

PHASE I REVIEW AND PHASE II WORK PLAN
FOR THE JESS PROJECT

JESS Report No. 1

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ACRONYMS AND ABBREVIATIONS

AAAS	American Association for the Advancement of Science
AHT	Agrar und HydroTechnik, GMBH
AID	U.S. Agency for International Development
ARD	Associates in Rural Development, Inc.
AVHRR	advanced, very high-resolution radiometry
BDP	Baardheere Dam project
BNA	Blue Nile Associates
BOSTID	Board on Science and Technology for International Development
BuRec	U.S. Bureau of Reclamation
CIPL	Commodity Import Program
CSU	Colorado State University
FAO	Food and Agriculture Organization of the United Nations
GSDR	Government of the Somali Democratic Republic
GTZ	German Agency for Technical Cooperation
JESS	Jubba Environmental and Socioeconomic Study
JuDAS	Jubba Development Analytical Studies project
LRDC	Land Resources Development Centre
LTC	Land Tenure Center, University of Wisconsin
MJVD	Ministry of Jubba Valley Development
MMP	Sir M. MacDonald and Partners, Ltd.
NAS	National Academy of Sciences
NTTCP	National Tsetse and Trypanosomiasis Control Program
PC	personal computer
PP	project paper
RMR	Resource Management and Research
RUP	resource user-producer group
SARSA	Human Settlements and Natural Resource Systems Analysis
TAMS	Tippetts-Abbett-McCarthy-Stratton Engineers, Architects and Planners
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
WASH	Water and Sanitation for Health
WDA	Water Development Agency
WHO	World Health Organization

PREFACE

The Jubba Environmental and Socioeconomic Study (JESS) project (number 649-0134) is jointly funded by the Government of the Somali Democratic Republic (GSDR) and U.S. Agency for International Development (AID). JESS is part of a larger project funded by USAID and the GSDR, the Jubba Development Analytical Studies (JuDAS) project. Technical assistance and JESS project management are being provided to the Ministry of Jubba Valley Development (MJVD) by Associates in Rural Development, Inc. (ARD) of Burlington, Vermont, under AID contract number AFR-0134-C-00-5047-00. This report describes activities that have occurred during Phase I of the project (September 1985 to April 1986) and those planned for Phase II (May 1986 to roughly March 1988).

Phase I activities and design of the Phase II work plan were accomplished by a combination of ARD, MJVD and AID staff and consultants, which included:

JESS Field Team

Dr. E. Drannon Buskirk	team leader, aquatics and fisheries
Dr. James Merryman	anthropology
Dr. Kathryn Craven	socioeconomics
Dr. Ian Deshmukh	ecology, vegetation and wildlife
Dr. Nancy Merryman	administrative coordinator, anthropology

ARD Home Office Staff

Mr. Richard Donovan	project manager and training
Dr. Gus Tillman	ecology and remote sensing
Dr. George Burrill	management
Mr. Richard Hart	budget and accounting systems
Mr. Ross Bryant	research assistant and procurement
Dr. James Thomson	institutional analysis
Dr. Abe Waldstein	anthropology
Ms. Karen Wiese	agricultural economics

ARD Consultants

Dr. Peter Bloch	economics and resettlement
Dr. William Jobin	water quality and public health
Dr. Curt Schneider	public health and epidemiology
Dr. James Ruff	hydrology and sedimentation
Dr. James Riddell	land tenure and anthropology
Mr. Len Malczynski	research design and data base management
Mr. Tom Hart	remote sensing

Mr. Earl Meredith fisheries
Mr. Thomas Kelly project start-up and logistics

Ministry of Jubba Valley Development

Mr. Aweys Haji Yusuf project manager
Mr. Ali Warsame Aden administration
Mr. Mohamed Hassan Aden JESS project
Mr. Ahmed Nur Weyrah JESS project
Mr. Omar Alwan Farrah JESS project

AID/Somalia

Ms. Sally Patton project manager
Mr. Dan Vincent chief, engineering division

The principal authors of this document are the JESS field team, along with Mr. Donovan and Dr. Tillman.

The proposed Phase II work plan is the result of collaboration among the same group of people, with additional input from panel members and staff of the National Academy of Sciences (NAS) Board on Science and Technology for International Development (BOSTID). Phase II activities will be implemented by ARD, MJVD, and a variety of cooperating agencies and institutions. Through subcontracts, the following organizations will participate in this effort:

- Blue Nile Associates (BNA),
- the University of Wisconsin's Land Tenure Center (LTC),
- Resource Management and Research (RMR),
- Colorado State University (CSU), and
- the Somali National University.

Many other collaborating institutions in Somalia are also part of the JESS project and are noted in the text of this report.

I. EXECUTIVE SUMMARY

In this report, ARD presents a review of Phase I activities and an outline of work to be performed during Phase II of the JESS project, which it is implementing in Somalia with AID funding and in collaboration with MJVD. JESS project relationships include collaboration and exchanges with the U.S. Bureau of Reclamation (BuRec) and NAS, both of which are managing components of a larger project, JuDAS, that also includes the JESS project. To attain JESS project objectives, ARD manages inputs from its various subcontractors--LTC, CSU, BNA and RMR--as well as numerous individual technical specialists.

The central core of JESS project activities is being carried out by a long-term field team of five people, based in Mogadisho. They include a natural resources planner (the team leader), ecologist, anthropologist, socioeconomist and office administrator (who also has professional credentials as an anthropologist). ARD's home office staff is providing managerial, administrative, technical, procurement and financial services to the JESS project.

A computerized bibliographic data base, including over 1,000 citations that are relevant to river basin development planning and assessment, is presented in a companion report to this volume--BIBLIOGRAPHY FOR THE JESS PROJECT (ARD, Burlington, VT, July 31, 1986).

A. Phase I

ARD began JESS Phase I activities with a subcontractors' meeting in Burlington, VT, in September 1985 to define project responsibilities and obligations. By October 1985, the JESS project office in Mogadisho had been established by a start-up team consisting of ARD's president, Dr. Burrill; technical project manager, Dr. Tillman; a logistics expert, Mr. Kelly; and the JESS field team leader, Dr. Buskirk. The long-term field team's ecologist, Dr. Deshmukh, and socioeconomist, Dr. Craven, arrived in late October, and the anthropologist, Dr. J. Merryman, in early January 1986 to complete the field team.

ARD's home office and the JESS team undertook a literature survey in Somalia, Europe and the United States. The reference citations gathered during this review were entered into a computerized bibliographic data base. This bibliography is presented in a companion volume to this report, BIBLIOGRAPHY FOR THE JESS PROJECT (ARD, Burlington, VT, July 31, 1986).

During Phase I, the JESS team established a functional office with a computerized data management system designed for report preparation, data storage, and project administration and management. In addition, JESS field team members made over 12 reconnaissance or extended survey visits to the Jubba Valley to make preliminary contacts, establish a field presence, set up field camps, design sampling strategies and collect data. During this phase, a primary objective was to prepare a work plan for Phase II. In designing the Phase II work plan, the JESS team was assisted by ARD's overall project manager, Mr. Donovan, and technical project manager, Dr. Tillman, as well as consultants in public health, water quality, hydrology, economics/resettlement and land tenure/anthropology.

Problems and delays were encountered during Phase I of the project, but resolved by cooperative solutions between JESS, AID and MJVD. Communications between the United States and Somalia posed major constraints to project coordination and procurement, but these problems were not beyond expectations and did not require significant schedule adjustments. All the organizations involved in the JESS project have shown remarkable flexibility in their efforts to meet Phase I objectives in a timely fashion.

B. Phase II Work Plan

The Phase II work plan is composed of interrelated environmental and socioeconomic baseline studies that will be directed by the JESS field team. These baseline studies will be supplemented and complemented by a series of special studies to be conducted by ARD home office personnel and involving slightly more than 31 person-months from technical consultants. The studies described in the work plan (see Section IV) will be carefully coordinated with other research being conducted in the Jubba Valley by the GSDR and other international agencies, including AID. MJVD will use information gathered by the JESS project and other studies to prepare a master plan for Jubba Valley development, with assistance from the German Agency for Technical Cooperation (GTZ).

The objectives for Phase II of the JESS project are:

- gathering and presenting data for the Jubba Valley that fit into the process of developing a master plan for valley development;
- establishing a realistic, long-term system for environmental and socioeconomic monitoring;
- preparing river basin planning and development guidelines;

- incorporating these guidelines into the mainstream of the Jubba Valley planning and development process; and
- training MJVD staff so that they can continue to collect and analyze data, and plan and monitor development activities.

The main portion of the Phase II work plan describes the components of the baseline studies in detail and provides technical descriptions and scheduling for the special studies. The direction of all the studies will be governed by two analytical tools or concepts:

- resource user-producer groups (RUPs), which are groups of people in the Jubba Valley with distinctive production and resource-use characteristics, and
- water balances in the Jubba Valley.

Use of these two analytical tools will intertwine the socioeconomic and environmental investigations to afford a holistic, rather than fragmented, understanding of the Jubba Valley.

II. INTRODUCTION

JESS is part of a larger project funded by AID and the GSDR, the JUDAS project. The JESS project began in September 1985 with the signing of a contract between AID and ARD. The specific objectives of the JESS project are to:

- provide GSDR with timely information to be used in formulating a socioeconomically and environmentally sound master plan for the Jubba Valley, as well as guidelines for designing future projects that are socioeconomically and environmentally sound;
- 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 impacts and enhance beneficial effects;
- provide GSDR with a realistic plan for monitoring environmental, socioeconomic, land-use and agricultural parameters in the Jubba River Valley so that national development decisions can be based on sound, current data; and
- develop institutional capabilities within MJVD through classroom and on-the-job training.

To implement the JESS project, ARD has a five-person field team in Somalia, including a natural resources planner (team leader), an ecologist, a socioeconomist, an anthropologist and an administrative coordinator. ARD has also enlisted the services of consultants and subcontractors for short-term technical activities.

In conducting the JESS project, ARD is cooperating with two other organizations, under contract to AID, that are involved in the JUDAS project. They are:

- the U.S. Bureau of Reclamation (Burec), which is conducting a soils and economic land-use classification program in the Jubba Valley; and
- NAS, which is providing peer review and external support to USAID/Somalia.

The JESS and BuRec teams are attached to different administrative departments at MJVD, and ARD's collaboration with BuRec is concentrated primarily on coordinating fieldwork in the Jubba Valley and information exchange in Mogadisho. NAS conducted a

workshop and reviewed a draft of the JESS Phase II work plan to assist USAID/Somalia in its project review and management process.

III. REVIEW OF PHASE I ACTIVITIES

Phase I activities consisted of project start-up (including personnel recruitment, logistics and procurement), a literature search, field reconnaissance in the Jubba Valley, NAS workshop and design studies leading to an initial draft of the Phase II work plan. The original work plan for Phase I is provided in Appendix A. Figure 1 on the following page presents a time-line for Phase I activities.

A. Project Start-Up

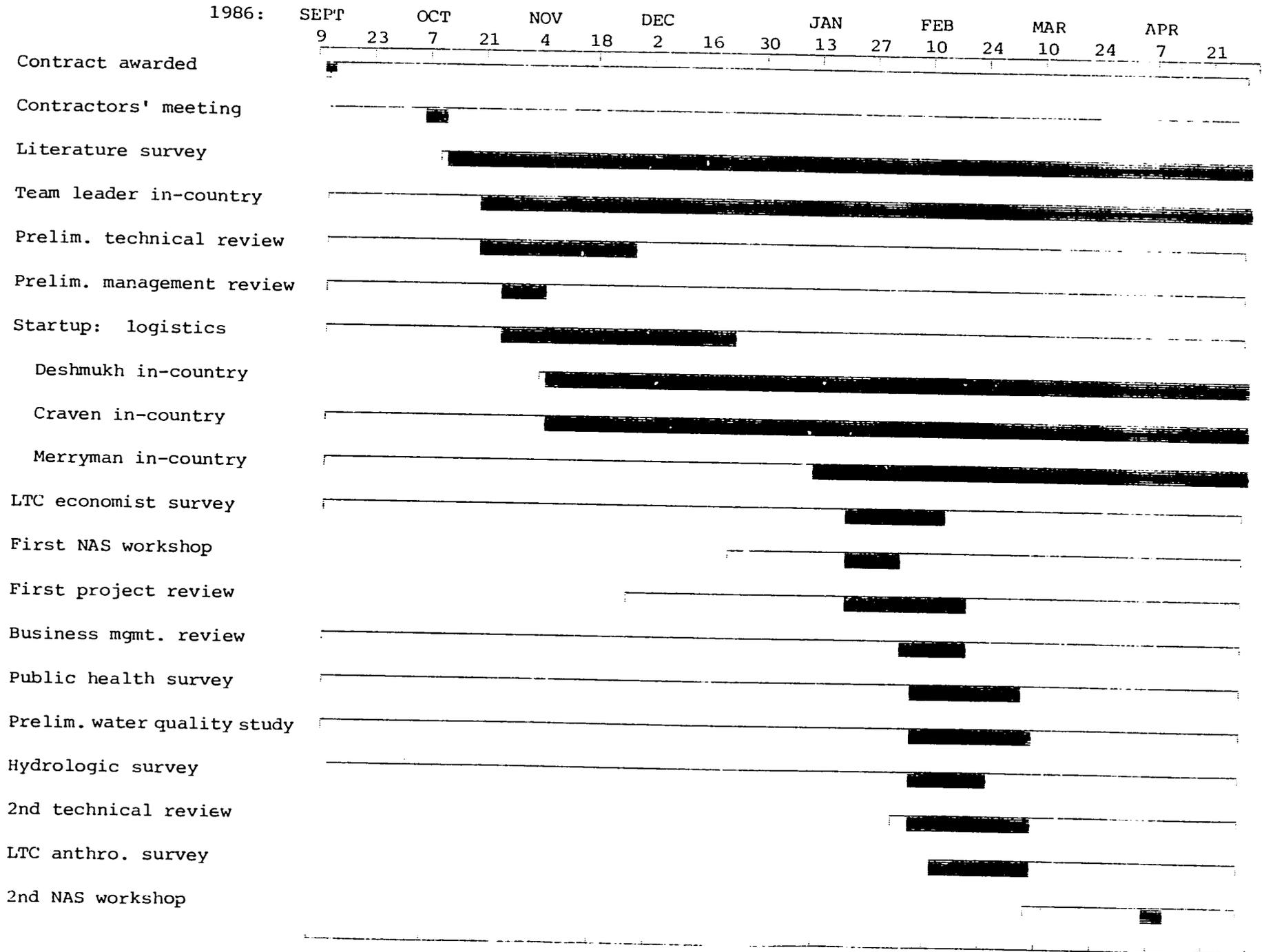
The JESS project was mobilized quickly in Somalia and the United States. Five weeks after the contract was signed, ARD's team leader and project start-up team were in Somalia. Three weeks after arriving, the team had established a working office and installed an operational computer system.

Somali office and field staff have either been assigned by MJVD (members of the Somali civil service) or hired under project-specific, personal-service contracts. As of the start of Phase II, JESS has five office employees, six counterparts and field technicians. The project also includes numerous other individuals in support functions. However, trained field technicians and enumerators were in short supply as the training and field studies began in June 1986.

With regard to institutional development, MJVD has given training a high priority. Project staff have been engaged in various kinds of training, including:

- initial office and field training (e.g., word processing and vehicle maintenance);
- Somali language training--two of ARD's long-term field staff have taken month-long intensive language training--and project staff have offered to conduct English language classes at MJVD;
- classroom training--ARD long-term staff have conducted sessions on development perspectives and baseline study methods;
- seminars--short-term consultants have given talks on a number of topics;
- on-the-job training--although the classroom sessions and seminars will continue, on-the-job training will be the primary focus during Phase II; and

Figure 1. Time-Line for Phase I Activities



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- external training--some project staff are being identified for training programs outside Somalia.

The various training efforts have yet to be fully coordinated.

For local expenditures, the JESS project uses funds from the Commodity Import Program (CIPL), which is a typical means of local project financing. Since the start of 1986, this process has been rather slow, as major portions of allocated funds were not released until after the first quarter had passed. However, administration of the CIPL budget promises to be more efficient in the future.

Logistic difficulties are a major problem for most projects in Somalia. The absence of facilities and services in rural Somalia, and shortages of essential supplies, such as fuel, are serious constraints to project implementation. Although the JESS project has experienced these difficulties, the situation has improved.

The project has adequate office space at MJVD, including five offices, a computer room and resource center. Project equipment and supplies are stored mainly at the residences of ARD staff members. A continuing problem with the quarters at MJVD is access during off-hours because the ministry is located in the presidential compound and security is rigorous.

Procuring and shipping camping gear, scientific apparatus, office machinery and computer equipment have been major responsibilities for ARD's home office staff. The project will have enough camping equipment for about 25 people, which will be used approximately half the time. When project teams are in the vicinity of major towns, they will utilize field stations--the project already has one field station at Baardheere and is developing another at Jilib. ARD has procured and shipped two boats and motors for aquatic studies and river transportation.

The JESS project is undertaking a major data management effort, and already has three IBM AT personal computers (PCs) and three Hewlett-Packard Portable Plus computers, as well as associated peripheral devices and software, in Somalia. Additional computers for data-entry workstations may be procured. Prior to the start of fieldwork, an ARD data management specialist designed a system that meets the project's information processing needs for both field and office functions, and will also serve MJVD after the project is over.

