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AGRICULTURAL RESEARCH CORPORATION  
WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT



FINAL REPORT

WSARP PUBLICATION No. 56

MARCH 1986

PDAAT-877

46148

**AGRICULTURAL RESEARCH CORPORATION**  
**WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT**

**THE GOVERNMENT OF SUDAN**  
**UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT**  
**THE WORLD BANK**  
**CONSORTIUM FOR INTERNATIONAL DEVELOPMENT**  
**WASHINGTON STATE UNIVERSITY**

**FINAL REPORT**

Publication No. 56

March 1986

Western Sudan Agricultural Research Project  
(Contract AID/afr-C-1539)

FINAL REPORT  
August 15, 1979 through December 31, 1985  
(With Extension of Selected Activities  
until March 1, 1986)

Prepared by

Washington State University  
as Lead University

with

The Consortium for International Development

for

United States Agency for International Development

March, 1986  
Publication # 56

Correct Citation:

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

Western Sudan Agricultural Research Project Final Report:  
August 15, 1979 through December 31, 1985 by J. Noel, J.  
Henson, D. Cook and J. Kearns. WSARP Publication No. 56.  
Khartoum, Sudan and Pullman, Washington, USA.

## **ACKNOWLEDGEMENTS**

The WSARP Final Report was prepared by Jan C. Noel, James B. Henson, Richard H. Cook and Jean R. Kearns. The assistance of Steven Bailey, Tareke Berhe, Trent Bunderson, Beth Frey, Thomas Gillard-Byers, Barbara Souriall, Genevieve Thompson, and Tsegazeab Woldetatio is gratefully acknowledged.

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## LIST OF ACRONYMS AND ABBREVIATIONS FOR WSARP PUBLICATIONS

Acronym	Organization or Meaning
A & E (A/E)	Architectural and Engineering
ACIAR	Australian Centre for International Agricultural Research
AID/Wash.	Agency for International Development/ Washington D.C.
AOAD	Arab Organization for Agricultural Development
ARC	Agricultural Research Corporation of Sudan
AVRDC	Asian Vegetable Research and Development Center
BNIADP	Blue Nile Integrated Agricultural Development Project
CAT	Contracting and Trading construction contracting firm
CGIAR	Consultative Group for International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropica
CID	Consortium for International Development
CIMMYT	Centro International Mejormiento Maize Y Trigo (International Maize and Wheat Center)
CIP	Centro International De Papa (Intl. Potato Center)
COP	Chief of Party
CRSP	Collaborative Research Support Program
CSIRO	Commonwealth Scientific and Industrial Research Organization
DECARP	Desert Encroachment Control Project (proposed)
DG	Director General
EASMI	Eastern and Southern Africa Management Institute
FAO	Food and Agriculture Organization of the United Nations
fd	feddan (1 feddan = 1.04 acre or 0.42 hectare)
FF	Ford Foundation
FSR, FSR/E	Farming Systems Research, Farming Systems Research and Extension
FU (-FU)	Farmers Union (often preceded by initials of Province/Region)
GOS	Government of Sudan
GTZ	Development Assistance Agency (West Germany)
ha	hectare (1 hectare = 2.47 acres or 2.38 fd)
HQ	Headquarters
HTS	Hunting Technical Services
IADS	International Agricultural Development Service
IARC	International Agricultural Research Center
IBPGR	International Board for Plant Genetic Resources
IBRD	International Bank for Reconstruction and Development
ICARDA	International Center for Agricultural Research in Dry Areas
ICRAF	International Council for Research in Agroforestry
ICRISAT	International Crops Research Institute for the Semi-arid Tropics
IDA	International Development Association (World Bank)
IDRC	International Development Research Center
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Institute
IITA	International Institute for Tropical Agriculture
ILCA	International Livestock Centre for Africa
ILLRAD	International Laboratory for Research on Animal Diseases
INTSORMIL	International Sorghum and Millet CRSP
INTSOY	International Soybean Program
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research

Acronym	Organization or Meaning
JMRDP	Jebel Marra Rural Development Project
KRT (or KHT)	Khartoum, Sudan
LMMC	Livestock Meat Marketing Corporation of Sudan
LS	Sudanese Pounds
LT	Long-term
MA	Master of Arts Degree
MAFNR/MAJ	Min. Agric., Food & Natural Resources/ Min. Ag & Irrig.
MBCR	Marginal Benefit Cost Ratio
MFC	Mechanized Farming Corporation
MOU/PSG	Memorandum of Understanding/Program Support Grant (between USAID and US Universities)
MS	Master of Science Degree
NAW	National Administration for Water
NMAPC	Nuba Mountain Agricultural Production Corporation
NMRDC	Nuba Mountain Development Corporation
NRC	National Council for Research
PACD	Project Assistance Completion Date (AID)
PEU	Planning and Evaluation Unit
PhD	Doctor of Philosophy Degree
PL480	Agricultural Trade, Development and Assistance Act (source of local currency provided by USAID to host country)
PRC	People's Republic of China
PSU	Project Support Unit
RA	Research Associate
SATEC	Regional Economic Development Services/East Africa (AID)
SEMAS	Societe D'Aide Technique Et De Cooperation, France
ST	Sag El Nam Agricultural Scheme
TA	Short-term
TEU	Technical Assistance
TDY	Training and Extension Unit
U/KRT	Temporary Duty
UNDP	University of Khartoum
UNICEF	United Nations Development Programme
USAID	United Nations Children's Educational Fund
US	United States Agency for International Development
USIS	United States of America
VE	United States Information Service
WA	Value Engineering
WB	Washington
WID	World Bank (see also IDA and IBRD)
WSARP	Women in Development
WSDC	Western Sudan Agricultural Research Project
WSU	Western Savanna Development Corporation
	Washington State University

## **I. EXECUTIVE SUMMARY**

The Western Sudan Agricultural Research Project (WSARP) was initiated in 1979 under the terms of the Consortium for International Development (CID)/ Agency for International Development (AID) contract afr-1539. Washington State University (WSU) assumed the lead university role for the Project, which was identified by USAID as a Title XII project to be implemented in the collaborative assistance mode.

The Project was broad in its scope and purpose. Basically, the objectives of the Project were as follows: (1) the establishment of a research infrastructure in Western Sudan, and (2) the development and conduct of applied/adaptive research programs.

In order to accomplish these objectives, the Project renovated existing research station buildings and constructed new facilities at sites in Kadugli, El Obeid, El Fasher, Ghazala Gawazet and Khartoum North. Other physical infrastructure was established together with associated procurement. The total spent for procurement and shipping of commodities, equipment, materials, and supplies was approximately \$3.84 million.

Human resource development included training programs implemented at three levels: (1) degree training in the United States, (2) short-term courses and training programs abroad and in-country, and (3) on-the-job training within the Project. Eight Sudanese either received or were nearing completion of a M.S. degree before the end of the Project. Seven Sudanese either received or had made significant progress towards a Ph.D. degree before the end of the Project. Approximately 60.1 person months of short-term training and on-the-job training occurred.

Research activities were conducted at all Project sites with monitoring provided by research committees at three levels. Approximately 57 formal Project publications and over 70 auxiliary documents were completed during the life of the Project, and Project scientists presented Project research papers at various professional meetings.

The CID/AID contract ended on December 31, 1985. However, under existing USAID and Government of Sudan (GOS) agreements, WSARP will continue to develop the research program in Western Sudan and complete the construction of facilities initiated under the CID/AID agreement.

Lessons learned within the first 6-1/2 years of the WSARP include the following:

- ◆ A multidisciplinary systems oriented research approach can be successfully implemented to focus complementary commodity and discipline efforts on developing adoptable technologies for solving Sudan's production problems.
- ◆ Logistic, administrative backstopping, and support of a Sudanese research program, especially outside Khartoum, must receive higher priority than similar efforts in settings with more developed support capabilities.
- ◆ Recruitment, training, and retention of research scientific, technical and support personnel must receive highest priority in the management of WSARP, in order to successfully carry out agricultural research development activities.
- ◆ Projects such as WSARP, wherein there are multiple major project stakeholders, must experience consensus among the stakeholders relative to project objectives, activities, and time requirements.
- ◆ Support should be continued for WSARP, and such support should be developed in concert with development of Sudan's rainfed agricultural sector.

WSARP was evaluated on numerous occasions during its implementation. The Project responded to each evaluation and incorporated recommendations in subsequent planning. The Project was as fully integrated into the parent Agricultural Research Corporation (ARC) as possible, and linkages were established with numerous research and development entities within and outside Sudan. Major Sudanese and donor stakeholders participated in Project development and decision making. Input from local producers and from Regional and national officials was utilized. WSARP has established a firm foundation upon which to build future rainfed agricultural research in Sudan. Expansion and replication of successful WSARP activities can contribute to improving the agricultural production and economy of Sudan.

## II. INTRODUCTION

This final report, prepared by Washington State University and the Consortium for International Development, as mandated under the terms of the CID/AID contract afr-1539, is final only in the sense that it marks the completion of the technical assistance contract between WSU/CID and USAID for the implementation of WSARP. Under existing agreements between USAID and the Government of Sudan, WSARP will extend through December, 1987, continuing the development of the Western Sudan research program which was initiated under the WSU/CID USAID agreement.

The report will deal with the first six years of this development effort, which is the period for which WSU/CID had a major role and responsibility. These responsibilities and accompanying activities will be summarized, with a focus on: (1) Project accomplishments, including physical and human resource development, provision of technical assistance, and management strengthening; (2) present and future Project impact; and (3) lessons learned. {

The perspective of this report is evaluative in perspective. It will attempt to describe not only what happened during the relevant time period, but also why. The purpose of this narrative style is to assist others to better predict and control the results of future development efforts and to clearly relate the Project's immediate objectives to those higher, longer-term objectives to which it contributes. Moreover, such a format is necessary in order to put into perspective the impact of the ever changing Sudanese economic and political climate within which the Project developed. These changes in the Project environment, many outside the control of either donors, contractors, or Project management staff, had a profound impact on Project activities. In response to these shifts in the Project environment, changes to the original design were necessary and imperative. This report also summarizes these necessary adaptations.

The scope of the WSARP was very ambitious, especially given the virtual absence of any support infrastructure in place at the time of Project implementation. Major efforts were expended in organization of logistical support for the construction program, acquisition and

on-site delivery of equipment and materials to develop and implement the research program, and for the support of both Sudanese and non-Sudanese Project personnel and their families. Such activities required a high degree of teamwork and cooperation from many quarters, including donors, contractors, governmental groups and Project staff. In addition, major management efforts were required to assemble as many interested parties as possible, eg. donors, local, regional and national policy makers, the ARC, scientists from the Sudanese and international community, and local producers themselves to collaborate on the development of the adaptive research program, so that it would have the best, most appropriate programmatic focus.

WSU/CID would like to especially thank Dr. D.A. Dafalla, Director, WSARP; Dr. Osman Khalifa, former Director, WSARP; Dr. M. Bakheit and Dr. H. Burhan, former Director Generals, ARC; the exciting and dedicated WSARP scientific staff; the WSARP administrative, technical, and support staff, and our architectural and engineering colleagues, who all nurtured and carried out the development of WSARP. The dedication, support and assistance of all our donor colleagues is gratefully acknowledged, and we would like to especially thank Dr. Ray Carpenter, Joyce Turk, Elizabeth Martella and Ken Lyvers, USAID; and Stuart Marples and Ingrid Foik, the World Bank (WB). Finally we wish to thank the Sudanese Government agencies and the Sudanese people in Khartoum and in the Regions who provided continuous support and assistance to the Project.

WSARP Sudanese and WSU/CID colleagues are encouraged by the success achieved to date. The lasting impact of this Project clearly lies in building on the firm research and outreach foundation, detailed in the following sections, which has been established.

### III. PROJECT GENESIS AND EVOLUTION

In order to put the Project's present and potential impact into perspective, it is necessary to review its genesis and the events which resulted in its evolution to the form which exists today. WSARP was one relatively small component of a large master plan to improve the effectiveness and efficiency of Sudan's agricultural research programs. The Project itself changed considerably from the time of its initial design by the World Bank in 1977 to its official implementation in August, 1979. In addition, the Project continued to evolve throughout its life in response to changing conditions in the external environment. Although modifications were made with the concurrence of donors and GOS during implementation, assessment of Project achievements was complicated by these evolutionary changes.

#### Ford Foundation Study, 1975

In 1975, the Ministry of Agriculture, Food and Natural Resources (MAFNR) requested the Ford Foundation to assist in a study of selected crop and discipline research capabilities and to suggest ways and means of strengthening the Sudan's agricultural research and related services. This study was carried out by a number of Sudanese and external scientists and administrators, and culminated in an international workshop on agricultural research and development in Sudan in November, 1976. The GOS and Ford Foundation agreed that the study reports and the results of the workshop be integrated into a master plan for strengthening the research capabilities of the Sudan, focusing primarily on the Agricultural Research Corporation.

#### Sudanese/IADS Studies, 1977

The International Agricultural Development Service (IADS) undertook the development of the recommended research master plan, with a study conducted in 1977 by a joint team of senior Sudanese and IADS scientists. The team was requested to also give attention to the coordination of regional research priorities into a comprehensive national program. However, this study did not include the western

regions of Sudan due to a concurrent World Bank Study which was focusing on that geographic area. The Sudanese/IADS study concluded with a Joint Team Report containing a series of 33 recommendations directed at various aspects of the ARC.<sup>1</sup> These recommendations can be generally summarized in six primary operational areas:

- ◆ the reorganization of the ARC and improvement of its operation and management (including a shift from isolated disciplinary research programs to coordinated commodity and factor problem research specific to regional/national concerns, the transfer of ARC headquarters from Wad Medani to Khartoum, improved research program planning and evaluation, and improved library and information services);
- ◆ the establishment of a coordinated multidisciplinary team approach to agricultural research, integrating crop and livestock production;
- ◆ expansion of the research station network into previously poorly serviced areas, with emphasis on the South and West, and including improved support services from the new Headquarters;
- ◆ manpower development and improved personnel management, at the technical as well as scientific level;
- ◆ the incorporation of economics and the social sciences into the research program; and
- ◆ improved linkages with external agencies for support and technical assistance.

This report further recommended the implementation and funding of projects designed to assist in the implementation of this master plan. Recommendations of this report are included as Appendix I.

#### World Bank Study, 1977

The concurrent World Bank/International Development Association (IDA) study of the research needs for Western Sudan primarily addressed the extension of the research network into these western

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<sup>1</sup>Idris, H.A. and A.H. Moseman, Sudan Agricultural Research Capabilities: The Joint Team Report to the Ministry of Food, Agriculture and Natural Resources, IADS, NY, 1977.

areas, but also the need to strengthen the ARC, which included the proposed moving of ARC headquarters to Khartoum. The World Bank study concluded with the design of a project, "Sudan Agricultural Research Project<sup>2</sup>," in June, 1977.

The Government of Sudan then requested IDA to further develop and finance this Project for the rainfed and semiarid regions of Western Sudan. Concurrently, USAID proposed another project for Northern Kordofan. Because it appeared that the funding requirements and emerging needs of the IDA project exceeded the scope of the IDA/Government of Sudan agreement, the Ministry of Agriculture, Food and Natural Resources responded to the USAID proposal by requesting that USAID fund the technical assistance aspects of the IDA project instead of the Northern Kordofan project. Subsequently, the project design was discussed and agreed upon during meetings between the Government of the Sudan, the World Bank, and AID in May, 1978.<sup>3</sup>

#### Project Defined 1978

In July, 1978, a formal loan agreement (Project Agreement) was signed between the GOS/ARC and IDA, and subsequently, a Project Grant Agreement was signed between the GOS and AID in September, 1978 for the "Western Sudan Agricultural Research Project". The IDA/GOS agreement was to finance construction and the purchase and operational expenses for a Project aircraft, while the GOS/AID agreement supported technical assistance, training, purchase of commodities, equipment, supplies, and some recurrent costs.

The purpose of the Project, as defined in the AID document was "to increase the capability of the Sudanese Agricultural Research Corporation to develop and test improved production systems that conserve and rehabilitate the natural resources and improve the standard of living of the subsistence farmers and pastoralists of

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<sup>2</sup>Sudan Agricultural Research Project, The World Bank, 1977.

<sup>3</sup>Sudan Agricultural Research Report, The World Bank, 1978, Report No. 2005-SU and the Implementation Volume of same report.

Western Sudan." In the IDA agreement, the purpose statement also included "the strengthening of the national agricultural research effort through the development of support services at the ARC headquarters." Thus, it appeared that the World Bank considered WSARP to be an integral part of the overall master plan for the development of agricultural research in Sudan, while the focus of AID's purpose was to increase the research capacity in the West. Both documents stressed an integrated crop/livestock production systems approach to research program development which was consistent with the increased mandate of the ARC to address, in addition to crop research, research on range, livestock, animal production, and natural resources.

#### Contractor CID Identified, 1978

In early 1978, USAID identified, under the Title XII Collaborative Assistance Mode, the Consortium for International Development as the technical assistance agency for implementation of the USAID portion of the Project.

In mid 1978, a CID resource team visited the Sudan and addressed programmatic requirements, which included identification of some alternatives to the original World Bank and USAID Project design.<sup>4</sup> Among those issues addressed was the location of Project Headquarters, which was later changed from Nyala to El Obeid.

In late 1978, Washington State University was designated to take the lead university role within CID.

In January, 1979, a WSU/CID team visited Sudan, toured proposed Project station sites and held discussions with Sudanese officials which were primarily directed to the infrastructural and support requirements of initiating and sustaining an adaptive research program in the West.

In March, 1979, a meeting was held in Washington, D.C. with representatives of USAID, the World Bank, the Sudanese ARC, the WSARP Project management, CID, IADS and WSU. Project status, proposed

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<sup>4</sup>Nye, W., A. Smith, et al., CID Research Team Report, July 1978.

station sites, staffing, procedures for addressing the construction and programmatic issues, the budget, and the administrative structure were discussed.

#### CID/USAID Contract Finalized, 1979

The terms of the Project Agreement documents were activated and a contract between CID and USAID was signed in August, 1979 with Washington State University as lead university.

In October, 1979, discussions were held in Sudan with the USAID Mission Director and Agricultural Officer. In addition to the issues previously discussed in Washington, the inclusion of the Ghazala Gawazet research station in Southern Darfur as part of the WSARP was reviewed. Although this station had previously been scheduled to be rennovated by the Western Savanna Development Corporation (WSDC) and transferred to WSARP in the latter's third year, the rapidly escalating costs of construction and the economic crisis in Sudan had resulted in its elimination from the WSDC. Because Ghazala Gawazet was located in one of the most potentially productive regions of the West, a decision was reached by the World Bank, USAID, the Ministry of Agriculture, Food, and Natural Resources and WSARP/WSU/CID staff that this station should become part of the WSARP research station network in the West. It was reasoned that WSARP could use this research station for its activities in Southern Darfur, since Project Headquarters were to be moved from Nyala to El Obeid. The latter move had been deemed necessary by USAID/GOS/WB because the infrastructural support, transportation, communication, and other support capabilities available in Nyala and Kadugli were felt to be inadequate to support the major construction and operational requirements of the Project Headquarters. At that time, El Obeid was the only site with a year-round airstrip, relatively reliable rail service, and functional daily communication linkages with Khartoum. In addition, collaborative use of WSARP facilities by other proposed projects [Desert Encroachment Control Project (DECARP) and Northern Kordofan] was deemed desirable, although neither project was eventually implemented. The budget was also discussed with the knowledge that the budget was not yet completely defined and would likely be revised

based on additional program activities. The expected budget adjustments would allow for mid-course changes in response to the rapidly changing external variables.

#### WSU/CID Consultant Team to Sudan, October, 1979

In October, 1979, a WSU/CID consultant team visited the Sudan to assess with USAID and ARC the new proposed site for Project Headquarters and the incorporation of Ghazala Gawazet operationally into the Project's program. As a result of these and other activities a scope of work was developed which was directed primarily at activities for the initial stages of Project implementation. (See WSARP Publication No. 1. An annotated bibliography of WSARP publications is included in Appendix II.) WSARP genesis and early evolution is summarized in Table 1.

#### WSU/CID Scope of Work Accepted, 1980

The initial scope of work for Project implementation was approved by USAID, WB and ARC in January, 1980 (WSARP Publication No. 1). This scope of work addressed: (1) the operational infrastructure; (2) the establishment of the Project Support Unit (PSU) and temporary Project Headquarters in Khartoum; (3) the construction program; and (4) the research program. Included were planning and evaluation activities to monitor and evaluate all Project efforts. Within the proposed research program, the roles of specific discipline areas, such as range/livestock, crop production, agricultural engineering (soil and water), sociology, and economics were addressed.

Also discussed was the location of ARC Headquarters, with major questions raised about the feasibility of the proposed move from Wad Medani to Khartoum, within existing budgetary constraints. It had been initially planned for the Project to purchase a building of adequate size to house ARC Headquarters and the Project Support Unit. Cost of buying such a building in Khartoum had escalated to the point where such was no longer feasible. Also, the lack of adequate ARC housing for senior management in Khartoum was a major constraint. Consequently, in late 1979, GOS, WB, and USAID decided that ARC Headquarters would not be moved, but that an ARC Liaison Office would

**Table 1**

**Summary of WSARP Genesis and Evolution -- 1975-1979**

1975	___	GOS Ministry of Agriculture, Food and Natural Resources requests study assistance from Ford Foundation.
1976	___	Ford Foundation Study completed and results presented in Workshop. Workshop recommends results be integrated into master plan for strengthening research capabilities of Sudan, primary focus on ARC.
1977	___	Sudanese/IADS team completes Joint Team Report which focused on various aspects of ARC improvement.
	___	World Bank study of Western Sudan concludes in design of proposed project "Sudan Agricultural Research Project".
	___	GOS requests IDA to further develop and finance project for rain-fed and semiarid regions of Western Sudan.
	___	USAID proposes project for Northern Kordofan.
	___	GOS requests AID funding of technical assistance aspects of IDA project.
	___	GOS, World Bank, USAID agree upon project design.
1978	___	GOS and IDA sign formal Loan Agreement.
	___	GOS and AID sign Project Grant Agreement.
	___	Project designated as Title XII Collaborative Mode by AID and CID designated as contractor.
	___	CID resource team addresses programmatic requirements of upcoming project.
	___	WSU designated as lead university.
1979	___	WSU/CID team visits Sudan and holds discussions with Sudanese officials.
	___	Meeting of USAID, World Bank, ARC, WSARP (Sudan) WSU/CID representatives held in Washington D.C. to discuss Project status, staffing, procedures for addressing construction and programmatic issues, budget and administrative structure.
	___	Contract signed between CID and USAID in August and scope of work developed.

be established in conjunction with a WSARP Support Unit and a small office facility built at Shambat, Khartoum North, to house both.

Included in the accepted scope of work was the initiation, as soon as feasible, of preliminary research activities at Kadugli and expansion of the existing gum arabic and agronomic research efforts at El Obeid. The pilot research program at Kadugli was initiated in 1980, and the gum arabic and agronomic research efforts at El Obeid were expanded the same year.

Based on the above planning activities, and the requirement for redefinition and planning of the major construction program in light of the rapid escalation of construction costs, the decision was made to give priority to construction at the Kadugli Research Station in Southern Kordofan. The renovation of existing facilities and construction of programmatically necessary additional buildings was to be undertaken as soon as possible. This decision was based upon the need to initiate research as soon as possible and to develop and validate research and support requirements and procedures that could be transferred to the other stations when they became operational.

USAID identified Karplen Consultants, a local Sudanese firm, as the architectural and engineering (A&E) firm for the Kadugli construction program, and the international firm of Contracting and Trading Co. (CAT) began construction in May, 1980.

#### A&E Firm Selected, January 1980

Grube-Zimmer, Inc. was identified, after an extensive search and review by the donors, GOS, and WSU/CID, as the architectural and engineering firm for the design of the major construction program, i.e., all but the Kadugli station, in January, 1980. A detailed development study of construction options, costs, feasibility and recommendations was made by Grube-Zimmer, Inc. in May, 1980.<sup>5</sup> This study finalized many of the initial design and construction issues for the proposed Project Headquarters at El Obeid, a research station at

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<sup>5</sup>Grube, J., WSARP Station Development Study, May 1980, WSU (WSARP Auxiliary Publication Series).

El Fasher, the proposed construction/renovation of facilities at Ghazala Gawazet, and the Khartoum Project Support Unit/ARC Liaison Office. In the latter case, consideration was given to the future expansion of this facility, should funds become available for the eventual transfer of the total ARC management offices from Wad Medani to Khartoum. This transfer could not be implemented at this time, because of the lack of sufficient funding.

Investigations of the construction environment in Sudan beginning in January, 1979, and continuing thereafter, indicated that there had been several significant changes since the original proposal forwarded by the World Bank in late 1977, and adopted by USAID without changes. Specifically: (1) the facility requirement was inadequately defined in the World Bank document; (2) the addition of construction costs at Ghazala Gawazet was not included; (3) inflation had had a dramatic impact on construction costs; and (4) the Western Savanna Development Corporation's construction program had come in at 50% above original estimates. As a result, reductions in Project scientific staffing and commensurate decreases in the construction program were agreed upon (in a series of donor/GOS/contractor meetings in late 1979 and early 1980) and subsequently implemented.

Based on the actual tenders for the Kadugli Station's renovation and construction activities and on the development study done by Grube-Zimmer, Inc., numerous discussions were held between USAID, ARC, the Ministry of Planning, the Ministry of Construction and Public Works and the Project regarding the construction needs. As a result of these discussions, it was decided that despite the previous cutbacks in staffing and housing, it would be necessary to request additional funding from USAID to allow sufficient funds for the inclusion of the proposed renovation and construction program at Ghazala Gawazet. The inclusion of this station to support research activities in Southern Darfur was deemed necessary by the GOS and donors to preserve the integrity of the original Project design.

### Project Paper Amendment, 1980

A Project Paper Amendment<sup>6</sup> was prepared and approved in mid-1980. Major design changes which were validated in this document included:

- ◆ the move of Project Headquarters from Nyala to El Obeid;
- ◆ changes in staffing patterns, primarily reflecting an increase in research support staff and decrease in scientists at the research stations, and the addition of ancillary support staff for Project-wide activities such as library, information services, and biometrics;
- ◆ alterations in the technical assistance staffing patterns, including changing the ARC Architect/Planner position to Project Engineer, changing the ARC Research Planning and Evaluation Advisor position to Chief Administrative Officer with the assignment of all direct ARC advisory activities to the position of Senior Advisor to the Director General of the ARC, changing the position of Agro-Climatologist to Range Specialist and renaming the position of Livestock/Crop Production Specialist as Livestock Specialist; and
- ◆ revision of the intended move of the ARC management staff to Khartoum, to the establishment of a Project Support/ARC Liaison Office in Khartoum.

Final locations and titles of WSARP stations and facilities are indicated in Figure 1.

### Project Implementation, Late 1980 to Mid 1982

In order to further develop the research program and related infrastructural, administrative, and support requirements, a series of implementation planning sessions were held in October/November, 1980. This planning process involved a number of consultants, WSARP staff, USAID and WB representatives, representatives of other organizations and projects, the Ministry of Agriculture, Food and Natural Resources (MAFNR), the University of Khartoum, and many others. Many members of the planning group were also able to participate in a comprehensive planning conference for the Kordofan Region. The result of these

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<sup>6</sup>AID Project Paper Amendment, Project 650-0020, May 1985.

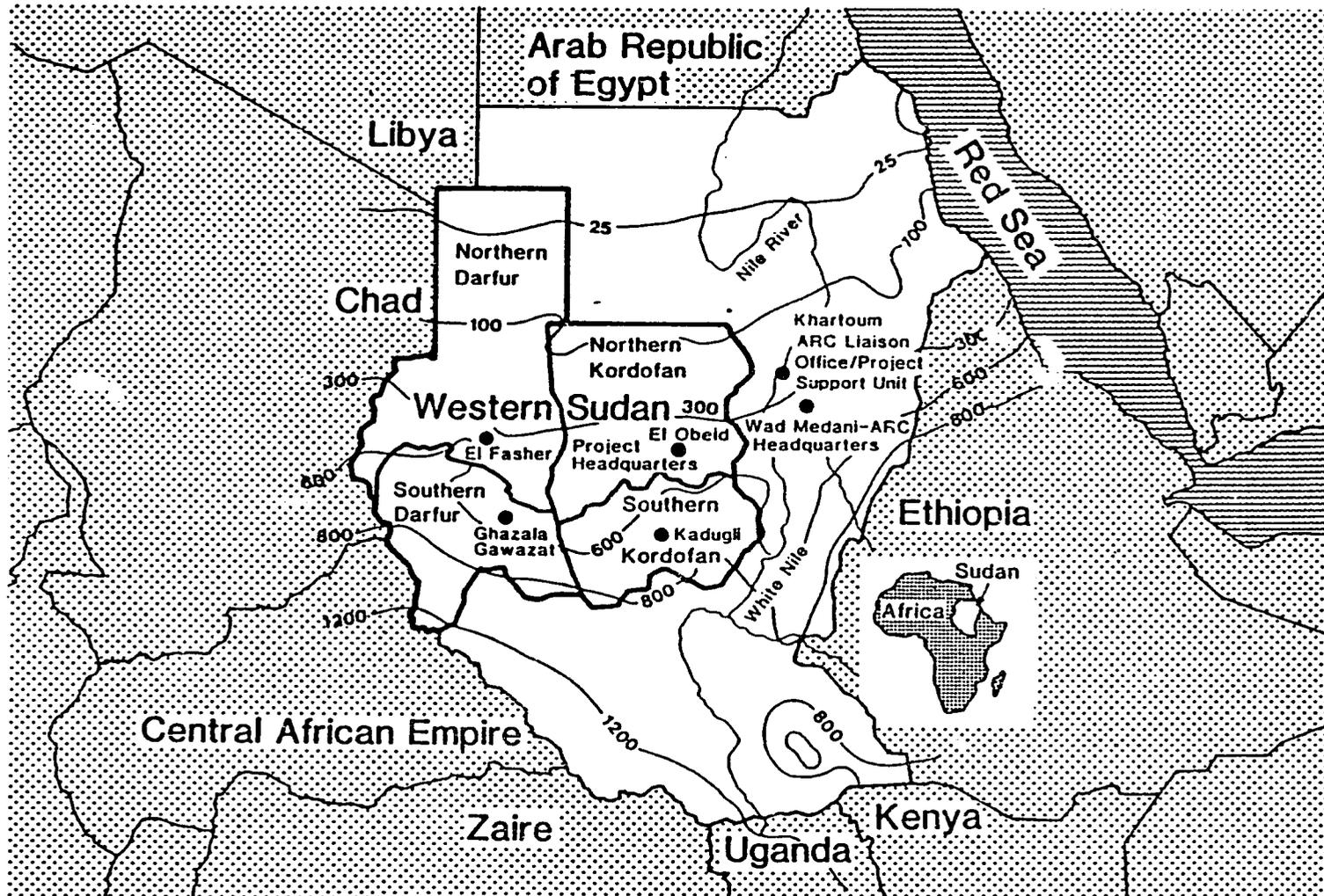


Figure 1: Locations of WSARP Research Stations and Related Facilities  
 (Numbers refer to rainfall isohyets, expressed in mm/yr)

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meetings was the preparation of a detailed plan describing research activities, the construction program, and related infrastructural and support requirements for the Project for 1980-81 and 1981-82, a period up to the scheduled mid-term evaluation in 1982 (See WSARP Publication No. 5). Research programs were outlined for this period, highlighting potential technical inputs in the areas of range, agricultural engineering, agronomy, horticulture and pest management, agricultural economics, social science, and animal production and health. The development of the Project Support Unit in Khartoum was addressed in detail as were the issues of staffing, training, and the Project and research time-frames.

The programmatic discussions of these meetings focused on the desirability of implementing a multidisciplinary, systems-oriented, adaptive research program, beginning with an understanding of the producers' needs and resource capabilities and relating these to the needs and capacities of local, Provincial, Regional, and national support agencies. Also highlighted was the need for a unified, integrated agricultural research program for the Western Regions, and the critical importance of incorporating the WSARP research program into the overall research effort of the ARC. Based on the activities of numerous other development projects in the Kadugli area [West German Development Assistance Agency (GTZ), Societe D'Aide Technique Et De Cooperation, France (SATEC), and NMRDC], the agricultural mechanization component of the Kadugli program was scaled back.

Although housing and facilities were extremely limited in Kadugli pending station construction completion, it was decided to implement research activities there as soon as possible. Results of the initial program would then be used as the basis for the establishment of a comprehensive Kadugli research program as soon as station facilities were completed. With the experience gained from establishment and operation of the pilot program at Kadugli, rapid establishment of the research programs at the other three stations would be facilitated.

The initial research in the Kadugli area was thus carried out by a very limited number of scientists. With the research infrastructure being developed concurrently rather than prior to conduct of research, difficulties associated with limited trained personnel,

transportation, communication and other support were encountered. In spite of these limitations, research progress was significant.

At the same time, recruitment efforts continued to identify Project trainees in disciplines which were consistent with established research program needs. Training periods of 3 years for an MS and at least 5 years for a PhD were projected. This resulted from ARC's initial requirement for 6 month internships to be served in Kadugli by all trainees prior to departure for training, and from a review of training performance records of ARC scientists who had trained in the US. Steps were taken to identify some trainees who had already commenced training in the US, in order to have some new scientists back in Sudan before Project completion. Also, the processes relative to construction tendering, prequalifying of contractors, and the identification of a construction firm continued.

During the period from late 1980-82, the Project proceeded with the implementation of planned activities including: (1) development of the research and support infrastructures; (2) implementation of the construction program; and (3) implementation of research activities. Major progress during this period is included in Table 2 and detailed in WSARP Publication Nos. 7-15.

#### Project Mid-term Evaluation, November 1982

In November, 1982, a Project mid-term evaluation, initiated by the USAID and the World Bank, was held to determine Project status and provide guidance for future Project programs. The evaluation team was composed of Dr. Kenneth Turk, Cornell University, team leader; Dr. Michael Collinson, CIMMYT/Kenya, USAID representative; Dr. John Vercoe, CSIRO, World Bank representative; and Dr. Hussein Idris, UNDP, GOS representative. The summary and recommendations of this report are contained in Appendix III. It is noteworthy that two of the team members were also members of the original Ford Foundation/IADS design study in 1976.

The Kadugli construction program was completed in mid-1982, and it was then possible to increase staffing levels accordingly. At the time of the mid-term evaluation, the multidisciplinary research program was in its initial stages. The evaluation team's

Table 2

Summary of WSARP Genesis and Evolution -- 1980-1986

1980	WSU/CID scope of work accepted by donors.	1983	Project implements approved recommendations of mid-term evaluation.
	Search and review process for A&E firm terminates, and donors, GOS and WSU/CID select private US firm, Grube-Zimmer to design and provide oversight for construction program with exception of Kadugli station.		Research at El Obeid expanded and systems approach adopted.
	Grube-Zimmer submits detailed study of construction options, considerations and recommendations.		Construction program experiences continued delays.
	Project Paper amendment prepared by USAID in collaboration with Project, WSU/CID and ARC/GOS. Project Paper approved by AID/WA.	1984	USAID sponsors external review of WSARP.
	Planning meetings held in Khartoum and Kadugli. Participants include consultants, WSARP staff, USAID, Ministry of Agriculture (GOS) University of Khartoum, WSU/CID and other organizations/project representatives.		USAID eliminates TA Social Scientist position.
	Project proceeds relative to 1980 planning document, including construction, training, research, and infrastructure development.		In-depth review of construction program completed. USAID makes decision to continue construction program in Darfur.
1982	Project mid-term evaluation held.	1985	USAID terminates TA positions of Sr. Range Scientist, Senior Advisor to Director General of ARC, Project administrative officers and Force Account Engineer in April.
	Kadugli construction completed.		WSU/CID technical assistance team composed of Sr. Agronomist, Deputy Director/Research Program Leader, and Soil and Water Specialist completes contract and departs country in July.
	Construction of El Obeid, El Fasher, and Ghazala Gawazet research stations and PSU/ARC Liaison Office experience continued delays.		Animal Production Specialist and Agricultural Economist's tours of duty extended and they depart country in November.
			WSU/CID support personnel conduct Project close-down activities in Sudan.
		1986	Returned WSU/CID scientists finalize data analysis, Project close-down and preparation of final reports.

recommendations clearly reaffirmed that WSARP's multidisciplinary adaptive research orientation was appropriate and was a marked departure from the usual ARC research approach. Accordingly, they recommended that additional mechanisms should be established to ensure its acceptance and incorporation within the ARC. The team also reinforced earlier Ford/IADS and World Bank recommendations, i.e. the desirability of transferring ARC management headquarters to Khartoum, which was in keeping with ARC's national responsibilities as the technical arm of the Ministry of Agriculture, Food, and Natural Resources.

The mid-term evaluation further recommended improvements in Project management and support, including: (1) a redefinition of the roles and responsibilities of all senior management personnel (Project Director; Director General, ARC, WSU Project Coordinator; and Chief-of-Party); (2) increased delegation of authority; (3) increased use of the IARCs as training resources; and (4) improved internal library information support and external communications. The team also recommended an increase in utilization of more informal data collection methods and more on-farm trials, in the Farming Systems Research and Extension (FSR/E) mode. The evaluation stressed the unavailability of qualified Sudanese personnel at all levels of the research/support infrastructure, and recommended several possible mechanisms to overcome this problem.

As a result, increased emphasis on WSARP-ARC interaction was initiated, and included the formalization of a number of intra-Project and Project-ARC research planning, review, and approval mechanisms. While the issue of overall ARC strengthening had moved outside the direct purview of WSARP, the emphasis placed by the evaluation team and the Project on this important issue contributed to the initiation of a number of activities by donors and ISNAR to review ARC's structure and functions, and to recommend additional changes.

The position of the Senior Advisor to the Director General of the ARC and the utilization of WSARP as a pilot program within ARC for evaluating the adaptive approach to agricultural research continued to be the Project's primary contributions to the overall national research effort vis-a-vis the ARC. The inclusion of Project System

Coordinators, i.e. Sedentary, Transhumant, and Nomadic, in the national program Coordinating Committees and the inclusion of the WSARP Director on both the finance and program committees of the ARC, improved programmatic integration between the Project and the ARC. Also, an increased number of joint ARC/WSARP activities were initiated, including Farming Systems training and increased research collaboration. Details concerning WSARP's adaptations in response to the mid-term evaluation are included in WSARP Publication No. 19.

#### 1982-1984

Substantial delays in the construction program occurred as a result of numerous factors. These included among others, construction contractor management deficiencies, the inability of GOS to provide on-site supervisory personnel, delayed payments, water usage bans, banning of firewood collection/burning in Kordofan which prevented firing of bricks, fuel and cement scarcities, and problems in site delivery of construction materials. Additional details are provided in Section V.A.1 of this report. As a result of the delayed availability of the station facilities the decision was made to attempt to initiate an integrated research program in El Obeid in 1982 utilizing temporary facilities until construction was completed. However, severe housing shortages in El Obeid limited this effort.

Utilizing the limited WSARP staff, ARC, collaborative efforts with INTSORMIL and ICRISAT personnel, and the input of Kadugli-based WSARP personnel, development of a comprehensive, integrated research program for Kordofan Region was initiated in 1983-84. Its design and implementation were, however, hampered by the lack of experienced senior research personnel in El Obeid. With the exception of the WSU/CID Soil and Water Specialist, all scientists were newly returned from training overseas. The lack of housing and research facilities in El Obeid pending station completion limited the success of recruitment efforts for senior Sudanese scientists. At this time it also became evident that a major recruitment constraint was the perception on the part of potential staff that the Project had a finite lifespan and that future personnel support in the West was uncertain. In fact, all but senior scientific staff who were

recruited by the Sudanese Project Director were informed that their positions could not be guaranteed beyond 1985. Also, in line with the definition in 1979-80 of the training program for senior scientists, most of the trainees were not due back in Sudan until the latter years of the Project, with some not scheduled to be completed until 1985-1987. For additional information regarding events, refer to WSARP Publication Nos. 19 and 33.

#### 1984-1985

An internal assessment of the USAID country-wide agricultural program began in 1984, and, accordingly, WSARP was reviewed by USAID. Following a USAID audit report of WSARP in February, 1984, an external USAID evaluation team, composed of Drs. Carl Gotsch and Bill Wright, reviewed Project activities in July-August, 1984. The team recommended the continuation of USAID technical assistance support to WSARP as an important component of AID's overall development strategy for the rainfed sector.

The Gotsch-Wright evaluation further strongly recommended that this commitment for long-term WSARP support be made immediately rather than allowing interruption of the program. (The Executive Summary of the evaluation report is included as Appendix IV.) In spite of those recommendations, major design changes were initiated by USAID in 1984-1985. These changes included: (1) elimination of the Technical Assistance (TA) position of social scientist; (2) modifications of the GOS/AID agreement to remove all USAID support for the Project Support Unit/ARC Liaison Headquarters in Khartoum and formal elimination of the Project Support Unit (PSU), Training and Extension Unit (TEU), and Planning and Evaluation Unit (PEU) from the agreement; (3) termination of the positions of Senior Advisor to the Director General of the ARC, Senior Administrative Officer, Project Engineer and Associate Administrative Officer from the technical assistance team; and (4) the withholding of the planned movement of additional expatriate scientists from Kadugli to El Obeid. The decision was also made to withdraw all support for force account activities and technical assistance, including procurement, for activities in Darfur.

Following an in-depth evaluation of the construction program by a USAID Value Engineering Team in October-November, 1984, it was decided by USAID to continue funding the construction program in Darfur, with the understanding that program development, additional procurement and operations for these stations would be supported by another donor, possibly the World Bank. Project events during this period are detailed in WSARP Publication No. 39.

In August, 1985, the remaining members of the WSU/CID technical assistance team completed their contracts, with the exception of the Animal Production Specialist, the Agricultural Economist, and the Grube-Zimmer Engineer, whose tours were extended through December, 1985. Local administrative personnel were hired to assist with the administrative requirements of the WSU/CID contract and research logistical support. Technical assistance relating to planning, implementation, and support for Project activities consequently continued at a greatly reduced level during the 1985 season. During the US Embassy's personnel reduction program in November, 1985, all remaining WSU/CID personnel left Sudan. Following their departure, WSU/CID contract close-down activities were conducted in Sudan in December, 1985 and January, 1986. Limited support for data analysis and final report preparation was provided through 28 February 1986. As of 1 March 1986, final data from the 1985 season which were to have been forwarded to WSU have not yet been received.

#### IV. PROJECT IMPACT

The Project was initially designed to develop and institutionalize an efficient system for agricultural research in Western Sudan. It was felt by the Project designers (GOS, AID, World Bank) that such a system, in concert with improved extension capabilities to make information available to the producer clientele, and with improved infrastructural development (including improvements in the transportation and marketing systems) would substantially contribute to improving the standard of living for traditional producers and the economy of the Western Regions and the nation.

The basic components of the agricultural research system design are now in place in Western Sudan. Kadugli, the prototype station in this research network, carried out effective adaptive research for over three years, and generated results which have already been extended to local producers and are now ready for wider dissemination. In addition, research results have been shared with policy-makers within the ARC, as well as with the Regional and national governments.

The WSARP has demonstrated that an adaptive research program in Western Sudan can be effective in producing results of immediate application to local and regional producers, and be efficient in utilizing the commodity and basic research capabilities of the other components of the ARC and of other national and international research entities. Through linkage mechanisms, including the position of the Advisor to the Director General of the ARC, joint training in farming systems methodology, joint research program planning and evaluation activities and others, the WSARP has attempted to institutionalize this research approach within the ARC.

The 1985-86 crop season marked the initial consolidation of the two programs at Kadugli and El Obeid into a single integrated adaptive research program for the Kordofan Region. A preliminary research program, utilizing the same concepts, has been developed for the Darfur stations in cooperation with ARC, the Regional government, the Western Savanna Development Corporation and other projects operating in Darfur. The development and institutionalization of the WSARP agricultural research operations in Western Sudan reached a peak in

early to mid-1985. After this time the decrease in technical research staff, compounded by the limited number of Sudanese scientists who had returned from training abroad; the decrease in support services provided by the PSU; the elimination of the position of Senior Advisor to the Director General of the ARC; and the increasing uncertainty about the Project's future, all resulted in a negative impact on the progress of the program. A lowering of morale and resultant decrease in Sudanese staffing at the scientific, administrative, and technical levels has occurred. Consequently, Project impact can be expected to be adversely effected by this loss of momentum.

It is important to note that in order to realize the benefits of progress to date, it will be necessary to revitalize operation of the research support infrastructure and, especially, to improve mechanisms to recruit and retain qualified personnel in the West. Several mechanisms have been put in place to accomplish this task, including (1) institution of the 25 percent salary incentive for scientists and other personnel to work in the West; (2) provision of high standard Sudanese housing containing basic appliances; (3) provision of research equipment, transportation, and supplies; and (4) the establishment of a challenging and rewarding research program. As the WSU/CID team terminated activities in Sudan it was apparent that future staffing is the highest priority issue for WSARP.

The potential impact of WSARP on ARC research management and programs as envisioned in the master plan and subsequently incorporated into the USAID and WB documents, was limited by a number of factors including: (1) the decision by ARC and donors for ARC Headquarters and senior management to remain in Wad Medani; (2) ARC's decision to locate the position of Senior Advisor to the Director General of ARC in Khartoum; and (3) lack of implementation of other necessary segments of the Joint Team master plan (See Appendix I). For example, while it was envisioned that all animal production, range and forestry, and natural resource research would come within the ARC responsibility, this in fact has not happened. Thus, WSARP is currently the only ARC activity encompassing these latter disciplines.

Large ARC human resource development programs were recommended in the master plan to increase the number and level of trained personnel

in the social sciences, economics, and other disciplines as well as the technical and support personnel. Due to limited ARC resources and lack of alternative funding sources, this recommended large human resource development plan has only been partially implemented by ARC. WSARP itself has contributed to an increase in number and level of training of ARC (WSARP) personnel. Also, the ARC, like other organizations in Sudan, has been impacted by a large outflux of trained personnel to alternative employment opportunities in the Gulf States and elsewhere during the past six years. Senior ARC management has changed four times within the course of the Project.

The position of Senior Advisor to the Director General, ARC, has functioned effectively to link ARC and Project scientists with one another and with other organizations both within and outside of Sudan. It has also provided valuable research input to both the ARC and WSARP. However, the factors discussed above prevented the realization of the substantial changes in central ARC research management, planning and evaluation envisioned by the original Project designers.

In order for the Project to substantially contribute to the higher order goals of improving the standard of living for the traditional farmers and pastoralists in Western Sudan in concert with improvements in the national economy, it was realized that an improved extension/information dissemination system and improved transportation and marketing systems would have to be established. The limited improvements in either area (although substantial investments in the latter areas are planned) have hampered the immediate ability of the Project to effect increases in crop production, improved livestock offtake, and, therefore resultant increases in income and standard of living for the producers of this area. However, within a very short time the research program has been able to produce a number of management and technological improvements demonstrated to increase production and productivity at the local level. With improvements in information dissemination and infrastructural development, it is anticipated that the research network of Western Sudan can have a significant short-term impact in the future. Research results showing high potential for present and future impact are described in detail in Section V.B.4 of this report.

The Project's impact to date has been to demonstrate that while extremely difficult, it is feasible to develop research networks in previously unserved portions of the country and that productive research results with immediate application to Sudan's production needs can be generated in the short run. The Project's ability to directly effect any of the overall management changes in ARC recommended by the Ford Foundation Study was sharply limited by the early design changes initiated by ARC and approved by donors.

The Project has addressed research results dissemination through: (1) direct researcher-farmer interactions; (2) the creation of the positions of Production Specialists (Research Extension Liaison Officers); (3) the inclusion of regional Extension Service personnel in the design and implementation of on-farm trials; and (4) establishment of ties with traders and members of the private sector. Such efforts should be expanded, since it will be necessary to further improve dissemination of research results if desired production increases are to be realized.

