PN-AAY-092
51825

JESS PHASE I DESIGN STUDIES

JESS Report No. 10

Prepared by:

William R. Jobin, Sc.D.; Peter C. Bloch, Ph.D.; James C. Riddell, Ph.D.; Curt R. Schneider, Ph.D.; and James F. Ruff, Ph.D.
Associates in Rural Development, Inc.
110 Main Street, Fourth Floor
P.O. Box 1397
Burlington, VT 05402
U.S.A.
Under AID contract number AFR-0134-C-00-5047-00.

Date: July 1986

CONTENTS

Section	Page
Acronyms	i
Preface	ii
Background for Phase I Design Studies	1
JESS' General Objectives and Resources	1
Process of JESS Study Design	2
Literature Search	3
Technical Start-Up	3
Jubba Valley Reconnaissance	3
NAS Workshop	4
Drafting the Phase II Work Plan	5
Role of Phase I Design Studies	7
Phase I Design Studies:	
A -- Water-Quality and Public Health Engineering Issues	A-1
B -- Economic and Resettlement Issues	B-1
C -- Land-Tenure Issues	C-1
D -- Public Health and Epidemiology Issues	D-1
E -- Sedimentation and Hydrology Issues	E-1

ACRONYMS

ADC	Agricultural Development Corporation
AHT	Agrar und HydroTechnik, GMBH
AID	U.S. Agency for International Development
AMREF	African Medical and Research Foundation
ARD	Associates in Rural Development, Inc.
BuRec	Bureau of Reclamation
EEC	European Economic Community
FAO	Food and Agriculture Organization of the United Nations
FINNIDA	Finnish International Development Agency
GSDR	Government of the Somali Democratic Republic
GTZ	German Agency for Technical Cooperation
IPM	Integrated Pest Management
JESS	Jubba Environmental and Socioeconomic Studies
JuDAS	Jubba Development Analytical Studies
LTC	Land Tenure Center
MCH	maternal and child health
MJVD	Ministry of Jubba Valley Development, GSDR
MOA	Ministry of Agriculture, GSDR
MOH	Ministry of Health, GSDR
NAS	National Academy of Sciences
NDDCP	National Diarrheal Diseases Control Program
NRC	National Refugee Commission
NTTCP	National Tsetse and Trypanosomiasis Control Program
PCI	Project Concern International
PVO	private voluntary organization
RFP	request for proposals
RMR	Resource Management and Research
SCR	Swedish Church Relief
SEBS	socioeconomic baseline survey
UNHCR	United Nations High Commission on Refugees
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
WDA	Water Development Agency, GSDR
WHO	World Health Organization

PREFACE

The Jubba Environmental and Socioeconomic Studies (JESS) are part of a larger project, Jubba Development Analytical Studies (JuDAS), which is a cooperative effort between the U.S. Agency for International Development (AID) and Ministry of Jubba Valley Development (MJVD) of the Government of the Somali Democratic Republic. In September 1985, Associates in Rural Development, Inc. (ARD), of Burlington, Vermont, signed a contract (number AFR-0134-C-00-5047-00) with AID to provide technical assistance and project management for JESS.

As part of this contract, ARD must publish all of its consultant reports. However, because of the exploratory nature of the studies presented here, insufficient information and the very short time frame for their execution, there may be some inaccuracies in this report. For this reason, ARD wishes to emphasize that the opinions expressed herein are those of the individual consultants and do not necessarily reflect the views of ARD, JESS, AID or MJVD.

BACKGROUND FOR PHASE I DESIGN STUDIES

JESS' General Objectives and Resources

The long-term goal of the JuDAS project is to compile data and perform assessments associated with planning optimal resources use in the Jubba Valley of Somalia. The JuDAS project has two primary purposes:

- to gather necessary information on soils/land use and social and environmental factors for incorporation into a master plan for valley development; and

- to provide MJVD with technical support and training.

The JESS team is assisting in Somalia's development by applying the results of its environmental and socioeconomic studies to development planning, impact assessment, ecosystem monitoring and staff training. Also under the JuDAS project, the U.S. Bureau of Reclamation (BuREC) is preparing a soils and land-use classification, and the National Academy of Sciences (NAS) is conducting a peer review and providing advisory services to USAID/Somalia, JESS and MJVD.

To help attain JuDAS' goal and purposes, JESS has been given the following specific objectives:

- supply GSDR with timely information to be used in formulating a socioeconomically and environmentally sound master plan for the Jubba Valley and guidelines for designing future projects;

- identify and evaluate interrelated socioeconomic and environmental effects that may be caused by development of the river valley, and further describe procedures and development activities to mitigate adverse effects and enhance beneficial impacts;

- provide GSDR with a realistic plan for monitoring environmental, socioeconomic, land-use and agricultural parameters in the Jubba Valley, so that national development decisions can be based on sound, current data; and

- develop institutional strength within MJVD through classroom and on-the-job training.

These objectives are being addressed by a five-person ARD field team in Somalia, including a natural resources planner (the

team leader), ecologist, socioeconomist, anthropologist and administrative coordinator. The JESS field team is also receiving substantial technical and administrative support from ARD home-office staff and short-term consultants.

There are three phases of JESS activities. Phase I was a six-month period for project planning and the start-up of field operations.

Phase II will last for two years. The main emphasis during this phase will be on primary data collection in the Jubba Valley. Some preliminary analysis of field data will be done during Phase II to provide MJVD and potential donors with timely information for project planning purposes. This preliminary information will be supplied to MJVD in the form of interim reports.

Phase III will consist of a six-month period when the final analysis of field data and all project products are completed. Final outputs to be produced during this period will include:

- an evaluation of potential impacts from construction of the Baardheere Dam and recommendations for ways to enhance positive and mitigate negative effects;
- a realistic plan for long-term monitoring;
- baseline maps of socioeconomic, environmental and land-use conditions in the Jubba Valley;
- resource management guidelines for future development; and
- to the extent possible, training MJVD staff to continue related assessment, monitoring and planning work in the future.

Process of JESS Study Design

The design of JESS studies began when ARD responded in January 1985 to the request for proposals (RFP) issued by AID. ARD's original technical proposal was then revised for the "best-and-final" stage of proposal evaluation, which occurred during July 1985. This proposal included a technical discussion of what ARD proposed to accomplish, given the very extensive range of topics suggested in the RFP. Using this proposal as a basis, ARD home-office and field personnel began the detailed process of JESS study design in Somalia during October 1985. As already noted, this process was the principal focus during the six months of Phase I. The design process included the following specific elements:

- literature search,
- technical start-up in Somalia,
- reconnaissance in the Jubba Valley,
- first NAS workshop in Mogadishu, and
- drafting of the Phase II work plan.

Literature Search

ARD and JESS contacted approximately 60 organizations around the world for information about JESS-related topics. The JESS team mainly reviewed Somalia-related documents, while ARD home-office staff conducted a more general review, gathering information from other river-basin projects around the world and also focusing on methodological issues relating to certain technologies and concepts pertinent to JESS (e.g., rapid rural appraisals, remote sensing).

This literature search was essential for the design of efficient, relevant studies and evaluation of results, and will continue for the duration of JESS. The more than 1,000 citations identified thus far are presented in a separate ARD report, BIBLIOGRAPHY FOR THE JESS PROJECT (JESS Report No. 2, 31 July 1986).

Technical Start-Up

As part of project start-up, ARD's home-office technical manager, went to Somalia with the JESS team leader at the start of the project. These two individuals reviewed a broad range of ongoing technical activities conducted by other organizations in Somalia and the Jubba Valley. Of particular importance was an assessment of the efforts of Agrar und HydroTechnik, GMBH (AHT), for the German Agency for Technical Cooperation (GTZ), on the master plan and BuRec on a soils and land-use classification for MJVD. This initial technical start-up helped clarify the planned activities of other organizations in the Jubba Valley and identified information gaps that JESS should address.

Jubba Valley Reconnaissance

During Phase I, JESS staff made ground trips to the Jubba Valley for purposes of environmental and socioeconomic reconnaissance. Most of these trips were to the middle and lower Jubba regions and included:

- establishing contacts and liaisons with local officials,
- testing field equipment and vehicles,
- learning the characteristics of habitats and populations,
- evaluating existing aerial photographs and maps, and
- inspecting potential study sites.

In addition to these overland trips, JESS personnel, consultants and NAS panel members were able to view the area from chartered light aircraft.

NAS Workshop

The main vehicle for NAS interaction is a series of workshops. The first was held in Somalia at the end of January 1986. This was a cooperative effort between MJVD and NAS, and had two parts--a field trip to the Jubba Valley and meetings in Mogadishu. JESS played a central role in logistic arrangements for the field trip and also participated in the meetings. JESS field staff, ARD's home-office project manager, the USAID project manager and a panel of specialists organized by NAS engaged in several small-group and one-on-one discussions about development issues, assessment approaches and comparative studies of man-made lakes in Africa.

At the first workshop, the NAS panel suggested that the following issues were particularly important relative to Jubba Valley development and JESS:

- the inclusion of small- and medium-scale development approaches, in addition to large-scale irrigation projects, which are currently in favor for valley development;
- trade-offs involved in the allocation of hydropower from the Baardheere Dam project between settlements in the Jubba Valley and Mogadishu;
- development opportunities and limitations associated with reservoir drawdown (i.e., use of the draw-down zone) and controlled floods;
- resettlement of people dislocated by projects;
- consideration of livestock and pastoralism in agricultural projects for the valley; and

- local and national institutional factors involved in development.

Drafting the Phase II Work Plan

Following the NAS workshop in Somalia, ARD home-office staff, the JESS field team and five consultants with extensive river-basin assessment experience began drafting the Phase II work plan. Advice and opinions were also sought from NAS scientists, professors at the National University of Somalia and representatives of numerous organizations in Somalia. This effort included interviews, lengthy discussions, brainstorming sessions, flights over the Jubba Valley and ground visits to the area.

The studies were then designed using lists of issues taken from:

- ARD's scope of work and best-and-final proposal;
- the first NAS workshop;
- experiences of ARD staff and consultants;
- literature on other river-basin assessments;
- planning efforts and developments elsewhere in Africa and around the world; and
- an outline of information required from MJVD for a World Bank appraisal of construction of the Baardheere Dam with power and irrigation development--ARD identified activities being conducted by other organizations in the Jubba Valley.

Based on all of these, AID, MJVD, NAS and ARD reduced the very long list of issues that was originally produced and agreed that the following study topics should be considered by JESS:

livestock
wildlife
aquatic fauna
ornithology
water quality
limnology
disease vectors
estuarine ecology
reservoir ecology
reservoir sedimentation
river scour
forestry
range management
biocide use
biological conservation
institutions
water and sanitation
watershed management

demography
family resource management
production systems
social services
health
nutrition
land tenure
women's issues
archaeology
resettlement
agricultural resettlement*
irrigation costs*
irrigation history*
labor*
markets
pastoralism
dam design and operations
ethnobotany

From this list, ARD staff and consultants drafted a series of preliminary study designs. The input of ARD home-office and JESS field staff went directly into the Phase II work plan. The reports of the five consultants utilized by ARD during Phase I have been compiled and are presented here. On completion of these preliminary designs for the Phase II studies, they were transferred to ARD's home office and incorporated into a draft work plan for Phase II. The draft work plan was prepared by ARD home-office staff and revised by the JESS field team prior to final editing and production by the home office.

The work plan (PHASE I REVIEW AND PHASE II WORK PLAN FOR THE JESS PROJECT, JESS Report No. 1, 31 July 1986) covers two years of environmental and socioeconomic investigations and analyses in Somalia and is keyed to numerous factors, including development perspectives (GSDR priorities), present and anticipated logistic and climatic constraints, manpower allocations, budgetary restrictions and product timeliness (e.g., the master plan and decisions about dam design and construction contracts).

The work plan includes the following types of studies:

- baseline studies of environmental and socioeconomic conditions in the Jubba Valley;
- impact assessments of selected development projects--interventions such as the Baardheere Dam project and irrigation schemes in the lower Jubba region; and

---

*Topic to be covered by JESS during Phase III, although other organizations may do initial research in this area in Phase II.

- special studies relevant to long-term Jubba Valley development (e.g., pastoralism and health considerations in dam design).

All of the studies aim to enhance the positive effects of development and mitigate adverse impacts associates with dam construction and other related projects in the Jubba Valley. The work plan includes considerations for facilitating JESS studies, such as the use of remote-sensing technologies and data management systems. It also provides a schedule for the proposed activities and indicates the level of effort planned for the various investigations.

Role of Phase I Design Studies

The previous sections have described the overall process of study design for JESS. The series of discussions included in this volume were preliminary assessments done by five ARD consultants during Phsae I that were subsequently incorporated into the Phase II work plan. They are compiled here largely for historical purposes and have not been substantially revised by ARD. The ideas in these preliminary studies have been included in the Phase II work plan only where they were deemed appropriate by the JESS field team and ARD home-office staff, after discussions with AID, MJVD, and NAS.

As per ARD's contract with AID, all consultant reports must be published. However, because of the exploratory nature of these studies, insufficient information and very short time frame for their execution, there may be some inaccuracies. For this reason, the opinions expressed herein are those of the individual consultants and do not necessarily reflect the views of ARD, JESS, AID or MJVD.

STUDY A

Water-Quality and Public Health Engineering Issues

William R. Jobin, Sc.D.

CONTENTS

Section		Page
I.	Introduction	A-1
	A. Organization of This Report	A-1
	B. Timing of Proposed Studies and Reports	A-1
II.	Major Issues in Water Quality and Public Health Engineering	A-3
	A. Water and Sanitation for Resettlement and New Communities	A-3
	1. Design Criteria, Health Goals and Costs	A-3
	2. Institutional Arrangements for Construction and Operation	A-4
	3. Location, Operation and Monitoring of Water Supplies	A-4
	B. Integrated Design and Operation of the Dam and Reservoir	A-4
	1. Monitoring Water Quality and Estimating Lake Conditions	A-5
	2. Operating Rules for Protecting Water Quality and Health	A-5
	3. Institutional Arrangements for Integrated Reservoir Operations	A-5
	C. Water Quality of River, Reservoir and Estuary	A-6
	1. Monitoring and Predicting Reservoir Conditions and Releases	A-6
	2. Lower River and Estuary Conditions	A-6
	D. Preferred Crops and Agricultural Systems from a Health Viewpoint	A-7
	1. Dheshek Agriculture	A-7
	2. Irrigated Agriculture	A-7
	E. Water Quality, Pest Management and Fisheries	A-7
III.	Work Schedule	A-11

I. INTRODUCTION

The purpose of this report is to outline a plan for assessing water quality and public health engineering considerations regarding proposed development in the Jubba Valley. This report is the result of a three-week visit to Somalia in February 1986 by Dr. William R. Jobin, director of Blue Nile Associates, in response to a request from ARD.

Since water resource development projects create suitable habitats for disease-bearing mosquitos, flies and snails, there are important links between reservoirs, irrigated agriculture, human health and livestock health. Fortunately, however, experience in many countries similar to Somalia provides ample rationale for guiding design and operation of proposed development projects to reduce these costly infections. Early health-related assessments and simple design modifications may result in significant health benefits, avoiding costly remedial programs for control of disease epidemics in agricultural communities, livestock herds and indigenous wildlife populations.

A. Organization of This Report

Section II outlines the five major water quality and public health engineering issues that JESS should address. These issues are crucial to balanced development in the Jubba Valley:

- community water supply and sanitation;
- integrated dam design and operation;
- water quality in the reservoir, river and estuary;
- preferred agricultural operations related to health; and
- pesticides and fish.