The project has had five CJ8 Jeeps from the outset. However, because of their limited carrying capacity, more vehicles are needed for the fieldwork. The Jeeps are currently being modified for the field (e.g., installation of roll bars and roof racks). Both USAID/Somalia and MJVD recognize the project's

need for additional vehicles and/or ones with greater capacity, particularly for the socioeconomic studies.

Arrangements for fuel storage and distribution are proceeding satisfactorily, although many problems were encountered in previous months. The JESS project now has the capacity to store approximately 6,000 liters of fuel. Additional storage will be necessary for the field stations and local transportation in Mogadisho.

Through the diligence and personal attention of MJVD officials, the JESS project received assigned radio frequencies only four months after its initial request. The project will coordinate radio procurement and operation with BuRec and Agrar und HydroTechnik, GMBH (AHT). Other electronic communications devices (i.e., telex and telephone) are in use, but delays are frequent.

B. Literature Search

JESS has contacted over 60 organizations around the world. The project has contacts ranging from private individuals to international organizations. The emphasis has been to gather information and literature to ensure the efficient design and implementation of JESS activities.

A literature review is essential to the design of the field studies and evaluation of their results. The JESS field team has mainly reviewed Somalia-related documents, while ARD's home office staff has conducted a more general review and entered the information on a bibliographic computer program. This computer literature program was transferred to the JESS project in Somalia during May 1986, so that it can serve as the basis for a computerized reference system for MJVD. The literature review will continue for the duration of the project. The citations identified thus far are presented in a separate ARD report, BIBLIOGRAPHY FOR THE JESS PROJECT (Burlington, VT, July 31, 1986).

C. Field Reconnaissance in the Jubba Valley

During Phase I, JESS staff made nearly a dozen on-the-ground trips to the Jubba Valley for purposes of environmental and socioeconomic reconnaissance. Besides these overland trips, JESS staff and consultants also made an inspection of the area from chartered light aircraft.

D. NAS Workshop

In addition to ARD and BuRec, NAS is another AID contractor for the JuDAS project. The primary vehicle for NAS interaction is a series of workshops, the first of which was held in Somalia at the end of January 1986. This workshop was a cooperative effort between MJVD and NAS, and consisted of two parts--a field trip to the Jubba Valley and meetings in Mogadisho. The JESS project played a central role in logistic arrangements for the field trip and also participated in the meetings. ARD's long-term field staff and the NAS panel engaged in several small-group and one-on-one discussions about valley development issues, assessment approaches and comparative studies of man-made lakes in Africa.

The NAS panel reached a consensus that the following Jubba Valley development issues should be given adequate consideration during the JESS project:

- the emphasis on large- versus medium- or small-scale irrigation projects as development approaches, in tandem with other development alternatives;
- allocation of the hydropower planned by the Baardheere Dam project (BDP) between settlements in the Jubba Valley and Mogadisho;
- agricultural development opportunities associated with the reservoir drawdown zone and controlled floods in the downstream areas;
- resettlement of people dislocated by the various projects;
- consideration of livestock and pastoralism in agricultural schemes; and
- local and national institutional factors involved in development.

These and other issues have been addressed in formulating this work plan for the Phase II studies.

E. Design of Phase II Studies

In February and early March 1986, a major effort was made to design the studies proposed for the Phase II work plan. This work was done in Somalia by the JESS project's long-term field staff, three visiting ARD staff members and five international experts on various aspects of river basin development, in consultation with MJVD personnel, NAS scientists, professors from

the Somali National University and representatives from numerous Somali organizations. These activities included interviews and brainstorming sessions as well as on-the-ground visits to and flights over the Jubba Valley. The design studies also capitalized on advice and discussions from the NAS workshop held in January 1986.

The studies were designed using lists of issues drawn from ARD's scope of work, the NAS workshop, experience of ARD staff and consultants, and literature on other river basin assessments, planning efforts and developments elsewhere in Africa and around the world. Through interviews, in-country research and team meetings, ARD identified activities being conducted by other organizations in the Jubba Valley and "whittled down" the very long list of issues that had been drawn up originally. ARD staff and consultants then drafted preliminary study designs. In addition to defining scope and methodology, the design studies include manpower requirements and scheduling suggestions. On completion of the preliminary design of the Phase II studies, they were transferred to ARD's home office and incorporated into a draft work plan for Phase II. Thus, the final product of all the preliminary design studies is the proposed Phase II work plan (see Section IV).

The draft work plan was reviewed at AID and MJVD in Somalia as well as the offices of NAS, ARD and its subcontractors in the United States. Based on meetings with NAS, MJVD, USAID/Somalia and the subcontractors, ARD field staff did an initial revision of the planned studies in the field. ARD home office staff then completed preparation of this version of the Phase I report and Phase II work plan.

IV. PHASE II WORK PLAN

A. Approach to and Scope of Field Investigations

In developed and industrialized countries, a proposed two-year work plan that encompasses complex, interrelated, socioeconomic and environmental studies would be offered as a tentative description of intent. In a developing country, such a work plan is, of necessity, even more tentative and requires even greater flexibility. For this reason, the Phase II work plan presented here is a working document that will undergo revision by ARD and the JESS team during periodic management and technical reviews and at other times, if necessary.

Given the common obstacles encountered during project implementation, a realistic work plan establishes priorities for tasks which will cover most, if not all, of the concerns that can be addressed by studies completed under worst-case scenarios. Supplemental studies and special assessments can be added to this basic body of work. Such additional studies will contribute to the growing body of planning knowledge, especially in terms of broadening the range of development opportunities (e.g., alternative agricultural approaches and institutional arrangements).

The JESS project is a data collection and analysis effort that will generate information for the purpose of contributing to a master plan for Jubba Valley development. The project is not a scientific expedition to gather data for academic publications, although approved scientific methods and techniques will be used to collect, compile and analyze the data. Nor is JESS an exercise in pure data collection, intended to result in multivolume sets of tables, charts and graphs that cannot be easily applied to planning activities. Finally, the project will not produce an environmental impact statement in the style of the U.S. National Environmental Protection Act, as no arguments against dam construction will be presented. The JESS project is proceeding on the assumption that USAID/Somalia and MJVD want to know which environmental and socioeconomic safeguards can be implemented during project development, including all phases of dam planning, construction and operation. The project aims to avoid or remedy the potential adverse effects of development and enhance the benefits of change. The Phase II work plan is predicated on these concepts and assumptions.

In general, this work plan describes two long-term sets of baseline studies that will gather primary and secondary data on socioeconomic and environmental conditions in the Jubba Valley. Every effort is being made to coordinate these studies with recent, current and future research conducted in the valley by other organizations. The JESS project's Phase I activities were

effective in establishing links with other organizations, securing agreements to exchange data on a timely basis and creating an atmosphere for vital logistical cooperation.

In addition to the two sets of baseline studies, the JESS work plan includes special investigations that will result in two types of interim working documents for MJVD:

- compilations and analyses of baseline information on particular topics; and
- impact assessments of selected developments proposed for the valley, such as the Baardheere Dam.

Some of these studies will produce recommendations of immediate value that could decrease in importance as development project plans and designs become more definite. For instance, health issues relating to dam design, construction and operation are an immediate concern and cannot wait to be addressed in the final report issued by the JESS project in September 1988. Thus, the results of a preliminary study on this subject will be presented in a working document for MJVD and BDP engineers early in Phase II. With the issuance of special interim reports, the final report prepared for MJVD need not be nearly so lengthy and cumbersome. While this approach is not specified in ARD's contract with AID, approval of this work plan will establish a means for more rational and useful dissemination of study results.

Those who evaluate this work plan may note apparently important omissions in the proposed baseline and special studies, especially if they are serious students of the socioeconomic and natural-resource effects of large dams in semiarid environments. Throughout Phase I, JESS staff and consultants were pleasantly surprised by the quantity and quality of recent studies conducted in the Jubba Valley. Many items listed in the comprehensive scope of work generated by AID for the JESS project have recently received adequate coverage by several organizations, such as AHT/GTZ, private voluntary organizations, the United Nations, World Bank and several engineering companies. Additional studies are now in progress or will begin shortly, with completion expected before the end of Phase II. Still, there are important gaps in the available information which this proposed Phase II work plan is designed to address, while avoiding duplication of other study efforts. To the extent possible, recent and ongoing studies that are of relevance to the JESS project will be discussed in this work plan for coordination and justification of the studies proposed here.

The JESS field team is small, which encourages interaction on both personal and professional levels. Furthermore, the Jubba Valley is remote from the project's headquarters in Mogadisho,

which will require a collaborative data-gathering effort by the team, especially in view of scarce and erratic supplies of fuel and other resources. Similarly, the work plan presented here is a collaborative effort and recognizes that the Jubba Valley's human systems are inextricably tied to the quantity, quality and distribution of natural resources. It is impossible (or at the very least, foolhardy) to study either social or environmental systems in the Jubba Valley without knowledge of both. In this context, all JESS scientists understand that they must frequently rely on other JESS staff for advice and interpretation. Every major finding and interim report will be discussed and reviewed by the team members in terms of its socioeconomic and natural-resource implications. However, such collaboration and integration in study planning and implementation is not shown in the work plan chronograms or activity outlines.

This work plan sets aside ample time for the synthesis of study results. There is time for detailed consideration of the data in different aggregations, disaggregations, correlations and other statistical manipulations, with one aim being to produce the most useful information for planners. However, there are problems with this approach in conducting studies under widely varying climatic conditions. In semiarid climates, the actual rainfall in any given year is usually substantially more or less than average, and resource-management strategies in such areas reflect these variations. As a result, a short study of one to two years cannot possibly encompass the normal long-term range of conditions. Thus, it is important to place the study period within the context of these variations and attempt to determine or predict conditions that are likely at other times.

Finally, this document was produced for a limited audience of professionals, including MJVD, AID/Somalia and the NAS Advisory Panel. Hence, it does not include rudimentary information, and certain technical terms are only briefly defined. More complex relationships are clarified so that professionals from various disciplines can understand the study elements.

B. Contribution to Master Plan

This work plan attempts to defy an old Somali proverb--laabi laba u la, which means "two different things cannot be thought of in a time." In the next two years, dozens of scientists and support personnel associated with the JESS project will address over 20 topics, ranging from archeology to xerophytes. The array of study topics and issues is large. An important publication of the American Association for the Advancement of Science on resource inventories describes approximately 60 ecosystem components and developments that are appropriate for baseline investigations (RESOURCE INVENTORY AND BASELINE STUDY METHODS FOR

DEVELOPING COUNTRIES, AAAS, Washington, DC, 1983). In preparatory studies for the overall JUDAS project, Mr. Joseph Dowhan identified 82 potential impact areas for the Jubba Valley. The JUDAS project paper (PP) lists 35 socioeconomic and environmental topics and issues. These sources are useful as starting points for initial consideration in a river basin investigation. During Phase I, the purpose of reconnaissance visits was to determine which topics are especially relevant to the Jubba Valley.

The scope of studies for the Jubba Valley discussed in this work plan is the result of literature reviews, exploratory site visits, discussions with Somalis and expatriates about other organizations' resource investigations, and the deliberations of 12 ARD staff members and 10 NAS scientists. The scope of JESS investigations is shown in Tables 1 and 2, which are matrices of the project's topics, issues and studies. Besides indicating the broad, overall types of considerations that are of interest, these matrices depict the interaction of multiple studies with respect to individual topics and issues. For instance, the socioeconomic baseline studies will cover over 20 topics, including five related to the environment and natural resources (e.g., vegetation and animal-product uses), which further demonstrates the project's interrelatedness and complexity.

The proposed master plan for Jubba Valley Development will depend heavily on information gathered by the JESS project. AHT and MJVD planners expect JESS reports to contribute to five of their eight resource inventory categories. These information needs include the following kinds of data:

- current land-use patterns;
- changes in water quality caused by altered river flows;
- socioeconomic characteristics of population groups in the Jubba Valley;
- production and resource uses of livestock; and
- infrastructure and social services of valley communities.

The JESS project will make significant contributions to the master plan for Jubba Valley development, beyond planners' expectations. This is because project reports will include more than resource inventories--they will also suggest ways to improve certain situations and propose wider sets of alternatives than are usually considered in river basin development planning.

Table 1. Environmental Studies

Topic/Issue	Hydrology	Sedimentation and River Scour	Water Scour	Water Quality	Soils	Vegetation Range and Forestry	Wildlife	Biological Conservation	Aquatic Resources and Fisheries	Health	Climate	Special Studies
Climate	x				x	x				x		
Surface water characteristics	x	x	x			x		x	x			x
Groundwater characteristics	x		x						x			
Soils	x	x		x	x		x					
Erosion and sedimentation	x	x	x	x				x				x
Geology and seismology	x			x	x							
Benthos								x				x
Aquatic vegetation	x	x	x			x		x	x			x
Terrestrial vegetation	x			x	x	x	x					
Wildlife					x	x	x					x
Livestock			x	x	x	x	x					x
Fisheries	x	x	x					x	x			x
Birds					x	x	x	x				
Fertilizers/ pesticides			x	x		x	x	x	x			x
Socioeconomic special studies	x		x	x	x	x			x			x

Topic/Issue	Hydrology	Sedimentation and River Scour	Water Scour	Soils	Vegetation Range and Forestry	Wildlife	Biological Conservation	Aquatic Resources and Fisheries	Health	Climate	Special Studies
Production systems	x	x	x	x	x	x	x	x	x	x	x
Land use			x	x	x		x		x	x	
Resource mgmt. rules/regulations	x		x	x	x	x	x	x			x
Water supply	x		x		x	x		x	x	x	x
Biotic invasions/ colonizations		x			x	x	x		x		
Health			x		x			x	x		x
Resettlement	x		x	x	x			x	x		x
Dam construction	x	x	x	x	x	x	x	x	x	x	x
Public infrastructure	x	x	x					x	x	x	
Reservoir drawdown	x	x	x		x	x		x	x	x	
Development alternatives	x	x	x	x	x	x	x	x	x	x	x
Controlled floods	x	x	x		x	x	x	x	x	x	x
Smallholder enterprises			x	x	x			x			x
Integrated development	x	x	x	x	x	x	x	x	x	x	x
Environmental monitoring	x	x	x	x	x	x	x	x	x	x	

Table 2. Socioeconomic Studies

Topic/Issue	Demographic Prof.	Resource Manage- and Allocation	Health/Nutrition	Social Services	Land Tenure and Resource Rights	Women's Issues	Special Studies
Population characteristics	x		x	x		x	x
Production systems	x	x			x	x	
Production input/output		x			x	x	
Land use		x			x		x
Social organizations		x		x	x	x	
Social services	x		x	x		x	
Local institutions		x			x	x	x
Archeological and historical resources							x
Resource management rules/regulations		x			x		x
Public health			x	x		x	x
Municipalities			x	x	x		x
Industries		x	x	x		x	x
Adaptive technologies		x	x		x		x
Environmental special studies		x	x		x		x
Fisheries		x	x				
Water quality		x	x		x		
Vegetation		x	x		x		

Topic/Issue		Demographic Profile	Resource Management and Allocation	Health/Nutrition	Social Services	Land Tenure and Resource Rights	Women's Issues	Special Studies
Livestock/wildlife		x	x		x			x
Health			x	x				
Resettlement	x	x	x	x	x	x		x
Hydropower allocation	x	x						x
Dam construction	x	x	x	x	x	x		x
Public infrastructure	x	x	x	x	x			
Reservoir drawdown		x	x		x			x
Development alternatives	x	x		x	x	x		x
Controlled floods		x			x			x
Smallholder enterprises	x				x	x		
Integrated development	x	x	x	x	x	x		
Socioeconomic monitoring	x	x	x	x	x	x		

Planners also expect the JESS project to perform an impact assessment for BDP. They want to know the effects of the dam on flora, fauna, groundwater, human health and settlements, and social structures. In general, the JESS team will be able to meet and potentially exceed planners' expectations, but difficulties do exist. JESS social scientists will mainly study rural areas, villages and small towns. Information on large towns, such as Kismaayo, will be obtained from other sources, such as the Human Settlements and Natural Resource Systems Analysis (SARSA) study.

Finally, the schedules of AHT and the JESS project are not synchronized, as AHT is scheduled to finish the master plan in 1988, about the time when JESS will draw to a close. Careful coordination and communication will be necessary if the mutual objectives of AHT and JESS are to be met. The project will take care to process data as they are received and make this information available to planners, but the compilation and analysis of some types of data will occur relatively late in Phase II or during Phase III.

C. Unifying Framework for Field Studies and Links to Phase III

A project of this diversity and scope is strengthened by a unifying technical approach to guide the research, field studies, planning and training activities. The principal aim of ARD's work on this project and in the Jubba Valley is to conduct analyses that lead to the successful implementation of realistic, cost-effective, sustainable development in the valley. Old and new ideas concerning development will be incorporated into ARD's approach. The emphasis is not just on mitigation of previously or currently proposed developments. New and different economic opportunities will also be identified, analyzed and presented. For example, new ideas on the inclusion of livestock in irrigation schemes will be emphasized to the same degree as a realistic assessment of the advantages and disadvantages of large-scale, double-cropping, irrigation schemes. Based on similar experiences from Africa and other regions, current and new development ideas will be reviewed in terms of their practicality, strengths, weaknesses and applicability to the Jubba Valley's environments.

