED IN IRRIGATION, HORTICULTURE, AND ARBORICULTURE, INCLUDING ON-THE-JOB TRAINING FOR YOUTHS THROUGH FIELD TESTING.

AN IVS IRRIGATION AGRONOMIST VOLUNTEER WILL INSTALL PUMPS AND DIVIDE THE INLAND IRRIGATION INTO THREE SECTIONS: A)HORTICULTURAL EXPERIMENTS INVOLVING TESTS OF FRUIT AND DATE TREES; B)WINTER ROTATIONS FOR BARLEY, SUGAR CANE, AND WHEAT; C)AND WINTER VEGETABLES SUCH AS ONIONS, BEETS, CABBAGE, PEAS, BEANS, POTATOES, AND SALADS. SHADE AND TIMBER TREES WILL BE PLANTED AROUND THE PERIPHERY AS A WINDBREAK. EMPHASIS WILL BE PLACED ON PRODUCING HIGH-YIELD

VARIETIES OF TRADITIONAL CROPS TO VERIFY THE MOST ECONOMIC IRRIGATION AND CULTIVATION METHODS. INTRODUCTION OF NEW CROPS WILL AT FIRST PLAY A MINOR ROLE.

BOYS AND GIRLS BEING TRAINED WILL WORK WITH THEIR PARENTS. STUDENTS WILL WORK ON SMALL PLOTS TO GROW THEIR OWN VEGETABLES. THE PLOTS WILL BE ON TWO SECTIONS OF THE FARM (LAKESHORE AND INLAND IRRIGATION), EACH OF 50 FEDDANS, AND WILL ABSORB 250 YOUTHS ON A TWO-YEAR PART-TIME COURSE.

THE IRRIGATION AGRONOMIST WILL WORK CLOSELY WITH HIS COUNTERPART HORTICULTURALIST IN SUPERVISING CROP TRIALS. AFTER THE MOST PRODUCTIVE VARIETIES ARE IDENTIFIED, A SEED MULTIPLICATION AND DISTRIBUTION SYSTEM WILL BE INTRODUCED IN THE COMMUNITY. SEED AND CUTTINGS WILL BE PURCHASED FROM THE GOVERNMENT OF SUDAN'S AGRICULTURAL RESEARCH AND DEVELOPMENT STATION AT ATBARA. PRODUCE WILL BE MARKETED THROUGH THE COMMUNITY'S COOPERATIVE SOCIETY WITH TECHNICAL SERVICES OF THE ON-POST COOPERATIVES INSPECTOR.

IT IS EXPECTED THAT OFFSHOOT ACTIVITIES SUCH AS FRUIT AND VEGETABLE PACKING AND MARKETING, TRANSPORT, ANIMAL HUSBANDRY, DAIRY AND MEAT PROCESSING AND MARKETING WILL PROVIDE EMPLOYMENT AND INCOME TO ANYONE WHO ENGAGES INTO COMMERCE WITH WADI HALFA'S COOPERATIVE COMMUNITY.

6500026 Sudan
WADI HALFA COMMUNITY DEVEL:IRRIGATION
FY 78 - 82 Status: A Total LOP Cost (x000): $ 518
Loan or Grant / Appropriation Code / LOP Cost: G / FN / 518
Subproject: 03

<<< DEVELOPMENT PROBLEM >>>

THE INLAND AREA NORTH OF THE WADI HALFA COMMUNITY COULD BE CULTIVATED AT A LOW COST IF THE SANDSTONE BEDS 200 TO 500 FEET BELOW THE SITE ARE SATURATED WITH WATER FROM THE NEW LAKE. WITHOUT THE USE OF THAT GROUNDWATER, IT WOULD BE IMPOSSIBLE TO BEGING FARM PRODUCTION ON THIS LAND AND OTHER POTENTIALL ARABLE LAND.

<<< STRATEGY >>>

FIVE YEAR OPERATIONAL PROGRAM GRANT TO INTERNATIONAL VOLUNTARY SERVICES WILL FINANCE VOLUNTEER TECHNICAL AND ADVISORY ASSISTANCE AND EQUIPMENT TO SUDAN'S WADI HALFA COMMUNITY TO TEST BOREHOLE IRRIGATION ON 50 FEDDANS CULTIVATION LAND.