In summary, the Project has had an impact on ARC, on the nation's research capabilities and on the producers in those locations where research has been ongoing. The potential for more significant impact is evident, but realization of such impact will require additional, long-term inputs to further establish and institutionalize the research program in Darfur and Kordofan.

## **V. PROJECT ACCOMPLISHMENTS**

In order to establish an effective system for agricultural research operations for Western Sudan, the Project's major objectives (outputs in ARC design terminology) were as follows: (a) the establishment of a research infrastructure in Western Sudan, and (b) the development and conduct of applied/adaptive research programs. Project inputs, including human and financial resources, are summarized in Appendices V and VIII. The activities have been previously detailed in WSARP Annual Reports, and the reader is referred to these publications for additional information. Not previously detailed in WSARP Annual Reports is the information in Appendices V and VI. These indicate some of the non-projected funded inputs provided by WSU/CID and by other cooperating organizations and institutions, and illustrate the highly collaborative nature of the WSARP efforts. Specific accomplishments are described below:

### **A. ESTABLISHMENT OF A RESEARCH INFRASTRUCTURE IN WESTERN SUDAN**

#### **1. CONSTRUCTION/FACILITIES DEVELOPMENT**

##### General

Physical facilities developed under WSARP included:

- ◆ renovation of existing building and construction of new facilities at the Kadugli Station in Southern Kordofan;
- ◆ construction of a new research station and Project Headquarters facility at El Obeid in Northern Kordofan;
- ◆ construction of a new research station at El Fasher in Northern Darfur;
- ◆ construction of new facilities at Ghazala Gawazet in Southern Darfur (with some minimal renovation of existing buildings);
- ◆ construction of a Project Support Unit/ARC Liaison Office at Shambat (Khartoum);
- ◆ force account construction at all Project sites of other types of facilities not included in the major construction contract; and



Visits by Project and donor personnel to WSU facilitated campus support of field activities. Left to right: Dr. J. Henson, WSU; Dr. Dafalla, WSARP; Ms. J. Turk, USAID; Dr. J. Kearns, CID; and Dr. J. Noel, WSU.



WSU administrators (left to right: Dr. Henson, International Program Development, Dr. A. Pettibone and Dean J. Ozbun, College of Agriculture) discuss WSU/AID collaboration with Administrator McPherson, AID.

- ◆ procurement of station facility spares.

Renovation of existing facilities and construction of new facilities at Kadugli began in May, 1980 in order to allow initiation of an early research program in that area. A major construction contract for the construction programs at El Obeid, Ghazala Gawazet, El Fasher, and at the Project Support Unit/ARC Liaison office at Shambat was initiated in 1981 and continued through the end of the Project. Force account activities under the supervision of the CID Project Engineer were ongoing from mid-1980 through April, 1985. Force account activities were assumed by a Sudanese engineer at that time. Major procurement of station spares was carried out in the final Project year to ensure a supply of necessary imported spares for the maintenance of the facilities in the immediate future.

By the end of the WSU/CID contract portion of the Project on December 31, 1985, both Kadugli Station and the Khartoum Project Support Unit (PSU)/ARC Liaison Office had been completed. The approximate state of completion at El Obeid was 95%, El Fasher 75%, and Ghazala Gawazet 75%. Supervision and construction were implemented under severe conditions and required a high degree of cooperation and involvement of all relevant personnel from both within and outside of the WSARP.

One of the basic tenets in the Project was that all construction was designed and constructed from the perspective of suitability to the Sudanese cultural and physical circumstances. The design minimized necessary support requirements and emphasized durability and cost efficiency. An initial investigation of the potential use of prefabricated materials was performed. However, the short-term benefits of speed and ease of construction were offset by the long-term liabilities of lack of suitable designs for the Sudanese family situation; the extremely high transportation costs; the risk of damage during transport to the West; the relatively high maintenance requirements; and the need for more elaborate cooling mechanisms. Retrospective assessment of lack of longevity of such prefabricated structures in Sudan clearly proved this decision well-founded.

Lessons learned from the Kadugli program were also successfully incorporated into the design and construction of the other stations. For example, heavy duty steel window and door frames which were utilized in El Obeid, El Fasher, and Ghazala Gawazet proved superior to the less durable aluminum fixtures which had been previously installed at the Kadugli station.

### Kadugli

Previously existing facilities at Kadugli included 5 senior houses, middle houses, 20 junior houses, a guest house, bachelor quarters, workers' wards, storage facilities and an office support building. These buildings had been constructed under an earlier development project funded by the Soviets. However, the buildings and station were never completed and were non-functional at the time of WSARP initiation. All facilities were in a state of disrepair and/or unfinished, and contained inadequate electrical and water distribution systems. The firm of Karplen Consultants, Khartoum was identified by USAID and hired by CID in January, 1980 to design and supervise renovation and new construction for the Kadugli Station. A contract with Contracting and Trading, Inc. of Lebanon was signed in May, 1980 to provide construction services.

Completion was initially projected for April, 1982, but the additional construction of a wet laboratory, agricultural engineering/sample preparation building, a store/canteen and additional storage/warehousing facilities were authorized when funds became available from the major construction program. The construction of these additions extended the construction period into 1982. The station was provisionally accepted from the contractor in June, 1982, with the usual one-year maintenance contract clause. The final acceptance date was June, 1983. The Kadugli Station research and residence facilities have proven to be adequate by WSARP members who subsequently lived and worked on the station.

The Kadugli facilities include new works as follows: 10 senior houses, 8 middle houses, 10 junior houses, a wet laboratory block, central warehouse, sample preparation/machinery building, generator house, fuel station, canteen, stores, commons building, and

installation of water and power systems. In addition to the new works many of the previously existing buildings were extensively renovated, and these included a guest house, bachelor quarters, administration building, 26 houses, and the site works. The Kadugli research station is illustrated in Figures 2 and 3.

El Obeid, Ghazala Gawazet, El Fasher, PSU/ARC Liaison Office

After a search and screening process, which met US Federal guidelines, the architectural and engineering firm of Grube-Zimmer of Portland, Oregon was selected in January, 1980, as the A&E consultant for the Project. A development study was completed by Grube-Zimmer in May, 1980<sup>7</sup>, and the design of the Project facilities, in close collaboration with the Project, ARC, and donors followed. After final review and acceptance of the Grube-Zimmer construction program design by ARC, Ministry of Planning and National Economy, USAID/Khartoum, USAID/Regional Economic Development Service Office/East Africa (REDSO/EA), the World Bank, and the Project, the search for and identification of a construction contractor was begun in late 1980. A prequalification committee composed of representatives of the WSARP, the Ministry of Finance, the Ministry of Planning and National Economy, the Ministry of Construction and Public Works, and Grube-Zimmer reviewed all prequalification documents.

Several prequalification committee members expressed strong opinions in favor of prequalifying at least two Sudanese contractors as long as data supplied could be reasonably interpreted to meet the established criteria. In the case of El Khidr and Deraige, this meant accepting a joint venture between El Khidr, who had the required experience but lacked financial strength, and Deraige, Governor of Darfur, who had no experience in construction contracting, but had the necessary financial capability. It was the committee's decision to prequalify El Khidr and Deraige.

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<sup>7</sup>Grube, J. WSARP Station Development Study, May 1980, WSU (WSARP Auxiliary Publication Series).

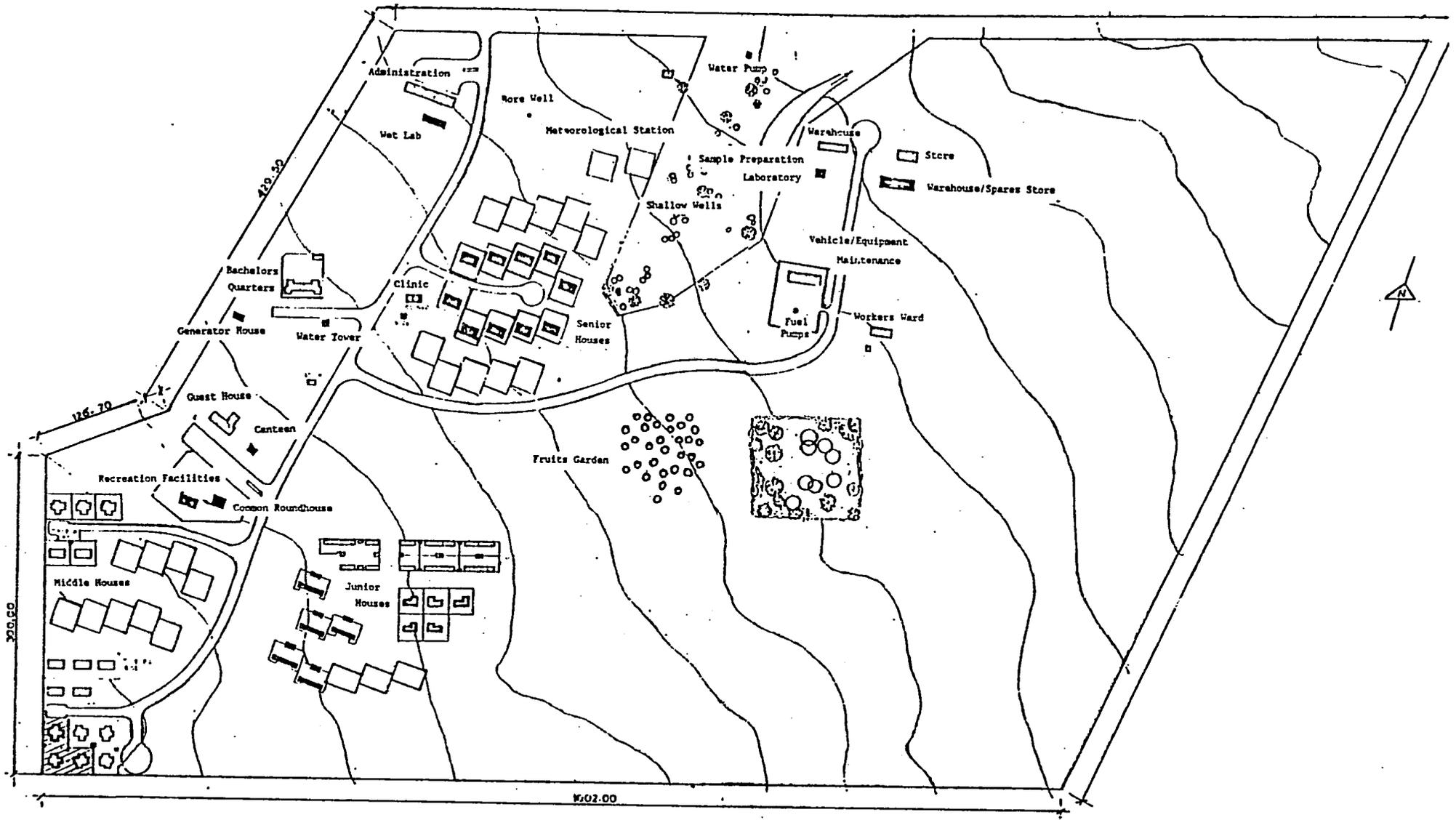
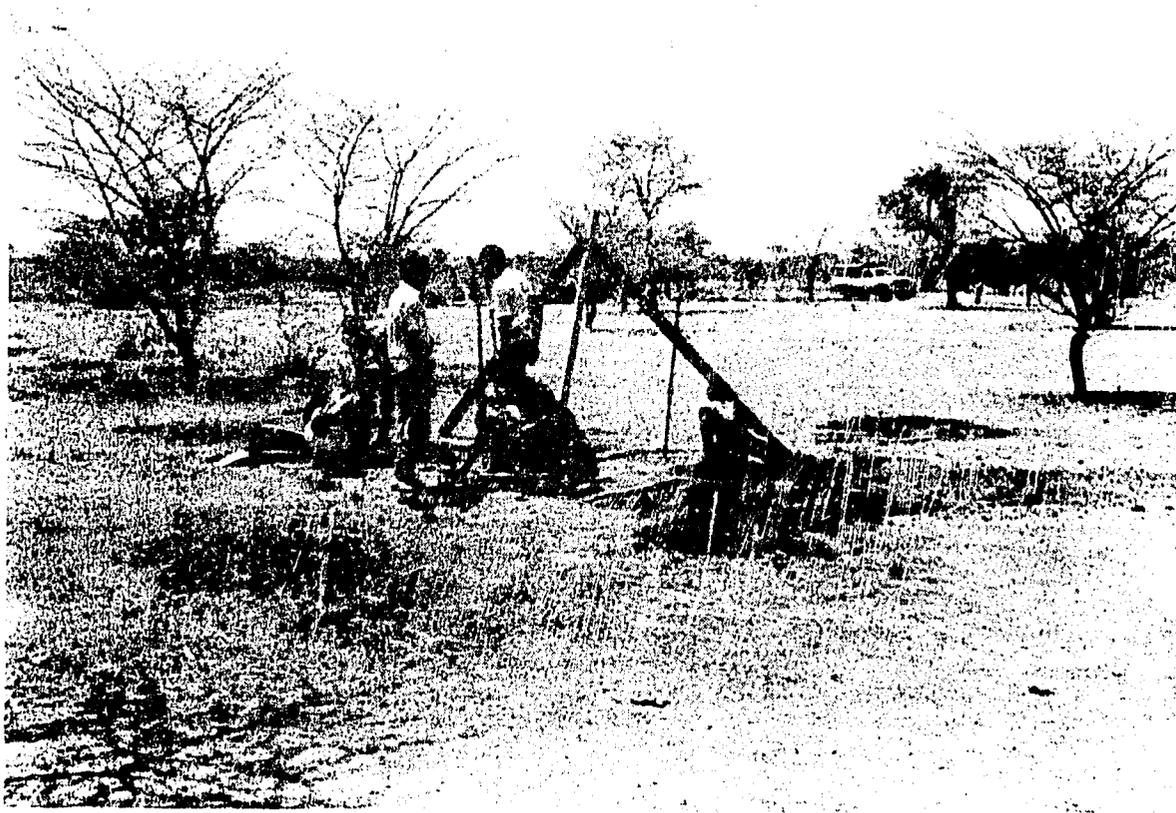


Figure 2: Kadugli Research Station: Site Plan



**Figure 3: Kadugli Research Station: View from the North**



**Construction activities not included in the major construction contracts were carried out by the Project Force Account program.**

Subsequently, the committee prequalified a total of seven non-Sudanese and two Sudanese contractors. Tenders were distributed on 1 December 1980 and bids opened on 1 March 1981. Five tenders were received, four from international contractors and one from the previously described Sudanese contractor. The Sudanese contractor, El Khidr and Deraige, was low bidder, with a tender in the amount of £S 12,664,905 which was well within the budget figure. Furthermore, the El Khidr and Deraige tender included a foreign currency component of 50% based on an exchange rate of \$1.25:£S 1.00. Foreign currency components of the four international contractors ranged from 60 to 80% with exchange rates of \$1.25:£S 1.00 and \$2.00:£S 1.00. The El Khidr and Deraige low foreign currency requirements were attributed by that firm to the fact that overhead and profit of a Sudanese contractor would be paid in local currency. In view of the low tender amount of the successful bidder, the prequalification/tender committee appointed a delegation to review the tender back-up documents. The tender phase concluded with a committee report recommending acceptance of the tender submitted by El Khidr and Deraige.

As cost estimates had been based on an anticipated foreign currency component of 60% with an exchange rate of \$2.00/£S, similar to the successful international contractor in Kadugli, a substantial cost savings of approximately 6.8 million dollars resulted to the Project by the acceptance of El Khidr and Deraige. Accordingly, the Project in consultation with the donors introduced a variation order prior to the signing of the construction agreement to put back into the construction program a number of items that had previously been removed due to budgetary constraints. These items included the addition of one bathroom and bedroom and a verandah in the senior houses to conform to current Sudanese standards, a general upgrading of middle houses, and additional junior houses. Additional funds were also made available to the Kadugli construction program to reinstate several previously deleted items. The final construction and contingencies budget approved by the Project, GOS, and donors is included as Table 3.

The contractors, El Khidr and Deraige proposed to employ the services of a People's Republic of China (PRC) owned and operated

Table 3

## Approved Construction and Contingency Budgets (Donor Funds)

I. KADUGLI (Includes Actual Final Expenditures;

Contract @ \$ 60% : £S 40% @ exchange rate of £S 1.00=\$2.00)

	TOTAL U.S.\$	TOTAL £S	U.S.\$ WORLD BANK	U.S.\$ U.S.A.I.D.
BASIC CONTRACT	3,071,230	1,023,743	3,071,230	0
VARIATIONS*	605,835	201,612	604,835	0
CLAIMS (PAYMENT DELAY/DEVAL.)	67,070	49,073	{453,626}* }	{151,209}* }
KADUGLI TOTAL	\$3,744,135	£S1,274,428	\$3,744,135	\$ 0

II. MAJOR CONSTRUCTION CONTRACT (contract @ \$ 50% : £S 50% @ exchange rate  
of £S 1.00 = \$1.25)BASIC TENDER

El Obeid	4,044,600	3,235,680		
El Fasher	1,878,820	1,503,050		
Ghazala G.	1,752,320	1,401,860		
ARC Hdq.	266,270	213,020		
Subtotal	\$7,942,010	£S6,353,610	\$5,956,510	\$1,985,500

VARIATION ORDER (Prior to Signing Contract)

El Obeid	745,830	596,660		
El Fasher	224,600	179,680		
Ghazala G.	272,880	218,300		
ARC Hdq.	42,190	33,750		
Subtotal	\$1,285,500	£S1,028,390	\$ 964,125	\$ 321,375

CONTINGENCY

El Obeid	1,197,610	958,090		
El Fasher	525,850	420,680		
Ghazala G.	506,300	405,040		
ARC Hdq.	77,120	61,700		
MAJOR CONTRACT TOTAL	\$11,534,390	£S9,227,509	\$ 8,650,795 (75%)	\$2,883,595 (25%)

\* Kadugli variations were made possible by dollar cost savings in the major construction contract and the budget projections for the variations were based on the 75% World Bank and 25% USAID formula. All dollar expenditures at Kadugli, were, however, paid by the World Bank.

construction organization. The utilization of this sub-contractor was in conflict with prevailing USAID regulations relative to employment of PRC businesses. After analyzing the options of splitting the construction into separate components or obtaining a waiver from USAID for utilization of a PRC sub-contractor, the latter option was chosen. In early May, 1981, the USAID waiver was obtained.

The construction program experienced numerous delays. Some of these could be traced to joint venture internal difficulties between the partners El Khidr and Deraige. Major financial management disagreements resulted in the establishment of two separately managed and financed construction efforts. Mr. El Khidr became responsible for El Obeid, and Mr. Deraige became responsible for the two Darfur stations. This effectively cancelled the complementary basis on which the two firms had pre-qualified. In addition, Mr. Deraige departed Sudan in January, 1984 and was absent for the balance of the construction period. His departure resulted in delayed payments to the sub-contractor, which in turn caused occasional work stoppages.

Additional construction delays were the result of the following:

- ◆ intermittent bans on the use of wood for firing of kilns and on the use of water for construction purposes due to the prevailing drought;
- ◆ transportation difficulties related to rail space allocation (throughout the life of the construction program and especially during the declared "state of emergency" in 1984 when railroad space was reserved for strategic goods such as food and fuel);
- ◆ periodic lack of available fuel for truck transportation;
- ◆ alterations in procedures and delays in the obtaining of import licenses and letters of credit;
- ◆ delays in clearance or release of materials of up to several months prior to and during the state of emergency (political) in 1983 and following the change of government in spring of 1985 (due to delays in government decisions on determination of new duties and tax rates);
- ◆ devaluation of Sudanese currency (approximately 57%);
- ◆ shortages and/or complete lack of local materials, especially cement and bricks;
- ◆ shortages of local skilled manpower;

- ◆ delays in payment to the contractor by donors and the government;
- ◆ logistical difficulties in transportation and communication to the isolated station sites; and
- ◆ water, power, and fuel scarcities at all sites.

Details of these and other factors affecting the construction program are contained in the 1981-1985 WSARP Construction Supervision Report (Grube-Zimmer, Inc., January, 1986. Copy available through WSARP and USAID, Khartoum).

However, as a result of a continuous and concerted efforts by Grube-Zimmer, Inc., the Project, and donors, remarkable progress has been achieved. The constructed El Obeid facilities (95% completed in December, 1985) include the administration unit and laboratories (See Figure 4), 21 senior houses, 22 middle houses, 20 junior houses, 2 gate houses, a pump house and tower, a canteen building, a maintenance building, a warehouse building, a junior guest house, and a senior guest house, as well as the necessary site works. The total facility square meter space at this station is 15,389 sqm. (See Figures 5 and 6.)

The facilities at El Fasher (75% completed in December, 1985) include the administration facility and laboratories, 5 senior houses, 8 middle houses, 6 junior houses, 2 gate houses, a pump house and water tower, a generator house, a canteen building, a maintenance building, a junior guest house, a senior guest house, plus site works. The total facility square meter space at this station is 5,365 sqm. (See Figures 7 and 8.)

The new Ghazala Gawazet facilities (75% completed in December, 1985) include the administration facility and laboratories, 6 senior houses, 8 middle houses, 8 junior houses, a junior guest house, a senior guest house, plus site works. (See Figures 9 and 10.) The total newly constructed facility square meter space at this station is 5,595 sqm.

The PSU/ARC Liaison Office facilities (100% completed in December, 1985) in Shambat (Khartoum North) include an administration

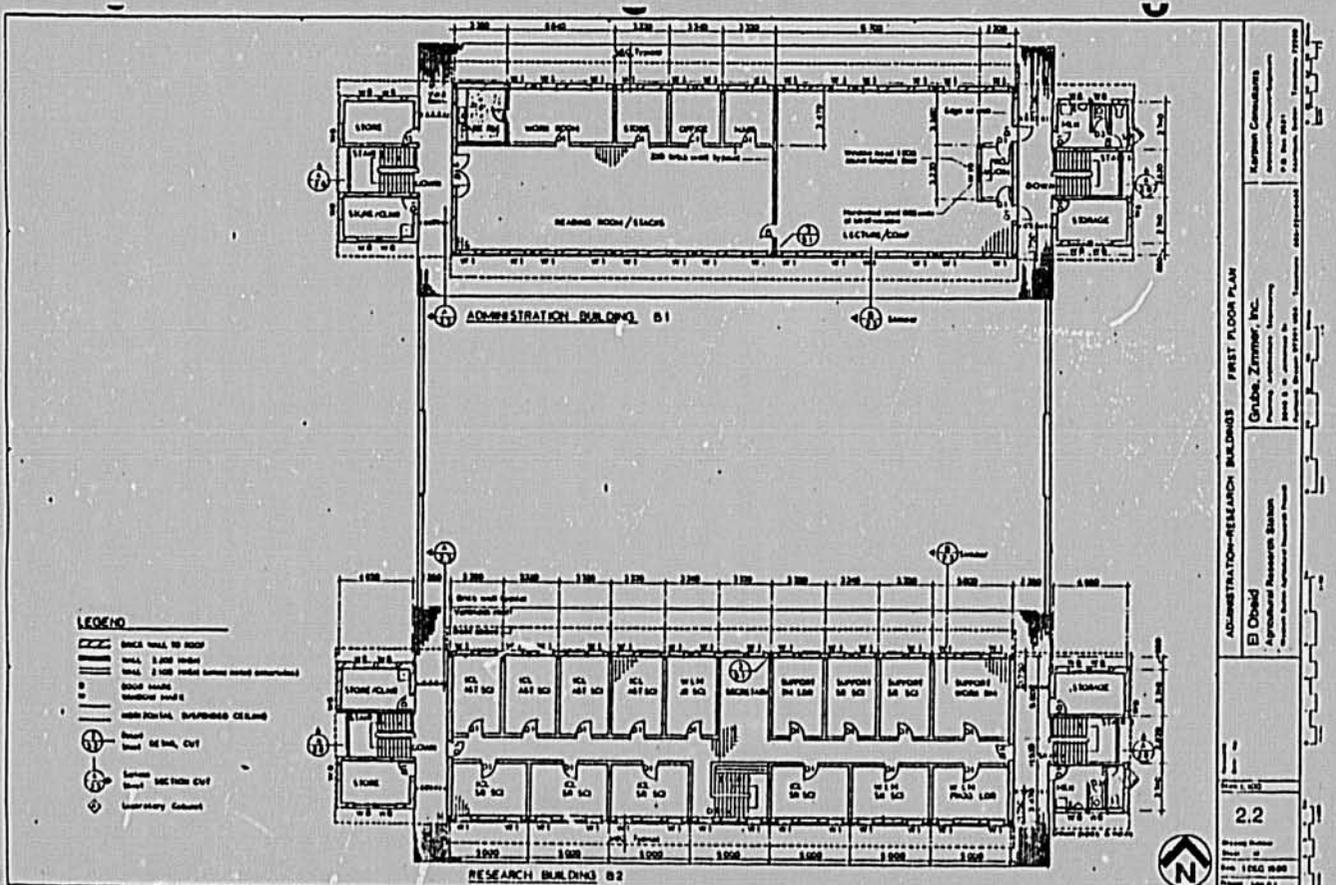
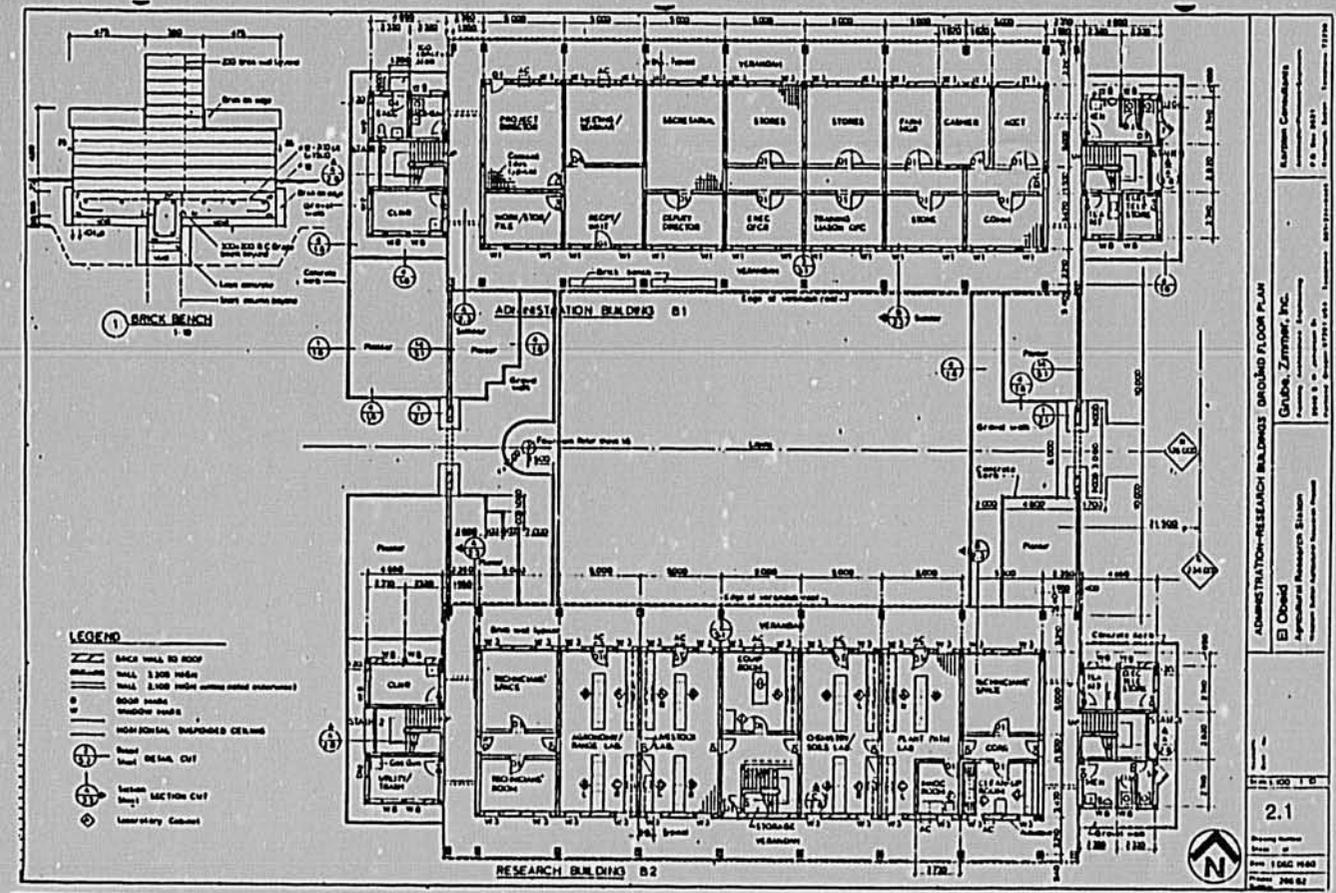
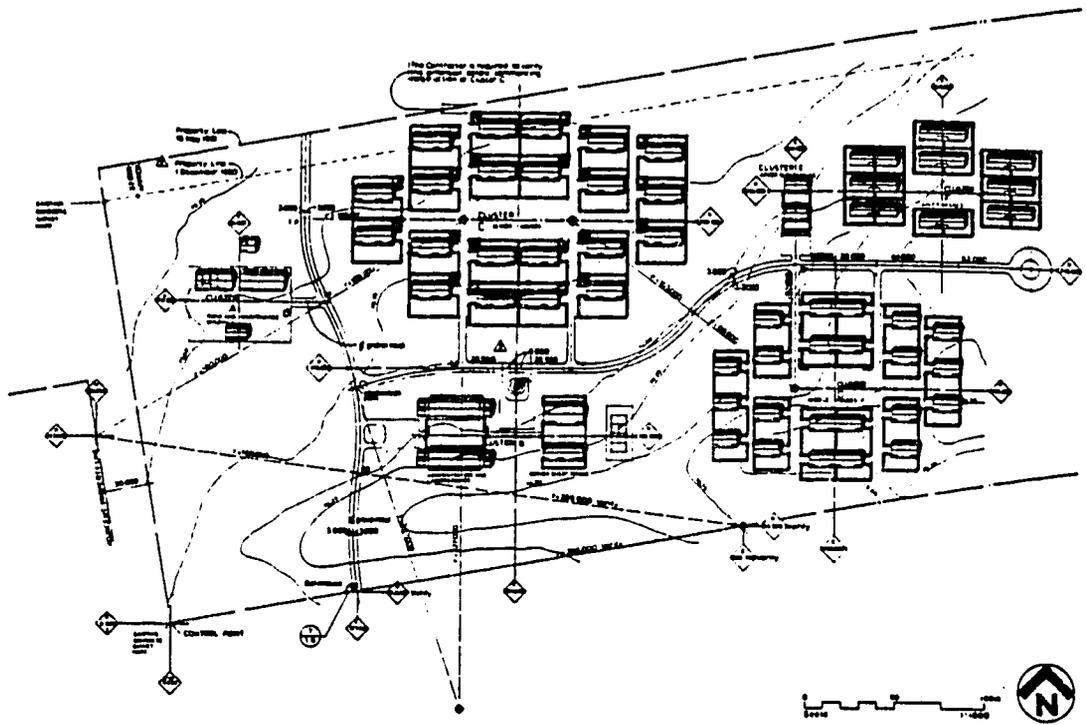


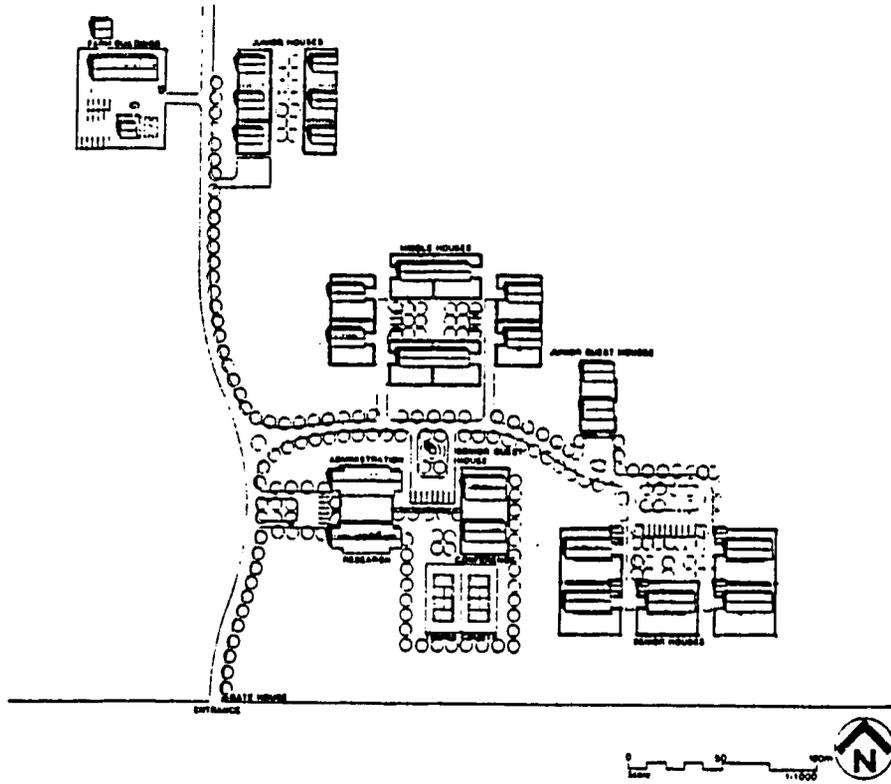
Figure 4: El Obeid Research Station: Administration and Laboratory Building Floor Plans



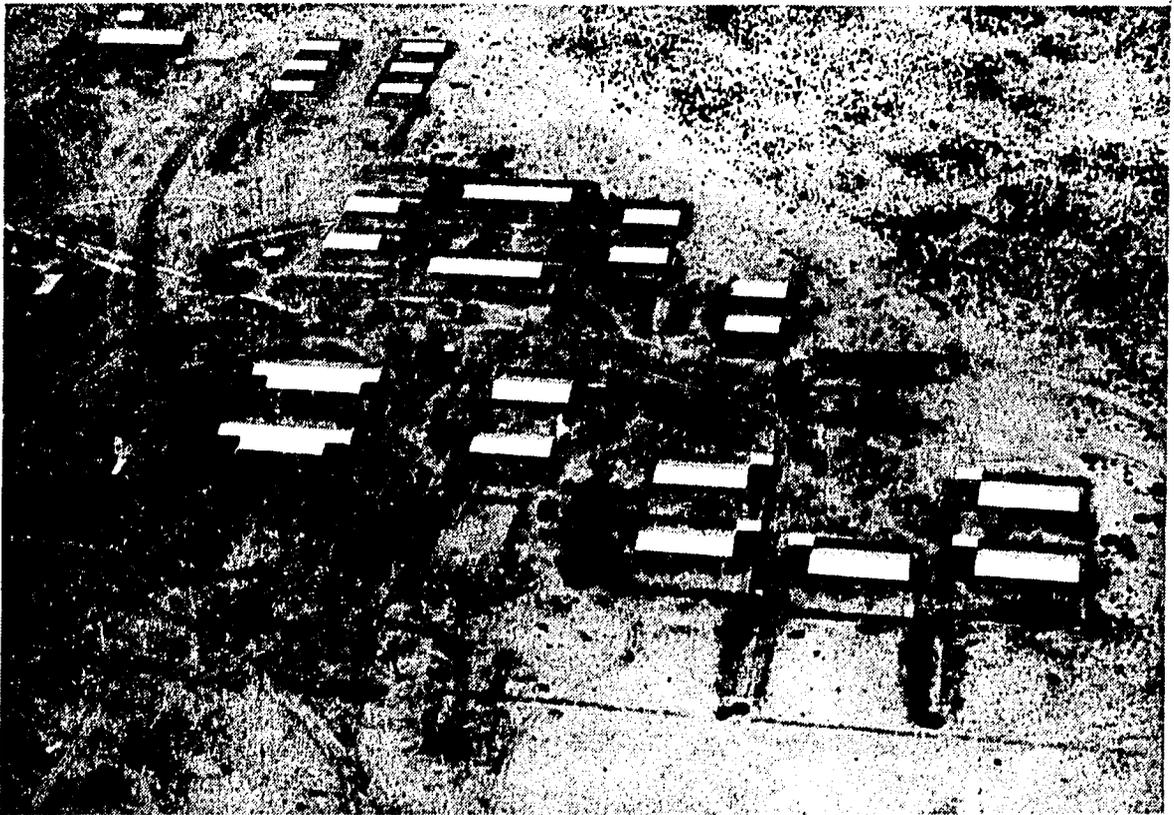
**Figure 5: El Obeid Research Station: Site Plan**



**Figure 6: El Obeid Research Station: View from the Southeast**



**Figure 7: El Fasher Research Station: Site Plan**



**Figure 8: El Fasher Research Station: View from the South**

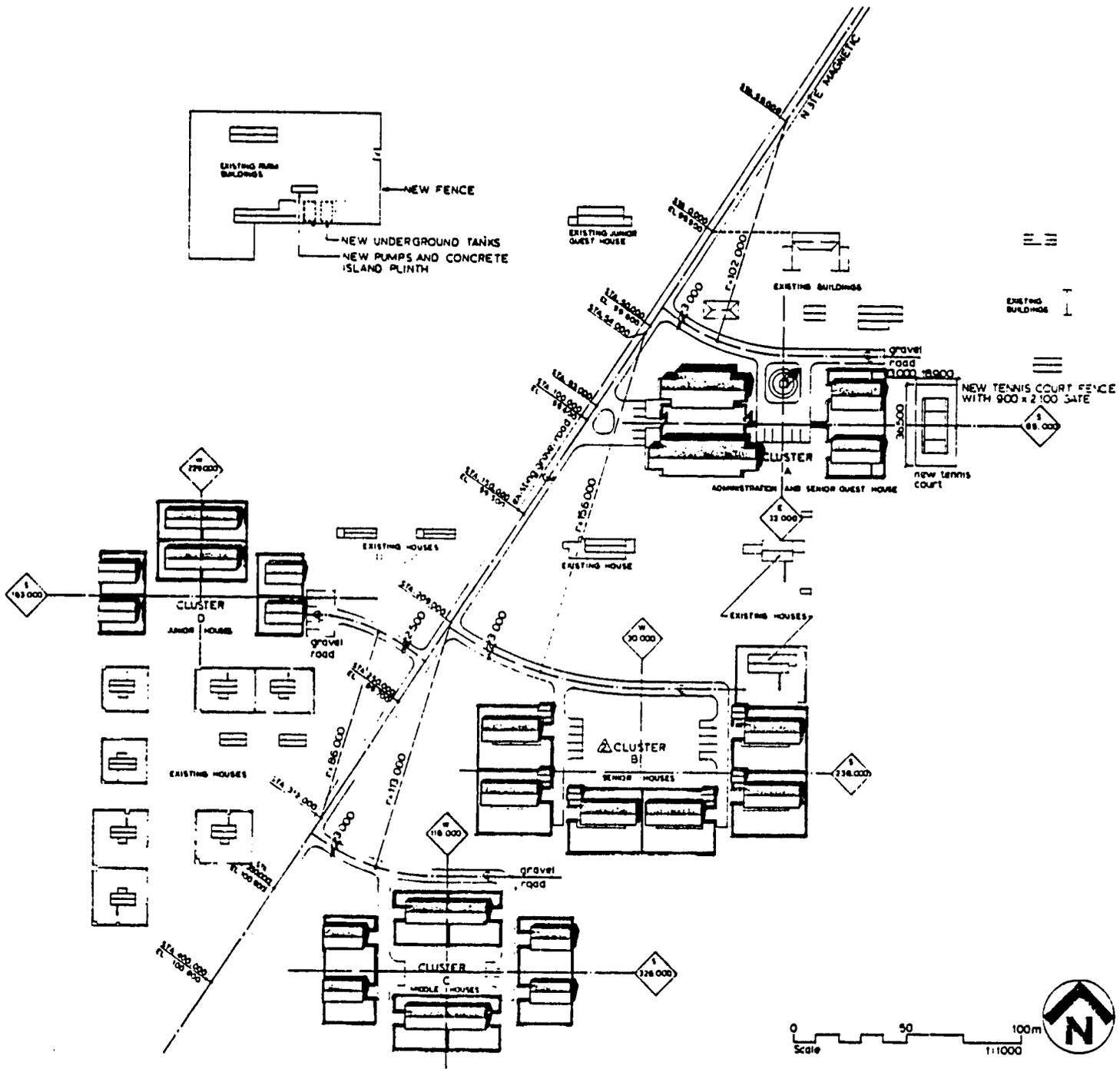
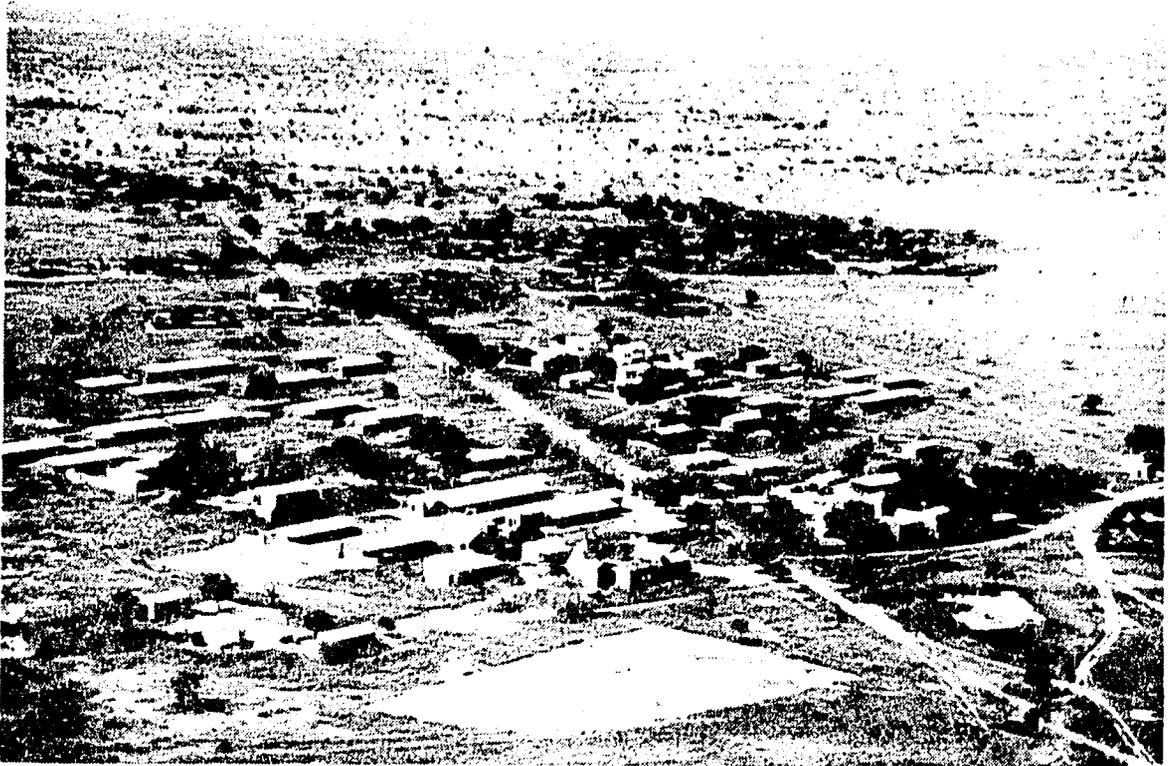
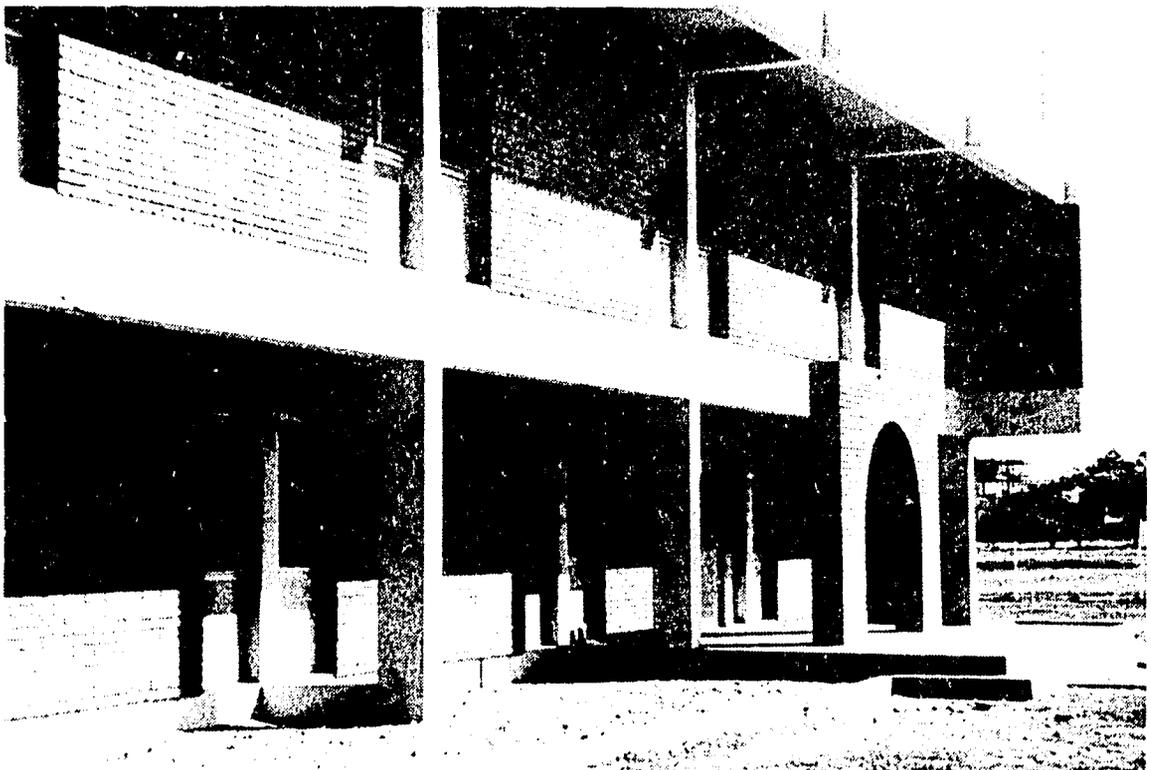


Figure 9

Ghazala Gawazet Research Station: Site Plan



**Figure 10: Ghazala Gawazet Research Station: View from the North**



**Figure 12: Project Support/Unit/ARC Liaison Office Shambat: Entrance**

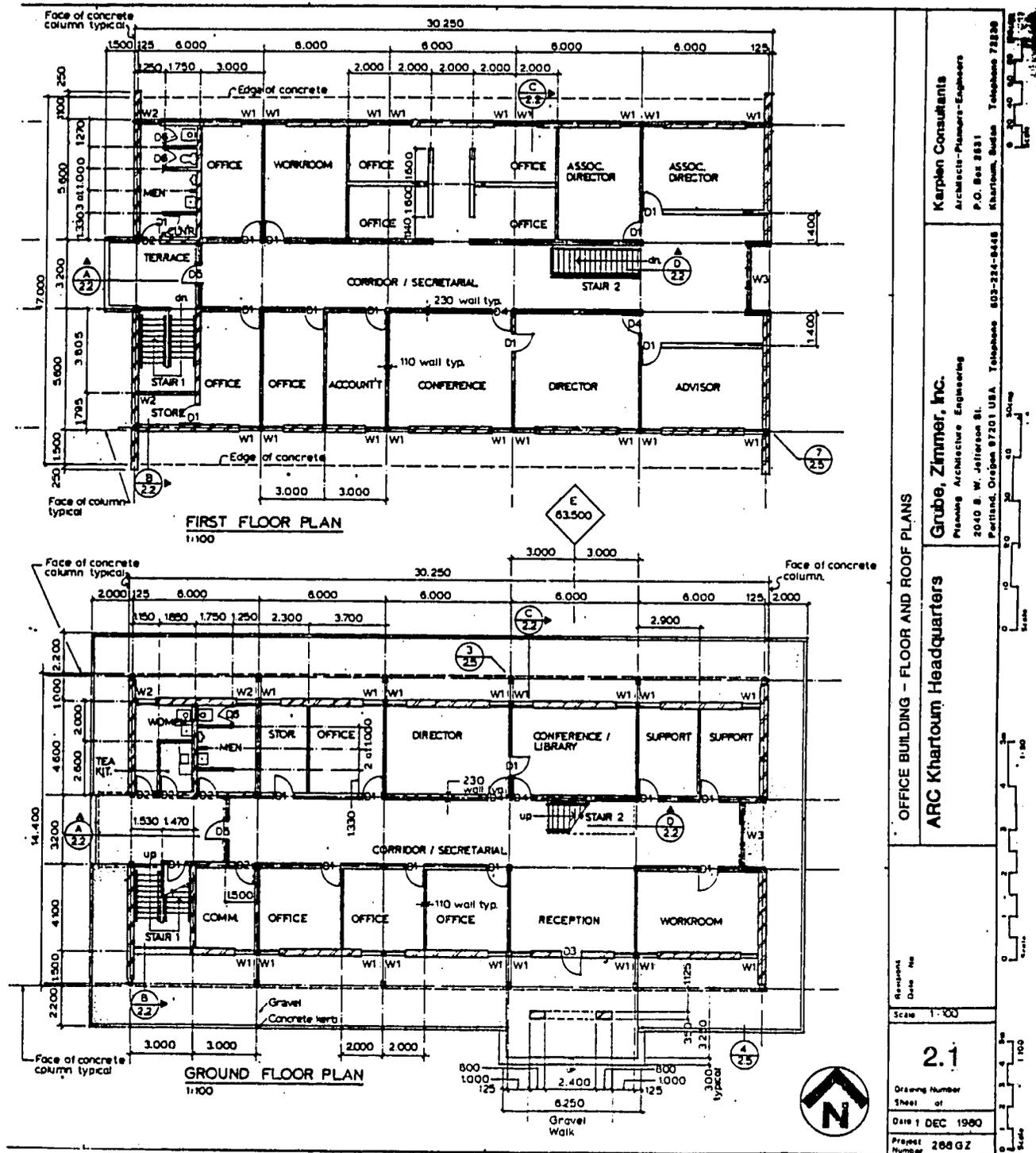


Figure 11: Project Support Unit/ARC Liaison Office: Floor Plan

building and a warehouse. (See Figures 11 and 12.) The total facility square meter space at this station is 1,122 sqm.