As broad-ranging as the development alternatives proposed in conjunction with dam construction may be, these options must be grounded in the realities, constraints and potential of the Jubba Valley's people and resources. The JESS project has already initiated a process of consulting with people in the valley and is working with MJVD to achieve the national goals and objectives set for the Jubba Valley.

It is important to clarify that JESS activities will be guided by a practical, though difficult, study framework which incorporates ARD's contractual obligations as well as the objectives of the JESS and JUDAS projects. ARD is not discarding theoretical concepts, but rather, plans to use them as analytical tools (see Section III.D). The difference is that a number of concepts will be used, without depending on any single approach, because most singular approaches have serious shortcomings at a practical level. ARD's search for a single unifying concept has been fruitless, and it is not clear that one idea can guide a series of studies as complex as those envisioned for the JESS project. Instead, ARD has defined an overall framework and practical approach to JESS activities that is articulated in five project objectives, which will be internally evaluated by ARD home office and field staff throughout the project. These objectives are:

- gathering and presenting data for the Jubba Valley that fit into a process for developing a master plan for valley development;
- establishing a realistic, long-term system for environmental and socioeconomic monitoring by MJVD;
- preparing river basin planning and development guidelines for Somalia;
- working with MJVD to incorporate these guidelines into the mainstream of the Jubba Valley planning and development process; and
- training MJVD staff so that they can continue to collect and analyze data, and plan and monitor future development activities.

Taking on all of the above objectives at once is a daunting, if not impossible, task. As such, the first two objectives will be most important to the JESS project during Phase II. The third and fourth objectives will receive greatest emphasis during Phase III. The last objective will be a continuing priority throughout the project, and efforts in this regard have already begun in the form of a manpower and training assessment that was carried out during Phase I.

This discussion helps clarify one principal difference between Phases II and III. Although Phase II includes considerable data analysis, Phase III will focus wholly on analysis, considering options, defining mitigation measures and developing planning guidelines. Phase II sets the stage for these activities through an intensive process of data collection and preliminary analysis, concentrating principally on the Jubba Valley itself. This proposed work plan for Phase II reflects

such an approach. Though the JESS project is already gathering information on alternative development strategies (e.g., a controlled downstream flood, livestock access, use of the reservoir drawdown zone), the Phase II plan does not discuss such alternatives in great detail. Rather, during Phase II, the team will gather accurate information on the existing dynamics of life in the valley so that the ensuing analysis, conducted during Phase III, has a realistic foundation.

Final clarification is needed on the links to Phase III. The information gathered during Phase II will be processed during Phase III and delivered to audiences in Somalia in four different forms:

- an overall JESS project report that identifies critical issues, impacts, opportunities and mitigative measures;
- specific reports on particularly important development topics, including impacts, mitigative measures and opportunities in the Jubba Valley;
- environmental and socioeconomic guidelines for use in considering development options in the valley, including suggestions on systems for implementing them; and
- a recommended plan and system for conducting continued environmental and socioeconomic monitoring in the Jubba Valley.

Though some of these outputs may be produced during Phase II (i.e., some of the specific reports on development topics and the monitoring systems), most will be completed during Phase III. Ultimately, this work must also reflect continuing changes in BDP progress and the evolving role of MJVD in guiding valley development, which will have a particularly important impact on the substance of the last two outputs.

D. Analytical Tools

In any situation, accomplishing the above can be quite difficult. Thus, as ARD and MJVD conduct research, they will employ a number of analytical tools or concepts. Two of the most important are:

- resource user-producer groups (RUPs); and
- water balances and input-output models relating to valley resources (e.g., goods and services, water, other materials, labor).

The RUP concept was developed by a social scientist with extensive experience in Somalia and pastoral nomads, in particular, which is one type of RUP. As described in ARD's best-and-final technical proposal for the JESS project, RUPs consist of groups of people with distinctive production and resource-use characteristics, given specific environmental constraints, available natural resources, cultural practices and territorial traditions. Besides pastoral nomads, examples of other RUPs include agro-pastoralists, refugees, dhesheek cultivators, irrigated area farmers and dryland agriculturists.

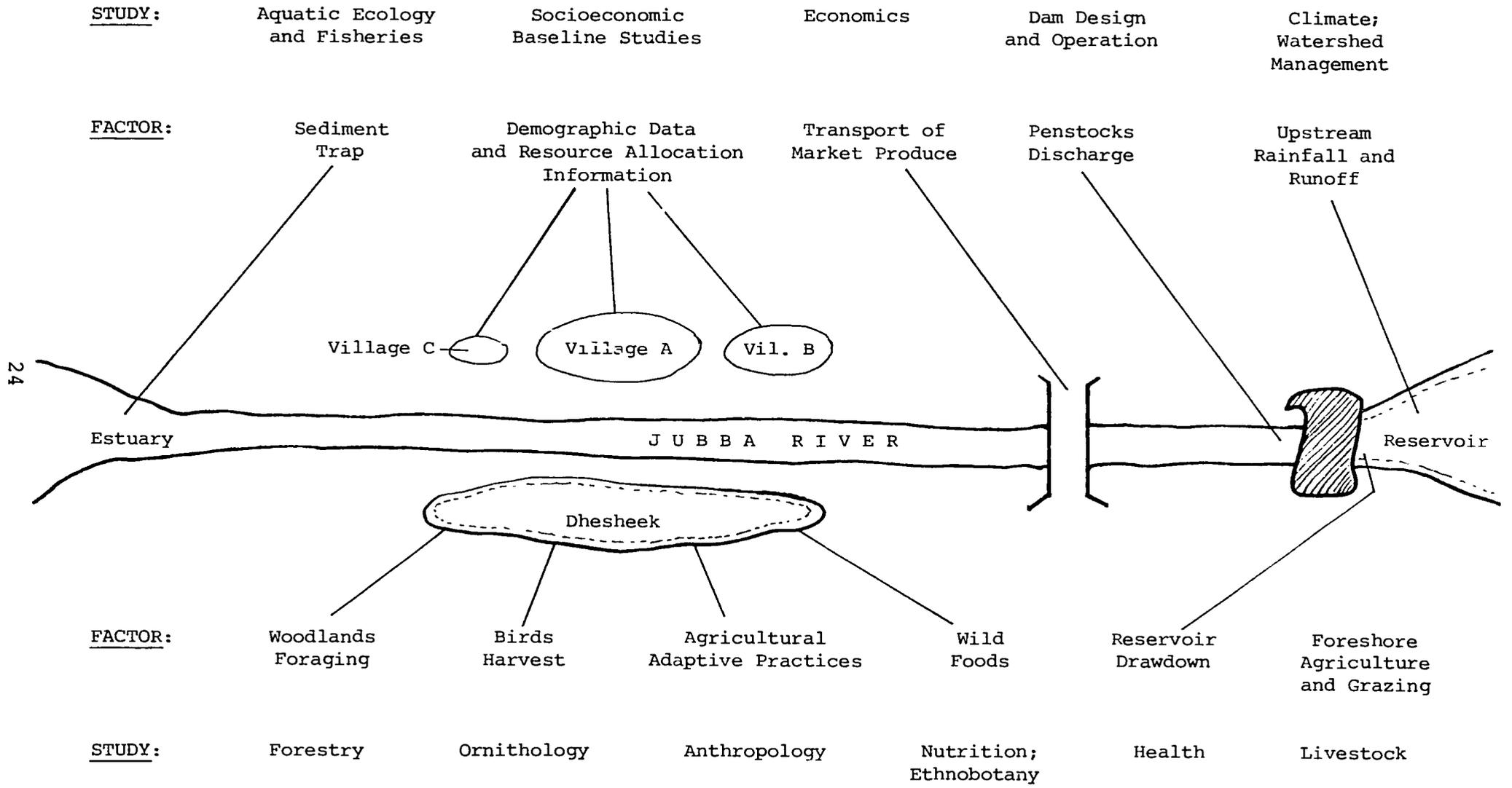
By establishing baseline information and investigating specific resource-use strategies, project scientists can predict the biophysical and socioeconomic effects that are likely to occur as a result of changes in natural or cultural resources. Monitoring changes within RUPs (through some type of sampling scheme) is one alternative being considered by ARD at this time. In such a scheme, market activities, agricultural production figures, and the use of goods and services (e.g., health, education, private businesses) are expected to be principal indicators of socioeconomic changes in the Jubba Valley. Environmental indicators will be largely confined to typical biophysical scientific measures (land-use, abundance and diversity of species, presence or absence of specific biota).

Because exchanges between resource users and producers result in flows, data collection within the RUP framework is more than doing simple inventories. It requires an understanding of processes and their components. In brief, the following simplified example illustrates one type of RUP in the Jubba Valley. It is for a dhesheek farming unit, and shows the components and interactions involved, along with the pertinent JESS study topics noted in parentheses. Figure 2 illustrates the types of considerations involved in defining RUPs.

Dhesheek production is a type of flood-recession agriculture in low-lying areas adjacent to the river that is dependent on periodic inundation by water and alluvium (hydrology and sedimentation). Farmers grow crops in dhesheeks in accordance with local trends and adaptive practices (agronomy and anthropology). Local families' diets (nutrition) are supplemented by waterfowl that are drawn to the area (ornithology) and wild foods gathered from adjoining woodlands (ethnobotany and forestry). Sediment that is not deposited on dhesheeks, bars and river bends may be swept into the estuary, where it can alter productivity (aquatic ecology and fisheries). On an impounded river, sediment may be generated by erosion due to rapid, sediment-free river discharges (river scour), which can undermine or accumulate at bridge abutments (sedimentation). A bridge may be essential to valley farmers for transportation of produce to markets in other areas (economics). Rapid river discharge may be a consequence of the size of the dam's penstocks

Figure 2

Studies of Interactions of Dhesheek Resource User-Producer Group



and spillways (dam design and operation) and rainfall in the watershed (climate). The rate of reservoir drawdown can affect the habitat of disease-causing organisms (health). The boundaries of the reservoir may alter the migration routes of nomads and animals (pastoralism). The drawdown rate will also directly affect the prospect of foreshore agriculture and grazing (livestock) in the reservoir area.

This characterization of RUPs requires an understanding of linkages, which is the essence of integrated studies. In fact, the main problem with this approach is deciding the number of groups to include. RUP linkages may extend in different directions, even overseas (e.g., Somali livestock markets and migrant labor), but the focus of JESS studies will be limited largely to the vicinity of the Jubba Valley.

Another principal analytical method to be used by ARD will be resource-balance sheets and/or input-output models. Historically, this approach has been used in hydrology, chemistry and energy-related activities. At the NAS workshop, it was proposed that the JESS project investigate the utility and feasibility of a water-balance model for the Jubba Valley as a means of integrating the various study components. This suggestion had considerable merit in that valley activities are attuned to hydrological tempos. The abundance, movements and distribution of livestock and wildlife are largely determined by the elements that make up the hydrologic cycle. The same can be said for agricultural production patterns and native vegetation. In turn, these factors greatly influence the response of social systems to annual wet and dry periods, rising and falling river levels, marketing opportunities and transportation. Significantly, human and animal health factors can ultimately be bound to hydrologic balance models as well.

In view of this recommendation, the JESS project will add special emphasis on water balances for the Jubba Valley, and attempt to correlate non-hydrological studies with annual and seasonal changes. These correlations should prove helpful in predicting the effects of increased river off-takes owing to development as well as extrapolating the potential effects of greater use of agricultural chemicals. Water-balance models for the Jubba Valley may prove to be a useful analytical tool for both environmental and socioeconomic monitoring.

E. Socioeconomic Baseline Studies

The socioeconomic baseline studies are designed to indicate the existing range and variation of social and economic production systems in the Jubba Valley, and show their relationships to riverine resource use as adaptive processes over time. The studies focus on the valley's current demographic characteristics as well as local production and marketing systems in the context of intended changes resulting from development, such as the Baardheere Dam. The studies' orientation is toward optimizing the benefits gained by valley residents and Somalia as a whole, while mitigating potential negative impacts, by providing a unifying framework that will permit measurement of consequences of the dam and subsequent development activities. The master plan for valley development calls for socioeconomic information, such as the adaptability of groups to changing production patterns. The socioeconomic studies include three data collection stages:

- "sondeo"/rapid reconnaissance,
- the baseline survey, and
- time-series studies.

The sondeo was designed to provide a preliminary, general overview of social and economic patterns in the Jubba Valley. This early phase of field investigation yielded qualitative indicators that were relevant to isolating key issues prior to preparation of the baseline survey questionnaires. Village-level meetings were held in all major ecological zones throughout the river basin to establish their major distinctive features--social structure, livestock and land-use patterns, health, land tenure and customary water-use patterns, interactions between inter-riverine resource user groups, emigration, history of settlements or pastoral uses of an area, and adaptive strategies for environmental, social or economic stresses. In the first stage (15 March to 15 June 1986), a set of hypotheses were generated to be tested using the quantitative data collected during Phase II.

The baseline survey will generate a large data base for the Jubba Valley, from Luuq to Kismaayo. These data will consist of responses to questions that are pertinent to the topics discussed in the following subsections. The sample population will be several hundred heads of households, selected using a stratified random cluster sample design. Initial stratification will be done on the population in the proposed reservoir area (Baardheere-Luuq), including those who may be targeted for resettlement. The population located downstream from the dam site (Baardheere to Kismaayo) will be further stratified by resource-user ecological zones. In each zone, village clusters

will be randomly selected within subdistrict (beel) units. Approximately 15 household heads will be randomly selected for interviews in each of the villages sampled. This sampling design has been tested with 845 households in the Bay Region and is outlined in detail in the 1984 SOCIOECONOMIC BASELINE STUDY OF THE BAY REGION.

In conjunction with the standardized household questionnaire, a meeting will be conducted in each village represented in the sampling frame. The village meeting will be structured as an open-ended discussion addressing village-wide concerns, such as access to water, grazing rights, land tenure, community organization of work and adjudication of disputes. In addition, a general history of each village will be outlined as well as a listing of contemporary social services offered by the village. Key informant interviews on specialized topics will qualitatively augment the quantitative data collected in the survey. This second stage is scheduled for July 1986 to September 1987.

Following the completion of the general baseline survey, five to 10 villages will be selected for the time-series studies that are representative of the valley's primary resource-user zones. Each will be visited several times in conjunction with seasonal production cycles to gain a deeper understanding of each major production system. This third stage is slated for September 1987 to April 1988.

1. Demographic Profile

Issue: Census data for the Jubba Valley are limited to one government-sponsored effort in 1975, and the basic information that is available on family structure is insufficient for sound development planning. Detailed information on the demographic profile for the valley is essential to determine labor availability, prospects for urban growth, and future requirements for infrastructure and social services, such as health and education.

The demographic data collected in the baseline survey will include information for a number of categories--family size and composition (age and sex), number of marriages for the household head, number of children and present location of household members. Planners have expressed a desire for demographic information on such RUPs as agriculturists and pastoralists.

2. Family Resource Management and Allocation

Issue: Subsistence strategies in remote areas of the Jubba Valley are based on extensive family relationships and allocation

of family resources. However, little is known in any microeconomic detail about family income and expenditures or the decision-making processes behind family resource allocation. Since the Baardheere Dam and other development efforts will change the range and type of economic opportunities available to Jubba Valley residents, a baseline of current practices must be defined and compared to economic conditions. Without this information, planners will be unable to forecast the effects of development at household, district or regional levels, or relate them to family production strategies, overall labor availability or migration patterns and impacts.

In collecting data on family resource management and allocation, project staff will conduct both household and market surveys. As part of the baseline studies, the JESS team will collect information on the range and mix of family income-generating activities, such as agro-pastoralism, smallholder agriculture, construction, trade, transportation, fishing, hunting/gathering, beekeeping, hired labor, and seasonal and long-term emigration. The team will also determine the processes used by families to allocate labor and other resources for these activities. Likewise, information will be gathered on all major categories of family expenditures--food, clothing, shelter, ceremonies, gifts, fees, education, medicines, labor and transportation, both seasonally and annually. At the same time, the team will investigate family strategies for handling cash or resource shortfalls as well as saving and/or investing economic surpluses. Particular attention will be paid to information from primary and secondary sources on families' economic responses to past changes. Data on past economic activities, migrations and investment patterns, coupled with comparisons of aerial photographs from 1960 to 1983/84 will aid the team in determining shifts in income-generation and investment strategies.

For its local market survey, the JESS field unit will visit marketplaces and interview merchants to determine the availability of items and unit prices (in cash or barter). These results can be used to corroborate data from the household survey, as well as by planners to assess regional and national economies with regard to goods and services in the valley. These items are principal indicators for monitoring changes in residents' economic welfare. Special attention will be paid to seasonal fluctuations in both supplies and prices that are caused by transportation problems during the rainy seasons. The market survey will include topics from other JESS studies, such as fish sales and natural-resource product uses. This survey will also contribute to the special markets and transportation study conducted for the project. The information on goods, services and RUP technologies will constitute a basis for monitoring future socioeconomic changes in the valley.

