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JESS WORKING PAPER: PRE-CONSTRUCTION CONCERNS WITH THE BAARDHEERE DAM



Juba Environmental and Socioeconomic Studies
Associates in Rural Development, Inc.

JESS WORKING PAPER: PRE-CONSTRUCTION
CONCERNS WITH THE BAARDHEERE DAM

JESS Report No. 16

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ABBREVIATIONS AND ACRONYMS

AHT	Agrar und HydroTechnik, GMBH
AID	Agency for International Development, Washington, DC
AIDS	acquired immune deficiency syndrome
ARD	Associates in Rural Development, Inc.
BDP	Baardheere Dam Project
ELC	Electroconsult
GSDR	government of the Somali Democratic Republic
GTZ	German Agency for Technical Cooperation
ICOLD	International Commission on Large Dams
JESS	Juba Environmental and Socioeconomic Studies
JuDAS	Juba Development Analytical Studies
km	kilometers
km ²	square kilometers
m	meter(s)
m ³	cubic meters
masl	meters above sea level
MFMR	Ministry of Fisheries and Marine Resources
MJVD	Ministry of Juba Valley Development
NRA	National Range Agency
TARDA	Tana and Athi River Development Authority
TVA	Tennessee Valley Authority
USAID	U.S. Agency for International Development, Somalia
WASH	Water and Sanitation for Health
WHO	World Health Organization

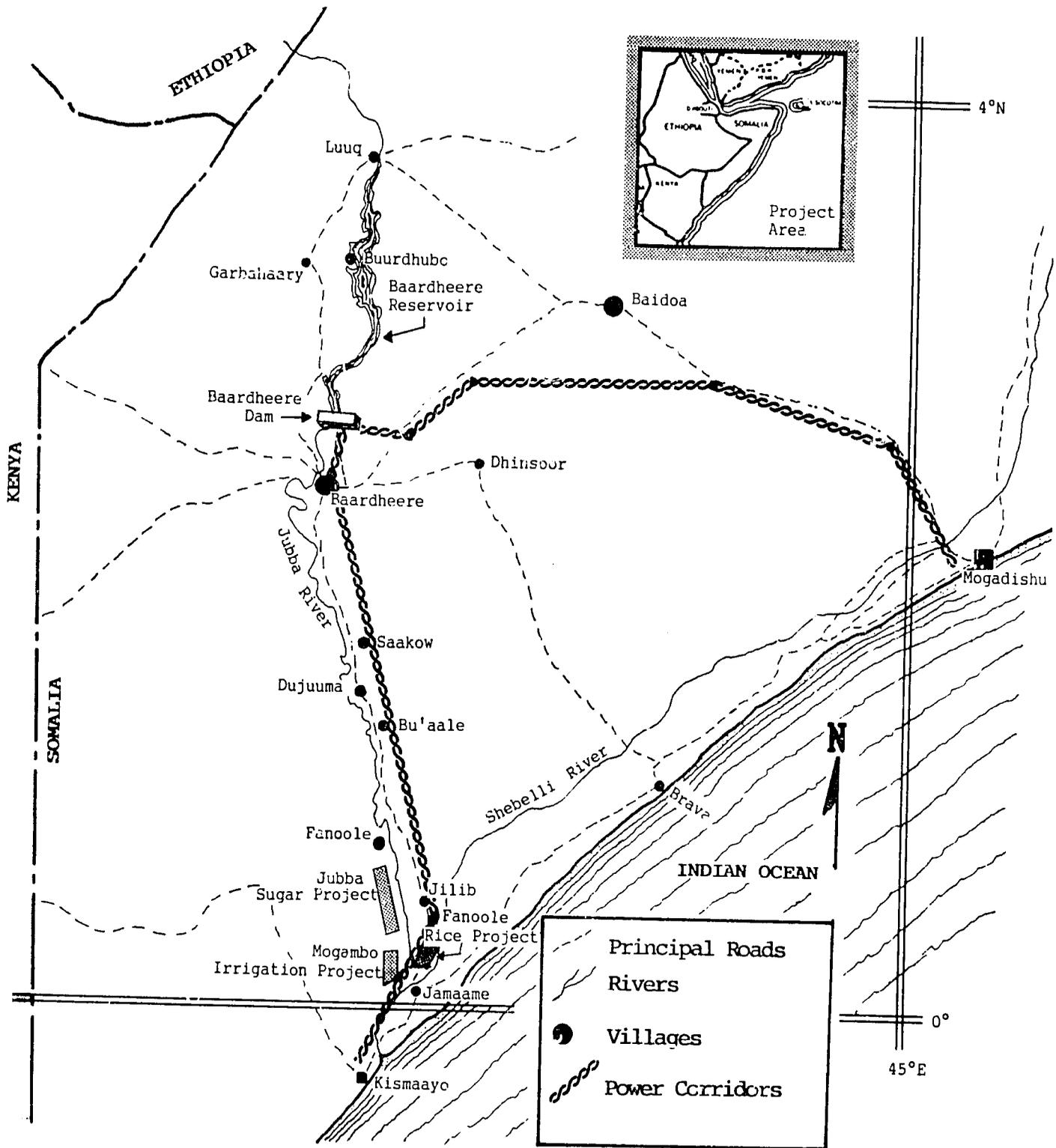
PREFACE

The Juba Environmental and Socioeconomic Studies (JESS) are a three-year program of river-basin investigations being conducted in southern Somalia. JESS is part of a larger project, Juba Development Analytical Studies (JuDAS), which is a cooperative effort between the U.S. Agency for International Development (AID) and Ministry of Juba Valley Development (MJVD) of the Government of the Somali Democratic Republic (GSDR). Associates in Rural Development, Inc. (ARD), was awarded a contract by AID (number AFR-0134-C-00-5047-00) to provide technical assistance and project management for JESS.

As required in ARD's technical assistance contract, JESS will make recommendations concerning the mitigation or avoidance of negative environmental and socioeconomic impacts associated with the Baardheere Dam Project (BDP) and subsequent Jubba Valley development. Substantive research that is being carried out by JESS in the valley (see Figure 1) will provide predevelopment baseline information that will serve as the basis for these recommendations.

Dr. R. E. "Gus" Tillman is ARD's senior environmental scientist and JESS team leader in Somalia. This working paper is intended as a preliminary assessment of the potential for negative impacts of Jubba Valley development in Somalia, in light of issues and problems that have plagued other tropical dams. Specific recommendations concerning the mitigation and avoidance of negative impacts will be detailed in ARD's final report on JESS, which is due to be published at the end of Phase III in November 1988.

Figure 1. Area of the Baardheere Dam Project and the Jubba Valley Development



I. EXECUTIVE SUMMARY

This JESS working paper focuses on local and regional concerns relating to construction of a 75-meter (m) high dam on the Jubba River in southern Somalia in East Africa (see Figure 1). The probable and possible effects of dam construction are discussed for engineers, planners and ministry administrators with the aim of defining the social and environmental costs and benefits of the Baardheere Dam.

Issues that are discussed at the project, local and regional levels include relocation (resettlement), in-migration, labor force, health, transportation, fisheries, forest products, water supply, sanitation, livestock, reservoir clearance, dam operation and cultural heritage. General and, in some cases, specific recommendations for the mitigation of adverse effects are presented for each section and directed at a particular audience, such as dam engineers, master planners and/or decision-makers.

The intent of this working paper is to focus attention on issues and problems that have plagued other tropical dams, but in a project-specific context. All of the issues and recommendations relate to the social and physical environment of the Jubba Valley or specific design features of the Baardheere Dam--this working paper does not purport to seek a global context. Future JESS reports, particularly those prepared during Phase III (April through October 1988), will continue to explore and make more specific recommendations regarding many of the topics covered here.

II. INTRODUCTION

A. Baardheere Dam Compared to Other Large Dams

As is true of most large dams, the Baardheere Dam is to be situated in a region that is relatively remote from Somalia's major urban centers. Based on other experiences with large dams in Africa, there is no doubt that the activities required to prepare for and undertake actual construction will produce vast short- and long-term changes in the region. For the most part, these are expected to be beneficial in terms of elevating regional and national standards of living and contributing positively to regional and national economies. At the same time, negative effects are also expected, some of which may be more or less accepted as normal and, possibly, temporal costs of economic development, while others may require action by responsible parties to mitigate or eliminate them. Rational development planning objectives are established to enhance the beneficial effects of projects and reduce, avoid or temporize undesirable conditions that result from implementing them. This working paper is an initial response by JESS for MJVD relative to achieving those objectives. Ongoing JESS research (to be completed by October 1988) should provide greater insight into the potential impacts of this project and a basis for avoiding or mitigating many of them.