<<< LOGICAL FRAMEWORK >>>

GOAL: TO IMPROVE ECONOMIC AND SOCIAL CONDITIONS CONTRIBUTING TO THE OVERALL DEVELOPMENT OF SUDAN. SUB-GOAL: TO CREATE CONDITIONS WHICH WILL ACCELERATE THE DEVELOPMENT AND RECONSTRUCTION OF WADI HALFA.

PURPOSE: TO ENHANCE THE ECONOMIC AND SOCIAL WELL-BEING OF PRESENT AND FUTURE WADI HALFA AREA POPULATION BY STIMULATING AGRICULTURAL DEVELOPMENT THROUGH IRRIGATION SYSTEMS DEVELOPMENT, CROP TRIALS, AND YOUTH AGRICULTURAL VOCATIONAL TRAINING; AND IMPROVING HEALTH/NUTRITION AND SANITATION CONDITIONS.

OUTPUTS: 1)LAKESHORE IRRIGATION SYSTEM; 2)INLAND BOREHOLE PUMP IRRIGATION SYSTEM; 3)YOUTH AGRICULTURAL VOCATIONAL TRAINING FARM PROGRAMME; 4)CROP TRIAL DATA IN FOODCROP, FRUIT, AND FODDRR PRODUCTION; 5)EXPANDED POTABLE MUNICIPAL WATER SYSTEM; 6)SANITATION FACILITIES; 7)NUTRITION EDUCATION AND PRE-SCHOOL CHILD FEEDING PROGRAMME.

INPUTS: INTERNATIONAL VOLUNTARY SERVICE(IVS) AND OTHER DONOR CONTRIBUTIONS: 1)SIX IVS/CATHOLIC RELIEF SERVICES(CRS) TECHNICIANS AND STAFF; 2)COMMODITIES: PUMPS, CEMENT, HOSE, PIPE, DRILLING RIG, HANDTOOLS, FITTING,ETC, THREE FOUR-WHEEL DRIVE VEHICLES, ONE FIVE-TON LORRY, ONE 12KVA GENERATOR, OFFICE SUPPLIES AND EQUIPMENT, HOUSEHOLD FURNITURE, FUEL TRANSPORT AND TRANSPORTATION COSTS; 3)TRAINING: SEMINARS, WORKSHOPS, OJT, VISUAL AIDS. HOST CONTRIBUTION: 1)600MM TECHNICIANS STAFF AND SKILLED LABOUR, 2)COMMODITIES: FUEL, SPARE PARTS, WATER SUPPLY

<<< ABSTRACT >>>

OPERATIONAL PROGRAM GRANT TO INTERNATIONAL VOLUNTEER SERVICES(IVS) WILL SUPPORT A SIX-PART COMMUNITY DEVELOPMENT PROJECT IN WADI HALFA, SUDAN. UNDER THE THIRD SUBACTIVITY, IVS TECHNICAL AND ADVISORY ASSISTANCE WILL BE USED TO TEST BOREHOLE IRRIGATION TO IRRIGATE A 50 FEDDAN CULTIVATION SITE INLAND FRO THE LAKESHORE AREA. THE SOIL AT THIS SITE IS OF MARGINALLY BETTER QUALITY THAN THE LAKESHORE AREA. THIS IRRIGATION COMPONENT OF WADI HALFA COMMUNITY DEVELOPMENT IS COMPLEMENTARY TO THE COOPERATIVE/YOUTH FARM ACTIVITY, WHICH IS USING PUMP IRRIGATION AT THE LAKESHORE SITE. SHOULD THE TEST PROVE THE AVAILABILITY OF SUFFICIENT GROUNGWATER AT RECOVERABLE DEPTHS, THE AREA OF POTENTIALLY ARABLE LAND WILL BE VASTLY IN CREASED. THE TWO CULTIVATION AREAS

(LAKESHORE AND INLAND) WILL COME UNDER COMMON MANAGEMENT AND CONTROL, WITH COOPERATIVE CROP TRIALS TAKING PLACE SIMULTANEOUSLY.