The Grube-Zimmer resident architect was evacuated from Sudan in November, 1985, as a part of a program by the US Embassy to reduce the number of US personnel in Sudan. On-site supervision in November-December, 1985, during the completion of the CID contract, was carried out by the Grube-Zimmer Sudanese partner firm of Karplen Consultants. Supervision from 1 January through scheduled final completion in April-May, 1986, will also be carried out by Karplen with input from Grube-Zimmer mechanical and electrical consultants.

Quality of construction has been remarkable under the circumstances. The resulting facilities will be adequate to support the WSARP research program, and will also serve as an important local and regional resource for training activities for local agriculturalists. For additional details regarding this construction program, refer to the 1981-1983 Construction Supervisor's Report<sup>8</sup>, (available through WSARP Headquarters, El Obeid and at USAID/Khartoum).

In addition to the anticipated accomplishments of the major construction program, additional long-term benefits will accrue to Sudan through further development of the construction capacity of the Sudanese institutions and personnel participating in this effort. Through the efforts of the Grube-Zimmer construction supervisory personnel, marked improvements in construction management capabilities of the local contractor were achieved. Also, the cadre of skilled workers and construction laborers in the West was expanded and improved as a result of the Project. As such, the construction program itself and the A&E activities, which paired US and Sudanese firms, had important training implications and subsequent human resource development impacts for this segment of Sudan's private sector.

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<sup>8</sup>Grube, J., 1981-1985 WSARP Construction Supervision Report, January, 1986.

### Force Account Construction

As a result of early planning activities which mandated cost decreases, all construction activities which could be carried out under mechanisms other than a major construction contract were removed from the major construction program. These activities were to be handled under a local force account mechanism. As a result, the WSU/CID Project Engineer's primary responsibility became the development, implementation and supervision of the force account construction activities, in addition to liaison activities with the other construction programs. The Grube-Zimmer and Karplen architect/engineers were assigned major responsibility for construction supervision of the major contracted construction.

A comprehensive force account plan developed in 1980-1982 addressed anticipated requirements at all four stations. In 1980 activities were initiated at Kadugli. Specifically these activities included the improvement and fencing of the airstrip, fencing of the station, improvement of the water well system, and construction of a road connecting the Kadugli Station with the research farm. The purpose of force account activity was to provide construction essential to support the needs of the research program, but withheld from the CAT and El Khidr-Deraige contracts. Priority was given to those activities directly related to the research program, and as a result the Kadugli Station received top priority. Initial force account efforts were hampered by a lack of timeliness in availability of both financial and human resources. In addition, government procedures for hiring local sub-contractors for the larger force account jobs were extremely cumbersome. The same set of problems that plagued the major construction program also impacted force account activities.

It was anticipated by Project management that the addition of a Sudanese Project Force Account Engineer employed via fS account would serve to accelerate the completion of the proposed activities. It was originally planned by the Project for this Sudanese Project Force Account Engineer to work in cooperation with the WSU/CID Project Engineer for approximately five months. This overlap time would serve to familiarize the incoming engineer with the Project. At the same

time, the work progress would have been enhanced since supervision on more than one site would be available. However, USAID eliminated the position of the WSU/CID Project Engineer in March, 1985. This action subsequently allowed an overlap time for the US and Sudanese engineers of less than one month. In addition, in the spring of 1985, USAID also eliminated support for the Darfur stations, which in turn prevented implementation of planned force account activities at Ghazala Gawazat and El Fasher.

In spite of these factors, force account accomplishments were significant. A summary of these accomplishments and pending needs is included as Table 4. (See also Higgins, D., Final Report - Project Engineer, 1985, available from USAID/KRT or WSARP Headquarters.)

#### Station Maintenance Spares

Adequate supplies of station maintenance spares for the Kadugli Station, and for the other sites of the major construction program were not provided by the construction contractors. Therefore, alternative mechanisms for obtaining maintenance spares were discussed on numerous occasions by donors and the Project/WSU/CID leadership. As a result of these discussions, a large effort was initiated in November, 1984 to define and procure spares for station maintenance at all five WSARP locations. A WSU/CID consultant for Station Maintenance and Operations spearheaded this effort, which culminated in the preparation of tendering documents for procurement of such spares. Since construction was primarily World Bank-financed, procurement of spares from non-US vendors was necessary, and a USAID waiver was required for WSU/CID procurement. This waiver was granted in September, 1985 and the required spares were immediately procured. By the end of the WSU/CID contract, the spares were either in Khartoum or en route to Sudan. Due to the relatively late date of approval of the necessary waiver, all ordered maintenance spares had not arrived in Sudan prior to CID contract completion but are expected to be received by the Project, in concert with USAID, in early 1986. A summary of maintenance spares procured by WSU/CID is included in Appendix VI.

Table 4

Summary of Force Account Accomplishments and Pending Needs

FORCE ACCOUNT SUMMARY

SITE	WORKS COMPLETED	WORKS IN PROCESS/PLANNED
KADUGLI	Kadugli Station development master plan developed 2 wells drilled on Station (seraf) Seraf main and auxillary pumps installed Water distribution on seraf developed Shallow well developed for garden Water pipeline installed to farm (5000 m) Culvert install./road improvement station entrance Station to Station Farm road constructed Irish bridge Station-farm road constructed Farm hafir developed for water storage Animal handling facilities constructed Farm water distributed to animal facilities Hay storage sheds built Station fenced Farm fenced Airstrip developed and fenced Staff quarters at Farm built Small farm clinical laboratory/office built Radio system installed and revised Guard/gate house built Electrical workshop built Ag mechanical building/Field sample lab modified Airstrip shelter and parking area built Vehicle parking sheds constructed Range exclosures built On-farm road laid out and cleared Drainage system improvements on seraf installed Numerous maintenance activities performed Airstrip safety improvements made Liaison with Karplen/CAT on construction program	Additional water development on Farm Additional developmant of farm roads Installat. of lightning protection system Construction of farm implements shed Additional water development on Station Development of seed storage facility Additional maintenance activities
EL OBEID	El Obeid Station development master plan developed Well developed at Benu horticultural out-station Pump, pipeline and water system at Benu developed Range exclosures built Benu farm fenced Benu station facilities fenced Several dry wells & finally 2 producing wells dug Detailed plans developed for impl. of station plan	Animal handling facilities Dirty lab for crop sample preparation Farm machinery sheds Development of main farm water system Additional water storage tank Additional pond storage Roof rainwater collection system Development of water distrib. fr. new wells Parking sheds
EL FASHER	El Fasher Station development master plan prepared Well drilled Fencing designed and materials purchased  Pipe for water development purchased	Pipeline to station/water system development Fencing Dirty lab for crop sample preparation Parking sheds and pumphouse Rainwater collection system
GHAZALA GAWAZET	Air strip cleared and developed for dry weather Pumps & engines rehabilitated to serve const. Wells serviced	Wet weather air strip surface Fencing for airstrip, station, facilities Development of remote farm water system Rehab and development of all farm water Dirty lab for crop sample preparation Parking sheds and pumphouse Additional water storage Rennovation of existing facilities Rainwater collection system

## 2. RESEARCH SUPPORT INFRASTRUCTURE

### General

The success of a research network is entirely dependent upon the ability to support the researchers who must live and work in relatively remote locations. The isolated nature of the WSARP research stations requires that inputs necessary for both living and research support be provided adequately and in a timely manner. In the absence of this support, both living and working environments rapidly become unrewarding and nonproductive. As a result, a major objective of the Project was the development of functional support infrastructure.

The major components of the research support infrastructure include: (1) human resource development; (2) administration and WSARP/ARC interface; (3) transportation and communication; (4) procurement; (5) maintenance (facilities and equipment); (6) library and information; and (7) other research support.

### Human Resource Development

The staffing patterns for the non-scientific support staff at all research stations in the initial design documents were reviewed by ARC and donor personnel and Project leadership in early 1979 and deemed to be inadequate. (See Table 5 for the original staffing patterns.) After extensive discussion relative to implications for recurrent costs and adequate support capability for each station, new staff projections were agreed upon by Project, donor, ARC and GOS representatives. The revised non-scientific staffing pattern is summarized in Table 6. This revision emphasized increased support personnel in the areas of skilled workers, mechanics, generator operators, and additional administrative support staff, the latter in line with ARC policy. Also, the revised patterns reflected the need for increased security and for providing continued support to a segment of the existing workers at Kadugli and El Obeid. The focus of recruitment was to identify persons with necessary skills, and in the case of all locations except the Khartoum Project Support Unit, willing to live and work in the remote western areas. Problems were encountered between ARC's required credentials and the realities of attracting such qualified persons to live and work in the West. In

Table 5

WSARP Non-scientific Staffing Patterns -- Original Design (1978)

	Project HQ (Nyala)	El Obeid	Kadugli	El Fasher	ARC HQ Khartoum
Station Superintendent	1	-	-	-	-
Executive Officer	-	1	1	1	-
Accountant	1	-	-	-	1
Cashier	1	1	1	1	1
Bookkeeper	1	-	-	-	1 (chief clerk)
Storekeeper	1	1	1	1	1
Librarian/ Assistants	3	-	-	-	-
Cartographer/ Photographer & Assistants	3	-	-	-	-
Communications Officer/Pilot	1	-	-	-	-
Radio Operator	1	-	-	-	-
Secretaries	12	6-7	5-6	3	2
Head Driver	1	1	1	1	1
Drivers	14	14	17	5	5
Farm Manager	-	1	1	-	-
Laborers	6	12*	34*	5	1
Total.	46	37-38	61-62	17	13

\* Does not include present ARC farm/grounds laborers at Kadugli & El Obeid.

Table 6

WSARP Non-scientific Staffing Patterns -- Revised (1980-82)

	Project HQ (El Obeid)	Kadugli	Ghazala Gawazet	El Fasher	PSU/ARC Liaison
Station Superintendent	1	1	-	-	-
Executive (Admin) Officer	1	1	1	1	1 <sup>1/</sup>
Controller	1	-	-	-	-
Sr. Accountant	1	1	1	1	2 <sup>2/</sup>
Asst Acct/Bookkeeper	1	1	-	-	2 <sup>2/</sup>
Sr. Clerk/Communications	1	1	1	1	1 <sup>2/</sup>
Cashier	1	1	1	1	2 <sup>2/</sup>
Secretaries/Clerks	8	3	3	3	2
Purchasing/Stores	1	1	1	1	1 <sup>2/</sup>
Asst. Storekeeper	1	1	1	-	2 <sup>2/</sup>
Transport Officer (Head Driver) <sup>3/</sup>	1	1	1	1	-
Drivers/Assts.	25	18	10	5	3
Office Laborers	6	4	2	-	4
Sr. Maintenance Engineer	1	-	-	-	-
Electrician	1	1	1 <sup>4/</sup>	1	-
Plumber	1	1	-	1 <sup>4/</sup>	-
Carpenter/Mason	1	1	1	-	-
Generator Operators	3	3	2	2 <sup>4/</sup>	-
Sr. Mechanic	1	1	1	-	-
Asst. Mechanic	1	1	1	-	-
Farm Manager	1	1	1	-	-
Farm/Grounds Cleaner Laborers (includes Head Laborers) <sup>5/</sup>	46	68	26	13	1
Grounds Supervisor	1	-	1	-	-
Head Guard	1	1	1	1	-
Guards	16	10	10	4	5
Guesthouse Housekeeper	1	1	1	1	1
Guest House Cook	1	1	1	1	1
Guesthouse Washers/Cleaners	2	2	2	1	1
Librarian/Asst.	2	1	6 <sup>6/</sup>	6 <sup>6/</sup>	-

1/ Head of PSU.

2/ ARC to provide from non-WSARP budgets.

3/ Maximum; may be decreased.

4/ Total number of skilled workers reduced by recruiting/training with combined skills.

5/ Numbers reflect present ARC commitments to farm laborers.

6/ Assistant librarian may be provided later or duties shared by Sr. Clerk.

many instances, it appeared that the best solution would be to hire local persons who did not hold required credentials, but who had the potential for obtaining the needed skills. This option was exercised in only a few cases.

Another major problem was the competition for skilled personnel by other development projects/activities in the West. The relatively low government scale salaries required by ARC impacted negatively upon the recruitment of potential Project workers for the western areas. Very simply, WSARP's salary scale (dictated by ARC/GOS) could not compete with those of other agencies. In some instances, the duties of a given category of support staff were assumed by someone of a different or lower category, without benefit of title or pay incentives to accompany such responsibilities. An example was the Kadugli Radio Operator who also served, without evident title or pay incentives, as the Station Librarian.

Training activities for the administrative and support staff were of both a formal and informal nature. Administrative training abroad was obtained by six individuals on a short-term basis, while in-country training activities and on-the-job training for administrative and support personnel were provided throughout the life of the Project. The latter was hampered in many instances by the lack of qualified Sudanese personnel with whom senior Project personnel could work. For example, the need for a Senior Facilities Maintenance Officer was identified in 1980 and reaffirmed by the mid-term evaluation in 1982. A person was finally identified to fill this position in 1984, but was still not on the job upon completion date of the WSU/CID contract (December 31, 1985).

An additional major problem in attracting and retaining appropriate support personnel was the perception by potential employees apparently gained through interaction with Project and/or ARC management, that Project positions were temporary in nature, with positions not guaranteed beyond 1985.

With the decision of USAID in early 1985 to withdraw support to the Darfur Stations, efforts to recruit and train support personnel for these stations was no longer feasible, although such will be

reinstated when World Bank funding arrangements for these stations are completed.

Provision of adequate secretarial/clerical assistance with both English and Arabic language capabilities was attempted. However, difficulties were encountered with identification of individuals with sufficient English competence for the preparation of scientific manuscripts and external Project communications. On-the-job training was conducted, but since government salary scales for such trained personnel were not competitive with those available in the private sector and with donor agencies, it was not possible to establish a sustainable intraproject capacity for meeting Project secretarial needs. As a result, such needs were met in Khartoum through the provision of secretarial assistance from the £S component (£S Trust Account) of the WSU/CID contract, which allowed for the payment of competitive salary levels. The long-term provision of secretarial assistance is anticipated to remain problematic.

The purchase of computers and the planned training of personnel in word-processing capabilities was another mechanism established to address Project office support needs. However, additional computer training will be required for scientists and administrators to gain proficiency. In this regard, a computer specialist was scheduled to visit Sudan in late 1985 to continue this training. However, like the other consultants scheduled for this period, his travel was prevented by the US Embassy travel advisory.

WSARP's overall human resource development activities for research and support personnel are summarized in Appendix VII.

#### WSARP Administration and WSARP/ARC Administrative Interface

The Project functioned as an integral part of ARC and to the maximum extent possible, followed all ARC administrative procedures. However, the nature of the Project and sponsored activities required some deviations, especially in response to donor and contractor procedural requirements. Whenever possible, necessary WSARP deviations from established ARC policies and procedures were developed in collaboration with ARC. WSARP and WSU/CID personnel met periodically with ARC administrators to review and make

recommendations on WSARP/ARC administrative structure, function and WSARP incorporation into ARC.

Both WSARP Project Directors (Drs. Osman Khalifa and Dafalla A. Dafalla) and the WSARP Associate Director for Administration (Mr. Osman Abdalla Muhamed) completed formal administrative training in the US. In addition, Project Director Dafalla and two ARC Director Generals, Dr. Burhan and Dr. Bakheit, reviewed programs and consulted with research administrators at numerous local, regional, and national agricultural centers in the US, and at several international agricultural research centers.

#### Budget and Finance

The budget and finance administrative functions of WSARP were complex due to the multiple sources of funding, differing fiscal years, different procedures associated with each funding source, and numerous changes in the various budgets over the life of the Project. Budget sources included: (1) USAID dollars (\$26,000,000); (2) World Bank IDA dollars (\$15,000,000); (3) USAID/GOS PL480 (£S 21,561,000); and (4) GOS regular budget £S (approximately £S 5,505,000). An overview of the budget sources relating to activities and implementing organizations is indicated in Figures 13 and 14.

Budgets based upon annual workplans and emerging needs of the Project were submitted annually to ARC, donors and the GOS. In response to recommendations of the mid-term evaluation, Station Directors assumed a more active role in budgetary planning in 1983. The construction budget has been previously summarized (Table 3). Annual budgets and expenditure reports were included in the Project Annual Reports. Additional WSARP financial summaries are included in Appendix VIII. Changes in GOS budgetary calendars and procedures following implementation of Sha'aria law resulted in cash flow problems on some occasions. Delays in payment to the construction contractor were encountered with all sources of funding. Mechanisms to overcome these delays were established by mid-1985 and construction cash flow problems eased after that time. The accounts were audited on numerous occasions during the life of the Project by external

Figure 13

WSARP Budget Structure by Source of Funds (US Dollars \$)

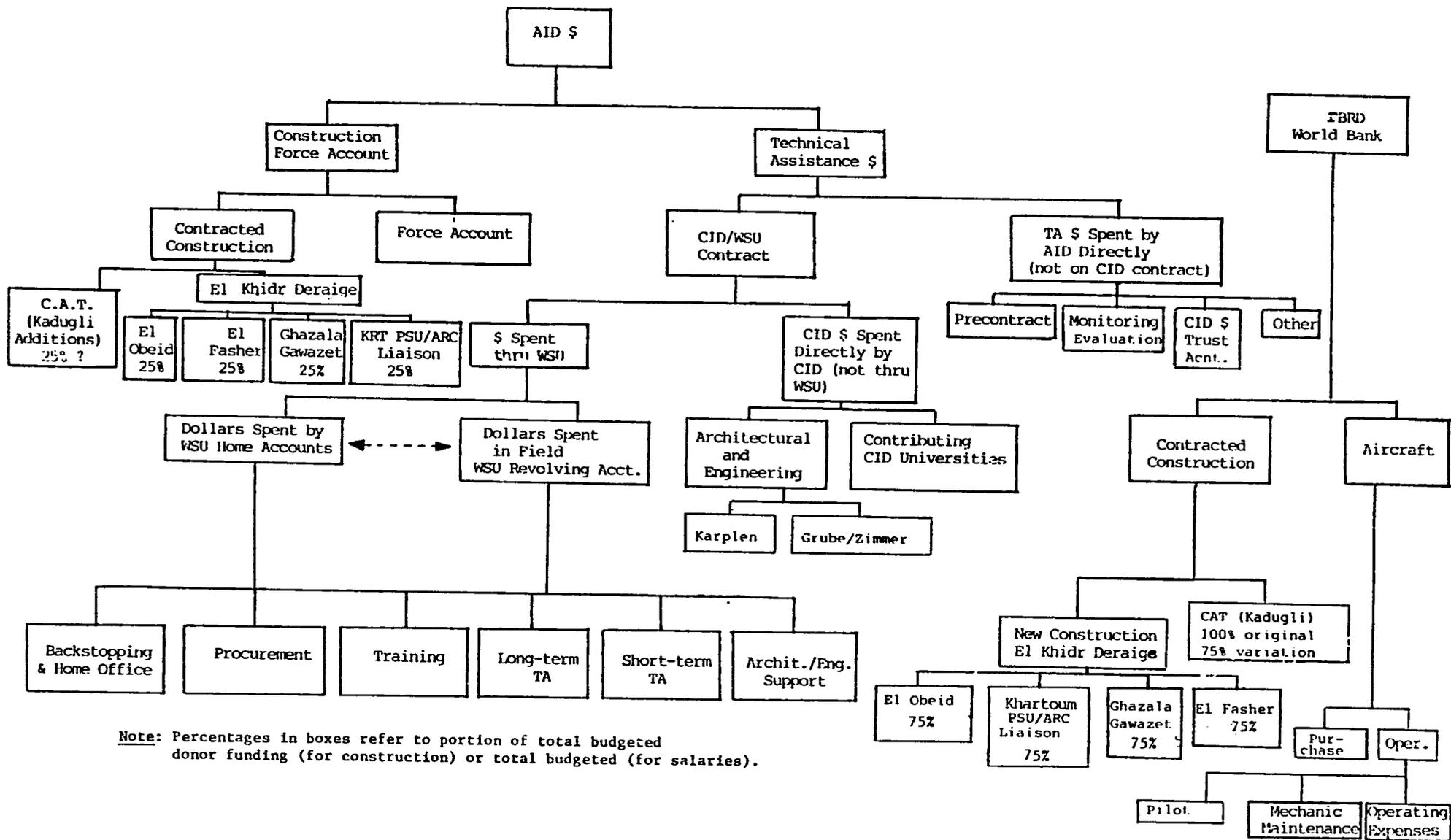
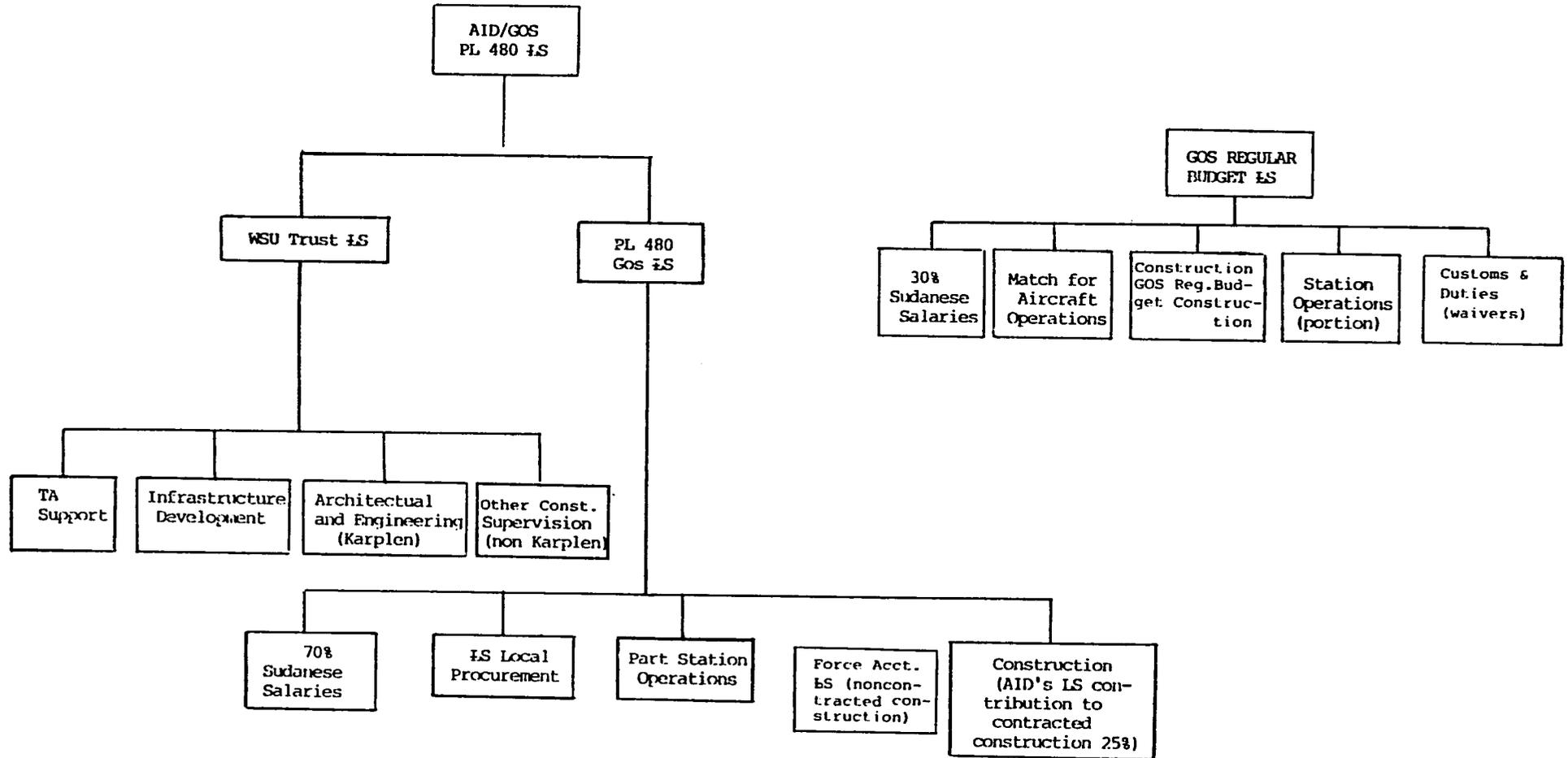


Figure 14

WSARP Budget Structure by Source of Funds (Sudanese Pounds £S)

Table B - WSARP Budget Structure by Source of Funds (Sudanese Pounds - £S)



**Note:** Percentages in boxes refer to portion of total budgeted donor funding (for construction) or total budgeted (for salaries).

auditors from CID, WB, the GOS Attorney General, and USAID. The Project responded to all recommendations.

#### Transportation and Communication

The transportation and communication system of the WSARP was designed and implemented to provide adequate intra-Project transportation and communication. In addition, this system was to provide linkages to the ARC, other cooperating entities within Sudan, and communication linkages with international agricultural research centers and other potential collaborators outside Sudan.

As defined in the World Bank document, the mainstay of the transportation system was to be an aircraft of suitable size to transport approximately fifteen to eighteen people and/or required commodities and supplies which were either too fragile or too urgent in nature to go overland. As a result of extensive review, the Project purchased a De Havilland Twin-Otter aircraft in 1980. A Project pilot, Mr. Thomas Mills, was hired in January, 1981 to operate the aircraft. Initially, the World Bank provided for salary for an aircraft maintenance person as well as the pilot. However, the decision was made by the Project management to contract with Sudan Airways for maintenance services of the aircraft. This arrangement proved to have several drawbacks, as adequate service was not routinely available on a timely basis. As a result, in late 1985, the decision was made by to hire a Maintenance Engineer for the airplane. He was subsequently hired in December, 1985.

Early in the life of the Project, an aircraft schedule was established which included bi-weekly service to Kadugli and El Obeid and weekly service to the Darfur stations for construction supervision. For a number of reasons, including limited fuel availability, lack of timely maintenance, leave taken by the pilot without adequate backup pilot capabilities, and extensive political pressure for use of the aircraft by parties outside of the Project, the minimum schedule necessary for Project progress was not maintained. However, since 1983 a concerted effort has maintained a schedule that is reasonably adequate to service both the research program and the construction program. With the arrival of the

Maintenance Engineer and increased fuel availability, it should be possible to operate the aircraft more frequently in the future.

The major overland transportation of Project equipment, commodities and supplies between the Project Support Unit and the stations in the West, and between the stations themselves was provided by Project lorries, six of which were procured under the WSU/CID contract. Maintenance posed a major problem, because of the extremely rough terrain and difficulties in supervising driver performance. However, the lorries have functioned well in transportation of a wide spectrum of Project materials to the West. With proper supervision and maintenance they can be expected to serve the Project adequately in the future.

Transportation within station sites and, to a lesser degree, between stations, is based on a fleet of Ford pickups. Selection of the Ford pickups was based on the following: (1) procurement of vehicles from the US was mandated by the USAID contract; (2) Ford vehicles are the most common vehicles operating in Western Sudan; (3) a Ford maintenance capability exists in the Project Headquarters city of El Obeid; and (4) the Ford pickups have sufficient clearance to operate in rough terrain. Due to import restrictions on tires, refitting of most vehicles with local tires of a proper dimension to provide proper clearance has been necessary for trucks to function optimally. Most of the pickups are still in operation after six years in an area where life expectancy for a pickup is in the range of 3-4 years.

The major difficulties with the transportation system have been: (1) the periodic lack of availability of fuel; (2) the maintaining of vehicles in safe operating condition, including keeping an adequate supply of the necessary spares on station; and (3) having an adequate number of vehicles allocated to each research station. The adaptive, field-oriented nature of the research program makes it imperative that an adequate number of vehicles are available to the scientists for field work. Field trips were carefully planned within and between disciplinary sections to allow for the most efficient use of vehicles possible.

A limited number of passenger vehicles were procured for transportation of personnel within Khartoum (local transportation is unavailable or inadequate), for transporting station personnel and their families to and from the nearest shopping and/or school areas (a distance of over 7 km in the case of Kadugli), and to transport local producers to participate in field days and similar activities. These passenger vehicles include two lorries, converted into buses, four twelve-passenger vans, for transportation to and from the airport and within the cities, and a limited number of station wagons/sedans for use by Project personnel in Khartoum and/or El Obeid.

During periods of extreme fuel shortage, the scientists showed considerable ingenuity in utilizing alternative transportation sources. Motorcycle transportation was initially tested, but proved infeasible due to the difficulty of maintenance in the extremely rough terrain. Use of donkey transport and camel transport by various WSARP staff proved a practical alternative on some occasions.

During the early phase of the Project, alternative commercial transportation options in Western Sudan were extremely limited. For instance, regularly scheduled aircraft service was only available to El Obeid. Later, however, limited aircraft service was available to El Fasher, Nyala, and Kadugli, as well as El Obeid. Overland transportation by rail has not been a viable alternative for movement of Project personnel or commodities, as clearly demonstrated by the experience of the construction program. This was due to rolling stock shortages, rationing of rail space and maintenance problems of the railway system itself.

Internal and external communication systems have been established and are currently functioning adequately, although this area has also proved challenging. It was not possible for the Project or ARC to obtain GOS permission to maintain an external telex. Communication by telephone to points outside Sudan has proven expensive and unreliable. As a result, the majority of communication of an urgent or time-sensitive nature was made utilizing telexes available either through the private sector (Arkel International, Inc.), the US Embassy, and more recently, the USAID Mission.

Communication with ARC Headquarters in Wad Medani was dependent on overland courier or internal telephone communications. The latter was not consistently reliable. As a part of the WSARP radio network, a radio was procured and sent to Wad Medani in 1981. Numerous attempts were made to put the radio into operation, but approval from ARC management to install the radio was not received until 1985. A radio technician was sent to Wad Medani upon receipt of this authorization, but the radio linkage was still not operational as of December, 1985.

Radio communication to the other stations was established as early as possible in the life of the Project, after numerous delays in the approval of a license for radio operation. The initial equipment was procured based on recommendations made by USAID. Subsequently, additional equipment was procured to improve the performance of the radios. With the exception of periodic power outages in all stations except Kadugli, the radio network has performed adequately. It is recommended that at least one back-up radio be maintained at each station, so that the communication linkage can continue when radio mechanical difficulties are encountered.

Additional communications within and among the stations and the Project Support Unit are provided via a weekly mailbag which is transported on the Project aircraft or on the aircrafts of cooperating organizations. An alternative timely mail service to areas other than El Obeid is virtually non-existent.

A major communication linkage between ARC scientists and WSARP scientists and between the Project/ARC and organizations outside Sudan was provided by the person who occupied the position of Senior Advisor to the Director General of ARC, Dr. James Riley. The need for an Information or Communications Officer was demonstrated and such a position was recommended during the early implementation planning of the Project. The issue was subsequently raised during the mid-term evaluation in 1982. A description for such a position was prepared and advertised. Until the position could be filled the Senior Advisor assisted in these activities, but the position has not been filled to-date. Thus, with the departure of the Senior Advisor in March, 1985, this important communication linkage was effectively severed.

The reestablishment of such communication through the appointment of an Information/Communication Officer, initiation of intra-station newsletters, increased intra-station travel by Project scientists, and other mechanisms, are deemed of high importance. Effective communication is imperative if the WSARP research program is to be truly efficient, complementing the research work being done elsewhere, and effective, utilizing state-of-the-art information and technology being developed elsewhere (within and outside Sudan). This area must be given higher priority in further Project and ARC planning.

#### Procurement

The Project expended \$3.84 million (including shipping costs) for procurement of commodities, equipment, materials and supplies. A detailed list of the final WSU/CID-provided non-expendable inventory (all equipment valued at \$500 or more and selected items under \$500), is included in Appendix IX. The procurement activities required the establishment of procurement mechanisms both in the US and in the Sudan. Once established, these mechanisms functioned effectively.

Procurement from the US was planned in two cycles, the first to coincide with the establishment of the basic infrastructure and the initial research plan in Kadugli in 1981-82, and the second to coincide with the anticipated completion of the Darfur and El Obeid stations in 1985. The decision was made by the Project in collaboration with donors that the procurement component (including determination of items to be procured and timing) should be dictated by evolving programmatic requirements. Phase I procurement therefore concentrated on those items necessary to establish a basic research effort at Kadugli (and to a lesser extent, El Obeid), the provision of household furniture and equipment, equipment for the technical assistance staff, and the equipping of temporary Project Headquarters and Project Support Unit in Khartoum. Mechanisms were established so that needs defined in Kadugli, El Obeid, and Khartoum were consolidated and relayed to Project management in Khartoum and to procurement personnel at WSU. The latter assisted in the identification of appropriate equipment and vendors utilizing the information/specification available from the field, and conducted the

actual procurement, as well as the staging and shipping of the items to Khartoum.

The procurement program functioned well to meet present and future Project needs in spite of a number of obstacles which included:

- ◆ the virtual lack of a history of use of US equipment and commodities in Sudan, and lack of familiarity by the Sudanese with US products, which led to delays in identification of suitable US alternatives;
- ◆ the global economic situation during this period which resulted in low levels of item stocking and subsequent long delays in delivery;
- ◆ the limited number of air and surface shipping agents that served the Sudan area;
- ◆ lengthy delays in obtaining dock space in Port Sudan, obtaining customs clearance, obtaining transport to transship from Port Sudan to Khartoum; and
- ◆ on two occasions, the lapse of the US-GOS importation agreement.

Local procurement was handled according to standard ARC and GOS regulations, and was funded primarily from GOS regular budget and PL480 funds. The availability of the latter source of procurement funding in 1980-81 resulted in the freeing up of additional dollar funds, and the external procurement plan was expanded accordingly to include additional scientific equipment, vehicles, training equipment, computers, and major appliances for senior Sudanese housing. In addition, dollars became available for force account activities and for procurement of station maintenance spares.

#### Maintenance

Maintenance of facilities, vehicles and equipment was identified as a high priority area from the onset of the Project. Further, it was recognized that the ARC system was currently unable to meet its maintenance needs and that some modification/revision of the existing system would be necessary for the Project. As a result, early amendments to the staffing patterns included increased numbers and categories of maintenance personnel. However, government salary levels, the lack of trained personnel in the West, and other

aforementioned staffing constraints hampered Project success in filling these positions.

During the USAID Project evaluation in late 1982, the need for increased leadership and for improved performance in all areas of maintenance was highlighted.

### Facilities

In December, 1982, a consultant from International Crops Research Institute for the Semi-arid Tropics (ICRISAT) assisted with the definition of maintenance requirements, including equipment and supplies, for the Kadugli station. Since no previous category for provision of leadership in the area of maintenance existed within the ARC/Ministry system, a new position entitled Senior Facilities Maintenance Engineer was created within the ARC in late 1982. Because this was a new position being introduced into the existing government system, a lengthy delay was encountered before approval was obtained through all channels. An individual was identified to be seconded from the National Association for Water (NAW) to fill this new position in late 1984.

A technical assistance Facilities Maintenance Advisor was brought to Sudan for a planned period of up to one year to work with this new individual. His duties were to assist in: (a) the establishment of comprehensive station maintenance programs for all stations; (b) the training of facilities maintenance personnel; and (c) the identification and procurement of necessary station maintenance spares not provided by the construction contractor. However, the Sudanese engineer failed to report to the Project as scheduled due to difficulties with his secondment. It was therefore not possible for the sole technical advisor to accomplish the full range of objectives. On-the-job training for maintenance personnel at Kadugli, El Obeid, and Khartoum was conducted, and personnel were trained. Also, recommendations were made for the comprehensive maintenance program. However, in the absence of a senior Sudanese Maintenance Engineer, establishment of sustainable comprehensive maintenance program was not feasible.

Procurement of spare parts for maintenance of the facilities at all sites was carried out as indicated in Section V.A.1 (Station Maintenance Spares) above. Since the Sudanese Maintenance Engineer had not yet joined the Project as of December, 1985 and the new stations are nearing completion, leadership in this area is critical if the stations are to remain in good condition and operate effectively.

### Vehicles

The technical assistance position of Vehicle Maintenance Engineer was created in late 1982 to meet immediate critical vehicle maintenance requirements, to establish vehicle service schedules and procedures, and to conduct on-the-job training of vehicle mechanics. These activities were conducted from September 1982 through August, 1985, primarily in Khartoum and Kadugli. Due to lack of incentives for both the recruitment and the retention of personnel once they were trained, technical maintenance performance declined following the termination of the technical assistance position in August, 1985. It is likely that vehicle maintenance will remain problematic in the absence of an adequate level of leadership and supervision for the current cadre of mechanical staff.

### Scientific/Research Equipment

Adequate maintenance of scientific/research equipment is necessary for the research program to function effectively. On-the-job training was conducted by senior scientific staff for technicians throughout the life of the Project. Upon the request of the scientists at Kadugli and El Obeid for assistance with existing equipment, and with the recognition that a large amount of scientific equipment would have to be set up following completion of the major construction program, an Equipment Maintenance Specialist was identified to go to Sudan in mid-1985. As a result of additional construction delays, however, this individual's arrival in Sudan was delayed until late November, at which time the US Embassy travel advisory precluded his travel. As a result, his scheduled objectives which included the setting up of new scientific equipment, the

training of personnel in the maintenance and operation of such equipment, and the establishment of regular equipment maintenance services, have yet to be accomplished. These tasks remain of critical importance as the new stations come on line.

### Farm Machinery

On-the-job training programs in maintenance/operations of farm machinery at Kadugli and El Obeid were conducted for Project personnel by a short-term advisor specializing in farm equipment. This individual recommended a number of improvements in the maintenance and operations of a wide spectrum of Project machinery and vehicles, including additional measures to ensure operator safety.

In summary, the establishment of effective maintenance programs for all aspects of the Project received high priority, and much was accomplished. However, it will be important to ensure that progress achieved to date be maintained and that additional steps are taken to continue improvement of maintenance systems and operations.

### Library and Information Systems

As indicated in the early Project planning documents, the establishment of library and information systems was undertaken early in the Project. An interim library was established at Khartoum under the leadership of the Senior Advisor to the DG/ARC, while a small satellite library was established at Kadugli. The major library is to be located in El Obeid at WSARP Headquarters in association with the Training and Extension Unit. Small operational libraries analogous to the one at Kadugli are also to be included at the Darfur stations.

As with all previous support positions, the recruitment and retention of qualified library personnel presented difficulties. On-the-job training of temporary library personnel by the Social Science Research Associate (who was also a trained librarian) was conducted from 1982 to 1984 pending identification and hiring of more senior level, trained library personnel. Short-term training was obtained for potentially permanent Kadugli librarians on two separate occasions, but the librarians departed from the Project as soon as

training was completed, in order to pursue other job opportunities. During the final stages of the WSU/CID contract, the Kadugli Library continued to function with the Kadugli radio operator as the acting librarian. He had received training in Khartoum to serve in this role. The limitations of this arrangement are clear since the only functions being performed are routine in nature, and the person lacks training to creatively manage the library or to interface effectively with the Headquarters library as an information resource leader.

A Senior Project Librarian to head the WSARP Headquarters library in El Obeid was identified in early 1985. This individual travelled to WSU for a two month training course in May, 1985. As part of this training, preliminary plans were completed for the organization and management of the El Obeid library. It was planned that two of the library personnel with whom the Senior Project Librarian worked at WSU would travel to Sudan to assist with the establishment of the overall library system, including its interface with ARC's library, and the setting up of the central WSARP library as the El Obeid Station neared completion. The need for such on-site help was obvious since the short training period was of a general nature and did not specifically address problems concerning ARC, El Obeid, etc. However, the travel of these WSU librarians was prevented by the US Embassy travel advisory in late November, 1985. Consequently, the establishment of the library system at El Obeid and its interface with those of the other Western stations and with ARC has not been completed.

Library materials have been identified and procured throughout the life of the Project in response to the programmatic needs of the evolving research program. Library books and journals were identified, prioritized, and procured. These are located either in the Kadugli library or are in El Obeid awaiting the final establishment of the central library. A list of library materials procured is included as Appendix X. USAID procurement regulations mandated the termination of all journal subscriptions in 1984, because the hard currency required for such subscriptions could not be continued beyond the end of the WSU/CID contract.

A system for provision of journal articles from journals other than those to which the Project subscribed was initiated in 1980.

This consisted of the circulation of the "Current Contents" journals to the scientific staff at Kadugli and El Obeid. Desired articles were identified and forwarded to the PSU and to WSU. The WSARP backstopping unit at WSU provided copies of the requested articles to the Project in Sudan. In addition, literature searches were conducted by the WSU libraries on receipt of requests from WSARP scientists. Information from the International Agricultural Research Centers and from a number of US and international organizations was also solicited on a regular basis and forwarded to the Project in Sudan.

The solicitation and circulation of information acquired from non-Project sources required a high level of input from the PSU and WSU. Some information mechanisms, such as the circulation of an intra-Project newsletter, were initiated early in the life of the Project, but were later abandoned due to the lack of sufficient manpower. The lack of an Information/Communications Officer impacted upon this issue. The areas of library and information management must continue to be of high priority in order to most effectively serve the needs of the research program.

#### Other Research Support

Additional support to the research program was provided by WSU, the University of Khartoum, ARC Headquarters (Wad Medani), and a number of other sources. Included among these off-station support activities were computer analyses of WSARP data, when such exceeded the capacities of local computation equipment; the analysis of soil, mineral, and other samples, when not feasible on the station itself; and other services. While every effort was made to establish a resident capability for those types of support services which were needed on a routine basis, it was decided that those activities which would only be required periodically would most efficiently be provided through cooperative agencies. However, subsequent experience proved that excessive dependence on organizations with limited operating funds and/or conflicting priorities could result in delays in the receipt of such services.

In some instances, research activities were negatively impacted. As a result, laboratory equipment needs at El Obeid were revised in

the period from 1984 to 1985 to increase the capacity of the Project in the West to perform routine support functions. Also, the additional of personal computers increased the Project's capacity for both data analysis and production of manuscripts, reports, and other written materials by the scientists themselves, in the absence of adequate secretarial support.

The development of the capacity to publish and otherwise share Project information with the ARC and various clientele was another important area. Development of this capacity included strengthening of ARC's internal publication capacity through the purchase of publication equipment for Wad Medani as well as for the Project Headquarters at El Obeid. Information to be generated and/or processed in the Training and Extension Unit as well as the scientific publications will be disseminated by the Project and ARC. Pending completion of the Project facilities at El Obeid, however, the publication and dissemination of written information functions were performed through WSU and the Project Support Unit in Khartoum.

## **B. DEVELOPMENT AND CONDUCT OF APPLIED/ADAPTIVE RESEARCH PROGRAM**

### **1. HUMAN RESOURCE DEVELOPMENT**

Human resource development for the applied/adaptive WSARP research program focused on the recruitment and training of scientific and technical staff. WSARP staffing patterns were revised in collaboration with donor and ARC as the program evolved. Initial and final approved staffing patterns are indicated in Tables 7 and 8.

The training program for WSARP research personnel was implemented at three levels: (1) degree training in the US; (2) short-term courses and training programs conducted in-country, at appropriate international organizations (eg. IARCs), or at US educational institutions; and (3) on-the-job training within the Project. The training program was continually refined to reflect evolving programmatic needs and priorities. In terms of degree training, it was agreed that the initial time projection of two years for a Master's degree and three years for a Ph.D. were unrealistic and not compatible with either ARC experience or Project needs. Because of

Table 7

WSARP Scientific Staffing Patterns -- Original Design (1978)

Station	Program/Discipline	
HEADQUARTERS (NYALA)	Project Director Deputy Project Director	
	<u>Water &amp; Land Use Research:</u> Program Leader Deputy Leader Soil Physicist Soil Chemist Agro-Climatologist Agro-Climatologist Water Engineer	
	<u>Research Support Services:</u> Program Leader - Production System Sociologist Sociologist Economist Economist Biometrician Groundnut Breeder Groundnut Breeder Research Liaison Officer	
	<u>Training &amp; Extension Unit (TEU)</u> Training Officer Assistant Training Officer	
	EL OBEID	<u>Crop Livestock System Non-Cracking Clays</u> Sub-Program Leader Non-Cracking Clays Gum Arabic Specialist Gum Arabic Specialist Agricultural Engineer Farm Management Economist Millet Breeder Livestock Specialist Kerkadeh Specialist Research Liaison Officer
		<u>Water &amp; Land Use Research:</u> Field Project Officer

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KADUGLI

Crop Livestock System Cracking Clays:  
Sub-Program Leader Cracking Clays  
Farm Management Economist  
Farm Management Economist  
Agricultural Engineer  
Agricultural Engineer  
Sorghum Breeder  
Livestock Specialist/Forage Agronomist  
Research Liaison Officer

Water & Land Use Research:  
Field Project Officer

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EL FASHER

Sub-Program Leader  
Camel Specialist  
Sheep & Goat Specialist  
Range Specialist

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ARC HEADQUARTERS

Senior Research Advisor to Director General  
Research Planning & Evaluation Advisor  
Project Architect  
Project Liaison Officer

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Table 8

## WSARP Scientific Staffing Patterns -- Revised (1982)

Station	Program/Discipline	Scientist Projected	Scientist In-Service	Status Dec. 1985
KADUGLI	<u>Cropping Program:</u>			
	Systems Agronomist	1	M. Kenani	none (departed)
	Agro-breeder	1	El Medina	El Medina
	Crop Protection	1	El Tayeb	none (departed)
	Weed Specialist	1	M. Yassin	none (departed)
	<u>Soil/Water Program:</u>			
	Soil/Water Management Specialist	1	none	none
	Agricultural Engineer	1	Mekki <sup>1/</sup>	Mekki <sup>1/</sup>
	<u>Range/Livestock Program:</u>			
	Range/Forage Specialist	1	I. Hashim <sup>2/</sup>	none (departed)
	Livestock production Specialist	1	Ageeb <sup>1/</sup> Fadalla <sup>2/&amp;</sup>	Ageeb <sup>1/</sup> Fadalla <sup>2/&amp;</sup>
	Social Scientist	1	Abu Sabah	Abu Sabah <sup>4/</sup>
	Agricultural Economist	1	Tighani	Tighani <sup>1/</sup>
	Sr. Production Specialist (Research Extension/Liaison)	1	none	none
EL OBEID	<u>Cropping Program:</u>			
	Systems Agronomist	2	El Hag Hassan	El Hag Hassan
	Agro-breeder	1	El Khider <sup>3/</sup>	El Khider <sup>3/</sup>
	Horticulturalist	1	Osman Adam	Osman Adam
	Entomologist	1	A. Beshir	A. Beshir
	<u>Soil/Water Program</u>			
	Water/Land Use Analyst	1	none	none
	Soil/Water Specialist	1	Madibo	Madibo <sup>1/</sup>
	Soil Physicist	1	Babiker I.	Babiker I.
	Agriculturalist Chemist	1	recruited, not arrived yet	
	Ag. Engineer (Soil/Water)	1	none	none
	Agro-climatologist <sup>5/</sup>	(2) <sup>5/</sup>	none	none
	<u>Range/Livestock Program</u>			
	Range/Forage Specialist	1	H. Mukhler	H. Mukhler
Livestock Production Specialist	1	none	none	

	<u>Economics Program:</u>			
	Economist/Biometrician	1	none	none
	Agricultural Economist	1	S.A. Beteik	S.A. Beteik
	Sociologist	1	M. Mekki	M. Mekki
EL OBEID (cont.)	<u>Liaison/Extension Program:</u>			
	Extension/Liaison Specialist	1	E. Dukheri	E. Dukheri
	Training Officer	1	none	none
	<u>Gum Arabic Program:</u>			
	Gum Arabic Specialist	2	Zakaria <sup>1/</sup> & Faroug <sup>1/</sup>	Zakaria <sup>1/</sup> & Faroug <sup>1/</sup>
<hr/>				
	<u>Cropping Program:</u>			
	Systems Agronomist	1	none	none
	Groundnut Breeder	1	Abdelrahman	(located in El Obeid)
	<u>Range/Livestock Program:</u>			
	Animal Production Specialist	1	none	
GHAZALA	Animal Health Specialist	1	none	
GAWAZET	Range Scientist	1	none	
	Liaison/Extension	1	none	
	Economist	1	none	
	Sociologist	1	none	
<hr/>				
	<u>Range/Livestock Program:</u>			
	Animal Production Specialist	1	none	
	Animal Nutrition	1	Fadlalla	(located in Kadugli)
EL FASHER	Animal Health (Vet. Dept.)	1	none	
	Range Management Specialist	1	I. Hashim	none (departed)
	<u>Economics Program:</u>			
	Ag. Economist	1	Siddig	
	Sociologist	1	Mekki	

- 1/ In training in U.S.  
2/ Scheduled for El Fasher, although temporarily located in Kadugli.  
3/ Scheduled for Ghazala Gawazet, although temporarily located in El Obeid.  
4/ Scheduled to go for training.  
5/ Agro-climatologist positions under discussion for several years.

the ARC requirement for a six-month internship on the Project before leaving for overseas training, and the added desirability of students doing their research in Sudan with the Project whenever possible, training schedules were revised to three years for a Master's degree and five for the Ph.D.