Section III proposes a work schedule for completing the studies of the five issues listed above.

B. Timing of Proposed Studies and Reports

Efficient planning of Jubba Valley development requires that potential water quality and public health effects of various development options be assessed before final designs are selected. Thus, recommendations relating to water quality and public health engineering would best be submitted in two early

10

interim reports, followed by a final report at the end of Phase II of JESS.

The first interim report will be completed by October 1986, prior to the World Bank pre-appraisal mission. The second interim report will be completed by February 1987 to coincide with scheduled loan meetings with the donors, and possibly before completion of the master plan. The final report will be completed at the end of JESS Phase II, scheduled to occur prior to any final design of agricultural or community facilities.

II. MAJOR ISSUES IN WATER QUALITY AND PUBLIC HEALTH ENGINEERING

Five major issues in water quality and public health engineering are considered in this report. They are:

- water supply and sanitation for resettlement and new communities;
- integrated design and operation of Baardheere Dam and Reservoir;
- water quality of the Jubba River, including the proposed reservoir, river and estuary;
- preferred crops and agricultural systems related to health considerations; and
- water quality, pesticide usage, fisheries and integrated pest management.

The rest of this section outlines these issues and the studies proposed to resolve them.

A. Water and Sanitation for Resettlement and New Communities

Only productive and stable human communities can make full use of the Jubba Valley's agricultural and livestock resources. Reliable, adequate and convenient water supplies for these communities and their livestock will be needed for resettled, expanded and new populations expected during development of the valley. The quantity, quality and convenience of these water supplies will be major factors in determining locations and acceptable sizes of these populations. Costs for such community water supplies and sanitation facilities will be directly related to the desired levels of health, which should be defined in the master plan. The three major steps in planning community water and sanitation facilities are discussed below.

1. Design Criteria, Health Goals and Costs

Per capita cost analyses for resettled, expanded or new communities will be made by relating quantity and quality of water supply to disease control and costs. These analyses will be based on the 1985 Decade Plan for Water Supply in Somalia and on the findings from a 1984 field survey in the reservoir area. Recent costs and resultant levels of health from the Gezira and Rahad irrigation schemes in central Sudan will be adjusted to Somalia conditions.

2. Institutional Arrangements for Construction and Operation

A critical element in the long-term success of community water supply and sanitation facilities is community involvement in planning, constructing and operating their own systems. Various community involvement options will be outlined for government consideration. AID's Water and Sanitation for Health (WASH) project will be consulted during this Phase II work.

3. Location, Operation and Monitoring of Water Supplies

Parallel to completion of the master plan and specification of policies regarding community water supplies and sanitation by the GSDR, preferred locations of water supplies and the recommended population limits for those supplies will be specified for the entire valley. Recommendations will be based on available data from the 1984 report of the Water Development Agency (WDA), from a field assessment of water quality and quantity of existing supplies to be conducted under this proposal, and from estimated carrying capacity for land and water resources prepared in cooperation with other components of JESS, such as those on livestock and vegetation.

B. Integrated Design and Operation of the Dam and Reservoir

A large and relatively stable body of fresh water behind Baardheere Dam--in an area of semiarid climate, saline groundwater, migrating human populations and nomadic pastoralists--may result in significant human and livestock concentrations on the reservoir perimeter. This possibility should be considered before final resolution of the differences brought up in the design review report of Electrowatt Engineers regarding dam design and including proposed operating schedules. Experience in the Caribbean region and with the Mahaweli project in Sri Lanka has shown that simple modifications of dams and reservoirs can produce favorable conditions for protection of human and animal health around the reservoir perimeter. Carefully planned operational schedules can produce favorable conditions for protecting human and animal health by reducing problems with undesirable aquatic vegetation, malaria mosquitos and bilharzia snails in the reservoir as well as downstream.

Modifications such as those proposed by Electrowatt in its design review include:

- slightly enlarged discharge outlets to provide greater flexibility in discharge rates;

- control of water velocities and turbulence at dam outlets to reduce habitat extent for disease-bearing insects and snails; and

- certain seasonal fluctuations in discharge rates to allow manipulation of reservoir levels and downstream flows as measures to further reduce vegetation and undesirable insects and snails.

Early evaluation and design modifications will increase operating flexibility in later years when power and irrigation needs must be kept in balance with climatic variations. The studies required for development of these improvements are outlined below.

1. Monitoring Water Quality and Estimating Lake Conditions

The quality of incoming water above the proposed reservoir will be related to the expected operating schedules and reservoir geometry in order to predict shoreline and outlet conditions of water quality, aquatic vegetation, and suitability of habitats for insects and snails.

2. Operating Rules for Protecting Water Quality and Health

Operating rules and design modifications will be recommended to maintain or improve water quality for human and agricultural purposes, and to protect human and animal health. These will be based on the 30-year simulation of reservoir operations prepared by Electroconsult, the consulting engineers for Baardheere Dam. Proposed shoreline modifications or remedial public health measures will be specified and costed for comparison with costs incurred through modifications of the original simulation of the reservoir's operation.

3. Institutional Arrangements for Integrated Reservoir Operations

Experience has shown that operational requirements for health needs in reservoirs do not always coincide with requirements for power generation and irrigation, producing conflicts under certain conditions. Rational assessment of the relative benefits from the conflicting needs requires that an organization be created to advise the operators of the dam regarding any conflicts. This entity would need information on the costs and benefits of available operational modifications, as developed in Section II.B.2 above. It would also need authority to advise on dam operations, and a monitoring system to assure that its recommendations are accurate and pertinent to the ever-

changing conditions in the reservoir and downstream. Options for the form of such an organization will be developed for GSDR consideration.

C. Water Quality of River, Reservoir and Estuary

Limited available data suggest that effects of impoundment on salinity and other characteristics of water from the upper Jubba River catchment area may cause problems with the quality of the concrete in the dam, corrosion of the turbines, downstream agriculture and estuarine ecology. Prediction of future conditions will require monitoring programs near the dam site and in the estuary to collect baseline data for simulating future water quality in the reservoir, river and estuary. Indications of extremely high chloride and conductivity levels during the dry season (January to March), followed by bursts of salts detected in early floods (April and May), demonstrate a need for year-round monitoring of salts and river-flow rates in order to prepare a mass balance for expected concentrations in the reservoir and downstream. Combined with tidal exchange rates in the estuary, salt concentrations in river water will be important factors in determining suitable irrigation and drainage practices, as well as crop selection. The steps needed to predict water quality in the river, estuary and reservoir are discussed below.

1. Monitoring and Predicting Reservoir Conditions and Releases

This study will start in April 1986 with daily collection of water-quality samples at Baardheere during the rainy seasons and monthly sampling during the rest of the year. Parameters measured will include all salts and suspended solids, as well as basic parameters of pH, color, temperature, turbidity, conductivity, and the settling and clarification rates of the suspended matter. This information, along with measurements of nitrate and phosphate nutrients, will be used to forecast likely conditions in the reservoir, including biological productivity.

2. Lower River and Estuary Conditions

Detailed simulation of the river and estuary will be made for alternative flow rates, based on monitoring of salinity, tidal exchange and nutrient levels. Saline intrusions, including vertical distribution and seasonal changes will be estimated. Results of this study will be related to probable effects on agriculture and aquatic habitats.

D. Preferred Crops and Agricultural Systems from a Health Viewpoint

At present, several alternatives are being considered for improved agriculture in the Jubba Valley, and each alternative has consequences for human and animal health. The alternatives include either dhesheek or irrigated agriculture, with crop systems including rice, bananas, cotton and sugar, or mixed rotations of several crops. If properly designed and implemented, some of these systems will have health benefits, while others will certainly require remedial health programs, due to increased insect and snail habitats and subsequent human and animal disease outbreaks. Early assessment of the probable changes caused by these various forms of agriculture can assist planners in selecting more favorable combinations of systems and crops for improved human and animal health. Experience in semiarid zones in Iran, Kenya, Sudan and even the Somali river valleys of the Shabeelle and lower Jubba can be used to estimate the health consequences of these various crop and agricultural practices. Field monitoring and assessments of existing schemes in Somalia will be conducted in the two studies described below.

1. Dhesheek Agriculture

Improved water management proposals for dhesheek agriculture in the middle and lower valley will probably result in decreased malaria and bilharzia risks due to shorter breeding periods for mosquitos and snails. Careful assessments during June and December 1986 of habitat and vector conditions will make it possible to quantify these expected benefits.

2. Irrigated Agriculture

Seasonal monitoring of existing schemes and detailed simulations of irrigated rice, sugar, banana and mixed-crop rotations will make it possible to estimate health effects related to crop selection and to major components of the irrigation and drainage canal systems. Experience in the Sudan, Iran, West Africa and Puerto Rico will be used to corroborate the local observations.

E. Water Quality, Pest Management and Fisheries

The potential for developing freshwater fish for food--and also as agents for control of malaria mosquitos, undesirable aquatic vegetation and bilharzia snails--indicates a need for managing water quality and for limiting use of toxic pesticides in Jubba Valley agricultural and health programs. Somalia has

become world famous for utilizing two species of local fish as alternatives to reliance on chemical control of malaria mosquitos. Recently published reports by the Ministry of Health (MOH) have shown that use of the fish, plus improved primary health care methods, resulted in successful and inexpensive control of malaria in Burao. Discovery of these same fish in the Jubba Valley indicates the feasibility of their use for mosquito control, if the aquatic environment can be properly managed. Similar experience in Egypt and the Sudan with fish for weed and snail control offers additional impetus for investigating this approach. Integrating fish and other biological control agents with simple primary health care and improved community water supply and sanitation will undoubtedly be the most feasible health strategies for generations to come. Commonly referred to as Integrated Pest Management (IPM), the use of a broad array of chemical, biological and physical methods decreases reliance on expensive imported pesticides and thereby improves health and economic benefits.

Detailed simulation of habitat conditions for the various fish species and for general fish populations, as well as inventories of pesticide stocks and application methods in present agricultural operations in the valley, will make it possible to evaluate potential uses of fish in integrated pest management of malaria mosquitos, bilharzia snails and undesirable aquatic vegetation. If warranted, pesticide persistence in human and animal foods and fluids will be assessed by chemical analyses. Computer simulation of desirable habitats for general freshwater and estuarine organisms will be developed, if fisheries data indicate such a need.

IV. WORK SCHEDULE

Blue Nile Associates' Proposed Phase II Work Schedule*
(April 1986-February 1987)

Study	1986									1987												1988	
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
A. Water Supplies																							
1. Design criteria					0.5																		1.0
2. Inst arrangements			1.0		0.1																		
3. Location												1.0		1.0									
B. Dam Design/Operation																							
1. Lake conditions			1.0		1.0																		1.0
2. Operating rules										1.0													1.0
3. Inst arrangements										0.1													
C. Water Quality																							
1. Inflows	3.0#	0.5#	1.0			0.5		0.1		0.5												1.0	1.0
2. Estuary			0.5					1.0		1.0		1.0		1.0									
D. Crops and Health																							
1. Dheshek agri.			1.0		1.0			1.0		1.0		1.0		1.0									
2. Irrigated agri.			1.0		1.0			1.0		1.0		1.0											1.0
E. Pesticides, Fish, IPM						2.0			1.0											3.0**		1.0	1.0
First Interim Report							4.0																
Second Interim Report											2.0												
Final report																							4.0

Total: 52.8 person weeks

* In estimated person-weeks. Underlining indicates fieldwork in Somalia.

** Addition for prediction of fish habitats (optional)

\# R. Klumpp

STUDY B

Economic and Resettlement Issues

Peter C. Bloch, Ph.D.

CONTENTS

Section		Page
I.	Economic Issues in Planning Phase II of JESS	B-1
	A. Labor Availability in the Jubba Valley	B-1
	B. Appropriate Scale of Irrigation	B-1
	C. Appropriate Technology	B-2
	D. Crop Selection	B-2
	E. Sex Roles	B-2
	F. Farmer-Herder Relations	B-3
	G. Pricing, Marketing and Public Policy	B-3
	H. Foreign Exchange Dependence and Recurrent Cost Financing	B-3
	I. Transportation and Communications	B-4
II.	Proposed Studies	B-5
	A. Irrigation Economics in Somalia	B-5
	B. Economic Implications of Suboptimal Results	B-6
	C. Economic History of Irrigation Projects in Somalia	B-8
	D. Employment Implications of Alternative River-Basin Structures	B-9
	E. Multiplier Effects of Different Irrigation Models	B-10
	F. Trade-Offs Between Hydroelectric Power and Irrigation	B-11
	G. Economics of Forage Production	B-12
	H. Marketing and Transportation of Agricultural Products	B-13
	I. Terms of Trade Between Agriculture and Urban Sectors	B-14
	J. Macroeconomic Impact of Jubba Valley Development	B-14
III.	Resettlement Issues	B-16
	A. Refugees	B-16
	B. Government Policy Options	B-17
	C. Non-Refugee Resettlement	B-18
Appendix -- Individuals Contacted		B-20

I. ECONOMIC ISSUES IN PLANNING PHASE II OF JESS

A. Labor Availability in the Jubba Valley

To address the issue of labor availability in the Jubba Valley, much more information is needed about valley individuals' and households' ability to achieve an adequate standard of living without offering their services to such employers as the Jubba Sugar Estate and Fanoole Rice Project. The JESS socioeconomic baseline survey (SEBS) can provide such data and thus, must be designed to address this issue. On the demand side, the studies proposed here on the economics of irrigation and employment impacts will provide insight into the demand side of the labor market and amount of induced demand for labor, respectively. The question cannot be answered without a careful cost analysis of current irrigation schemes in Somalia and consideration of the needs and aspirations of Somalis who will be expected to provide the labor needed for Jubba Valley development.

B. Appropriate Scale of Irrigation

There are several dimensions to this issue:

- total number of hectares to be irrigated in the valley,
- size of individual irrigation schemes, and
- size of the individual management unit, i.e., each farmer's holdings.

The first is technically a function of soils and water availability, and economically dependent on labor and capital. On the technical side, the German Agency for Technical Cooperation (GTZ) and Agrar und HydroTechnik (AHT) estimate there is a potential 175,000 hectares to be irrigated between the dam site and Baardheere. There are no credible estimates yet on the economic factors.

The appropriate size for an irrigation scheme is a complex issue and depends partly on the crops grown (for example, sugar may have economies of scale up to several thousand hectares, while bananas may be most efficient on medium-size farms). However, the larger the scheme, the more complex the management demands will be. If management is a scarce resource, as it seems to be in Somalia, either schemes should be smaller than would otherwise be optimal or decision-making decentralized within the scheme.

The size of individual holdings is almost independent of the size of the irrigation scheme. A 1,000-hectare scheme could have 1,000 smallholders, each with one hectare; a single medium farm management unit could have a 500-hectare perimeter; or any conceivable variation could be employed. The decision depends partly on technological factors--for example, economies of scale may matter if mechanization is appropriate--but its main determinant is the project's goals. If the main goal is to provide a large number of farmers with the means to survive, small plots are appropriate. On the other hand, a surplus to market is needed, farmers should have enough land to produce such a surplus above and beyond their subsistence needs.

C. Appropriate Technology

Appropriate technologies are those that use a nation's abundant resources and economize on scarce ones. In Somalia, it is not evident which resources are scarce and which abundant. Factor prices do not reflect scarcities very well--some markets have become freer in the last two years, but input markets are not among them, land does not have a true market, and the labor market is a complete unknown. At present, the only indubitably abundant resource in the Jubba Valley is land, which would suggest that appropriate technology is extensive, with a focus on labor and capital productivity, rather than yields per hectare.