3. Health and Nutrition

Issue: Poor health and nutrition can have a significant impact on human socioeconomic capabilities in remote rural areas like the Jubba Valley. Furthermore, poor nutrition is often a leading factor in the poor health of residents because it makes them more vulnerable to disease, and conversely, poor health (e.g., worms, vomiting, diarrhea) aggravates their poor nutritional status. While some sparse information on this topic exists, more is needed to prepare a health profile for various valley areas. Because of the possible negative health impacts of dam construction and the development of irrigated agriculture, particular emphasis should be placed on current health and nutrition problems and their improvement as a basis for future planning.

The socioeconomic baseline study will include questions on health and nutrition that will contribute to the analyses of a number of JESS special studies, including water quality, health, nutrition, ethnobotany and disease vectors. More specifically, the socioeconomic team will collect household and village information on water sources, prevalent diseases, highest-risk age/sex groups, kinds of health care available and types sought, length of incapacitation due to illness, and number of locally available, trained health personnel, in both traditional and modern medicine. In addition, data will be gathered on seasonal food sources and consumption, food preferences and taboos by age and sex, and supplemental diets. Finally, residents will be asked their perceptions of changes in family health and nutrition during the past decade. This information will form the basis of a report on the prevalence of diseases and their distribution in the Jubba Valley. Questionnaire data indicate only one aspect of people's health--an epidemiological study would be necessary to complete the profile. If organizations such as the Ministry of Health and United Nations Children's Fund (UNICEF) conduct an epidemiological survey in the Jubba Valley, the JESS project will certainly cooperate.

4. Social Services

Issue: As development occurs and people become concentrated in ever larger groups, there will be a need for expansion of infrastructure and social services. AHT has done a general report on this issue which covers urban areas in the Jubba Valley, but there is still a need to identify gaps in services at the village level. AHT has expressed a desire for information on infrastructure and social services in the valley from the JESS project.

The JESS team plans to include a checklist of village-level infrastructure that can be completed during administration of the baseline survey. This list will include whether or not the village has electricity; closed or open wells; a sewage disposal system; paved, gravel or dirt roads; Koranic, primary or secondary schools; a health post and pharmacies; shops; transportation; and other social services. The team will also try to ascertain the approximate level of literacy, languages spoken, number of children attending school regularly, and location of schools and other facilities. Finally, they will attempt to measure changes in the availability of social services and infrastructure over the past 10 to 20 years, and to evaluate their effect on the community.

5. Land Tenure and Resource Rights

Issue: In the Jubba Valley, lands that are not titled or held by lease are used communally according to a complex hierarchy of rights to natural resources. These rights are based on unwritten rules of seniority or current historic agreements between resource user groups. Development in the Jubba Valley will affect these rights by changing access patterns, altering migration routes, inundating grazing and agricultural areas, and increasing land values due to a guaranteed water supply. Information on patterns of resource-use rights is needed so that resource management organizations and methods for negotiation with resource user groups can be established before confrontations erupt as development projects are implemented.

For the JESS field investigation of resource-use rights, an anthropologist from LTC (an ARD subcontractor) will conduct a two-month study on such rights in the Jubba Valley during late fall 1986. This study will be conducted on a subdistrict (beel) basis, in conjunction with the JESS socioeconomic field unit. It will identify and categorize types of resource-use rights, with special emphasis on development. To the extent possible, this study will also explore users' perceptions of appropriate rights under proposed development scenarios. This effort will take place early in Phase II, so that certain components of the investigation may be continued in the long-term socioeconomic baseline survey, if necessary. In part, this study will contribute to a special report on land tenure in Somalia.

6. Women's Issues

Issue: Until recently, women's roles have usually been ignored in planning and assessing development projects, despite their enormous contributions to agricultural and pastoral production systems and family decision-making on health, income and resource allocation. In the Jubba Valley, women play major

roles in both economic activities and health care. They often serve as focal points for the family while the men of the household travel with herds of livestock to distant grazing and watering areas for extended periods of time. If predicted labor shortages occur in the valley, the role of women in large-scale agricultural projects could become highly significant.

The JESS field team's socioeconomist will pay special attention to women's issues in the Jubba Valley throughout the baseline survey. She will conduct individual interviews with women, exploring their roles in every aspect of family life. In addition, she will hold group meetings with village women to discuss their perceptions of changes that will result from proposed development projects. The project is not proposing an interim report on this topic as it will be emphasized in the final report. At this point, JESS is also not proposing any additional consultant support for this study, although it may become necessary to hire a specialist to provide such assistance.

F. Environmental Baseline Studies

For clarity, this document separates the environmental and socioeconomic studies, but it should be remembered that most issues will be dealt with in an interdisciplinary manner. For example, a special study of pastoralism is described in a subsequent section (IV.G.1). In fact, much additional information for that study will come from the aerial censuses, vegetation analyses and environmental baseline studies. Similarly, vegetation mapping may appear to be a straightforward environmental investigation. However, existing natural vegetation has been changed by human intervention, such as pastoralism and shifting cultivation, and provides fodder for livestock.

One primary objective of Phase II is data collection for assessment and planning. Most of the methods used in the environmental studies will be similar to those utilized in other parts of eastern Africa or other river basin assessments. A brief indication of the methods to be used is provided with the description of each study. It is likely that some of these techniques will need to be modified slightly in light of subsequent field experience.

Throughout the studies, particular attention will be paid to assessing the flood regime's effects on all aspects of the riverine environment, including human resource use. Sampling will be timed to account for wet- and dry-season variations as well as geographic differences. Long-term changes will be assessed from aerial photographs, literature reviews, and interviews with knowledgeable individuals from within and outside the valley. The valley will be divided north to south into

current and future land-use and vegetation zones, and studied accordingly. East-west stratification will ensure that attention is concentrated in the riverine zone where most future development is likely to occur. Affected areas further from the river will be studied, although less intensely.

As in other sections of this work plan, the proposed environmental baseline studies are organized by issue, with the aim of directing the research toward the objective of producing useful information for planners. Although data are sparse, the environmental records for the Jubba Valley are more complete than the socioeconomic information. Thus, some of the issues presented here have already been partly addressed by previous studies conducted by international donors, government agencies or private organizations. In these cases, the focus of JESS studies has been adjusted accordingly.

The JESS environmental unit will consist of the ecologist and team leader, trained field assistants, MJVD counterparts, periodic consultants and enumerators. The environmental studies will require more consulting specialists, who either make repeated visits to Somalia or begin data collection and evaluations that will be continued by the JESS ecologist and team leader.

1. Geology/Seismic Hazards

Issue: Inappropriate geologic foundations or seismic events can threaten dam integrity to the point of eventual dam failure, which invariably results in great physical damage and loss of human life.

No additional studies on geology or seismic hazards are planned for Phase II. Numerous geomagnetic surveys have been conducted in the Jubba Valley during searches for petroleum and mineral deposits. Reservoir geology was investigated by Technital SpA in 1976 and 1977, which resulted in a photogeological study of approximately 200 square kilometers. In addition, GeoSurvey International produced a Landsat atlas of natural resources, including geological interpretation, for the Jubba Valley. In October 1985, Electrowatt Engineering Services, Ltd., reviewed the geological data and estimates of seismic hazards. Other than recommending further geologic tests at the dam site for engineering purposes, Electrowatt raised no serious objections to the previous geologic studies. Phase II of the JESS project can do little in this area except reiterate the Electrowatt review without appreciably increasing the study's level of effort.

2. Hydrology

Issue: Reliable long-term hydrological data are essential for dam design and water-resource development planning. For developing countries in semiarid climates, these data are often incomplete and inaccurate.

Various engineering firms have evaluated existing hydrological data for the Jubba River and concluded that the available information is adequate to proceed with dam design and construction. AHT/GTZ and ARD's hydrology consultant also reviewed the hydrology data and reached this conclusion. Furthermore, Sir M. MacDonald and Partners, Ltd. (MMP) is continuing hydrological studies at river-gauging stations. The JESS project will seek a cooperative agreement with MMP to share field data, but will also contribute to hydrologic studies by taking current flow measurements with a portable meter during the water-quality studies at various sampling stations.

A JESS hydrology consultant will begin to assemble the data needed to construct a preliminary water-balance model. As the project progresses, this model will be refined as new data become available from ongoing studies. The water-balance model can be used as a basic structure for the environmental and socioeconomic studies, as water input and output modeling is a major factor in understanding agricultural and social patterns in the Jubba Valley. The hydrological model can also be used to analyze water-related disease cycles and pesticide diffusion. During Phase III analyses, this model can be correlated with various elements of the environmental and socioeconomic baseline studies.

Issue: In the Jubba River, biota are attuned to flood and drought conditions. Dhesheek farmers are dependent on river floods for inundation, which brings alluvial sediments and water to their lands. Control of river discharge, as with a dam, will end these natural floods, thereby leading to extensive changes for both biota and farmers. An artificial flood, created by controlled discharge from the proposed Baardheere Dam, may possibly satisfy dhesheek requirements without causing extensive hydropower production losses or property damage.

Using models, engineers can simulate artificial floods. Such an exercise would involve integrating data on river discharge, lowland drainage patterns, stream-bank elevations, dhesheek volumes, open-channel hydraulic equations and other information. According to AHT, this simulation will be performed as a part of a dhesheek study to be funded by GTZ in 1987. The JESS project will coordinate its efforts with this study in terms of the dhesheek ecological investigations and implications of artificial flood discharge on the reservoir's draw-down rate.

Issue: Groundwater is important as a source of domestic water supply for many communities. While the demand for potable groundwater will increase in the future, aquifers in some parts of the valley have low yields and undesirable water quality (often a heavy salts concentration). A groundwater inventory is needed by planners and government officials.

The Somali Water Development Authority, funded by the GTZ, has been conducting groundwater studies. Groundwater exploration programs have also been done by UNICEF, Swedish Church Relief and other organizations in the valley. According to AHT, information on aquifer yields and water quality in the Jubba Valley will be available in late 1986.

The JESS project will contribute to the groundwater data base by performing water-quality tests on groundwater samples. In addition, the JESS water-quality consultant will conduct a water supply study for selected areas in the Jubba Valley. This study will also produce estimates of required groundwater development for village water supplies to match projected increases in human populations.

3. Sedimentation

Issue: Sedimentation has reduced the efficiency of numerous reservoirs on a global scale and has shortened the useful life of many impoundments to a point where economic losses exceed benefits. While sedimentation rate estimates for the Baardheere reservoir indicate a long life, there is a lack of data to fully support these estimates. Suspended sediment measurements and bed-load contribution evaluations are generally weak or lacking.

For a bed materials analysis, samples of exposed riverbed material will be collected during the beginning of a low-flow period. Sampling sites will be located at or near river-gauging stations, especially those at Luuq and Baardheere. Samples will be taken to either the National Soils Laboratory at Afgoi or the Somali National University's chemistry department to be analyzed for size, gradation and specific gravity using standard soil science methodology. ARD consultants will supervise the collection of samples by Somali counterpart technicians and analysis of the results. If necessary, the sampling program can be repeated during a subsequent low-flow period. From these data, calculations will be made regarding probable bed-load contributions to reservoir sedimentation rates. If justified (i.e., significantly different estimates are found compared to those made by the engineering companies), a special interim report will be prepared for MJVD. At a minimum, the results of this study will be given to BDP engineers, as they become available.

To investigate suspended sediment discharge, sediment samplers will be suspended from the bridges at Luug and Baardheere initially and then at other river-gauging stations, if there is sufficient technical staff and logistic support. A suspended sediment sampler is lowered into the river during high water flows. Samples are collected from different river strata, and the process is repeated at various points across the river. Either ARD consultants or MMP will supervise the sampling and data analysis. MMP advisors have displayed an interest in including this sampling parameter in their hydrological studies. Initial contacts in this regard have been made, and consultations continue. Thus, JESS suspended sediment studies may prove unnecessary. If implemented, the third phase of MMP's work will involve suspended sediment collection and analysis.

4. River Scour

Issue: Following closure of a dam, suspended sediments drop to the reservoir bottom due to reduced flow velocity. As a result, water released through penstocks, outlets or spillways at the reservoir's downstream end is not heavily laden with suspended material. Thus, the water discharged is highly erosive and usually scours the riverbed and banks in an action called river scour. This highly erosive condition persists at varying distances downstream until the suspended materials come into equilibrium with the flow velocity. Existing riverine structures, such as bridge foundations, pilings and irrigation intakes, are particularly vulnerable to river scour in that these in-stream structures were designed for less erosive discharge conditions. The extent of probable river-scour effects following dam closure has not been adequately addressed in existing engineering reports on the BDP.

For river cross sections, bridge-opening geometry and Manning "n" value (stream roughness) determinations, river cross-section measurements will be taken by survey crews under the supervision of ARD consultants. These cross sections will be taken at the Luug and Baardheere gauging stations as well as other selected downstream sites. It has not been determined whether these surveys will utilize transits and levels or precision altimeters for the cross sections. The data will be analyzed by ARD consultants to determine stage-discharge relationships for the most important gauging stations. Furthermore, cross-sectional data will be evaluated for potential river-scour effects. At the same time, survey crews will photograph river cross sections and the Baardheere bridge. These will be analyzed to determine Manning "n" values and the vulnerability of bridge foundations. The surveys will be conducted during one low-flow period, with follow-up work during a second low-flow period, if necessary.

Existing high-quality aerial photographs (1:30,000) will be examined to identify river forms, scour locations, eddy zones, flow patterns and dhesheek areas. These photographs were taken from December 1983 to February 1984 and show medium- to low-flow conditions. If the scale proves insufficient for reliable interpretation, specific river stretches will be identified for large-scale aerial photography in a 35-millimeter format. By combining the results of the two studies proposed here, ARD scientists will be able to estimate the river-scour effects that will result from dam operation. An interim report will be presented to MJVD on completion of these short-term studies.

5. Water Quality

Issue: Productive, stable human communities are crucial to successful agricultural and livestock development in the Jubba Valley. This is particularly true for resettled, expanded or new communities. The quality, quantity and convenience of water supplies and sanitation will be major factors in determining the location and acceptable sizes of both human and livestock populations. JESS scientists will address three major water-quality issues, including costs, institutional arrangements and location of water supplies. The water-quality findings will be used in other studies, such as those on fisheries and aquatic ecology.

In terms of design criteria, health attainment and costs, per capita cost analyses for resettlements and expanded or new communities will be performed by relating the quantity and quality of water supplies to disease control and costs. These analyses will be based on the 1985 DECADE PLAN FOR WATER SUPPLY IN SOMALIA, developed by the Ministry of Health in conjunction with the World Health Organization (WHO). A 1984 study of the proposed reservoir area conducted by GTZ for the Water Development Agency (WDA) will also be used in this analysis. Recent costs and health attainment figures for the Gezira Irrigated System and Rahad Irrigation Area in Sudan will be adjusted to reflect conditions in Somalia. The options and costs for different health levels will be presented to planners in an interim report prior to October 1986. These options will also be useful to the World Bank pre-appraisal mission that is expected to occur in November 1986.

The second investigation will outline institutional arrangements for various community involvement options for water supply planning, construction and operation of community facilities. AID's Water and Sanitation for Health (WASH) project and WHO have a number of publications that will be used to prepare this brief study. The results will be presented in a second interim report, prepared during February 1987.

A third study will concentrate on the location of water supplies and monitoring regulations. This work will parallel scheduled completion of the master plan and the specification of policies regarding community water supplies and sanitation. It will identify preferred water supply locations and recommend population limits for each location in selected areas of the Jubba Valley. These recommendations will be based on data from the 1984 WDA report and supplemented by field assessments of water quantity and quality. Data from other JESS activities, such as the vegetation and livestock surveys, will also be factored into the recommendations.

Issue: The limited available data suggest that an impoundment on the Jubba River at Baardheere could have undesirable effects on downstream agriculture and estuarine ecology. It is necessary to collect additional data through a systematic water sampling and analysis program to serve as input for simulation models of future reservoir water quality and generate predictions for river and estuarine areas. Extremely high chloride and electrical conductivity levels were found for the dry-season flows from January to March, followed by bursts of salts in the rising floodwaters of April. These occurrences demonstrate the need for a one-year water-testing program to prepare a mass balance for expected concentrations in the future reservoir and downstream flows. The potential effects of estuarine tidal exchange on agriculture in the lower Jubba Valley will also be evaluated.

For water testing and prediction of surface-water quality, an ARD consultant has established a water-testing program at Baardheere in cooperation with the Somali National University's chemistry faculty. The JESS team leader will provide backup and monitoring of the water-quality field studies. During rising- and high-flow periods, water samples will be taken several times a week, with the ideal being daily samples. Sampling intensity will drop to once a month during other flow-level periods. The samples will be analyzed for temperature, pH, turbidity, conductivity, salts and total suspended solids. Settlement and clarification rates will also be measured, and selected samples analyzed for nitrates and phosphates.

The Somali National University has an excellent, well-maintained chemistry laboratory, and the faculty is eager to participate in such a long-term study, provided that JESS handles initial supervision of the sampling regime and provides logistic support for the field staff. A tentative arrangement has already been reached with the chemistry faculty, and a formal agreement is being negotiated. Since late May 1986, an ARD consultant has been supervising data collection and analysis, and an interim report on this topic is being prepared.