Accordingly, it was noted that this time frame would put additional pressure on the ARC to provide staff to WSARP prior to the return of trainees from abroad. It was also noted that with a limited number of ARC personnel available in certain disciplines, eg. animal production, range science, social sciences, and economics, the consideration of secondment from appropriate Ministries would be necessary. Accordingly, recruitment for trainees and scientists from non-ARC organizations as well as ARC was initiated. Several trainees were recruited by WSARP/ARC and joined the Project while in training abroad, both as a direct result of WSARP/ARC efforts and as an indirect result of the decline in other sources of GOS funding for training abroad.

WSARP training programs are summarized in Appendix VII. It should be noted that the WSARP scientific training program was very modest in relation to the size of the Project. The balance of the staffing was planned to be provided by ARC through existing staff and its other training programs. The ARC had a total of over 166 scientists with an additional 77 in training abroad at the time of the Project's inception.

## 2. DEVELOPMENT/EVOLUTION OF RESEARCH APPROACH AND PROGRAM

### Introduction

Initial Project documents indicated that research activities were to identify and test production increasing technologies for traditional crop/livestock systems which would conserve and/or rehabilitate the natural resources of the area. Target production systems were identified in these documents based on their ecological characteristics, specifically: (1) livestock production at the desert fringe; (2) semiarid livestock production in the Sudanian and Sahelian Zones; (3) integrated crop/livestock production on stabilized sands;

and (4) integrated crop/livestock production on the cracking clays. In addition, it was suggested that a systems approach be used in formulating and implementing research programs.

Accordingly, the construction sites for WSARP's four research stations were strategically located, one in each of the four Provinces of the West. Thus, each of the four ecological areas specified in the original planning documents was represented by a research station.

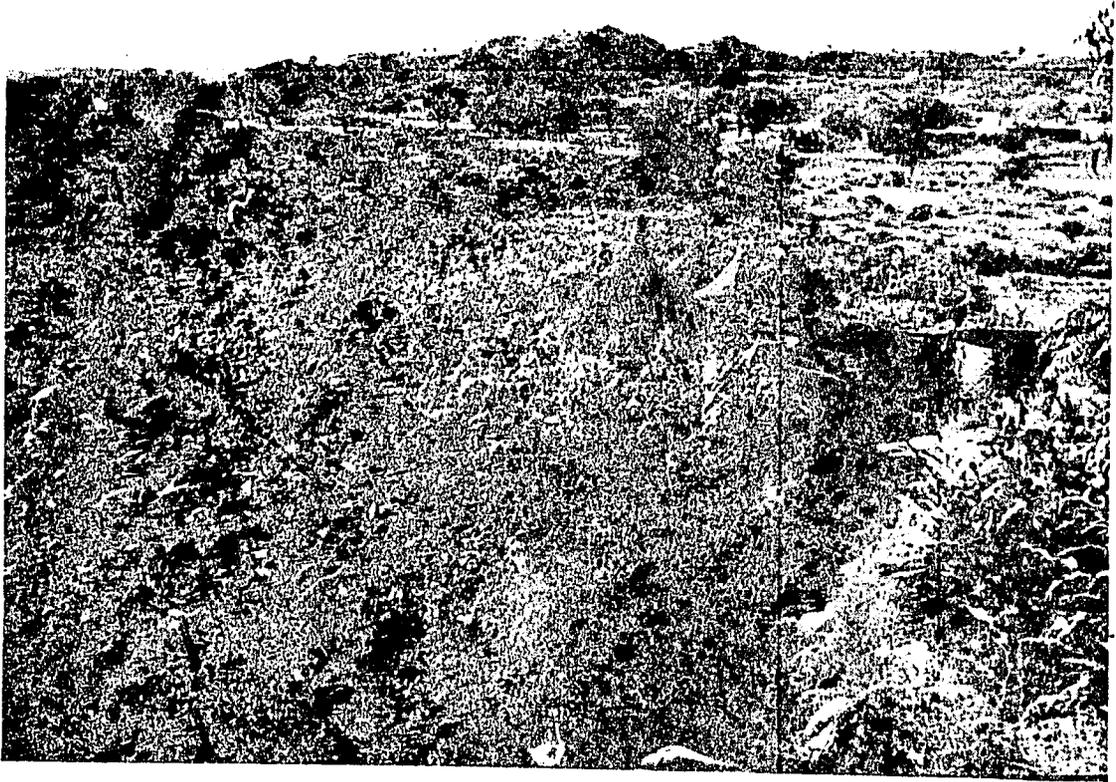
Project staff were also cognizant of the important role policy played in providing social and economic incentives for agricultural development. Therefore, early research program planning encouraged the participation of local, Provincial/Regional, and national agricultural and financial policy-makers. Building on the comparative advantages of rainfed agriculture to provide the basic economic foundation for supporting local, Regional, and national development, the Project sought to merge the self-interests of both traditional producers and policy-makers/administrators into a unified research support mechanism.

#### Kadugli

As determined in the 1979-80 scope of work, research activities were initiated in Kadugli in accordance with the early World Bank documents. Preliminary diagnostic surveys in the target area of the Nuba Mountains revealed that multiple production systems were in use, and further, that each of these systems utilized a variety of ecological zones, and associated soil types for their activities.

The production systems identified included: (1) sedentary producers (sedentary system) primarily involved in crop production; (2) those in which seasonal livestock migrations occurred, but cropping played an important role (transhumant system); and (3) a third type in which migratory pastoral production was the virtually sole objective (nomadic system).

The basic objectives of the research effort were to develop and test adoptable technologies which would lead to sustainable increases in the productivity and production of traditional producers. Research staff recognized, at the outset, the importance of understanding how producers allocated their scarce resources among a spectrum of



**The Kadugli production systems include sedentary farmers (top) and transhumant livestock producers (below).**

production activities to achieve their production objectives. Such an understanding was recognized as central to the design of potentially adoptable technologies. Thus, the focus of the research was redirected away from the technical definition of production systems based solely on ecological characteristics to a more behavioral, functional definition incorporating producer resource allocation and production objectives.

Utilizing rapid appraisal methods whenever possible, with in-depth data collection limited to those areas in which some specific additional information was required, the research program identified production constraints and potential interventions. Research activities were then prioritized based on potential maximum impact for improving production through reduction of such constraints. The highest priority was placed on the sedentary and transhumant production systems because of the number of producers, their present contribution to export commodities and the production potential of the geographic area involved. The nomadic system was deemed of lower priority in Southern Kordofan and received minimal attention. The development of the Kadugli research program is discussed in detail in WSARP Publication Nos. 13 and 14.

Identification of potential technical and management interventions to increase production and productivity were carried out and moved as rapidly as possible onto cooperating farmers' fields or within their herds and flocks. As a result of the Project mid-term evaluation in mid-1982, more formal use of the Farming Systems terminology was introduced. However, the basic Project approach remained the same and emphasized a multidisciplinary systems approach to finding solutions to factors constraining the production of important commodities in Western Sudan.

Pending completion of a road between the research station facilities and the research farm, on-station activities were carried out on temporary ARC research plots located off the permanent Kadugli research farm. In 1983-84, the permanent research station farm was utilized for on-station trials. These station trials were limited to the testing under prevailing conditions of promising interventions for which sufficient information was not available to substantiate

on-farm trials. These station trials became increasingly discriminating over time as the research program became more focused and built on results obtained within the Project and by others working in Sudan.

The pilot activities at Kadugli proved a successful model for replication of the research planning approach at the new stations. Research results are summarized in Section V.B.4 and detailed in numerous WSARP publications (See Annotated Bibliography, Appendix II for additional information).

#### El Obeid

The existing gum arabic research program in El Obeid was officially transferred to the Project in 1980. Activities between 1980 and 1982 at El Obeid basically continued these gum arabic/agroforestry activities. Close contacts were established with the program in Kadugli. Many aspects of the research approach being utilized at Kadugli were adopted by the gum arabic program. When it became evident that the completion of the station at El Obeid would be delayed, the Project rented housing and converted two houses into temporary laboratories to conduct integrated multidisciplinary research. Kadugli-based WSARP scientists were sent periodically to El Obeid where they assisted the small El Obeid staff. This WSARP team worked closely with International Sorghum and Millet CRSP (INTSORMIL) personnel and with others in the geographic area to define the comprehensive research effort for El Obeid. In 1983-84 this research was carried out utilizing the existing agroforestry facilities and the aforementioned rented facilities. This program was expanded in 1984-85 as additional Sudanese scientists returned from completion of their overseas training programs. In the process of instituting the same research approach as that done at the Kadugli Station, the absence of economic or social science personnel was a constraint in El Obeid. Frequent interaction between Kadugli- and El Obeid-based personnel was established as a temporary mechanism to attempt to cope with the lack of these disciplines.

Members of the El Obeid research team, with the exception of the Soil and Water Specialist (TA) were all newly returned trainees, so

there was a lack of experienced senior scientific input. The decision by USAID to concentrate all technical assistance in Southern Kordofan rather than moving a portion to El Obeid in 1984 as originally planned contributed to this constraint. As a result, the El Obeid research activities were more disciplinary in focus and less an integrated systems program than in Kadugli. However, in the 1984-85 season, a move to on-farm trials and other adaptive research activities occurred.

In spite of these constraints, the progress of the research program at El Obeid was considerable. Research results from this station are also included in Section V.B.4.

#### Darfur

Preliminary discussions were held from 1982-1985 with Regional, and local government officials and with other agencies and projects operating in Darfur. Preliminary research plans were drawn up by WSARP with collaborative input from these organizations. Following the delay in the construction program in Darfur, and the USAID decision to focus resources solely on Kordofan, finalization of the Darfur research program has not yet been attempted. The research approach used in Kadugli and being adopted in El Obeid appears equally applicable to the Darfur Region. Building on the results of activities by the Western Savanna Development Corporation (WSDC), the Jebel Marra Rural Development Project (JMRDP), and others, it should be possible to refine the research program in this area within a short period of time.

Project activities in the Darfur Region will continue, utilizing funding by the World Bank in conjunction with the WSDC for the immediate future. Since the Darfur research program was always intended to be complementary to and closely linked with that in Kordofan, mechanisms to ensure close cooperation between the research in Darfur and Kordofan will be essential.



**Project Director Dafalla A. Dafalla examines millet near the El Fasher Station.**



**Horticulturalist Dr. O. Adam Osman at El Obeid's Benu out-station.**

### 3. RESEARCH MANAGEMENT STRUCTURE AND FUNCTION, INCLUDING ARC INTERFACE/INTEGRATION

#### Introduction

WSARP is a part of the ARC and must function within the context of the administrative and management structure of its parent organization. Nonetheless, there are necessary and logical differences relative to the manner of interface utilized by WSARP with ARC headquarters as compared to the way other research stations interface with that central unit. In the case of other research stations, the Station Director or head of station represents the station on program and finance committees and interacts directly with administration of ARC representing his/her station. WSARP differs from the usual within the ARC, however, in that there are four research stations represented by one director and also in the organization of the research program.

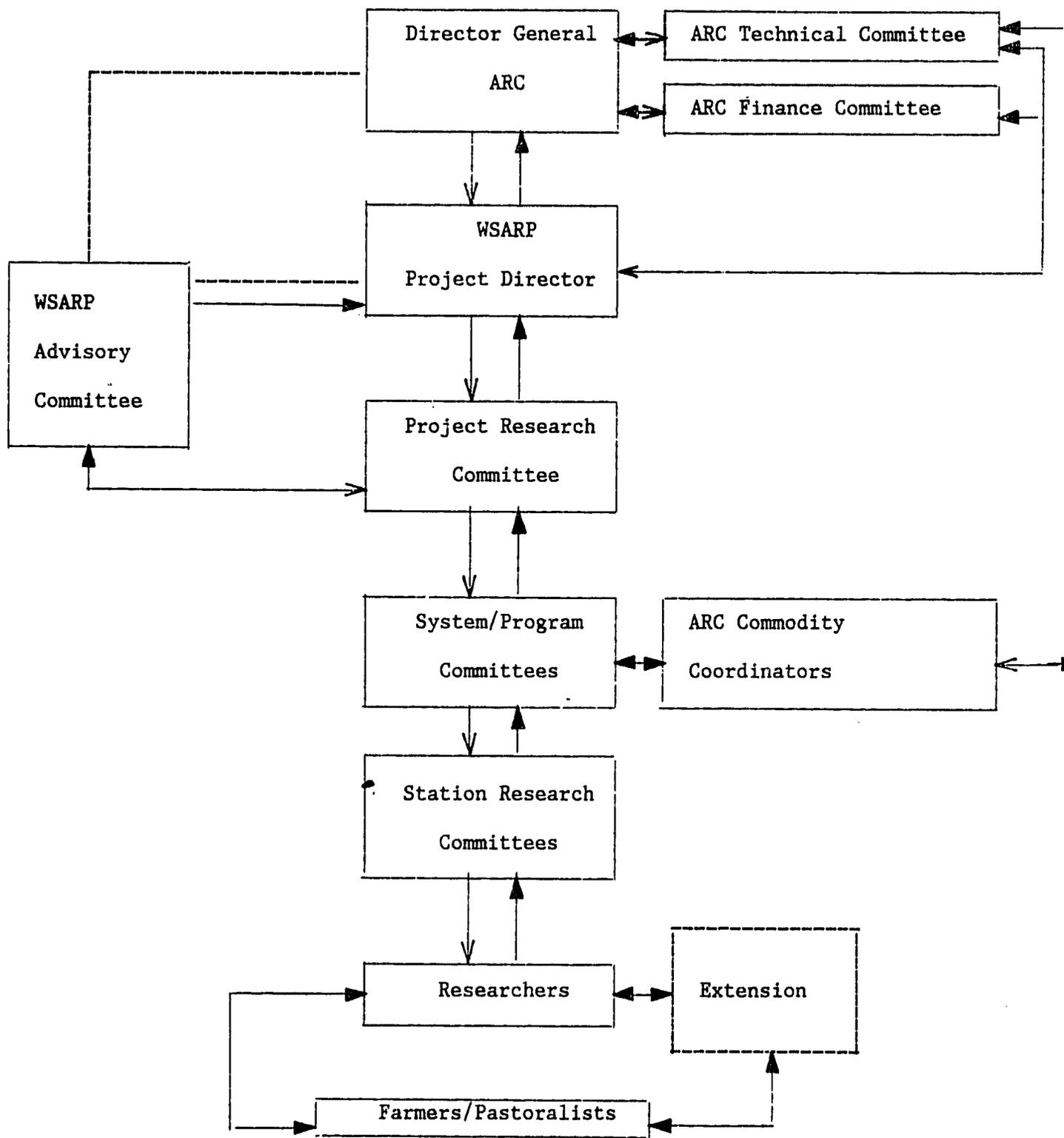
As indicated previously, WSARP has a more applied/adaptive research orientation than is the case for most of the ARC research activities. The important interface between WSARP researchers and the producers has been emphasized in the initial World Bank and USAID documentation. The theme of a systems approach emphasizing the constraints and potential intervention methodology has been a part of WSARP planning and implementation throughout the tenure of the Project. This emphasis on systems poses a different management, administrative, and planning structure than those traditionally in place for other ARC stations. This point is elaborated further in the following section of this report.

#### Research Administrative Structure

The research administrative structure designed and adopted by WSARP is illustrated in Figure 15. The Director General of the ARC has overall responsibility. The WSARP Project Director interfaces with the Director General directly and through two important ARC committees -- the Technical Committee and the Finance Committee. The former addresses technical issues relating to all ARC research programs and the latter is responsible for the budgetary aspects. The

Figure 15

WSARP Research Administrative Structure -- 1982



WSARP Project Director represents the Western Research Stations on these two committees.

The Project Director is provided with input by a Project Research Executive Review Committee (formerly Project Research Committee), three Systems/Program Committees (Sedentary, Transhumant, and Nomadic) and the Station Research Committees (one per station). The WSARP researchers, working as interdisciplinary groups, interface with the producers to define needs and possible approaches, and to develop proposed interdisciplinary research activities. The researchers present the proposed activities to the relevant Station Research Committee which in turn is chaired by the Station Director. The proposed programs are then forwarded to the System/Program Committees which include the Sedentary Production Systems Committee, the Transhumant Production Systems Committee and the Nomadic Production Systems Committee. These committees examine proposals forwarded from each station and submit resulting recommendations to the Project-wide Research Executive Review Committee which is chaired by the Project Director. The three Systems Committees and the WSARP Research Executive Review Committee assist in enhancing complementarity and minimizing duplication among the proposed activities in each production system and at each station. The Project Research Executive Committee, on which the Director General of ARC sits, makes overall recommendations to the Project Director. The Project Director can then evaluate these recommendations and process his conclusions to ARC through the Technical Committee, the Finance Committee and then directly to the ARC central administration. This research management structure was implemented by WSARP during the tenure of the contract. The research structure and the purposes, activities and membership of the various committees are summarized in Tables 9 and 10.

#### Research Planning, Monitoring, and Evaluation

As indicated, the orientation of the research by WSARP was to focus commodity and disciplinary research based on the production systems and the producers. Both on-farm and on-station research was utilized in the WSARP work schemes. Close and effective networking with the ARC, other organizations within Sudan, and the International

Table 9

## WSARP Research Planning Structure (1982)

RESEARCH STRUCTURE/ ORGANIZATION/INFOR- MATION SOURCE	PURPOSES/ACTIVITIES	MEMBERSHIP/COMPOSITION*	RESEARCH STRUCTURE/ ORGANIZATION/INFOR- MATION SOURCE	PURPOSES/ACTIVITIES	MEMBERSHIP/COMPOSITION*
Farmers/Pastoralists	Provide information and details concerning systems and needs; continual feed-back into Project; constraints	Farmers/pastoralists (selected) in Project areas	System/Program Committees	<ol style="list-style-type: none"> <li>1. Coordinate Systems/Programs Project-wide</li> <li>2. Define System/Program research priorities</li> <li>3. Define System/Program Work-Plan and recommend to Project Research Committee</li> <li>4. Develop and make recommendations to Project Research Committee regarding budget for program activities</li> <li>5. Evaluate System/Program activities Project-wide</li> <li>6. Interact with ARC</li> </ol>	<ol style="list-style-type: none"> <li>1. Chairperson(s)/System Programs</li> <li>2. System/Program Leaders</li> <li>3. All stations represented</li> <li>4. ARC representative(s)</li> <li>5. Others, as appropriate</li> </ol>
Researchers/ Collaborators	<ol style="list-style-type: none"> <li>1. Planning and conduct research activities</li> <li>2. Make recommendations to Station Research Committee - research proposals</li> <li>3. Interact with farmers/pastoralists</li> <li>4. Interact with colleagues</li> <li>5. Interact with other relevant organizations</li> </ol>	All researchers	Project Research Committee	<ol style="list-style-type: none"> <li>1. Define research priorities</li> <li>2. Define research activities and work plans</li> <li>3. Recommend budgets and activities to Project Director for final approval</li> <li>4. Interact with ARC</li> </ol>	<ol style="list-style-type: none"> <li>1. Project Director, Chairman</li> <li>2. Deputy Project Director</li> <li>3. One US Senior Scientist</li> <li>4. One Sudanese Senior Scientist</li> <li>5. System/Program Leaders</li> <li>6. Relevant ARC National Coordinators</li> </ol>
Station Research Committee	<ol style="list-style-type: none"> <li>1. Define research needs and priorities for region or sub-region</li> <li>2. Make recommendations to Systems Committee</li> <li>3. Determine research support requirements</li> <li>4. Recommend research activities at local level</li> <li>5. Coordinate activities at station level</li> <li>6. Form System/Program Subcommittees</li> </ol>	<ol style="list-style-type: none"> <li>1. Station Research Leader</li> <li>2. Station Director</li> <li>3. Research Scientists</li> <li>4. Senior Maintenance and Operations Officer</li> </ol>	Project Director	<ol style="list-style-type: none"> <li>1. Responsible for Project administration and activities</li> <li>2. Makes final decisions on Project activities and budgets</li> </ol>	Project Director
			Director General of ARC	Overall responsibility for ARC and Project	Director General of ARC

\* Consultants both from within and outside Sudan, as appropriate, will be utilized.

**Table 10**

**Revised Composition and Duties of WSARP Committees (1984)**

COMMITTEE/ADMINISTRATOR	PURPOSE	COMPOSITION	APPROX. MEETING INTERVAL & SUGGESTED VENUE
WSARP Advisory Committee	To insure program compatibility with national and regional goals and activities.	As shown in Table 11, plus representatives of Farmers Union, National Council for Research, Regional Universities	Annually at WSARP Headquarters
Director General, ARC	Assure that Project activities are in harmony with, and complementary to, ARC objectives and practices.	—	—
WSARP Director	Develop administrative implementation plans and approve allocation of Project resources.	—	—
Project Research Executive Review Committee (Administrative)	Review and approve Project work plan.	ARC Director General (1) WSARP Director (1) WSARP Deputy Director (1) Chairman, Production Systems Program Committee (1) Western Station Directors (4)	Annually at ARC Headquarters
Production Systems Program Committee (Technical)	To integrate station programs into unified Project work plan.	ARC Deputy D.G. Programmes (1) WSARP Deputy Director (1) Western Station Directors (4) Senior Scientists from each Western Station (4) Technical Representative from Kordofan & Darfur (1) Regional Government (2) ARC Senior Advisor (1)	Semi-annually Rotated among WSARP stations
Station Research Committee (Technical) (one per station)	Develop station research program and continually review its progress.	Station Director (1) All Station Senior Scientists Farm Manager (1) Invitees as required	Quarterly, at each station

Agricultural Research Centers (IARCs), and other organizations outside Sudan was effectively carried out. Such networking is essential to the effectiveness of the FSR approach.

Proposed research activities were designed by the researchers, discussed/modified with colleagues using an interdisciplinary approach, and subsequently discussed within the Station Research Committees. The proposed research activities then moved through the administrative system as defined earlier in this document for final approval for action.

Research was monitored in an on-going manner by the Station Research Committee, the Systems/Programs Committees, and the Project Research Executive Review Committee. In addition, the Project Advisory Committee provided an overview with participation from a broad spectrum of Sudanese institutional representation (See Table 11). Also, the ARC Technical Committee monitored the proposed activities and results to determine effectiveness of the research program.

Monitoring and evaluation has been performed by external agencies as well as by consultants from Sudanese and US institutions (See Appendices V and XI). Thus, a proven workable structure is in place for the design, monitoring and evaluation of the WSARP research program.

#### Research Station Management

As previously indicated, the WSARP represents four research stations, which are managed collectively rather than as individual stations, as has been the usual case in Sudan. The research activities were initiated at Kadugli as quickly as possible so that these efforts would provide experience and input to develop the necessary operational procedures for subsequent research stations. The planned research station administrative structure for Kadugli is given in Figure 16. The administrative structure indicates the importance of the Station Director, who is responsible for the individual station administration and management. This figure also illustrates the various activities including the research program per se and the support mechanisms. This general approach has also

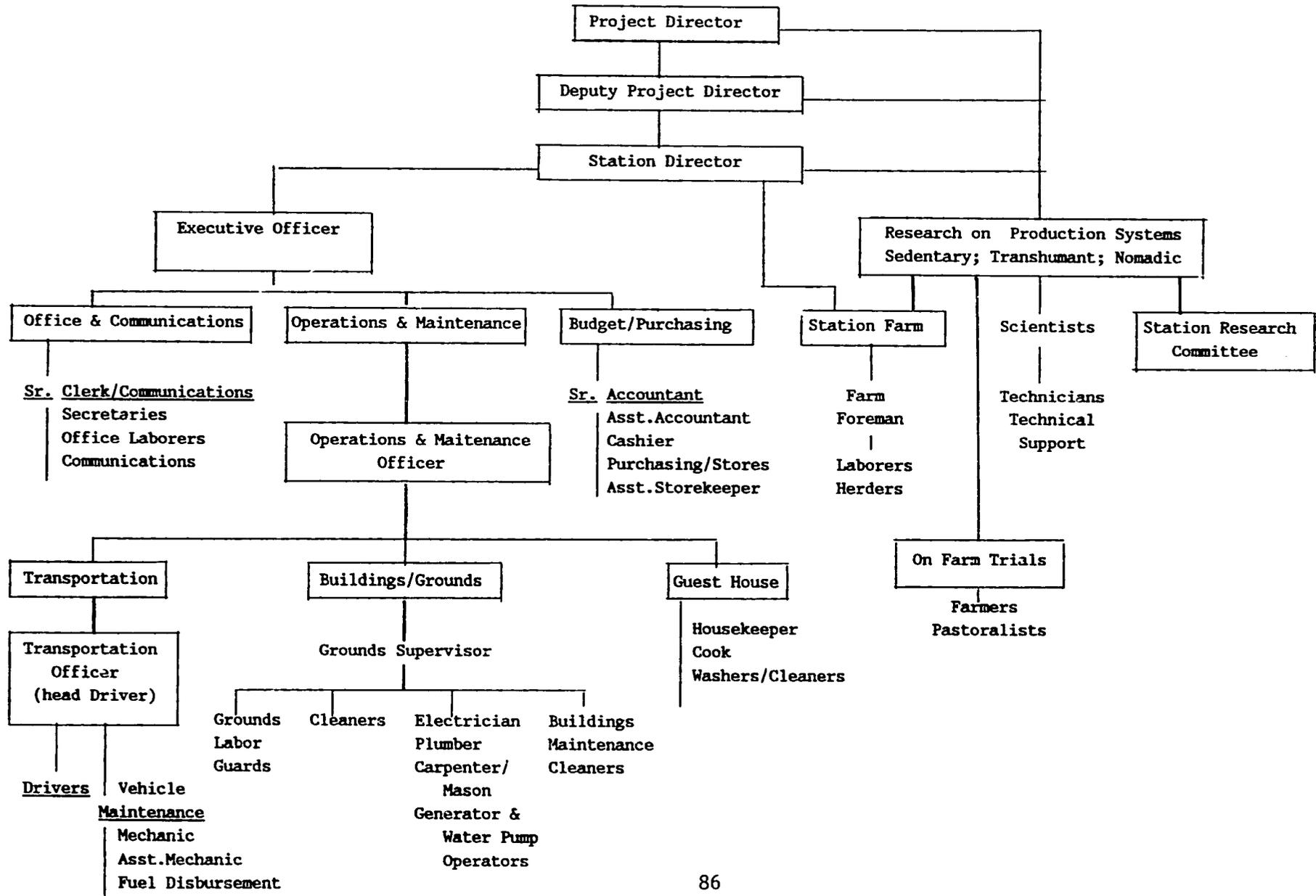
**Table 11**

**WSARP Advisory Committee Membership List**

1. ARC Director General (Chairman)
2. WSARP Director (Secretary)
3. WSARP Deputy Director
4. WSU Project Coordinator
5. ARC Senior Advisor
6. Under-secretary, Ministry of Agriculture
7. Under-secretary, Animal Resources, MOAI
8. Under-secretary, Natural Resources, MOAI
9. Director, Western Savanna Development Corporation
10. Dean, Faculty of Agriculture, University of Khartoum
11. Dean, Faculty of Agriculture, University of Gezira
12. Director General Mechanized Farming Corporation
13. Director, Rural Development Department
14. Director, Council for Social and Economic Studies, NCR
15. Director General, Ministry of Agriculture, Kordofan Region
16. Director General, Ministry of Agriculture, Darfur Region
17. Representative(s) CGIAR
18. Deputy Director General (Programmes) ARC

Figure 16

Planned Research Administrative Structure -- Kadugli





External evaluation and monitoring of the WSARP research program assisted in program planning. From left to right: Dr. El Hag A. Gasim, Station Director, El Obeid; Dr. C. Gotsch, USAID Evaluator; Dr. D. A. Dafalla, Director; and Dr. Bill Wright, USAID Evaluator.



WSARP scientists and technicians (pictured above), additional ARC scientists and others participated in collaborative activities such as the ARC/CIMMYT Farming Systems Workshop, Wad Medani, 1985.

been adopted at El Obeid and should be implemented at the other stations.

#### Summary

The necessity of effective integration of WSARP activities into the ARC has been recognized from the outset. The Sudanese Project Director is a permanent staff member of the ARC and works closely with the Director General of the ARC. The latter has and continues to participate in planning, monitoring and evaluation of activities related to the Project. In addition, ARC commodity coordinators and other ARC scientists have participated in various research planning and implementation activities for the research program. The administrative structure takes into account the relationship of WSARP to ARC and provides mechanisms for input by WSARP into the ARC administrative and management structure.

The major question concerning the relationship of WSARP to ARC relates less to the interaction of the scientists and administrators, and more to the adoption of the WSARP research approach by ARC and subsequent support of these activities by the ARC and GOS. At the time of conclusion of the USAID contract with CID, the permanent institutionalization of the WSARP approach into the ARC was in its early stage. Likewise, the acceptance of the approach by WSARP scientists was at a fundamental level and continuing to evolve. The completion of the WSU/CID contract TA effort with the lack of both continuity and the provision of appropriate resources has undoubtedly delayed the acceptance of this approach to an undetermined degree.

Thus, the Project and ARC developed and implemented mechanisms for integration of WSARP activities into the ARC. These were evolving and were not completely realized, due to the duration of the contract and to other factors, including the rapid turnover of ARC management (four Director Generals in the 6-1/2 year period). It was suggested to USAID one and one-half years before the completion of the contract that this situation should be addressed and necessary steps taken to plan a continuum of activities over time, to further develop WSARP and the associated stations and programs and to further institutionalize WSARP as an effective and accepted part of ARC. These suggestions

were defined in the Fifth Annual Report of WSARP, but were not acted upon by USAID. As a result, the contract terminated with accompanying uncertainty and frustration by Project Sudanese and TA personnel alike.

#### 4. RESEARCH RESULTS

##### Introduction

Western Sudan typically produces about 400,000 metric tons each of sorghum, millet, and groundnuts plus slightly over 100,000 tons of sesame, annually. This production is equivalent to approximately 20% of the sorghum, 90% of the millet, 50% of the groundnuts, and 45% of the sesame produced in the Sudan. In addition, Western Sudan is a major source of all but one (harricot beans) of the top eleven agricultural commodities (by value) exported by the Sudan in 1982.<sup>9</sup>

In terms of livestock resources, Sudan's national herd numbers in excess of 53 million head, with 18 million cattle, 19 million sheep, 13 million goats, and 3 million camels.<sup>10</sup> This collectively accounts for over 17% of Africa's ruminant population.<sup>11</sup> Cumulative percentages show that the West of Sudan supports approximately 75% of all livestock and 65% of the cattle, with Southern Darfur being the most important cattle producing area.

Economically, livestock contribute approximately one-half of the total agricultural sector's contribution to the GNP, and contribute a smaller percentage to total export earnings. Total foreign exchange increased from approximately \$30 million in 1979/80 to over \$80 million in 1983/84. Sheep exports accounted for over 90% of the

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<sup>9</sup>Sudan Foreign Trade Exports by Commodity -- 23rd Annual Report, Bank of Sudan, March 1983.

<sup>10</sup>Booker Agricultural International Ltd. and the Center for Tropical Veterinary Medicine, Regional Animal Disease Control Project Vol. IV, 1981, Sudan/Edinburgh.

<sup>11</sup>Winrock International, Livestock Program Priorities and Strategy, 1981.

foreign exchanges earning attributable to livestock/products and were the third most important export commodity for the Sudan in 1984/85.<sup>12</sup>

Until recently, in spite of its importance, little attention has been given to developing new technology to increase the productivity of farmers and pastoralists in Western Sudan. Especially in crop production, declining productivity has characterized recent trends. WSARP's research program has utilized a systems approach to develop and test technologies to improve productivity and production of selected commodities. WSARP has involved a broad spectrum of local clientele groups (comprised of both men and women), including farmers, pastoralists and traders, local and regional leaders, and others, to enhance broad and equitable participation in an accrual of benefits from the research program.

#### Previous Research

Previous agronomic research results by WSARP and others for crops grown under rainfed conditions in the Sudan have been considered in the ongoing design of WSARP research, and have shown the following:

#### Fertilizer Trials

- ◆ Fertilizer should be incorporated into or placed in the soil adjacent to plants so it is easily accessible to plant roots. Broadcasting fertilizer, a common method of application in Sudan, is inadvisable since that which falls far from widely-spaced plants will not only be lost to the plants, but will also tend to promote weed growth;
- ◆ In Southern Kordofan, crop response to the sole application of nitrogen has not been impressive, but combined application of nitrogen and phosphorus more than doubled sorghum grain yields and increased stover weight by more than 23%;
- ◆ In Northern Kordofan, on the goz and gardud (See Appendix XII for glossary of Arabic and local terms) soils, significantly higher yield responses were found only when both nitrogen and phosphorus

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<sup>12</sup>Booker Agricultural International Ltd. and the Center for Tropical Veterinary Medicine, Regional Animal Disease Control Project, Vol. IV, 1981, Sudan/Edinburgh.



**The 1985 Farmer's Field Day at the Kadugli Station utilized formal presentations (above) and field/herd visits (below) to share WSARP research results.**

were applied to cereal crops, although the yield results were highly dependent on the effective rainfall across trial locations.

### Improved Cultivars

- ◆ In Northern Kordofan millet yields in the decade ending in 1983/84 were 54% of the respective yields for the decade ending in 1970/71. During this time the performance of improved cultivars has, in general, been very location specific. However, the newly released cultivar Ugandi and the ICRISAT/ARC Bristled Population did well in 1984 in the major millet growing areas across Western Sudan.
- ◆ Sorghum yields have decreased in Western Sudan, but not as rapidly as those for millet. In the decade ending with the 1983/84 season, sorghum yields in Kordofan Region were 80% of the levels achieved in the decade ending in 1970/71. Local cultivars performed well under conditions of good soil fertility and plentiful rainfall. However, newly introduced, short-maturing cultivars out-yielded local cultivars on marginal soils and under limited rainfall conditions.
- ◆ Groundnut yields have decreased by about 10% over the past decade in Kordofan Region. The Agricultural Research Corporation is screening for new cultivars that are higher yielding and resistant to Aspergillus flavus infection.
- ◆ Although sesame production has decreased by about 38% in Kordofan during the past decade, it has received little attention to date.
- ◆ Very little screening of grain legumes, cowpeas, and mungbeans has been undertaken to date.
- ◆ At present a very poor agricultural support infrastructure exists in Western Sudan. Effective infrastructural development is necessary to provide for a dependable seed production and supply system for farmers, which is critical to realize the full benefits of genetically superior germplasm.

### Cultural Practice Trials

- ◆ Trials conducted in Southern Kordofan have indicated that the best cultural practices for producing a good crop of rainfed sorghum on the cracking clays include the application of combined fungicide/insecticide to seed prior to planting; prompt planting after the first 50-100mm of rain; and weeding one week after seedling emergence; and

- ◆ for Northern Kordofan, insufficient research has been done to develop a similar set of cultural practice guidelines.

### Livestock Production

Relatively little longitudinal data has been gathered to quantitatively evaluate the constraints, and to assess their impact on the productivity of livestock under traditional management practices in Kordofan Region. Specific aspects of one or more components of the traditional production systems have been evaluated (eg. specific disease problems, analyses of the nutrient content of native forages, etc.), but little progress has been made in assessing the potentials for improving livestock productivity among traditional producers in the Region.

In developing its overall research program, the WSARP has generally tried to build on the data of previous research efforts. However, what is obvious from a historical review of the relevant literature is that more trials need to be conducted on farmers' fields to ensure that new varieties and cultural practices (in the case of agronomic programs) and new management and husbandry practices (in the case of livestock programs) are truly improvements. Moreover, traditional producers frequently undertake both crop and livestock production activities, and therefore, new technologies must be designed with a consideration of the way in which traditional producers allocate their scarce resources amongst an array of production enterprises.

### Kadugli Research Program

#### Summary of Kadugli Research Program, 1984/85:

The Kadugli Research Station focused its research program on the two predominate production systems in Southern Kordofan. The first of these is the traditional sedentary system of the Nuba Mountains, where research efforts have been directed at exploiting the potential of this system for developing mixed farming agricultural practices. An interdisciplinary research program, utilizing both on-station and on-farm trials, has focused on:

- ◆ testing new and improved varieties and identifying improved cultural practices for sorghum, sesame, and cowpeas, the principal crops grown in the area;
- ◆ examining new and improved dual-purpose legumes for incorporation into the traditional cropping system;
- ◆ using conserved forages, crop residues, and modified animal husbandry practices to improve livestock productivity;
- ◆ initiating on-farm trials, in cooperation with the Nuba Mountain Rural Development Project, with draft animals to capitalize on the potential for decreasing labor constraints by incorporating animal traction into traditional cropping practices; and
- ◆ providing socioeconomic data on traditional households and commodity price information for establishing guidelines for research program development and evaluating the efficiency of local markets and farmer marketing strategies.

The second major production system in the area is the Baggara transhumant livestock system. The research program addressing production constraints in this system focused on:

- ◆ evaluating rangeland productivity and identifying potentially adoptable improvements in natural resource management practices;
- ◆ evaluating the productivity and seasonal nutritional status of livestock under traditional management practices and initiating in-herd/in-flock supplemental feeding trials; and
- ◆ providing socioeconomic data to evaluate producer-market interactions, marketing strategies, and elasticities for the output of cattle, sheep, goats, and livestock products.

#### Research Results - Kadugli Sedentary Production System

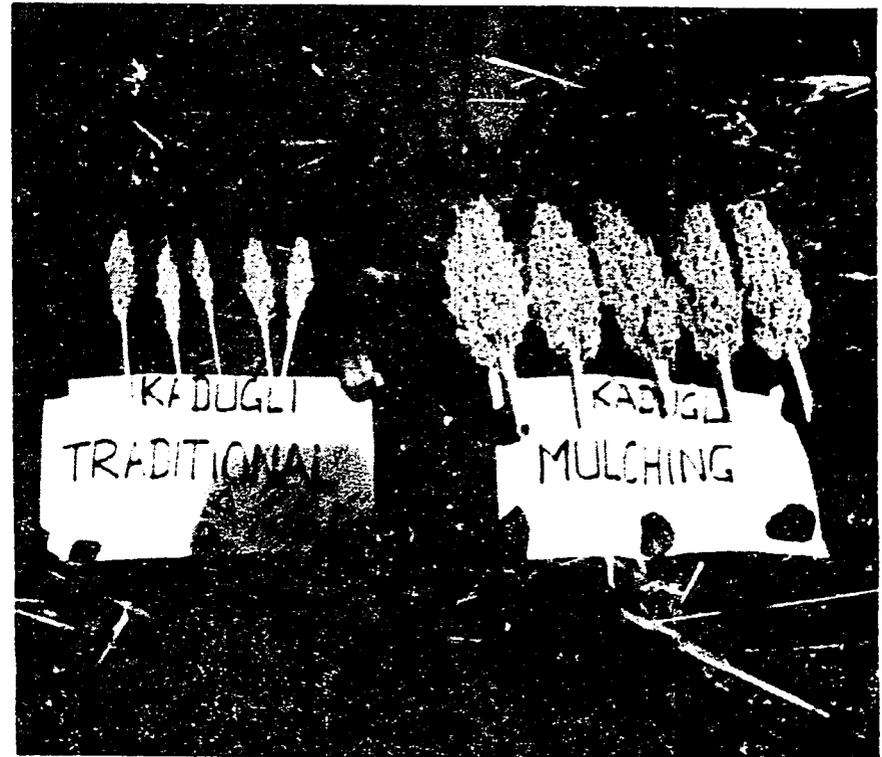
Cultural practice trials have concentrated on using improved, short-maturing varieties of sorghum, specifically examining weeding practices, plant populations, seed dressing, fertilizers, and soil/water conservation practices. Results to date indicate that sorghum yields can be maximized (in years with below average rainfall) by using improved, short-maturing varieties, eg. Dabar and Gadem El Hamam; weeding 2 and 4 weeks after emergence; using 20 cm between plants in rows and 60 cm between rows; and using phosphate fertilizer in the range of 40 kg/ha. Mulching was shown to increase yields 2.3

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Left: Short-maturing varieties of sorghum, (Gadem El Hamam, foreground) produced significantly more grain than traditional varieties (rear) in years of below average rainfall.

Below: Conservation of limited water supplies through mulching and other techniques showed initial promise in on-station trials.



times over traditional practices; however, economic analysis showed that such practices must be adapted to farmer conditions to be feasible.

Variety screening trials focused on the most important crops in the area, as well as on several crops considered highly promising for introduction, eg. mungbeans and possibly guar and pigeonpeas. Selection for advancement to the next cropping season for either on-station or on-farm trials was based on: yield; Striga-resistance (sorghum); low pod shattering (sesame); bean and forage yields; degree of nodulation (cowpeas and mungbeans); and farmer acceptability (guar and mungbeans).

On-farm trails have shown that:

- ◆ Hageen Dura #1, hybrid sorghum, performed well under farmer-managed conditions and farmers are willing to commit their acreage to Hageen Dura production, provided that seeds are available in a timely manner; and
- ◆ improved, short-maturing varieties of sorghum, with seed dressing and fertilizer, out-yielded all the local varieties with traditional practices across all locations (1985). Researcher-managed fertilizer trials with improved, short-maturing varieties of sorghum showed that the rates of return to improved varieties in comparison with the long-term average yields for Southern Kordofan ranged from 268% to 404%.

Fertilizer trials for the 1984/85 and 1985/86 cropping season using Gadem El Hamam, Dabar, and a local variety indicated that phosphorus is a limiting macro-element, and that sorghum yields are consistently doubled by the application of 20-40 kg/ha  $P_2O_5$  in the form of triple super phosphate. When more than 20 kg/ha of  $P_2O_5$  is applied, it then becomes necessary to add nitrogen fertilizer in order to get increased benefits from phosphorus application. Nitrogen fertilizer in the form of urea did not give positive yield responses in the absence of phosphorus. Better yields of sorghum were realized when N/P fertilizer was used. In general, the improved short-maturing varieties of Gadem El Hamam and Dabar yielded twice as much as the local check variety (Iriana or Karamaka), although the application of phosphorus or nitrogen/phosphorus combinations doubled the yield of all varieties tested. With an improved variety plus phosphorus or



Above: WSARP Social Scientist Mr. Abu Sabah (left) discusses cowpeas with Kadugli sedentary farmer.

Below: Cooperative agreements were signed between producers and WSARP for the conduct of on-farm/ in-herd trials.



nitrogen/phosphorus fertilizer it should be possible to obtain 3-4 times the yield of a local variety grown under traditional practices. At present the recommendation for the Kadugli area is the soil incorporation, at planting, of 20 kg/ha of P205. If urea is available, 10-20 kg/ha of nitrogen should be top-dressed and soil incorporated after the first weeding.

Legume trials have concentrated on those showing a high potential for grain production for household consumption and/or sale, as well as for forage production. In this regard, cowpeas, mungbeans, guar and pigeonpeas show a high potential. On-farm trials with cowpeas (1985) indicated that early planting (June 15-30), with plant spacing of 20 cm within rows and 50 cm between rows, could be expected to yield 2-3 tons of forage/ha with an effective rainfall of 350-500 mm. Preliminary economic analysis showed that the highest benefit/cost ratios were found with legumes intercropped with sorghum and sesame.

On-farm livestock trials have concentrated on the introduction of draft for transport and improvements in nutrition for traditional cattle. Economic analysis of animal draft transport trials demonstrated benefit/cost ratios ranging from 1.15 to 3.45 over a five-year period when only rental benefits are considered and 4.92 to 11.24 over a similar period with the addition of potential welfare benefits. Supplemental feeding trials have shown that high levels of good quality forage are required to make a significant impact on productivity and, further, that such forage is scarce and expensive during the dry season, when animals are in their poorest nutritional state. The conservation of native grass hay is presently not feasible because of the poor quality product which results from problems in harvesting, curing, and storage.

#### Future Research Activities for the Kadugli Sedentary Production System

The following research activities for the Nuba Sedentary system are recommended for the next production season:

- ◆ Expand researcher- and farmer-managed trials to examine the adoptability of: (1) introduction of improved varieties of sorghum (Gadem El Hamam, Hageen Dura #1); and (2) improved



Range/livestock research with sedentary farmers emphasized enhancing the complementarity of cropping and livestock enterprises.



Introduction of oxcarts for transport of grain was enthusiastically received by local sedentary farmers.

cultural practices (weeding, plant populations, phosphate fertilizer, and seed dressing) in relation to both labor availability and alternatives for resource allocation.

- ◆ Initiate researcher-managed, on-farm trials to evaluate the introduction of improved varieties of sorghum, sesame, and cowpeas on jubrakas (housegardens) to increase the availability of food for household consumption during the "hungry period."
- ◆ Conduct selected on-station variety screening trials that focus on sorghum, sesame, cowpeas, mungbeans, and to a lesser degree on guar, pigeonpeas, maize and groundnuts. Varieties tested should be restricted to those adapted to agro-climatic conditions similar to Southern Kordofan.
- ◆ Conduct on-station trials to further assess the feasibility of improved soil/water management practices for both "far fields" and jubrakas.
- ◆ Expand on-farm draft animal trials to include a pilot study to assess the potential for the development of village-level credit programs supported by revenue generated from ox-cart rentals.
- ◆ Conduct in-herd/on-farm diagnostic studies to critically evaluate the seasonal nutritional status of sedentary livestock and then to initiate strategic supplemental feeding trials which emphasize the use of high quality forage legumes to improve the digestibility of low quality crop residues (sorghum stalks and leaves) and supplemental phosphorus. Both large and small ruminants should be utilized in these trials.