Before discussing the Baardheere Dam, it is necessary to provide some perspective on large dam construction, both globally and in Africa. According to the proposed design, the Baardheere Dam will be 75 meters high and of "roll-crete" construction. The dam's width will be 500 meters, and the structure will impound a reservoir nearly 160 kilometers (km) long, but only .25 square kilometers (km²) in area. At normal operating levels, the reservoir volume is estimated at 3,400 million cubic meters (m³). Using the standards of the International Commission on Large Dams (ICOLD), Baardheere will be classified as a large dam--it will be the largest civil works undertaken in Somali history, by a considerable factor.

In a broader context, Baardheere Dam will be relatively modest, compared to large dams elsewhere. Numerous African dams are considerably larger and sited in more complex environmental and social systems. Table 1 shows Baardheere Dam in the context of other selected large dams.

Table 1. Baardheere Dam Compared to Other Large Dams*

Dam	Country	Height(m)	Reservoir Area(km ²)	Reservoir Volume(10 ³ m ³)
Akosombo	Ghana	141	8,482	148,000
Aswan High	Egypt	111	6,850	164,000
Kariba	Zimbabwe	128	5,100	160,368
Sobrdinho	Brazil	--	4,500	110,670
Kafua Gorge	Zambia	--	4,340	160,000
Cabora Bassa	Mozambique	171	3,800	63,000
Guri	Venezuela	106	3,280	75,700
Kafue Gorge	Zambia	--	3,100	56,700
Tucurui	Brazil	--	2,160	43,000
Kossou	Côte d'Ivoire	--	1,600	29,500
Gebel Aulia	Sudan	--	1,500	--
Brokopondo	Surinam	54	1,500	--
Itaipu	Brazil	--	1,350	27,000
Kainji	Nigeria	70	1,260	15,800
Buyo	Côte d'Ivoire	--	900	--
Mtera	Tanzania	--	610	--
Baardheere	Somalia	75	425	3,400
Massingir	Mozambique	--	170	2,884
Masinga	Kenya	--	120	1,560

*Compiled from multiple sources.
 --Data not available.



View of the Jubba River looking south from proposed Baardheere dam site. (Paul Dulin)

B. Organization of this Working Paper

The remainder of this working paper is arranged in three sections, based on the urgency of actions that need to be taken before and after construction. It is directed at the three major units involved in Jubba Valley development planning--AHT/GTZ, JuDAS/ JESS and MJVD.

Section III, addresses concerns about the labor force for dam construction and its well-being. Many of the components covered in this section will be considerations to be included in contract tenders prepared for construction contractors by MJVD's BDP. Thus, BDP planners are the primary intended audience for this section. Since bid documents and tenders are laboriously prepared well in advance of actual construction, BDP will have adequate lead time to consider and/or modify the recommendations presented in this section for incorporation into their planning activities.

Section IV, discusses a liberal range of concerns that may or may not affect Baardheere Town and District. Some of these effects will precede construction and, thus, require more immediate attention. Other concerns are speculative and may, in fact, prove to be groundless following further studies during master planning. The remaining components address post-construction issues that will be a part of long-range planning. This section is primarily intended for the MJVD master planning unit.

Section V, deals with issues that will rise to prominence only after dam construction and closure, but need to be resolved long before closure of the dam and filling of the reservoir. MJVD will have more lead time for discussion and decisions regarding these concerns, but requires specific information on the topics treated here for informed decision-making. Thus, this section is not only intended for MJVD, but also as a guide for JESS in that the Phase II work plan and Phase III analyses need to provide a solid informational base for future discussions and decisions. In addition, several issues may serve as the basis for long-term monitoring programs to provide feedback for future planning and evaluation of valley development.

Some of the observations and recommendations in the three sections are intentionally reiterative, as they are of equal importance to the three major units involved in the Baardheere Dam and Jubba Valley development. In other instances, development impacts may be interrelated, so it follows that some recommendations need to be considered by more than one (or all) of the authorities involved.

Given a few remaining uncertainties in BDP scheduling and limited regional data, priorities for the concerns discussed in

this working paper are difficult to establish. To the extent possible, and solely as perceived by JESS, priority items are presented first in each section. These issues also receive fuller discussion and associated recommendations are less tenuous. More speculative concerns follow and merit less text, although the potential for unpleasant surprises demands that they be given some attention before these issues can be dismissed by MJVD.

Throughout this working paper, recommendations are made for MJVD to perform certain activities or functions that, cumulatively, are far beyond the ministry's existing institutional capacity. In this working paper, MJVD is viewed as the planning, organizing and coordinating institution that will direct the technical, personnel and financial resources of other GSDR ministries and agencies, as well as international lending and donor groups, concerning construction of Baardheere Dam and other related development projects in the Jubba Valley. In studying or implementing the recommendations contained in this working paper, it is assumed that MJVD will seek continuing advice and assistance from other institutions, including government bodies and international organizations. MJVD has already established formal and informal channels of exchange with other institutions, and these exchanges will become more firmly defined as development planning for the Jubba Valley progresses.

III. LABOR CONCERNS

A. Displaced People

A common failing in dam construction projects is that planners treat the displaced population as an onerous burden, both physically and financially, without considering them first as people and second as a positive resource to provide labor and/or services for a large construction force. In the area surrounding Baardheere, there will be critical increasing needs for skilled and unskilled labor, fuelwood, construction material and food supplies that can be delivered, in part, by people who will be forced to move as a result of rising reservoir water.

Compulsory deracination creates severe stress with physiological, psychological and sociocultural implications for the affected populations (Scudder 1973). Even if resettlement plans are designed and implemented to equitably compensate these people for loss of property and employment, a majority will still harbor resentment toward forced relocation. While a fuller discussion of resettlement follows in Section V, which focuses on closure concerns, a case is made here for preferential use of the people to be displaced as resources for labor, goods and services related to dam construction and reservoir clearing.



Villagers like these in Caanoole near Baardheere will be heavily affected by development of the new dam. Whether these impacts are negative or positive depends on how they are incorporated in Jubba Valley development. (Paul Dulin)

Part of the psychological stress caused by forced relocation stems from not knowing if, or when, displacement will occur. Once people begin to observe preliminary construction activity at the dam site, they will raise questions about the security of tenure at riverside locations. At present, the best existing map of the reservoir area is at 1:20,000 scale with five-meter topographic contours (Technital SpA 1979). This map has not been translated into a real ground-surface delineation because of topographic irregularities on the ground of less than five meters, and a surveyed perimeter has not been defined or delineated on the ground. Thus, the actual extent of inundation cannot be compared with existing holdings to determine what property losses will definitely occur, except in the most obvious cases.

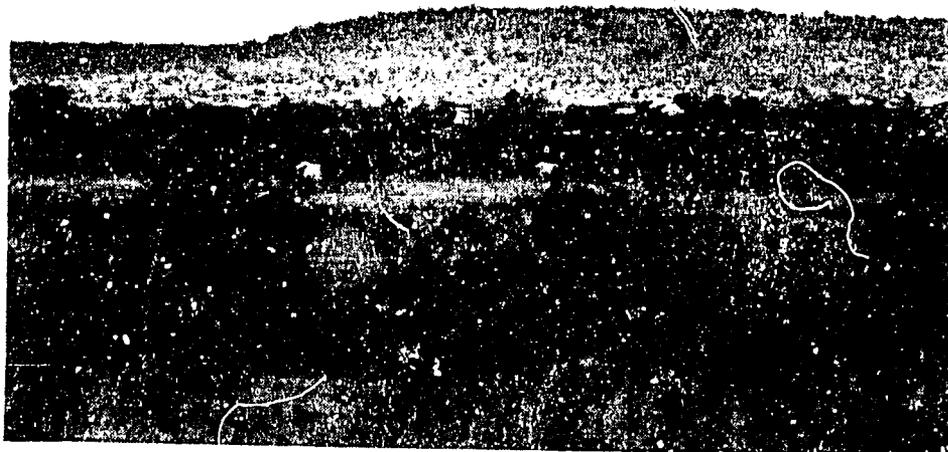
MJVD has commissioned a ground survey of the reservoir perimeter using durable markers so that landholders can visually determine the extent of their property losses. This will aid in preparing estimates of land loss and providing quick resolution of future disputes regarding compensation for property losses. In the terms of reference prepared for the resettlement study which is currently in progress, MJVD has requested that semipermanent markers be placed along the future reservoir perimeter. This will resolve much of the current uncertainty about which lands will actually be affected by dam construction.