A second study of lower river and estuary conditions will simulate variations in these areas for alternative flow regimes, utilizing data on water salinity, nutrients and tidal exchange. Estimates will be made of saline intrusion, including vertical distributions and seasonal changes. An attempt will also be made to relate the results of this study to probable effects on agriculture and aquatic habitats, including those in the estuarine zone.

Issue: Closure of the Baardheere Dam may create a need for increased use of biocides in the Jubba Valley to control disease vectors (e.g., snails, mosquitos and flies) and pests (for example, insects, nematodes and undesirable aquatic vegetation) in the reservoir and irrigation canals. If biocides are applied in an uncontrolled fashion, deterioration of water quality will occur as toxic chemicals enter river flows and groundwater.

Scientists will study the habitat conditions of fish that may be used in biological control programs. These will be compared to models of future reservoir and downstream riverine conditions. On the basis of this comparative study, it will be possible to make recommendations about fish species that should be selected for each area to control disease vectors. These models will also suggest vegetation and shoreline configurations for controlling mosquito populations as well as reservoir water levels for regulating snail populations.

In a second investigation on this issue, pesticide use will be studied through an inventory of current pesticide shipments and use in the area. If warranted, pesticide persistence in human and animal foods will be measured using the chemistry faculty's laboratory equipment. One faculty member recently completed an extensive training program on pesticide analysis in Italy and is eager to apply these new skills in Somalia. He has already performed preliminary analyses of pesticide levels in mothers' milk in Mogadisho.

6. Soils

Issue: Preliminary data from soils interpretation studies and water sampling programs definitely indicate a potential for serious hazards to agricultural development in the Jubba Valley. Soils in many areas tend to be heavy (i.e., clayey) and poorly drained. Salt concentrations in the river are often high, sometimes too high for agricultural use. This combination of poorly drained soils and saline irrigation water could lead to severe and extensive soil salinization unless sophisticated water management strategies are employed along with elaborate drainage systems. Serious soil salinization has already occurred in the Shabeelle Valley under similar conditions.

As already outlined in the section on water quality (IV.F.5), the JESS project will conduct a one-year testing program, which will include salt concentration and electrical conductivity measurements to assess agricultural water quality. In a companion effort to JESS, BuRec is preparing an economic land-use classification for the Jubba Valley that utilizes extensive soil sampling and analyses. The BuRec study will produce vital data on soil texture and drainage characteristics. During Phase III, the data sets on soils and water quality will be analyzed. The JESS project will participate in this analysis, but no field soil studies will be conducted during Phase II beyond the BuRec effort. Past economic analyses have focused on large-scale irrigated crops (e.g., rice), but the JESS project will investigate smallholder and rain-fed development alternatives in agriculture and agro-pastoral situations.

7. Vegetation, Range and Forestry

Issue: The present abundance, diversity and condition of vegetation in the Jubba Valley are unknown. The Phase I literature review revealed a small number of recently prepared vegetation maps and natural resource inventories for the area, most notably the Southern Rangelands Survey done by Resource Management and Research (RMR), and vegetation and land-use maps prepared for the National Tsetse and Trypanosomiasis Control Program (NTTCP). However, the data from these surveys are presented in unique formats and thus far, have not been properly analyzed in terms of their applicability or value for development planning.

To evaluate existing vegetation surveys and establish natural resource inventories of the Jubba Valley, the JESS ecologist has begun an assessment of the Southern Rangelands Survey and NTTCP vegetation and land-use maps. A 100-kilometer strip will be delineated on the base maps, extending approximately 50 kilometers on either side of the Jubba River. A vegetation map of this strip will be prepared using the 1:30,000 aerial photographs taken in 1983 and 1984. This map will be ground-truthed and verified by general observation of vegetation in the field and during the selection of vegetation sampling sites (described below). A botany consultant with extensive knowledge of Somali flora will assist in this process. Sample large-scale aerial photographs will also be used to update the 1983/84 aerial photos.

In an intensive study of riverine vegetation, the JESS team ecologist and Somali assistants will do a series of transects perpendicular to the river to assess the effects of the river's flood regime on plant community structure, taxonomy, seasonal rhythms, phenology and seed dispersal. Evidence and indicators of livestock activity will also be recorded. The riverine flood-

zone investigations should allow predictions of vegetative changes if flooding is reduced or stopped. Seasonal changes will not be studied in the reservoir area, since these will only be of academic interest once inundation has occurred.

Issue: Several studies provide narrative descriptions of human and livestock use of natural vegetation in the Jubba Valley. However, quantitative data on these uses are generally lacking for the area. Such data are essential for planning sustainable livestock development projects based on natural forage.

First, to identify vegetation trends, an ARD staff member or photogrammetry consultant will compare the 1983/84 aerial photographs with ones taken in 1960. From this short study, it will be possible to estimate the amount of natural vegetation that has been converted to other land uses during this 24-year period. Crude conversion rates can be estimated from the study.

Second, ethnobotanical studies will be conducted to determine human uses of wild plants. Preliminary investigations will be carried out by the JESS ecologist and botany consultant during ground-truthing of the vegetation map. Ethnobotanical investigations will continue throughout the baseline data collection period. The field and market surveys will be supplemented by interviews with agriculturists, pastoralists, traditional healers and beekeepers. Additional data will be taken from parts of the socioeconomic baseline survey. If data from these sources prove incomplete, additional surveys will be performed late in Phase II or early in Phase III.

The third study addressing this issue concerns forestry and will be conducted by an ARD forestry consultant in cooperation with the JESS team ecologist. The consultant will examine relevant sections of RMR's Southern Rangelands Survey, particularly the data on wood volume and charcoal production, and will also review vegetation maps prepared by JESS and others, paying special attention to the reservoir area and pockets of natural forest in the middle Jubba region. Fieldwork associated with this investigation will include surveys of wood use for fuel, housing and temporary enclosures. This study is scheduled for a two-month period between January and March 1987, although it is possible that this consultancy will be split into two segments.

Fourth, a series of aerial strip censuses will concentrate on seasonal range use along the Jubba River. RMR will use a standard aerial counting technique to estimate livestock and wildlife populations and other features of interest in a 100-kilometer strip along the river. Censuses will be conducted during both the wet and dry seasons, beginning in September 1986, and possibly extending through the spring of 1988. RMR will

assist the JESS field team in determining flight paths, stratification and sample sizes. These flights will also be used to locate particular areas where human, livestock or wildlife populations are concentrated for possible follow-up by JESS field teams. In addition, large-scale aerial photographs will be taken of selected areas along the Jubba River, dhesheek Wamo and Shabeelle swamps. These areas will be studied for current uses of the flood recession zone, as indicators for possible use in the reservoir draw-down area.

Fifth, relative to sustainable range use, the JESS field ecologist will conduct intensive vegetation surveys around watering points and other areas where livestock congregate. These efforts will be coordinated with the GTZ livestock survey planned for 1987. As part of this study, the ecologist will distribute simple, inexpensive rain gauges to cooperating individuals, and may seek assistance from district commissioner's offices and rural schoolteachers. This activity will continue throughout Phase II to assess the effects of livestock on natural vegetation on a seasonal basis.

8. Wildlife

Issue: Certain portions of the Southern Rangelands Survey and NTTCP land-use survey cover aspects of wildlife populations that are adjacent to the Jubba River in fairly large geographic aggregations. Some sections of these two surveys concentrate on larger wildlife species as well as the status and future development of conservation areas. However, as they are currently presented, the data do not meet planning needs.

To address this issue, the initial step is a continuing evaluation of existing wildlife surveys. The JESS team ecologist will study the various surveys to extract pertinent wildlife data for the Jubba Valley. As part of this work, the ecologist will interview principal authors involved in past surveys to determine whether additional data were collected, but not included in the published reports.

Second, for a wildlife survey, the JESS team ecologist will collaborate with a biological expedition made by the University College of London from July to September 1986. In this study, University College scientists will conduct surveys and studies of riverine forests in the middle Jubba region. Included on the team will be experienced botanists, an ornithologist and a mammologist. Limited surveys by other groups may also be conducted.

The aerial strip census is the third field investigation intended to address this issue. As part of the vegetation studies, RMR will conduct aerial strip censuses which include

counts of larger wildlife species that are visible from the air. RMR will use a methodology that was developed by them and has been tested extensively throughout East Africa.

Issue: Little is known about wildlife trends and the ways valley residents utilize wildlife resources.

An interview survey will be conducted that, in combination with data from the socioeconomic baseline studies, will fill this information gap. The JESS team ecologist and Somali assistants will conduct interviews of valley residents to assess trends in and uses of wildlife populations. Local village markets in the Jubba Valley will also be surveyed to identify animal products that are commonly available for sale. If desired, questions on the use of wild animal products (e.g., furs, skins, meat, jewelry or feathers) and wildlife nuisance problems, such as crop destruction, can be included in the socioeconomic baseline survey.

In cooperation with the United States Information Service, JESS is attempting to obtain the services of a Fulbright scholar for investigations of past and present wildlife diversity and abundance. This study would involve a comparison of current data with historical records of collecting expeditions in southern Somalia. If the opportunity develops, this study would begin in June 1977.

Issue: Very little is known about avian populations in the Jubba Valley, although it may be an important migratory route for birds from Eastern Europe and the Middle East. Some bird populations may increase with the creation of a large freshwater reservoir at Baardheere. In addition, birds may increasingly constitute serious agricultural pests in the region.

Resident birds of the riverine forest will be studied in detail by the University College team. However, this group will not be present when paleo-arctic migratory birds are in the Jubba Valley. Despite their importance as an international conservation issue, little is known in East Africa about these birds between their departure from Europe and Asia, and arrival in Kenya and regions to the south. JESS will employ an ornithologist consultant with appropriate expertise to determine overwintering avian populations during March 1987. Depending on these investigations, this consultant may return the following November to study the riverine area as a potentially significant migration route for birds.

This second ornithology consultancy will involve an assessment of current bird pest problems as well as those that are likely to accompany valley development. The effects on aquatic birds as the reservoir fills and downstream areas change

will be studied. The field visit by this consultant will occur during periods when crops are most vulnerable to bird pests.

9. Biological Conservation

Issue: The GSDR has taken steps to designate conservation areas in the valley, but has not had an opportunity to evaluate them in terms of either their conservation potential or overall integration into the Jubba Valley master plan. International conservation organizations and donor agencies have recommended the incorporation of biological conservation areas into development plans for Somalia. Meanwhile, aerial photographs show that development is presently occurring in some of the areas already designated.

The JESS project will identify possible areas for biological conservation and parks. As information is gained from the vegetation and wildlife surveys, the JESS team ecologist will identify areas with riverine plant or animal communities that are worthy of protection against unnecessary destruction. The criteria used by the United Nations Educational, Scientific and Cultural Organization (UNESCO) for biosphere reserves will be employed to evaluate potential protection zones. Priority consideration will be given to conservation areas already identified by the GSDR.

Consideration will also be given to areas suitable for parks. Criteria for park sites involve factors other than unique biota and high biological diversity. Factors such as scenic beauty, access, transportation, safety and historical significance will also be included in park evaluations.

10. Fisheries and Aquatic Resources

Aquatic resources are important to biotic production in the Jubba Valley. Since development typically affects productivity and environmental quality, measures of the productivity of key organisms are important to the environmental baseline studies. Productivity can be estimated from standing crops of organisms, habitat attributes and other factors. The JESS project will determine standing crops of fish and aquatic flora, and use this information in estimating biological productivity (see Section IV.H.8).

Issue: Historically, the Jubba River has been an understudied and underutilized resource in terms of fisheries and aquatic products. Because of the orientation of Somali economic and social systems toward livestock, there has been little use of or development interest in Jubba River fisheries. Thus, not much is known about this potentially valuable resource. In other

African nations, successful, productive fisheries have been developed in new impoundments.

To address this issue, an ARD consultant will conduct fishery studies in two stages. The JESS team leader will provide backup and monitoring during the studies on aquatic resources. During September and October 1986, the consultant will perform an initial reconnaissance of the Jubba River, which will be used to develop a detailed plan of operations. These efforts will involve analyzing aerial photographs, inspecting major types of fish habitats, stratifying the river for data collection, interviewing local fishermen concerning their catch, economics and gear efficiency, and exploring arrangements with Somali Marine Products for collaborative studies in the estuary and offshore areas. Information gathered for the socioeconomic baseline survey on fishery activities, marketing and consumption will also contribute to the study design.

Experimental fishing and other studies will be conducted during April and June 1987, at times when the Jubba waters are rising and falling. Fish samples will be taken using nets, traps, chemo-fishing and other techniques. Estimates will be made of species abundance and diversity. Particular attention will be paid to the estuary, proposed reservoir site, dhesheek Wamo and a currently impounded riverine area at Fanoole.

Issue: Many species of fish migrate with seasonal and lunar cycles. Finfish and invertebrates often migrate upstream from marine areas into brackish and fresh water for breeding, feeding and other purposes. Since the Jubba River does not have a large, defined delta area, estuarine productivity is not likely to be significant. In addition, there is a barrage at Fanoole that has already altered flow regimes and sediment deposition in the estuary. Further, the Somali coastal marine area is one of the few locations in the world with extensive oceanic upwellings that carry nutrients from the ocean floor. These factors operate in concert to reduce the significance of any contribution of the Jubba River to estuarine or coastal fisheries.

The JESS project will conduct a fish migration study early during the 1987 work period, in which identification tags will be affixed to selected fish species. Following the release and subsequent recapture of the fish, migration patterns can be determined. Local fishermen, vendors and government officials will be encouraged to report areas of fish capture and submit retrieved tags to JESS field personnel. Given the short duration of this study and other constraints, the results are not expected to be conclusive, but they may indicate fish movement patterns between Fanoole and Baardheere before dam closure.

Other fish-related studies by the JESS project will focus on the control of mosquito populations (see Section IV.F.5), reservoir ecology (IV.H.8) and estuarine ecology (IV.H.9).

Issue: The Jubba River has hippopotamus and crocodile populations that will be affected by impoundment. It is possible that alterations in the flow regimes could expand these populations, perhaps to nuisance proportions. In addition, the movements of these animals during low-flow regimes are unknown, either within the Jubba River or to adjacent wetlands.

A crocodile and hippo survey will be conducted during both fish sampling periods to record their numbers and locations. In addition, aerial censuses will also be done at low altitudes over the river to locate and count these species. During the aerial census in the dry season, the survey will be expanded to cover the dhesheek wamo and Shabeelle swamps. Through observation and interviews with local residents, the JESS ecologist will attempt to determine whether or not hippos migrate between the Jubba River and Shebeelle swamps.

11. Health

Issue: Most African impoundments have produced significant increases in water-related diseases, especially malaria, schistosomiasis and gastro-enteric infections. These diseases are already present in the Jubba Valley and can be expected to increase with proposed water development projects, such as impoundments and irrigated agriculture. Phase I activities revealed that several health surveys focusing on malaria, schistosomiasis and gastro-enteric diseases were recently conducted in the valley by the Somali Ministry of Health (in cooperation with WHO) and private voluntary organizations. This work established that these diseases are prevalent in the Jubba Valley.

The JESS staff will undertake vector surveys for snails and mosquitos from February through May 1987. These surveys will be conducted by technicians from the National Antimalarial Service and Schistosomiasis Control Project within the Ministry of Health, but with JESS logistical support (i.e., a vehicle and equipment) and under the supervision of an ARD consultant. Aside from the counts, the JESS project will make maps of vector incidence, and health information will be collected as part of the socioeconomic baseline survey. In addition, the project will prepare a report on the health implications of dam design and reservoir operation (see Section IV.H on special environmental studies). JESS considers this information adequate for the regional planning scope of the master plan for valley development.

JESS recognizes the need for more detailed health baseline studies in specific project planning and program implementation. For example, an effective treatment program for a particular locality requires knowledge of the prevalence and severity of a specific disease. In addition, health situations change over time, and there will be an appreciable delay between the baseline studies and dam closure. A number of factors can alter health conditions in the Jubba Valley during this period, such as improvements in primary health care and education.

Numerous studies, including recent work, have indicated the presence and prevalence of water-related diseases in the Jubba Valley. Through the vector survey, the JESS project will establish the presence and abundance of the most important vectors as part of the environmental and socioeconomic baseline studies. However, during Phase I, various groups expressed interest in an epidemiological survey, which ARD considers to be outside the project's scope of work, as health changes can be estimated from the vector survey and existing epidemiological work.

The JESS project has indicated a willingness to cooperate in epidemiological surveys. In fact, the project's public-health and water-quality consultant has prepared recommendations for such studies. Since an epidemiological survey was not included in the JESS contract or ARD's proposal, no resources were allocated for this study, and an epidemiological survey was not planned. ARD is preparing proposals for these surveys, if they are requested by USAID/Somalia or MJVD.

12. Climate

Issue: Climatic patterns in Africa's semiarid regions are characterized by extreme variability in seasonal and annual rainfall. Additional variations exist among different sections of the Jubba Valley. These variations create severe hardships in the valley for both sedentary agriculture and pastoral livestock groups. Remote areas in developing countries typically have insufficient weather data for climate modeling and prediction, but the Jubba Valley has better meteorological records than were anticipated before Phase I activities began.