A DANDO 400 TYPE MOBILE PERCUSSION DRILLING RIG WILL BE USED TO DRILL 200 TO 500 FEET THROUGH SAND, SOIL, AND SOFT SANDSTONE. FOUR TRAINEE DRILLERS WILL OPERATE AND MAINTAIN THE RIG THROUGH THE LIFE OF THE PROJECT. THE IVS WATER ENGINEER WILL SUPERVISE AND CONTROL THE USE OF THE RIG AND WILL TRAIN THE DRILLERS.

UP TO FIVE BOREHOLES WILL BE FITTED WITH A DIESEL POWERED SUCTION PUMP. ONE HOLE WILL FITTED WITH AN EXPERIMENTAL WINDMILL POWERED PUMP, AS THERE IS A PREVAILING WIND AT WADI HALFA.

THERE IS A RISK THAT WATER MAY NOT BE FOUND IN SUFFICIENT VOLUME. SHOULD THIS BE THE CASE, THE PUMPS PURCHASED FOR THIS PURCHASE WILL BE USED TO EXPAND THE LAKESHORE AREA BY 500 FEEDANS. THE RIG WILL BE USED FOR FURTHER WATER EXPLORATIO ON ALTERNATIVE SITES ALONG THE LAKE WHERE THE GEOLOGICAL STRUCTURE IS FAVORABLE.

IT WILL ALSO BE USED TO EXPAND THE SANITATION SCHEME TO CIPE WITH THE NEEDS OF THE EXPANDING POPULATION.

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6820226 Mauritania
Small Perimeters
FY 81 - 82 Status: T Total LOP Cost (x000): $ 457
Loan or Grant / Appropriation Code / LOP Cost: G / SH / 457

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<<< ABSTRACT >>>

Project to introduce village-level, farmer-managed, irrigated crop production in the southern part of Mauritania along the Senegal River. The project will assist the National Society for Rural Development (SONADER), a parastatal agency responsible for developing and executing irrigation schemes, to develop new irrigated farms under village cooperative control.

Project activities will include the introduction of motor pumps, the parceling of existing perimeters in 0.40 ha sectors, the initiation of a credit system through village cooperatives, and a long-term training program for villagers and pump operators. The proposed credit system will allow cooperatives to purchase pumps, fertilizer, seeds, insecticides, and spare parts. AFRICARE will provide technical assistance in all agricultural production activities, the construction of irrigation works, farm management, and rice marketing. (ABS)

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6640312 Tunisia
Central Tunisia Rural Development
FY 79 - 86 Status: A Total LOP Cost (x000): $ 26612
Loan or Grant / Appropriation Code / LOP Cost: L / HE / 3500
G / HE / 3272
L / FN / 11040
G / FN / 8800

Subproject: 03 Small Holder Irrigation

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<<< ABSTRACT >>>

Project to improve small farmer access to and use of agricultural groundwater in Central Tunisia by expanding on-farm irrigation infrastructure and disseminating and institutionalizing appropriate on-farm water management practices. The Central Tunisian Development Authority, assisted by Oregon State University (OSU), will have primary responsibility for implementation.

The project will: develop 3 irrigation perimeters based on 4 existing (but capped) deep wells (the Government of Tunisia will develop a fourth perimeter); provide some 200 new shallow wells and improve 300 existing shallow wells; and develop 100 natural springs for irrigation (and potable water). OSU will conduct controlled field tests of alternative water management and cropping systems, and in cooperation with CDTA will train personnel in irrigation and water conservation. (PD-AAN-357)

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6550003 Cape Verde
TARRAFAL WATER RESOURCES
FY 77 - 83 Status: T Total LOP Cost (x000): $ 3217
Loan or Grant / Appropriation Code / LOP Cost: G / FN / 2200
G / SD / 17
G / SH / 1000

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<<< DEVELOPMENT PROBLEM >>>

Subsistence agriculture, the principal source of livelihood in Cape Verde, is becoming less viable as scarce arable land is devastated by prolonged droughts intermixed with rare downpours which wash away valuable topsoil and vegetation. To help remedy this situation, the Government of Cape Verde (GOCV) has proposed expanding 600 hectares of land already under irrigation in the Tarrafal region. GOCV, however, lacks the funding, equipment, and trained personnel needed to implement this proposal.