People living within this marked perimeter, especially heads of households, should be preferentially hired for unskilled positions in the construction labor force. Wages earned as laborers would partially reduce the tension of being unable to forecast an economic or geographic future for their families. Further, MJVD should give these people concessionary preferences for the necessary task of reservoir clearing, perhaps by providing financial credits to purchase clearing equipment or training in charcoal production technology. Charcoal and fuelwood should find ready markets in Baardheere Town, at the construction site or in Mogadishu.

The construction force is likely to exceed 2,000, a majority being unskilled or semiskilled laborers, which could include much of the landholder population currently living within the reservoir perimeter. It would be to the GSDR's advantage to offer preferential employment opportunities to these landholders as well as refugees who are now living in camps that will be inundated. If this policy is firmly established and publicized in urban centers, there may be a significant reduction in the unnecessary migration of job-seekers from other regions into the project area.

Furthermore, people living in the inundation zone should be encouraged to continue small-scale agriculture until dam closure by giving them preference as food vendors at the construction

camp. Given that some productive riparian cropland will be inundated, these lands should be exploited intensely during the period between signing construction contracts and final closure, since the agricultural productivity of these soils will be irretrievably lost beneath reservoir water. Once compensation is made for property to be inundated, owners too often abandon the land, thereby hastening its loss as a productive part of the economy. To forestall this unfortunate circumstance, MJVD should assist landholders by helping establish loan mechanisms so that riverside farmers can purchase agricultural inputs--such as improved seed, agricultural chemicals and irrigation pumps--to increase short-term productivity on their plots.



Refugee village on west side of the
Jubba Valley south of Luuq. (Gisela Gresham)

With the money, training and experience they have gained during construction from reservoir clearing, farming or actual work on the dam, the displaced population will be more valuable contributors to resettlement ventures planned by MJVD. In fact, they may gain enough economic independence so as to not require extensive government assistance with relocation. However, this argument should not be used to lessen government inputs that are necessary to implement successful, sustainable relocation programs. If viewed as a valuable resource and motivated to contribute to construction efforts, the population to be displaced need not become an onerous burden for BDP or MJVD.

Obviously, MJVD intends to establish a relocation program that will be implemented before dam closure. A sizable number of refugee camps, especially those near Buurdhubo, will have to be relocated. At issue is whether these camps will be moved to new locations or the GSDR will decide to use the relocation program to integrate refugees who wish to become citizens into a permanent, productive place in Somali society. The former is an easier, less expensive option, but maintains the lasting burden of caring for a large refugee population. In 1983, the GSDR made a firm commitment to assist willing refugees to establish permanent settlements. The government may wish to use the need for refugee camp relocation as a mechanism to promote permanent settlement options for camp inhabitants in the Jubba Valley.

If specific relocation sites are to be selected for permanent settlements, it is important for MJVD to carefully assess proposed sites. It is not sufficient to limit studies to soil suitability for agricultural or economic parameters--MJVD must also utilize JESS socioeconomic data to determine which people are currently using land selected for relocation sites and how it is being used. Relocation projects encounter many difficulties if the local population does not benefit from or is penalized by the implementation of resettlement. Relocated settlements have higher probabilities of success if local residents are consulted and integrated into project planning and implementation. This platitude is commonly raised, but so often ignored that successful relocation projects are extremely rare. A large population of displaced people, whether refugees or landholders, cannot be relocated in a single area or region without encountering local opposition or stressing local resources. To the extent that receiving communities are a part of the planning for and implementation of relocation, problems and conflicts will be reduced.

B. In-Migration

During construction of the Kamburu Dam in Kenya, 2,000 full-time laborers moved into this remote region, and a population of equal size became established nearby in an unplanned, temporary settlement in less than one year (Odingo 1979). This rapid influx of laborers and construction-camp followers has occurred during the construction of every African dam and can be expected to occur with the Baardheere Dam. This unusually rapid population growth places heavy burdens on local resources and is usually most detrimental to the local citizenry, who are neither adapted to nor prepared for "boomtown" conditions. Food prices inevitably rise, and only steady wage earners on the construction force and successful merchants are able to cope with price increases for basic commodities. Inadequate nutrition is likely to be common among families who do not have household members employed on the construction force or in commercial enterprises.

New arrivals typically carry a variety of diseases, some of which may be unknown in the project area. Baardheere District is already hard-pressed to meet the health needs of its present population, with only one doctor per 64,000 citizens and one nurse per 3,600 (AHT 1985). Even if expanded health facilities at the construction site are made available to nonworkers, new arrivals will still overwhelm existing medical services and contribute to increasing poor health in the region.

Much of Baardheere Town has substandard living conditions with poor housing and nearly nonexistent water supply, sanitation and solid-waste disposal. As the town closest to the construction site, much of the non-labor population influx will occur in Baardheere Town, which will create even more substandard housing and increase the burdens on sanitation and waste disposal. The town has no central water supply, and untreated water from the river is distributed by private vendors for domestic use. An increase in the town's population will not disrupt this distribution system except to increase the number of vendors. Aside from extreme low-flow periods, the river will continue to carry an adequate, albeit contaminated, water supply for the expected increase in population.

MJVD needs to carefully predefine hiring criteria for contractors and publish them in urban newspapers and radio broadcasts to limit the influx of job-seekers. Recruiting and hiring standards must be precisely defined with contractors and carefully coordinated between Baardheere District and other areas that wish to send laborers to BDP.

Dam construction requires skilled workers who have previous experience in hydro development projects, and there is a small cadre of experienced East African workers who travel from one dam construction job to another. These men may have begun working on the Kariba Dam, Cobora Bassa or one of the Tana River dams in Kenya. Because of their specialized skills and experience, and since there has been very little previous work on dam construction in Somalia, it is likely that dam contractors will need to recruit some of these men. They will undoubtedly return home or seek other dam construction jobs after the Baardheere Dam is finished, so their temporary presence in Somalia does not pose serious problems, if they receive adequate medical screening (see the next subsection concerning health, III.C). MJVD needs to recognize the likelihood of and need for foreign guest workers, and should make preparations for working with other ministries to define procedures for securing the necessary entry, health and work permits.

C. Health

An unhealthy labor force impedes construction and results in poor-quality work. BDP and construction contractors will profit from advance planning and expenditures on medical services for the labor force. Health concerns relative to the labor force include medical screening of employees, construction-camp health facilities and health education for laborers.

BDP should mandate that contractors conduct medical screening of potential employees or require medical certification before hiring them. This requirement is in the best interest of contractors and the entire Baardheere District. It is far more cost-effective to screen potential employees than hire an unhealthy worker who may spread disease to other workers at the camp or introduce disease into the region. The construction schedule is based on seasonal variations in river discharge, so during low-flow periods, activity will be intense and contractors can ill afford an outbreak of a contagious disease in the labor force. Just one laborer hired without medical screening could conceivably precipitate such an outbreak.

Schistosomiasis (bilharzia) and malaria are seasonably endemic in the Jubba Valley, with peak transmission occurring shortly after onset of the Deyr (November to December) and Gu' (April to May) seasons (Jobin 1986a). Onchocerciasis (river blindness) is not reported in Somalia, although blackfly vector habitat does occur in the Jubba River and blackfly populations have been reported in the Shabeelle Valley. Jobin (1986a) does not consider onchocerciasis to be a serious threat in the Jubba Valley, but recommends further investigation as part of JESS. Dracunculiasis has been reported as serious in neighboring countries, and this disease could be imported by foreign workers, if proper surveillance is not employed (Paul, Isley and Ginsberg 1986). Cholera and yellow fever are potential threats to a long-term work force and can become very serious epidemics, especially in the close working and living conditions of a labor camp. Cholera has been reported recently in rural areas of Somalia, which must increase concern about this disease in the labor force and region.