The JESS team does not propose a detailed weather study, as data collected over only 14 months would be misleading and of limited value for long-term predictions. There are long-term meteorological stations in the Jubba Valley, which have not been in continuous operation, but do have sufficient records for the preparation of evaporation rate estimates. In ARD's best-and-final technical proposal, a meteorological station at the dam site was proposed, presuming the presence of an engineering team. Phase I studies have shown that this site is unoccupied and

cannot be used as a reliable meteorological station. However, the meteorological data collected at Luuq, Baardheere and the Jubba Sugar Corporation will be sufficient for the team's riverine assessment purposes.

JESS will collect rudimentary rainfall data as part of its environmental baseline survey, primarily to measure rainfall normalcy during the study period. These data will be collected by giving rain gauges to cooperators--district commissioners, schools, clinics or individuals--throughout the Jubba Valley. The objective is not to collect data for predictive purposes, but to give the study period a local climatic context.

G. Special Socioeconomic Studies

In addition to the socioeconomic baseline survey, the JESS team proposes to carry out a number of special studies on issues that need to be treated in greater depth or are important to development planning apart from the baseline survey's general conclusions. Most of these studies will draw heavily on the socioeconomic baseline survey as their principal source of information, but will be augmented through additional fieldwork and/or integration with other reports. For example, the pastoralism study will include work done by an ARD consultant, information from the socioeconomic baseline survey, data from vegetation studies and livestock counts compiled during the aerial censuses. Some of the special socioeconomic studies are scheduled for late Phase II and may not be completed until Phase III.

1. Pastoralism

Issue: Somalia has perhaps the most pastorally oriented economy of any country in the world today, with at least 60 percent of its population dependent on pastoral livestock production. Livestock exports comprise the vast majority of foreign exchange earnings. Consequently, any major development project cannot ignore its impact on the livestock sector. Nomadic pastoralism is prevalent in the Jubba Valley, which provides invaluable water and grazing to livestock brought from considerable distances on both sides of the valley. Previous reports suggest that in the driest years, as much as half the national herd converges in the inter-riverine zone between the Jubba and Shabeelle rivers.

It is known that some pastoralists live and migrate within the valley while others move in and out of the area, but the decision-making systems governing these movements and migration patterns are still not clearly understood, despite the work of two groups--RMR and the Land Resources Development Centre

(LRDC)--who have mapped pastoral movements in the valley. Follow-up visits should be made to some of the pastoral groups that use the valley seasonally, but are not resident there, so that a clearer picture of their home environments and resulting socioeconomic strategies can be obtained.

An ARD consultant will spend three months in the Jubba Valley and vicinity, starting in the fall of 1987. Based on grazing area data from the socioeconomic baseline survey and other sources, this consultant will locate major herd concentrations outside the Jubba Valley. The consultant will attempt to establish patterns of movement back into the valley and estimate livestock numbers for each herding group. Herd movements will be verified by the aerial census work proposed as part of the environmental baseline studies. Demographic and resource-use information will also be collected on these populations of pastoralists for comparison with findings from the socioeconomic baseline, vegetation and other studies.

A major thrust of this study will be innovative approaches to resource use and management by pastoralists. Techniques for enhancing the welfare of pastoralists and their environment will be major considerations for discussion in the final report.

2. Agricultural Resettlement

Issue: Expansion of agricultural production in the Jubba Valley is extremely dependent on a labor force that is currently deemed to be too small. Adequate expansion of that labor force will most probably have to draw on nonagricultural populations, such as nomads, urban dwellers and, possibly, refugees. The adaptability of these groups to agricultural life and the implications for agricultural productivity require close scrutiny. This is particularly true given that the transition must be made, in most cases, to irrigated agriculture, which has technical and organizational requirements that differ greatly from rain-fed farming. While a number of reports exist on the stability of agricultural resettlement schemes for the Shabeelle area, to date, there is no adequate study of resettlements on the Jubba.

Toward the end of Phase II, the need for this study will be assessed. If a decision is made to proceed, the JESS socioeconomicist will interview current and former settlers at the Dujuuma, Mareerey and Mogambo projects, many of whom will be identified during administration of the socioeconomic baseline survey. She will then combine this information with secondary reports on Shabeelle resettlement efforts and work currently being carried out by economics students at the Somali National University on labor problems at large state farms in the lower

Jubba Valley, many of which employ former settlers from these projects.

3. Resettlement

Issue: The proposed impoundment zone will flood several small settlements, three to four refugee camps and an unknown number of individual smallholdings. For planning purposes, it is necessary to have an accurate count of the number and socioeconomic characteristics of people who will need to be relocated or resettled before the impoundment fills.

The JESS field team will determine the number of people who will be affected by rising reservoir waters. This study, conducted early in Phase II, will include aerial counts and a ground census in the inundation zone. JESS staff will also conduct the socioeconomic baseline survey among groups in the area. Based on these results, ARD consultants will prepare a report with recommendations for resettlement planning. However, it will not address specific plans for resettlement villages in terms of size, design or location, as this is beyond the project's scope of work. JESS will coordinate its work with relocation, resettlement and compensation plan studies sponsored by MJVD, and the smallholder resettlement study funded by Japanese donors.

4. Land Tenure

Issue: In African development projects, traditional user groups frequently lose resource rights when the economic values of those rights are inflated by project implementation or pre-project speculation. When loss of rights occurs, project benefits accrue to urban investors or absentee landowners, to the detriment of traditional resource users.

The JESS project will conduct an analysis of production strategies to address this issue. This study will be based partly on data compiled during the socioeconomic baseline survey, as the JESS field team will interview farm households on the location of each agricultural parcel used by the family, regardless of whether it is in fixed agriculture or communal grazing. For every household, these plots or areas will be located on aerial photographs and assigned to a specific ecological zone (e.g., floodplain, upland savanna). In addition, the team will determine whether resource use is permitted through traditional rights, land title or government lease.

Another study will focus on land speculation. During Phase II, a researcher will examine applications for land registration at district offices in the Jubba Valley. The probable boundaries

of lease applications will be located on aerial photographs and the land use recorded. A random selection of applicants will be interviewed to ascertain their motivation for lease application. This study may be conducted under the auspices of the AID/LTC Title Registration Research project, but if not, ARD and LTC will explore the possibility of accomplishing this work through LTC graduate student thesis research, under the direct supervision of LTC professionals and the JESS anthropologist.

Issue: In semiarid, tropical environments, water rights and access are as important as land tenure. While there is a system of traditional water rights in the Jubba Valley, a national rights policy is lacking. The traditional systems are adequate to deal with the demand for livestock watering and domestic use, but are not capable of coping with the large volumes of water required for medium- to large-scale irrigation.

The Food and Agriculture Organization (FAO) of the United Nations and GSDR are developing national water rights legislation, which is expected to cover irrigation development in Somali river basins. The JESS project will limit its work on water rights to the socioeconomic baseline survey and studies of local institutions.

Issue: The GSDR did not specifically address land tenure issues for rangelands in the National Land Law of 1975. Under this law, rangelands are currently being administered as national property, but without policy guidelines for enclosures, improved pastures, irrigated agriculture or protection from livestock movement.

Although the JESS project will gather data on rangeland use through numerous studies (e.g., socioeconomic baseline survey, aerial census, special studies on pastoralism, vegetation and livestock), no specific study is planned on the land tenure issue, which must be addressed by the government at both regional and national levels.

5. Development of Local Institutions

Issue: In remote areas of developing countries, resources can often be managed better by local institutions founded on community participation, compared to central government agencies based in a distant capital city. Prior to implementation of a development project, such local institutions often exist as informal decision-making groups. In the Jubba Valley, these groups can be strengthened to provide valuable feedback regarding the effects of dam construction and other related developments on the environment and production systems. In addition, these groups can provide an indigenous infrastructure for organizing and implementing development projects at the local level.

An ARD home office staff member with institution-building expertise will spend one month between September and November 1986 conducting a preliminary study of local institutions in the Jubba Valley. Prior to this, the staff member will have reviewed literature pertinent to Somalia, East Africa and resource use. Information from the socioeconomic baseline survey and discussions with JESS field staff will orient the specialist before he visits the valley. JESS social scientists will identify potential institutional contacts in preparation for this study. For a comparative context, the ARD consultant will inspect water-user organizations on the Shabeelle River. He will evaluate and make recommendations in two areas--local institutional arrangements that can enhance resource use and production, and mechanisms for building communication and cooperation among MJVD and local institutions in the Jubba Valley.

6. Irrigation Costs

Issue: With controlled flows on the Jubba River, agricultural development in the valley will include more irrigation projects. Designs for these developments will require an assessment of irrigation costs.

Several groups--BuRec, AHT, Tippetts-Abbett-McCarthy-Stratton Engineers, Architects and Planners (TAMS), and the World Bank--are performing studies of irrigation costs in Somalia. The consensus of the parties involved is that work by the JESS project in this area would be redundant. Accordingly, JESS will not conduct studies on irrigation costs. Prior to the commencement of Phase III, the project will review the findings of the various irrigation studies. If major alternatives have been overlooked (e.g., supplemental irrigation for smallholder farms and irrigated production of forage, perhaps), the JESS project will undertake studies of irrigation costs early in Phase III.

7. Economic History of Irrigation Projects

Issue: Somalia has implemented several irrigation projects in the Jubba and Shabeelle valleys with varying degrees of success. There are important lessons to be learned from these projects that should be used to plan future projects in the Jubba Valley. Experience gained in Somali irrigation projects can be compared to that of other irrigation systems in Africa and elsewhere.

This study will involve collaboration between the JESS economist and an LTC consultant. The JESS staff member will examine past and existing irrigation projects in Somalia. The

LTC consultant will also conduct Somali studies, particularly of developments on the Shabeelle River, as well as focusing on irrigation economics experience outside Somalia. Together, these scientists will produce a "lessons learned" report, which will suggest techniques and policies that have proven successful, so as to avoid the mistakes of previous projects. In addition to hard numerical facts, this report will include aspects of culture, management and other considerations. A major thrust of this work will be innovative alternatives to large-scale irrigation, especially with regard to smallholder agriculturists and pastoralists--a potential backbone of development in the Jubba Valley. Data for part of this study will be collected during the local socioeconomic baseline studies, prior to the consultant's arrival in mid-1987 (June to September). This consultancy will require two months.

8. Markets and Transportation

Issue: Important expansion in agricultural or pastoral production generally requires growth in the marketing and transportation networks that must handle an increased flow of goods and support services. Very little concrete information is currently available concerning the amounts of agricultural goods marketed in the Jubba Valley or prices paid for those goods in different seasons. The breadth and depth of networks that carry these goods from resource-producing areas to major consuming locations are unknown. Likewise, little is known about the quantities, prices and means used to bring goods from outlying areas into the valley for consumption. In short, the network for resource use and production is unclear.

At present, there are no marketing studies in the Jubba Valley. Potential studies in 1987 may be funded by GTZ and the European Economic Community. The JESS project will conduct a marketing study at camp, village and town levels. The design and results of this investigation will be coordinated with subsequent studies by other organizations. During the study period, an improved road may be completed between Saakow and Bu'aale. If this happens, the JESS team may be able to compare data collected before and after road construction, which will facilitate projections of the impacts of future valley development.

Information for this study will come from various sources. The socioeconomic baseline survey will provide data on prices paid for goods at the family level. Information on the seasonal availability, quantity and cost of various goods, number of intermediaries involved in purchases and sales, and number of sellers will be obtained at local marketplaces. In addition, local enumerators will be hired in eight major valley towns to record information on the availability and prices of various goods. Marketing information will also be gathered on fish and

the products of pastoralists, hunters and gatherers. This study will be conducted by the JESS field economist. It will coincide with the socioeconomic baseline survey and continue for at least 14 months.

9. Labor

Issue: Current agricultural projects report scarce labor supplies during certain seasons in the Jubba Valley. The human population is small. Thus, the presence of a labor pool that is large enough to meet the requirements of proposed large-scale irrigation projects and other developments is questionable. Because of the importance of labor in the valley, a fairly detailed study of labor shortages and responses to different incentive levels must be made so that planners can better identify ways to use this scarce resource in future development.

A major labor study of the Jubba Valley is being performed by the World Bank, and an AID regional project in the lower Jubba Valley, titled SPECIAL STUDY ON RURAL/URBAN DYNAMICS (SARSA), will cover urban labor. These studies may make it unnecessary for the JESS project to conduct a labor study. If such an investigation is necessary, the nature of the work plan and external events may allow the JESS economist to conduct a labor study (described below) in late Phase II or Phase III.

Information from the demographic, income and resource-allocation portions of the socioeconomic baseline survey will provide a good picture of current labor availability and use in the valley's rural areas as well as conditions under which people leave their farms to seek employment elsewhere. The SARSA study in Kismaayo and Jilib should supply adequate information on the size and disposition of the urban labor force in those areas. These pieces of information will be put together with data collected at large-scale projects and small to medium-scale commercial enterprises concerning wage rates, hiring and the number of people seeking work who are turned away seasonally or annually. This should complete the picture of response incentives and relative unemployment in the valley. For some data collection, JESS staff may work with students from the Somali National University.

In addition, aerial census counts and large-format aerial photography are expected to provide data on the distribution of valley populations and any important changes in that distribution over the 14-month study period. An analysis of village and town data from national and international perspectives (e.g., employment of valley residents returning from jobs in the Gulf states) must be done, perhaps by planners separate from the JESS project.

10. Rural and Urban Dynamics

Issue: Useful socioeconomic information for regional planning often requires a regional perspective and not just concerning the local farm situation, even if the area is primarily agricultural. For this reason, it is essential to consider interactions between rural and urban areas, and the flow of goods, services and people between the two zones. Rural locations often depend on urban areas for manufactured consumables, food rations in lean times, farm implements, health services, agricultural and veterinary inputs, and marketing facilities for their own production. In turn, urban zones depend on rural areas for food, surplus labor and customers for urban-produced goods. The identification of linkages that are most dynamic in the Jubba Valley will serve as an aid to planners in terms of specifying the elements that will most need strengthening as the entire regional system expands in adaptation to new developments.

An AID project, SARSA, will investigate these changes mainly in the lower Jubba area, and this study will be adequate for planning purposes. The JESS project will cooperate with the SARSA team on the study design and technical matters to avoid any duplication of effort.

11. Nutrition

Issue: Contrary to expectations or design, resource development sometimes leads to a deterioration in nutrition. Even population groups that are not directly involved in a specific development project may find their nutritional status affected by changes in the regional production of certain crops, prices or marketing policies, or the development of a new infrastructure. Furthermore, periodic drought, local birthing practices, women's workloads and seasonal remoteness can all aggravate poor nutritional conditions. Thus, it is important to determine the factors currently affecting nutritional levels among the Jubba Valley's population and document past events that have caused these levels to change. In the future, as developments in the valley accelerate, it will be necessary to monitor these factors and establish a surveillance system to provide an early warning of any deterioration in the health or nutritional status of valley residents.

To this end, an ARD nutrition consultant will spend one or two months in Somalia designing and executing a study of the nutritional status of valley populations, based on a highly stratified (restricted) sample. This study will include an anthropometric survey of children, investigation of the frequency and value of foods most commonly consumed (with information on

seasonal consumption reinforced by data from the socioeconomic baseline survey) and assessment of the main causes of nutrition-related problems among valley inhabitants. In drawing conclusions and formulating recommendations, the consultant will use information from the socioeconomic baseline survey and JESS special studies on water quality, health, disease vectors and ethnobotany. Based on all this information, the consultant will establish methods for monitoring nutritional status in the valley after the study period has ended.

12. Cultural Heritage

Issue: Archeological and religious sites may be present in the Baardheere Dam's inundation zone. Phase I activities did not find any indication of firm evidence or systematic surveys of such sites in this zone. At a minimum, the proposed reservoir area should be surveyed for locations with archeological, religious or historical significance.

An ARD consultant with extensive archeological experience in Somalia will conduct a three-month archeological reconnaissance of the inundation zone. This consultancy will be divided into a preliminary reconnaissance visit of one month, beginning in September 1986, and a more detailed, two-month study, starting in July 1987. The consultant may be assisted by Somali graduate students who are currently at the University of Georgia. The team will operate out of the JESS base camp at Baardheere, but will work independently of JESS field staff. The objective of this study is reconnaissance--to locate potential sites without detailed investigation. Follow-up studies of any sites identified are beyond the scope of the JESS project and would likely be part of the loan agreements for dam construction or a research proposal for funding by a private or public foundation.

H. Special Environmental Studies

1. Construction Site Environment and Workers

Issue: The in-migration of a large labor force for dam construction will have serious implications for development planning. Laborers can unwittingly import diseases that are currently not endemic to the region. Poorly designed labor camps that lack a proper water supply, sanitation, shelter and health posts can increase the spread of disease to local population centers. Increased demands for food, shelter and services will stimulate local economies and cause further in-migration of merchants, farmers and service vendors, thus creating "boomtown" conditions. Unless plans are made to accommodate this rapid population influx with expanded water supplies, sanitation and

health services, disease will become rampant and the quality of the overtaxed environment will decline.

ARD will prepare an interim report for MJVD on preconstruction concerns, which will be based on existing literature, staff experiences with other dam projects, a review of facilities, the layout at Baardheere, features of the construction camp and support items, and reports of the JESS health consultant. The report will include a view of the situation from a development perspective, in which the construction facilities and process can be assessed relative to their potential for development of the area. Besides this study, the report will include an investigation of the health implications of dam design and reservoir operation, described in the next subsection (IV.H.2). ARD will coordinate this work with GTZ, which is funding a development plan for the municipality of Baardheere.