<<< STRATEGY >>>

Two-year project consists of a grant for commodities, technical assistance, and training to test farmland expansion viability in Cape Verde's Tarrafal region by constructing water exploration structures, developing irrigation system planning, and providing technical training to host country government personnel. Host country contribution consists of PL-480 revenues along with direct contributions.

<<< LOGICAL FRAMEWORK >>>

GOAL: Increase income and employment for small farmers in the Tarrafal region of Cape Verde. Sub-Goal: Expand arable land under irrigation in the area, and identify and utilize optimal watershed conservation and irrigated agriculture methods.

PURPOSE: Provide the Government of Cape Verde with the equipment, technical assistance and training required for carrying out investigations and planning regarding a proposed 600 hectare expansion in land under irrigation in the Tarrafal region.

OUTPUTS: 1. Wells. 2. Galleries. 3. Dams, tunnels, and canals. 4. Terraces and dikes. 5. Technical assistance. 6. Training.

INPUTS: 1. A.I.D. Direct Grant: $1,600,000. 2. Government of Cape Verde (GOCV) PL480 revenues: $303,000. 3. GOCV Direct Contributions: $634,000.

<<< ABSTRACT >>>

Grant is provided to the Government of Cape Verde (GOCV) to conduct investigations and planning regarding a 600 hectare expansion of farmland under irrigation in the Tarrafal region. The GOCV Ministry of Agriculture and Water will be the project executor.

Groundwater exploration will be undertaken by drilling 50 steel-cased wells of large and small diameters to analyze aquifer characteristics and salinity changes, respectively. In addition, ten exploratory galleries, or slightly graded tunnels of 1 km in length and 2 m in diameter will be drilled. Gallery construction will be cost-effective as maintenance will not be needed and the grading in the tunnels will eliminate the expense of pumping. Technical assistance will be provided to design a plan for construction of two medium-sized dams, each of 100-foot elevation, and related tunnels and canals needed to transport the dam water to the proposed nearby irrigation sites. With the help of U.S. technical assistance, GOCV technicians will study the feasibility of constructing terraces and dikes to control soil erosion.

Plans for irrigation systems and crop technologies will be developed by two U.S. consulting teams who will conduct short-term analyses of soil fertility, cultivation practices, and location of water sources for this purpose. These teams also will suggest new cultivation techniques and methods to transport water from source to field. Finally, economic analysis will be carried out based on the data collected by the two U.S. teams. GOCV personnel will receive M.S. degree and intensive training in the areas of hydrology, geology, agronomy, and agricultural economics.

The 600 new hectares of farmland will be divided into a 100 ha portion for research and the remaining 500 ha to be allocated to collective farming. The 20,000 inhabitants of the Tarrafal region will eventually benefit from this project if GOCV's findings are considered economically feasible.

(SOURCE: PD-AAG-119-A1)

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6080127 Morocco
DOUKKALA IRRIGATION
FY 76 - 84 Status: A Total LOP Cost (x000): $ 13000
Loan or Grant / Appropriation Code / LOP Cost: L / FN / 13000

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<<< DEVELOPMENT PROBLEM >>>

SHORTAGE OF WATER SUPPLY DUE TO LIMITED AND IRREGULAR RAINFALL AND INADEQUATE AGRICULTURAL PRACTICES COMBINE TO CREATE LARGE FOOD IMPORT REQUIREMENTS AND SEASONAL UNEMPLOYMENT WITH LOW PER CAPITA INCOME AND UNPRODUCTIVE URBAN MIGRATION IN THE DENSELY POPULATED DOOKKALA AREA OF MOROCCO.

<<< STRATEGY >>>

INSTALL SPRINKLER AND DRAINAGE SYSTEMS; CONDUCT DOUBLE CROPPING USING HIGH VALUE CROPS WITH HIGH LABOR DEMAND; EXPAND AND STRENGTHEN AGRICULTURAL MANAGEMENT SERVICES AND AGRICULTURAL CREDIT; CONSTRUCT VILLAGE CENTERS, SCHOOLS, ELECTRICAL GENERATING STATIONS, ROADS AND STIMULATE GROWTH OF VILLAGE INFRASTRUCTURE; CONDUCT LAND CONSOLIDATION AND DISTRICUTION PROGRAM.