Of more recent concern is the increasing spread of acquired immune deficiency syndrome (AIDS) in Africa. At present, AIDS is not reported in Somalia, but the disease could be brought into the country by foreign workers if medical screening is not employed. It is critical that this disease not become established in Somalia.

It is recommended that a screening and certification process for all contractors and health agencies be coordinated, controlled and standardized by the national government, preferably the Ministry of Health (Goodland 1978). All workers

should have recent vaccinations for tetanus, smallpox, cholera, typhoid and yellow fever (smallpox may be unnecessary, although the last reported case was in Somalia). Workers should also be required to present proof of negative tests for schistosomiasis, malaria, tuberculosis, AIDS and venereal disease as a condition for employment. Ideally, a camp health post should be fully established and functional before the arrival of the main labor force. Health-post staff could conduct tests, keep medical records, and provide vaccinations and malaria prophylaxis for new employees as they arrive. The post should be completely equipped with the personnel, medicines and vaccines needed to treat or prevent the most common tropical water-related diseases. This action can contribute positively to regional public health and reduce the probability of health-related delays in construction schedules.

D. Labor Camp Facilities

Plans prepared by Electroconsult (ELC 1984) for the layout of the construction camp include a water-treatment plant and pumping station upstream of the dam site. BDP should insist that this treatment plant have settling, filtering and chlorinating capacities, since safe potable water is a crucial element in protecting the health of the labor force. BDP should also insist that this plant have the capacity to supply the entire labor force and not be restricted to exclusive use by expatriate engineers and guests.

The camp plan also includes a sewage plant located approximately 200 meters below the main contractor's camp. While details are not given, it will presumably be sized appropriately and engineered to safely accommodate all camp sullage. This is especially important because Baardheere Town uses untreated river water for drinking and other domestic uses. Further, BDP or the contractors should designate a safety zone around the treatment plant so that unplanned settlements do not arise near it. During normal operation, discharge from the treatment plant should not pose serious health hazards, but it is necessary to consider situations during plant breakdowns or equipment malfunctions.

The planned camp layout does not specify a site for a health post, although an area is set aside for social and commercial buildings. In conjunction with the Ministry of Health, BDP should pay close attention to the design, adequate staffing and provisioning of this medical post. Given the remote character and current low level of medical services in Baardheere District, this post will be essential during construction and could be continued as a regional health center following departure of the main labor force. The post should be equipped for emergency first aid and minor surgery, and also to serve as the main

dispensary of medicine and vaccines for the camp. This post should be functional prior to the arrival of workers.

Efforts to protect and improve the well-being and productivity of the labor force will be more effective if good health practices are reinforced by a health education program. If workers drink untreated river water or disdain the use of sanitary facilities, poor health will plague the project. A small health education effort, including lectures, posters and discussions with health-post staff, should be used to instill safe health practices among the labor force. An AID Family Health Project has been training Somali staff in health education techniques. To the extent that the importance of safe water and sanitation can be conveyed to workers, and they can be encouraged to use health-post facilities, BDP and the contractors will benefit from a healthy work force.

BDP must insist that contractors conform to acceptable international standards in providing housing for the labor force. The World Health Organization (WHO) has set standards for labor camps that establish guidelines for the amount of living space per worker and availability of facilities. BDP may find it profitable to visit ongoing construction at the Kiambere Dam in Kenya and discuss contracting standards for labor-camp facilities with the Tana and Athi River Development Authority (TARDA).

Considering the large capital investment for camp infrastructure, MJVD should also consider the use of labor-camp facilities for future activities. It is possible that camp buildings could be used as regional posts for various government ministries to meet the expanding needs of this rapidly developing area. The site and structures could also be used by MJVD as a regional headquarters when the development focus intensifies following dam closure. Of course, some camp buildings and facilities will be used for dam operation-and-maintenance personnel. The communications systems created for dam construction could be expanded to provide regional links and connections with Mogadishu. Labor-camp health facilities could be staffed and outfitted to provide services for the local population.

Understanding that the ELC layout of the construction site is illustrative rather than fixed, it appears that adequate provision has been made for a defined social and commercial area. Presumably, recreation areas will also be included, perhaps a football field and basketball courts. Areas for social gatherings, such as tea shops and a cinema, should be planned for quiet evening recreation. With a labor force of over 2,000, these recreational and social facilities are of extreme importance for the physical and mental well-being of the workers. It is also important that contractors make provisions for religious services in the social and commercial area.

Characteristic of most labor camps is the presence of numerous unwanted animals that forage on discarded litter and food wastes. Rodents are the most common and can be important agents of disease transmission. BDP should hold contractors responsible for controlling vermin at the camp site.

IV. BAARDHEERE TOWN AND REGIONAL CONCERNS

A. In-Migration

Implementing Somalia's largest capital-intensive construction project will create a human influx in the Baardheere region that will greatly exceed the number of workers required to work on the dam. This influx will be facilitated by better access through the construction of Jubba Valley roads and improvements on the Mogadishu-Baardheere road. In addition, truckloads of construction materials from Somali ports will provide a supplemental, inexpensive means of transportation for people going to Baardheere. Further, residents of northeastern Kenya will be attracted by commercial opportunities in Baardheere and will move across the border to sell wares or seek employment.

Baardheere's present population of approximately 12,000 is likely to double during construction, and if Kenyan experience with Tana River hydro development is an apt guide, nearly 30 percent will remain in the area to take advantage of opportunities offered by the newly created reservoir. If unhealthy slums are to be avoided, the MJVD master-planning unit and town leaders must begin to prepare plans for infrastructure expansion in Baardheere. Water supply and sanitation needs must be assessed in view of the expected population increase. Currently, Baardheere Town has no central facilities for water supply and sanitation, so it will be necessary to begin planning for entirely new systems. New settlement zones must be identified on the periphery of the village without reducing the agricultural production potential of better soils along the riverbanks. Settlement in preselected areas can be encouraged by providing domestic water supplies and electric lines to places where settlement is preferred.

A detailed soil inventory of the area immediately around Baardheere should be completed to identify sites that are most suitable for the intensive cropping which will be necessary to feed increasing human populations. Sites should also be identified for lengthier nomadic encampments. At the Bura Irrigation Project in Kenya, nomads have established more permanent campsites near the center of the project to sell livestock and livestock products to workers, and take advantage of irrigation canals as watering points. This could also easily occur in Baardheere with the resulting problems of more intense fuelwood utilization and overgrazing. Deforestation and overgrazing could become especially severe if drought occurs during the construction period, as can be expected.



Aerial view of Baardheere on the Jubba River as of December 1983. Construction activities on the dam will most likely result in a doubling of the town's size. (Air Survey and Development GMBH)

B. Health

Normally a discussion on the regional health implications resulting from construction would be a featured component of a report on pre-construction concerns. Baardheere Town and the region will experience numerous changes in health parameters during dam construction and its subsequent operation. However, previous JESS reports on the health impacts of dam design, health consequences of water supply and sanitation, and water quality and public health engineering provide more than adequate coverage of the regional health implications of building the Baardheere Dam Project (Jobin 1986a, 1986b and 1986c). In addition, more detailed recommendations for improving health will be presented in future JESS reports. As a result, no further discussion of the health sector is provided in this section.

C. Construction Materials and Transportation

Most of the imported construction materials will arrive at the port in Mogadishu, some 450 km from the dam site. There will be continuous flow of heavy trucks to the site carrying concrete, machinery and other construction supplies. This traffic is estimated at one truck every seven or eight minutes 24 hours a day, or 180 to 206 trucks per day (Baardheere Dam Technical Committee Meeting 1987). Fortunately, most traffic will not need to pass through Baardheere Town, but will pass through Baydhabo and several small towns en route, creating problems with noise and dust in these villages and increased accidents involving people and livestock. BDP should urge the Ministry of Public Works to cut back vegetation that crowds the road between Baydhabo and Baardheere to improve the line of vision. At present, trees grow so close to the highway that it is difficult for drivers to see pedestrians or grazing livestock until they step out onto the road.