2. Health Implications of Dam Design and Reservoir Operation

Issue: The incidence of several diseases, such as malaria, schistosomiasis and onchocerciasis (river blindness), can be reduced or avoided if certain modifications are included in the dam design. In addition, disease vector habitats can be restricted by certain reservoir operation practices. These design and operation modifications should be considered before the actual designs and operational strategies are finalized.

A study of the disease implications of dam design and reservoir operation will be produced by ARD's home office staff in conjunction with JESS health and engineering consultants. Besides features of the dam design, the considerations will include draw-down rates and frequencies, shoreline configurations and vegetation clearance patterns for enhanced disease control, and daily activity patterns of people in the reservoir area. This report may be combined with the previous study, which will cover health problems of the labor force, and presented to MJVD, USAID/Somalia and donor agencies before October 1986.

3. Watershed Management

Issue: Biophysical watershed management activities prolong a reservoir's useful life. Frequently, sound watershed management practices are not incorporated into the planning process at an early stage, thus permitting uncontrolled development in a proposed reservoir area. Such development often increases rates of deforestation and erosion, and more costly mitigation measures are subsequently required once soil losses have already occurred.

In a biophysical watershed management study, ARD's home office staff and forestry consultant will assess the watershed management potential of the reservoir zone. The upper parts of the watershed are outside Somalia's national borders and, hence, will not be evaluated in this study. From these surveys, a plan of action for watershed management will be prepared for MJVD. This interim report will include the results of investigations on reservoir clearing and recommendations for clearing policies. Reservoir clearing will also consider health implications for disease vector control (see IV.H.2).

4. Reservoir Sedimentation and River Scour

Issue: Reservoir sedimentation and river scour will occur after closure of the Baardheere Dam. Certain techniques may be effective in avoiding or reducing the undesirable effects of watershed and river-course erosion.

Based on data collected during the JESS sedimentation and river-scour studies, ARD's home office, in collaboration with CSU, will prepare a special report that includes recommendations for a plan of action to control erosion in the reservoir zone. This special report will also address riverbed stabilization and the protection of in-river structures.

5. Forestry

Issue: In many impoundment projects, deforestation in the reservoir area has increased rates of erosion and subsequent reservoir sedimentation. Forestry planning and implementation help reduce the dangers of deforestation and guarantee a future supply of fuelwood for human populations, which increase as a result of development interventions.

The topic of this special study was also included in the environmental baseline investigations. The JESS ecologist will continue to build on the results of a two-month forestry consultancy. Phase I activities revealed no pressing need for a forestry management plan for the Jubba Valley at this time. The acacia forests in the valley are not severely threatened, except around refugee camps and agricultural resettlement areas. The gallery forest will be studied by the JESS ecologist and a scientific team from University College of London.

6. Ethnobotany

Issue: Residents of the Jubba Valley utilize wild plants for medicines, food supplements and other ways that may be unknown outside the immediate region. A small local study of

plants with medicinal utility was conducted in the valley by university scientists. An ethnobotanical catalog is an essential part of natural resource baseline information.

Aspects of this study have already been discussed under the socioeconomic and environmental baseline surveys. An ARD botanical consultant will assist the JESS ecologist with several botanical investigations, including a study of ethnobotany--the noncommercial use of wild plants or plant parts by valley residents. ARD's botanical consultant has extensive experience in Somalia and, thus, will be able to quickly instruct the JESS ecologist in recognizing both common and unique Somali species. In addition, the use of plants as medicines will be recorded. The information gathered during this effort will be exchanged with the Royal Botanic Garden at Kew in the United Kingdom or Missouri Botanical Garden in the United States, as both institutions are important centers for African ethnobotanical research. An interim report discussing the findings of this study will be considered.

7. Disease Vectors

Issue: Significant increases in the incidence of malaria and schistosomiasis are commonly associated with African impoundments. Since both diseases are currently prevalent in the Jubba Valley, preventive measures must be taken to avoid increases in disease following closure of the Baardheere Dam. Since disease incidence is a function of vector density and the extent of vector habitat, a disease vector survey will be useful for environmental health planning.

The JESS team proposes to assist the National Antimalarial Service and Schistosomiasis Control Project in a disease vector survey. Both units are parts of the National Ministry of Health and have trained technicians for vector survey work. These units are not currently conducting surveys in the Jubba Valley, as they lack the funds and vehicles for fieldwork. After February 1987, USAID/Somalia may be in a position to provide a vehicle from the BuRec soils project for a vector survey. If the Ministry of Health agrees to supply the technicians and work space, an ARD health specialist with vector survey experience in Somalia will supervise the start-up of this effort in 1987. The JESS team will provide logistic support, necessary equipment and technical assistance for each survey. The duration of the disease vector surveys has not been fixed and will depend on agreements reached with USAID/Somalia and the Ministry of Health.

8. Reservoir Ecology

Issue: Closure of the Baardheere Dam will create a lacustrine, instead of riverine, aquatic habitat. The difference between the two has been studied in detail for other African impoundments and will provide one basis for modeling the potential effects in this case, if specific limnological data are collected for the Baardheere area of the Jubba River.

ARD will engage the services of a consultant with experience in East African limnology for a one-month study of the Baardheere-Luuq area, which will be conducted in May or June 1987. Benthic and lotic samples will be collected. Using physical and chemical data from the water-quality baseline study, a reservoir water-quality model will be developed. From this model and studies of reservoir bathymetry, the limnologist consultant will make predictions regarding faunal and microfloral changes in the future reservoir. The limnologist will also be required to make preliminary estimates of waterweed proliferation in the reservoir. This information will be integrated with information from the fishery and ornithological studies, thereby covering the main array of aquatic food chains and relationships.

9. Estuarine Ecology

Issue: Estuaries are usually highly productive ecosystems that are vulnerable to modifications of river flow regimes. In many African impoundment projects, rich estuarine and coastal fisheries have been adversely affected by dam closure. Estuaries typically play important roles in the feeding, breeding and nursery functions of marine species. During Phase I, JESS staff had several opportunities to observe the Jubba River estuary from the ground as well as light, low-flying aircraft. There are indications that this estuary is not as vulnerable as most in Africa. It lacks a pronounced delta and does not support an extensive mangrove forest or reed marshes, which increase estuarine productivity.

An estuary survey will be conducted as part of the water-quality baseline study and fish survey. ARD consultants will collect water samples for laboratory analysis and survey fish species in the estuary. The abundance and diversity of organisms will be assessed in terms of their habitat characteristics. The water-quality consultant will conduct a short study on tidal exchange and the limits of saltwater intrusion. Water samples will be analyzed for electrical conductivity to determine the characteristics of the salt wedge. Since dam discharge regimes will probably not be determined before the end of the study period, it will be necessary to model several potential discharge scenarios. Once the data sets are available, computer simulation models will be executed in the United States and an interim

report issued by February 1987. The level of effort for this study has been included in the water-quality baseline survey.

10. Livestock and Wildlife Migration

Issue: Migration is a common strategy used by African wildlife to cope with drought. The technique has been successfully copied by nomadic herders. The movement patterns are not random, but are quite varied. In the Jubba Valley, the general movement patterns for livestock have been published, although only on a gross scale. More precise locations for migratory pathways are necessary if planners are to avoid placing development projects where they will either harm or be damaged by migrating animals.

The JESS ecologist will study aerial photographs to identify the most heavily used wildlife and livestock migration routes in the Jubba Valley. Wet- and dry-season aerial censuses will contribute additional data on herd locations, concentrations and movements. Further information will be gleaned from the socioeconomic baseline survey and studies of pastoralists. Interviews at watering points will also be used to determine the characteristics of livestock movements. Overflights for remote-sensing purposes will yield additional data on wildlife routes and the timing of migrations. The routes identified through these means will be recorded on the project's base maps.

11. Fishery Development

Issue: Fishery development is normally a part of cost-benefit analyses for African impoundments. When fully exploited, successful fishery development can add to local economies and provide local residents with a valuable source of protein. However, the JESS project chooses to delay or postpone a special study on fishery development, except as part of the health and water-quality studies.

Phase I studies and interviews clearly demonstrated that Jubba Valley residents do not heavily use existing riverine, estuarine and coastal fisheries. The traditional Somali preference for livestock herding and diets based on those animals does not indicate a need for research on reservoir fishery development. Also, an initial inspection of the estuary suggests a relatively low level of productivity. The barrage at Fanoole is already an impediment to fish migration. For these reasons, a fishery development study has been given a low priority at present. Furthermore, considering the time lag between the completion of JESS activities and dam closure, such investigations can be conducted at a later date, if desired.

Yet, an impoundment fishery is a potentially important economic and food resource for the future. Despite the above discussion, a reservoir fishery would very likely develop with or without advance planning and preparation. The main concern should be to determine an exploitation pattern that provides maximum yields without excessive deleterious effects. Accordingly, the JESS project will prepare recommendations for a fishery development study that could begin during dam construction.

JESS scientists will explore potential introductions of fish for the biological control of mosquitos in the reservoir area. Somalia is a leader in using fish for this purpose in household water supply systems. The main concern is the feasibility of using these species in a large lake. This study will entail reviewing the life histories and habitat requirements of these pest-control fish species. This information will then be matched with the predicted water quality and habitat characteristics for the proposed reservoir. The level of effort for this work is included in the water-quality baseline studies.

I. Studies Facilitation

1. Remote Sensing

Remote sensing will be used extensively by the JESS team. Aerial photographs are now used in socioeconomic reconnaissance, vegetation, land-use and water-quality studies. The project's available resources include monochromatic, vertical aerial photographs at 1:30,000 scale, taken in 1983-84; similar photographs (at the NTTCP offices) taken in 1960; 1:50,000 photomosaics of the 1983-84 series of aerial photographs; a Landsat image atlas of natural resources compiled in 1975 from 1973 imagery; aerial counts of livestock, wildlife, dwellings and other observations from the Southern Rangelands Survey; and 35-millimeter slides of aerial views for selected sites from Luuq to Kismaayo. The present array of remote-sensing materials will be supplemented with large-scale seasonal aerial photography (1:5,000 to 1:10,000) of selected areas in the Jubba Valley, identified as unique or "hot spots" during the baseline studies.

JESS scientists will also use applications of satellite imagery, such as advanced, very high-resolution radiometry (AVHRR), a technique suitable for vegetation monitoring. A study has been designed to assess the condition of vegetation as it relates to the quantity, distribution and quality of runoff from the upstream watershed. This study is important because two-thirds of the Jubba River watershed lies outside Somalia's national boundaries.

In this study, ARD will contract for monthly interpretation of composite data from a National Oceanic and Atmospheric Agency satellite with AVHRR imagery. These data have been recorded daily for the Jubba watershed since August 1981 by the Remote Sensing Center in Nairobi. This study will coincide with the sedimentation studies already described under hydrology (Section IV.F.2). AVHRR is sensitive to plant moisture and, thus, provides important indices of seasonal vegetation conditions. In Phase III, correlations between vegetation conditions in the upper watershed, and discharge volume and suspended sediments data collected at Luuq and Baardheere will be determined. This analysis may form the foundation of long-term monitoring programs for reservoir operation.

2. Data Management

The JESS team will generate and process a large amount of information in the form of surveys, reports, office communications and bibliographic documentation. One project aim is the design and implementation of an information management system and training in its use, prior to the commencement of field operations. The team seeks to avoid becoming overwhelmed by data, something which has occurred in previous studies of African river basins.

The JESS project has already applied much effort to computer equipment and programs. The team has three IBM PC-ATs and three Hewlett-Packard Portable Plus computers in Somalia, as well as such software as dBase III, Statpac, Symphony, Lotus 1-2-3, Nutshell, Harvard Total Project Manager and other programs. These microcomputer systems are capable of handling both field data and project administration needs, including word processing, statistical applications, bibliographic records and project administration/management.

An ARD specialist in data base management will contribute four months of effort to the JESS project. In May and June 1986, this specialist designed a data base management system, coordinated data management with field data collection forms, such as the socioeconomic questionnaires, evaluated the capabilities of existing equipment and personnel, and began training personnel in data base management. The data base specialist will also assist with the analysis of data at the end of Phase II and during Phase III.

J. Schedule

The studies proposed for Phase II feature levels of effort (i.e., a range of two weeks to 14 months) based on the scope and analysis of objectives for particular topics as well as budgetary

constraints. A broad array of considerations has gone into scheduling project activities. These include climatic cycles, especially the wet and dry periods; social and religious events, such as Ramadan and the Somali October celebration; logistic constraints, such as vehicle availability, fuel scarcity and seasonal road problems; work schedules of cooperating organizations; and consultant availability. At the end of this section, the schedule of activities and reports for Phase II are presented in Figures 3 and 4, with the consultant level of effort in the field shown in Table 3.

K. Institutional Development

In March 1986, ARD completed a draft manpower and training assessment for the JESS project that discusses some aspects of institutional development in depth. During 1986, the World Bank is proposing to implement a broad institutional analysis of MJVD as part of its pre-appraisal activities. With this in mind, current efforts in this area are confined to the topics of training and field presence, as these are of principal importance to JESS.

1. Training

The assigned MJVD counterparts and other Somali JESS staff have appropriate academic backgrounds in some instances, but are inexperienced in important aspects of river basin assessment, data collection and analysis. Since the project paper considers training to be an important institutional development activity of the JESS project, training programs are a major team objective, especially for counterpart staff.

JESS training activities will mainly emphasize on-the-job and, to a lesser extent, classroom training. ARD believes it will be possible for Somalis to attend short courses, field trips, conferences and other training activities through funding from the JUDAS project or other sources. Since a good command of the English language is important for most of these courses, JESS, USAID/Somalia and MJVD have begun to address this training need.

Consistent training involves providing adequate supervision, the relevance of course content to local conditions and adequate consideration of logistical problems. Two months of effort have been allocated for a training specialist to assist with the coordination, design and implementation of training programs. This includes a minimum of one month of assistance in Somalia during the fall of 1986, to assist JESS and MJVD with the design of training activities and reviewing progress to date.

2. Field Presence

From the perspective of both logistics and long-term institutional development, MJVD needs to establish a consistent physical and technical presence in the Jubba Valley. Through BuRec, BDP and other activities, MJVD is already visible in the area and is now in the process of establishing more permanent physical bases in the valley. These bases include field staff, communications equipment and transportation (including fuel depots). The JESS project will support these efforts through contributions of equipment and logistical assistance.

On the technical side, temporary and permanent MJVD staff members and other JESS consultants will be working throughout the Jubba Valley, especially during the period from May 1986 through the end of Phase II. ARD has also proposed an assessment of ways that JESS and MJVD might work with local institutions, over the long run, on activities such as environmental and socioeconomic monitoring and input into development planning efforts (see Section IV.G.5). Whether governmental or not, these links to local institutions are viewed as crucial to MJVD's long-term success in the valley.