#### Baggara, Transhumant Livestock Production System

Rangeland productivity and utilization studies in the Nuba Mountains have shown that:

- ◆ most rangelands are only in fair condition due to a dominance in the herb layer of tall, coarse, fast-maturing annuals of low nutritional quality, largely the result of inadequate grazing pressures during the growing season and the high incidence of burning during the early dry season;
- ◆ woody vegetation on most rangelands is declining in abundance and diversity in response to existing pressures from selective browsing, frequent burning, and a rising demand for land and wood products;
- ◆ fires annually consume an estimated 25-30% of the net primary production, and their prevention could allow for a 43% increase in livestock biomass; and



**Range fires constrain the optimal utilization of range resources throughout Western Sudan.**



**The sedentary sentinel herd provided information which may pave the way for increased year round livestock production in Southern Kordofan. Animal Nutritionist Dr. Babo Fadlalla.**

- ◆ approximately 30% of the rangelands are unutilized by livestock during the dry season due to the absence of water.

Inefficient utilization of the natural resource base is a fundamental problem for all livestock producers in Southern Kordofan. This is primarily the result of:

- ◆ inability and/or unwillingness to cope with physical (mud) and disease factors associated with rainy season use of cracking clay plains;
- ◆ widespread burning and limited sources of water during the dry season;
- ◆ land-use conflicts among producer groups over land and water resources; and
- ◆ absence of effective land-use policies to allow interventions for improved grazing management and rangeland improvement.

Monitoring studies with sentinel herds have shown that cattle can be maintained year-round on southern rangelands at levels of productivity equal to or greater than that found under traditional migratory practices, providing that:

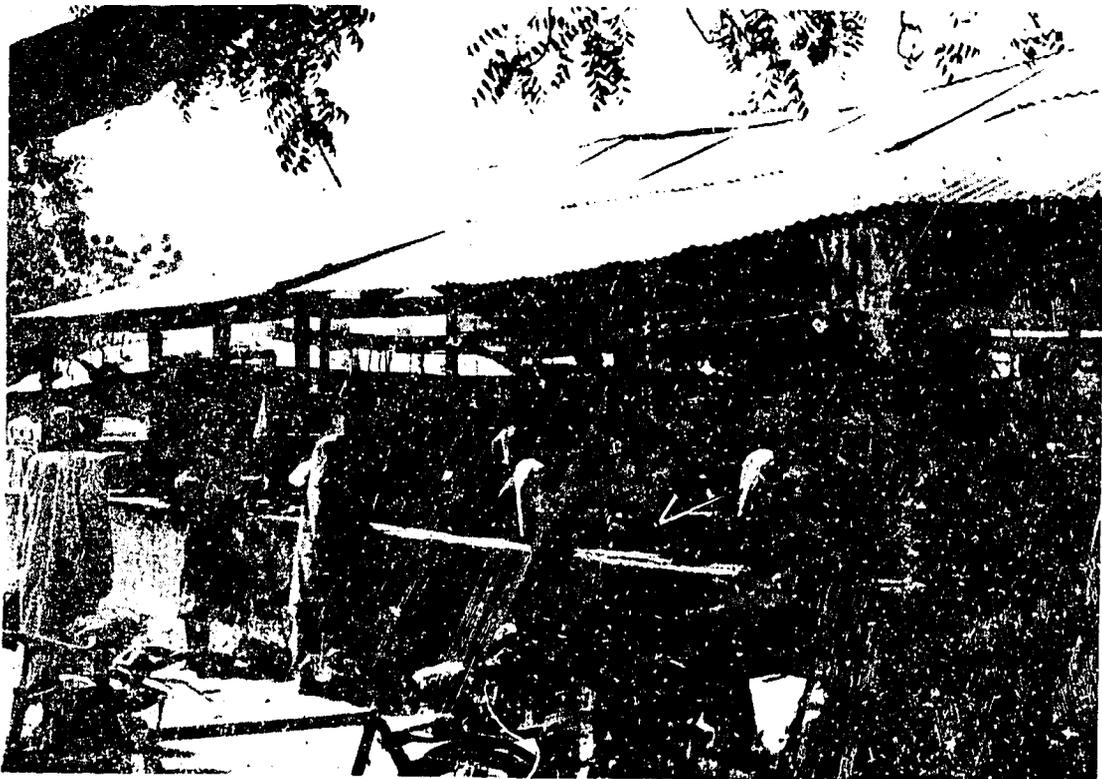
- ◆ animals are given at least one year to adapt to climatic conditions;
- ◆ year-round sources of natural forage and water are available; and
- ◆ strategic control of ectoparasites is practiced.

In-herd trials that assessed the seasonal nutritional status of transhumant cattle and sheep have shown that:

- ◆ for cattle, phosphorus content of the grazing ration ranges from 0.05% to 0.13%, on a seasonal basis, and adult animals are in a negative energy and nitrogen balance, while the majority of adult lactating animals are clinically deficient in phosphorus during both the dry and rainy season; and
- ◆ for sheep, energy and phosphorus appear the most limiting nutrients for pregnant ewes during the rainy season, while energy, crude protein, and phosphorus are limiting during the dry season (1985).



Market Economist, Mr. M. Speece (left) and Social Scientist Mr. Abu Sabah (center) discuss commercial potentials for jubraka (housegarden) crop production.



Additional information about market strategies and opportunities is required.

Researcher-managed, in-herd, dry-season supplemental (sesame cake at maintenance levels) feeding trials with adult, female cattle (1984/85) showed that:

- ♦ supplemented cattle gained significantly more weight, produced significantly more milk, had calves with significantly higher birth weights, and maintained significantly higher plasma phosphorus levels (normal), than did unsupplemented controls;
- ♦ during the subsequent rainy seasons, previously unsupplemented cows gained significantly more weight (compensatory growth) than previously supplemented cows, and there was no significant difference in milk production between groups;
- ♦ lactating cows showed the lowest plasma phosphorus levels during the rainy season (1981); and
- ♦ the marginal benefit/cost ratio for the dry season supplementation of lactating cows was -0.18, due to the relatively high purchase and transport costs of sesame cake.

Researcher-managed, in-flock, dry season supplemental (sesame cake at 1.2 maintenance levels plus a phosphorus supplement) feeding trials for breeding ewes (1985) showed that the level of supplementation was not sufficient to demonstrate any significant improvement in productivity between treatment groups. This was primarily the result of very poor grazing in the study area as a result of the drought. Approximately 16% of all lambs less than 3 months of age died of respiratory disease. Ewe losses ranged from 12% to 20% and were highest in unsupplemented animals.

Livestock marketing studies indicated that producer marketing strategies were quite complex, being dependent on rainfall patterns, commodity prices, demand for liquidity, and scale of anticipated purchases. The rapid increase in the market price for sorghum during the 1984-85 season, which resulted in a price ratio of male cattle/sack of sorghum of 1:1 by May 1985, made the usual practice of selling small ruminants for most staple food purchases impossible to follow during the 1985 dry season. The sale of milk and milk products is a significant income-generating activity for Baggara women.

## Future Research Activities for the Baggara, Transhumant System

The following are proposed future research activities:

- ◆ Conduct a feasibility study, in collaboration with the Regional Government, for water development on a limited scale in the southern areas of Kordofan to increase the availability of dry season grazing, accompanied by an improved system of grazing management and strategic animal disease control.
- ◆ Conduct studies on the marketing of livestock by producers and the contribution to households of milk consumption and sales.
- ◆ Conduct analysis of forage plants selected by grazing ruminants in relation to their seasonal nutritional status.
- ◆ Implement improved management and husbandry practices for the sedentary sentinel cattle herd to assess the potential productivity gains achievable under producer conditions for cattle maintained year-round on southern ranges.
- ◆ Initiate phosphorus supplementation of breeding cows during the rainy season.
- ◆ Initiate phosphorus supplementation of pregnant ewes during the rainy season and supplemental feeding of early-weaned lambs with crop residues and legume forage during the dry season.

## El Obeid Research Program

### Introduction

The most common sedentary production system in Northern Kordofan is dominated by the production of millet, groundnuts, and cowpeas, and to a lesser extent livestock, primarily small ruminants. The production of horticultural crops is localized in certain areas, which frequently include khors (ephemeral streams) and alluvial pans from nearby jebels (mountains). Individual horticultural holdings range in area from one to more than thirty hectares, with an average size of approximately two to three hectares. Gum arabic (Acacia senegal) plays an important role as both a cash crop and in the traditional bush-fallow system of cultivation in restoring soil fertility and combating soil erosion.

Goz sands are the predominate soil type and are characterized by high infiltration capacity but poor retentivity for nutrients and water. Considering the comparatively low rainfall averages in

Northern Kordofan, water shortage will remain the most serious limitation to crop and livestock production. Rainfall distribution is erratic and limited to 70-100 days per annum, and thus dictates the need to identify early-maturing, drought-resistant crop varieties and to optimize cultural practices to make the maximum use of available water.

In addition to the goz sands, gardud soils are also frequent in the area. These are hard, heavy textured soils which are difficult to cultivate using traditional hand tools. Their compaction makes water infiltration very low and, as a result, much of the rain water is lost to runoff. Accordingly, methods need to be devised to increase infiltration and facilitate cultivation of these soils.

The sedentary research program for Northern Kordofan has focused its activities on crop improvement and varietal screening, principally pearl millet, sorghum, groundnut, sesame, cowpeas, and to a lesser extent, roselle, watermelon, pigeonpea, and guar. Horticultural crops, including a variety of vegetables and fruit crops are also being evaluated in both on-station and on-farm trials. Variety screening trials of both native and exotic forage legumes have been initiated. Cultural practice trials, including soil and water management practices, have focused on: (1) plant population density trials; (2) fertilizer trials; (3) weeding trials; and (4) soil and water conservation trials, eg. mulching and residue management, seed cradle planting in gardud soils, drip irrigation for horticultural crops, and the establishment of windbreaks.

Intercropping trials have focused on the crops traditionally intercropped by producers, eg. millet, sesame, cowpeas, sorghum, and groundnuts. Crop protection studies have concentrated on millet varieties and their susceptibility to stem borers and nafasha (moth larvae) infestation, the use of sorghum as a repellent crop for millet, and a wild sesame variety for sesame.

On-farm trials have concentrated on: (1) a variety of horticultural crops; (2) sorghum and millet; (3) fruit crops; (4) gum arabic; and (5) forestry research on forage shrubs, sand dune fixation, and mesquite research. In-flock livestock studies have concentrated on desert sheep, i.e. evaluation of production parameters

and constraints, seasonal diet composition, grazing management in relation to natural resource utilization, and animal draft for the transport of native forages to major markets for sale as supplemental animal feed.

Limited activities have been initiated to assess the nomadic livestock production system in Northern Kordofan. This system is dominated by camel and sheep production, although large numbers of goats are also reared. Opportunistic cropping is practiced in some cases, generally involving millet and, occasionally horticultural crops. Research activities with this nomadic system have focused on the Sudan Desert Sheep, the dominant breed in the area and an important source of both domestic income and foreign exchange. Significant improvements in desert sheep productivity are considered possible by: reducing the age at first conception; increasing lambing percentages; and modifying traditional breeding practices. Research activities have focused on:

- ◆ quantitatively defining major production constraints;
- ◆ evaluating the effect of docking on the growth and conception rate of breeding ewes; and
- ◆ initiating in-flock trials to assess the effect of supplementary feeding on lambing percentage and lamb viability.

#### El Obeid Research Results 1983-84

The 1983-84 cropping season was the first season that agronomic and horticultural research programs were initiated at the El Obeid Research Station. Because of delays in constructing fencing and in land clearing on the research station farm, the agronomy trials reported here were conducted on the Kaba Farm, belonging to the Rural Development Corporation, and representing the gardud soil type. Winter season horticultural trials were conducted in farmers' gardens in the Bangadeed area. Although rainfall totaled approximately 357 mm during the crop season, the rains terminated in mid-September and most crops suffered from late season drought.

The agronomic program focused on the major crops grown by traditional producers in the area and included: (1) crop improvement variety screening trials; (2) cultural practice trials designed to

evaluate the effects of fertilizer and inoculum application, plant spacing and intercropping on groundnut yields; (3) rainy season variety screening and plant spacing trials on watermelon; and (4) studies on promiscuous nodulation in soybean. Some specific results are as follows:

Pearl Millet: Variety ICMS 7817 gave the highest grain yield/ha, significantly higher than the seven lowest yielding varieties tested. In addition, 1153 accessions in the pearl millet germplasm collection were grown for observation and selection purposes.

Sorghum: The International Sorghum Disease and Insect Nursery consisted of 30 entries from Texas A&M University. The most noticeable disease was long smut.

Cowpeas: Cowpea variety screening trials consisted of 10 entries, of which eight were exotic and two were local varieties. The exotic variety Chino M1 gave the highest yield (705 kg seeds and 1962 kg dry forage/ha), and in all cases the exotic varieties out-yielded the local varieties. In addition, exotic varieties were erect and matured before the end of September, while the local varieties were prostrate and matured later. In all varieties tested, pods reached physiological maturity while the forage was still green, making cowpea a suitable dual-purpose crop for both seed and forage production, as well as a crop suitable for intercropping, providing farmers with an early income before their other crops mature.

Groundnut: Trials on the effects of nitrogen (@ 0, 25, and 50 kg/feddan) and inoculum (2 applications) did not produce a statistically significant increase by nitrogen application. Trials on the effect of phosphorus application (40 kg/fd) gave a nonsignificant increase in total biomass production. Applications of gypsum (0, 250, 500, 750, and 1000 lbs/fd) produced nonsignificant increases in total biomass production. Plant spacing trials indicated that mean total pod yields with closer intra- and inter-row spacings (10 cm and 40 cm,

respectively) gave slightly higher yields than with wider spacings, although differences were not significant.

Trials to evaluate the effect of intercropping on groundnut yields showed that significantly higher yields were obtained when groundnuts were intercropped with millet and sesame. The best yields (317 kg groundnuts/ha) were obtained from intercropping with millet, with one row of groundnuts/two rows of millet. Alternating rows of groundnuts with millet gave the poorest yields. The LER value (land equivalent ratio) varied from 1.05 to 2.11 with millet compared to 0.08 to 1.46 for sesame.

Groundnut variety screening trials showed that in one set of trials the variety Soanhoma gave the highest yield (302 kg/fd) compared to only 18 kg/fd for the local variety Barberton. In a second set of trials variety ICGS 81-20 gave the highest yield of 263 kg/fd compared to 215 kg/fd for Barberton, which ranked in ninth place among the 22 varieties tested.

Horticultural Trials: The vegetable and fruit gardens in the Banjaded area are established on alluvial deposits from ephemeral rivers. Observations of farmer cultural practices revealed the following: (1) unnecessarily wide plant spacings and/or overpopulation; (2) frequent irrigation regardless of season; (3) vegetables grown on flats and flood irrigated land resulting in great losses for certain crops (tomato); (4) weeding rarely practiced; (5) fruit trees rarely pruned; and (6) pests and diseases unchecked. In addition, farmers have limited access to good quality seed and different varieties. More specifically:

- ◆ Tomato: Variety screening trials using nitrogen (80 kg/ha-split dose), weeding as necessary, and malathion for insect control (aphids and white flies) showed no significant differences in total yields between varieties, but significant differences in fruit weight with ACE producing the largest fruits.
- ◆ Radish: Variety screening trials using nitrogen (40 kg/ha) showed that China Rose Winter had the highest yields but White Icicle, a white variety, was more acceptable in the market.
- ◆ Sweet Pepper: Intra-row spacing and nitrogen fertilization trials showed that closer spacing (30 cm) increased yield by 25%

over larger spacing (60 cm). Response to nitrogen was not significant, although the control had the lowest yield. Similar results were obtained with hot pepper and eggplant.

- ◆ Soybean: Promiscuous nodulation trials using 11 cultivars (8 promiscuous and 3 check) showed that none of the cultivars tested produced nodules, indicating the absence of R. japonicum or other rhizobium species that are effective on soybeans.

#### El Obeid/WSARP/INTSORMIL On-Farm Trials, 1984/85/86

Summary: The 1984 crop year in Northern Kordofan, Sudan, was very dry with a mean of 128 mm of effective rainfall. Several important facts stood out as a result of the severe drought: (1) the WSARP campaign for early and drought-tolerant genotypes of millet and sorghum is now being recognized; and (2) the early bristled variety, Ugandi, which WSARP has been promoting, proved to be superior to the local types under this year's harsh environmental conditions. Furthermore, the Hageen Dura #1 hybrid sorghum developed by ICRISAT/Sudan was also found to be early-maturing, drought tolerant, and well-adapted to both the clay and sandy soils of Northern Kordofan. The Regional Ministry of Agriculture is trying to obtain seed of Ugandi, or other early maturing varieties and Hageen Dura #1 in large quantities for distribution.

Introduction: According to the Department of Statistics and Economics reports, sorghum yields in Northern Kordofan were 162 kg/fd, or 390 kg/ha in the 1970/71 crop season. Sorghum yields fell to 45 kg/fd (110 kg/ha) in 1983/84. Similarly, millet yields were 197 kg/fd (470 kg/ha) in 1970/71, but fell to 56 kg/fd (130 kg/ha) in 1983/84. Considering the annual 2-3% increase in population, it is not difficult to recognize the large deficit in food production. Weather data showed that 1984 precipitation was extremely low. Total rainfall around El Obeid was 128 mm (mean), with 44 mm in July, 48 mm in August, and 35 mm in September. Production statistics for 1984 will likely be much lower than those indicated above.

Results: With the exception of some on-farm trials, most of the 1984 on-station trials failed because of drought, and whatever seed was produced by early varieties was eaten by birds. Hence, all experimental details have been omitted and comments and conclusions are based predominantly upon research observations. A summary of observational results are as follows:

- ♦ Hageen Dura #1: Considering the low rainfall, with means less than 130 mm in the El Obeid area, the performance of Hageen Dura #1 can be considered impressive. It should be noted that yields were possible in areas of floodways or low-lying areas with good watershed. Hageen Dura #1 matures very early and can fit well into the available short-growing period of the area. It is earlier and more drought-resistant than P 898012. It is well-adapted to both clay and sandy soils.

Farmers who have consumed Hageen Dura claim that its kisra (pancake) and asiida (porridge) qualities are excellent. A lot of campaigning will be needed in: (1) instructing farmers to plant at closer spacing than they normally do because Hageen Dura is no-tillering (or low tillering-type); and (2) convincing farmers not to replant seed from this hybrid. Farmers in villages where trials were located want to obtain seed for the coming crop season. The average yield in 4 villages was 754 kg/ha, ranging from 225 to 1319 kg/ha.

- ♦ Millet: Ugandi millet was successfully grown in four villages. In the absence of any other food crop, farmers admitted that they ate some of the millet as fariikh (in the milk-dough stage). In these villages Ugandi completed its life-cycle while the local variety, Baladi did not. (The average yield from 3 sites was 123 kg/ha.)
- ♦ Germplasm Collection: Seventeen entries of sorghum, one entry of millet, and one entry of cowpeas were obtained during the cropping season.

#### On-farm Trials for the 1985/86 Season

These trials focused on millet, sorghum and cowpeas. Millet varieties included Ugandi, which is short-maturing, bristled, and bird tolerant; Bristled Population, which is a promising elite strain from ICRISAT/Sudan, similar to Ugandi but with more compact heads; and Bayud and Eish bornu, local check varieties. Sorghum varieties included P 898012, which is drought tolerant; IS 9830, which is short-maturing and Striga tolerant; SRN-39, which is short-maturing and Striga tolerant; Um Benin, which is high yielding; and Wad Melli,

a local check variety. Cowpea varieties included El-Kh Sel. #1, INTSORMIL's shortest-maturing local variety; IT 82 E- 9, 18,32, and 60, all IITA early-maturing varieties.

#### Soil and Water Conservation Trials 1984/85

Practices which were field tested during the 1984/85 cropping season included mulching, residue management, inter-row surface tillage, soil amendments, ridge-furrow cultivation, planting in seed cradles, and depth-of-planting trials. Research efforts also included studies of soil properties and dryland hydrologic processes, introduction of drip irrigation, and instrumentation for collection of weather data. Despite the unusually low rainfall during the cropping season, results showed that crop yields could be increased with water conservation (both grain and biomass were used to measure the effectiveness of various moisture conservation practices).

Mulching and residue management increased the sorghum biomass on cracking vertisols by 53% and 138%, respectively. Increases of 56% and 63% in sorghum biomass and grain yields, respectively, were observed with naturally occurring residues left on the surface. Mulching also retarded weed growth. For millet, grown on goz sands, biomass increased by 168% and grain yields increased by 83% when dry millet stalks were used as mulch. Field results were the poorest in plots where residue was burnt.

Ridge-furrow cultivation did not prove beneficial, as this practice resulted in depressed crop yields in cracking vertisols and crop failure in gardud soils. Ridges were difficult to maintain in goz sands because of the unstable nature of the soil. Seed cradles could not be maintained in the sandy soils. In gardud soils, seed cradles were easy to maintain and showed a dramatic effect on emergence, seedling survival, and early growth. Field trials with soil amendments such as gum arabic and ground clay gave poor and inconclusive results. Soil moisture measurements in the goz sands indicated that deep rooted crops have a better chance for survival than shallow rooted varieties.

### Future El Obeid Agronomy Program

The predominant crops grown by traditional producers in Northern Kordofan are millet and sorghum, and the focus of the El Obeid agronomy program for 1986 will be to improve the productivity of these two cereal crops. Environmental hazards, eg. low soil moisture and fertility; poor genetic stock; poor cultural practices; pests and disease are the major constraints. The program will include:

- ◆ establishing collections of local/exotic genetic stocks;
- ◆ screening/breeding of high-yielding, early maturing, drought-tolerant varieties of sorghum and millet;
- ◆ screening for disease and pest resistance including nafasha (Rhaguva sp. moth larvae), Simta (Cyrtocamenta sp.) and stemborer;
- ◆ screening for Striga tolerance;
- ◆ research to improve cultural practices including: population density studies; crop nutrition/soil improvement; fertilizer studies; intercropping (sorghum/millet + legumes); sorghum/millet rotational studies; time/frequency of weeding and tillering/productivity;
- ◆ screening for drought tolerance in other selected crops;
- ◆ intercropping as a method of reducing pest infestations; and
- ◆ identification and monitoring of pests will also be included

### WSARP Research - Involvement of and Impact on Women

Women contribute significantly to Western Sudan's agricultural production. WSARP project activities have been undertaken which provide information on female participation in the household and in the field. Production activities undertaken in both the sedentary farming system and the transhumant production system by females have been investigated. Araujo (1981, WSARP Publication No. 11), Abu Sabah and Patrick (1984, WSARP Publication No. 30), Gillard-Byers and Abu Sabah (1985, WSARP Publication Nos. 42 and 43), and Gillard-Byers (1986, WSARP Publication No. 55) provide descriptive information about existing and potential production roles and needs for women in the sedentary systems. Such factors as daily, seasonal and sporadic labor

demands, production and marketing activities, consumption patterns, and marketing strategies have been examined to identify constraints to more effective agricultural production and opportunities for improvement.

Likewise, Teitelbaum (1983, WSARP Publication No. 25), Michael (1985, WSARP Publication No. 52) and Cook, et al. (WSARP Publication No. 43) report similar research on production roles relating to gender in the transhumant producers. To more effectively access this group, a woman graduate student was provided by WSU/CID.

Results of some of these studies are summarized in the following paragraphs.

In the sedentary farming system, labor allocations for production on the "far farms" (production areas located on the clay vertisols) and the jubraka (production areas located around the farmstead usually with sandier soils on the footslopes of the mountains) are documented. Women are the predominant labor source for jubraka production. In two Nuba villages, women provided 67% and 45% of the total family labor for jubraka production. Male adult and child family members as well as hired labor provided fewer labor hours in both cases. In contrast, on the "far farms," adult females provided 37% of the labor necessary for production of intercropped or mixed crops of sorghum, sesame and cowpeas in both villages. Production of those commodities is the main set of activities undertaken on the "far farms."

Management activities undertaken on the jubraka are generally under the control of women, with 52% of the management activities controlled by the adult female number of the household. On the basis of estimated subsistence requirements, jubraka production accounts for 19% of sorghum, 160% of cowpea, 18% of sesame, and 70% of groundnut subsistence requirements. Surpluses produced from the jubraka may be marketed.

Females in the sedentary farming system play an important part in transporting commodities. Some of the activities undertaken by females include transport of grass, water, wood, charcoal and grain. These activities take an enormous amount of labor time. Therefore, they were an important consideration in a project designed to examine the use of oxen for transport purposes. Nafirs (communal work

groups), consisting exclusively of female members, are responsible for the transport of grain from the "far farms" at harvest time. Experimental results suggest that the introduction of one pair of oxen and one oxcart for a 135 day harvest period would result in reduced female labor requirements of over three thousand women days of labor. The labor savings that would occur during other times of the year would also be large.

WSARP program activities have addressed the participation of female members of the farm family in household and field production activities. It is clear that consideration of these producers is crucial in the design of programs by WSARP staff if Project objectives are to be realized. Therefore, WSARP must continue to address constraints to production on the jubraka and transportation bottlenecks which reduce the effectiveness of the female producer in meeting other demands placed on her time by household chores and in participating in alternative production endeavors.

In the transhumant system, women play a dominant role in marketing of milk products, are involved in a number of production activities and exert significant influence in decisions concerning both production and marketing of livestock. In contrast to the sedentary system, transhumant women are minimally involved in crop production activities. Sedentarized female members of these groups do, however, perform farming tasks. WSARP management will need to seriously consider hiring female technicians to undertake field work to facilitate collection of accurate data and dissemination of results with respect to female transhumant family members.

Women play an important part in the household, production and marketing activities. They must be effectively included in future research program design considerations. In this regard, a decision was made in 1982 by Project management that a minimum of one out of the three Production Specialists (research-extension liaison officers) at each station should be a woman. To date, these positions have not been filled.

Participation in WSARP activities by a number of women from WSU, CID, USAID, the World Bank, ARC and others has helped facilitate the integration of gender role considerations into WSARP efforts.

## VI. LESSONS LEARNED AND RECOMMENDATIONS

In order that experience gained during implementation of WSARP's first 6-1/2 years may be of use to future participants in Sudan's agricultural research development efforts, the following observations, conclusions and recommendations are summarized.

(1) A multidisciplinary, systems oriented research approach can be successfully implemented to focus complementary commodity and discipline efforts on developing adoptable technologies for solving Sudan's production problems. However, this departure from traditional agricultural research management will require continued assistance, support, and monitoring to ensure its continued use by WSARP and its incorporation into the overall agricultural research system. Such will require creative collaboration within the ARC and between and among the various stakeholders in Sudan's agricultural research program including the ARC, producers, extension services, local and Regional government institutions, and other organizations/institutions engaged in agricultural research.

(2) This project appears to have had a large administrative and support TA component in comparison to the scientific staffing. This was necessary in the institution development stage because of limited local capacity and the requirement to utilize ARC/GOS salary levels for permanent local WSARP personnel. The logistic, administrative backstopping and support of a research program in Sudan, especially outside Khartoum, must receive higher priority than in analogous efforts in settings with more developed support capabilities. Adequate support allows researchers to concentrate on research. Efforts to de-emphasize administrative and related support by decreasing such personnel in order to concentrate resources on the research were premature. This resulted in decreased researcher productivity, as scientists were forced to concentrate on providing their own living and research support before research could be conducted.

(3) Recruitment, training, and retention of research support personnel must remain the highest priority for WSARP and other agricultural research development activities. Incentives such as career structures that reward performance, training and personnel

management improvements must be addressed. Technical and support personnel, including technicians, mechanics, facilities maintenance personnel, secretaries/clerks, materials control personnel, financial personnel and others must receive higher priority. Since an adequate pool of such personnel does not currently exist in the West, increased numbers and types of training programs, perhaps in collaboration with other organizations in the area, are recommended. At the scientific level, opportunities for professional advancement, including publication, short- and long-term training and interactions with professional colleagues can be powerful incentives for Project/ARC personnel.

(4) Because of the multiple major Project stakeholders (ARC; Ministries of Agriculture, Planning and Finance; USAID; the World Bank; WSU/CID; and WSARP) and the rapid turnover of personnel in most of these organizations, it was difficult to establish and sustain consensus on Project objectives and activities. This was further complicated by the numerous evolutionary changes in the Project mandated by the external environment. Additional formal mechanisms to achieve, record, and communicate such consensus and decisions are recommended.

(5) Related to (4) above, differing time frames for reporting, budgeting, accounting, and other critical activities at times constrained Project effectiveness and efficiency. With the exception of the discrepancies in total Project time span [WSU/CID contract termination, IDA funding termination, and USAID's Project Anticipated Completion Date (PACD)] and the changes in GOS budgeting cycle, most were resolved during the life of the Project. However, joint planning by major stakeholders in these areas would have contributed substantially to Project effectiveness and is recommended for future activities.

(6) Given the time frame and the changes which occurred in the Project's external environment, the scope proved to be overly ambitious. The national and Regional political and climatic events which occurred during Project implementation directly and indirectly impacted Project implementation, and resulted in substantial delays. Likewise, many changes in ARC management constrained efforts to

effectively meld Project activities with those of the ARC. In retrospect, it is tempting to suggest that the Project should have been implemented in two phases: the first for local and offshore training and construction; with the research program developed in the second phase. However, the valuable feedback and adaptation which occurred as a result of the simultaneous implementation of all components will ultimately result in a superior research capacity. WSARP's potential future contribution, given stabilization of the Project environment, remains substantial. It is recommended that support be extended to WSARP, incorporating or in concert with support for selected additional activities directed to development of Sudan's rainfed agricultural sector.

## VII. CONCLUSION

In conclusion, WSARP has substantially achieved its agreed objectives, i.e. to establish a research infrastructure and develop an applied/adaptive research program in Western Sudan. The Project made significant progress toward institutionalizing the research approach within the ARC. Through its formal and informal training activities, WSARP has positively impacted the present and future human resource base for research and other development activities in Sudan. Within a very short period of time, the research program developed and tested technological and management interventions which show potential for increasing production of Western Sudan's important agricultural commodities, while maintaining or improving the natural resource base. Some of these improved production technologies/practices have already been used and further disseminated by local producers. Collaboration is ongoing and planned with the IARCs and with other national and international organizations. WSARP has established a firm foundation upon which to build future rainfed agricultural research in Sudan. It has now reached a stage where its activities can be expanded and replicated to contribute significantly to improving the agricultural production and the economy of the nation.

## APPENDIX I

### RECOMMENDATIONS FROM THE IADS JOINT TEAM REPORT TO MAFNR

The Government of the Sudan is giving priority to the agriculture sector in its development programs. With full appreciation of the important role that research must play in economic development, the Minister of State for Agriculture, Food, and Natural Resources in 1975 requested the Ford Foundation to make a study of selected crop and discipline research capabilities and to suggest ways and means of strengthening the Sudan's agricultural research and related services. The Ford Foundation provided a total of 20 consultants, specialists in various disciplines and crops, who prepared reports on 10 basic food crops, seven disciplines, and four administrative services.

An integrated summary of the consultant's reports was prepared for an International Workshop on Agricultural Research and Development in the Sudan held in Khartoum, November 20-22, 1976. It was felt that prospective research developments would be of interest to many national and international institutions because the agricultural scope and potential of the Sudan is so large and diverse.

Following the Workshop it was mutually agreed by officials of the Government of the Sudan and the Ford Foundation that the reports of the special study teams and the information provided through the Workshop should be integrated into a master plan for the strengthening of agricultural research capabilities in the Sudan, involving primarily the further development of the Agricultural Research Corporation (ARC), into an extended viable research institution. The International Agricultural Development Service (IADS) was invited to undertake this task, with continued financial support by the Ford Foundation.

On the basis of preliminary observations and discussions in the Sudan in January-February 1977 it was agreed that the further review would be enhanced by a Joint Team of IADS and senior Sudanese agricultural research specialists. The Joint Team was requested to give attention also to the coordination of regional research priorities into a comprehensive national program.

The Team review was undertaken during the period from July 11 through August 14, 1977. With logistical support furnished by the Government of Sudan, the Ford Foundation, and local agencies, the Team made field visits from July 19th through 28th to major production areas of the Sudan (excluding the Western region which is being reviewed by the World Bank), to meet with local agriculturists, farmer representatives, and public officials to determine needs of the local agriculture and the potentials and research requirements for development.

The Team took into account the goals and objectives for agriculture as presented in the Six Year Plan. While the Plan does not specify priorities it does furnish guidance with respect to kinds of development schemes contemplated in the different types of farming areas, and it defines development goals, objectives and production targets.

The Plan embraces a wide variety of projects or schemes for which present levels of technology in the Sudan are inadequate. The Team gave special attention to steps that would ensure maximum effective use of presently available research resources in the country and also considered actions necessary to build the longer-term capabilities to furnish a continuous flow of development-oriented technology.

The reorganization of the ARC and improvement of its operation and Management should receive priority attention. The responsibilities vested in the ARC are formidable. As the national corporation established to produce improved technology for the Sudan's agricultural development, the ARC must provide improved materials and practices for the varied farming systems and ecosystems throughout the country. The ARC leadership and research staff, from the Director General through the coordinating leaders of the national interdisciplinary research teams, must maintain a national perspective and focus.

Recommendation 1. The ARC should be reorganized to give more effective national leadership to those research functions recently transferred to it, and for integration of crop and livestock research. This will be facilitated by shifting from the traditional discipline orientation of research to commodity and factor problem research of national and regional concern.

Recommendation 2. The headquarters of the ARC should be relocated from the Gezira Research Station to a site at Um Don Village, near Khartoum, where a national posture and outlook can be established, and where continuous liaison can be maintained with officials concerned with national development planning, in keeping with the ARC's nationwide responsibilities as the technical arm of the Ministry.

Recommendation 3. An agricultural research scientist with demonstrated capability and experience in the organization and management of agricultural research of broad geographical scope and interdisciplinary complexity should be recruited as a consultant to assist the Director General with the overall organization and management of the ARC. This position should be filled for a minimum period of five years.

Recommendation 4. A scientist with experience in research program planning and organization should be recruited as a consultant to assist with the development of a program-planning, budgeting, and management system, and a project structure that will serve as a base also for program coordination and evaluation. This position should be filled for a minimum of five years.

Recommendation 5. An experienced specialist in information and publications services should be recruited as a consultant to assist with the planning of such services, including determination of personnel, facilities, and equipment required for the ARC headquarters and throughout the network of research stations. This position should be filled for a minimum period of two years.

Recommendation 6. An experienced agricultural librarian should be recruited as a consultant to assist with the planning of a modern library and documentation service at the ARC headquarters designed to provide for cross-referencing and for maximum use of publications available in the Sudan and to serve the needs of the national research station network. This position should be filled for a minimum period of two years.

Recommendation 7. A qualified person should be recruited as a consultant to assist with the development and improvement of transport and communications services. This position should be filled for a minimum period of two years.

Recommendation 8. Research scientists should be obtained as consultants in specialized fields or disciplines, for short-term or long-term assistance, as needed. These positions would be identified as the respective research programs are strengthened.

A coordinated multidisciplinary team approach to agricultural research in the Sudan would facilitate the development and application of improved technology throughout the country, to serve all types of farming regions, and modern as well as traditional areas.

Research for agricultural development in most agriculturally advanced nations is conducted on a coordinated, problem-oriented, multidisciplinary team basis. An increasing number of the more progressive developing nations are restructuring their national research systems in this pattern. The Union of Agricultural Research Scientists of the ARC recognizes the shortcomings of the discipline-oriented approach to research for accelerating agricultural development and has urged that ARC research be reorganized to the coordinated multidisciplinary approach.

Recommendation 9. The organization of the ARC should be restructured, as rapidly as possible, to the coordinated multidisciplinary team approach for commodity and non-commodity research.

Recommendation 10. Decisions should be taken on priority or phasing of the establishment and/or strengthening of multidisciplinary research teams. The report offers suggested priorities.

Recommendation 11. An agricultural scientist with demonstrated experience and capability in coordinating leadership of multi-disciplinary research teams should be obtained as a consultant, to assist with the forming and operation of such teams in the ARC. This position should be filled for a minimum period of five years.

A research station network should be developed to serve the needs of present farming areas, as well as new schemes to be set up under the Six Year Plan.

The Sudan has a long and creditable history of research designed to guide agricultural development. This extends from establishment of the Shambat Agricultural Station in 1904, through the development of the Gezira Research Station in 1918, to the subsequent installations at Yambio, Tosi, and Kadugli, and the stations set up more recently at Hudeiba, Sennar, Guneid, Kanana, and other locations. Agricultural development to date in the Sudan has been concentrated in the riverine areas. The research stations have been established to guide the respective production schemes, for intensive cropping of cotton and sugar, as well as more diversified agriculture in recent years.

The existing research stations furnish a good base for developing an effective national network of facilities--designated in this report as Main Stations and Field Stations--that will serve more effectively the needs of agricultural development throughout the Sudan. The Special Research Stations, designed to give attention to selected commodity or problem areas, would complete the national network of stations.

The existing stations are important for the further intensification and vertical development of existing schemes, but the lack of research facilities is a principal limiting factor in the further development of agriculture in the Western Savannah, the Southern Region, the rainfed mechanized farming areas, and other selected locations--such as the Northern Region--where new schemes are to be undertaken in the Six Year Plan.

Recommendation 12. The development of a national network of research stations should be given priority support in the Six Year Plan period and in future years. Special attention should be given to areas of the Sudan that do not now have access to improved, adapted technology, including the Western Savannah and the Southern Region.

Recommendation 13. The upgrading of existing research stations, or the establishment of new stations, should be coordinated with the expansion or initiation of the respective development schemes, to ensure availability of suitable technology as the schemes progress.

Recommendation 14. In addition to the funding provided through the Six Year Plan development budget allocations to the ARC and the APRA, support for buildings and operation of research stations should be furnished by the agricultural development schemes that would be served by such stations.

Recommendation 15. The establishment of the new Headquarters Station for the ARC, at the Um Dom site near Khartoum, should be given priority attention to provide offices and facilities essential for the Directorate of the national research organization, and for the research and administrative support services for research throughout the Sudan.

Recommendation 16. An office of Station Development, Operation and Maintenance should be established at the ARC Headquarters to provide guidance for the improvement of the national research station network.

Recommendation 17. A specialist in research station development, operations, and maintenance, should be recruited to assist with the establishment of the headquarters of the ARC, the development and upgrading of facilities in the national research station network, and the formulation of operation, management, and maintenance procedures. This position should be filled for a minimum of five years.

Mandpower development and improved personnel management, for professional and technical staff, should receive priority attention.

The strengthening of the national agricultural research system of the Sudan will require a substantial increase in the number of scientists, from approximately 360 at the present time to about 700 by the end of the next 12 to 15 year period. The number of technicians should also be increased during this time, from the present 460 to about 1500. Education and training facilities are available or are being established in the Sudan, to provide for training of technicians and of research personnel to the bachelor's or M.Sc. level. Most training to the Ph.D. level will continue to be obtained abroad in the immediate future.

Recommendation 18. A schedule should be set up for the systematic development of agricultural research manpower, including technicians. This schedule should include priorities for those disciplines or fields of research most crucial to the acceleration of development schemes. The proposed organizational structure for the ARC, the pattern presented in this report for identifying the disciplines needed in specific research projects, and the examples of the coordinated multidisciplinary research programs for sorghums and sesame provide guidance for assessing manpower requirements.

Recommendation 19. Personnel management procedures should be improved, and a system for evaluating and promoting research personnel on the basis of their performance in the job should be established.

Recommendation 20. A Manpower Development and Management Office should be established at the ARC Headquarters to ensure attention to the training and servicing of staff for the national research system.

Recommendation 21. A capable specialist in research personnel management should be recruited to assist with manpower development and management services, including development of criteria, standards, and procedures for evaluation of research personnel. This position should be filled for a minimum period of two years.

Economic and social factors will become more serious as the pace of agricultural development and change is accelerated.

Large investments in large schemes could be very profitable--or could encounter large losses. Guidance with respect to production costs and returns, domestic and foreign markets, price policies, credit and other economic factors will be essential. Social stresses are already serious as the result of development schemes that have modernized and increased production--but that have disrupted the way of life of many rural people.

Several units in the Government of the Sudan are now studying economic and statistical factors, but such studies and services do not provide for the types of investigation which must be integrated with the agricultural sciences in designing suitable technology, and techniques for its application that foster social as well as economic development.

Recommendation 22. A Socioeconomic Research Division should be set up in the ARC, to furnish research competence to participate in coordinated multidisciplinary teams, to assist in research to improve farming systems, and to provide more adequate information and guidance for development planning.

Recommendation 23. Well trained, qualified staff for research in economics and the social sciences should be located at the research stations in the different agricultural regions to give attention to problems in the respective development schemes.

Improvements are needed in the transfer of technology, to ensure more rapid application of research results to farmers' fields.

The extension services in the Sudan are decentralized, and primary responsibility for funding, staffing, and operations is vested in the provinces. The services vary, but in general they are inadequate and should be strengthened. The provincial extension services, area development projects, and production schemes provide the points for contact and linkages with the research stations serving the respective areas.

Recommendation 24. Extension service departments should be set up, or strengthened, in the provinces, in area development projects, and in production schemes to provide for advice, service, and transfer of improved technology to farmers and to refer back to the research stations the problems that should receive priority research attention.

Recommendation 25. Subject matter specialists should be employed by the ARC and located at the research stations to furnish the primary liaison with the provincial, area development, or production scheme agencies concerned with extension services.

Recommendation 26. An office with a small but highly qualified staff should be established at the ARC headquarters to be responsible for improving research advisory services.

Recommendation 27. A person experienced in the evaluation, field testing, and application of improved technology should be recruited to assist in establishing the technology transfer function in the ARC, including the office in the headquarters that should be responsible for linkages with extension organizations and for the subject matter specialist services in the national research station network. This position should be filled for a minimum period of five years.

Cooperation with external agencies is already extensive and the resources for cooperative technical assistance have increased substantially in the past decade. In addition to the research experience and improved technology from agriculturally advanced nations, the international agricultural research centers and the new capabilities of national research systems in a number of developing countries furnish sources for interchange and support.

Recommendation 28. A staff position should be established for an International Cooperation Officer at the ARC headquarters, to ensure that the ARC is fully informed about capabilities and interests of all external support agencies and to serve as the principal contact within the ARC for these agencies.

Recommendation 29. The research support office at the ARC headquarters responsible for program planning and evaluation should arrange for such special review committees and consultants as would be desirable to ensure effective periodic assessment of the research programs of the ARC.

The implementation and funding of projects designed to strengthen the ARC and the national research capabilities should receive concurrent attention from the government of the Sudan and external support organizations. The further development of the national research system will require continuing, long-term attention, with substantial flexibility to adapt to changing priorities in national development.

Recommendation 30. Development goals and priorities should be defined more clearly as the Six Year Plan is implemented, to ensure activation of those projects of greatest significance to agricultural growth. The strengthening of the General Administration for Planning of the MAFNR and the establishment of the Socio-economics Research Division in the ARC would permit more effective planning on a national scale.

Recommendation 31. Continuing effective liaison should be maintained between the Ministry of Finance, Planning and National Economy and the directorate staff of the ARC in development planning, research program planning, and budget planning for the ARC.

Recommendation 32. Additional funds should be provided for operating costs of the ARC, to permit effective use of current facilities and staff resources in furnishing improved technology to meet critical needs of the Six Year Plan. Support should be furnished from production, marketing, and industrial organizations that benefit from the research, as well as through additional funds from the government.

Recommendation 33. Research and technical backstopping units should be set up within the major agricultural development schemes that cannot be served with improved technology from current ARC facilities. Such units should be funded, for development and operations, by the respective schemes and they should be integrated into the national station network and research programs of the ARC.

Recommendation 34. External assistance organizations should be encouraged to proceed promptly in supporting selected projects or components of the national research system. The Team has identified a number of opportunities for such cooperative support.

Recommendation 35. The development of the ARC and the national research capabilities of the Sudan must remain flexible and adapt to changing requirements for improved technology as the Six Year Plan is implemented. A review of progress in building the national research system should be undertaken at the mid-term of the Plan to redirect resources to changing needs and priorities.