A lack of road maintenance and failure to control encroaching vegetation endangers drivers, pedestrians and animals. (Gisela Gresham)

Road reconstruction and/or improvement will be needed to withstand the onslaught of these heavy vehicles. Such traffic will rapidly deteriorate road surfaces, thereby slowing traffic and causing a high incidence of breakdowns and vehicle and tire

damage. Poor roads also increase the likelihood of accidents. Facilities for truck repairs between Mogadishu and Baardheere are very limited, so uninterrupted transport is not likely. BDP must consider the implications of this problem, and should plan and outfit truck-repair stops at strategic points along the route, although it is likely that enterprising Somalis will establish commercial repair stops.

BDP will also have to determine in advance how much truck traffic will need to go to the west bank of the river. The bridge at Baardheere will need to be evaluated in terms of its capacity to bear this additional burden. The bridge is approximately four meters wide which may not be sufficient to permit the passage of heavy construction machinery, such as cranes, bulldozers and scrapers. It may be necessary to reinforce this bridge prior to dam construction as well as selecting other points along the river where heavy machinery could safely cross during low-flow periods.

D. Road Construction

Baardheere Town and District will undergo changes before dam construction as a result of road improvements in the Jubba Valley. The Jilib-Saakow road will increase human populations in the middle Jubba region and augment agricultural production through easier access to markets. The new Saakow-Baardheere road will give farmers in the middle Jubba region a choice of markets or routes, either south to Jilib or north to Baardheere. Initially, goods will probably be sent south toward Jilib for shipment to Kismaayo or Mogadishu. However, once Baardheere's population starts to increase and dam construction activities begin, it is more likely that there will be a shift toward Baardheere. Trucking charges from Baardheere will be less than from Jilib in view of the large number of trucks carrying materials to the dam site that will be competing for return cargos to Mogadishu. MJVD should alert the Ministry of Public Works to this possibility for planning the Baardheere-Saakow road.

E. Fuelwood

The amount and availability of fuelwood for Baardheere District and, indeed, the entire Jubba Valley is of great concern. Fuelwood is the primary source of energy for domestic and small-scale commercial uses and is likely to remain so long after dam closure. The expected population increase in Baardheere Town and the region will place considerable stress on local and regional fuelwood supplies, which will diminish rapidly.

Initially, clearing activities in the reservoir zone may be able to supply fuelwood to villages and the construction site, if the clearing is managed properly. However, this supply is limited in volume and constrained by the distance between cutting sites and markets, unless it can be floated by river transport to riverside villages. At present, cutters from refugee camps use large fuelwood rafts to float wood from cutting sites upriver to camps south of Luuq. This same method could easily be used in the reservoir area. Further, as will be discussed in Section V.B on reservoir clearing, MJVD and the National Range Agency (NRA) will wish to restrain the cutting of woody vegetation to the area below the future reservoir's maximum normal water level of 141.9 meters above sea level (masl).

It is already possible to see deforested areas surrounding Baardheere and other Jubba Valley population centers, especially in the vicinity of refugee camps upstream of the dam site. This problem will increase in magnitude with the onset of dam construction and in-migration of job-seekers and merchants, unless MJVD and NRA are prepared to take action in establishing fuelwood plantations near major villages. A major lesson learned from the Bura Irrigation Project in Kenya was that it was very costly not to implement the fuelwood reserves and plantation according to original schedules. It is important that MJVD not repeat this mistake in the Jubba Valley. Part of JESS Phase II studies will address the fuelwood situation in and around the reservoir area.

The construction camp will require a large amount of fuelwood for cooking. Much of this may be taken directly from the area to be inundated through concessionary clearing contracts with people who will be displaced. This clearing will have to be carefully monitored to prevent cutting in the protected zone immediately above the normal operating water level of 141.9 masl. A few patches of remnant riverine or gallery woodland can meet much of this expected demand.

F. Water Supply and Sanitation

Baardheere Town is blessed with a dependable water supply from the Jubba River, although it is of dubious quality. This supply will become more dependable following dam closure because discharge rates will not drop to extremely low levels during periods of drought. At very low flow, the Jubba forms large and stagnant pools near watering sites that are not only contaminated, but also provide suitable habitats for snail and mosquito disease vectors.

Attempts to drill deep wells for Baardheere Town have been unsuccessful as the groundwater is too saline for human consumption. Electrical conductivity values of over 7,000 umhos

per centimeter have been measured for Baardheere's deep wells. Shallow wells have similar values, so it is likely that the town will continue to depend on the Jubba River as a source of potable water.



The Jubba River is used as a potable water supply as well as for bathing, washing clothes, irrigation and watering livestock. (Paul Dulin)

As noted previously, Baardheere Town does not have a central water-pumping facility--thus, domestic water is distributed by private vendors with donkeys and a small number of privately owned pumps. This untreated river water poses serious health hazards to inhabitants, and the risks will increase with upstream construction and clearing. Animals and humans enter the river freely at watering points to drink or bathe, and it is expected that contamination levels are already high. As the human population increases as a result of construction and subsequent development, exposure and the spread of infectious waterborne diseases will become a greater concern.

The MJVD master-planning unit will need to address this important issue by elaborating a plan for improved water supply and sanitation systems for Baardheere Town. These plans should be incremental, as described by Kalbermatten et al. (1980), so that they are not overcapitalized and overconstructed initially, but may be expanded as needs increase. MJVD may wish to seek assistance from AID's Water and Sanitation for Health (WASH)

project in planning facilities and systems for Baardheere Town. If a successful model can be employed for Baardheere, it can ultimately be applied to other developing urban centers in the Jubba Valley. Town leaders and residents should be involved in all stages of planning for water supply and sanitation systems.

G. Livestock

A surprising number of reports relating to Jubba Valley development fail to treat the economic contribution of livestock in spite of noting that a significant proportion of pastoral nomads in Somalia utilize the valley for water and forage during dry periods. Movements of these pastoralists and their herds will definitely be curtailed as a result of construction activities and the presence of a reservoir 160 km long. The movement of heavy machinery for the construction of new buildings, storage areas, settlements and expanded areas of cultivation will markedly alter livestock and wildlife migration routes between grazing sites, although very little is known about the present migration routes of pastoralists and wildlife in the Jubba Valley. There is likely to be an increase of livestock movement through Baardheere Town to take advantage of the bridge or avoid upstream construction areas.

Deviations from traditional migratory routes as a consequence of construction can lead to overgrazing and higher livestock disease transmission, if livestock are forced to use fewer, narrower migration corridors. Migration through town can expose local livestock to a wider range of diseases, increase the incidence of human disease and illness associated with livestock and excrement, and further contaminate domestic water supplies. Even after the completion of JESS, more information will be needed on pastoral routes through the proposed reservoir area and implications of having to alter those routes as a result of a new, permanent, 160-km long body of water. From aerial photography, it is clear that nomads currently cross the Jubba at several points between Baardheere and Luuq, especially at Buurdhubo, and will be unable to use these routes once the reservoir fills. At this point, there is little action MJVD can take to resolve the potential conflicts created by altered migration routes, except to plan on continuing studies of livestock movement patterns in the reservoir area during the construction period.

In addition, the presence of construction camp will probably prompt more pastoralists to stay near the camp for longer durations, hoping to sell animals to camp personnel. If measures are taken to control insect populations in or near the camp, these measures may also reduce the threat of tsetse flies in adjacent areas, which would also encourage encampments of longer duration. As a result, overgrazing and increased wood-cutting

for fuel and animal enclosures would likely become more severe during construction. While there is very little opportunity to control these situations, owing to the independence of pastoral nomads, MJVD should be aware of the likelihood of these problems occurring and seek means to avoid or mitigate the effects of pastoral encampments near the construction site.



Pastoralists move camels, sheep, goats and cattle throughout the Jubba Valley along traditional corridors where they find sufficient water and forage. (Paul Dulin)

H. Communications

It is difficult to conceive of managing and coordinating a large dam construction project in Baardheere without significant improvements in communication links between Mogadishu and the construction site. Planning communications improvements cannot wait until construction activities begin--in fact, improved communication facilities should be in place before construction commences. Furthermore, communication channels should not be the sole responsibility of construction contractors, as the system should remain intact and functional after construction is finished. Improved communications will be essential for operating the dam and controlling reservoir levels. The final ELC report (1984) includes plans for extensive communications in the construction area that can be extended to other areas. BDP

must insist that these plans be followed closely during construction.