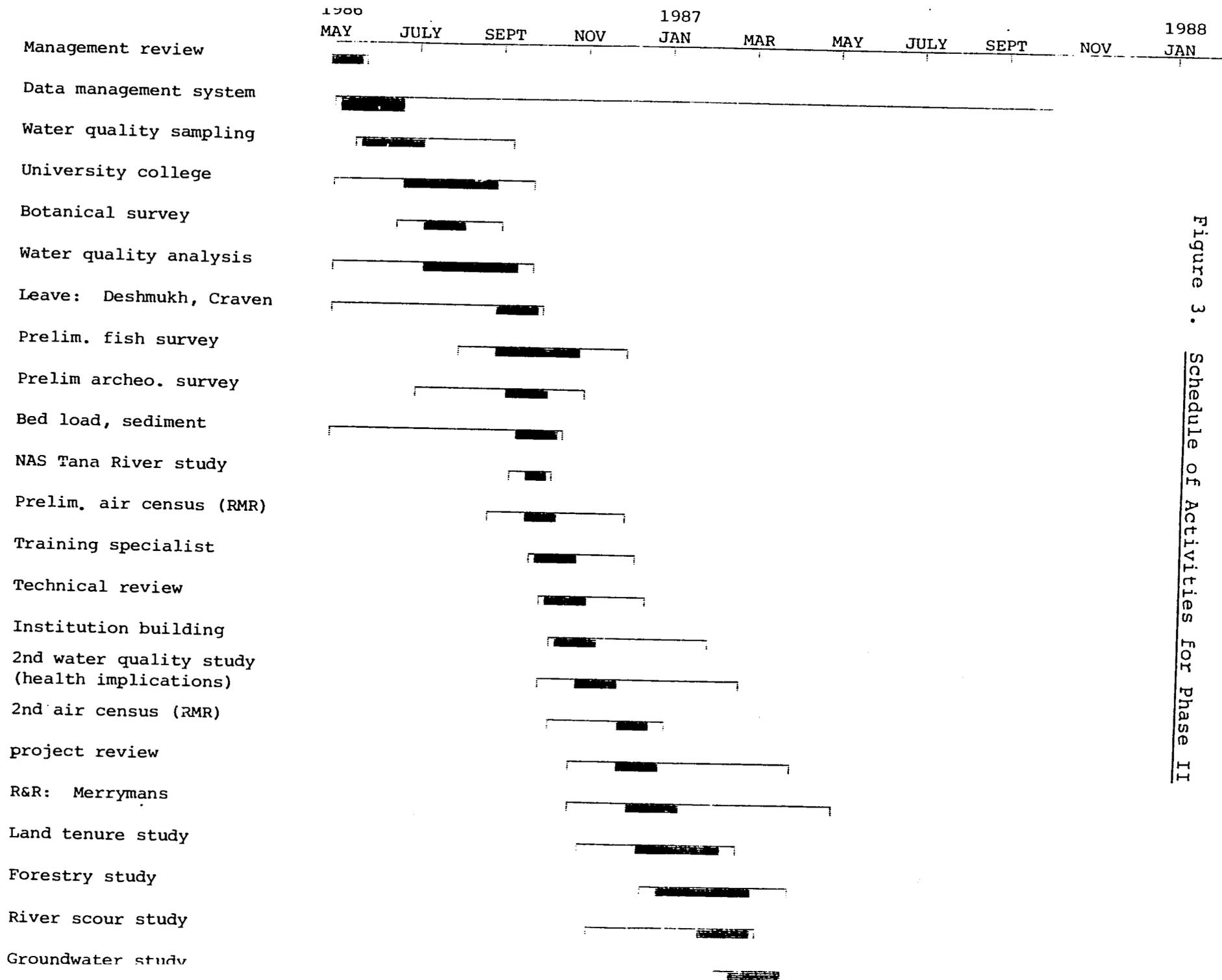
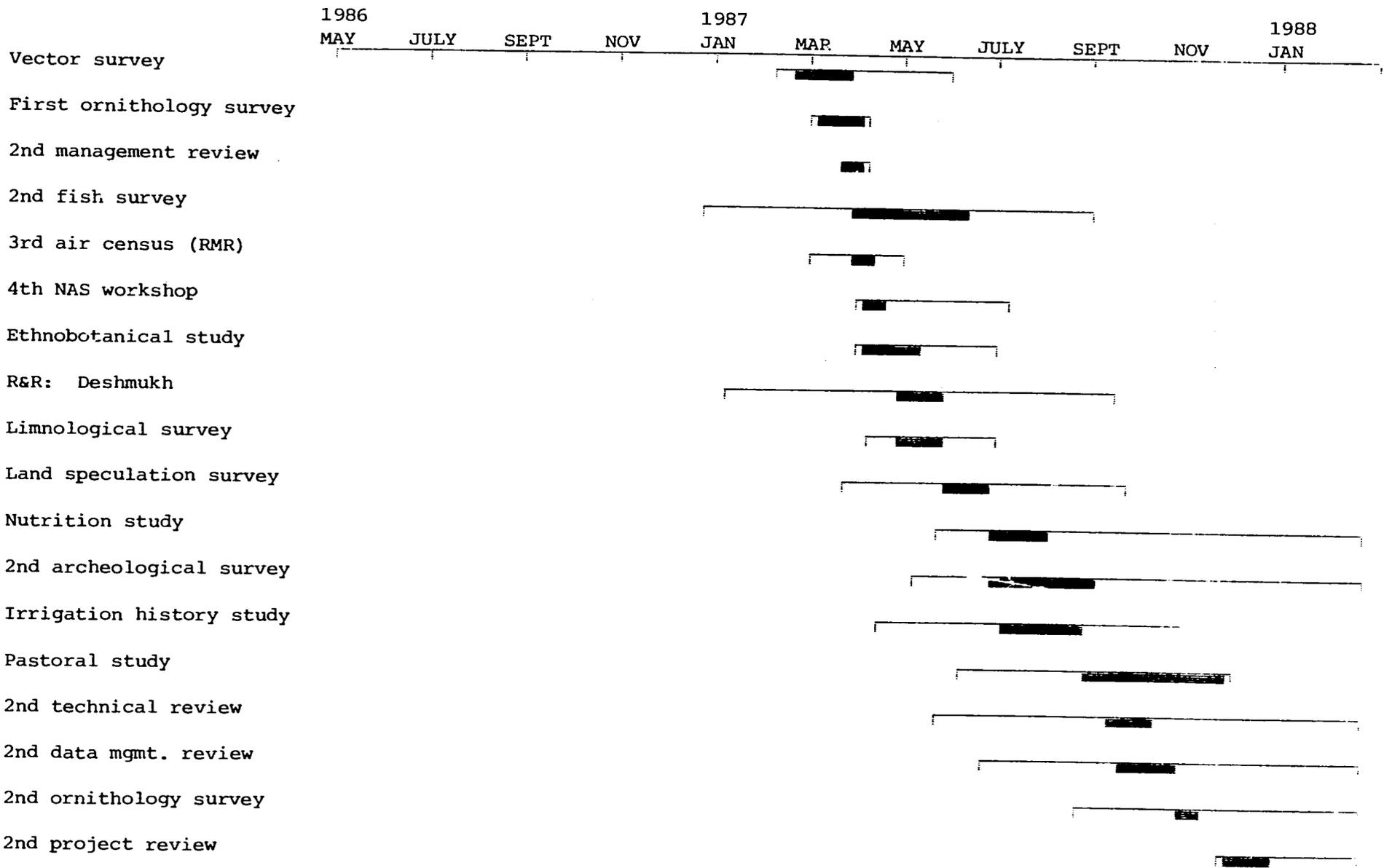


Figure 3. Schedule of Activities for Phase II



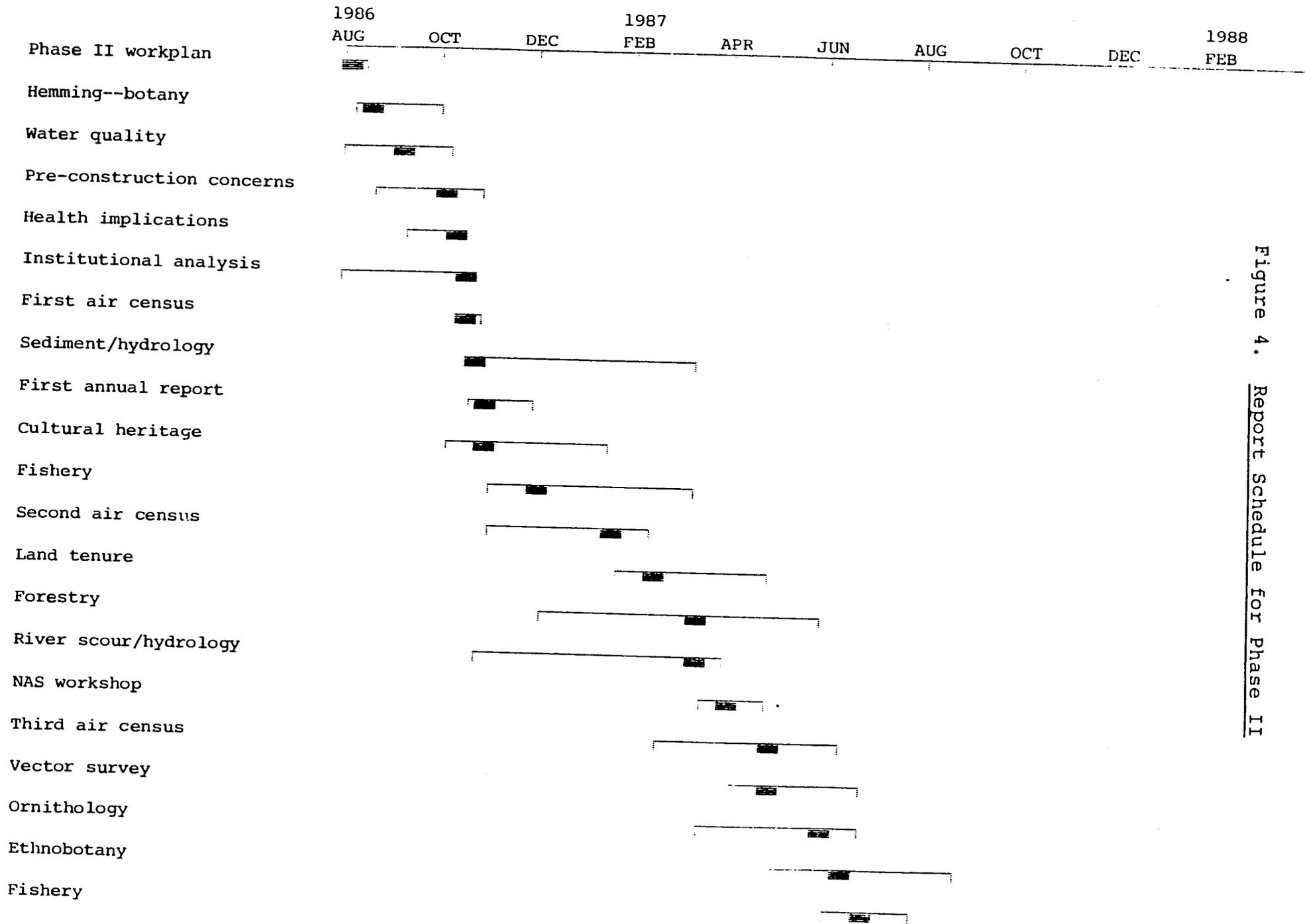


Figure 4. Report Schedule for Phase II

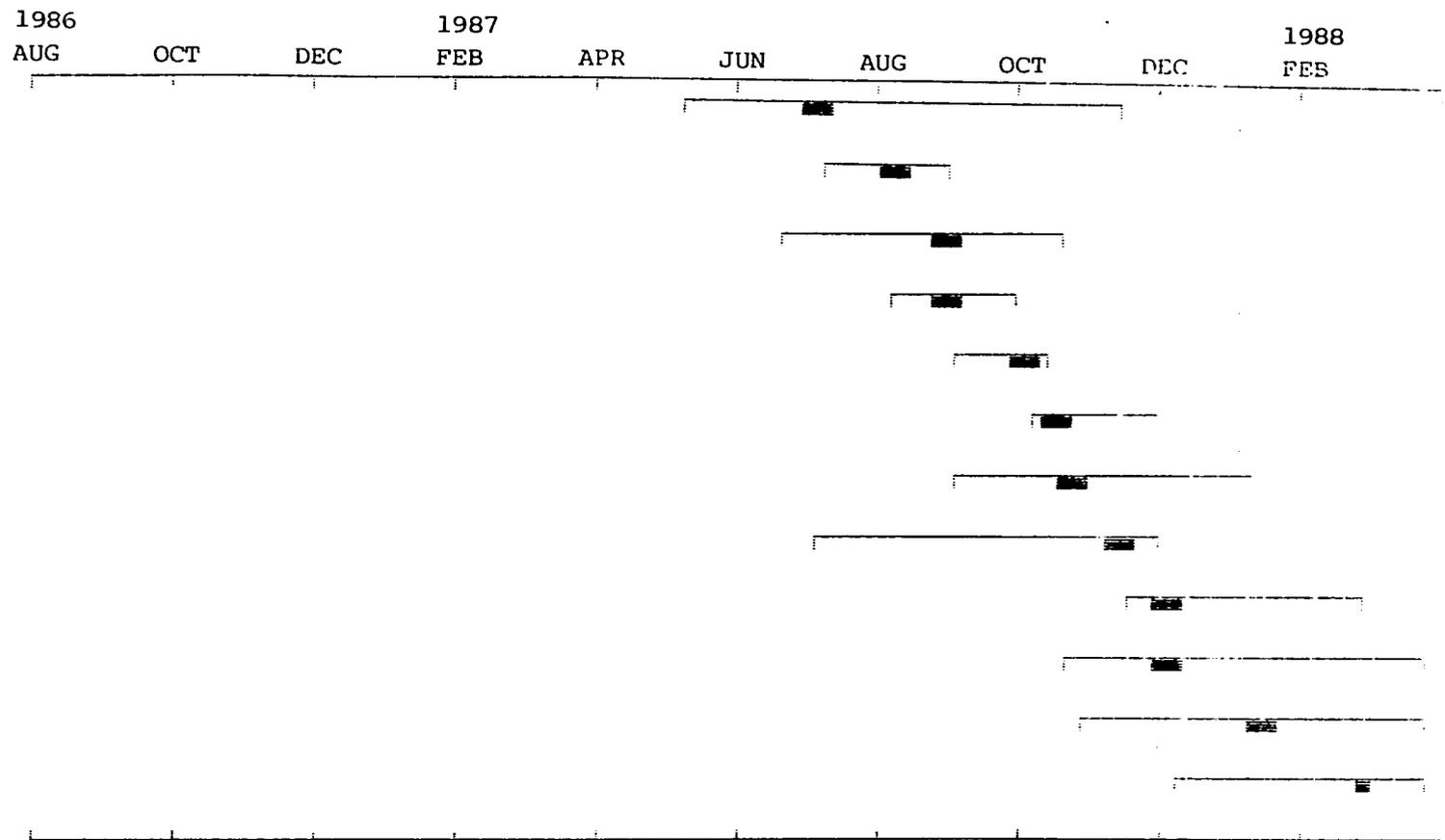


Table 3. Consultant Level of Effort in the Field

<u>Study</u>	<u>Person-Months</u>	<u>Total by Area</u>
<u>Hydrology</u>		
sedimentation	1.50	
river scour	<u>1.50</u>	
		3.00
<u>Water Quality/Public Health</u>		
water quality	3.00	
public health	3.00	
vector survey	1.00	
water supply	<u>2.25</u>	
		9.25
<u>Vegetation Studies</u>		
botany	2.00	
ethnobotany	1.00	
forestry	<u>2.00</u>	
		5.00
<u>Wildlife</u>		
inventory	2.00	
ornithology	<u>1.50</u>	
		3.50
<u>Aquatic Resources</u>		
fisheries	4.00	
limnology	<u>1.00</u>	
		5.00
<u>Socioeconomic Studies</u>		
land tenure	3.00	
pastoralism	3.00	
irrigation	2.00	
nutrition	2.00	
institutional	1.00	
cultural heritage	<u>3.75</u>	
		14.75
<u>Remote Sensing</u>		
air census	4.00	
satellite imagery	2.00	
photography	<u>1.00</u>	
		7.00
<u>Date Management</u>		
study design	1.00	
analysis start	<u>1.00</u>	
		<u>2.00</u>
Total		49.50

Appendix A

JUBA ENVIRONMENTAL AND SOCIOECONOMIC STUDIES (JESS)

DRAFT REVISED WORK PLAN, PHASE I

9/13 TO 10/27

Contract negotiations
Washington, D.C. briefings
Contractors' discussions: LTC, Blue Nile, CSU
Subconsultant meetings
Logistical planning
Personnel processing
Bibliographic system development
Literature review
Commencement of equipment procurement

10/27 to 11/30

Protocol
Contacts development - Burlington, MO
and Nairobi,
Language training
Logistical arrangements - Burlington,
Mogadishu, and Nairobi
Literature survey - Mogadishu,
Burlington, and Nairobi
Office set up at MJVD and K-4
Office staff search and selection
Reconnaissance visit to Juba Valley
Compilation of field equipment list
NAS discussions
Development of workplans
CIPL 1985 supplementary budget
Remote sensing discussions
Consultant terms of reference
Monthly report

12/1 to 12/31	Office set up and staff training Continue language training until 1/1 Field staff selection Field training Vehicle modifications for field Field equipment procurement Juba site visits - Bardheere and Kismayu CIPL 1986 budget Monthly report
12/1 to 3/15	Continue literature search - orientation period. Begin drafting phase II work plan (JESS staff with consultants)
1/7 to 1/31	LTC economist advises on land tenure, institutional, and cultural study design
1/7 to 1/31	LTC economist advises on socioecono- mic study design, including reset- tlement issues
1/14 to 2/14	Donovan assists in work plan prep- aration, assesses training needs, participates in NAS workshop
1/24	NAS workshop
1/1 to 1/31	Juba aerial reconnaissance Continue field equipment procurement Anthropologist orientation Juba site visit - Luuq Continue field training Continue office training Preliminary resettlement field work, as necessary Monthly report

2/1 to 2/31	Data base designer advises on DP; timing to be coordinated with GTZ's data base specialist. Person possibly R. Hart who can also commence data base training
2/1	Tillman in Italy for archival research
2/7 to 3/7	Tillman advises on environmental study design and assists in drafting Phase I report
2/7 to 2/28	James Ruff (CSU) evaluates hydrology data and reservoir configuration, designs study to evaluate sedimentation and bed load contribution, and explores irrigation issues, as necessary
2/7 to 2/28	Public health engineer sets up up water quality testing program, establishes analysis criteria and procedures after evaluating in-country capacity to sample and analyze water from Juba River; possible extension into Phase II for data collection, evaluation, and training
2/7 to 2/28	Epidemiologist (Schneider) advises on study design for health surveys and evaluates on-going programs with NTTCP, Dutch and Swedish efforts in Juba Valley
2/1 to 2/28	Italian archives search Aerial survey - reservoir area Resettlement field work, as necessary Continue office training Continue field/specialist training Monthly report

3/1
3/7

JESS Colloquium
Draft phase I report completed,
submitted in draft to MJVD and
USAID/Somalia, transferred to ARD for
finished editing; work plan for Phase
II included or appended to report

3/1 to 3/31

Resettlement field work, as necessary
Continue field/specialist training
Begin Phase II studies
Monthly Report