D. Crop Selection

There should be no preconceptions about this issue, as there have been in other river basins (like the Senegal, Gambia and Niger) with disastrous results. For example, rice should not be grown in areas with a labor shortage, especially if dryland farming is a viable proposition, as it appears to be in most of the Jubba Valley. Nor should it be grown where water is not abundant, as it is one of the most moisture-demanding crops. Crop selection should be made only after careful studies of market prospects that take production costs into account. A mix of new and traditional export crops as well as substitutes for imports is the likely result.

E. Sex Roles

This issue is related to labor availability, inasmuch as most African societies assign clearly defined productive roles to men, women and children. In agro-pastoral communities, it is frequently women who do the bulk of the farm work, while men tend cattle on circuits that take them away from the farm for many months of the year. The JESS SEBS will have to determine whether this pattern is typical of Jubba Valley residents because it will

not be appropriate to design labor-intensive projects if much of the potential labor force is committed to activities that take them outside the valley for a large portion of the year.

F. Farmer-Herder Relations

This issue is certainly significant in the Jubba Valley, but no one knows just how important. Clearly, there are pure nomads who use the river solely as a seasonal source of water and forage, agro-pastoralists whose animals also enter the valley during dry seasons and sedentary farmers who keep animals around their settlements. Each group has different demands for water and grazing/browsing land, and they will be differentially affected by the extension and intensification of riverine farming. One of the two most important tasks of SEBS (assessing labor availability is the other) is understanding the interactions between farming and all types of livestock activities--the mutual dependencies that now exist (e.g., forage for manure, milk for grain) and conflicts that arise over competing needs for the same, limited resources.

G. Pricing, Marketing and Public Policy

It appears that GSDR has come to believe that complete control of the modern agricultural sector will not work. The partial liberalization of agricultural prices and removal of the Agricultural Development Corporation's (ADC) monopoly on marketing crops have apparently had a positive effect on farmers' willingness to produce for market. Continued improvements will probably require liberalization of input markets as well, along with the allocation of sufficient foreign exchange to assure an adequate supply of imported inputs. JESS' role here is twofold:

- to ascertain farmers' interest in producing for market and constraints they perceive on their ability to do so; and

- to understand the potential for local private-sector involvement in marketing.

H. Foreign Exchange Dependence and Recurrent Cost Financing

The financial issues involved in river-basin development must not be neglected. Social cost/benefit analysis ignores recurrent costs and cash flow, and "shadow prices" of foreign exchange are calculated under the assumption that the government uses rational criteria to allocate it. In Somalia, neither is tenable because the government's budget and balance of payments are so hard-pressed that the availability of funds cannot be

ignored. Also, if a large part of project benefits are external to it (e.g., induced effects), neither the project nor the government are likely to be able to capture them to put them back into the proper budget categories. This issue is important in evaluating potential river-basin development because some types of irrigation, for instance, are much more import- or cash-intensive than others. While this issue will really be of greatest concern to AHT designers of the master plan, JESS studies should be aware of it as well.

I. Transportation and Communications

Next to dam construction, the road from Jilib to Baardheere is the single most important element in the infrastructure for Jubba river-basin development. The entire middle valley (or at least, one bank) could be opened up by such a road, and farmers and herders, who now practice subsistence production, could enter the wider national market. JESS baseline studies should try to identify parts of the middle valley that are most likely to undergo the most dramatic changes as a result of the road and dam, and focus a greater amount of its data collection in those areas.

II. PROPOSED STUDIES

A. Irrigation Economics in Somalia

Implicit in most thinking about Jubba Valley irrigation development is the assumption that the best way to irrigate is by surface flooding and the most economical means of accomplishing this is gravity flow. Certainly, gravity flow is likely to be cheaper than diesel pumping and also more reliable, so long as water is sufficiently abundant. Problems with the availability and cost of diesel fuel and pumps, especially maintenance facilities and parts, have been and will likely continue to be severe in Somalia, whereas electric power will be cheap and presumably uninterrupted after the Baardheere Dam is completed.

There are several problems with surface irrigation that must be resolved before it is possible to recommend it wholeheartedly for generalized development in the Jubba Valley. First, there is a great need for leveling, not only initially, but every couple years. This may create unrealistic demands on management, whether it is done by smallholder farmers or professional project directors. Second, gravity-flow canals tend to be long--the 52-kilometer Fanoole canal is an example. Again, required waterweed removal may pose an unmanageable maintenance problem. (It should be noted that the Chinese-managed Fanoole project cannot or at least does not now maintain the canal.) Third, there seems to a labor shortage in the Jubba Valley, given the wage rates that projects are willing to pay.

The principal alternatives to surface irrigation are sprinkler and drip irrigation. Both are used extensively in many parts of the world. They are unquestionably less labor-intensive than surface irrigation for most crops, but in the Somali context, it may be more interesting that they are less demanding in terms of management time, effort and expertise. They are modern technologies, in contrast to, as Mr. Savva of the Ministry of National Planning puts it, the outmoded technologies of the 1940s--i.e., surface-flow, gravity-feed irrigation.

The major issue is what are the government's goals for irrigation. If it is the settlement of nomads, smallholder irrigation will be needed for plots that are big enough for forage production as well as grain and other food crops. If Somalia wishes to achieve self-sufficiency in food grains, it will need either state farms with substantial mechanization to avert labor shortages or smallholders working on plots that are large enough (over three hectares double-cropped) for production of a substantial surplus for market. If resettlement of refugees to foster self-reliance is the objective, plots of appropriate size for family farms (approximately one hectare) could be

apportioned with no intent of producing a marketable surplus. Other issues include:

- amount of local control of irrigation management;
- desired amount of irrigation (e.g., trade-offs with hydropower);
- portion of the cost of irrigation development to be borne by farmers, the government and other donors;
- whether the liberalization of farm prices and trade is likely to continue;
- whether the availability of agricultural inputs will be liberalized and if so, when; and
- whether electric power will be available to the valley.

It should be possible to develop a sound economic analysis of alternative irrigation technologies and water-delivery systems in around two person-months or perhaps less, divided approximately equally between Somalia and the United States. The first task is to inventory the international literature available in the United States, focusing on experiences in Israel with drip irrigation and Arabian and North African experience with sprinklers. In Somalia, most time would be spent at Shabeelle and lower Jubba sites where various irrigation techniques have been tried, gathering and sifting data to ensure that the So evidence can be compared to patterns predicted from international experience.

In terms of manpower requirements, one person-month of effort by an economist with experience in project evaluation techniques, especially irrigation, will be required. Second, one person-month of research assistance or possibly a summer internship for a U.S. graduate student, accumulating bibliographic material and extracting relevant data will be needed. Transportation will be required for the economist, perhaps the research assistant and a Somali counterpart for one month to travel from Mogadishu to the middle and lower Shabeelle and Jubba. Preferable scheduling for this work would be during one of the two summers of Phase II, and since the needs of other studies proposed in this report indicate that it should be sooner, as opposed to later, the summer of 1986 is suggested.

B. Economic Implications of Suboptimal Results

All economic analyses of development projects are supposed to include sensitivity analyses, i.e, discussions of how benefits

24

and costs might vary given different scenarios, such as the timing of construction and rainfall and river-flow patterns. The purpose of such analyses is to determine the robustness of the analyst's conclusions about economic feasibility when actual conditions at the time of implementation differ from those assumed. Sensitivity analysis is almost always conducted after a project's final engineering design has been decided and focuses on a single discrete project, rather than an interrelated program of river-basin development.

In cases such as development of the Jubba Valley, there are certain variables that will affect some kinds of projects more than others. River-flow patterns will obviously be more important to irrigation than dryland farming. The availability and cost of diesel fuel will matter more to pump irrigation projects than those employing gravity flow. Pricing policy decisions will have a greater impact on the profitability of marketed crops, as opposed to those consumed by producers. Given the climatic and policy uncertainties facing project planners and farmers, the variance of outcomes may be just as important as the mean--planners and farmers will have to be aware of the risks and uncertainties that accompany the expected values of results. Thus, a simultaneous summary of possible outcomes for different types of projects using various technologies under differing sets of external conditions is proposed.

This would be an exercise in standard social cost/benefit analysis. It should be based on data from existing projects in Somalia and elsewhere, gathered simultaneously with the data need for the proposed study on irrigation economics. The expected findings are that activities which appear to be better because their "expected" rate of return is higher may also have high probabilities of failure or very poor results. Insofar as project planners and farmers are averse to risks, they may wish to choose projects with smaller risks, even if the average return is lower.

Without careful planning, this sort of study could grow to be as intricate and difficult to interpret or use as Resource Management and Research's (RMR) Southern Rangelands Survey, for example. It is easy to get lost in numbers in a study like this, and the problem is most severe when dealing with a simulation exercise, rather than real data. The human costs of this kind of difficulty could be substantially reduced if an appropriate spread-sheet program could be written by an expert, but the operator would still have to be directed away from trying out a nearly infinite number of alternative cases.

For manpower, this work would require one month of an economist's time who has experience in project evaluation techniques, plus a contract with a computer programmer to create the necessary spread-sheet program. The logistics and equipment

needs would be simply for the spread-sheet and computer time. This study could be done simultaneously with the investigation of irrigation economics.

C. Economic History of Irrigation Projects in Somalia

Irrigated agriculture has a long history in Somalia. The Jubba and Shabeelle have been tapped since the colonial era to produce bananas, and there have been many state-sponsored cash-crop production projects since independence, especially since the revolution. Before any new irrigation efforts are undertaken, there is a definite need for a thorough review of previous Somali experience. Otherwise, it is likely that many of the mistakes made in the past will be repeated and successful techniques will not be.

To accomplish such a review, the principal task is to assemble and analyze existing documents at documentation centers and project offices in Mogadishu and probably the field as well (e.g., Afgoi, Fanoole). This effort will require much persistence and would be a perfect introductory piece of work for a U.S. graduate-student intern, if one could be employed by JESS.

An inventory of all past and present irrigation projects with information in Somalia should be done. This could be most easily accomplished by conducting an exhaustive search of several key libraries and documentation centers--notably at AID, the Ministry of National Planning and the Food and Agriculture Organization for the United Nations (FAO)--as well as several key departments in the Ministries of Agriculture and Water Resources. To identify current projects, a good place to begin would be a review of the Ministry of National Planning's PERFORMANCE OF THE SOMALI ECONOMY IN 1984 (June 1985) or the 1985 version if it is finished by the start of this research, or the report of Task Force 1 for the 1985 Agricultural Sector Survey.

JESS should compose and transmit a letter of introduction that requests each responsible office to cooperate in opening its files to the researcher. This letter will be sent at least one month in advance of when the researcher expects to begin work there, and a follow-up telephone call or visit made two weeks before the start of work. JESS should also design a questionnaire which specifies standardized information that the researcher is to obtain from the various reports. This instrument should be pretested on one or more project reports available to JESS before or at the very start of the research. In addition to information reported on the questionnaire, the researcher should note any qualitative points of interest about each project, where such information is available.

Manpower requirements for this review will be two months of time in Somalia for a U.S. project intern and one week from a long-term ARD staff member. No logistics or equipment will be required, aside from in-country transportation. If the researcher is a U.S. student, timing of the study should coincide with the academic schedule, June through August of 1986 or 1987.

D. Employment Implications of Alternative River-Basin Structures

The purpose of this study is to investigate the labor requirements of various anticipated options for Jubba Valley development. The principal focus will be on various alternative types of irrigation, together with auxiliary production and distribution activities (e.g., farm implements and marketing) that irrigation will require once it reaches a certain scale. This work should follow the completion of studies on the multiplier effects of river-basin development and irrigation economics, both of which will provide important inputs for this study.

This will be a macroeconomic study based on microeconomic data from published or other sources, supplemented by interviews with farm management researchers. The methodology is very straightforward--compiling labor requirements for various production options under different land-tenure and irrigation-management systems, and then aggregating up to realistic amounts of potential agricultural development for the Jubba Valley. The amount of auxiliary-sector growth induced by irrigation can be estimated with reference to the proposed study on multiplier effects, given the absence of a credible Somali input/output table. Information sources will include project documents from ongoing activities, previous socioeconomic studies of other regions in Somalia, and whatever data have been assembled by AHT and other agencies in the Jubba Valley. The expected output is an assessment of changes in the demand for labor under alternative patterns of river-basin development. In combination with the labor-supply information gathered primarily as part of SEBS, this study will enable river-basin planners to understand the extent to which labor will be a constraint to development.*

This work should take an experienced human-resource planner no more than three weeks of data gathering and analysis, plus one week for report writing. In large part, the sources of data will be the same as for the other studies mentioned above, so no additional research assistance or equipment should be needed.

---

*An idea of the approach to be used (albeit on a larger scale) can be gained from the Mauritania RAMS project's EMPLOYMENT IMPLICATIONS OF ALTERNATIVE DEVELOPMENT STRATEGIES (Nouakchott, 1981).

This study should be done following completion of the investigations already discussed for irrigation economics and the multiplier effects of river-basin development, which implies that it should be scheduled early in the second year of Phase II.

E. Multiplier Effects of Different Irrigation Models

The assertion was made during the NAS panel's visit that small irrigation projects have higher income-generation multipliers than large ones. To systematize this proposition, important dimensions of scale must first be specified and second, whether local or national multipliers are to be measured.

Regarding the first point, a distinction should be made between the size of the scheme and individual holdings (Bloch et al., 1985). There is certainly a minimum project size below which there will be little induced local development of input suppliers, construction contractors and commerce. For a given transportation and communications system, there is a minimum number of hectares to be irrigated or farmers to be served to yield sufficient economies of scale for nonfarm rural enterprises to operate profitably. On the other hand, large schemes will likely be too big, swamping the capacity of local small entrepreneurs to respond to their needs and requiring an entirely different scale and scope of nonfarm enterprises. The NAS panel member was probably thinking of another distinction, between a unified state farm, growing crops that differ from local subsistence foodstuffs, and a smallholder scheme producing at least the local subsistence crop and probably cash crops as well. Indirect income generated by the latter type of scheme is thus very likely to have the pattern suggested--since local farmers capture a larger share of value added (factor incomes) in a smallholder scheme, it is likely that their local re-spending will be greater than for laborers on a state farm.

However, it is not at all clear that the <u>national</u> re-spending multiplier will be greater for a smallholder scheme. This is especially true if the state farm generates more total value added per hectare or worker than smallholder schemes. The national propensity to consume, which is probably unknown, is the parameter that predicts the national multiplier. If aggregate incomes (or possibly even the margin above subsistence-level incomes) are higher for state-farm production than smallholders, it is likely that the indirect income component will be larger, too. Thus, while it is likely to be true that smallholder schemes of moderate size will have a larger effect on local income generation than state farms, it is unclear whether the same ranking will occur in terms of national income. If there is a conflict, it will be up to the Somali government to determine whether rural or national income generation is its priority.

National macroeconomic data are not good enough to estimate marginal propensities to consume, especially for commercial agricultural income and hence, the strength of national-level multiplier effects. The Bell and Hazel approach used for the Muda River in Malaysia may be appropriate, but only after SEBS has been completed. Thus, the methodology for a study of this type is not obvious. However, there is one fairly satisfactory method. There are data on consumption patterns in Mogadishu, and there must be some information on such patterns in rural areas as well. Using these parameters, it should be possible to simulate the effect of increases in rural and urban incomes on the demand for various types of goods and services, and use ad hoc estimates of factor incomes generated by the purchase of these goods and services to develop spending patterns. While this is not very rigorous, it may be all that can be done before the household data and new Project Concern International (PCI) surveys, that are apparently planned, are available. A survey of local small businesses seems to have been done by the Germans, which should provide some idea of the elasticity of supply for local goods and services.