While the priority for communication links should be between Mogadishu, the main port and Baardheere, MJVD will also have to consider improvements between Baardheere and points in the Jubba Valley, such as Saakow, Bu'aale, the Fanoole Barrage and Jilib. These downstream residents and water users must be apprised in advance of water-release schedules. Likewise, if controlled flooding of dhesheegs is to occur until alternative agricultural development projects are fully implemented and all the dam's turbines are operational, local farmers must be notified by dam operators, perhaps through District Agricultural Officers, to prevent dangerous and costly over-flooding.

I. Post-Construction Use of Labor Camp

MJVD should begin making plans to use construction camp facilities after dam closure. The buildings necessary for maintenance of a large labor force can be constructed to be more durable at little extra cost. Since Baardheere lacks government buildings and there will be an increasing government presence following closure, camp buildings can be used after construction as regional posts for various parts of the government. Given the investment in camp infrastructure, especially for potable water, sanitation, electric power, waste disposal and communications, the GSDR should not let the site remain idle after the dam begins operations.

For instance, the medical post can easily be used as a regional health center to help control expected increases in water-related disease, such as bilharzia and malaria. The engineers' quarters could become permanent housing for the staff of the dam operations center. Buildings can also be used for a regional communications center with permanent connections to Mogadishu, Baardheere, Saakow, Bu'aale, Jilib and Kismaayo. The compound could provide a regional headquarters for providing agricultural extension to the upper Jubba Valley. The Ministry of Livestock, Forestry and Range may wish to establish a veterinary laboratory in the compound to complement the current facility in Kismaayo.

The perimeters of many reservoirs are protected partly by creating national parks or reserves, and this concept has been discussed in relation to the Baardheere Dam. If this should become a reality, construction camp facilities could easily be used for park or reserve headquarters. Even if a reserve is not established, the GSDR will wish to protect selected portions of the reservoir area or watershed through the control of natural vegetation or tree plantations. Thus, NRA will need office facilities for forest specialists or watershed managers.

MJVD's master-planning unit should work closely with BDP to define camp construction guidelines and determine future use of the facilities. Since camp buildings are normally a part of construction contracts, this planning activity should commence as soon as possible in order to be included in contract tenders.

J. Seismic Hazards

Large reservoirs have induced seismic events as a result of the additional weight of water in new man-made lakes. It is expected that the dam design has taken into account the potential for seismic events with regard to dam stability. However, nearby structures, such as the bridge and larger buildings in Baardheere Town, may not be built to withstand earth tremors that could result from filling of the reservoir. Engineers from BDP or the Ministry of Public Works should assess this possibility before the end of construction. Fortunately, buildings in Baardheere are not multiple-story structures, nor are they constructed of especially heavy materials. Thus, residents are not at major physical risk from seismic hazards, whether or not they are induced by the reservoir.

K. Vermin Control

As in the construction camp, vermin will proliferate in Baardheere Town as a result of higher human densities without improvements in shelter or waste-disposal facilities. The role of pests, such as rats and insects, in disease transmission is well-known. Unfortunately, construction towns are nearly always characterized by increases in vermin and accelerated disease transmission. The best method of controlling vermin and pests is to reduce unsanitary habitats. Food wastes and human excreta must be disposed of properly, if vermin are to be kept at low levels and remain nonthreatening to human and livestock populations. Currently, Baardheere Town does not have systematic disposal of refuse and excreta--thus, new facilities must be established. MJVD should initiate discussions with town officials to begin planning for safer waste-disposal systems.

V. CLOSURE CONCERNS

A. Resettlement

As with most large impoundments, the resettlement of displaced populations is a major concern with BDP. Recently, the lack of attention paid by international lending institutions to resettlement issues prior to dam construction has been severely criticized and highly publicized. In the past, governments and lending institutions have had very lax policies concerning dislocated people, and as a result, resettlement plans and compensation methods have been poorly defined, causing severe duress for the affected populations. These situations were noticed by the international press, and heavy pressure has been applied to governments which contribute to international lending organizations to ensure that equitable resettlement and compensation measures are included in lending policies. In the case of Baardheere Dam, several potential lenders have made it clear that resettlement and compensation issues must be adequately resolved before loan agreements can be reached. MJVD prepared a contract for a resettlement study of the reservoir area in 1986, which should be completed in 1987.

The resettlement of people living in the reservoir area will be a complex problem for MJVD, calling for very creative solutions from the ministry and GSDR. The area is relatively inaccessible for parts of the year, owing to a lack of roads in the zone to be inundated. In addition, MJVD must confront questions of legal land titling. As in most remote areas of Somalia, it is unlikely that all landholders have legal title to the lands they farmed, despite long tenure on the holding. Legally, the government could take a position that land users without title do not require compensation, but this position could cause conflicts and ill will in a population that will be extremely important to BDP's success.

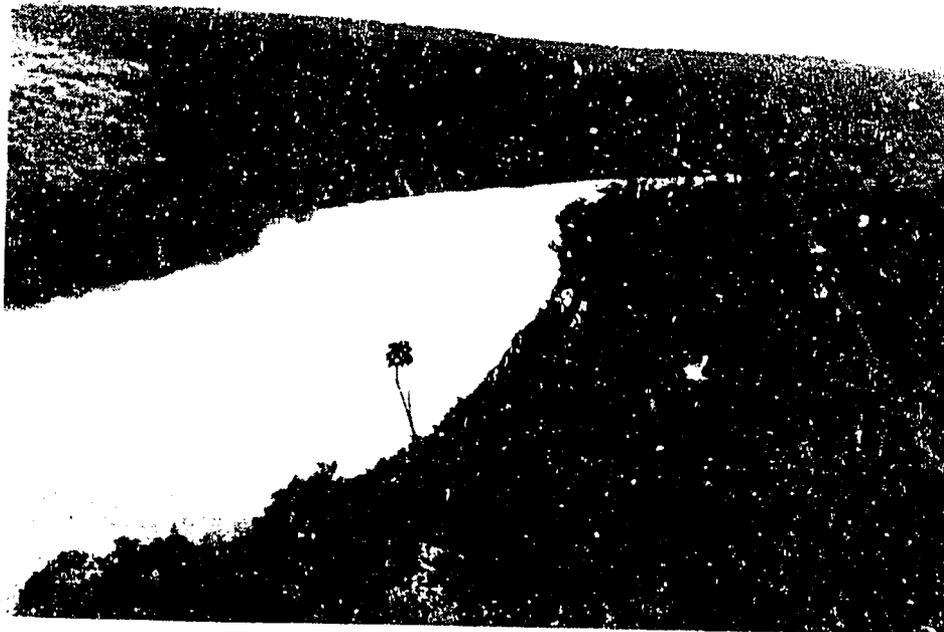
In accepting the heavy responsibility of resettlement and recognizing the complexities involved in such planning, MJVD prepared exemplary terms of reference for the resettlement study. In these terms, the ministry required that compensation plans and equitable rates be established for untitled land in continuous possession or occupancy as well as legally titled land. Further, the terms of reference require that community participation be emphasized through discussions with people to be relocated and a questionnaire to codify their desires for resettlement options. In addition, MJVD is requiring plans for monitoring the well-being and incomes of relocated populations for a period of up to 10 years.

Of special merit to MJVD, the ministry is requiring that the study produce resettlement recommendations and plans for a

sizable population of refugees currently living in large camps that will be within the reservoir perimeter. MJVD is also demanding that the study address permanent resettlement and integration solutions for refugee populations as well as discussing the simple relocation of existing camps. If these terms of reference are followed, the study will force the resolution of very difficult issues surrounding the fate of Somalia's refugee populations.

B. Reservoir Clearing

The proposed reservoir area should not present serious problems in terms of clearing woody vegetation, as dense riverine forest is not abundant. There are small pockets of riverside forest, but these should not be difficult to clear and the wood can be transported by raft to ready markets in the construction camp or Baardheere Town. However, the eastern portion of the lower reservoir area has a fairly dense cover of small trees and shrubs of savanna vegetation that are typical of the region. This eastern slope is quite steep and access to it could be difficult. In addition, ephemeral tributaries (toggas) have denser woody vegetation on steep slopes, and access to these locations will be very difficult.