<<< LOGICAL FRAMEWORK >>>

GOAL: INCREASE AGRICULTURAL PRODUCTION FOR IMPORT SUBSTITUTION AND FOR EXPORT; INCREASE EMPLOYMENT IN RURAL AREAS.

PURPOSE: ESTABLISH IRRIGATED AGRICULTURE ON 15410 HA IN THE DOUKKALA REGION BY 1979.

OUTPUTS: 1.SPRINKLER IRRIGATION SYSTEM AND DRAINAGE SYSTEM INSTALLED.
2.EXPANDED AGRICULTURAL MANAGEMENT SERVICES AND AGRICULTURE CREDIT.
3.CONSTRUCTION OF PROJECT AND VILLAGE INFRASTRUCTURE.

INPUTS: LAND. PLANNING, DESIGN AND SUPERVISION. CONSTRUCTION EQUIPMENT AND MATERIALS. LABOR. CAPITAL. TOTAL PROJECT COST:$94.4M;USAID CONTRIBUTION:$13.0M;IBRD CONTRIBUTION:$30.0M;GOVERNMENT OF MOROCCO CONTRIBUTION:$51.4M.

<<< ABSTRACT >>>

PROJECT DESIGNED TO CONVERT 15410 HECTARES IN NORTHWEST MOROCCO FROM DRY-FARMING TO MORE EFFICIENT, SPRINKLER-IRRIGATED FARMING. ANCILLARY BENEFITS: FARM ACCESS ROADS, RESERVOIRS, LAND PREPARATION/CONSOLIDATION, WINDBREAKS, SCHOOL, VILLAGE CENTERS, O&M EQUIPMENT, MARKETING/EXTENSION SERVICES, LIVESTOCK INDUSTRY, ELECTRICITY, COMMUNICATIONS. WHEAT, MAIZE, BEETS, COTTON, TOMATOES, FORAGE, LIVESTOCK WILL CONSTITUTE PRIMARY PRODUCTION COMMODITIES. ACTIVITIES CREATE EMPLOYMENT, IMPROVED LIVING CONDITIONS, INCOME, WATER SUPPLY, SCHOOLS FOR POPULATION 32000(PREDOMINANTLY SMALL FARM FAMILIES). PROJECT WILL MOST BENEFIT FARMS LESS 5 HA OR 78% OF DOUKKALA FARMS & CREATE 4100 MAN YRS/YR EMPLOYMENT. BILHARZIA CONTROL INCL.

(SOURCE: PD-AAA-195-B1)

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6850208 Senegal
BAKEL CROP PRODUCTION
FY 77 - 84 Status: A Total LOP Cost (x000): $ 7209
Loan or Grant / Appropriation Code / LOP Cost: G / FN / 4200
G / SH / 3009

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<<< DEVELOPMENT PROBLEM >>>

THE MAJOR CONSTRAINT TO AGRICULTURE IN THE SENEGAL RIVER BASIN AREA OF SENEGAL IS THE VARIABILITY OF RAINFALL AND THE UNDERUTILIZATION OF WATER RESOURCES. THE RIVERSIDE FARMERS NEAR BAKEL GROW DRY SEASON SORGHUM AND MILLET AND A SORGHUM CROP USING POST-FLOOD RECESSION AGRICULTURE. RECESSION CROPPING IS LOW-YIELDING AND UNCERTAIN. RICE HAS BEEN TOTALLY LOST FOUR YEARS OUT OF THE PAST FIVE. WITH NO ALTERNATIVE TO SUBSISTANCE FARMING, MANY YOUNG PEOPLE EMIGRATE TO FIND WORK ELSEWHERE, THUS CAUSING A LACK OF GROWTH IN THE REGION.

<<< STRATEGY >>>

SIX-YEAR PROJECT PROVIDES GRANT FOR FARM CONSTRUCTION (DIKES, IRRIGATION PUMPS, LAND CLEARING, VILLAGE WAREHOUSES, FARM EQUIPMENT), TECHNICAL ADVISORS, FARMER TRAINING, AND HEALTH SERVICES TO IMPROVE CROP PRODUCTION IN THE BAKEL AREA OF SENEGAL. HOST COUNTRY IMPLEMENTS PROJECT AND FINANCES SENEGALESE TECHNICAL ASSISTANCE, ADMINISTRATIVE EXPENSES, AND A REVOLVING LOAN FUND FOR ANNUAL FARM SUPPLY NEEDS. LOCAL FARMERS PROVIDE CONSTRUCTION LABOR AND LOCAL-LEVEL MANAGEMENT.