This study would require two to three person-weeks of time in Mogadishu plus one week in the United States. The only equipment needed would be an econometrics software program like RATS. This work should be scheduled toward the end of Phase II, as it requires some input from SEBS.

F. Trade-Offs Between Hydroelectric Power and Irrigation

During the first NAS workshop, several social scientists expressed concern about possible underutilization of the development potential occasioned by construction of the Baardheere Dam. Specific concerns were raised about the engineering studies' concentration on hydropower and tendency to neglect both traditional downstream uses of the water and agricultural utilization of the reservoir draw-down area. On the other hand, participants minimized the value of such uses of the dam's potential energy production.

There is a need for an economic investigation of the trade-offs, if any, between the amount of hydroelectric power the dam will produce and agricultural use for the water. For example, it is possible that the economic benefits of preserving dhesheek agriculture are large relative to the value of the last few megawatt-hours of electricity--a simulated annual river flood might enhance the former at the expense of the latter.

The Technital and Impresit studies of the Baardheere Dam and downstream irrigation potential, plus successive studies of the dam and MJVD/AHT studies on hydrology and dhesheek, small- and medium-scale irrigation, should provide a primary source of data

on engineering possibilities for varying the rate of water throughput and consequent differences in irrigation capacity and power generation. A thorough search for international documentation on this subject, in combination with visits to the engineering firms responsible for construction of similar dams elsewhere in the tropics, should precede any time spent studying and analyzing the case of the Baardheere Dam and Jubba Valley. It should be possible to develop a systematic set of physical trade-offs for different assumptions about efficiencies and river flows--expressed, for example, as tons of grain grown per megawatt-hour of power foregone. These can then be costed in a straightforward manner, with the result being a set of "opportunity costs." To illustrate, the type of conclusion which this study might reach is that the simulated flood needed to provide sufficient water to dhesheeks to maintain current use levels would reduce electricity yields by some number of gigawatt-hours. Valued at economic prices, the net cost of this decision could be determined and would, of course, be negative if dhesheek food production were worth more than the electricity.

Such an investigation would require no more than one person-month in Somalia, plus one week in Britain, Italy and/or the United States, accumulating documentation on engineering trade-offs. There would be no need for logistics or special equipment. This study could be done any time after the World Bank pre-appraisal mission visits Somalia and does an update of the economic and engineering information necessary for this work.

G. Economics of Forage Production

The relationship between pastoralists and settled people will change irrevocably once the dam is built. One possible way of mitigating the impact of reservoir and downstream development on herders is to provide alternative routes and water points for transhumants to minimize conflicts over use rights to riverine resources. Currently, it appears that herders gain access to the river at many points and have evolved a system of rental for fields which have already been harvested so their livestock can graze on the stubble. With the onset of irrigation, many of the routes now used will be cut off and stubble will be available for a much shorter time if double-cropping is practiced. Water points or channeled transhumant routes will be useless unless some type of animal feed is available.

There will certainly be more fodder (such as rice straw and husks) available if irrigation development yields the high amounts of grain that are expected. However, the amount of fodder that will be available during the dry season is unclear, especially if successful irrigation farmers begin to accumulate livestock and reserve fodder for them. Thus, it is reasonable to

investigate the prospects for production of livestock feed by sedentary farmers, on either irrigated or dryland plots.

Essentially, this study will utilize agronomic information on forage production that is available locally (or if that is not possible, sent to Mogadishu from the United States) and determine the costs of production for different forage crops under various conditions. For irrigation farmers, the advantage of forage crops may be their relatively low labor requirements, such that farmers producing other labor-intensive crops (e.g., rice) could grow those on part of their land and forage crops, like alfalfa or green maize, elsewhere. SEBS should gather information on the willingness and ability of herders to pay for forage and water when they lose access to parts of the river valley because of the dam. These two sets of information will indicate whether irrigated or dryland forage crops have the potential to contribute to the benefit stream flowing from development of the river basin.

This effort would require two to four person-weeks of time from an agricultural economist. No special equipment or logistics will be needed. This study should be done late in Phase II or early in Phase III.

H. Marketing and Transportation of Agricultural Products

Farmers require functioning, accessible markets. Somalia appears to have a very responsive private sector in the Shabeelle and lower Jubba valleys, but not in the middle Jubba, which is almost certainly due to the high transportation costs occasioned by the lack of roads there. However, little is known about the functioning of local markets in the main towns now served by roads--Jilib, Baardheere and Kismaayo--in meeting residents' input and consumption needs as well as providing an outlet for their crops, livestock and, possibly, fish. In addition, little is known, and perhaps little of use can be learned now, about the capacity of Bu'aale and Saakow to become market centers once an all-weather road is built.

To really understand market functioning and flexibility requires a great deal of on-site observation. Data should be collected daily over several years to understand how price fluctuations correlate with external events and trends. If the NAS panel is correct that local people (schoolchildren, for example) are usually available to help, this might be a place to try enlisting local people to collect price and availability data for a range of goods in several towns. Otherwise, less frequent data could be gathered by the JESS socioeconomic team.

This study will take one month for analysis. The logistics and equipment required will depend on the research design. This work should be conducted throughout Phase II.

I. Terms of Trade Between Agriculture and Urban Sectors

The purpose of this study is to illustrate the importance of appropriate pricing policy for successful agricultural development. It will build on the studies of crop budgets done by the BuRec economist, Mr. Dick Pond, and a review of the performance of Somali agriculture before and after the partial liberalization of pricing and marketing arrangements in 1984.

The methodology for this investigation will consist of a simple historical comparison of indices for the prices farmers pay for inputs and consumer goods and receive for their produce. Comparative experiences from other countries that have gone further in liberalization will provide lessons about directions Somalia ought to consider.

Depending on the condition of the BuRec information and availability of good consumption data from the budget study underlying calculation of the consumer price index, this investigation will require two to four weeks of an economist's time. No logistics or equipment will be needed. This work should be scheduled for late in Phase II or early in Phase III to provide the longest possible time series of data since liberalization in 1984.

J. Macroeconomic Impact of Jubba Valley Development

Jubba Valley development will have a major impact on the Somali economy. Dam construction will cost several hundred million dollars, and the annual flow will amount to a sizable fraction of the gross national product in those years. The regional impact, especially on the town of Baardheere, will be staggering. The capital inflow for those years will have to be matched by an eventual outflow when the loans are repaid. It is hoped that to counterbalance this, oil imports will go down and exports of the products of irrigated agriculture will rise. All of these flows will be significant influences on incomes, prices, the government's budget and balance of payments.

First, this is really a master planning task. If the GTZ intends to do such a study and their approach is deemed suitable, JESS will not have to do this work. If JESS must do so, it should be done in the style and approach of World Bank and International Monetary Fund country economic reports, since there is no functional macroeconomic model for Somalia and creating one would require too many person-months. This would involve

amassing a large volume of data, making projections about the future based on assumptions regarding the magnitude of the flows briefly discussed above and drawing appropriate conclusions. The most difficult thing to predict in this way is inflation.

The manpower requirements for such an investigation are unknown. If JESS must do it, probably three weeks of a macroeconomist's time would be needed. There would be no logistic or equipment needs. The study should be done during Phase III.

III. RESETTLEMENT ISSUES

A. Refugees

Estimates of the number of refugees in Somalia vary widely. GSDR has consistently published figures that are judged to be overestimates by much of the relief community, and the best single assessment appears to be that the true figure is likely to be about 30 percent lower than official figures. Since the government now says there are 200,000 refugees in 12 camps in the Geddo Region, using the adjustment suggested above would indicate that the actual figure is closer to 140,000. All of these camps are close to the Jubba River--eight clustered around Luuq* and four to the east and southeast of Garba Haarey. It appears certain that all of the latter will be inundated, but some of the Luuq camps are close enough to the proposed reservoir's upper limits that it is not clear (without ground verification) whether they will be affected.

The camps are approximately equal in population. Without access to publications from the United Nations High Commission on Refugees (UNHCR) or National Refugee Commission (NRC), the only published breakdown indicates that in 1981-82, the typical camp contained approximately 15,000 refugees.** RMR's maps seem to show that the camps cover substantially different areas, with the largest appearing to be several times the size of the smallest. If both observations are true, there are great differences in the housing density among the camps, which suggests that special care be taken in sampling for survey work conducted in the camps.

---

*Maps prepared by RMR show nine camps near Luuq, eight of them downstream.

**The source for this figure is THE SOCIOECONOMIC DEVELOPMENT OF SOMALIA--1981/1982, prepared by a delegation of the commission of the European Economic Community (EEC) in Somalia in December 1982. It suggests that the Garba Haarey refugee population was 35,300 at the end of 1981, compared to 68,800 at the Luuq Ganane camps. Thus, the average camp size is approximately the same in both clusters. The Garba Haarey camps are Bur Dhubbo with a population of 15,000 to 20,000 and located 48 kilometers southeast of Garba Haarey; Hilo Mareer, 13,000 to 17,000, 57 kilometers to the east; Malka Hiddo, 15,000 to 20,000, 63 kilometers to the east; and Suriya, 15,000 to 20,000, 60 kilometers to the east. These estimates sum to a total population of 58,000 to 77,000 for the Garba Haarey camps, not 35,300, but that is because the higher numbers are "official" figures issued by UNHCR and the lower is EEC's estimate, based on conversations with the author of the latter's report in Mogadishu in 1982.

There is no consensus on refugee population figures since 1982. The Ethiopians have recently claimed that 200,000 to 300,000 refugees have returned to Ethiopia, but the Somalis dispute this. It is likely that drought victims from northern Kenya, Ethiopia and Somalia may have entered the camps, counterbalancing any outflow of refugees returning home. There is strong evidence that the recent drought in Ethiopia may have driven a new wave of refugees across to existing camps, but this is thought to have occurred primarily in the north. To conclude, it appears that there are very likely several tens of thousands (probably 40,000 to 50,000) of refugees in camps that will be flooded out when the reservoir fills.

B. Government Policy Options

First, the government could resettle refugees who will be flooded out in other temporary camps in the hope that they will all go home eventually, as opposed to promoting development for them. Second, GSDR could place them on existing state-farm types of projects along the Jubba River, using them as a labor pool in areas with a labor shortage (e.g., Jubba Sugar and Fanoole). To do so, it should be determined whether any of the Dujuuma settlers who were sent to Jubba Sugar and Fanoole are still there and what happened to them. In fact, the history and present status of Dujuuma merit a specific study, perhaps to provide an object lesson on the pitfalls of inadequately planned settlements. Third, the government could expand state-farm types of projects or build new ones, employing refugees as laborers. Fourth, GSDR could treat them as potential citizens and settle them with the same enthusiasm that it tried to settle nomads after the 1974 drought in Kurtun-waarey. Allocation of farms with some degree of tenure security is an integral part of such a scheme.

It should be noted that the policy options discussed above represent a continuum of increasing degrees of acceptance of the likelihood that refugees will remain as sedentary farmers in Somalia. It is hoped that JESS will be able to ascertain the government's position on this issue or offer a range of possible options.

AID's resettlement project papers (Refugee Self-Reliance, CDA Forestry and Refugee Settlement) contain useful insights about ways to get at the issue of refugee settlement. The rapid-assessment sweeps that the latter project apparently plans to do quite soon along the Jubba may yield a goodly amount of information about existing land use and population in several parts of the valley. The JESS socioeconomic team should definitely participate in these rapid-assessment missions, if the various parties at AID can agree on such inter-project cooperation.

The Kurtun-waarey/Sablaale/Qorioley efforts at irrigation and nonirrigated improved farming should be studied intensively by those who are trying to understand the problems and prospects of settling nomads and agricultural development. However, the Shabeelle region is different from the Jubba in several important respects:

- it is close to the market for its products;
- its water resources are inadequate, even for the amount of irrigation being done now (at least four months per year), whereas the Jubba's flow is sufficient for current projects all the time in most years (and would probably be adequate in almost all years without the Fanoole weir); and
- conflicts over land and water resources, involving Europeans, townspeople and clans, have been out in the open for over 100 years, but in the Jubba, the first disputes involving outside forces arose with Fanoole and Jubba Sugar, which means that eventual resolution of land-tenure conflicts in the Jubba Valley will be required.

C. Non-Refugee Resettlement

There seem to be very few non-refugees permanently residing in the area that will be flooded by the proposed reservoir. The AHT team has expressed the conviction that there are "hundreds, not thousands" of such residents. The maps from RMR's Southern Rangelands Survey appear to support this--there are only four villages in the area, three with six permanent houses each and one with four, and two also have about a dozen temporary houses. This adds up to no more than 200 people with homes identified on the maps. Additional support comes from AHT photo interpretation, which suggests that farming in the area only involves around 200 hectares, which would support 20 families at an average (dryland) farm size of 10 hectares. If a JESS flyover confirms that there are only these four villages, a complete census could be done, thus giving a perfect baseline study of this resettlement component. This baseline should include much detail on all aspects of the villagers' socioeconomic life, so that the resettlement program can truly compensate them for their loss.

Another issue of importance for resettlement is the availability of land along the river. JESS should ascertain the extent to which land with development potential is:

- registered officially with the District Commissioner or Ministry of Agriculture; and

- claimed by "local people," but unregistered.

Some of the most desirable land probably falls in both categories, as attested to by anecdotes about conflicts between Mogadishu residents armed with certificates of registration and valley residents carrying knives and sticks. The JESS socioeconomic team should make a concerted effort to identify areas where this type of conflict is likely and understand the conditions for possible agreements. Such an understanding, especially about the implicit valuation placed on disputed land by "local people," will be a valuable input into planning an institutional mechanism for land-tenure arbitration that operates smoothly as development proceeds.

APPENDIX

Individuals Contacted

Ministry of Agriculture

Maxmoud Mohamed Ali, director, Land and Water Department
Mohamed Hersi Bahal, general manager, Afgoi-Mordile Irrigation project
Michael von Boguslawski, GTZ advisor to the minister

Ministry of Planning

A. Savva, Water Resources Division
Martin Wulfe, Energy Division

National University of Somalia

Mohamed Said Samatar, director of planning

Partnership for Productivity

John Grierson, general manager, Somalia
Shari Berenbach, director of programs

USAID/REDSO Nairobi

Carolyn Barnes, social scientist

USAID/Somalia

Ray Fox, agriculture officer
George McCloskey, head of refugee office
Meredith Scovill, program economist
Mariam Warren, project manager, refugee projects
Mohammed Farah, sociologist

U.S. Embassy

Frank Pavich, refugee officer

World Bank

Brian Falconer, resident representative
George Beier, agricultural economist

STUDY C

Land-Tenure Issues

James C. Riddell, Ph.D.

CONTENTS

Section	Page
I. Introduction	C-1
II. Issues	C-2
A. Protecting Existing Rights	C-2
B. Seniority of Rights	C-2
C. Water Rights	C-3
D. Current Land Legislation and Law	C-4
E. Grazing and Rangeland	C-5
F. Land Speculation	C-6
G. Tenure Security and Investments	C-6
III. Methodology	C-8
IV. Conclusions	C-9
Appendix -- People and Institutions Visited	C-10

I. INTRODUCTION

Land tenure in the Jubba Valley is not a serious problem at present, but will soon become one as competition for land intensifies. Already, many people are trying to register land. Indeed, Ministry of Agriculture (MOA) and district-level officials were quite frank and open in discussing potential difficulties. Equity issues are bound to emerge as the dominant land-policy problem.