APPENDIX II.A

LIST OF WSARP PUBLICATIONS

<u>Publication Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
1	Henson	WSARP General Outline of Early Planning and Implementation Requirements	Jul. 1979
2	Henson/Noel	Scope of Work for Initial WSARP Project Activities	Jan. 1980
3	Dwyer	Consultant Report on Range-Livestock	Jan. 1980
4	Henson/Noel	First Annual Report	Sept. 1980
5	Henson/Noel	Summary of WSARP Planning Meeting of October-November 1980 Including Consultants Reports	Nov. 1980
6	Ahmed, Ali Dinar, Geneif, Riley, Elhussein	The Horticultural Resources of the Kordofan Region of Sudan	Oct. 1982
7	Henson/Noel	Second Annual Report.	Aug. 1981
8	Meinhart	Consultant's Report on Research Station Development	Jan. 1980
9	Wilson	Consultant's Report on Livestock Production	Mar. 1981
10	Bunderson	Annual Report on Range Research	Sept. 1981
11	Araujo	Social Perspectives on Agricultural Research and the Southern Kordofan, Sudan: Systems of Agricultural Production Among the Nuba	Dec. 1981
12	Dwyer	Consulting Report on Range Research at the Kadugli Station: Review and Recommendations	Dec. 1981
13	Henson/Noel	Work Plan, Volume I: General Research Program and Plans	Oct. 1982

LIST OF WSARP PUBLICATIONS - CONTINUED

<u>Publication Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
14	Henson/Noel	Work Plan, Volume II: Project History and Functional Structure	Oct. 1982
15	Henson/Noel	Work Plan, Volume III: Research Plan for the Kadugli Research Station	Oct. 1982
16	Maguire	Review of Seed Program in Sudan	Sept. 1982
17	Krezdorn	Report of Visit to Sudan to Review Fruit Tree Research Program and Related Factors	May 1983
18	Riley	Work Plan, Volume IV: Initial Research Proposals - Kadugli Research Station	Aug. 1983
19	Henson/Noel	Fourth Annual Report	Aug. 1983
20	Riley	A Summary of the Darfur and Kordofan Planning Workshops	Apr. 1983
21	Nunn	Report of Visit to Sudan to Review the Organization and Development of Research Support for the WSARP Experimental Station	Feb. 1983
22	Riley	Research Program for the Kordofan Region 1984-85	May 1984
23	Cook, Bunderson Fadlalla, Henson	Application of Farming Systems Research and Development to an Extensive, Sedentary Livestock Production System in Southern Kordofan, Sudan	Nov. 1983
24	Gingrich, Elseed, Kenani, Bunderson	Kadugli Agronomy Research 1983	Apr. 1984
25	Teitelbaum	Social Science Report 2/82 to 3/83	Aug. 1984

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LIST OF WSARP PUBLICATIONS - CONTINUED

<u>Publication Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
26	Arya	Gum Arabic as an Evaporation Retardant and Its Effect on Sorghum Seedling Growth and Establishment in Goz Sands	Apr. 1984
27	Obeidalla, Riley	Development of the Horticultural Potential of Kordofan Region of Sudan	Sept. 1984
28	Patrick	Adoption of a New Technology and Problems Encountered in a Nuba Mountain Village	Sept. 1984
29	Cook, Bunderson Fadlalla	Range/Livestock Research Activities 1982-83	Aug. 1984
30	Abu Sabah and Patrick	The Sedentary Production System in the Nuba Mountains Area	Oct. 1984
31	Dwyer	Consulting Report: Range/Livestock Research Review and Recommendations	Sept. 1984
32	Winch	Farming Systems Research: Its Strengths and Weaknesses and the Need to Link Farm Research to Macro-Economic Circumstances	Dec. 1984
33	Noel/Henson	Fifth Annual Report	Nov. 1984
34	McDonald	Hybrid Sorghum Production in the Sudan	Jan 1985
35	Arya	Soil and Water Management and Conservation Program, North Kordofan	Feb 1984
36	Hogan	Research Program for the Kordofan Region: 1985-1986	May 1985
37	Riley	Increasing Crop Productivity of Western Sudan - Results of Selected Agronomic Trials	June 1985

LIST OF WSARP PUBLICATIONS - CONTINUED

<u>Publication Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
38	Riley	Recommended Water Conservation/ Utilization Interventions and Research Directions in Kordofan Region of Western Sudan	Aug. 1985
39	Noel/Henson	Sixth Annual Report	Oct. 1985
40	Arya	Soil and Water Management/ Conservation Research in the Kordofan Region of Sudan: Report on Research Activities and Results for the 1984-85 Season	Oct. 1985
41	Cook <u>et al.</u>	WSARP 1984-85 Research Program Results - Vol. I. Summary of Kadugli Sedentary and Trans- humant Research Program Results	Oct. 1985
42	Woldetattios, Gillard-Byers, Bunderson, Abu Sabah, Cook et al.	WSARP 1985-85 Research Pro- gram Results - Vol. II. Sed- entary Production System Research Program Results Kadugli Station	Dec. 1985
43	Cook, Fadlalla, Bunderson <u>et al.</u>	WSARP 1985-85 Research Pro- gram Results - Vol. III. Transhumant Production System Research Program Results, Kadugli Station	Dec. 1985
44	Riley	Final Report of Senior Advisor to the Director General/ARC	July 1985
45	Arya	Some Aspects of Moisture De- pletion and Conservation in Goz Sands and Their Implica- tions for Improving Agronomic Practices and Land Use (Final Report)	Oct. 1985
46	Hall	The Role of Cowpeas in Agri- cultural Production Systems in Western Sudan	Sept. 1985

LIST OF WSARP PUBLICATIONS - CONTINUED

<u>Publication Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
47	Cluff	El Obeid Water Supply/Water Harvesting Potential in Western Sudan	Oct. 1985
48	Bunderson	Final Report: Range-Livestock Research Results, 1984-85	Nov. 1985
49	Speece	Agricultural Marketing Structures and Marketing Constraints in Kordofan, Sudan: Recommendations for WSARP Research and Implementation	Dec. 1985
50	Trail	Extension Short-term Advisor Final Report: Strengthening Research/Extension Linkages in Kordofan Region	Dec. 1985
51	Symons	Short-term Advisor Report	Dec. 1985
52	Michael	Final Report - Production and Consumption by Gender and Role Among Transhumants in Western Sudan: The Baggara (Hawazma) of Kordofan	Dec. 1985
53	Woldetattios	Terminal Report of WSARP Agronomist Tsegatzeab Woldetattios	Dec. 1985
54	Cook	Final Report: Animal Production Specialist and Chief of Party	Feb. 1986
55	Gillard-Byers	Final Report: Agricultural Economist	Feb. 1986
56	Noel, Henson, Cook, Kearns	WSARP Final Report	Mar. 1986
57	El Hag H. Abuelgasim; Osman Adam Osman; Abdel Rahman Osman	Annual Report: El Obeid Research Station 1983-1984	Mar 1986

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## APPENDIX II.B

### LIST OF AUXILIARY REPORTS, PAPERS, WORKING PAPERS AND BRIEFS

<u>Author/Editor(s)</u>	<u>Title</u>	<u>Date</u>
Oviatt, P.	Engineering Consultancy Report	Nov. 1979
Riley, J.	Mission Report - Short-term Consultancy with the ARC in Sudan	Mar 1980
Grube, J.	WSARP Stations Development Study; Grube-Zimmer, Inc.	May 1980
Rogers, L., T. McGuire, M. Johnson and C. Becker	Consultancy Reports, Ag. Economics, Animal Health, and Ag. Engineering (incorporated into WSARP Publication #7, Second Annual Report)	Nov 1980
Shurtleff, M.	Final Report (incorporated into WSARP Pub. #7)	1981
Riley, J.	Germs of Ideas for Potential Research in Western Sudan	Oct 1981
Holechek, J.	Range Livestock Nutrition Problems and Research Approaches in Western Sudan	July 1983
Cook, R.	The Role of FSP in FSR; paper presented at the WSARP Farming Systems Workshop, Khartoum	Mar 1983
Cook, R.	Nomadic Production Systems in Northern Kordofan - A Reconnaissance Survey; presented at the WSARP Regional Meetings and Planning Workshops	Apr 1983
Bunderson, T.	The Nature and Influence of Fire on the Range Ecology of Semiarid savannas in Western Sudan; Proc. 2nd Intern. Rangeland Congress, Adelaide, Australia	May 1984
Bunderson, T., R. Cook and B. Fadlalla	Pastoral Systems - Basic Problems in Resource Management: An Opportunity for Farming Systems Research; Proc. 2nd Intern. Rangeland Congress, Adelaide, Australia	May 1984
Bunderson, T.	Primary Productivity and Energetic Relationships of Wild and Domestic Ungulate Communities in Africa; Proc. 2nd Intern. Rangeland Congress, Adelaide, Australia	May 1984
McDonald, L.	Hybrid Sorghum Production in the Sudan - Roguing and Blooming; (incl. in WSARP Publication #34)	Oct 1984

WSARP AUXILIARY REPORTS, PAPERS, WORKING PAPERS AND BRIEFS

<u>Author/Editor(s)</u>	<u>Title</u>	<u>Date</u>
Bunderson, T.	Improved Integration of Legume Crops into the Agro-pastoral System of the Nuba Mountains, Sudan; paper presented at the Farming Systems Symposium, Manhattan, Kansas, Oct. 1985.	Oct 1985
Bunderson, T.	Flock Demographics and Productivity of Baggara Sheep; (included in: WSARP Publication #40)	1985
Rogers, L.	Final Report, Agricultural Economics Consultancy March-April 1984	Apr 1984
Owens, G.	Final Report: Gerald Owens, Deputy Project Director and Chief of Party	Jan 1985
Patrick, N., J. Teitelbaum, Abu Sabah & B. Michael	Annual Report/Socioeconomic Section, Kadugli Station	1984
Patrick, N.	Constraints to Agricultural Production within the Sedentary Farming System	1984
Fadlalla, B. and R. Cook	Design and Implementation of In-Herd/On-Range Trials - The Use of Sentinel Herds; presented at Farming Systems Workshop, ICARDA, Aleppo, Syria	Mar 1985
Fadlalla, B. Cook, R.	Feeding Crop Residues and Cut Native Hay to Grazing Cattle During the Dry Season	Nov 1984
Yousif, A.I.	The Role of WSARP in Darfur (presented at Darfur Research Planning Meeting by Dr. Yousif, Ministry of Agriculture and Natural Resources, Darfur Region)	Dec 1984
Cook, R.	Dar Kababish Exploratory Production Systems Survey	Apr 1983
Bunderson, T., R. Cook, B. Fadlalla	Livestock Production Systems: The Case of Western Sudan	1983
Cook, R. and T. Bunderson,	Transhumant/Nomadic Production System(s): The Nutritional Status of Sudan Desert Sheep- A First Approximation	1983

WSARP AUXILIARY REPORTS, PAPERS WORKING PAPERS AND BRIEFS

<u>Author/Editor(s)</u>	<u>Title</u>	<u>Date</u>
Cook, R.	Trip Report to the Abu Haraz Livestock Market	Aug 1983
Cook, R., B. Fadlalla, and T. Bunderson	Transhumant/Nomadic Production System(s): The Nutritional Status of Transhumant Cattle During the Dry Season - A First Approximation; paper presented at ICARDA Farming Systems Workshop	June 1983
Patrick, N.	A Plan for Integrating Extension and Research in the Nuba Mt. Area	1983
Kenani, M. and I. El Medina	Annual Report: Season 1980-81 - ARC, WSARP, Kadugli	1982
Cook, R., T. Bun- derson, B. Fad- lalla and J. Henson	Application of Farming Systems Research and Dev- elopment to an Extensive, Sedentary Livestock Production System in Southern Kordofan, Sudan; paper presented at the Farming Systems Symposium, Manhattan, Kansas	Oct 1983
Bunderson, T.	Consulting Report to WSDC on Techniques for Evaluating and Monitoring Range Conditions and Carrying Capacities in South Darfur	1983
Cook, R., T. Bun- derson and B. Fadlalla	Improving Productivity of Pastoral Systems in Arid and Semi-arid Africa - I. Functional Characteristics of Pastoral Systems and the Role of Farming Systems Research and Development	Aug 1983
Patrick, B.	Infrastructural Constraints	1983
Kenani, Gingrich	Notes on a Trip to Abu Habila	1983
Bunderson, T. and R. Cook	Cattle In-herd Feeding Trials, 1984; (included in WSARP Pub. # 40)	1984
Bunderson, T. and I. Hashim	Cattle In-herd Feeding Trials, 1985; (included in WSARP Pub. # 40)	1985
Bunderson, T. and H. Mukhtar	Results of an Exploratory Reconnaissance Survey to North Kordofan	1983
Bunderson, T. and R. Cook	Production and Feeding of Conserved Forages to Traditional Cattle in the Nuba Mountains, Sudan; pres. at Farming Systems Symposium, ICARDA, Syria	Mar 1985

WSARP AUXILLARY REPORTS, PAPERS, WORKING PAPERS AND BRIEFS

<u>Author/Editor(s)</u>	<u>Title</u>	<u>Date</u>
Kenani, M.	The Concepts of Farming Systems as Related to WSARP	1984
Stenquist, L.	End of Tour Report, Chief Administrative Officer	Apr 1983
Bunderson, T., Cook, & Fadlalla	Trip Report to Western Savanna Development Corporation and Ghazala Gawazet	May 1983
Patrick, N.	Report of Visit to El Obeid, ARC - August 1983	Aug 1983
Teitelbaum, J.	Social-Cultural Factors in the Monitoring and Control of Desertification; paper presented at the Desertification Workshop, University of Khartoum, Feb. 1983 (incl in WSARP Pub. # 25)	Aug 1983
Teitelbaum, J.	The Transhumant Production Systems and Change Among Hawazma Nomads of the Kordofan Region of Western Sudan; XIth Intl. Congress of Anthropological/Ethnological Sciences, Vancouver, B.C.	Aug 1983
Sammani, M. and A. Humeida A.	Evaluation Report of the Social and Economic Section, Kadugli Station	Aug 1983
Patrick, N. Riley, J.	1983 Annual Economic Report, Kadugli WSARP/ARC Regional Workshop: April 1983, National Research Priorities	1983 Apr 1983
LaRocque, R.	TDY Trip Report to WSARP (Inventory)	1984
Riley, J.	Promising Technology for Increasing Production on Small Commercial Farms in Western Sudan	Apr 1984
Bunderson, T.	Summary of Strategy, Focus, and Scope of the Kadugli Research Program	July 1984
Noel, J. and J. Henson	WSARP: Strategies, Issues and Recommendations	Mar 1984
Noel, J.	Proceedings: WSARP Planning/Management Workshop, Khartoum	Apr 1984
Noel, J. and Michael, B.	The Interaction of Physical, Biological and Socio-economic Factors in Determining Human Roles in a Dynamic Agricultural Production System - The Hawazma Transhumants of Western Sudan; paper presented at WID conference, Washington D.C.	Oct 1983

WSARP AUXILLARY REPORTS, PAPERS, WORKING PAPERS AND BRIEFS

<u>Author/Editor(s)</u>	<u>Title</u>	<u>Date</u>
Gotsch, C. and B. Wright	Final Report: Agricultural Research in the Sudan With Special Emphasis on the Western Sudan Project	Nov 1984
Cook, R., Bunder- son, and Fadlalla	Design Considerations for Farming Systems Research and Development for African Pastoral Systems	Jan 1985
Riley, J. et. al	WSARP Research Strategy for Darfur	May 1984
Cook, R. and B. Fadlalla	Disease Incidence in a Sedentary and Migratory Herd in Kordofan, Sudan: Implications for a Change in Traditional Husbandry Practices; sub- mitted to Tropical Animal Health and Production Aleppo, Syria, March 1985	1986
Hall, A.E.	The Role of Cowpea in Agricultural Systems in Western Sudan	Oct 1984
Omer, M, K. Saxton, and D. Bassett	Optimum Sorghum Planting Dates in Western Sudan by Simulated Water Budgets (WSU Scientific Paper # 7151)	Aug 1985
Dafalla, D.	Agricultural Research for the Semi-arid Regions of Western Sudan	1984
Fadlalla, B.	The Dry Season Nutritional Status of Transhumant Baggara Sheep, Kordofan Region, Sudan; paper presented at International Conference on Animal Production in Arid Zones, Damascus, Syria	Sept 1985
Arya, L., T. Woldetatos, and J. Riley	Potentials for Increasing Crop Productivity Through Soil and Water Conservation in the Sahelian and Savannah Zones of Sudan; Proc. of the International Arid Lands Research and Development Conference, Tucson, Arizona, Oct. 1985	Oct 1985
Noel, J., D. Dafalla and J. Henson	A Research Program for Traditional Farmers in the Semiarid Regions of Western Sudan; Proc. of the International Arid Lands Research and Dev- elopment Conference, Tucson, Arizona, Oct. 1985.	Oct 1985
Cook, R. and B. Fadlalla	Nutrition and Disease Interactions and Their Impact on Cattle Production in South Kordofan	1983?
Cook, R. and B. Fadlalla	The Seasonal Phosphorus Status of Transhumant Cattle: the Effect of Dry Season Protein/Phosphorus Sup- plement on Plasma Phosphorus Levels and Productivity	1986

WSARP AUXILIARY REPORTS, PAPERS, WORKING PAPERS AND BRIEFS

<u>Author/Editor(s)</u>	<u>Title</u>	<u>Date</u>
Cook, R. and B. Fadlalla	The Seasonal Phosphorus Status of Transhumant Sheep in South Kordofan, Sudan	1986
Cook, R.	Criteria for Evaluating Livestock On-Farm Trials; presented at the Farming Systems Workshop, ICARDA, Aleppo, Syria	Nov 1985
Hogan, L.	Agricultural Research in Western Sudan - A Discussion	Dec 1984
Mannion, M.	Final Report: Station Maintenance Specialist	Oct. 1985
Hannum, J.	Final Report: Chief Administrative Officer	May 1985
Dafaila, D. and R. Cook	The Western Sudan Agricultural Research Project- An Experiment in Farming Systems Research; pre- sented at the CIMMYT FSR Research Administrators' Conference, Maseru, Lesotho	Nov 1985
Higgins, D.	Final Report: Project Engineer	Dec. 1985
Grube, J.	1981-1985 WSARP Construction Supervision Report Grube-Zimmer, Inc.	Jan 1986
Hogan, L.	Final Report, Deputy Project Director and Chief of Party	Dec 1985
Thompson, G.	Final Report: Administration/WID Consultancy	Dec 1985

## APPENDIX II.C

### LIST OF THESIS PUBLICATIONS -- WSARP GRADUATE PROGRAMS

Name	Title	Date
<b>M.S. Programs:</b>		
Faroug El Hadi	The Effects of Presowing Treatments of <u>Acacia senegal</u> Seeds on Germination and Early seedling Establishment, Washington State University (WSU)	1984
Mekki Abdel Latif Omer	Simulation of Water Budget and Sorghum Responses to Planting Dates in Western Sudan, WSU	1984
Babiker A. Ibrahim	Effects of Subsoiling on Corn and Potatoes as Affected by Irrigation Frequency, WSU	1985
Ibrahim Daw El Madina	Flowering of Contrast Cowpea <u>Unguiculata</u> L. Walp Genotypes Under Different Temperatures and Photoperiods, Univ. California/Riverside (U Cal/Riverside)	1985
Sid Ahmed Beteik	An Economic Analysis of Sorghum Fertilization in the Nuba Mountain Area of Western Sudan, WSU	1985
Abdel Gadir Ageeb	Genetic Evaluation of Straightbred and Crossbred Cattle in the Sudan, WSU	1986
Ibrahim El Dukheri	Analysis of the Three Types of Farming in the Nuba Mountains: Firm Level Production Function Analysis, WSU	(Proj. 1986)
<b>Ph.D. Programs:</b>		
Hassan El Awad	Early and Late Nitrogen Fixation and the Yields and Biological Nitrogen Fixation of Cowpeas [ <u>Vigna unguiculata</u> (L) Walp] Under Well-watered and Drought Conditions, U Cal/Riverside	1984
El Tigani Mirgani El Amin	Economic Implications of Capital/Credit Position of Small Farmers on Productivity and Agricultural Development in Western Sudan, WSU	(Proj. 1986)
Gadelkarim Madibo	Rock Phosphate Dissolution in Soils as Affected by Source of Rock, Soil Type, Method of Placement and Sulfur Addition, U Cal/Riverside	(Proj. 1986)
Ahmed El Wakeel	Seedling Establishment, Nodulation and Acetylene Reduction of <u>Leucaena leucocephala</u> Under Drought, Utah State University	(Proj. 1986)
Faroug El Hadi	Interaction Between Environmental Factors and <u>Acacia senegal</u> Genotypes in Nodulation and Nitrogen Fixation, Oregon State University	(Proj. 1987)
Mekki Abdel Latif omer	Minimum Mulch and Tillage Effects on Fallow Water Conservation by Measurement and Simulation, WSU	(Proj. 1987)

## APPENDIX II.D

### ANNOTATED BIBLIOGRAPHY

#### Introduction

The Western Sudan Agricultural Research Project began generating reports in its initial project year, 1979. Prior to the establishment of a project reporting procedure, approved by ARC in 1982 all WSARP reports received consecutive numbers. Subsequently, only major reports continued to receive sequential numbers. An Auxillary Series of project reports, published by WSARP include: informal intra-project reports; papers and presentations given at conferences and meetings; brief trip reports; final reports by Technical Assistants (when not programmatic in nature); and other similar reports. These latter documents are intended for internal distribution only and are therefore listed as Appendix IIB.

#### I. Annotated Bibliography - WSARP Project Reports

##### Publication

<u>Number</u>	<u>Report Title - Author/Editor</u>	<u>Date</u>
1	<b>WSARP General Outline of Early Planning and Implementation Requirements.</b> James B. Henson (14 pages).	07/79

This report was the result of an initial pre-implementation visit to Sudan by representatives of CID. The document summarizes a number of important discussions between USAID and Government of Sudan project representatives concerning the implementation of the project, requirements for initial start-up and later implementation, and priorities and needs. It was anticipated that this document would form the basis for early implementation efforts. Included are the results of discussions pertaining to the reorientation of staffing and other aspects of the project.

2	<b>Scope of Work for Initial Western Sudan Agricultural Research Project Activities.</b> James B. Henson and Jan C. Noel (21 pages).	01/80
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This scope of work was prepared based upon numerous discussions between USAID, project, ARC, and World Bank personnel, and forms the basis for defining project activities during the initial implementation period. A summary of research activities and facility and support requirements for Kadugli is also included. Tentative phasing of project activities, a revised staffing pattern, and interim equipment facility and support/operational requirements are discussed. The various alternatives relating to the potential relocation of ARC headquarters to Khartoum are examined. A discussion of issues relating to the establishment of an administrative infrastructure, a

project support line, and the construction and research programs are included.

- 3 **Range Management Research in Sudan: Consultant Report On Range Livestock.** Don D. Dwyer (14 pages). 01/80

This report is the result of a short-term consultancy by Dr. Dwyer to Sudan in late 1979 to assess the potential research focus for range management and livestock production activities in the four provinces of Western Sudan. The report outlines a research approach, and recommends the initiation of activities in Kadugli. Also included is an evaluation of Ghazala Gawazet as a potential research site. The report offers suggestions for an educational approach for training Sudanese in the area of range/livestock production while stresses the importance of interfacing US educational coursework with in-country thesis research.

- 4 **First Annual Report.** Ed. J. B. Henson and J. C. Noel (9 pages plus quarterly reports and appendices). 09/80

The First Annual Report is a supplement to the project quarterly reports, summarizing the activities and accomplishments of project year one. It includes discussions on staffing (Sudanese and technical assistance), office space and housing, the establishment of the project support unit, project planning activities and program implementation to date. Also discussed are WSU campus backstopping procedures, commodity and equipment procurement, construction and training programs.

- 5 **Summary of Western Sudan Agricultural Research Project Planning Meeting October/November, 1980.** Ed. J. B. Henson and J. C. Noel (48 pages). 11/80

This report summarizes the decisions made at which a series of planning meetings were held between October and November, 1980 to address a broad spectrum of issues concerning project implementation. Donors, representatives of the government of Sudan, and WSU/CID, formulated a two year plan for the following project activities: the construction program, the research plan for 1980-82, including range research, agricultural engineering research, agronomy, horticulture and pest management, agricultural economics, social science, and animal production and health; research support; organizational interactions and relationships; and the project support unit. During this period a number of consultants visited the project, and their reports are incorporated as a part of this document. Also included is a

training schedule, administrative structure, project and research time frame. The participants or discussants in the aforementioned meetings are listed.

- 6 **The Horticultural Resources of the Kordofan Region of Sudan.** 10/86  
M. K. Ahmed, H. M. Ali-dinar, A. A. Geneif, S. A. Elhussein,  
and J. J. Riley. (36 pages)

This publication is a result of a joint team review by ARC/WSARP of the horticultural research and production areas in the Kordofan Region from February 28 to March 7, 1981. The publication reviews environmental factors, existing cultural practices and problems, and marketing issues of the major horticultural production systems in Kordofan. The publication recommends an increased emphasis on horticulture in Kordofan and suggests terms of reference for the WSARP horticulturalist. A detailed listing of horticultural crops found in the Kordofan Region is included.

- 7 **Second Annual Report.** 08/81  
Ed. J. B. Henson and J. C. Noel (28 pages plus appendices).

The Second Annual Report summarizes project year two activities, specifically project planning, staffing, commodity/equipment, facility development research activities and activities of the Advisor to the Director General of the ARC, and the project support unit. It includes quarterly reports and appendices. Project year two marks the first year that research results from Kadugli were available, and these are included.

- 8 **Consultants Report on Research Station Development.** 01/80  
D. J. Minehart (8 pages).

This report covers a short-term consultancy in Sudan from October 24 to November 9, 1979 by the author to assess the proposed sites for the WSARP Research Stations. The report notes the tentative station sites and focuses on advantages and disadvantages of the sites currently selected as well as setting forth recommendations for the selection of permanent site. The proposed station sites at Kadugli, El Obeid, and Ghazala Gawazet are addressed in detail.

- 9 **Consultant Report on Livestock Production.** 03/81  
Dr. R. T. Wilson (11 pages).

This reports summarizes a visit to Sudan by the author from 25 February to 3 March 1981 to evaluate the needs and potentials for the livestock component of the WSARP research program. A summary of subjective impressions of the livestock and range resources in the Kadugli area is followed by a discussion of the present research program.

Project research scientists in 1981 were limited to a social scientist and a range ecologist. The recommendation is made that a livestock production specialist be identified as soon as possible. The need for additional information on livestock numbers and distribution, livestock demography and productivity, livestock nutrition and animal health, and draft and transport animals is noted.

- 10 **Annual Report on Range Research.** 09/81  
W. T. Bunderson (65 pages).

This report was compiled after the WSARP range scientist's first year in Sudan (October 1980-September 1981) and is prepared in two sections. The first identifies the objectives of the project as related to range livestock research and provides a detailed description of the program activities including rationale and the methodology used. A second part sums up the research conducted to date on the range livestock ecology of South Kordofan. Range research during this period focused primarily on the gathering of base line data essential for evaluating the productive potential of the ecological reserve base as a first step into identifying and testing improved production systems. Included are descriptions of the geography, climate, geology and range resources of the area, range condition, patterns of range use, and the pattern and effect of burning.

- 11 **Social Perspectives on Agricultural Research and Development in Southern Kordofan, Sudan: Systems of Agricultural Production Among the Nuba.** 12/81  
F. P. Araujo (56 pages).

This report by the WSARP social scientist, describes the agricultural systems among the Nuba people in Southern Kordofan province from September 1980 to August 1981. The first section deals with general aspects of economic and agricultural development. The systems of agricultural production in Southern Kordofan are then described in more detail. Included are research areas and field sights, a description of the system in Shatt Damam, land tenure, kinship, labor division, consumption patterns, types of farms and production cycles, and income and marketing information. The report highlights the existing communal labor systems and the importance of labor of women.

- 12 **WSARP Consulting Report on Range Research at the Kadugli Station: Review and Recommendations.** 12/81  
D. D. Dwyer (15 pages).

This report covers the author's visit to the Kadugli station between 26 October and 7 November 1981 to review the 1980/81

range research program and to help in planning activities for 1981/82. The report identifies range research accomplishments for 1981, assesses their quality, sets forth a proposed work plan for 1982 and 1983, and offers suggestions and recommendations. The report supports the work of the range scientists to date and stresses the need for integration of research activities, adequate research support, and quantitative assessment of data.

- 13 **Work Plan, Volume I., General Research Programs and Plans for the Period of October 1982 to July 1984.** 10/82  
Ed. J. B. Henson, J. C. Noel (81 pages).

The report briefly reviews WSARP development and organization and focuses on the research program. It also describes the basic physical, biological and socio-economic settings, defines the production systems with emphasis on the transhumant and sedentary producers, specifies production constraints, and discusses required research resources.

- 14 **Work Plan, Volume II., Project History and Functional Structure.** Ed. J. B. Henson and J. C. Noel (47 pages). 10/82

The first section deal with the history of the project, its purpose, goals, philosophy, and identifies research needs for Western Sudan. The second section details the WSARP organizational and planning structure, including research administration and administrative support at the station and Khartoum project support unit levels. Staffing and training patterns, relationships with ARC, and cooperation with external operations are reviewed. The reports concludes with a review of the status of equipment and commodity procurement and a time frame for previous and projected activities.

- 15 **Work Plan, Volume III., Research Plan for Kadugli and Other Stations.** Ed. J. B. Henson and J. C. Noel (130 pages). 10/82

Volume III of the work plan provides detailed information on WSARP research approach, the target area and resource base, the production systems and target groups, and production constraints. The research program is discussed on a station by station basis (Kadugli, El Obeid, El Fasher, and Ghazala Gawazet) research results and projected future activities. The report concludes with a discussion of research support needs.

- 16 **Review of Seed Programs in Sudan.** 10/83  
J. D. Maguire (25 pages).

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This publication is a result of a trip to Sudan from 8 August to 7 September 1982 by the author to review seed production and technology in the Kordofan Region of Sudan. The status and background of seed production in Sudan is summarized in the initial section. Observations made by the consultant during a tour of seed facilities in Khartoum, Kadugli, El Obeid, Wad Medani and Senar are included in the second section. Recommendations to improve the supply of quality seed in Western Sudan comprise the final section of the report. Summaries of annual seed production targets, seed crops, and seed production activities in Sudan are included.

- 17 **Report of Visit to Sudan to Review Fruit Tree Research Program and Related Factors.** 05/83  
A. H. Krezdorn (25 pages plus appendices).

This report summarizes a visit to Sudan from 30 March to 20 April 1983 to review ARC fruit tree research in Sudan and to review WSARP horticultural program plans. The report reviews the current situation in Sudan including the incidents of citrus virus, and the virus free budwood plan (VFBP). The report further summarizes visits to ARC stations and to major fruit production areas.

- 18 **Work Plan, Volume IV., Initial Research Proposals, Kadugli Research Station.** Ed. J. J. Riley (174 pages). 08/83

Volume IV contains initial research proposals prepared by the scientific and technical staff of the Kadugli research station. Proposals are numbered sequentially and presented in chronological order. Individual experiments are presented by title, duration, objective, justification, methodology, and resources required. Cooperating entities are identified.

- 19 **Fourth Annual Report.** 08/83  
Ed. J. B. Henson and J. C. Noel (281 pages).

The Fourth Annual Report is a comprehensive overview of the WSARP, detailing activities of project year four and summarizing project activities to date. In addition to subjects covered in previous annual reports, discussions of the project support unit/ARC liaison office, transportation and communications, maintenance program, private sector and women's involvements, library and information system, publications, time frame and project issues are discussed.

- 20 **A Summary of the Darfur and Kordofan Regional Planning Workshops.** Ed. J. J. Riley (33 pages). 04/83

This report summarizes the main points of the regional planning workshops held in El Obeid, Kordofan Region, April 9 and 10, 1983 and El Fasher, Darfur Region, April 11 and 12, 1983. Issues discussed include: relevance to regional development, implications for national program planning, potential involvement of other organizations, and ties between WSARP and the regional governments, and extension of research results. The report includes tabular summaries of relative research emphasis as related to production constraints and program emphasis by station with indications of national and international collaborators. Lists of papers presented at the meetings and lists of participants are included.

- 21 **Report of Visit to Sudan to Review the Organization and Development of Research Support for the WSARP Experiment Station.** E. W. Nunn (37 pages plus appendices). 02/83

This report summarizes a visit to Sudan by station development and operations consultant E. W. Nunn from November 24 to December 11, 1982. The first section is a general overview and philosophy of research station support requirements including administrative services, research services, physical plant services, farm operations, and the farm manager. The second section summarizes observations from the tour and of all four WSARP stations and makes recommendations for future activities. Appendices include an example master land use plan for research station and a detailed list of equipment needed for research stations support.

- 22 **Research Program for the Kordofan Region 1984-1985.** Ed. J. J. Riley (80 pages). 05/84

This report details the 1984-85 research program for the Kordofan Region. The work plan herein has been reviewed and approved by all relevant WSARP research committees. The report is broken into two sections with the initial section addressing Southern Kordofan and the second section addressing Northern Kordofan. Each section is further subdivided into the sedentary sector and the migratory sector. Each sector objectives, strategies, activities and resource requirements are detailed. Appendices include senior staff and WSARP publication listings.

- 23 **Application of Farming Systems Research and Development to an Extensive, Sedentary Livestock Production System in Southern Kordofan, Sudan.** R. H. Cook, W. T. Bunderson, B. Fadlalla, and J. B. Henson (28 pages). 11/83

This paper was presented at the farming systems workshop in Manhattan, Kansas in October, 1983. It discusses the application of farming systems research and methodology to the Nuba sedentary production system in Southern Kordofan, Sudan. The paper discusses farming systems research and development in livestock systems in general and follows with a discussion of the Nuba system in Sudan. The Nuba livestock production system, production constraints, and research domains are characterized, proposed interventions presented, and the implications for use of the methodology in Sudan discussed.

- 24 **Kadugli Agronomy Research 1983.** 04/84  
 J. R. Gingrich, A. K. Elseed, M. M. Kenani and  
 W. T. Bunderson (50 pages).

This publication describes research activities and results in the area of Agronomy at the Kadugli research station 1983. The first section is devoted to on-station research trials while the final section describes on-farm research. Research commodities include sorghum, millet, soybean, legumes, pearl millet and sunflower. Below average rainfall adversely impacted the research results. However, growing promise were identified for future research.

- 25 **Social Science Report February 1982 to March 1983.** 08/84  
 Ed. J. M. Teitelbaum (138 pages).

This publication details the activities and results of the social science unit at Kadugli during the indicated period. The report begins with an initial description of the research approach. Specific research activities in the transhumant production systems are discussed including definition of the production calendar, identification of constraints, socio-economic ecologic and organizational descriptions, and detailed descriptions of various production activities and actors. A third section deals with the identification of recommendation domains and selection of farmers for on-farm trials. Other social science activities and projected future activities are included. Attachments and appendices include a seasonal production calendar and a series of papers and proposals prepared by the socio-economic unit at Kadugli.

- 26 **Gum Arabic as an Evaporation Retardant and its Effect on Sorghum Seedling Growth and Establishment in GOZ Sands.** 04/84  
 L. M. Arya (22 pages).

The lack of available subsoil moisture supply is considered a primary cause of lack of seedling emergence. This paper describes the used of Gum Arabic as an evaporation retardant

for seedling emergence and growth in the GOZ Sands. Gum Arabic was shown to be effective in retarding evaporation from sandy surfaces in potted goz sands. However, increased growth in the treated pots led to an increase in transpiration demand and the growth could not be sustained. The paper recommends additional experiments to determine an optimum amount method, timing of Gum Arabic application, and the persistence of gum in the soil. The potential for use of other evaporation retardants such as clays and hydrophillic polymers was noted. On-farm research under field rather than potted conditions was deemed essential.

- 27 **Development of the Horticultural Potential of Kordofan Region of Sudan.** A. A. Obeidalla and J. J. Riley (14 pages). 10/84

This report, prepared by the Director of Horticulture for Kordofan Region and the Senior Advisor to the Director General, ARC, analyses the present status and future potential for horticultural production in Kordofan Region. The Kordofan Region is briefly characterized geographically and geologically and the horticultural production systems described. Production constraints are identified and potential solutions discussed briefly. Present and planned horticultural development project are discussed. The paper concludes with a discussion of the potential beneficial environmental effects of increased emphasis on horticultural production to decrease environmental pressures on the rainfed lands.

- 28 **Adoption of a New Technology and Problems Encountered in a Nuba Mountain Village.** N. A. Patrick with additional observations by J. J. Riley (29 pages with a supplementary 8 page section). 10/84

This publication describes an experiment to test the adoption by a group of traditional producers of Gadem El Hamam a short season sorghum variety, and Aldrex T, a seed dressing. Secondary objectives were to refine farmer managed trial methodology and to test the extension methodology. The paper describes the methodology and includes observations of participating farmers. Results of the trials and observations of the methodology are described. Yield results are presented in relationship to planting date, weeding practices, seed treatment.

- 29 **Range Livestock Research Activities 1982-1983.** W. T. Bunderson, R. H. Cook, and B. Fadlalla (130 pages). 08/84

This report details the range livestock activities and results for the 1982-1983 research season. The report is organized in seven parts. The first, the introduction,

addresses agriculture in Sudan in general and the WSARP research strategy. Sections two, three and four detail the characteristics of the physical environment, the range land resources, and the livestock resources in South Kordofan. Section five characterizes the Baggara transhumant systems and relevant research results. Section six characterizes the Nuba sedentary system and details results of research activities. Section seven describes a nomadic production system and defines future activities. The final sections describe additional activities conducted by the range livestock unit and present research results in tabular form.

- 30 **The Sedentary Production System in the Nuba Mountain Area.** 10/84  
M. A. Abu Sabah and N. A. Patrick (120 pages).

This report, by the members of the socio-economic unit at Kadugli, describes the sedentary production system of the Nuba Mountains Area in detail. Organized into five major sections, the report begins with the discussion of the research methodology and methods of data analysis. The second section provides a brief description of each of the surveyed villages surveyed including physical setting, general agricultural, social and political organization. The third section is a statistical examination of the fourteen villages to determine the homogeneity of their system and concludes that they represent a single recommendation domain. Section four presents agricultural production information to define the sedentary production system in the Nuba Mountains including: household and social information; the cropping subsystems; the livestock subsystem; and other economic activities. The final section includes concluding remarks and recommendations for future research activities and recommendation domains. The appendices includes a glossary of Arabic and local language terms.

- 31 **Consulting Report: Range and Livestock Research-  
Review and Recommendations.** D. D. Dwyer (19 pages). 10/84

This report is a result of a short-term consultancy from 18 August to 5 September 1984 by range consultant Dr. D. Dwyer. The purpose of the trip was to review the range livestock research program, make recommendations on future activities, and supervise the dissertation work of Ahmed El Wakeel, graduate student at Kadugli. The report summarizes the significant range research findings to date at Kadugli, recommends future research activities for Ghazalal Gawazet and El Fasher, and makes recommendations for extension of the project beyond its current termination date. The future of the sentinel cattle research herds at Kadugli, the roll of range livestock as a part of Sudan's total rainfed agricultural strategy, the progress of Sudanese Ph.D.

candidates in range science, and project administration are discussed. A section on recommendations is subdivided into general, research, long-term training, and recommendations on the replacement of the range scientist at Kadugli. The recommendations support continuation of the research approach at Kadugli and its extension to the additional station; the addition of a forage agronomist; the addition of an extension component; improved information transmission to donors and cooperating agencies; detailed recommendations on future research activities; and recommendations for future conduct of research activities by project graduate students. The report stresses the need for long-term support of the research effort.

- 32 **Farming Systems Research: Its Strengths and Weaknesses and the Need to Link Farm Research to Macro-Economic Circumstances.** 12/84  
F. E. Winch (29 pages).

This is an invited paper to the WSARP Farming Systems Research Workshop. The paper outlines the historical development and conceptual framework of a farming system and defines farming system research including alternative models. The potential strengths and weaknesses of the FSR approach are discussed. The importance of linking research at the farm level with that at the Macro-Economic level is then explored emphasizing key economic parameters, important economic policy issues for agricultural research, and the role of agriculture in Sudan's economic crisis. The paper concludes with a discussion of the suggested role of economic policy makers in the design of Farming Systems Research.

- 33 **Fifth Annual Report, August 15, 1984.** 02/85  
Ed. J. C. Noel and J. B. Henson (55 pages plus appendices).

The Fifth Annual Report follows the general format of previous annual WSARP reports. An additional section on Project, USAID, Africa Bureau strategies is included. Issues during project year five include the development of a USAID Mission Strategy for Sudan, question of extension of technical assistance beyond August 15, 1985, issues related to Sudanese staffing, maintenance program, construction program, budget, and force account are considerable. Additional information is provided in the thirteen accompanying appendices.

- 34 **Hybrid Sorghum Production in the Sudan.** 01/85  
L. McDonald (195 pages).

This report is a result of a short-term consultancy by Mr. L. McDonald from 9 July to 20 November 1984 to assist the seed corporation and the ARC in the propagation of hybrid Hageen Dura 1. This report focuses on the more important aspects relating to the production of Hageen Dura 1, the first hybrid sorghum released in Sudan. The first part of the report discusses the development of a hybrid sorghum program, followed by the conditions encountered in the first year of production of certified hybrid seed on a large scale. The report summarizes the evolution of the hybrid sorghum program and contains pertinent information necessary for those individuals or organizations considering the development of private hybrid seed production in the Sudan. The bulk of the report is devoted to an extensive series of annexes (1-13) providing additional information about the status of sorghum improvement in Sudan, the release of the sorghum hybrid, the sorghum seed production advisory committee, various activities associated with the establishment of sorghum seed propagation capabilities, the field inspection manual for the Sudan (certification standards), rouging and blooming, and management and cultural practice recommendations.

- 35 **Soil and Water Management and Conservation Program, North Kordofan.** Lalit M. Arya (57 pages). 02/84

This report outlines a program for soil and water management, specifically for North Kordofan, Sudan. Because water availability is the overriding constraint facing traditional producers in the region, the focus of the proposed program emphasizes maximizing soil water storage and minimizing non-useful losses. Specifically, field trials are proposed which address: 1) mulching and residue management; 2) improving soil moisture in the seed zone in sandy soils; 3) water harvesting to increase water supply in cropped fields; 4) rehabilitation of gardud soils; 5) drip irrigation for horticultural production; and 6) shelter belts and windbreaks for soil and water conservation. Detailed proposals for initiating many of these field trials are contained in an accompanying appendix.

- 36 **Research Program for the Kordofan Region.** Ed. Lemoyne Hogan (79 pages). 05/85

This report contains an outline of the proposed research activities for the Kadugli and El Obeid Research Stations for the 1985-1986 cropping season. In the case of both stations, research programs focused on the sedentary (agro-pastoral) and the migratory/nomadic production systems which predominate in the target areas of each station. The salient features of each production system are summarized, and followed with a list of detailed, proposed experiments

intended to address important production constraints of that system. An accompanying appendix contains a list of senior project staff as of April, 1985.

- 37 **Increasing Crop Productivity in Western Sudan - Results of Selected Agronomic Trials.** Ed. James J. Riley (pages 192). 06/85

This report does not provide a comprehensive compilation of all the results of agronomic trials conducted in Western Sudan, but rather collates research information that has been gathered on means of increasing crop productivity in the area. Specific research areas which are addressed include: 1) crop response to fertilizers; 2) performance of improved cultivars; 3) modifications/improvements in agronomic cultural practices; 4) on-farm trials; and 5) development of improved implements. An extensive list of supplemental references, by subject area, is included to provide the reader with additional sources of research information.

- 38 **Recommended Water Conservation/Utilization Interventions and Research Directions in Kordofan Region of Western Sudan.** James J. Riley (74 pages). 09/85

This report is not a formal water resources study of Kordofan Region, but rather, seeks to identify priority areas for research in water resources in the region and to evaluate the feasibility of potential water-related interventions from the technical agricultural perspective. The report outlines: 1) criteria and considerations in the selection of a target area; 2) the feasibility of potential interventions, including village drinking water catchments and storage tanks, cultivation of gardud soils, drip irrigation in commercial gardens, water spreading and sand dams, reduction of evaporation losses from open water surfaces, and Irish bridges for fording streams. Priority research areas identified include, among others, pilot livestock grazing development trials in southern Kordofan, hafir water conservation and management, and increasing the bio-productivity of hafirs and reservoirs. A list of resource people, resident in the Sudan and additional references, frequently with location, is included.

- 39 **Sixth Annual Report.** Ed. J. C. Noel and J. B. Henson (54 pages, plus appendices). 10/85

The Sixth Annual Report follows the general format of previous annual WSARP reports. Highlighted in this report are several important factors which had a significant impact on project activities, specifically: (1) a deteriorating

national political and economic climate; (2) a continuation of drought/famine conditions; (3) civil unrest between the North and south; and (4) uncertainty concerning continued project activities. The immediate impact of these and other factors are discussed with respect to: (1) planning, monitoring, and evaluation activities; (2) construction and facilities development; (3) staffing and training activities; (4) implementation/impact of the research program; and (5) project administration/support activities. Detailed information including quarterly reports is provided in twelve accompanying appendices.

- 40 **Soil and Water Management/Conservation Research in Kordofan Region of Sudan: Report on Research Activities and Results for the 1984-85 Season.** L.M. Arya (123 pages). 06/85

This report outlines the research program/results of the WSARP soil and water specialist. Included are results of field tests on the physical characteristics of the major soil types found in northern Kordofan, eg. goz sands, gardud soils, and cracking vertisols. Soil moisture conservation field trials, using, among other techniques, mulching, seed cradles and ridge-furrow beds, depth of planting, and plowing/ridge-furrow cultivation are discussed. Appendices contain detailed data for many of the trials.

- 41 **WSARP 1984-85 Research Program Results - Vol. 1 - Summary of Kadugli Sedentary and Transhumant Research Program Results.** Ed. R.H. Cook (96 pages). 10-85

This report summarizes the results of agronomic, range/livestock, and socioeconomic research activities which addressed some of the more important constraints of the two predominate traditional production systems. Results from on-farm and in-herd, researcher- and producer-managed research trials are presented, as well as, varietal improvement studies undertaken on the research station farm.

- 42 **WSARP 1984-85 Research Program Results- Vol. II - Sedentary Production System Research Program Results, Kadugli Station.** Woldetatos, T.; Gillard-Byers, T.; Bunderson, W.T.; Abu Sabah; Cook, R. (260 pages). 02-86

This report details the research results of on-station and on-farm trials targeted to address constraints of traditional, agro-pastoralists. Specifically, on-farm trials focused on the responses of phosphorus fertilization; improved cultural practices, eg. time of weeding and application of seed dressing; improved integration of food/forage legumes into traditional cropping patterns dry-season supplementation of cattle; and introduction of

animal draft. On-station trials focused on identifying improved cultivars of the most important crops, eg. sorghum, sesame, and cowpeas, as well as screening of new crops for diversifying the agronomic resource base of traditional producers. Socioeconomic efforts to develop data resource bases for assisting the design of future research activities are also included.

- 43 **WSARP 1984-85 Research program Results -** 03-86  
**Vol. III - Transhumant Production System Research Program**  
**Results, Kadugli Station.** Fadlalla, B.; Bunderson, W.T.;  
 Cook, R.H.; Hashim, I.; Gillard-Byers, T. (240 pages).

Program emphasis in this report focuses on range/livestock and socioeconomic research activities. In-herd trials concentrated on an evaluation of the seasonal nutritional status of cattle, sheep, and goats and attempts to overcome critical nutritional deficiencies through dry-season supplementation. Range studies concentrated on an evaluation of the traditional patterns of resource utilization by pastoralists and identifying appropriate means to improve the efficiency of resource use. In-herd supplemental trials emphasized the benefit/cost factors involved in providing purchased feeds under volatile market conditions. Socioeconomic studies focused on establishing seasonal livestock marketing data and developing cultural guidelines for the future implementation of producer-managed trials.

- 44 **Final Report of the Senior Advisor to the Director** 07-85  
**General of the Agricultural Research Corporation.**  
 James J. Riley (44 pages plus 10 appendices).  
 This report outlines the historical background of the Senior Advisor's position and the duties and responsibilities performed in this position for a period of approximately five years. The historical perspective contained in this document provides insight into some of the problems encountered in the implementation and maintenance of programmatic continuity of the WSARP. Considerable detail is provided on liaison efforts with domestic and international research organizations. The associated appendices contain detailed information on potential areas for further strengthening the effectiveness of the Agricultural Research Organization's capacity to meet the needs of Sudan's traditional, mechanized, and irrigated agricultural sectors.

- 45 **Some Aspects of Moisture Depletion and Conservation in** 10/85  
**Goz Sands and Their Implications for Improving**  
**Agronomic Practices and Land use in Western Sudan.**  
 L.M. Arya (43 pages).

Based on almost two years experience in Western Sudan, the author provides a framework for future research activities designed to increase the productivity of sedentary farmers in areas with predominately goz sands. Feasible and potentially successful water and soil conservation techniques are discussed which could measurably improve crop production in these arid/semi-arid areas. Several methods for promoting seedling establishment and the importance of identifying new deep rooted varieties are discussed.

- 46 **The Role of Cowpea in Agricultural System in the Western Sudan.** A.E. Hall (12 pages). 12/85

This report contains recommendations for future agronomic activities focusing on the development of cowpeas in the traditional cropping systems of Western Sudan. These recommendations are based on a three-week visit by the author to Western Sudan in the late rainy season of 1984. Recommendations emphasize: (1) further studies on improving cowpea production in the northern areas with sandy and sandy/loam soils; (2) expansion of efforts to collect local germplasm; (3) further screening trials of new, improved, imported varieties; (4) improving traditional methods of intercropping; (5) examine ways to improve storage methods; and (6) screen new varieties utilizing household consumption tests/surveys. Also included is a commentary written by several WSARP scientists.

- 47 **El Obeid Water/Supply Harvesting Potential in Western Sudan.** C. Brent Cluff (5 pages plus computer print out modeling tables). 10/85

This report was undertaken during a two week visit to the Sudan with the purpose of establishing recommendations for improving the capacity of the El Obeid water system to cope with the dependent population in the area. The results of the modeling exercise indicated that evaporation covers on the hafirs combined with a compartmented reservoir could drought proof the El Obeid water supply which became exhausted for approximately 5 months during the 1985 drought.

- 48 **Range-Livestock Production in Southern Kordofan, Sudan: Final Report on Research Activities from 1980-1985.** W.T. Bunderson (43 pages). 11/85

This final report of the range/livestock specialist outlines research results obtained over a period of approximately five years in the southern Kordofan Region. Areas addressed include: (1) rangeland classification and evaluation; (2) natural resource utilization/livestock productivity; (3)

integration of efforts to improve rangeland productivity and grazing with agro-forestry; (4) recommendations for improving livestock nutrition; (5) improved integration of legumes into traditional agronomic production systems; (6) impact of animal draft on sedentary productivity; and (7) implementation of improved dry season grazing management systems for traditional producers.

- 49 **Agricultural Marketing Structures and Marketing Constraints in Kordofan, Sudan: Recommendations for WSARP Research and Implementation.** M. Speece, (87 pages). 10/85

This report is based on information and data collected by the author during a six-week visit to the Sudan in July/August, 1985. The first section deals with the functioning of the market system in Kordofan, specifically, market structures, flow of goods, functions in the market, pricing mechanisms, and market competition. The second section includes detailed discussions of market constraints, research needs in marketing, and the kinds of agricultural interventions which are most applicable given the existing market structure.