<<< LOGICAL FRAMEWORK >>>

GOAL: INCREASED CEREAL PRODUCTION IN THE SENEGAL RIVER BASIN REGION OF SENEGAL IN ORDER TO PROVIDE A MORE ATTRACTIVE ALTERNATIVE TO OVERSEAS WORK FOR THE SONIKE IN THE AREA.

PURPOSE: INTRODUCE FARMER MANAGED IRRIGATED CROP PRODUCTION IN THE BAKEL AREA TO ACQUAINT THE FARMERS WITH THE IMPROVED TECHNOLOGIES AND DEMONSTRATE THE ECONOMIC AND TECHNICAL FEASIBILITY OF IRRIGATED CULTURE AND INTRODUCE IMPROVED HEALTH AND SANITATION.

OUTPUTS: 1)CREATION OF AT LEAST ONE SMALL IRRIGATED PERIMETER IN EACH OF 23 RIVERSIDE VILLAGES. 2)INTRODUCTION OF IMPROVED TECHNOLOGIES INCLUDING ANIMAL TRACTION FOR DRYLAND CULTURE IN EACH PARTICIPATING VILLAGE. 3)EXPANSION OF EXISTING HEALTH DELIVERY SYSTEM INTO PROJECT VILLAGES.

INPUTS: 1)TECHNICAL ASSISTANCE 2)ADMINISTRATIVE INFRASTRUCTURE 3)ADMINISTRATIVE OPERATING COSTS 4)PUMPS AND HAND TOOLS 5)VILLAGE LABOR 6)ANIMAL TRACTION EQUIPMENT 7)DIKES 8)TRAINING AND MATERIALS FOR HEALTH PROGRAM 9)HEALTH/ENVIRONMENTAL SURVEILLANCE PROGRAM.

<<< ABSTRACT >>>

GRANT AND TECHNICAL ASSISTANCE PROVIDED TO SENEGAL TO INTRODUCE SMALL-SCALE IRRIGATED AGRICULTURE INTO 23 VILLAGES ALONG THE SENEGAL RIVER NEAR BAKEL. PROJECT WILL ALSO INTRODUCE IMPROVED PRACTICES FOR THE TRADITIONAL DRY LAND CROPS AND EXPAND HEALTH SERVICES IN THE PARTICIPATING VILLAGES.

AT LEAST ONE SMALL PERIMETER AREA, RANGING FROM 30 TO 50 HECTARES, WILL BE IRRIGATED IN EACH VILLAGE. THE TOTAL IRRIGATED AREA WILL BE OVER 1800 HECTARES. VILLAGE-LEVEL COOPERATIVES WILL MANAGE THE IRRIGATED PERIMETERS. TECHNICAL INPUTS WILL BE PROVIDED BY SAED (SOCIETE D'AMENAGEMENT ET D'EXPLOITATION DU DELTA - MINISTRY OF RURAL DEVELOPMENT AND HYDRAULICS) AND SERDA (A SENEGALESE CONSULTING FIRM). SAED WILL IMPLEMENT THE PROJECT. THE PROJECT COMPONENTS INCLUDE:

1)FARM CONSTRUCTION: SAED WILL LOCATE ANY NECESSARY FLOOD PROTECTION DIKES OR LOW PROTECTION DIKES (2 METERS). D-8 BULLDOZERS WILL CLEAR STUMPS FROM THE PERIMETER AREAS. THEN THE VILLAGERS, SUPERVISED BY SAED TECHNICAL AGENTS, WILL CONDUCT ALL THE IRRIGATION WORKS BY HAND (I.E. CANALS, LATERALS, FIELD BUNDS, DRAINS, AND SMALL PERIMETER DIKES). LISTER DIESEL POWERED PUMPS WILL BE INSTALLED ON SMALL RAFTS TO DRAW WATER FROM THE SENEGAL RIVER OR FROM SWAMPS.