In general terms, the recent summary study done by Mr. Allan Hoben covers all that is currently known about land tenure in Somalia. However, there is no detailed information about specific forms of land tenure in the Jubba Valley. Based on extensive computer searches and conversations with Somali colleagues, it appears that no fieldwork has been done on this issue in the valley since Mr. Ugo Ferrandi and Mr. Nello Puccinoni studied it during the colonial period. In addition, the amount of change that has occurred since then is hard to determine. The Central Rangelands Project has found that rather dramatic changes are occurring, such as enclosure of the range and settled cropping. In addition, European Economic Community (EEC) agronomists have found equally dramatic changes in the northeast. People are adopting and reviving modified forms of traditional water harvesting and initiating small-pump irrigation for vegetable gardening. They are demanding that MOA officials in the region ensure their land rights on territory that has always been part of the communal range. If such dramatic changes are taking place in these areas, similar ones are anticipated in the Jubba Valley.

As the resource base of the Jubba Valley is developed, it will be necessary to consider how access, control and transfer of these resources are to be organized. These will be the land-tenure issues of the future. Land tenure refers to holding rights in landed resources--range, water, fields and household plots. No one ever holds all the rights in landed property. The state holds some, extended kinship and various groups have others, and individuals, depending on their circumstances, claim still different ones. Thus, land tenure concerns the system of rules and practices that determine who has rights to use which resources, for how long and under what conditions. In terms of development efforts proposed for the Jubba Valley, there are several land-tenure issues that need empirical study.

II. ISSUES

A. Protecting Existing Rights

It is hardly fair that people, who have kept fragile soils in production in a harsh environment before major developments are made, should suddenly find themselves with few rights to their old territory once it has been improved. No land-tenure system can ever be static, especially in an environment that is subject to major fluctuations due to drought, flood and large-scale population movements, including refugees. In the past, land-tenure systems have had to respond to such changes and thereby exhibited much flexibility. With the dam, accommodations will not necessarily meet the new challenges. Some land that has been held against all contenders (e.g., alluvial fans in the reservoir area) will be under water. Other parcels, like the dhesheeks (depressions), will no longer be flooded unless special institutional and technical arrangements are made to do so. In addition, well-drained soil resources that were of no value for rain-fed agriculture will become very valuable under irrigation.

The proposed study on this issue would ascertain who has access to land resources in the Jubba Valley as well as rights of transfer and alienation of those rights within the existing social system. It is also important to know the number of plots used for existing enterprises. In addition, a study will be needed to determine which ecological zones are utilized in current farming systems. It is expected that a minimum of three ecological zones are used. First, there are river-basin resources, alluvial fans and flooded dhesheeks. Second, the BuRec team found that dryland farms are located on deep clay soils away from the river that have good rainwater retention, which is vital for dryland farming. Third, the rangeland zone must be far enough away from the river to avoid tsetse-fly infestation. Researchers at the National Tsetse and Trypanosomiasis Control Program have mapped the infestation zone, and interviews in the region with herd managers confirmed the supposition that livestock are kept as far away from the river as possible. From existing aerial photographs, it can be seen that watering trails originate from holding compounds a kilometer or more from the river.

B. Seniority of Rights

It is a common mistake in Africa to assume that because a certain land resource is said to be communally held that all the individuals using it have equal rights. Experience has shown that it is quite common for the rights of some members to be senior to others. For example, in arid regions, the most ancient claims to river-basin resources are often held by pastoral groups

who have exercised militant control over the area in the recent past. Cultivators along the river's edge may be there by permission of the pastoral groups' leaders. The cultivators' rights are certainly recognized and protected, but perceived locally as being of a derived status. The difficulties encountered in the Mauritanian and Malian river-basin development efforts should serve as fair warning. These projects assumed that the government could simply extinguish all claims and issue new land rights.

If land tenure is to be a working institutional arrangement for predictable use of resources, it must be recognized by all participants as legitimate. In this case, both cultivators and pastoral overlords see the traditional system as the most legitimate, and it is easy to understand how this would be the case. Governments have a habit of radically shifting national land policy from a position where all land is social property to be managed by cooperative societies to a stance that encourages private initiative. Customary rules are ordinarily better understood, more predictable and certainly more stable. One further point of clarification is that saying land tenure is traditional does not mean it is unchanging. Such systems respond to local dynamics that are seldom understood by outsiders.

An investigation of the history of settlement and land claims in the area should be done on a beel basis. This study would not only identify people using riparian resources throughout the annual cropping cycle, but also nomadic groups that have watering rights. That is, the study will determine all of the various groups in the beel with rights, as well as the categories of users that give use rights to others (i.e., seniority relationships). This research will also need to explore current users' perception of their appropriate rights in the new resource mix.

C. Water Rights

Customary water rights are quite complex because of the variety of water sources--the river as well as seasonal springs, wadis, wells and cisterns. Ownership rights range from communal to private. Of course, access to river water will be most affected by development efforts. Once the dam is completed, the availability, timing and distribution of river water will change for almost all the users of Jubba river-basin resources. The tenure issue is who will have access to how much water, when and for how long. The GSDR must establish a policy in advance if it is to avoid chaos and insecurity. An effective policy will need to recognize that the various categories of users will be making different demands. Small water-user groups operating at the beel and district levels will have quite different needs from those of large government and private enterprises. At the heart of the

issue is determining whom these resources are being developed for, and how the very unequal bargaining power between large and small users can be handled in a fair way.

Unfortunately, a full separate study of this vital issue cannot be recommended at this time. The whole problem of water-rights legislation is currently under joint exploration by GSDR and FAO. As of this writing, there is no water-rights legislation in Somalia. FAO has already helped the GSDR draft three versions of such legislation, but all have been rejected at different levels for varying reasons, according to colleagues in FAO's legal department.

Specific studies should await the outcome of these efforts so that there will be a policy environment for the data collected. In the meantime, the JESS socioeconomic baseline survey will need to include questions on water points being utilized and how people gain access rights to these resources. Also, the baseline data should include examples of conflicts over water rights and at what level they are resolved. This information should emerge during discussions concerning family economic strategy planning. LTC professional staff and the ARD institutions specialist could provide backstopping for interpretation of these data.

D. Current Land Law and Legislation

Current land legislation addresses equity issues in a very workable fashion. It allows for renewable 50-year leases that are subject to review by MOA representatives at renewal time. The size of holdings is limited to 60 hectares for dryland farming and 30 for irrigation. The law explicitly forbids usurous relationships, sharecropping and other partial tenures and transfers. In addition, there can be no renting or selling lease rights without permission of the MOA representative and local authorities, such as the district commissioner and head of police. Larger commercial concessions can be granted by the MOA on a case-by-case basis. Legally, land can only be used after a lease has been issued in the form of a ministerial decree. As of 16 December 1985, only 9,159 land-use decrees had been issued, leaving the vast majority of farmers outside the law for the current agricultural season.

No study of this important topic is recommended at this time. The MOA is well aware that it does not have the capacity to enforce all of the law's regulations. Personnel consulted at the MOA land-registry office also recognize that changes need to be made to remove the centralized top-heavy administration of the registry system. Under current law, the Minister of Agriculture must personally sign each decree. In addition, the minister must review all applications for a variance of any rule, which are

especially common from the private plantation sector. Given the numerous demands on the minister's time, this bottleneck in the process is all but insurmountable.

Land-registration personnel are aware of the need for a change in policy and procedures. They are also cognizant of another problem--use decrees as they are issued are simply filed in the order they are issued. They are not part of any land-use planning or monitoring activity in different economic zones. According to the director of the office, the minister has indicated that next to the dam, a land-use planning map to help coordinate MOA's many activities is the highest priority.

JESS can contribute to this policy discussion within MOA by making sure that its findings are shared with the various ministries. For example, the baseline survey could include a summary statement of ongoing land-use planning that is being done by various agencies working in the valley. (A proposed study of land registration is discussed below under land speculation in Section II.F.)

E. Grazing and Rangeland

GSDR has yet to address specific land-tenure arrangements for Somalia's range through legislation. The 1975 Land Law declared that all land in Somalia was national land. Accordingly, rangeland is currently administered as national property, but as changes in use occur, such as enclosure for fodder production which is now occurring in the central rangelands, the administration has no policy guidelines to follow. In some cases, the government is burning fences and in others, encouraging registration. This is an area that will have to be addressed soon. Range use will be a major resource-tenure issue for generations to come, as raising livestock is a major economic activity for an estimated 60 percent of all rural Somalis.

The proposed study would determine which groups are currently using range in the Jubba Valley and the extent of their territorial claims. This study will also investigate multiple-use rights that exist on the range and variations based on seasonal and drought conditions. In addition, the study will address the issue of types of water access that will be needed by livestock managers once irrigation begins to enclose portions of the riverbank. This investigation will require intensive interviews with elders, sheks (gadis) and herders. These should be done at the beel level, including groups that live away from the river. This research will determine the social relations and hierarchical arrangements that exist among various herding groups.

F. Land Speculation

In spite of the fact that the current land legislation does not make any allowance or provision for land speculation, all of the district commissioners and MOA officials consulted agreed that many people are seeking lease titles to river-basin land in the Jubba Valley. Preliminary interviews in the region indicated that thinly disguised sharecropping arrangements are very much in evidence. People with capital are buying pumps and irrigating the land of traditional settlers for half the crop. While this case of shared risk may be acceptable in the short run, it will only lead to stagnation of production in the future, if control of the land is passing to the pump owners.

The first proposed study would document sharecropping and other types of inferior tenure arrangements to determine their operational modes and assess their impact on economic planning. This investigation would also explore with cultivators which kinds of cooperatives and group farming arrangements they are familiar with and how they evaluate them relative to their own situation.

The second proposed study to address this issue would be to look into the number and rate of land-lease titles sought in each district. In addition, it would attempt to document which land is registered to see if these putative cooperative agreements between pump owners and landholders are not actually land usurptions by more cognizant residents of the region.

This study could conceivably be tied in with LTC's AID-supported title registration research project, which is separate from JESS, but USAID/Somalia may want to participate in such an effort as a separate activity to include similar investigations along the Shabeelle. This research will have to be done at multiple levels, starting with the district offices and then tracking leases as they move from level to level. Titleholders will have to be interviewed to find out the location of the land, types of investments on the land and working arrangements.

G. Tenure Security and Investments

This issue is an extension of the one just discussed. Rural Somalia has a long history of group and individual rights that protect the security of investments which improve the resource base. In the past, these have included wells, catchment ponds, cisterns and recession agricultural areas. In customary law, the individual or group of contributing individuals that make the investment have full rights to allocate the benefits from their resource improvements.

It is proposed that a follow-up study be done once the socioeconomic baseline survey is completed. The baseline study will document the types of investments that are currently part of the economic strategies of valley residents as well as the prevalence of these activities. The proposed study would describe the kinds of rights people have, how they are transferred and how people feel they should be handled (e.g., compensation, replacement) after the dam is completed.

III. METHODOLOGY

All of the proposed investigations will require fieldwork since there has been no systematic data collection on land tenure in the Jubba Valley since the colonial period, and even then, only limited studies. Because of this, the proposed research should be both descriptive and exploratory. It is hoped that they will then lead to policy dialogues within GSDR.

Given the nature of the questions being posed, the fact that they touch on areas the present government does not see as appropriate for policy discussions (e.g., historical ties of kinship and traditional political units) and that some of the behaviors concerning land use are negatively sanctioned in the law, only a very culturally sensitive approach will work. The research will have to involve Somali academics and specialists to provide cultural sensitivity and language expertise as well as to serve as a buffer. Dr. Mohamed Samatar's group from the National University of Somalia and perhaps Dr. Mohammed Ali from the Somali Academy are recommended for this role. In addition, Mr. Mohammed Farah from USAID/Somalia should be included at as many stages as possible. Participation by LTC staff is probably critical to ensure that all of the necessary questions are answered for a thorough analysis.

The basic technique envisioned for this research would be a rapid reconnaissance by a team where the same open-ended questions would be asked at each beel. It would seem to be best to coordinate these studies with the socioeconomic baseline survey. In this way, the feedback from two teams working in the same area on closely related topics would be maximized. There would be little or no conflict, as the socioeconomic team will be sampling households, while the land-tenure reconnaissance group will be interviewing customary leaders, elders and administrators. Also, both teams would be able to maximize their use of aerial photography, transportation and supplies.

IV. CONCLUSIONS

It must be remembered that all of the proposed studies are simply baseline studies. According to GTZ and BuRec, it will take at least 10 years to complete the dam and irrigation system. However, changes that will be introduced into the region by the construction, roads, worker villages and changing demand structures for goods and services will have already altered valley communities well in advance. The baseline survey should be followed by almost continuous studies to monitor the direction of change manifested among people in the Jubba Valley.

Those at greatest risk are the intensive riverine farmers in the communities between Bu'aale and Jilib. Their farming systems are models to be followed. These systems are intensive along two dimensions. First, crops range from roots and tubers, such as manioc, through grains (e.g., sorghum and maize) to fruit trees. Second, they are intensive in the use of existing soil resources at different levels as well as the number of plants per hectare. However, the members of these communities do not appear to share the same ethnic history as their neighbors with better political connections. In these villages, the team's Somali counterparts could not easily communicate, and even the simplest query, such as asking the name of the village, required that someone be found to translate. Although these people may be Somali citizens with all the rights that this implies, they are the most likely not to know, understand or have the capacity to defend these rights.

This is corroborated by a report from local anthropologists that people in these communities claim to control the crocodiles in the river. Ethnic Somalis, who use the river for watering livestock and farming, have to give some nominal respect to the elders of these villages to avoid problems with crocodiles. In a recent case, a man was taken to court because "his" crocodile had bitten off the leg of another man who was an ethnic Somali. The "owner" was found guilty and had to pay an indemnity. Resorting to such claims of mystical power only demonstrates the weakness of the position of these people in the valley's social structure.

Ideally, once the kinds of tenure arrangements are determined, donor agencies would insist on a government registration program of all customary holdings that are at least five years old as a contingent for releasing funds. In this way, the problem with early speculators who are buying up land and registering it prior to the baseline surveys would be avoided.

APPENDIX

People and Institutions Visited

EEC Commission to Somalia

Aramide Gasparini
Vincent de Visscher
M. Vitillo

Food and Agriculture Organization of the United Nations

M. Mitsud

Field

Two BuRec survey teams doing soil surveys in the valley
District commissioners and staff at Baardheere and Saakow
Villages of Brako and Kulmis

Ministry of Agriculture

Mahmoud M. Ali, chief, Land Registration Office
Michel Cervesato, Food Early Warning System
Michel Leblanc, FAO

Ministry of Jubba Valley Development

Aweys Haji Yusuf
Baardheere experimental farm implementation group
GTZ staff and counterparts
JESS staff and counterparts

National Range Agency

Denis Herlocker
Richard Holt
Somali counterparts

National Tsetse and Trypanosomiasis Control Project

Mohamed Abdirahman

National University of Somalia

Mohamed Said Samatar, Dean of Social Sciences

U.K. Overseas Development Assistance

D. A. Welbourn, anthropologist

Somali National Research Council

Mohammed I. Abyan
Mohammed Ali
Mohamed Fadal
Mohammed Farah
Mohamed Said Samatar

U.S. Agency for International Development/Somalia

L. Cohen, mission director
Mohammed Farah, sociologist
George McCloskey, head of refugee office
Sally Patton, JuDAS project manager

U.S. Bureau of Reclamation (Mogadishu)

Daniel Macura, chief of party
Thomas Cook, hydrologist
William Forrest, soil scientist
Richard Pond, economist

STUDY D

Public Health and Epidemiology Issues

Curt R. Schneider, Ph.D.