- 50 **Recommendations for Strengthening Research-Extension Farmer Linkages in Kordofan and Darfur Regions.** T.F. Trail (141 pages). 10/85

This report outlines a detailed plan for improving agricultural research linkages with extension, agricultural development agencies, traditional farmers, farmers on mechanized schemes, and the private sector in Kordofan and Darfur Regions. A major focus concerns the development of procedures to assist research programs in the design of appropriate technologies for farmers in both the traditional and mechanized sectors.

- 51 **Final Report Farm Equipment Specialist.** William B. Symons (23 pages). 07/85

Summarizing activities of a four-week assignment with WSARP in Sudan, the author highlights areas considered necessary to improve the efficiency of machinery/vehicle performance on the project. In addition to suggestions for improving the operational status of many Project machines and vehicles, the author offers detailed recommendations regarding: (1) the operation and maintenance of farm machinery and vehicles; (2) training programs for mechanics and associated staff; (3) purchasing/inventorying procedures for spare parts; and (4) general improvements/strengthening maintenance/support infrastructure.

<u>Publication Number</u>	<u>Report Title - Author/Editor</u>	<u>Date</u>
52	<b>Production and Consumption by Gender and Role Among Transhumants in Western Sudan: The Baggara (Hawazma) of Kordofan.</b> B.J. Michaels (31 pages).	01/84
	This report contains a summary of the author's activities during two years of field work in Sudan collecting data for a Ph.D. thesis. The report is organized into four principal sections; social organization, spatial organization, social economy, and production/consumption. In addition, attached appendices contain information on Baggara culture, use of space, and fieldwork methodologies.	
53	<b>Crop Production in South Kordofan, Sudan. Final Report on Kadugli Agronomy Research Activities 1984/85.</b> T. Woldetattios (85 pages).	10/85
	This report contains a detailed discussion of Kadugli agronomy trials for the 1984/85 cropping season. Variety screening trials, cultural practice trials, including residue management/water conservation trials, as well as on-farm, producer and researcher managed trials are discussed. Recommendations for the future focus of the agronomy program in southern Kordofan are given.	
54	<b>Livestock Production Specialist/Chief of Party Final Report: Status of Project Outputs and Recommendations for Future Program Focus.</b> R.H. Cook (36 pages).	02/86
	This report contains a summary of Project accomplishments in the areas of infrastructure development, administrative/management organization, and research program development and implementation. A summary of agronomic and livestock/range research results are included for the Kadugli Research Station. Recommendations for future program foci, specifically in the areas of staff development and livestock system programs are presented.	
55	<b>Socioeconomic Section Report: Program Design, Implementation and Results for the Period, July 1984 - October 1985.</b> T.E. Gillard-Byers (31 pages).	02/86
	The report outlines program design and implementation with special emphasis placed on individual Project results and the potential for adoption by small producers. Recommendations for future WSARP activities in both the sedentary farming system and the transhumant (nomadic) production system are discussed.	
56	<b>Western Sudan Agricultural Research Project Final Report: August 15, 1979 through December 31, 1985.</b> J. Noel, J. Henson, D. Cook and J. Kearns (155 pages).	02/86

157

This final report covers the six years of the technical assistance contract between WSU/CID and USAID for the implementation of the Western Sudan Agricultural Research Project. This evaluative document summarizes Project accomplishments (including physical and human resource development), technical assistance, management strengthening, constraints to implementation, present and future Project impact, and lessons learned. Establishment of the research support infrastructure, including construction; development and implementation of the adaptive research program; research management strategies; research results, and conclusions/recommendations are presented in detail.

57      **Research Results El Obeid 1984-85. El Obeid research staff.**      In Process

### APPENDIX III

#### SUMMARY AND RECOMMENDATIONS -- WSARP EVALUATION TEAM MID-TERM REPORT TO USAID AND THE WORLD BANK

Substantial progress has been made in the early phases of the rather complex Western Sudan Agricultural Research Project (WSARP). An administrative structure, with a project support unit, has been established and is functioning. Good working relationships exist between project administration, the donors, staff at headquarters, the coordinating staff at Washington State University, and the staff of the Consortium for International Development, the prime contractor for technical assistance.

An aircraft has been purchased and is functioning to help meet project needs for transport and communications. A radio network soon will be functioning to provide improved communications between administration and each of the field stations and they with each other.

Some research has been initiated at the Kadugli station in South Kordofan and further projects are in various stages of planning. On the basis of the original time frame, the research program and plans for the future are slightly ahead of schedule. Early investigative work was initiated in range management and social anthropology that has built up a strong base of description and understanding of the local range environment and of household, farm and community organizations in South Kordofan. This and other accumulated information has been of value to incoming scientific staff allowing their rapid orientation to the local situation. Project scientists have become thoroughly involved with farmers and have developed a working knowledge of traditional farming practices. Three disciplinary sections: range management and animal production, socio-economics, and cropping systems-agronomy have proposed research programs for the 1983-84 season and in some cases 1984-85.

Members of the evaluation team were impressed with the apparent enthusiasm for the implementation of a systems approach as a new tool of agricultural research. In the Western Sudan, with its nomads, transhumants, and sedentary farmers, with strong interfacing of crops and animals, both within and between farming systems, the WSARP has tremendous opportunity for impact on the orientation and methodology of the systems research approach.

General work plans have been developed for the other stations but no specific research proposals have been prepared.

The construction program at the stations is considerably behind schedule due to many factors. The major facilities at Kadugli have been completed and some staff positions have been filled. Much remains to be done to develop roads and driveways, parking areas, the station farm and maintenance and repair shops. Construction of buildings, houses and other facilities at El Obeid, El Fasher and Ghazala Gawazat will not be completed until February 1984. Headquarters staff of the project will move from Khartoum to El Obeid at that time.

The major constraint to the success of this project is a lack of experienced, qualified Sudanese staff at all levels - scientists, technicians, and operational support staff. Full value of the technical assistance scientists will not be obtained without adequate, qualified Sudanese counterpart scientists to provide the continuity necessary for research to be effective. A second constraint is a lack of adequate mechanisms and personnel for maintenance of vehicles and other equipment and physical facilities at each of the stations.

The alleviation of these and other constraints and deficiencies which would improve overall project administration and operation, are dealt with in the summary recommendations that follow. They are arranged in groups according to the major sections of the report. The reader is referred to the text for comments relating to the recommendations given for consideration by project management and others concerned with the project and the ARC. Additional specific recommendations and suggestions are given in the report.

#### Integration Into ARC and Coordination with GOS Institutions

Recommendation 1. There is a need for the WSARP to operate as an integral and complementary part of the ARC. Close linkages and informational exchanges must be maintained between project and management and ARC on budgets, research project appraisal and approval, in research operations and in staff recruitment and career development. (p. 4)

Recommendation 2. The transfer of the ARC headquarters to Khartoum would aid in the development and strengthening of the WSARP stations and other units of the ARC system. In addition, it would give a national posture and outlook that would ensure continuous liaison with officials concerned with national development planning and donor agencies. It would be in keeping with the ARC's nationwide responsibilities as the technical arm of the Ministry of Agriculture, Food and Natural Resources. (p. 5)

Recommendation 3. To facilitate liaison and collaboration between the agencies cooperating in the development of the WSARP, a Project Coordinating Committee should be established to meet twice annually to discuss and decide issues of concern to all parties. Composition of the committee would include the Director General of the ARC, the Project Director, representatives of the World Bank, USAID, CID and GOS. (p. 6)

Recommendation 4. To strengthen its role in transfer of technology and agricultural extension, it is recommended that WSARP appoint a sufficient number of production specialists (minimum of three specialists in every station) to cooperate with the research scientists and the provincial extension services in the conduct of on-farm trials and the training of extension personnel and farmers. (p. 7)

Recommendation 5. It is suggested that a consultant be appointed to carry out a short term study of one or two months to explore possibilities of financial contributions to WSARP from levying of assessments on marketed crops, livestock and forest products from the Western Regions. (p. 7)

#### Project Management and Support

Recommendation 6. With many demands on the time of the Project Director and Deputy Director, it is essential for them to delegate routine details to subordinate staff in order to allow them the time for a better overview of project needs and basic policy decisions. Control of delegated responsibilities should be achieved by a reporting system monitored by the Project Director. (p. 8)

Recommendation 7. The line between the duties of the Deputy Director and his dual role as Chief of Party for technical assistance should be clearly defined and clear to all, especially the expatriate technical assistance staff. (p. 9)

Recommendation 8. The WSARP should take advantage of training courses of varying length offered by the International Centers, i.e. ICARDA, ICRISAT, IITA and ILCA, for selected members of the staff. Also, other opportunities for short term training should be explored, such as a course on research management offered by the Economic Development Institute, sponsored by the World Bank and the International Service for National Agricultural Research (ISNAR), and a training course given in the Netherlands supported by the European donors of the CGIAR at which development oriented research procedures, based on a systems approach to research, are taught. (p. 12)

Recommendation 9. It is suggested that WSARP follow up on preliminary discussions that have been held with CIMMYT's East African Economic Program and arrange for participation of some staff in training workshops on farming systems research. (p. 12)

Recommendation 10. Mechanisms for circulation of journals, articles and reports among the scientists at the stations need to be clearly defined and developed. The appointment of a chief librarian is needed to get a system working within the WSARP and to assist in gathering relevant information from other institutions in the Sudan and elsewhere. In the meantime it is recommended that the scientists utilize the library materials at the other ARC stations, especially the Gezira Station at Wad Medani, for information in earlier research reports and current scientific journals as a complement to the materials that will be available in the libraries of the four western stations. (p. 13)

Recommendation 11. With some evidence of slippage in communications between the large number of organizations participating in this project, the evaluation team urges that the administration define channels of communication and procedures and that those involved recognize the

importance of adequate communications and make an honest effort to achieve this objective. (p. 13)

Recommendation 12. It is recommended that project management proceed, as early as feasible, to arrange a schedule for regular aircraft flights to the stations. This would make possible closer working relationships between the field staff and the headquarters staff. (p. 13)

Recommendation 13. If funds are available and if a qualified Sudanese can be recruited, the team recommends that consideration be given to the addition of a program information-communications officer. After the position is filled, the use of an experienced consultant could be highly useful to assist in the organization of a communications and information infrastructure throughout the research system. (p. 13-14)

#### The WSARP Research Approach and Work Plan

Recommendation 14. The evaluation team recommends that the project systems approach be defined as complementary to the present commodity and disciplinary research activities of ARC. Further, it is recommended that the project adopt a three stage strategy to encourage a sustained use of a systems approach by ARC after donor withdrawal: (1) identification with ARC and the full use of ARC procedures; (2) build up of credibility in the eyes of ARC management and scientists by its field-work; and (3) modification through convinced ARC channels of those procedures not wholly consistent with the organization and management of a systems approach in research. (p. 16)

Recommendation 15. The team recommends an open approach and an operative model which clearly draws on applied research done by others, particularly from past and present ARC programs, but also from international applied research efforts in the IARC's and CRSP's. (p. 17)

Recommendation 16. After a detailed operating model has been finalized, a 2-3 day workshop is recommended with two objectives: (1) to familiarize all project scientists new to a systems approach with its operational characteristics and interdisciplinary needs; and (2) to brief ARC administrators and researchers, particularly available national commodity coordinators, on the role and operation of the WSARP systems approach and the vital linkages with ARC institutions and scientists, and with other GOS agencies. (p. 17)

Recommendation 17. The team recommends that research activities proposed for the project be evaluated as 'central' or 'support' thrusts and that through the project period, central thrust activities dominate the research program. Further, research proposals need to be reviewed for the importance of their objectives to the central 'interventionist' thrusts and the appropriateness of the methodology to achieve those objectives at the lowest possible cost. The desirability of an intervention must be judged on its relevance and its likelihood of success. (p. 19-20)

Recommendation 18. It is recommended that project management ensure that at least one animal production scientist, one socio-economist and one crop agronomist be allocated to each station (with the possible exception of El Fasher if a crop agronomist is not essential there). These are the core of any adaptive research team where both animals and crops feature in the system. (p. 21)

### Proposed Research Programs

Recommendation 19. The team feels it is imperative that a better balance is achieved for the experimental program in the next season, and is confident that practical relevant, interventions can be identified using rapid diagnosis techniques and by drawing on past technical research done in the Sudan or elsewhere. It recommends, therefore, this work be undertaken immediately with a view to including more on-farm experiments, derived from a systems approach, in the 1983-84 season research proposals. (p. 22-23)

Recommendation 20. Detailed comments on the methodology are presented in the text. Overall it is recommended that proposed methodology be reviewed to include a much greater use of informal survey methods to identify possible interventions which can be included in central thrust adaptive research programs, and less dependence on formal surveys. (p. 24)

Recommendation 21. The team recommends that: (1) evaluation criteria be kept as simple as possible; (2) data to monitor these criteria are collected in the course of formal surveys essential to the central thrust of the project; and (3) that the need for these data do not dictate the collection methods used or the size of samples to be covered. (p. 25)

Recommendation 22. With reference to the specific research proposals reviewed, the team recommends that any direct interventions which are identified take priority if there are inadequate resources to implement the whole of the revised program. (p. 27)

### Administration

Recommendation 23. With existing difficulties in staff recruitment, the team recommends that project administration proceed immediately to identify and recruit scientists, technicians, and maintenance staff that will be needed for El Obeid, El Fasher and Ghazala Gawazat so that research can be planned and started soon after the facilities are completed. (p. 31)

Recommendation 24. To improve recruitment the WSARP should consider immediately implementation of incentives which do not contravene Government regulations. These would include, for instance, provision of free fully furnished houses to senior and junior Sudanese scientists and senior technicians. Negotiations with the Ministry of Agriculture and the Ministry of Finance should be stepped up at a high level to implement the 25% increase in salaries of the WSARP and ARC staff on newly determined basic salaries. (p. 34)

#### APPENDIX IV

##### EXECUTIVE SUMMARY -- AGRICULTURAL RESEARCH IN THE SUDAN WITH SPECIAL EMPHASIS ON THE WESTERN SUDAN PROJECT BY C. GOTSCH AND B. WRIGHT

In the latter part of July, 1984, a two-man team consisting of Carl Gotsch (economist) and Bill Wright (soil scientist) spent roughly five man-weeks in Sudan reviewing the country's agricultural research situation. The team was asked to comment on a variety of issues, but our main focus was on USAID's upcoming decision regarding the extension of the technical assistance portion of the Western Sudan Agricultural Research Project (WSARP). In pursuit of this objective, we talked to a cross-section of the Sudanese development community including representatives from the Ministry of Agriculture, the Agricultural Research Corporation, the World Bank, USAID and Washington State University. We also traveled to visit the WSARP research centers at Kadougli and El Obeid and visited the Agricultural Research Corporation (ARC) headquarters at Wad Medani.

The overall impression we gained from our investigation was a positive one and we strongly recommend that USAID make a long-term technical assistance commitment to the WSARP project. Our reasoning is straight forward:

(1) USAID is in the process of making major commitments to the development of the Western Sudan. The road to El Obeid represents an infrastructure investment that will one day be seen as a key element in "opening the West." Additional funds have also been ear-marked for credit, storage and marketing programs. In addition, the Mission has pressed hard-- and with considerable success--to persuade the Sudanese government to develop agricultural policies that would provide incentives for farmers in the area to increase output. Failure to deal adequately in the development plan with the third leg of the "development stool", i.e., with insuring a continuing supply of agricultural technology, would be a serious omission.

(2) The present project team, albeit young, is competent and enthusiastic. The contractor has put together a solid expatriate team and, by all accounts, is managing the project in a competent and professional way. One might quibble with the mix, (e.g., there seems to be a need for some type of policy analyst and perhaps a strengthening of the agronomy component), but in general there is sufficient intellectual leadership at key points to give the relatively inexperienced Sudanese staff the necessary guidance.

The project's "farming systems" approach is an appropriate methodology for the task with which they are faced. Relatively little is known about the Western Sudan in terms of agricultural research and considerable effort will be needed simply to identify the most appropriate points of intervention. After several days of conversation, we are persuaded that the staff understands "farming systems" as an effort to involve the end-user in the research and diffusion process, a process that requires them to work as a team in formulating the producer's problems in the integrated way that he perceives them. They did not suggest that this in some way diminishes the need for commodity and discipline based research that has traditionally been the source for new agricultural technology. Reassurance on this point was important because of fears that perhaps the project had become so enamored with the the farming systems approach that it was in danger of spreading available resources over too many activities.

Although the team's recommendations regarding the extension of the present technical assistance program are positive, there are several points where the present program could be strengthened. Particularly important is the need for an increased input from a senior policy analyst that would help to articulate the link between the Mission's Western Sudan strategy and the research focus. This would do much, in our judgment, to deal with a perception in some quarters that the research program lacks focus.

(3) It is difficult to estimate what the appropriate magnitude of the continued support should be. The largest expenditures under WSARP (i.e., the buildings and facilities) have already been committed and are therefore sunk costs. At issue is the continuation of the technical assistance program. A back-of-the-envelope calculation suggests that \$7-8 million over a five year period would be about right. This figure is based on the assumption that each man-year would cost roughly \$150,000. Assuming that no significant extension component was added, an 8-man team would require \$6 million. To this one would want to add some additional funds for equipment, consultants and Sudanese training.

Although the figures given above are extremely crude, they emphasize that the decision to continue the project would not be a major financial commitment for the Mission. When these sums are set alongside the funds being designated for infrastructure and other programs, it seems clear that to save on the research program would be counter-productive. Moreover, we strongly recommend that the Mission decide in favor of making a long-term commitment at this point rather than attempting to fund the continuation of the project through stop-gap measures.

(4) With respect to the larger issues confronting Sudan's agricultural research program, the most pressing, i.e., how to cover recurrent costs, is obvious. Everyone is well aware of the problem, but it is not clear what mix of measures might provide a solution. An inter-ministerial committee is supposedly working on methods (commodity levies, taxes from Schemes, etc.) by which more funds could be raised. There has also been discussion within the Mission about the use of local currency funds generated by PL 480 shipments for this purpose. It seems to us that such a commitment to ARC in support of work on groundnuts, sorghum and other

crops important to the Western Sudan would help break the recurrent cost bottleneck while at the same time maintaining the coherence of the Mission's dryland research focus.

(5) In pursuit of a national dryland development strategy, the Mission may also wish to consider initiating work in the Eastern zone. The demise of the Blue Nile rural development project leaves a facility that could easily be converted to agricultural research. Given that the levels of development in terms of infrastructure, urbanization, and population density are all advanced in the Eastern zone, a commitment to agricultural research in the area would appear to have a high benefit-cost ratio.

APPENDIX V.A

LEVEL OF EFFORT PROVIDED BY WSU/CID  
THROUGH CID CONTRACT -- LONG-TERM ADVISORS

Position Title	Name	Start Date	Completion Date								TOTAL <sup>1</sup>	TOTAL <sup>2</sup>
				79-80	80-81	81-82	82-83	83-84	84-85	85-86	(\$)	(LS Trust)
<b>FIELD STAFF, PROFESSIONAL:</b>												
Deputy Dir/COP	Harwood, R.	01-Oct-79	15-Dec-81	10.5	12	4	-	-	-	-	26.5	
	Owens, G.P.	15-Oct-81	21-Mar-84	-	-	10	12	7	-	-	29	
	Hogan, L.	15-Apr-84	14-Aug-85	-	-	-	-	4	12	-	16	
	Cook, R.	14-Jul-85	28-Feb-86	-	-	-	-	-	-	[6.5*]		
Chief Admin Off	Shurtlaff, M.	26-Sep-79	03-Nov-80	11	2.5	-	-	-	-	-	13.5	
	Higgins, S.	03-Oct-80	30-Apr-81	-	7	-	-	-	-	-	7	
	Stenquist, L.	01-Apr-81	15-May-83	-	4.5	12	9	-	-	-	25.5	
	Hanum, J.	23-Apr-83	22-Apr-85	-	-	-	4	12	8	-	24	
	[Mr. Horton, pd. fr. LS Trust after 5/85]											7
Project Engineer	Higgins, D.	16-Jun-80	14-Apr-85 **	2	12	12	12	12	8	**	58	
	[Mr. Shawgi, pd. fr. LS Trust after 4/85]											
Advisor to DG/ARC	Riley, J.J.	16-Jun-80	14-Apr-85 **	2	12	12	12	12	8	**	58	9
Range Scientist	Bunderson, T.	15-Sep-80	15-May-85	-	11	12	12	12	9	-	56	
Social Scientist	Araujo, F.	15-Aug-80	02-Sep-81	-	12	0.5	-	-	-	-	12.5	
	Teitelbaum, J.	08-Jan-82	07-Jan-84	-	-	7.5	12	4.5	-	-	24	
Animal Prod Spec	Cook, R.	22-Jul-82	28-Feb-86	-	-	1	12	12	12	6 ***	43	
Agric Economist	Patrick, N.	20-Mar-82	20-Apr-84	-	-	5	12	8	-	-	25	
	Gillard-Byers, T	01-Jun-84	28-Feb-86	-	-	-	-	2.5	12	6 ***	20.5	
Agronomist	Gingrich, J.	12-May-82	11-May-84	-	-	3	12	9	-	-	24	
	Woldetattios, T.	01-Jun-84	14-Aug-85	-	-	-	-	2.5	12	-	14.5	
	Berho, Tareke	01-Feb-86	28-Feb-86	-	-	-	-	-	-	1 ***	1	
Vehicle Maint Off	Cenidoza, A.	26-Sep-82	14-Aug-85	-	-	-	10.5	12	12	-	34.5	
	[Bong Chu Kim after 10/85]											2
Land-Water Spec	Arya, L.	02-Sep-83	14-Aug-85	-	-	-	-	11.5	12	-	23.5	
<b>FIELD STAFF, NONPROFESSIONAL:</b>												
Research Assoc	Michael, B.	27-Sep-82	26-Sep-84	-	-	-	10.5	12	1.5	-	24	
Deputy Admin Off	Higgins, S.	01-May-81	15-Apr-85	-	1.5	8.6	11.6	12	8	-	41.7	
	[Various, pd fr LS Trust past 4-15-85]											16
Sr. Secretaries	(Various)	(Various)	(Various)	2.4	3.2	7	7.6	-	-	-	20.2	
	[Various, pd. fr. LS Trust after 1983]											40
<b>HOME OFFICE, PROFESSIONAL</b>												
Coordinator	Henson, J.	15-Aug-79	30-Jun-84	7	6.4	7.1	7.3	5.5	-	-	33.3	
	Noel, J.	01-Jul-84	31-Dec-85	-	-	-	-	1.3	7	1.7	10	
Deputy Coordinator	Noel, J.	15-Aug-79	30-Jun-84	6	6.4	7.1	6.8	6.8	-	-	33.1	
	Henson, J.	01-Jul-84	14-Aug-85	-	-	-	-	0.2	1.9	-	2.1	
	Smith, G.	20-May-84	31-Dec-85	-	-	-	-	2	4.8	1.8	8.6	
Trainee Advisor	Grathwol, E.	01-Nov-80	31-Jan-84	-	2.2	1.8	1.8	0.8	-	-	6.6	
<b>HOME OFFICE, NONPROFESSIONAL:</b>												
Secretary	(Various)	15-Aug-79	31-Dec-85	12	12	12	12	12	12	6.5	78.5	
Purch/Time-Slip	(Various)	15-Aug-79	31-Dec-85	2.2	0.1	0.2	8.1	8	12	6.5	37.1	

SUBTOTALS:	FIELD STAFF, PROFESSIONAL	536.0	18.0
	FIELD STAFF, NONPROFESSIONAL	85.9	56
	HOME OFFICE, PROFESSIONAL	93.7	
	HOME OFFICE, NONPROFESSIONAL	115.6	
	SHORT-TERM ADVISORS (Paid from CID contract)	33.6	
	<b>Total Person Months Paid from CID \$ Contract</b>	<b>864.8</b>	

- \* Per. mths. incl. with Animal Production Specialist
- \*\* Paid by contract thru 14 Aug. 1985, but non-WSARP duties
- \*\*\* Incl. report writing auth. Jan-Feb. 1986 which not incl. in Aug-85 (CID amendment 13) revision of level of effort to est. 862 mo.

<sup>1</sup> Position paid from dollar contract.  
<sup>2</sup> Position paid from LS Trust.

Additional Person Months Paid from CID LS Trust	74.0
<b>Grand Total Person Months (including LS Trust Funded)</b>	<b>938.8</b>

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**APPENDIX V.B**

**LEVEL OF EFFORT PROVIDED BY WSU/CID  
THROUGH CID CONTRACT -- SHORT-TERM ADVISORS**

<u>Name</u>	<u>Position</u>	<u>Dates</u>	<u>Person Months</u>
Don Dwyer	Range/Livestock	20 Oct-10 Nov 1979	0.75
Phil Oviatt	Engineer	23 Jul-4 Sep 1979	1.30
M. Shurtleff	Administration	15 Aug-10 Sep 1979	0.50
Don Minshart	Station Development	24 Oct-9 Nov 1979	0.50
James Riley	ARC Advisor	26 Feb-10 Mar 1980	0.75
Earl Muir	A/E Advisor	3 Oct-12 Oct 1979	0.35
Don Dwyer	Range/Livestock	20 Oct-8 Nov 1980	0.75
Clarence Becker	Ag. Engineer	19 Oct-9 Nov 1980	0.75
Von Jarrett	Heavy Equipment	9 Jun-20 Jun 1980	0.50
Don Dwyer	Range/Livestock	24 Oct-12 Nov 1981	0.75
Trevor Wilson	Livestock	25 Feb-1 Mar 1981	0.25
A. Krezdorn	Fruit/Hortic.	30 Mar-20 Apr 1983	0.75
Ernest Munn	Station Development	24 Nov-11 Dec 1982	0.33
Samani	Anthropologist	23 Jul-18 Aug 1983	0.75
Ahmed Humeida	Ag. Economics	23 Jul-18 Aug 1983	0.75
R. Shetty	FSR Agronomist	29 Mar-4 Apr 1983	0.25
LeRoy Rogers	Ag. Economist	29 Mar-26 Apr 1983	1.00
Robt. LaRocque	Inventory	29 Feb 84-21 Jun 84	3.75
Don Dwyer	Range/Livestock	28 Mar-18 Apr 1983	0.75
Lynn McDonald	Sorghum Breeder	9 Jul-20 Nov 1984	4.50
Don Dwyer	Range/Livestock	18 Aug-5 Sep 1984	0.75
Michael Mannion	Maintenance	11 Nov 84-2 Jun 85	7.66
Tom Trail	Extension	9 Jun-4 Aug 1985	2.00
Wm. Symons	Farm Machinery	1 Jul-15 Aug 1985	1.00
Mark Speece	Mkt. Economist	13 Jul-15 Aug 1985	1.50
G. Thompson	Administration	8 Dec-31 Dec 85	0.75
			-----
TOTAL THROUGH 31 DEC. 1985			33.64
Dave Coahran	Equip. Specialist	[Scheduled for Nov-Dec 85	
Spitzer/Fisher	Library	but cancelled because of	
Tony Wright	Computer	US Embassy ban on travel]	
			-----
CID CONTRACT TOTAL			33.64

APPENDIX V.C

PARTIAL LISTING OF WSARP FIELD CONSULTANTS AND ADVISORS  
PROVIDED OUTSIDE THE CID CONTRACT

Name	Position	Dates	Person Months	Funded by
LeRoy Rogers	Ag. Economist	19 Oct-9 Nov 1980	0.75	WSU
Travis McGuire	Vet. Medicine	19 Oct-2 Nov 1980	0.50	WSU
Mack Johnson	Vet. Medicine	25 Oct-2 Nov 1980	0.25	WSU
Jim Maguire	Seed Specialist	8 Aug-9 Sept 1982	1.00	WSU
Jim Maguire	Seed Specialist	15 Mar-15 Apr 1985	1.00	WSU
P. Wandschneider	Water Economist	5 June-15 Jun 1985	0.33	WSU
Gen Smith	Administration/WID	30 Mar-26 July 1985	2.00	WSU & CID/WID
			-----	
WSU SUBTOTAL			5.83	
Jerry Holocek	Range Nutrition Specialist	29 Feb 83-21 Jun 84	1.00	New Mex St U
Warren Jones	Landscape Planner	Jul-Aug 1984	0.50	U/Az
Brent Cluff	Water Conservation	4 July-12 July 1985	0.25	U/Az
			-----	
OTHER CID SUBTOTAL			1.75	
FUNDED BY OTHER SOURCES				
David Gephart	REDSO Engineer	Oct-Nov 1983	1.00	USAID
Kenneth Turk	Cornell/Proj. Midterm Eval.	12-30 Nov. 1982	0.65	USAID
Hussein Idris	UNDP/Proj. Midterm Eval.	13-29 Nov. 1982	0.60	USAID/GOS
Michael Collinson	CIMMYT/Proj. Midterm Eval.	14-26 Nov. 1982	0.50	USAID
John Vercoe	CSIRO/Proj. Midterm Eval.	13-18 Nov. 1982	0.25	WB
Michael Collinson	CIMMYT/FSR	30 Mar-5 Apr 1983	0.25	USAID
Tom Nordbloom	ICAPDA Livestock/Economist	20-25 Aug 1983	0.25	ICARDA
George Ghobrial	USAID Agronomist	Aug-Sep 1983	0.25	USAID
Carl Gotsch	Economist (USAID Eval.)	Jul-Aug 1984	0.75	USAID
Bill Wright	Agronomist (USAID Eval.)	Jul-Aug 1984	0.75	USAID
Trevor Wilson	Livestock Specialist	Aug. 1984	0.25	ILCA
Tony Hall	Cowpeas Specialist	23 Sept-10 Oct 1984	0.75	Bean CRSP
Michael Collinson	CIMMYT/FSR	18-24 Jan 1985	0.25	USAID/CIMMYT
Fred Palmer	Agron./CIMMYT	19-24 Jan 1985	0.25	USAID/CIMMYT
Ed Reeves	FSR/Kentucky	18-24 Jan 1985	0.25	USAID/CIMMYT
Guido Grissel	ILCA/FSR	19-24 Jan 1985	0.25	USAID/CIMMYT/ILCA
			-----	
OTHER SUBTOTAL			7.25	

APPENDIX V.D

ADDITIONAL WSU/CID BACKSTOPPING SUPPORT  
NON-PROJECT FUNDED

UNIT/DEPARTMENT:	PERSONNEL:	ROLE	UNIT/DEPARTMENT:	PERSONNEL:	ROLE:
1. International Program Development Office - Washington State Univ.	J. Henson J. Noel G. Thompson L. Williams S. Burkhart A. Gass L. Distad H. Damous E. Larson	Director - monitor/supervise/assist Assoc. Dir. - monitor/supervise/assist Program Associate; Women in Development Orientation; Debriefing Publications, Seminar support Secretarial management Travel assistance Office assistance Word processing assistance	9. WSU WSARP Advisory Committee	R. Rogers T. Barbet J. Tiedeman J. Engibous G. Gamble H. Chaudry T. Trail J. Males L. King	Ag. Economics Veterinary Medicine Forestry and Range Management Agronomy and Soils Anthropology Civil and Environ. Engineering Extension and Adult Education Animal Science Agricultural Engineering
2. CID Executive Office	J. Fischer D. Dwyer D. Daines J. Reuss J. Kearns J. Hedrick E. Vimmerstedt	Exec. Dir. - Monitor/assist Exec. Dir. - Monitor/assist Deputy Dir. - Monitor/supervise/assist Deputy Dir. - Monitor/supervise/assist Deputy Dir. - Monitor/supervise/assist Treasurer - Financial monitor/assist Treasurer - Financial monitor/assist	10. WSU Farming Systems Committee	Various Faculty	
3. International Project Support Office	B. Souriall A. Stutler M. Weitz S. Bailey B. Frey R. Pate	Secretarial/administrative assistance Accounting Word processing/secretarial assistance Procurement assistance Word processing/editorial assistance Word processing	11. WSU Departmental Support/Backstopping- The following departments/units provided additional backstopping support to WSARP:	Various Faculty and Staff	Adult and Continuing Education Agricultural Economics Animal Science Anthropology Architecture Business & Economics/Marketing Central Stores Civil & Environmental Engineering Coloquium Multiple Use Research Center Communications Cooperative Extension Dryland Research Unit English Department/ESL Center Entomology Facilities Planning Foreign Languages Forestry and Range Management General Ag. and Home Economics Horticulture & Landscape Arch. Instructional Media Services Irrigated Ag. Research and Ext. Center Material Maintenance Mechanical Engineering Physical Plant Plant Pathology Rural Sociology Sociology Veterinary Clinical Medicine Veterinary Microbiology & Pathology W. Washington Research and Ext. Unit WSU Libraries
4. WSU Controllers/Grant & Contracts Finance Office	M. Bamberry F. Frank	Accounting Inventory control			
5. WSU Purchasing Office	P. Triplett M. Damanpour J. Luden P. Berry	Manager - Procurement assistance Procurement Procurement Procurement			
6. WSU Computing Center	D. Buck	Computer assistance/procurement tracking			
7. WSU Library, International	R. Fisher E. Brekke A. Spitzer	Librarian (International Collection) Librarian (International Collection) Librarian			
8. WSU Language Training	D. Wigend H. Demous	Instructor (Arabic) Instructor (Arabic)			

APPENDIX VI

FACILITIES MAINTENANCE PROCUREMENT LIST

<u>Vendor:</u>	<u>Item:</u>	<u>Quantity:</u>	<u>\$ Amount:</u>
Bennet & Sauser; Switzerland	1. Pumping Unit Assembly	1	\$527.55
	2. Handcrank & Pin Assy	1	\$31.06
	3. V-Belt	1	\$14.18
	Total		----- \$572.79
English Drilling Equip Co Ltd, Eng.	1. Sampson Post Assembly	1	\$271.96
	2. Tubular Pitman H.1015	1	\$712.62
	3. Body (Gearbox)H.1017/A	1	\$529.98
	4. Beam Assembly H.1018	1	\$409.15
	5. Miscellaneous		\$4,022.38
Total		----- \$5,946.09	
Flygt Corporation; Norwalk, CT	Parts: Flygt Pump C3127.180	.	
	1. Seal Unit Upper	2	\$238.00
	2. Seal Unit lower	2	\$552.00
	3. Inspection Screw	2	\$19.90
	4. Allen Screw	2	\$26.00
	5. Allen Screw Sh Imps	2	\$9.00
	6. Washer	2	\$19.00
	7. Washer Sh Imps.	2	\$84.00
	8. Inspection screw O ring	2	\$0.90
	9. Ball Bearing Upper	2	\$82.00
	10. Ball Bearing Lower	2	\$184.00
	11. O Ring(see PO for size)	2	\$3.20
	12. O Ring(see PO for size)	2	\$11.60
	13. O Ring(see PO for size)	2	\$6.10
	14. O Ring(see PO for size)	2	\$24.00
	15. O Ring(see PO for size)	2	\$26.00
	16. O Ring(see PO for size)	2	\$30.00
	17. O Ring(see PO for size)	2	\$26.00
	18. O Ring(see PO for size)	2	\$26.00
	19. Rubber Wear Ring LT	2	\$130.00
	20. Rubber Wear Ring MT	2	\$68.00
	21. Rubber Wear Ring HT	2	\$118.00
	22. Brass Wear Ring LT	2	\$250.00
	23. Brass Wear Ring MT	2	\$246.00
	24. Brass Wear Ring HT	2	\$140.00
	25. Brass Wear Ring HI	2	\$164.00
	26. Impeller LT 410	2	\$670.00
	27. Impeller LT 411	2	\$852.00
	28. Impeller LT 412	2	\$1,136.00
	29. Impeller LT 442	2	\$1,432.00
	30. Impeller LT 441	2	\$968.00
31. Impeller mT 430	2	\$720.00	

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<u>Vendor:</u>	<u>Item:</u>	<u>Quantity:</u>	<u>\$ Amount:</u>	
Flygt Corporation; Norwalk, CT	32. Impeller mT 431	2	\$906.00	
	33. Impeller MT 432	2	\$1,032.00	
	34. Impeller MT 433	2	\$1,032.00	
	35. Impeller HT 461	2	\$818.00	
	36. Impeller HT 463	2	\$1,108.00	
	37. Impeller HT 465	2	\$752.00	
	38. Impeller HT 467	2	\$838.00	
	39. Impeller HT 250	2	\$554.00	
				-----
		Total		\$15,301.70

Flygt Corporation; Norwalk, CT	Parts:Flygt Pump C3101.090(EX)		
	1. Seal Unit Upper	1	\$164.00
	2. Seal Unit lower	1	\$119.00
	3. Inspection screw	1	\$17.00
	4. Inspct. screw 3101.090	1	\$46.00
	5. Ball Bearing Upper	1	\$28.00
	6. Ball Bearing Lower	1	\$77.00
	7. Lock Washer	3	\$6.60
	8. Circlip	1	\$0.65
	9. Allen Screw	1	\$5.25
	10. O Ring(see PO for size)	1	\$2.95
	11. O Ring(see PO for size)	1	\$5.40
	12. O Ring(see PO for size)	1	\$3.55
	13. O Ring(see PO for size)	1	\$6.70
	14. O Ring(see PO for size)	1	\$7.40
	15. O Ring(see PO for size)	1	\$9.50
	16. O Ring(see PO for size)	1	\$10.00
	17. O Ring(see PO for size)	1	\$0.75
	18. 16 Key	1	\$1.45
	19. Rubber Wear Ring LT	1	\$39.00
	20. Rubber Wear Ring MT,HT	1	\$20.00
	21. Brass Wear Ring LT	1	\$71.00
	22. Brass Wear Ring MT,HT	1	\$70.00
	23. Impeller LT 410	1	\$313.00
	24. Impeller LT 411	1	\$420.00
	25. Impeller LT 412	1	\$500.00
	26. Impeller LT 440	1	\$334.00
	27. Impeller LT 441	1	\$518.00
	28. Impeller LT 442	1	\$532.00
	29. Impeller mT 430	1	\$218.00
	30. Impeller MT 435	1	\$395.00
	31. Impeller MT 432	1	\$301.00
	32. Impeller MT 433	1	\$319.00
33. Impeller MT 434	1	\$339.00	

<u>Vendor:</u>	<u>Item:</u>	<u>Quantity:</u>	<u>\$ Amount:</u>
Flygt Corporation; Norwalk, CT	34. Impeller HT 252	1	\$202.00
	35. Impeller HT 254	1	\$215.00
	Total		----- \$5,317.20

<u>Vendor:</u>	<u>Item:</u>	<u>Quantity:</u>	<u>\$ Amount:</u>
Bohler Bros, Texas	Spares for Pumping Units:		
	1. Breather	1	\$9.90
	2. Oil Gage	2	\$8.00
	3. Bearing 22217	1	\$69.40
	4. Bearing 6314	1	\$27.00
	5. Bearing NU 309	2	\$29.40
	6. Locking assy 80x120	2	\$108.60
	7. Locking assy 45x75	1	\$41.20
	8. Oil Seal	1	\$5.70
	9. Oil Seal	1	\$4.10
	10. Comp Nr.8307	2	\$8.40
	11. Gasket	2	\$6.20
	12. Hex screw	16	\$10.40
	13. Lock washer	16	\$6.40
	14. Axle 70	1	\$47.50
	15. Bearing 22309	2	\$95.80
	16. Hex screw	12	\$16.80
	17. Flexlock Nut	12	\$6.00
	18. Safety plate	4	\$2.00
	19. Hex screw	16	\$15.20
	20. Washer	8	\$3.20
	21. Pin	1	\$21.70
	22. Seal	2	\$9.00
	23. Crank pin	1	\$34.50
	24. Collet slotted	1	\$14.50
	25. Bearing 22210	3	\$86.10
	26. Plate Spring	2	\$5.20
	27. Hex nut	1	\$1.30
	28. Hex screw	4	\$67.20
	29. Flexlock nut	8	\$6.40
	30. Hex screw	4	\$3.80
	31. Washer 17	8	\$4.00
	32. Oil seal	1	\$4.20
	33. Clamping sleeve	1	\$1.30
	34. Cable	1	\$29.80
	35. V-belts	2	\$112.80
	35A. Tubing pump	1	\$1,410.00
	Tubing pump Spares: 36-45		
	36. Piston valve	10	\$588.00
37. Valve seat	10	\$209.00	
38. Cup	5	\$41.00	
39. Rubber ring	10	\$37.00	

<u>Vendor:</u>	<u>Item:</u>	<u>Quantity:</u>	<u>\$ Amount:</u>
Bohler Bros, Texas	40. Valve Ball	10	\$640.00
	41. Adaptor cage	5	\$230.00
	42. Standing valve cage	1	\$68.60
	43. Piston Body	1	\$54.60
	44. Piston nut	1	\$25.80
	45. Cr Barrel	1	\$215.00
	46. Winches (complete)	2	\$3,540.00
	47. Stuffing box	4	\$1,680.00
	48. Landing Plate	4	\$113.60
	49. Accessories	4	\$308.00
	Total		----- \$10,083.60
Thorn EMI Lighting Products; Essex, Eng.	Electrical Light Fitting Spares		\$1,923.52
Armitage-Shanks, Staffordshire	Sanitary Ware as Follows:		
	1. Cistern & Cover	20	\$398.70
	2. Cist.Fittings(incl in 1)		
	3. Magnia WC	5	\$105.95
	4. Finned Pantrap	5	\$9.69
	5. Seat/Cover	10	\$132.60
	6. Domex Screws	5	\$6.24
	7. Back Inlet	10	\$27.69
	8. Bib-Trap	20	\$479.70
	9. Basin	5	\$95.16
	10. Centre BKT - Washbasins	5	\$12.16
	11. Steel Hangers	5	\$3.19
	12. Pillar taps	10	\$101.66
	13. Shower Tray	5	\$654.88
14. Flex.Hose	40	\$358.80	
	Total		----- \$2,376.40
Petbow, Limited Kent	Spares for Portable Welding Machines		\$2,449.79
Delta Accessories & Domestic Switchgear, Ltd. Lancashire	General Electrical Accessories		\$1,189.96

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<u>Vendor:</u>	<u>Item:</u>	<u>Quantity:</u>	<u>\$ Amount:</u>
Lister Diesels, Inc Olathe, Kansas (England)	1. Piston	10	\$703.40
	2. Piston Ring Set	20	\$384.60
	3. Bearing	24	\$668.64
	4. Bearing	10	\$805.30
	5. Valve	40	\$378.80
	6. Inlet Valve Guide	20	\$118.00
	7. Exhaust Valve Guide	20	\$167.80
	8. Valve Spring	20	\$46.20
	9. Valve Spring	20	\$26.20
	10. Nozzle	20	\$546.00
	11. Injector	10	\$1,062.80
	12. Fuel Pump	5	\$877.75
	13. Fuel Pump Element	10	\$302.30
	14. Delivery Valve	10	\$119.00
	15. Fuel Filter	5	\$180.70
	16. Fuel Filter Element	150	\$277.50
	17. Joint Set	50	\$917.00
	18. Joint Set	20	\$704.80
	19. Cylinder Block	2	\$746.70
	20. Joint	2	\$0.74
	21. Cylinder Head	2	\$954.36
	22. Gasket	25	\$298.00
	23A. Dipper	5	\$12.25
	23B. Con Rod	5	\$1,018.10
	23C. Bearing	5	\$139.30
	24. Bush	10	\$242.80
	25. Con Rod Bolt	10	\$185.60
	26. Locknut	10	\$15.40
	27. Dipper	10	\$24.50
	28. Rocker Lever	5	\$371.30
	29. Valve Cotter	5	\$9.40
	30. Valve Cap	5	\$11.55
	31. Push Rod	5	\$168.15
	32. Push Rod	5	\$168.15
	33. Valve Tappet	5	\$298.75
	34. Valve Tappet	5	\$371.55
	35. Tappet Head	2	\$67.30
	36. Crankshaft	2	\$832.32
	37. Camshaft	2	\$708.74
	38. Bush	5	\$28.05
	39. Bush	5	\$282.00
	40. Oil Pump	5	\$1,021.30
	41. Oil Pump Plunger	5	\$72.55
	42. Oil Seal	5	\$31.35
	43. Felt Washer	40	\$49.60
	44. Joint	1	\$0.37
45. Joint	5	\$3.95	
46. Joint	1	\$0.62	

<u>Vendor:</u>	<u>Item:</u>	<u>Quantity:</u>	<u>\$ Amount:</u>
Lister Diesels, Inc Olathe, Kansas (England)	47. Fuel Pipe	5	\$140.35
	48. AA Air Cleaner	2	\$168.00
	49. DA Water Tank Connect	2	\$41.26
	50. EA Starting Handle	2	\$30.76
	51. FA Fuel Tank	2	\$79.60
	52. NA Exhaust Silencer	2	\$24.00
	53. QA Holding Down Bolts	5	\$48.75
	54. SH Tool Kit	2	N/A
	55. Nut	2	\$27.62
	56. Injector Pipe	4	\$73.36
	57. Fuel Leak Off Pipe	4	N/A
	58. Key	6	\$79.86
	59. Parts List	4	\$19.20
	60. Inst. Book	4	\$19.20
61. Book	4	N/A	
62. Book	4	N/A	
	<b>Total</b>		----- \$17,173.50

GEC-Xpelair, Ltd. Birmingham	Fans: Replacement Parts & Accessories		\$7,448.35
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Adam & Harvey, Ltd. London	1. Seal Assembly	3	\$121.88
	2. Shaft	1	\$62.40
	3. Impeller Nut	3	\$9.17
	4. Impeller Key	3	\$3.00
	5. Wear Ring	3	\$0.98
	6. Motor Bearings	1	\$22.75
	7. Impeller	3	\$85.80
	8. Volute	1	\$0.00
	9. Gasket	3	\$0.98
	10. Gasket	3	\$2.73
	11. Gasket	3	\$0.98
	12. Gasket	3	\$0.98
	13. Gasket	3	\$0.98
	14. Pump Unit	1	\$437.53
	<b>Total</b>		----- \$751.02

<u>Vendor:</u>	<u>Item:</u>	<u>Quantity:</u>	<u>\$ Amount:</u>
TRW Pleuger; Statesville, North Carolina	Pleuger Submersible Pump and Spares:		
	1. Submersible Motor Pump	1	\$413.40
	2. Non return valve	1	incl.
	3. Taper	1	\$55.90
	4. Submersible Cable	30 m	\$38.03
	5. Cable clips	10	\$38.68
	6. Supporting Clamp	2	\$40.95
	7. Motor Starter	1	\$243.75
			-----
	Total		\$830.70

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## APPENDIX VII.A

### WSARP HUMAN RESOURCE DEVELOPMENT DEGREE PROGRAMS

<u>Degree Program/ Trainee</u>	<u>University</u>	<u>Disciplina</u>	<u>Start</u>	<u>Completion</u>	<u>Research Topic/Location/Comments</u>
<b>MS Degree:</b>					
1. Babiker Abdalla Ibrahim	Wash. State	Soils	Jan-83	Jun-85 *	Effects of subsoiling and moisture on grain and vegetable crops (U.S.)
2. Sid Ahmed Beteik	Wash. State	Ag. Econ.	Oct-83	Jan-86 *	Economic analysis of sorghum fertili- zation in the Nuba Mts. (data fr. Sudan)
3. Abdel Gadir Ageeb	Wash. State	Animal Sci.	Jun-83	Jan-86 *	Genetic eval. of Sudanese cattle for pot. improvements (research in Sudan)
4. Mahmoud Mekki	Wash. State/ U. Missouri	Social Sci.	Jun-83	Jun-86	Transf. to U/MI after remed. under- grad. defic.; non-thesis MS
5. Ibrahim Daw El Madina	U. Cal. at Riverside	Agron.	Jan-83	Aug-85 *	Cowpea genotypes under different photo- periods/temperatures; took varieties adaptable to Sudan back with him.
6. Ibrahim El Dukheri	Wash. State	Extens/Econ.	Jul-84	Sep-86	Farm level production functions in Sudan; data from Sudan
7. Mekki A.L. Omer **	Wash. State	Ag. Engin.	Jun-81	Jul-84 *	Simulation water budget/sorghum response to planting dates in Western Sudan (data from Sudan)
8. Faroug M. El Hadi ***	Wash. State	Forestry	Jun-81	Jan-84 *	Effects of presowing treatments on Acacia senegal estab; seeds fr. Sudan
<b>PhD Degree:</b>					
1. Hassan Osman El Awad ****	U. Cal. at Riverside	Agronomy	Jul-83	Sep-84 *	Nitrogen fixation and yields of cowpeas under well-watered and drought conditions
2. Gadelkarim M. Madibo ****	U. Cal. at Riverside	Soils	Sep-82	Mar-86	Use of phosphate rock for direct application to soils
3. El Tigani Mirgani El Amin	Wash. State	Ag. Econ.	Jun-81	Jun-86	Production modeling (in process); research and data fr./in Kadugli
4. Ahmed El Wakeel ****	Utah State	Range Sci.	Sep-82	Jun-86	Leucaena production studies; research done in Kadugli
5. Mekki Abdel Latif Omer	Wash. State	Ag. Engin.	Aug-84	Jun-87	Soil/water modeling; research to be done in Sudan; June 86
6. Faroug El Hadi	Ore. State	Forestry	Jan-84	Aug-87	Nitrogen fixation evaluation in Acacia senegal; research part. done in Sudan
[7. Moustafa Ahmed Rahma] ****	Utah State	Range Sci.	May-82	Jun-86	Terminated by WSARP/ARC and Utah State in 1984 after extended absence from Project following research in Sudan