Small pockets of riverine forests are distributed all along the Jubba River. This woody vegetation should be cleared and commercialized before the reservoir fills, preferably by people who will be displaced. (Paul Dulin)

Since there will be increasing demand for fuelwood, MJVD should not have difficulty letting contracts or concessions for clearing. Woodcutters can easily access the area by boat or trails, and, as mentioned, fuelwood can be rafted to the construction site or Baardheere Town. Again, people who will be displaced by inundation should receive preferential treatment in allotting clearing contracts or concessions. It would be difficult to restrict clearing activities to only those who live in the inundation zone, but they could gain preference by having access to credit to purchase simple clearing equipment or implements. They should also be given special vendors' permits to sell fuelwood at the labor camp.

It will be critically important to remove all woody vegetation with tops that would emerge above the minimum normal operating level of the future reservoir (128 masl). These emergent tops create more favorable vector habitats by reducing wave action and encouraging waterweed proliferation (Ploskey 1985). Experience with other tropical reservoirs clearly demonstrates the benefits of clearing woody vegetation that would emerge during reservoir drawdown (Kapetsky and Petr 1984). However, vegetation with root systems above the maximum normal operating level should be retained and protected to provide up-slope erosion control.

Vegetation that would not be emergent when the reservoir is at the minimum water level (128 masl) need not be removed, although it obviously constitutes a resource loss if that wood is not used as construction material or fuelwood. However, the eventual decay of such trees would provide nutrients for a developing fishery as well as creating potential spawning sites for fish. Submerged vegetation helps protect young fish from predators and overexploitation by improved fishing gear and techniques. It is unlikely that MJVD will need to consider cutting fishing lanes as the woody vegetation is not dense enough to present future difficulties. At this point, future use of the reservoir for navigation is unclear, although it would provide easier wet-season access to settlements along the reservoir's perimeter. However, this woody vegetation will not pose obstacles to navigation and does not require further discussion.

The shallow lacustrine area may have less problems with emergent woody vegetation than the narrow sections of the reservoir. This area is the current site of large refugee camps, and much of the vegetation near the river has already been cut for fuelwood. In addition, the topography of this area would not handicap further clearing, since access is relatively good during the dry seasons.

In the upper reservoir area, woody vegetation is less dense, and no clearing problems are expected, except that some planted trees will need to be cleared and owners should be compensated

for their value. Clearing products would have a ready market as fuelwood and building materials in the village of Luuq or at refugee camps that will not be flooded by the reservoir.

C. Livestock Access

At this point, little thought has been given to future uses of the reservoir perimeter. Doubtless, there will be many proposals, perhaps far in excess of available frontage on the reservoir. Immediate uses may be for irrigated agriculture using small pumps, similar to existing riverside conditions between Baardheere and Luuq. It is more than likely that there will be proposals for natural preserves or national parks as means of controlling erosion in the immediate catchment area. However, a sizable segment of Somali society has a considerable vested interest in future reservoir use, though they may be unable to have a timely voice in planning this use. Pastoral nomads currently use the river to water livestock, which becomes most critical during periods of drought.

A master plan for the Jubba Valley and reservoir must include livestock and/or wildlife corridors for access to watering sites. If corridors are not retained for watering points and migration, nomads will have no alternatives to conflict with those who seek to deny access rights. There would be little economic penalty if guaranteed corridors, one to two kilometers wide along selected routes to the reservoir, were set aside for use by pastoral nomads. In fact, there would be considerable benefit from retaining a viable livestock component in valley and national economies. Undoubtedly, livestock access to the river and reservoir will be restricted because of agricultural development, but access need not be totally eliminated through chance. In conjunction with NRA, MJVD should begin seeking likely access routes to the future reservoir and take legal action to hold these routes for livestock herders. Unless these corridors are delineated early, land speculators and farmers may take title to the entire reservoir perimeter, well in advance of dam closure.

D. Filling Schedules

Given the annual and seasonal variability of the Jubba River's flow, filling schedules for the reservoir will be difficult to determine, but will involve a series of very important considerations for MJVD. Currently, the reservoir capacity is estimated at approximately 3,278 million m³ at the normal operating water level (141.9 masl), which is slightly more than 50 percent of the river's average annual discharge. In the simplest terms, this means that the dam could cut off all river flow for more than six months of an average year's flow.

However, discharge variations of the river do not permit such simplicity in that the discharge can vary from less than 20 to 2,000 cubic meters per second (m^3/sec), depending on seasonal and annual meteorological conditions in the catchment area, especially the Ethiopian highlands.

There are compelling economic reasons to raise the reservoir to the minimum operating water levels of 128 masl as quickly as possible to allow the turbines to commence generating electricity. However, there are equally compelling reasons to allow water to pass through the bottom outlets for downstream irrigation at large projects, such as the Fanoole Rice Project, Jubba Sugar Estates and Mogambo Irrigation Project, before the minimum operating level has been reached. Fortunately, the current dam design (which incorporates bottom discharges) and construction schedule give MJVD flexibility to govern the rate of filling without necessarily penalizing downstream aquatic life, power generation and agriculture. ELC (1984) envisions an 11-month filling schedule starting in October that would permit measured discharges to meet requirements for downstream irrigation and test the turbines.

An important factor, which is perhaps outside the control of MJVD, is when dam closure will occur. If closure takes place during high river flows, important benefits of flood control and agricultural water release can be gained with less delay in the time to begin generating electricity. If closure occurs at low flow, the latitude for bottom releases is negligible, and time between closure and power generation is considerably lengthened. The October closing schedule would be optimal in this situation to take advantage of Deyr rains and have enough water in the reservoir for irrigation use during Jilaal.

E. Downstream Fisheries/Aquatics

During the closure of Cabora Bassa in Mozambique in 1974/75, downstream flows were severely reduced for over 15 months with severe losses in downstream fisheries (Kapetsky and Petr 1984). If MJVD endorses ELC's filling schedule, this unfortunate circumstance will not occur in the Jubba River. At present, little is known about Jubba fisheries or the potential for future fisheries. JESS fishery surveys have clearly shown that the river's fisheries are grossly under-exploited with fishing limited to artisanal endeavors, primarily for personal consumption. These fishery surveys indicate great potential for a freshwater fishery in the Jubba with an estimated annual catch of 1,600 metric tons, worth about US\$1,000,000. If this fishery potential is to be accurately predicted and exploited, MJVD will need to make arrangements with the Ministry of Fisheries and Marine Resources (MFMR) to continue a longer term fisheries assessment of the river.

Much fishing activity in the Jubba Valley is done on a part-time basis and centers on dhesheegs, rather than the river's main channel (Meredith 1987). Fish stocks enter dhesheegs during flood periods and grow rapidly in these nutrient-rich habitats. As the dhesheegs begin to become smaller, fish are unable to return to the river. When the water volume in these depressions is reduced through seepage and evaporation, fish can easily be harvested with nets and basket traps at relatively low cost and with high catch-to-effort ratios. During periods of extremely low flow, these fishing techniques are employed in the main river channel as well.



When the Jubba floods, fish enter dhesheegs. As the waters recede, due to seepage and evaporation, the fish are trapped and then easily harvested. (Gus Tillman)

During the fishery surveys, it was not possible to determine the role of dhesheegs in fish spawning. It is possible, even likely, that many river fish utilize the rich dhesheeg habitats for spawning. If dhesheegs are important spawning sites, flood control by the Baardheere Dam will reduce the river fisheries. MJVD should urge MFMR to expand its studies of fish biology in the Jubba River. MJVD could encourage these studies by assigning a JESS research boat and motor to MFMR to carry out this research.

To believe that downstream fisheries will not be impaired during construction and filling of the reservoir would be

extremely naive. Fish stocks will decline owing to regulated flows and habitat reduction through the loss of flooded depressions in the floodplain. Currently, residents take advantage of dhesheeg fishing during dry seasons, and the total area of flooded dhesheegs will be dramatically reduced once the dam becomes operational. Some compensatory actions will also occur in that the river will have regulated flows that will permit continuous on-river fishing. At present, fishermen are unable to fish continuously on the river because of high flows and strong currents during the wet seasons. In addition, a much larger fishery can be developed on the 425 km² reservoir. Estuarine fisheries may be severely curtailed during filling of the reservoir, but should recover shortly after normal operating levels have been achieved in September of the following year or at the onset of Deyr rains.