CONTENTS

Section		Page
I.	Health Issues Based on Available Data	D-1
	A. Diseases	D-1
	1. Human Diseases	D-1
	2. Zoonoses and Animal Diseases	D-4
	B. Environmental Changes Associates in Dam Construction	D-5
	1. Dam and Spillway	D-5
	2. Impoundment	D-5
	3. Downstream Irrigation Areas	D-5
	4. Nomads	D-6
	C. Synopsis of Current Health Programs in Somalia	D-7
	1. Ministry of Health	D-7
	2. PVOs in the Jubba Valley	D-9
	3. Other Health-Related Services in Somalia	D-9
	4. Ministry of Livestock, Forestry and Game (National Range Agency)	D-10
	D. Health Services in the Jubba Valley	D-10
	1. Official Health Establishment	D-10
	2. Primary Health Care	D-11
	3. Private Health Services	D-11
	4. Traditional Somali Medicine	D-11
	5. Some Disease Control Options and Other Public Health Issues	D-12
II.	Health Assessment Studies Proposed for Phase II	D-15
	A. Mosquito Survey	D-15
	1. Location	D-15
	2. Time	D-15
	3. Species to be Collected	D-15
	4. Personnel	D-15
	5. Support and Equipment	D-16
	6. Supervision	D-16
	B. Survey for *Schistosomo Haematobium* in Human Population: Assessment	D-16
	1. Location	D-16
	2. Time	D-16
	3. Methods	D-16
	4. Personnel	D-17
	5. Support and Equipment	D-17
	6. Treatment of Positive Cases	D-17
	C. Snail Survey	D-17
	1. Location	D-17
	2. Time	D-18
	3. Species to be Collected	D-18
	4. Personnel	D-18
	5. Support and Equipment	D-18

I. HEALTH ISSUES BASED ON AVAILABLE DATA

A. Diseases

1. Human Diseases

Malaria

In Somalia, malaria may show a fairly uniform intensity of transmission, which may occur throughout the year. The principal parasite is *Plasmodium falciparum*, the agent of malignant tertiary fever, accounting for about 95 percent of all cases. The main transmitter is the domestic mosquito, *Anopheles gambiae* var. *arabiensis*, with *A. funestus* close behind.

The main impact of the disease is probably on children aged two to five. Older children and adults develop an immunity associated with constant reinfection, which tends to modify the severity of attacks.

The Ministry of Health (MOH) lists malaria among the most important diseases with regard to public health in Somalia. Prevalence rates vary according to region and source, although systematic, area-based data are hard to obtain. One problem encountered in estimating numbers of cases in any region is a tendency of figures to reflect clinic visits, i.e., individuals sick enough to seek medical help. These morbidity figures are always low compared with the true prevalence, since many carriers are not sick, and many sick people do not go to a clinic. When apparently healthy people are surveyed, a great majority recall having had a malarial attack during the previous year. In a survey conducted by Swedish Church Relief (SCR) in 1983, 96 percent of the people in the town of Bu'aale (529 families queried, or 3,074 individuals) acknowledged having suffered an attack in recent months. The figure for Saakow was 98 percent (529 families, or 3,650 people), and for Jilib it was 99 percent (419 families, or 2,263 people).

Since malaria transmission is by mosquito bite and mosquitos require water to complete their breeding cycle, malaria is classed as a water-related disease. Any increase in the availability of still or non-flowing surface water potentiates the mosquito population and, thus, transmission of the disease.

Schistosomiasis

Schistosomiasis haematobium, or urinary bilharzia, is caused by the only human schistosome known to exist in Somalia at

present. Infection is limited to the valleys of the Shabeelle and Jubba rivers. The parasite is transmitted by the snail Bulinus abyssinicus.

Koure et al. (1981) examined a total of 278 people in the Jubba Valley and recorded 81 positives, or a prevalence of 29.1 percent. The breakdown by region was as follows: lower Jubba, 49 positive of 117 examined (41.9 percent); middle Jubba, 31 positive of 39 examined (2.6 percent). In more exhaustive studies in the lower Shabeelle region, the same authors encountered fairly even distribution of cases among both sexes and all age groups.

Schistosomiasis is recognized by Somalis because of its primary signal of blood in the urine. In point of fact, blood is only detectable in urine by eye when infections are fairly heavy, thus popular assessment will necessarily ignore all but the heaviest infections. Nevertheless, in questionnaires administered in 1983 by Project Concern International (PCI) in the lower Jubba region (45 communities in four districts), schistosomiasis was identified as of concern in 24 communities (reported by PCI as 53 percent of its sample). In the SCR survey, the following figures were derived from questioning two or three thousand people about episodes of bloody urine during the previous year: in Bu'aale, 61 percent; in Saakow, 49 percent; and in Jilib, 49 percent.

Currently, transmission is heavier in the lower and middle Jubba regions because, compared to the Gedo region, surface water (from the almost perennial Jubba River) is more constantly available in the dhesheeks and irrigation canals.

Bulinus spp. snails prefer still or very slow-moving water and are often found in small pools and water holes. Snails increase with the spread of irrigated agriculture, breeding in rice fields and irrigation canals.

Diarrheal Diseases

A number of important pathogens enter the gastrointestinal tract through the mouth, including viruses (poliomyelitis, infectious hepatitis), bacteria (typhoid and paratyphoid fevers, cholera), protozoa (amoebae and Giardia spp.) and worms (Ascaris spp. and pinworm). It is seldom possible to assign an etiology to each case of diarrhea, as causes may be multiple. People recognize signs and symptoms, and consider that diarrheas constitute one of the principal health problems in Somalia. The PCI report (from the lower Jubba) considered that 13 of 15 communities listed diarrhea among the health hazards. In the SCR report, people recalling attacks of diarrhea during the previous

year amounted to 64 percent of the respondents in Bu'aale, 89 percent in Saakow and 81 percent in Jilib.

Diarrheas may be waterborne and outbreaks can be explosive if a community shares a polluted source of water. Of course, the bottom line is fecal contamination, which may be minute and inapparent.

Worm Infection

Although Ascaris spp. and pinworm are transmitted by mouth, they are not classed strictly as waterborne diseases. Water can, however, be involved, particularly when it is in short supply, and easily contaminated with worm eggs. Intestinal worms were reported to affect 79 percent of people in Bu'aale, 79 percent in Saakow, and 82 percent in Jilib, on the basis of the SCR report cited above. In the PCI report, respondents in 12 of 45 villages said worms were a problem.

Viral Diseases

The arthropod-borne viruses transmitted by mosquitos constitute an important, if unassessed, element in the list of waterborne diseases of the Jubba River Valley. Dengue is rumored to occur throughout southern Somalia. Yellow Fever has not yet been reported, but does constitute a threat. Other viral infections that have appeared in epidemics in East Africa include chikungunya, o'nyong-nyong, West Nile and Rift Valley fevers. These are all transmitted by mosquitos of the genus Aedes. Increased mosquito breeding as a consequence of perennially available surface water, whatever its source, will only increase the risks.

Intestinal Leishmaniasis (Kala-Azar)

This protozoan disease had not been reported from Somalia before 1986. A few cases of the African type of kala-azar have now been diagnosed in Mogadishu. The protozoan parasites are transmitted by phlebotomine sandflies in Kenya and the Sudan. Rodents may form a reservoir of infection. The sandflies are thought to breed in rodent holes dug in termite hills. They probably require a humid microclimate, assured as much by soil humidity as by animal respiration in the burrow. The threat of this disease in the context of Jubba River Valley development would seem to be a long shot and is mentioned here only for the sake of completeness.

River Blindness

This infection, caused by the filarial nematode Onchocera volvulus, is transmitted by the blackfly (Simulium spp.). At the present time, blackflies are not known to breed in the Jubba River. They require fast, clear, heavily oxygenated running water in which to breed. In Kenya, Simulium neavei lays its eggs on the carapace of a freshwater crab (and control can be achieved by killing off the crab population). It would seem logical to expect blackflies from Kenya (or possibly from Yemen) to colonize the Jubba River if the construction of the dam and spillway create suitable breeding conditions.

2. Zoonoses and Animal Diseases

Trypanosomiasis

Trypanosomiasis is a serious disease of cattle and camels in southern Somalia. The protozoan blood parasite may be Trypanosoma brucei, T. Vivax or T. congolense. The insect transmitter is the tsetse fly, Glossina spp.. The disease is well recognized by nomad herdsmen, who seldom take their animals too close to watered areas that may support tsetse breeding. The Jubba and Shabeelle rivers constitute areas of fly infestation. Development of irrigated lands creates man-made habitats for the fly.

Although the vector of human trypanosomiasis in East Africa (Glossina palidipes) has been collected in Somalia, the human parasites have never been found there. There is a barrier-corridor of fly-free territory between the Kenya border and the Jubba River.

Fly surveys and prototype control efforts have been developed in Somalia. There is no doubt that the creation of a man-made lake south of Luuq will complicate the efforts of the Tsetse Control Program.

Leptospirosis

The prevalence of antibodies to serological variants of human Leptospira spp. is higher in Somalis than in people from other parts of the world (Cacciapuotui et al., 1982). The condition may reflect the water-sharing that occurs in dhesheeks among people, cattle and wild animals such as rodents. Infection also typically occurs among people who must immerse their hands and feet for prolonged periods in semi-stagnant water such as that found in rice fields, presumably contaminated with rodent urine. The transfer of cattle leptospirosis to humans is

apparently a serious public health problem in Somalia, where surface water tends to be in short supply and thus shared by cattle and humans.

B. Environmental Changes Associated with Dam Construction

1. Dam and Spillway

New turbulent water areas may be created by the spillway releases, and these may promote *Simulium spp.* breeding. While it is true that blackflies are unknown at present in the Jubba River Valley, they occur in Kenya and in Yemen and are known to use upper-air currents to fly long distances in search of new breeding sites. In West Africa, they have been recorded as moving 400 kilometers to reinfest sanitized areas.

The possibility of blackfly invasion should be recognized at an early stage in MJVD's plans and a contingency plan developed to deal with the problem should it arise.

2. Impoundment

It is risky to try to estimate the magnitude of the proposed impoundment, but some generalities can be stated. The dam site is 30 kilometers north of Baardheere. There is a narrow gorge winding north of the dam site some 60 or 70 kilometers. Under impoundment, the narrow reservoir will widen out into a lake with an estimated surface area of 30,000 to 40,000 hectares. It is important to note that this lake will probably be fringed by a belt of shallow water (shore to about one-meter depth) that will be well-lit, well-aerated, producing submerged and emergent vegetation, and harboring various snails and mosquitos. It is estimated that the shallow belt could constitute as much as 10 square kilometers or 1,000 hectares of surface area, more if there are islands in the lake. At the present time, this section of the river is uninhabited except for a few isolated *reers*, which may or may not remain long in one place, plus four large refugee centers on the west bank.

3. Downstream Irrigation Areas

Dhesheeks

Each year the dhesheeks are filled during the floods. Aerial inspection of the entire river valley in February 1986 indicated that the larger dhesheeks were still filled, a few weeks in advance of the next year's floods. Thus, the dhesheeks

appear to represent permanent aquatic habitats, probably supporting a unique endemic fauna and flora. They deserve to be protected and studied. There seems no doubt that they are highly productive of snails and mosquitos, although this requires study.

Rain-Fed Agriculture

Marginal areas along the Jubba River and its large tributaries in the middle and lower Jubba regions support seasonal agriculture based on the rains of the gu and, to some extent, deyr seasons. Under present conditions, these areas probably do not contribute heavily to the maintenance of waterborne disease vectors. The vectors of malaria and the arboviruses may benefit from humid microclimates sustained by the crop vegetation.

Irrigated Agriculture

The large agro-industrial developments of the lower Jubba region include the Jubba Sugar Estate, Fanoole Rice Project and Mogambo banana estates. They rely on irrigation canals for their water. At present, it would appear from aerial inspection that many, but not all, of these canals are choked with vegetation and undoubtedly provide breeding grounds for snails and mosquitos. With the advent of the Baardheere Dam, regulation of downstream water flow will encourage expansion of the present system, thus an arithmetic and possibly geometric increase in the supply of water-related disease vectors.

4. Nomads

Another complication in the extension of medical services is the dispersed or nomadic nature of most of the rural population. It is estimated that as many as 60 percent of those living in the Jubba River Valley may be nomads. Three categories are encountered in Somalia:

- semi-settled or transhumant nomads who herd cattle, sheep, goats and camels, but also engage in agriculture, with permanent settlements or villages from which the younger people move with their herds during the rainy season toward distant grazing sites, leaving behind the women, the very old and the very young;

- seminomadic pastoralists who do a small amount of cultivation of fast-maturing crops in addition to their herding activities, are linked to one area for

only a short time and are without settled communities to which they can return; and

- "true" nomads who never engage in agriculture, and whose wanderings are cyclical and regulated by the seasons.

The man-made lake north of Baardheere will impede some of these traditional nomad pathways, and an anticipated increase in tsetse breeding sites around the edge of the lake will make the vicinity unattractive to animal herders. Thus it is expected that a consequence of the lake will be to shift nomad movements northward, around Luuq, or deflect them altogether.

C. Synopsis of Current Health Programs in Somalia

1. Ministry of Health

Within MOH are the Department of Curative Medicine, Department of Health, Department of Primary Health Care and Department of Community Health. The Department of Community Health includes the Refugee Health Unit in cooperation with the National Refugee Commission (NRC). Several programs of interest to JESS come under the Department of Public Health:

- National Antimalaria Service--A control program for malaria has been in operation for many years in Somalia. The work began with active and passive case finding and periodic spraying. Somalia has now taken the lead in the world of biological control of mosquitos by means of larvivorous fish. These are fish native to Somali waters, including *Oreochromis spilurus* and *O. niloticus* plus four or five species of *Notobranchius*. Although larvicides are still used for spot control, mostly in the form of smothering oil covers, the program's emphasis today is on biological control. Mosquito breeding in southern Somalia is year-round, with two seasonal peaks corresponding to the rainy seasons. Permanent ponds, dhesheeks and *berkeds* are the principal mosquito sources. Control involves introduction of larvivorous fish into these bodies of water. The National Antimalaria Service operates three posts in the Jubba Valley at Jamaame, Jilib and Baardheere.

- National Tsetse and Trypanosomiasis Control Program (NTTCP)--This program has been conducting tsetse surveys in southern Somalia, including the Jubba River Valley. Upon identification of a breeding site, aerial spraying using 110 to 140 kilograms of

endosulphan per hectare is done five times at 12-day intervals. This timing is demanded by the life cycle of the fly--the larval stage pupates immediately upon release from the mother, the pupae require 60 days to develop, and new larval deposition occurs 12 days after emergence as an adult. Phase I of NTTCP also included land-use surveys to determine the feasibility of coordinating control activities with future development. Phase I ended early in 1985 and reports were prepared. Funds are now being sought from donor agencies to support Phase II activities, i.e., practical application of theories developed under Phase I.

- Schistosomiasis Control Project--In 1976, with assistance from the World Health Organization (WHO), mobile teams began to conduct a survey to detect both snails and infected individuals. The project was limited to the lower Shabeelle region in the Qorioley and Merca districts. Later, studies were added in Kurtunwary and Sablale districts. There were plans for the project to conduct extensive surveys in the Jubba Valley, but these were not completed prior to termination of the project in 1982.

- National Diarrheal Diseases Control Program (NDDCP)-Childhood diarrheal diseases are among of the top-priority health problems in Somalia. In cooperation with WHO, a control project was proposed as part of the National Health Plan preparation. It was estimated that an NDDCP could obtain a decrease in infant mortality from 165 per 1,000 in 1979 to 125 per 1,000 in 1985, going to 50 per 1,000 in 1988. Plans included making oral rehydration therapy widely available, encouraging breastfeeding, epidemic disease control and environmental sanitation, all of which would require training additional health care personnel, improved communication of results, and health education efforts.