TECHNICAL ASSISTANCE: ADVISORS WILL HELP FARMERS WITH THE AGRONOMIC ASPECTS OF IRRIGATED CULTURE. A SMALL FIELD TRIAL STATION WILL BE ESTABLISHED TO TEST THE PACKAGES BEFORE PRESENTATION TO FARMERS. FARMERS WILL VISIT SIMILAR PROJECTS FOR TRAINING. 3)CENTRAL INFRASTRUTURE: HOUSES, A WORKSHOP, A WAREHOUSE AND VEHICLES ARE FOR STAFF SUPPORT.

4)FARM INPUTS: GOS WILL ESTABLISH A REVOLVING LOAN FUND FOR ANNUAL FARM NEEDS. GOS WILL ALSO INTRODUCE ANIMAL TRACTION TO REDUCE HUMAN LABOR REQUIRED FOR DRY LAND CROPPING.

5)HEALTH: THE INCIDENCE OF PARASITIC DISEASES WILL BE MONITORED FOR ANY INCREASES DUE TO THE IRRIGATION. HEALTH SERVICES WILL BE IMPROVED BY RETRAINING DISPENSARY NURSES, SUPPLYING EQUIPMENT AND DRUGS, AND BY DEVELOPING A CADRE OF VILLAGE SANITARIANS AND FEMALE HEALTH WORKERS.

THE VILLAGE CO-OPS WILL GROW RICE, SORGHUM, AND MAIZE ON THE IRRIGATED LANDS, AND SELL THE CROPS FOR CASH OUTSIDE THE BAKEL AREA.

(SOURCE: B6S50208005701)

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6880213 Mali
ACTION BLE
FY 78 - 83 Status: A Total LOP Cost (x000): $ 2066
Loan or Grant / Appropriation Code / LOP Cost: G / SH / 2066

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<<< DEVELOPMENT PROBLEM >>>

Mali, the fifth poorest country in the world with a per capita income of only $100, is a nation of predominantly small pastoral and agricultural farmers. While vast land areas suitable for farming do exist along the Niger River and its tributaries, basic agricultural inputs and irrigational methods are lacking. Unfortunately, the Government of Mali has neither the financial nor technical resources to put these areas to productive use.

<<< STRATEGY >>>

Four-year project consists of a grant to the Government of Mali for technical assistance, participant training, and commodities to establish a system of irrigation grain production in the Dire area. Host country will provide institutional support and counterpart funding.

<<< LOGICAL FRAMEWORK >>>

GOAL: Increased food grain production which will contribute toward Mali's achievement of self-sufficiency in food.

PURPOSE: To demonstrate that wheat and sorghum production can be increased under irrigation in the Dire area, in a manner which maximizes benefits to small wheat producers.

OUTPUTS: System of irrigation grain production functioning in the project area, comprising the following elements: 1. Small pumps installed. 2. Extension system established. 3. Farmers organized. 4. Farmers trained. 5. Cereals and some legumes cultivated. 6. Pump repair system functioning. 7. Fuel supply system functioning. 8. Credit system functioning. 9. Station and on-farm research functioning. 10. Seed production program functioning. 11. Market system functioning. 12. Action Ble operation auto-financed.

INPUTS: 1. Staffing of Action Ble. 2. Small pumps, certified seeds, implements, and other inputs. 3. Funds for construction of project input warehouses, offices, pump repair shop, staff housing. 4. Three vehicles and three motorboats. 5. Equipment for office, repair shop, research station, extension agents, mechanics. 6. Participant training. 7. Sociological monitoring.

<<< ABSTRACT >>>

Grant is provided to the Government of Mali to increase grain production in the Dire area through irrigation. Action Ble (AB), a parastatal organization, will implement the project with expatriate technical assistance.

A system of small, farmer-built irrigation pumps, using water from a Niger River tributary, will be created. Some 500 low-head diesel pumps (5-15 m lift, 4 HP) will irrigate 2,000 ha. Each pump will be owned and operated by four farmers cultivating 1 ha each. In addition, 105 animal-driven, Pakistani-type "flow" pumps will irrigate 420 ha to demonstrate the feasibility of their use in Mali. To facilitate pumping operations, a pump repair system including a central supply shop and eight itinerant mechanics will be established, and fuel supplies (500 liters/pump) will be shipped during the flood season.