F. Reservoir Fishery

Given the possible seven-year construction period for the Baardheere Dam (ELC 1984), discussion of a reservoir fishery may appear premature, especially when so little is known about the expected physicochemical parameters of the impoundment. However, all African reservoirs have had an under-exploited fishery in their early years because of two important factors. First, they were not completely cleared of vegetation and the subsequent decay of this material produced powerful nutrient blooms that were quickly taken up by plankton and periphyton. Consequently, fish populations also experienced explosive population growth because of increased nutrient availability. Once these nutrients were partially depleted by outflows and fish harvests, the yields decreased to sustainable levels, in equilibrium with the reduced nutrient supply. In most cases, national governments were unable to take full advantage of the initial fish surplus because of the second factor--lack of a fishery infrastructure.

Even in countries with a rich tradition in river fisheries, conversion to lake fishing takes considerable adjustment on the part of fishermen, as different technologies and strategies must be employed. In Somalia, there is little reported evidence of a fishing tradition beyond reports by Meredith (1987)--thus, stimulating people to fish in a reservoir may be even more difficult. Clearly, training and encouraging fishermen is not within the technical capabilities of MJVD, nor should it be. In the time before dam closure, MJVD should seek active assistance from MFMR in preparing plans to activate a reservoir fishery to take optimal advantage of the initial proliferation of fish. Further, MJVD should encourage MFMR to participate in the Committee on Inland Fisheries in Africa (of the Food and Agriculture Organization of the United Nations) and seek additional training opportunities for the ministry's inland fishery specialists.

G. Drawdown Agriculture

According to ELC estimates (1984), approximately 105 km² of surface area can be exposed annually between the flood control level (148 masl) and normal operating level (141.9 masl), if full flood-control storage is achieved. A larger area would be exposed between the normal and minimum operating (128 masl) levels. Certainly, not all of this area can be used for recession agriculture, since a large part of the reservoir is in a relatively steep gorge. However, in the lacustrine zone, it has very strong possibilities. Given existing experience in the valley with recession agriculture in dhesheegs, it is likely that people will quickly take advantage of this moisture-rich zone for planting crops. Other possibilities include raising fodder for livestock in the drawdown zone, which would be less susceptible to fluctuating water levels. At present, the soils may not be appropriate for annual crops, but as sediments are deposited during high water levels, the soil quality may improve appreciably.



As the Baardheere Dam is closed, traditional downstream dhesheeg agriculture may disappear in many places, although similar practices will be used in the drawdown area of the new reservoir. (Paul Dulin)

Until operating schedules become more firmly defined and the reservoir's bathymetry is determined, it will be difficult to establish any firm basis for planning recession agriculture. In

addition, reservoir operation recommendations for health concerns may preclude many potential recession-agriculture opportunities, if these recommendations are accepted by MJVD.

H. Reservoir Operations Team

Dam operation is an exacting, demanding task that will require trade-offs among power generation, irrigated agriculture, dam maintenance, fishery development and health concerns. Jobin (1986a) recommends a multidisciplinary operations team including one health professional to oversee dam operations--a recommendation that the author of this working paper supports. Of course, it is clearly recognized that firm power generation and flood control are the major objectives of dam operation and, hence, power engineers and hydraulic specialists should be the dominant forces in deciding on annual operating schedules. Downstream agricultural interests should also contribute to water-release decisions through representation on the team by a member of the Ministry of Agriculture. However, in the interplay of interests among power generation, flood control and agriculture, there will be some leeway to consider health inputs, especially with regard to slight fluctuations in reservoir levels to reduce disease-vector habitats, as recommended by Jobin (1986a).

This team approach has been used effectively by the Tennessee Valley Authority (TVA), and MJVD may be able to take advantage of TVA's experience with the team concept in dam operations. MJVD should create a multidisciplinary dam operations team consisting of representatives from the power, agriculture and health sectors.

I. In-Stream Protection During Reservoir Filling

Based on aerial photograph interpretation and reconnaissance, there are very few in-stream structures (e.g., bridges, docks, barrages) on the Jubba River. This is due partly to low human densities (use) and extreme fluctuations in river flow. In-stream structures need to be very well constructed to withstand flood conditions in excess of 1,500 m³/sec, which are frequent in the Jubba River. With the Baardheere Dam, planned floods will still occur, but will be more subdued, rarely over 700 m³/sec. However, water discharged from the bottom outlets will be very erosive owing to a lack of sediments, and these erosive discharges may cause extensive damage to nearby in-stream structures, such as the Baardheere Bridge. The filling period, which will extend over 11 months if ELC recommendations are followed, will provide an excellent opportunity to strengthen bridge foundations and install protective devices on each foundation.

Other government agencies may also wish to take advantage of this controlled low-flow period to construct other in-stream structures, such as bridges and docks. Larger municipalities may wish to build small docks for watering points and fish landings to reduce crocodile hazards. This may also be an excellent time to do maintenance on the headworks at the Fanoole Rice Project and the barrage. As MJVD will not have responsibility for these works, it would only be necessary to keep other ministries apprised of the filling schedule or arranging for further cutbacks in flow for short periods during filling, if that is necessary for downstream repair work.

J. Cultural Heritage

Somalia has a rich cultural and religious history stemming from its pastoral traditions and geographic location favorable to precolonial commerce in East Africa. Early movements and settlements in the Jubba Valley have received scant attention from historians and archeologists despite evidence of extremely long occupancy. A preliminary cultural heritage reconnaissance in the proposed reservoir area by JESS produced artifacts of archeological interest (Brandt 1986). A second survey, planned for 1987, will continue this reconnaissance work at a slightly more intense level. The intent of this survey is to locate likely sites for further investigations, perhaps involving excavation of the most promising sites. The presence of large caves on the eastern slope of the gorge near the dam site may provide further evidence of prehistory occupation. MJVD should urge the Somali Academy of Science to cooperate and participate, to whatever extent possible, in the second JESS cultural heritage survey.



Clearing in the area of the future reservoir has uncovered hundreds of cultural heritage sites, many of which are potentially important for characterizing the settlement and historic significance of the area. (Thomas Gresham)

K. Faunal Salvage

Inevitably in impoundment projects, some organizations express concern about faunal salvage during filling of the reservoir. When attempted, these ventures are dramatic and newsworthy, but not very cost-effective or successful. At this point, a discussion on faunal salvage plans are very premature and would be based on supposition, rather than facts. In the course of JESS surveys, more information will be collected on wildlife populations in the reservoir zone, and decisions will be made on the necessity of planning for the salvage of animals trapped by the rising waters. Based on preliminary observations and literature reviews, it is not likely that there will be a need for such animal-rescue operations. However, it is recommended that MJVD continue to monitor JESS environmental studies and remain alert to possibilities for the salvage of rare and/or endangered species, should their presence or habitat be discovered within the reservoir perimeter.

VI. CONCLUSIONS

A considerable number of studies regarding the proposed Baardheere Dam have been completed, and several more are currently in progress. It is likely that this dam will have the highest ratio of completed studies to power generation of any dam in history. These studies have covered the gamut of topics in a sincere attempt to avoid pitfalls common to other tropical dams. Yet, as this working paper demonstrates, questions and issues remain, perhaps denying final resolution until the Baardheere Dam has a brief operating history. However, it must be emphasized that the points raised here are not of the same level of magnitude or consequence as those cataloged in the review of Goldsmith and Hildyard (1984).

Development projects, especially those with irrigation or hydropower components, expect to leave lasting marks on existing physical and social environments because development is change. Another obvious point is that development has costs--financial, social and environmental. One point of this working paper is to make these social and environmental considerations as clear as the financial ones, with recommendations for further discussion and negotiation. From these efforts, social, environmental and financial costs can be minimized, and the costs and benefits equitably distributed.

Normally, hydropower projects increase stresses on remote populations and environments while seeking to transmit most, if not all, of the benefits to urban centers that have greater political influence. An obvious thrust of this working paper on pre-construction concerns is to encourage planners to look at likely local social and environmental costs that can be inexpensively mitigated, and to have social and economic benefits for local populations exceed these costs. Baardheere Dam is a national priority development project with massive regional and local implications. With increasing attention to smaller details, as outlined in this working paper, MJVD's master-planning unit and BDP can maintain national and subnational development priorities without needlessly destroying or irretrievably altering local systems, except in positive directions. If this working paper contributes in any small way to this end, it has served its purpose.

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