Collaborative projects of MOH and WHO include:

- Maternal and Child Health (with UNICEF).
- Sexually transmitted diseases.
- Tuberculosis Control (with UNICEF and FINNIDA).
- Leprosy Control--the only leprosy hospital in Somalia is on an island in the Jubba River near

Jilib. It functions as a separate unit within the health system, with its own doctor and staff. Patients live in an isolated village near the hospital. According to the SCR report, World Concern (a PVO) has begun to support the hospital's activities.

- Extended Program of Immunization (with UNICEF)--this program began in 1978. It includes mobile teams using vehicles equipped as part of the cold chain. The six diseases covered by the program are poliomyelitis, tuberculosis, diptheria, pertussis, tetanus and measles.

- Schistosomiasis Control Project (see above).

- Managerial Process for National Health Development.

- Joint Nutrition Support Program.

- National Diarrheal Diseases Control Program (see above).

2. <u>PVOs in the Jubba Valley</u>

- Swedish Church Relief (SCR)--primary health care in middle Jubba region.

- FINNIDA--TB control in lower Jubba region.

- African Medical and Research Foundation (AMREF)--primary health care in Gedo region.

- Caritas Somalia/Caritas Germany--primary health care in Gedo region.

- Project Concern International (PCI)--primary health care in lower Jubba (with AID).

- World Concern--leprosy control in middle Jubba.

3. <u>Other Health-Related Services in Somalia</u>

- Faculty of Medicine and teaching hospitals (Ministry of Higher Education).

- Armed forces.

- First aid in schools.

- Water supply and sanitation.
- Food hygiene control (import and export).

4. Ministry of Livestock, Forestry and Game (National Range Agency)

- Veterinary departments, regional and district veterinary extension services--livestock.
- Vaccination programs. These are included here because nomad groups, which constitute as much as 60 percent of the population in the Jubba Valley, may be more responsive to central authority regarding questions of animal health than regarding human health problems, and because many animal diseases are of potential importance to humans, e.g., brucellosis, TB, trypanosomiasis, anthrax, tetanus, rabies, camel pox, etc.

D. Health Services in Jubba Valley

1. Official Health Establishment

The regional hospital in the Gedo region is located in Garba Haarey. There are hospitals or health posts with beds at Dolow, Luuq, Buulohawa, Elwak and Baardheere. All the districts except Dolow and Elwak have a maternal and child health (MCH) clinic.

In the middle Jubba region, the regional hospital is in Bu'aale. There are district hospitals in Saakow and Jilib and MCH centers in Saakow, Jilib and Dujuuma.

The regional hospital for the lower Jubba is in Kismaayo. There are district hospitals or health posts with beds in Afmadow and Badaade and MCH centers in all four districts (Afmadow, Jamaame, Badaade and Kismaayo).

Official health services in Somalia, especially in rural areas, are extremely inadequate. Services in these establishments are primarily curative, except for MCH. There is a general lack of equipment and trained personnel, thus some of the health posts remain closed for long periods. Needed medicines are usually more readily purchased from a private pharmacist rather than obtained gratis from a health post.

2. Primary Health Care

Recognizing the urgency of the situation, MOH is committed to:

- establishing a national primary health care program;
- extension of community health workers and traditional birth attendants;
- constructing latrines and wells, where feasible;
- developing MCH services;
- supplying drugs; and
- transporting the sick to health centers.

The Department of Community Health Care began with support from WHO, UNICEF and OXFAM. At present, most activities have been taken over by PVOs. In the Jubba River Valley, these include PCI (lower Jubba), SCR (middle Jubba) and AMREF and Caritas (Gedo).

3. Private Health Services

The large agro-industrial estates of the lower Jubba (Jubba Sugar, Fanoole Rice Project, Mogambo estates) provide their own health facilities to employees and their families.

4. Traditional Somali Medicine

For most rural Somalis, the starting point in the search for medical care is usually the sheik or wadad, a religious consultant familiar with the Koran. In urban settings people are apt to visit the wadad first and the hospital second. In most rural areas, however, people must depend entirely on the wadad. The advantages of this arrangement are that the wadad is a community member, is available, and is probably effective in dealing with a wide variety of common illnesses (e.g., mental illness, broken bones, and hemorrhages) where a combination of herbal medicine and religious faith, coupled with learned methods of manipulation, may be quite effective. It should be noted that the wadad's help may be welcomed by the nurse or doctor in getting the patient into a constructive frame of mind.

5. Some Disease Control Options and Other Public Health Issues

Refugees

Rising water will force relocation of four refugee centers now located on the west bank of the Jubba River below Luuq--Bordubo, Hilo Mareer, Malka Hidday and Suriye. Such a major relocation will strain NRC resources. The NRC is likely to recommend simply moving the people away from the water so that their new communities will again be adjacent to the impounded reservoir. The consultant believes that this move should be strongly resisted by MJVD. Although it is true that securing water for domestic purposes is a problem in the area, and wells tend to be too salty, the juxtaposition of the refugee centers too close to the impoundment will cause a disastrous increase in prevalence and incidence of a number of waterborne diseases whose control will prove problematic (including malaria, schistosomiasis, trypanosomiasis, infant diarrhea, arthropod-borne viral infections, leptospirosis and worm infections).

A much better solution would be to relocate the centers to the north of Luuq, or sufficiently far from the edge of the impoundment so as to discourage casual contact. This will prevent human pollution of the lake, delay or prevent contamination of lakeside vectors with human and domestic animal parasites, and reduce the chances for uncontrollable epidemics of waterborne diseases. The refugee centers are presumably not intended to be permanent. Water can be made available by piped supplies to central distribution tanks, just as in the centers to the north.

Currently, a plan to establish a national park around the periphery of the impoundment is being considered. This would be a praiseworthy development, solving a potentially serious public health problem and at the same time creating a national resource that might one day be valuable if tourism becomes important to the Somali economy.

Drawdown Vector Control

The man-made lake above Baardheere will have a wide margin of shallow water that produces mosquitos and snails. A proven and effective way of discouraging these vectors is to rapidly release water over the spillway so as to effect a rapid drawdown in the lake, exposing snails to the air and stranding mosquito larvae on the mud. The lake will be a relatively small one, but the effectiveness of rapid drawdown may be hampered by the fairly long, narrow reservoir between the lake and the dam, which will probably hold water back and reduce release time. Another constraint might be a tendency of the lake to refill slowly in

drought times, affecting turbine efficiency. Nevertheless, the possibility of using drawdown as an approach to vector control in the lake should be considered as a health maintenance option, to be explored in terms of possible engineering modifications in the plans for the dam.

Blackfly Monitoring

The risk of introducing blackfly breeding in the spillway and downstream from the dam was mentioned in Section I.A.1. After dam construction, an added duty of National Antimalaria Service staff in Baardheere should be to make regular visits to the dam site and the waters immediately downstream to sample for blackfly colonization. If detected early, it would be a relatively easy matter to control, using techniques developed by the Onchocerca Control Program in West Africa (if the invader proves to be *Simulium damnosum*) or by means of crab control (if the new species proves to be *S. neavei*).

Dam Construction Site

Labor force requirements at the Baardheere construction site are not yet known, although it would be reasonable to expect an eventual influx of 2,000 to 2,500 workers plus families and a satellite population. It is unlikely that the present town of Baardheere, 30 miles away, will absorb this increase, and a new community will have to be built to service the work force.

This sudden concentration of newcomers, most of whom will be recruited from elsewhere and may be from outside the country, will exert considerable stress on the local environment. Crowding, water scarcity, uncertain sanitary arrangements and pollution of surface waters will promote increased frequency of intestinal and respiratory diseases. A predominance of single men in the work force will encourage prostitution and venereal disease.

It is very likely that the construction site and work camp will remain as a permanent community after completion of the dam. Provision of adequate health services for the labor force ought to be contractually required of the builders. This would include construction, staffing and maintenance of a hospital with full services. The fate of such an establishment following completion of the construction contract cannot be foreseen at this time. If its functions and maintenance eventually depend on the limited resources of MOH, continuation of its services will require considerable financial and organizational assistance to the ministry.

In addition to providing health services, the contractors should be contracted to provide safe piped water supplies, efficient human waste disposal systems (e.g., VIP latrines), and improved-standard housing.

Nutrition

It is noted that nutrition is, quite properly, identified as a component of health, to be considered in the Phase II work plan. However, no nutritionist was included in the list of experts assembled to prepare the present report.

II. HEALTH ASSESSMENT STUDIES PROPOSED FOR PHASE II

A. Mosquito Survey

1. Location

Collecting sites must be accessible by road and reasonably close to established National Antimalaria Service centers. In the lower Jubba region, collecting sites will include large dhesheeks, irrigation canals between Yoontoy and Fanoole, rice fields at Fanoole, banana groves of the Mogambo estates and other likely sites. In the middle Jubba region, collecting will be done at accessible protected edges of the Jubba River, in Dujuuma, and in Bu'aale (domestic water collections). In the Gedo region, collections will be made from urban water sites in Baardheere, from the Jubba River at Baardheere and (if possible) from the water's edge at the location of the refugee camps, and in Luuq.

2. Time

Collections should be made at selected sites at least four times a year to take advantage of the bimodal seasonality of this area. It is suggested that the following might be attempted:

- late rainy season (June);
- early dry season (August);
- after second rains (December); and
- end of second dry season (February).

A week of collecting during each period should suffice.

3. Species to be Collected

The survey should include collection and inventory of all mosquito species encountered, not only *Anopheles*, but also *Culex*, *Aedes*, *Mansonia*, etc. as well as recording of vegetation types, seasonality (if any), and notable bionomic associations.

4. Personnel

A subcontract arrangement with the National Antimalaria Service would allow utilization of trained entomologists already in government employment. According to Deputy Director Mohamed

Hassan Aweys, as many as 15 trained personnel could be made available. There are National Antimalaria Service stations in Jamaame, Jilib and Baardheere.

5. Support and Equipment

Major purchases would include one vehicle (diesel Jeep), petrol, oil and lubricants, and at least two dissecting microscopes with mirrors. Small items would include collecting equipment (long-handled dippers, mosquito suction tubes, cigar boxes or the equivalent, #2 insect pins, etc.), but some of this equipment can be provided by the National Antimalaria Service.

6. Supervision

National Antimalaria Service staff would supervise the survey work, and an ARD consultant would make one visit at the end of the first year.

B. Survey for Schistosoma Haematobium in Human Population: Assessment

1. Location

Population centers to be surveyed must be accessible by motor vehicle at some time during the year. The following urban centers could be included--Jamaame, Jilib, Fanoole, Bu'aale, Dujuuma, Saakow, Baardheere, Luuq, and refugee centers south of Luuq.

2. Time

Surveys can be performed whenever access to population centers is assured. It will be easiest to schedule these visits during the height of the dry season (July, August, September).

3. Methods

Morning urine specimens will be collected from as many people as possible of all ages and both sexes. Two visits to each locality will be required. The first will be to organize the work, alert participants, introduce project personnel and distribute collection bottles. On the second day, the filled bottles will need to be collected, skin tests performed and specimens read. For S. haematobium, each urine specimen will be allowed to sediment, followed by manual centrifugation of an

aliquot which will be "read" under the compound microscope. For S. mansoni, intradermal skin tests will be done as the individuals present themselves, to be read 15 minutes later.

4. Personnel

It is proposed that Somali technicians trained under the former Schistosomiasis Control Project be used. The present director is Dr. Alio. It is suggested that Dr. S. Upatham (Faculty of Biology, Mahidol University, Bangkok, Thailand) be contacted about supervision. He was central to the former project, and maybe he or his associates would be available to supervise the work.

5. Support and Equipment

Major requirements would include a vehicle, petrol, oil and lubricants, two compound microscopes with mirrors (student grade), and a supply of S. mansoni skin-test antigen (could be supplied by John Bruce, Lowell University, Lowell, Massachusetts, for $3,000/gram--a gram is enough to test 1,000 people). Small items would include screw-cap, wide-mouth, polyethylene collection bottles, disposable plastic 10-cc syringes, #18-gauge long needles, plastic pipettes, screw-cap 10-cc centrifuge tubes, hand centrifuge, balance, test-tube racks, rubber tubing, microscope slides, #2 square cover glasses, folding work table and chairs, disposable tuberculin-type syringes and #25 gauge needles for skin tests, and a small portable Honda generator.

6. Treatment of Positive Cases

It may be advisable to be prepared to support a suggestion from the Department of Public Health to treat positive cases. Praziquantel (made by Bayer/Germany) tablets should be available. The cost should be negotiated by the GSDR, but should be between US$0.80 and US$6.00 per tablet. The dosage is one tablet per person, and one thousand tablets would be required.

C. Snail Survey

1. Location

Select sites similar to those visited in the mosquito survey (see Section II.A.1), and add accessible parts of the Jubba River.

12

2. Time

Collections should be made at selected sites at least four times a year to take advantage of the bimodal seasonality of this area. It is suggested that the following might be attempted:

- late rainy season (June);
- early dry season (August);
- after second rains (December); and
- end of second dry season (February).

A week of collecting during each period should suffice.

3. Species to be Collected

All aquatic snail species should be collected, recording associated vegetation, seasonality and bionomic associations. Particular emphasis should be placed on a search for *Biomphalaria pfeiferri.*

4. Personnel

It is proposed that Somali technicians trained under the former Schistosomiasis Control Project be used. The present director is Dr. Alio. It is suggested that Dr. S. Upatham (Faculty of Biology, Mahidol University, Bangkok, Thailand) be contacted about supervision. He was central to the former project, and maybe he or his associates would be available to supervise the work.

5. Support and Equipment

This survey could use the vehicle supplied for the human schistosomiasis survey. Additional required equipment would include one dissecting microscope with mirror; long-handled, wire-mesh scoops (one per worker plus two spares); glass vials; five liters of 70 percent ethanol for preserving snails; labeling supplies and glass-marking pencils; and plastic Petri dishes.

STUDY E

Sedimentation and Hydrology Issues

James F. Ruff, Ph.D.

CONTENTS

Section		Page
I.	Background	E-1
II.	Characteristics of the Jubba River	E-2
	A. Present Characteristics	E-2
	B. After Closure of Baardheere Dam	E-2
	1. Effects at the Reservoir	E-2
	2. Effects Downstream	E-4
III.	Future Water Use for Irrigation	E-7
IV.	Data Collection for Sedimentation Studies	E-8
V.	Low-Level Outlet Design	E-9
Appendix -- Sedimentation Data Collection Requirements		E-10

I. BACKGROUND

The Baardheere Dam will influence sediment transported by the Jubba River, and effects of this transportation will be observed both spatially and temporally. This report describes those effects and offers guidelines for the study and evaluation of potential impacts. This information can then be used to make decisions regarding mitigation measures and/or operation and maintenance procedures and schedules.

The proposed dam is sited in a relatively narrow gorge. The maximum normal water level at the dam is 141.9 meters above sea level, which results in a water depth at the dam site of about 50 meters. The reservoir width between the gorge walls will generally be less than one kilometer in the upper and lower thirds of the reservoir. However, near the middle, the valley spreads out, and the width of the reservoir surface will extend out to a maximum of about 10 kilometers. Closure of Baardheere Dam will result in an impoundment of water with a volume of approximately 3,400 x 10^6 cubic meters, extending about 180 kilometers upstream from the dam.