AB will create a revolving fund to provide farmers with credit to purchase the pumps (at real cost, to ensure the permanence of the project), and

production inputs such as improved seeds and fertilizers, along with a seed production program to ensure sufficient supplies of certified seed. AB will also set up an extension system of 24 agents, who will receive pre-service training and in-service training at the village level and who will work with village leaders to train 2,400 area small farmers in such areas as pump maintenance, water management, and application of farmer's own unmixed seed. Extension efforts will be complemented by station and on-farm research, whose results will be delivered annually to farmers, in such areas as variety trials and crop rotation. A marketing system will be instituted to direct products toward free market areas or though official channels. To upgrade AB's institutional capability, its staff will be increased and trained to supervise farmer production, and a wheat levy will be instituted to help AB attain financial self-sufficiency.

The project will result in cultivation of 2,420-ha of irrigated wheat, of which 2,200 ha will be double-cropped with sorghum and 500 ha triple-cropped by adding legumes or forage, for a total of over 9,000 metric tons of grain.

(SOURCE: B6880213004201)

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6880206 Mali
MALI CROP PROD. - ACTION RIZ-SORGHO
FY 76 - 83 Status: A Total LOP Cost (x000): $ 4258
Loan or Grant / Appropriation Code / LOP Cost: G / FN / 2005
G / SH / 2253

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<<< DEVELOPMENT PROBLEM >>>

IN SIXTH REGION OF MALI ARABLE LAND IS LIMITED TO NIGER RIVER BASIN DUE TO LIMITED RAINFALL AND HIGH SUBSOIL PERMEABILITY. PRODUCTION TECHNIQUES ARE INEFFICIENT. CEREAL PRODUCTION CHRONICALLY DEFICIENT IN THIS REGION. AREA MUST IMPROT MUCH OF ITS GRAIN.

<<< STRATEGY >>>

LOW-COST, LABOR-INTENSIVE, LOW-TECHNOLOGY APPROACH BUILDS UPON EXISTING INFRASTRUCTURE TO INTRODUCE MORE EFFICIENT PRODUCTION TECHNIQUES.

<<< LOGICAL FRAMEWORK >>>

GOAL: INCREASED STANDARD OF LIVING AND NUTRITION FOR POPULATION OF 6TH REGION OF MALI BASED ON STABLE FOOD SUPPLY.

PURPOSE: INCREASE CEREAL PRODUCTION IN CHRONICALLY DEFICIT GAO AREA OF THE 6TH REGION OF MALI AND INTRODUCE THE FARMERS IN THE AREA TO THE CONCEPT OF TECHNOLOGICAL DEVELOPMENT.

OUTPUTS: INCREASED NUMBER OF HECTARES PROTECTED FROM FLOODS AND USING IMPROVED TECHNIQUES IN THE AREA. INCREASED AVERAGE YIELD PER HECTARE. FARMERS FAMILIARIZED WITH NEW TECHNOLOGIES.

INPUTS: CAPITAL: CONSTRUCTION OF INSUBMERSIBLE DIKES, WATER AND FISH CONTROL STRUCTURES, PURCHASE OF IMPROVED SEED AND SEED PROTECTION MATERIALS, PURCHASE OF HAND TOOLS, INSTALLATION OF A FIELD RESEARCH STATION. TECHNICAL: STAFFING, ADMINISTRATIVE SUPPORT, TRAINING, DEMONSTRATION.

<<< ABSTRACT >>>

IN GAO REGION PROJECT EXPANDS EXISTING "ACTION RIZ-SORGHO." IMPROVES EXISTING POLDERS WITH BETTER FISH AND WATER CONTROL, EMERGENCY PUMPING, IMPROVED SEEDS. PERMANENT, INSUBMERSIBLE DIKES ASSURE COMPLETE WATER CONTROL AND ALLOW FARMER TO SHIFT FROM BROADCAST TO TRANSPLANT. PROJECT INTRODUCES OX-DRAWN WATER WHEEL (NORIA). ESTABLISHES LOCAL FIELD RESEARCH STATION. GOM MANAGES PROJECT WITH PRESENT STAFF. PROJECT SPLIT FROM EARLIER CROP PRODUCTION 6880206 BECAUSE OF MAGNITUDE.

(SOURCE: PD-AAC-184-B1)