II. CHARACTERISTICS OF THE JUBBA RIVER

A. Present Characteristics

At present, the Jubba River from the dam site downstream to the sea can be characterized as a sand-bed channel with clay/sand banks. There are no apparent instabilities in the system, such as major bed or bank erosion, which is evident from the vegetation and tree growth on the bends. The vegetation is consistent, trees mature, and the banks are not denuded, undercut and sloughing. There are no reaches where sediment deposits are excessive or a braided channel occurs, which would indicate a significant change in the channel slope or sediment transportation capacity of the river. The river appears to be in regime, i.e., a balance between water and sediment discharge.

The overall sediment entering the river does not appear to be excessive, and the Jubba appears to transport it quite efficiently all the way to the sea. There are ephemeral tributaries that dump sediments into the river in relatively large quantities for short periods of time. Some of the residual evidence from these sediment slugs can be seen as fans near the confluence of these streams with the Jubba. However, these fans appears to be quickly and efficiently absorbed into the river's overall sediment transportation capacity.

At low level, the river flows between the alternate and point bars that are exposed. Residual dunes that move through the system at higher flows are evident on the bars and form some of the bars.

The river's lower reaches exhibit a classic meander pattern, characterized by a sinuous channel and recent loop cutoff. In general, the river appears stable. Some adjustment in the river pattern can be expected as it compensates for the reduced slope caused by the recent cutoff. This adjustment may occur over several years.

B. After Closure of Baardheere Dam

1. Effects at the Reservoir

The impounded water of the reservoir will create a backwater upstream from the reservoir. The extent of this backwater effect will depend on the elevation of the reservoir water surface when floods enter the reservoir. The effect will be to increase the depth of water in the river channel and reduce the velocity for a given discharge, relative to the rate without the dam. This velocity reduction will result in the deposition of sediment in

the Jubba River in the backwater reach above the reservoir. Thus, some aggradation (i.e., a rise in the riverbed) may occur upstream from the reservoir in the reaches of the Jubba influenced by the backwater. However, the fluctuation in the reservoir water level will have a major influence on this aggradation. The effect may only be seen as part of the overall accumulation of sediment in the reservoir's upper reaches, if the reservoir water level remains low. The result of aggradation of the river channel near Luuq will be higher flood stages at lower flood discharges. However, aggradation of the channel will be a lengthy process, and evidence of it may not be discernible for several decades.

The reservoir will be an efficient sediment trap. Electroconsult estimates that 95 percent of the total sediment load (bed load plus suspended sediments) will be retained in the reservoir. The majority of sediments will be deposited at an elevation just below where they enter the reservoir. This location is fixed by the operational water level at the time of major floods. The reservoir operations studies performed by Electroconsult indicate that the minimum reservoir water level will be 128.0 meters. The reservoir-level duration curve shows that the water level in the reservoir will either be at or exceed the maximum normal water level of 141.9 meters for 25 percent of the time, the elevation of 140.0 for half of the time, 137.0 meters for 75 percent of the time and 134.0 meters for 90 percent of the time. Thus, the majority of sedimentary deposits can be expected to occur between the elevations of 134.0 and 141.9 meters above sea level.

These depositions will be inundated or exposed for intervals ranging from weeks to years and can be expected in areas where the reservoir widens in the downstream direction. This is because the upper end of the reservoir will be at this location for a large proportion of the time when floods enter the reservoir. Normally, the deposits at higher elevations between Luuq and the reservoir's wide section will be exposed at periods when floods enter the reservoir. These flood flows will cut channels through the delta formations and carry some of the exposed sediments to lower reservoir levels. The incised channel may also result in streambeds through the deposits that contain islands or appear as braided channels. Vegetation may appear on these islands if they are exposed for some time.

Deposition of sediment in the reservoir will eventually reduce its capacity. However, this does not appear to be a concern for reservoir operation. Additional data should be collected to confirm and improve the prediction of sediment transported by the river. This information would merely be used to confirm the invert elevation of the low-level outlets.

Some sediments entering the reservoir will reach the dam. At times, large floods will enter the reservoir when it is at the lowest operating water level. These occasions will cause some deposits within the reservoir to move downstream. Also, silts, clays and some sands may be carried to the dam by density currents within the reservoir.

Sediment will also enter the reservoir from ephemeral tributary streams around its boundary. Small alluvial fans will form at these confluences. Some sloughing of the banks and small slides will deposit colluvium in the reservoir. Wave action will move the deposits to lower elevations.

A small proportion of the total sediment load will be deposited on the bottom of the reservoir near the dam and some flushed out of the reservoir through the bottom outlets and power penstocks. The volume of sediment passing through the system will only be five to 10 percent of that entering the reservoir based on Electroconsult's estimated 95 percent trap efficiency in the reservoir.

2. Effects Downstream

Relatively clear water will be discharged from the dam into the river channel downstream. This clear water will entrain sediment and scour the riverbed downstream from the dam until equilibrium is reached. The depth of scour will be a function of the sediment characteristics of the bed and banks, water discharge, and initial and final slopes of the river. As the river channel degrades, the surface of the bed will become coarser as finer material is plucked from the surface. Removal of the finer material will result in an armoring effect that may reduce degradation to less than would be predicted, based on analyses of the bed material. Armoring is a covering layer of a fraction of the coarser or larger sizes from the bed material, which results in a channel bed that is less erodible.

Flow over the spillway will occur for a short period during the maximum flood in most normal years, but not at all in some years. Thus, relatively stagnant water will remain in the spillway stilling basin. Gabions will be used to protect the stilling basins and tailrace channel from scour at the end of the concrete structure. Some scour will occur at the downstream end of the gabions because of the change in local shear stress. Provisions at the gabion structure should be made for general degradation of the river channel and local scour.

General degradation of the river (deepening of the channel bed) will affect existing bridges and water intakes. Bridge piers and abutments should be protected and stabilized. Even though a bridge has been stable and safe at high flood flows

experienced in the past, bridge piers and footings may be undermined as a result of the combination of general degradation and local scour. This degradation could extend for several hundred kilometers downstream of the dam and will depend on the discharge released, sediment transportation characteristics and final slope of the river.

General degradation of the channel will affect the riverbanks also. They will become higher and may be undercut and slough into the river. Further adjustment may occur because of the flow and sediment transportation capabilities resulting from the relatively constant flow condition. This adjustment may be meandering within the existing river channel, if the flow does not completely cover the channel. It is difficult to predict if the new flow conditions will result in a less stable river channel. Less stable could mean bank erosion that could be alleviated with some bank protection or a rapidly migrating channel that is difficult to control. It is also possible that the river channel will quickly adjust and remain stable with little or no outside intervention.

If irrigation intakes are located in the Jubba or along its banks, they may have to lowered to continue to operate satisfactorily. This may require pumping into channels that were previously gravity-fed. Piping from the intake to the bank may have to be extended for existing floating intakes. Because of the clear water released from the reservoir, the river may begin to attack the banks and scour the bed beginning in the reach immediately downstream from the dam. Bank-stabilization measures may be needed at some locations to maintain channel alignment, but specific requirements cannot be predicted in advance. Thus, a long-term monitoring and maintenance program for the river channel should be part of the operational scheme for the development authority. Monitoring could be a visual inspection with photographs taken at regular intervals to document suspect areas. Field surveys could also be part of the documentation procedure. Inspections should be conducted after major flood events, and aerial photographs used to document and monitor changes in the river. This program must continue throughout JESS.

Based on Electroconsult's preliminary reservoir operations study and flood routing through the reservoir, the river flow will generally be about 125 to 200 cubic meters per second. The flow is expected to increase to about 700 cubic meters per second through the low-level outlets during flood periods. Adding the maximum discharge through the turbines of about 300 cubic meters per second, a total of about 1,000 cubic meters per second could potentially be discharged into the Jubba. Normally, this condition will not occur. However discharges of this magnitude would cause over-bank flow onto the floodplain and into dhesheeks.

Peak flows exceeding 700 cubic meters per second passing over the spillway will occur only occasionally during major flood events. The majority of the time--six to eight months a year, the flow will be less than 200 cubic meters second. This uniform flow will provide a relatively constant water level in the river which may encourage weed growth along the banks. Periodic fluctuations in the flow rate, while maintaining the same average flow, is a proven method for controlling malaria, mosquitos, snails and aquatic growth.

A general lowering of the riverbed will have an impact on dhesheek farming. Over-bank flows will occur less often because of controlled discharge releases and higher banks. To continue using this type of farming method, alternative means of providing water to the dhesheeks must be developed. If outlets and canals are constructed for water to flow by gravity from the Jubba to dhesheeks, the lower water level in the river will not allow the water level in the dhesheeks to rise as high as when floods overtop the banks and flow onto the floodplain. Thus, some original dhesheek farmland would not produce a crop. If high-capacity pumps are used to supply water to dhesheeks, water levels comparable to those obtained through natural flooding would be possible.

III. FUTURE WATER USE FOR IRRIGATION

Power generation has been emphasized as the priority water use for the Baardheere dam and reservoir. However, irrigation will play a significant role in establishing agricultural and food self-sufficiency for Somalia. Both uses of the water are possible with proper design and management. However, planning for both schemes should proceed simultaneously.

Initial priorities for design and construction of the irrigation water-delivery system should be established. To design an efficient, operational and manageable irrigation system, the design parameters must be known. The discharge or water requirement is the first and most important criterion. If the required discharge is unknown or underestimated, the project will fail because the system will never be able to supply sufficient quantities of water, unless additional remedial measures are employed. Hence, estimating the quantities of water needed should start at the field level and work back to the main canal or river. Canal losses for seepage, evaporation, livestock and domestic water should be included in the estimate. In addition, estimated water quantities should be based on data obtained from existing systems, pan evaporation and anticipated cropping patterns. These quantities should be translated into the maximum discharge required. Finally, the discharge estimate should consider changes in cropping patterns that may result because of changes in markets, transportation, governmental controls and policies.

Determining the discharge will require a policy decision on whether the flow will be delivered on a continuous, rotational or demand basis. The use of night storage systems, either in canals or intermediate reservoirs, invariably results in problems with siltation, aquatic weeds and bilharzia snails. Rotation must occur at some level, and that level must be determined--the farm-level ditch, distributary ditch or branch canal. Required discharges should be worked out for several optional operational procedures, which should include inputs for insect and parasite control as well as health factors. These procedures will give a basis for formulating the final policy decision and design criteria.

IV. DATA COLLECTION FOR SEDIMENTATION STUDIES

Measurements of suspended-sediment loads must be made at numerous discharges throughout the year. Suspended-sediment discharge measurements and concurrent water discharge should be made every day, if possible, or at least every two to four days during the rising and falling portions of the flood hydrograph. Depth integrated suspended-sediment samples should be collected at several vertical sections representing areas of equal-flow sectors throughout the cross section. Discharge readings should be obtained from the nearby river-gauging station reading or current meter measurements.

Bed-load transportation during this period is impossible to obtain, for all practical purposes. Thus, bed-load estimates must be made by considering the makeup and gradation of the material comprising the bed load. Bed-load material samples can be collected from the exposed river channel during low-flow periods. Samples should be obtained from areas that have relatively uniform channel geometry. If possible, the channel should be straight with the cross section and the channel's slope relatively constant. Judgment should be used in selecting the site for collecting the bed-load sample. Sandbars that appear to have armoring material on the surface should be avoided, as this is part of the bed load, but is not truly representative of the total bed load.

Samples should be collected at several locations and near river-gauging stations. If sampling cannot be performed at all the gauging stations, the most important locations are Luuq and Baardheere. If bed-load samplers are available, samples should be taken at the same time as suspended-sediment samples. If not, information obtained from the riverbed at low flow will be used to predict bed-load transportation. Analyses of the samples will give their size, gradation and specific weight.

Part of the data collected in the planning stages JESS should be existing bridge-opening geometry, elevations of the lower cord of bridge stringers, footing elevations, abutment side slopes and bank-protection measures. The depth of piles, foundations or footings on which the bridge is constructed should also be determined. Bridge plans and construction data should be obtained, if possible. In any case, careful monitoring of scour around the bridge piers should be included in any operational maintenance plan.

V. LOW-LEVEL OUTLET DESIGN

The low-level outlets are 3.5 meters in diameter. The maximum discharge through each outlet will be 175 cubic meters per second. At this discharge, the velocity in the pipe will be 18 meters per second. Cavitation damage at an imperfection or offset in the boundary of the outlet conduit or valve body can be expected at these velocities. Thus, the diameter of the outlet pipe should be increased or a larger number low-level outlets incorporated in the final design to reduce the discharge through each valve. Velocities on the order of six meters per second are acceptable, and no velocity should be greater than nine meters per second within the outlet conduit. Velocities less than six meters per second are expected in the power penstocks.

APPENDIX

Sedimentation Data Collection Requirements

(1) Data to be collected:	Bed material, temperature
(2) Data collected by:	Field or river survey crew member One or two members of a 3 or 4 man survey crew.
(3) Collection period:	Low flow in river. (most likely to obtain representative sample at this time) At same time suspended sediment data is collected if a bed load sampler is available.
(4) Location:	At river gaging station locations. Priority should be given to Luug and Baardheere stations.
(5) Equipment required:	Shovel and sample bags. Bed load sampler (This has a low priority if a trained crew is not available.)
(6) Data analyses:	Size, gradation, and specific gravity.

(1) Data to be collected:	Suspended sediments discharge, water discharge, river gage elevation, temperature
(2) Data collected by:	Field or river survey crew member 3 or 4 man survey crew.
(3) Collection period:	All river stages. Priority should be given to rising and falling limb of flood hydrograph. Every 3 or 4 days during the flood if possible, if not, as often as possible. Periodically every 2 to 4 weeks remainder of year.
(4) Location:	At river gaging station locations. Priority should be given to Luug and Baardheere stations.
(5) Equipment required:	Suspended sediment sampler, depth integrating or point integrating sampler
(6) Data analyses:	Size, gradation, and specific gravity.

(1) Data to be collected:	Water discharge rating at river gaging station.
(2) Data collected by:	Field or river survey crew member 3 or 4 man survey crew.
(3) Collection period:	All river stages. Priority should be given to rising and falling limb of flood hydrograph. Every day during the flood if possible, if not, as often as possible. Periodically every 2 to 4 weeks remainder of year.
(4) Location:	At river gaging station locations. Priority should be given to Luug and Baardheere stations.
(5) Equipment required:	Current meters and associated equipment.
(6) Data analyses:	Stage discharge relationship for gaging stations.

****** NOTE: This information may be collected by the Ministry of Agriculture through Sir Malcolm MacDonald and Partners, Ltd., Keith Stallard.

---

(1) Data to be collected:	River cross sections, bridge opening geometry, Mannings "n" values.
(2) Data collected by:	3 or 4 man survey crew.
(3) Collection period:	Low flow in river. (most likely to obtain representative sample at this time)
(4) Location:	At river gaging station locations. Priority should be given to Luug and Baardheere stations.
(5) Equipment required:	Transit, level, theodolite or electronic distance measuring equipment, rods, stakes, hammers, monuments, steel chain, and cloth tape, and assorted survey equipment. Camera and film. Data forms and field books.
(6) Data analyses:	Stage discharge relationship for gaging stations.

---

(1) Data to be collected:	Aerial photographs of river and flood plain.

(2) Data collected by:	Aerial photographic firm.
(3) Collection period:	Low flow and high flow stages in river.
(4) Location:	Entire river. Priority should be given from short reach above Luug downstream to Fanoole.
(5) Equipment required:	Aircraft, camera and asssociated equipment. Color infrared, color, and black and white film. (Probably only realistic to hope for black and white film.)
(6) Data analyses:	River forms, scour locations, eddy zones, flow patterns, deshek areas through photo interpretation.