\* Completed training on-schedule and returned to Sudan and WSARP

\*\* These students had to enroll in and complete an MS before starting their PhD program

\*\*\* Initiated training on non-WSARP funding and transferred to Project

## APPENDIX VII.B

### WSARP HUMAN RESOURCE DEVELOPMENT SUMMARY OF SHORT-TERM AND ON-THE-JOB TRAINING PROGRAMS

Category and Participants	Course/Training Description	Dates	Pers. Months	Totals
<b>Administration:</b>				
Dr. Osman Khalifa	Visits to U.S. agricultural research stations	July-Aug. 1980	0.50	
Dr. Hamid Burhan	Visits to U.S. agricultural research stations	July-Aug. 1980	0.50	
Dr. Osman Khalifa	Managing Rural and Agric. Projects, Wash. DC	Aug.-Sept. 1980	1.50 *	
Dr. D.A. Dafalla	Visits to ICRISAT, ILCA, CIMMYT (Nairobi)	Jan.-Feb. 1982	1.00	
Dr. Mhd. Bakheit Saed	Visits to ILCA (Addis) and CIMMYT (Nairobi)	Mar. 1982	0.50	
Dr. D.A. Dafalla/Dr. Mhd. Bakheit Saed	WSU & outlying research stations, re budget, personnel, research support serv.; U. AZ, Griffin Res. Station, Georgia, & U. Calif.	July-Aug. 1982	2.25	
Mr. Osman Abdalla Mhd.	USAID Procurement Workshop, Khartoum	Oct. 1982	0.25	
Dr. D.A. Dafalla	INTSORMIL, Tucson; World Bank, Wash.D.C. and WSU, Pullman, WA.	Jan. 1983	0.75	
Dr. D. A. Dafalla	ISNAR/ESAMI Agric. Research Mgt., Tanzania	Aug. 1983	0.50	
WSARP Sr. Admin. & Scientists	WSARP Planning Workshop and Management Training Short-course	Apr. 1984	0.50 **	
Mr. Osman Abdalla Mhd.	Training in Admin./Mgt. incl. computers, mgt. res. support services, personnel, etc. WSU, U. California	May-Jul. 1985	2.00	
Dr. Dafalla A. Dafalla	Managing Rural and Agric. Projects, Wash. DC	Jun-July 1985	1.50	
Mr. Mukhtar Kenani	Ag. Research Management Training, Swaziland	Sept. 1985	1.0	
Various Admin.	On-the-job training in accounting/admin./mgt with long and short term CID/WSU Advisors	Aug.79-Dec.85	Various	
				Subtotal: 12.75
<b>Research Scientists:</b>				
Dr. B. Fadlalla	ILCA Livestock Conference	Dec. 1981	0.3	
Mr. Mukhtar Kenani	CIMMYT Workshop, Nairobi	June 1981	0.5	
Mr. Mukhtar Kenani	CIMMYT Workshop, Nairobi	Oct. 1981	0.5	
Dr. D. A. Dafalla	CIMMYT FSR Seminar, Nairobi	Apr. 1983	0.25	
Mr. Mukhtar Kenani	Egypt Major Cereals Training Program, Egypt	Apr.-May 1983	1.00	
Mr. Abdel Aziz	Agricultural Development and Economics	Apr.-Sept. 1983	6.00 *	
Dr. Babo Fadlalla	Animal Nutrition - New Mex. State U. and WSU	Jul.-Aug. 1983	1.25	
Dr. El Hag Abu Gasim	Striga Workshop, North Carolina State U.	Aug. 1983	0.75	
Mr. Zakaria Saad	Agro-forestry, Univ. of Idaho	Aug. 83-May 84	9.00	
Dr. Babo Fadlalla	Animal Nutrition - ILCA, Addis Ababa	Sept.-Oct 1983	0.75	
Dr. Osman I. Gameel	Int. Crop Protection - Brighton, U.K.	Nov. 1983	0.25	
Dr. Osman A. Osman	Symposium for Tropical Hort., Addis Ababa	Jan. 1984	0.25	
Mr. Mhd. A. Abu Sabah	CIMMYT FSR Diagnostic Workshop I, Zimbabwe	Feb. 1984	0.75	
Mr. Hashim Mukhtar	Trop. Pasture/Fodder Seed Prod., Australia	Mar.-Apr. 1984	2.00	
Dr. Babo Fadlalla	Livestock Prod. in Arab Countr. - S. Arabia	Nov. 1984	0.25	
Various WSARP and ARC	CIMMYT/WSARP/ARC Farming Systems Workshop	Jan. 1985	9.30	
Mr. Abd. Rahman El Khider	CIMMYT On-farm Research Workshop	Feb.-Mar. 1985	0.75	
Dr. Dafalla A. Dafalla	Dryland Agriculture Station Tour, Midwest US	Aug. 1985	0.25	
Dr. I.A. Babiker (ARC)	Dryland Agriculture Station Tour, Midwest US	Aug. 1985	0.25 *	
Dr. M. Saeed Ali (ARC)	Dryland Agriculture Station Tour, Midwest US	Aug. 1985	0.25 *	
Mr. Mhd. A. Abu Sabah	CIMMYT FSR Diagnostic Workshop II, Zimbabwe	Sept. 1985	0.50	
Dr. Osman A. Osman	11th African Horticultural Symposium, Cairo	Dec. 1984	0.25	
Dr. Osman Adam Osman	12th African Horticultural Symposium, Nairobi	Nov. 1985	0.25	
Dr. D.A. Dafalla	CIMMYT Regional Networkshop	Nov. 1985	0.25	
				Subtotal: 29.35
* Partially non-WSARP funds				

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Category and Participants	Course/Training Description	Dates	Pers. Months Totals
<b>Research Technicians:</b>			
Mr. Ahmed Kheir Al Seed	ICRISAT Farm Development	1982-83	6.00 *
Mr. Bakheit A. Azrag	CIMMYT/WSARP/ARC Farming Systems Workshop	Jan. 1985	0.25
Mr. Ahmed Kheir Al Seed	CIMMYT/WSARP/ARC Farming Systems Workshop	Jan. 1985	0.25
Mr. Suliman Abdalla	CIMMYT/WSARP/ARC Farming Systems Workshop	Jan. 1985	0.25
Mr. Salah Bahr Ali	CIMMYT/WSARP/ARC Farming Systems Workshop	Jan. 1985	0.25
Mr. Ahmed Hashim Ahmed	Nutritional analysis techniques, ILCA	Feb.-Mar. 1985	2.00
Mr. Adam Mohamed Ali	Nutritional analysis techniques, ILCA	Feb.-Mar. 1985	2.00
Various Socioec. Technic. Kadugli Station	On-the job training with Socio-ec. Advisors, Drs. Anaujo, Patrick, Teitelbaum, Gillard-Byers re use of equip.; computers, libr., methods	1980-1985	Various
Various Range/Livestock Techn. Kadugli Station	On-the-job training on use of equip./libr., methods, with Range/Livestock Specialists, Drs. Bunderson, Cook, Fadlalla	1980-1985	Various
Various Crop Science Technicians, Kadugli	On-the-job training on use of equip./libr., mths with Drs. Gingrich, Woldetatio, Berhe, and Sr. Scientists	1981-1985	Various
Various Soils Technic. El Obeid Station	On-the-job training on use of equip. & methods with Dr. Arya and Sr. Scientists	1983-1985	Various
			Subtotal: 11.00
<b>Support Personnel:</b>			
Mr. A. Mohamed El Amin	Library Training Individual Course, Shambat	Feb.-Mar. 1983	1.50
Mr. A. Mohamed El Amin	USIS Library Short Course/Internship, Khartoum	Jun.-Jul 1983	1.50
Mr. Mekki M. Al Eid	Short Course Library Management, WSU	Jun.-July 1985	1.50
Mr. Adam Njaja	USIS Library Short Course, Khartoum	Jun.-July 1985	1.50
WSARP Farm Machinery Operators/Mechanics	On-the-job training with Farm Machinery Op. & Maint. Advisor, Dr. W. Symons	July-Aug. 1985	1.00
Storekeepers, El Obeid and Kadugli	On-the-job training with Inventory/Materials Control Advisor, R. LaRocque	Feb.-June 1984	Various
WSARP Vehicle Mechanics and Assistants	On-the-job training with Vehicle Mainten. Officer, Mr. A. Cenidoza	Sept.82-Aug. 85	Various
Facilities Maintenance Support Staff, Kadugli	On-the-job training with Facilities Maint. Advisor, Mr. M. Mannion	Nov.84-Mar.85	Various
			Subtotal: 7.00
* Partially non-WSARP funds			-----
GRAND TOTAL PERSON MONTHS:			60.1

## APPENDIX VII.C

### WSARP HUMAN RESOURCE DEVELOPMENT CONFERENCES, MEETINGS AND WORKSHOPS

(Not Otherwise Included Under Specific Short-term Training Programs)

Title/Description	Participants	Dates
Kordofan Regional Planning Workshops, Kadugli	WSARP, ARC, MAFNR, U/KRT, HTS, Farmers Union, Reg. Govt., etc.	Oct. 1980
WSARP Advisory Council, Khartoum	*ARC, WSARP, Council members	Oct. 1982
Desertification Conference, El Obeid	Mr. Zakaria Saad	Oct. 1982
Desertification Workshop, Kartoum	Various WSARP, ARC and others	Feb. 1983
Horticultural Workshop, Wad Medani	Various WSARP, ARC and others	Mar. 1983
Kordofan Regional Workshops, El Obeid	WSARP, ARC, FU, Nomadic Affairs, NMDC, INTSORMIL, LMMC, Kord Reg Min, etc.	Apr. 1983
Darfur Regional Workshops, El Fasher	WSARP, ARC, Darfur Reg. Assembly, CARE, NAW, WSDC, Sag El Nam, U/KRT, etc.	Apr. 1983
Farming Systems Workshop (CIMMYT/WSARP), KRT	Various WSARP, ARC, U/KRT, AID, WB, FF, BNIADP, HTS, Animal Production, others	Apr. 1983
WSDC/WSARP Joint Darfur Planning Tour	Various WSARP and WSDC	May 1983
Ghazala Gawazet Research Planning Workshop	WSARP, ARC, USAID, Range Dept, Animal Production Dept, Vet Services	May/June-83
ARC Commodity Coord. Meeting and Joint Tour of WSARP Stations	WSAI ARC Commodity Coordinators	Aug. 1983
WSARP Coordinating Committee	WSARP, ARC, WSU/CID, WB, USAID	Oct. 1983
ICARDA, Aleppo; re WSARP-ICARDA FSR Wkshop	Dr. Cook, WSARP	Oct. 1983
Jt. Kadugli/El Obeid Station Committee Mtg.	Various ARC/WSARP	Jan. 1984
Jt. ARC Program Committee/WSARP Mtg.-Kadugli	Various WSARP and ARC,	Feb. 1984
WSARP Systems Committee, Kadugli	WSARP, ARC, U/KRT, AID, Animal Prod., Range Dept., extension, etc.	Mar. 1984
Intl. Range Conference, Australia	Dr. Trent Bunderson and Hashim Mukhtar	Apr. 1984
WSARP Coordinating Council	Council Members/CIMMYT	Apr. 1984
Hybrid Sorghum Seed Production Mtg., Barakat	Var. ARC, WSARP, Ntl. Seed Admin., FAO, Dekalb, various pvt. firms	Oct. 1984
Various Meetings at IITA, ICRAAF, ILCA	Dr. D.A. Dafalla	Nov/Dec-84
Kordofan Regional Ministry Meeting, Kadugli	WSARP Kadugli/El Obeid & Various Kordofan Regional Ministries, Ag., etc.	Dec. 1984
Darfur Regional Research Planning Meeting	WSARP Kadugli/El Obeid, WSDC, JMRDP, and Var. Darfur Reg. Ministries	Dec. 1984
Abu Karshule Desertif. Conf., Kordofan	Mr. A. Mohana	Dec. 1984
International Conference, IITA, Lagos	Dr. D.A. Dafalla	Mar. 1985
ICARDA/IDRC Livestock On-farm Trials Wkshop	Drs. Cook and Fadlalla	Mar. 1985
Abu Gubeiha Environmental Seminar, Kordofan	Mr. A. Mohana	May 1985
African Agric. Devel. Conference, Pomona, CA	Dr. D.A. Dafalla	May/June-85

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**APPENDIX VIII.A**

**BUDGET/FINANCE SUMMARY  
WSU/CID DOLLAR EXPENDITURES<sup>1</sup>**

SUMMARY SHEET	Expended Thru 3/31/86	In Process Mar. 86	Total Expend & Enc <sup>2</sup>	Total Through 2/28/86
SALARIES	\$ 2,417,363	\$ 5,505	\$ 2,422,868	\$ 2,435,800
SHORT TERM ADVISORS	85,229	3,034	88,263	161,900
FRINGE BENEFITS	461,501	1,049	462,550	494,100
INDIRECT COSTS	3,344,127	10,771	3,354,898	3,553,400
TRAVEL & TRANSPORTATION	718,756	10,184	728,940	884,200
ALLOWANCES	862,656	1,204	863,860	921,900
OTHER DIRECT COSTS	573,494	(4,950)	568,544	677,400
EQUIP/VEH/MATLS/SUPPL.	3,808,142	29,683	3,837,823	4,190,500
PARTICIPANT TRAINEES	590,669	592	591,261	705,800
ARCHITECTURE & ENGINEERING	3,218,747	000	3,218,747	3,406,400
<b>TOTAL</b>	<b>\$16,080,684</b>	<b>\$57,072</b>	<b>\$16,137,754</b>	<b>\$17,501,400</b>

<sup>1</sup> For details, refer to 6th Annual Report (WSARP Publication No. 39).

<sup>2</sup> Does not include final pending expenditures.

NOTE: These figures reflect all expenditures and encumbrances still outstanding as of 1 March 1986. Current CID billing to USAID reflects only actual expenditures through February 1986.

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**APPENDIX VIII.B**

**BUDGET/FINANCE SUMMARY  
WSU/CID ES TRUST FUND**

<u>CATEGORY:</u>	<u>8/81-8/82</u> <u>YEAR 3</u>	<u>8/82-8/83</u> <u>YEAR 4</u>	<u>8/83-8/84</u> <u>YEAR 5</u>	<u>8/84-8/85</u> <u>YEAR 6</u>	<u>8/85-12/85</u> <u>YEAR 7</u>	<u>TOTAL</u> <u>(THRU DEC/85)</u>
<b>A. SALARIES</b>						
1. Senior Secretaries	5,093.270	27,613.040	40,469.474	33,511.290	11,435.580	118,122.654
2. Hourly/Other Support	0.000	384.000	2,472.370	54,254.908	62,700.690	119,811.768
3. Consultant Fees	0.000	0.000	13,650.400	150.000	0.000	13,800.400
<b>B. TRAVEL</b>						
1. Car Rental/Taxi/Other	0.000	0.000	2,467.500	5,083.200	600.000	8,150.700
2. R&R/Term Home Leave	0.000	39.550	95.000	133.000	0.000	267.550
3. Emergency	0.000	0.000	2,736.000	189.440	0.000	2,925.440
4. DG/PD to USA	4,680.000	(1,819.400)	11.750	0.000	0.000	2,872.350
5. Conference	425.000	7,369.200	1,971.400	2,558.000	0.000	12,323.600
6. Coordinator/Staff	83.450	975.000	12,715.450	96,445.650	8,740.000	118,959.550
7. Aircraft Charter (incl. in B.6. above)						
<b>C. ALLOWANCES</b>						
1. Quarters	46,200.000	76,700.000	167,950.000	90,448.300	9,050.000	391,248.300
2. Utilities	1,371.410	2,424.960	14,238.660	15,044.740	1,720.040	34,799.810
3. Security	450.000	1,770.000	3,048.160	7,235.000	1,600.000	14,103.160
4. Maintenance	6,329.250	10,566.585	52,845.639	32,690.650	45,230.000	147,662.124
5. Temporary Lodging	599.589	798.234	7449.731	5,781.420	2,638.360	17,267.334
6. Supplemental Post	0.000	253.064	1,716.587	900.000	0.000	2,869.651
7. Per Diem	1,573.660	7,466.582	16,916.448	51,920.074	4,202.250	82,079.014
<b>D. OTHER DIRECT COSTS</b>						
1. In-Country Communications	1,304.371	8,651.710	10,987.441	20,558.530	11,262.750	52,764.802
2. Office Incidental	0.000	0.000	797.900	3,206.600	2,855.650	6,860.150
3. Reports/Duplication	0.000	0.000	120.000	178.000	0.000	298.000
4. Clearing/Shipping	3,300.450	29,693.617	41,253.265	88,875.925	23,563.540	186,686.797
5. Vehicle Insurance	0.000	376.730	5,304.000	130.000	0.000	5,810.730
6. Conference Expenses	0.000	0.000	1,546.000	11,563.570	0.000	13,109.570
7. Miscellaneous	0.000	202.500	559.170	3,498.950	302.000	4,562.620
<b>E. KARIYEN SUB-CONTRACT</b>	0.000	2,742.210	57,811.290	162,041.500	67,275.000	289,870.000
<b>F. SUPPLEMENTAL SUPPORT TO CONSTRUCTION SUPERVISION</b>		-	-	25,370.430	11,250.000	36,620.430
<b>G. LORRIES/BUSSES</b>	0.000	0.000	0.000	173,000.000	0.000	173,000.000
<b>H. AID DIRECT EXPENSES</b>	In Yr 5	In Yr 5	29,804.300	69,577.950	17,448.870	116,831.120
<b>I. EXCHANGE LOSSES</b>	0.000	32,873.912	0.000	(1,622.970)	0.000	31,250.942
<b>J. CONTINGENCY</b>	0.000	0.000	0.000	0.000	0.000	
<b>TOTAL:</b>						<u>    </u> Ls 2,004,928.566
Balance remaining upon "close-out" of CID/WSU WSARP Trust Account #0200297-3:						
Balance remaining in CID/WSU WSARP Trust Account #0200297-3:						
Sudanese Pounds in Account: Ls 172,810.429						
Sudanese Pounds in Petty Cash: Ls 292.123						
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Ls 173,102.552						

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**APPENDIX VIII.C**

**BUDGET/FINANCE SUMMARY  
OTHER WSARP BUDGETS**

BUDGET CATEGORY	EXPENDITURES BY SOURCE OF FUNDING ***		
	LS PL480	LS GOS Reg. Budget	WB \$
Salaries, wages - in-country	1,509,917	646,098	
Travel in-country	240,202		
Goods and Services - in-country	2,529,815	144,557	\$155,995
Equipment	516,166		
Aircraft Purchase			\$1,712,299
Aircraft Operations		254,547	\$259,741
Construction			
CAT (Kadugli)	407,303	817,609	\$407,303
Ei Khidr/Deraige (Non-Kadugli)	2,185,147	2,185,147	\$7,363,948
Force Account	1,418,108		
	-----	-----	-----
	LS 8,806,658	LS 4,047,958	\$9,899,286

\* Note: Sources of funding included herein are Sudanese Pounds (LS) from AID PL480 funds, LS from the GOS Regular Budget and U.S. dollars from the World Bank.

\*\* Note: World Bank expenditures are through Dec. 1985; others are through June 1985, the latter being the most recent figures available from WSARP, Khartoum.

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APPENDIX IX

FINAL WSU/CID NON-EXPENDABLE EQUIPMENT LIST

INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
-----	-----	-----	-----
0005	Air conditioner, 1700 BTU, superthrust	G.E.	ELO
0006	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0007	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0008	Air conditioner, 1700 BTU, superthrust	G.E.	SHMBT
0027	Air conditioner, 1700 BTU, superthrust	G.E.	SHMBT
0045	Air conditioner, 1700 BTU, superthrust	G.E.	KAD
0055	Air conditioner, 1700 BTU, superthrust	G.E.	SHMBT
0150	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0153	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0218	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0222	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0301	Air conditioner, 1700 BTU, superthrust	G.E.	KAD
0325	Air conditioner, 1700 BTU, superthrust	G.E.	KAD
0402	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0403	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0404	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0405	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0406	Air conditioner, 1700 BTU, superthrust	G.E.	SHMBT
0491	Air conditioner, 1700 BTU, superthrust	G.E.	KAD
0651	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
0652	Air conditioner, 1700 BTU, superthrust	G.E.	KAD
1159	Air conditioner, 1700 BTU, superthrust	G.E.	KHRT
1687	Alarm, security system w/12 switches	Alder Systems	SHMBT
1683	Alarm, security system w/12 switches	Alder Systems	SHMBT
1684	Alarm, security system w/12 switches	Alder Systems	SHMBT
1685	Alarm, security system w/12 switches	Alder Systems	SHMBT
1686	Alarm, security system w/12 switches	Alder Systems	SHMBT
1345	Amplifier, Linear	Cubic Comm	SHMBT
1346	Amplifier, Linear	Cubic Comm	SHMBT
1347	Amplifier, Linear	Cubic Comm	SHMBT
1348	Amplifier, Linear	Cubic Comm	SHMBT
1349	Amplifier, Linear	Cubic Comm	SHMBT
1106	Anvil, blacksmith, 100 lbs	McMasters-Carr	KAD
0268	Balance, 20g, Mettler	Fisher	KAD
1637	Balance, B5000	Thomas	SHMBT
1638	Balance, FDC, #01920120	Thomas	SHMBT
1931	Balance, Mdl 01920120, Analytical	Thomas	At SHMBT; for ELO
1316	Balance, Mdl B-100	Thomas	SHMBT
1729	Balance, Mdl B3000-DO (#1379-753)	VWR	At SHMBT; for ELO
1581	Balance, Mdl B3000-DO (#1379-753)	VWR	At SHMBT; for GG
1582	Balance, Mdl B3000-DO (#1379-753)	VWR	At SHMBT; for EF
1728	Balance, Mdl DH2A (#12002-003)	VWR	At SHMBT; for GG
1579	Balance, Mdl DH2A (#12002-003)	VWR	At SHMBT; for EF
1580	Balance, Mdl DH2A (#12002-003)	VWR	At SHMBT; for ELO
1829	Balance, Mdl DLM2	VWR Sci	At SHMBT; for EF
1828	Balance, Mdl DLM2	VWR Sci	At SHMBT; for GG
1830	Balance, Mdl DLM2	VWR Sci	At SHMBT; for ELO
1650	Balance, TA-4200	VWR	SHMBT

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
-----	-----	-----	-----
1322	Balance, Triple Beam torsion	Fairbanks	KAD
0790	Balance, analytical, digital, Mdl H80	Cahn Instrument	KAD
0069	Balance, direct reading, Mdl L-920, Ohaus	Pacific Scient.	ELO
0794	Balance, electric, top-loading, Mdl B3000-D	Curtin Matheson	ELO
0796	Balance, electronic, 500/.01g	Fisher	ELO
1343	Bath, Hygrometer Jar	Pacific Scientific	ELO
0052	Bed, queen, w/mattress, headbrd, bx sprngs	Hurricane Int'l	SHMBT
0618	Bed, queen, w/mattress, headbrd, bx sprngs	Hurricane Int'l	KHRT
0681	Bed, queen, w/mattress, headbrd, bx sprngs	Hurricane Int'l	KHRT
0289	Bed, queensize, complete	Sears	KAD
0331	Bed, queensize, complete	Sears	KAD
0744	Bed, queensize, complete	Sears	ELO
0930	Bed, queensize, complete	Sears	KAD
0090	Bed, single	Sears	KHRT
0091	Bed, single	Sears	KHRT
0257	Bed, single	Sears	ELO
0258	Bed, single	Sears	ELO
0383	Bed, single	Sears	KAD
0625	Bed, single	Sears	KHRT
0729	Bed, single	Sears	KAD
0741	Bed, single	Sears	ELO
0742	Bed, single	Sears	ELO
0939	Bed, single	Sears	KAD
0939	Bed, single	Sears	KAD
1380	Blade grader, rear, Big Ox	Dalton/Coop/Gates	KAD
1381	Blade grader, rear, Big Ox	Dalton/Coop/Gates	KAD
1382	Blade grader, rear, Big Ox	Dalton/Coop/Gates	KAD
1383	Blade grader, rear, Big Ox	Dalton/Coop/Gates	KAD
1682	Blade, w/7' mouldboard, Mdl MF227	Massey-Ferguson	KAD
0712	Bookcase		KAD
0909	Bookcase	Hurricane Int'l	KAD
0156	Bookcase (etagere), Bradston	Hurricane Int'l	KHRT
0167	Bookcase (etagere), Bradston	Hurricane Int'l	KHRT
0397	Bookcase (etagere), Bradston	Hurricane Int'l	ELO
0398	Bookcase (etagere), Bradston	Hurricane Int'l	ELO
0617	Bookcase (etagere), Bradston	Hurricane Int'l	KHRT
0745	Bookcase (etagere), Bradston	Hurricane Int'l	ELO
1800	Bookcase, #722660 (3-Shelf) Tan Mdl 4651	E&I Cooperative	SHMBT
1801	Bookcase, #722660 (3-Shelf) Tan Mdl 4651	E&I Cooperative	SHMBT
1802	Bookcase, #722660 (3-Shelf) Tan Mdl 4651	E&I Cooperative	SHMBT
1803	Bookcase, #722660 (3-Shelf) Tan Mdl 4651	E&I Cooperative	SHMBT
0165	Bookcase, #90-31, Baker's rack, Bradston	Hurricane Int'l	KHRT
0746	Bookcase, #90-31, Baker's rack, Bradston	Hurricane Int'l	KAD
0025	Bookcase, Bradston	Hurricane Int'l	SHMBT
0339	Bookcase, Bradston	Hurricane Int'l	KAD
0378	Bookcase, Bradston	Hurricane Int'l	KAD
*	Bookcase, Steelcase (Quantity 5)	E&I Coop	SHMBT
1555	Buffet		

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
-----	-----	-----	-----
0294	Buffet, Bradston	Hurricane Int'l	KAD
0297	Buffet, Bradston	Hurricane Int'l	KAD
0298	Buffet, Bradston	Hurricane Int'l	KAD
0614	Buffet, Bradston	Hurricane Int'l	KHRT
0615	Buffet, Bradston	Hurricane Int'l	KHRT
0672	Buffet, Bradston	Hurricane Int'l	KHRT
0673	Buffet, Bradston	Hurricane Int'l	KHRT
0919	Buffet, Bradston	Hurricane Int'l	KAD
0718-A	Buffet, dark wood	-	KAD
0718-B	Buffet, dark wood	-	KAD
0720	Buffet, dark wood	-	KAD
0041	Buffet, dining room, #90-40, Bradston	Hurricane Int'l	SHMBT
0106	Buffet, dining room, #90-40, Bradston	Hurricane Int'l	KAD
0163	Buffet, dining room, #90-40, Bradston	Hurricane Int'l	KHRT
0388	Buffet, dining room, #90-40, Bradston	Hurricane Int'l	ELO
0396	Buffet, dining room, #90-40, Bradston	Hurricane Int'l	ELO
1006	Buffet, dining room, #90-40, Bradston	Hurricane Int'l	KAD
1556	Buffet, dining room, #90-40, Bradston	Hurricane Int'l	KHRT
1674	Buffet, dining room, #90-40, Bradston	Hurricane Int'l	KAD
1804	Cabinet for Microfiche, #841-18MF	Highsmith	SHMBT;for EO Library
1805	Cabinet for Microfiche, #841-18MF	Highsmith	SHMBT;for EO Library
1806	Cabinet for Microfiche, #841-18MF	Highsmith	SHMBT;for EO Library
1807	Cabinet for Microfiche, #841-18MF	Highsmith	SHMBT;for EO Library
1100	Cabinet, 10-drawer, toolset complete	McMasters-Carr	KHRT
1101	Cabinet, 7-drawer, toolset complete	McMasters-Carr	KHRT
0810	Cabinet, Cornell Insect		KAD
1816	Cabinet, Datavue, 10-tray (Mdl Q133-0002)	Demco, Inc.	SHMBT;for EO Library
0290	Cabinet, Insect, Cornell	Cornell	SHMBT;for EO
0810	Cabinet, Insect, Cornell	Cornell	SHMBT;for EO
1142	Cabinet, safety, 30 gal	A.M. Thomas	KAD
0806	Calculator, w/card reader, HP41C	Hewlett-Packard	KAD
1633	Calculator/card reader, HP11C	Hewlett-Packard	KAD
1547	Camera Outfit 1053D (phase 'scope H120TGPP4)	Central Pacific	At SHMBT; for GG
1548	Camera Outfit 1053D (phase 'scope H120TGPP4)	Central Pacific	At SHMBT; for ELO
1549	Camera Outfit 1053D (phase 'scope H120TGPP4)	Central Pacific	At SHMBT; for EF
0724	Camera, 50mm, w/lens, Pentax K1000	VWR	ELO
0115	Carpet	Perry & Scudder	KHT
0130	Carpet	Perry & Scudder	KHRT
0175	Carpet	Perry & Scudder	KHRT
0176	Carpet	Perry & Scudder	KHRT
0387	Carpet	Sears	KAD
0612	Carpet	Sears	KAD
0023	Carpet. Nylon	Sears	SHMBT
0024	Carpet. Nylon	Sears	SHMBT
0072	Cart, tea		SHMBT
0791	Centrifuge, bench top	Damon IEC	KAD
0077	Centrifuge, Benchton, 160 gm	Fisher	KAD
1659	Centrifuge, Clinical, Microhematocrit	Central Pacific	At SHMBT; for GG

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1660	Centrifuge, Clinical, Microhematocrit	Central Pacific	At SHMBT; for ELO
1661	Centrifuge, Clinical, Microhematocrit	Central Pacific	At SHMBT; for EF
0265	Centrifuge, Damon HNS, 230V, 50Hz	Fisher	KAD
1652	Centrifuge, HNS-11	VWR	At SHMBT; for ELO
1653	Centrifuge, HNS-11	VWR	At SHMBT; for ELO
1654	Centrifuge, HNS-11	VWR	At SHMBT; for GG
1655	Centrifuge, HNS-11	VWR	At SHMBT; for EF
1050	Centrifuge, clinical, Mdl 429	Damon IEC	KAD
0750	Chair, Brown Cushion		KAD
0124	Chair, Occasional	Perry & Scudder	KHRT
0125	Chair, Occasional	Perry & Scudder	KHRT
0126	Chair, Occasional	Perry & Scudder	KHRT
0127	Chair, Occasional	Perry & Scudder	KHRT
0128	Chair, Occasional	Perry & Scudder	KHRT
0142	Chair, Occasional	Perry & Scudder	KHRT
0186	Chair, Occasional	Perry & Scudder	KHRT
0905	Chair, Occasional	Hurricane Int'l	KAD
0605	Chair, Occasional, Bradston	Hurricane Int'l	KHRT
0606	Chair, Occasional, Bradston	Hurricane Int'l	KHRT
0607	Chair, Occasional, Bradston	Hurricane Int'l	KHRT
0657	Chair, Occasional, Bradston	Hurricane Int'l	KHRT
0658	Chair, Occasional, Bradston	Hurricane Int'l	KHRT
*	Chair, Office (Quantity 12)	E& I Coop	KHRT
1596	Chair, lounge, #1840, Bradston	Hurricane Int'l	KAD
1597	Chair, lounge, #1840, Bradston	Hurricane Int'l	KAD
1598	Chair, lounge, #1840, Bradston	Hurricane Int'l	KAD
1599	Chair, lounge, #1840, Bradston	Hurricane Int'l	KAD
1578	Chair, lounge, #1840, Bradston	Hurricane Int'l	KAD
1595	Chair, lounge, #1840, Bradston	Hurricane Int'l	KAD
0608	Chair, lounge, Bradston	Hurricane Int'l	KHRT
0609	Chair, lounge, Bradston	Hurricane Int'l	KHRT
1611	Chair, lounge, Bradston	Hurricane Int'l	KHRT
1612	Chair, lounge, Bradston	Hurricane Int'l	KHRT
1613	Chair, lounge, serp #2440, Bradston	Hurricane Int'l	KHRT
1614	Chair, lounge, serp #2440, Bradston	Hurricane Int'l	KHRT
1615	Chair, lounge, serp #2440, Bradston	Hurricane Int'l	KHRT
1616	Chair, lounge, serp #2440, Bradston	Hurricane Int'l	KHRT
0716	Chair, mustard yellow, Bradston	Hurricane	KAD
0717	Chair, mustard yellow, Bradston	Hurricane	KAD
*	Chair, occasional		
0730	Chair, occasional, Bradston	Hurricane Int'l	KAD
0737	Chair, occasional, Bradston	Hurricane Int'l	KAD
0742A	Chair, occasional, Bradston	Hurricane Int'l	KAD
0742B	Chair, occasional, Bradston	Hurricane Int'l	KAD
0749	Chair, occasional, Bradston	Hurricane Int'l	KAD
0169	Chair, occasional, green, White Craft	Perry & Scudder	KHRT
0170	Chair, occasional, green, White Craft	Perry & Scudder	KHRT
0303	Chair, occasional, green, White Craft	Perry & Scudder	KAD

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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0304	Chair, occasional, green, White Craft	Perry & Scudder	KAD
0355	Chair, occasional, white, Whitecraft	Perry & Scudder	KAD
0356	Chair, occasional, white, Whitecraft	Perry & Scudder	KAD
1903	Charger, Battery	Helbing Bros	SHMBT, for EO
1679	Charger, battery, 30 amp, 230V	McMasters-Carr	SHMBT
1680	Charger, battery, 30 amp, 230V	McMasters-Carr	KAD
0141	Chest, of drawers, Whitecraft	Perry & Scudder	SHMBT
1617	Chest, tall (high chest) #166-05, Bradston	Hurricane Int'l	SHMBT
1618	Chest, tall (high chest) #166-05, Bradston	Hurricane Int'l	SHMBT
1619	Chest, tall (high chest) #166-05, Bradston	Hurricane Int'l	SHMBT
1620	Chest, tall (high chest) #166-05, Bradston	Hurricane Int'l	SHMBT
1103	Cleaner, parts, 5 gal	McMasters-Carr	SHMBT
1656	Colorimeter, Spectronic 20	Central Pac	At SHMBT; for ELO
1657	Colorimeter, Spectronic 20	Central Pac	At SHMBT; for EF
1658	Colorimeter, Spectronic 20	Central Pac	At SHMBT; for GG
1341	Compressor, PM	Soil Moisture	ELO
1104	Compressor, sgl stage, tank mount	McMasters-Carr	KHRT
1338	Computer, IBM PC Portable	Photo & Sound	KAD
1538	Computer, IBM Portable	IBM	SHMBT; for EO
1539	Computer, IBM Portable	IBM	SHMBT; for EO
1540	Computer, IBM Portable	IBM	KAD
1541	Computer, IBM Portable	IBM	SHMBT
1180	Condensor, crude fiber (digestion)	VWR	KAD
1433	Conference Table, Boat-shaped	Steelcase	SHMBT; for EO
1434	Conference Table, Boat-shaped	Steelcase	SHMBT
0532	Container, 20ft	Arkel Int'l	SHMBT
0531	Container, 40ft	Arkel Int'l	SHMBT
*	Container, Shipping	Arkel	SHMBT
1699	Container, Shipping (Qty 2)	Arkel	SHMBT
0727	Container, metal, shipping, 20ft	Arkel Int'l	KAD
0728	Container, metal, shipping, 20ft	Arkel Int'l	KAD
0728	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
0880	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
0881	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
0882	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
0883	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
0884	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
0885	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
0886	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
0887	Container, metal, shipping, 20ft	Arkel Int'l	ELO
0888	Container, metal, shipping, 20ft	Arkel Int'l	SHMBT
1810	Controlled Environment Room (Seed Storage)	Crepcoc Inc	SHMBT; use as nec
1811	Copier, Canon Md1 PC-25	Freke & Co	SHMBT; use as nec
1812	Copier, Canon Md1 PC-25	Freke & Co	SHMBT; use as nec
1813	Copier, Canon Md1 PC-25	Freke & Co	SHMBT; use as nec
1814	Copier, Canon Md1 PC-25	Freke & Co	SHMBT; use as nec
1815	Copier, Canon Md1 PC-25	Freke & Co	SHMBT; use as nec
1816	Copier, Canon Md1 PC-25	Freke & Co	SHMBT; use as nec

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1817	Copier, Canon Mdl PC-25	Freke & Co	SHMBT; use as nec
1818	Copier, Canon Mdl PC-25	Freke & Co	SHMBT; use as nec
1819	Copier, Canon Mdl PC-25	Freke & Co	SHMBT; use as nec
1820	Copier, Canon Mdl PC-25	Freke & Co	SHMBT; use as nec
0430	Copier, photocopy, Nashua Mdl 1220S	PRC Engineering	SHMBT
0431	Copier, photocopy, Nashua Mdl 1220S	Nashua Int'l	SHMBT
1062	Copier, photocopy, Nashua Mdl 1220S	Nashua Int'l	KAD
1063	Copier, photocopy, Nashua Mdl 1220S	Nashua Int'l	SHMBT
1064	Copier, photocopy, Nashua Mdl 1220S	Nashua Int'l	SHMBT
1065	Copier, photocopy, Nashua Mdl 1220S	Nashua Int'l	SHMBT
1066	Copier, photocopy, Nashua Mdl 1220S	Nashua Int'l	KHRT
1067	Copier, photocopy, Nashua Mdl 1220S	Nashua Int'l	KHRT
1068	Copier, photocopy, Nashua Mdl 1220S	Nashua Int'l	KHRT
1700	Credenza, Steelcase		SHMBT
1303	Deminerlizer, Mdl D0805	Barnstead	KAD
0270	Deminerlizer, w/conductivity meter	VWR	KAD
0016	Desk, Bradston	Hurricane Int'l	SHMBT
0656	Desk, Bradston	Hurricane Int'l	KHRT
0735	Desk, Bradston		KAD
1621	Desk, Bradston	Hurricane Int'l	KAD
1622	Desk, Bradston	Hurricane Int'l	KHRT
1817	Desk, Steel, Economical	Highsmith	SHMBT
1646	Desk, Steelcase, Executive	Steelcase	SHMBT
1647	Desk, Steelcase, Executive	Steelcase	SHMBT
0476	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0480	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0481	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0482	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0483	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0484	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0485	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0486	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0487	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0489	Desk, executive, 36"x20", tan	E&I Coop	SHMBT
0116	Desk, w/chair, Whitecraft	Perry & Scudder	SHMBT
0120	Desk, w/chair, Whitecraft	Perry & Scudder	SHMBT
0133	Desk, w/chair, Whitecraft	Perry & Scudder	SHMBT
0182	Desk, w/chair, Whitecraft	Perry & Scudder	SHMBT
0183	Desk, w/chair, Whitecraft	Perry & Scudder	SHMBT
0190	Desk, w/chair, Whitecraft	Perry & Scudder	SHMBT
1053	Dictaphone, travel Master, Mdl 2250	Dictaphone	SHMBT
1054	Dictaphone, travel Master, Mdl 2250	Dictaphone	SHMBT
1812	Distill. apparatus, Barnstead, Mdl A1013	Barnstead	SHMBT; for EO
1813	Distill. apparatus, Barnstead, Mdl A1013	Barnstead	SHMBT; for EO
1814	Distill. apparatus, Barnstead, Mdl A1013	Barnstead	KAD
1815	Distilling Apparatus, micro-Kjeldahl	Kjeldahl	SHMBT; for EO
1816	Distilling Apparatus, micro-Kjeldahl	Kjeldahl	SHMBT; for EO
1557	Distilling apparatus, 1.9H, Barnstead	Fisher	KAD

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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0792	Distilling apparatus, 1LL/hr, Mdl 92254	Fisher	ELO
1677	Distilling apparatus, micro-Kjeldahl	A. Thomas	KAD
0906	Dresser	Hurricane Int'l	KAD
0908	Dresser	Hurricane Int'l	KAD
0619	Dresser, Bradston	Hurricane Int'l	SHMBT
0678	Dresser, Bradston	Hurricane Int'l	SHMBT
1626	Dresser, Bradston	Hurricane Int'l	SHMBT
1627	Dresser, Bradston	Hurricane Int'l	SHMBT
1623	Dresser, Bradston	Hurricane Int'l	SHMBT
1624	Dresser, Bradston	Hurricane Int'l	SHMBT
1625	Dresser, Bradston	Hurricane Int'l	SHMBT
1628	Dresser, large #166-06, Bradston	Hurricane Int'l	SHMBT
1629	Dresser, large #166-06, Bradston	Hurricane Int'l	SHMBT
1630	Dresser, large #166-06, Bradston	Hurricane Int'l	SHMBT
1575	Dresser, lt. brown, w/mirror	-	KAD
0010	Dresser, medium #166-05, Bradston	Hurricane Int'l	SHMBT
0137	Dresser, medium #166-05, Bradston	Hurricane Int'l	KHRT
1631	Dresser, medium #166-05, Bradston	Hurricane Int'l	SHMBT
1632	Dresser, medium #166-05, Bradston	Hurricane Int'l	SHMBT
0122	Dresser, w/mirror, Whitecraft	Perry & Scudder	KHT
0123	Dresser, w/mirror, Whitecraft	Perry & Scudder	KHRT
0132	Dresser, w/mirror, Whitecraft	Perry & Scudder	KHRT
0184	Dresser, w/mirror, Whitecraft	Perry & Scudder	KHRT
0185	Dresser, w/mirror, Whitecraft	Perry & Scudder	KHRT
0191	Dresser, w/mirror, Whitecraft	Perry & Scudder	KHRT
1545	Dresser, w/mirror, Whitecraft	Perry & Scudder	KHRT
1576	Dresser, white, Bradston	-	KAD
0248	Drill Press, .5hp motor, Mdl 2275	Oliver Van Horn	KAD
1172	Drill, grain	Dalton/Coop/Gates	KAD
1095	Drill, vegetable	Gen. Implements	KAD
1096	Drill, vegetable	Gen. Implements	KHRT
0022	Dryer, GE	G.E.	SHMBT
1917	Evaporation Station, Metric, mdl #110306	Weathertronics	SHMBT; for EO Lab
1344	Extractor, 15-bar, ceramic plate, Mdl 1500	Soil Moisture	ELO
0800	Extractor, 5-bar, pressure plate	Soil Moisture	ELO
1400	Feed Mill, Grinder	Meadows Co	KAD
1554	Feedmill, Wiley	Thomas	ELO
1559	Feedmill, Wiley	Thomas Scientific	KAD
*	File Cabinet, 4-drawer (Quantity 15)	E& I Coop	SHMBT
*	File Cabinet, 5-drawer (Quantity 7)	E& I Coop	SHMBT
1918	File, Cole, Flat 20" (#4332) - Library	Highsmith	SHMBT;for ELO Library
*	File, Search/Reader	Bell & Howell	SHMBT;for ELO Library
1811	File, Vertical (legal), # 60-579	Highsmith	SHMBT;for ELO Library
1812	File, Vertical (legal), # 60-579	Highsmith	SHMBT;for ELO Library
*	File, Visual	E& I Coop	SHMBT;for ELO Library
1566	File, lateral, 4 drawer #842-461, brown	E & I Coop	SHMBT;for ELO Station
1567	File, lateral, 4 drawer #842-461, brown	E & I Coop	SHMBT;for ELO Station
1568	File, lateral, 4 drawer #842-461, brown	E & I Coop	SHMBT;for ELO Station

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1569	File, lateral, 4 drawer #842-461, brown	E & I Coop	SHMBT;for ELO Station
1570	File, lateral, 4 drawer #842-461, tan	E & I Coop	SHMBT;for ELO Station
1571	File, lateral, 4 drawer #842-461, tan	E & I Coop	SHMBT;for ELO Station
0700	Filter holder, manifold Md1 1225	Curtin Matheson	KAD
1675	Freezer	GE	KAD
0151	Freezer, chest-type, 20.3cu-ft	Westinghouse	SHMBT
0296	Freezer, chest-type, 20.3cu-ft	Appliance Ovrss	KAD
0327	Freezer, chest-type, 20.3cu-ft	Appliance Ovrss	KAD
1044	Freezer, chest-type, 20.3cu-ft	Westinghouse	KAD
1153	Freezer, chest-type, 20cuft, Md1 CF-20H-25	Frigidaire	KAD
1154	Freezer, chest-type, 20cuft, Md1 CF-20H-25	Frigidaire	SHMBT
1155	Freezer, chest-type, 20cuft, Md1 CF-20H-25	Frigidaire	ELO
1156	Freezer, chest-type, 20cuft, Md1 CF-20H-25	Frigidaire	SHMBT
1157	Freezer, chest-type, 20cuft, Md1 CF-20H-25	Frigidaire	KAD
1504	Furnace, Muffle, 1500 series, Md1 FD1520 M	Central Pacific	SHMBT; for ELO
1505	Furnace, Muffle, 1500 series, Md1 FD1520 M	Central Pacific	KAD
1506	Furnace, Type 1500	VWR	SHMBT
0350	Generator	Lister	KAD
0351	Generator	Lister	KHRT
0649	Generator, Honda	Honda	KAD
0049	Generator, diesel, 12.5KVA, MDL RCF061	Kohler	SHMBT
0149	Generator, diesel, 12.5KVA, MDL RCF061	Kohler	KHRT
0199	Generator, diesel, 12.5KVA, MDL RCF061	Kohler	KHRT
0699	Generator, diesel, 12.5KVA, MDL RCF061	Kohler	KHRT
0249	Generator, diesel, 16.5KW, MDL 2DRFOP61	Kohler	KHRT
0736	Generator, elec. diesel, 10.5KW, Md1 15RFOY61	Kohler	ELO
1069	Germinator, AH temp/light seed	Seedburo	KAD
1928	Germinator, Seed	Seedboro	In PORT SUDAN;for ELO
1929	Germinator, Seed	Seedboro	In PORT SUDAN;for ELO
1577	Germinator, lt/dk minimum	Seedburo	KAD
1364	Grinder, Wiley Mill, ED5	Thomas Scientific	SHMBT;for ELO
1365	Grinder, Wiley Mill, ED5	Thomas Scientific	SHMBT;for ELO
1366	Grinder, Wiley Mill, ED5	Thomas Scientific	SHMBT;for ELO
1367	Grinder, Wiley Mill, ED5	Thomas Scientific	KAD
1360	Grinder, Wiley Mill, Intermediate	Thomas Scientific	SHMBT;for ELO
1361	Grinder, Wiley Mill, Intermediate	Thomas Scientific	KAD
1362	Grinder, Wiley Mill, Intermediate	Thomas Scientific	SHMBT;for ELO
1363	Grinder, Wiley Mill, Intermediate	Thomas Scientific	SHMBT;for ELO
1143	Grinder, Wiley mill	A.M. Thomas	KAD
0266	Grinder, cutting (soil) mill, AM Thomas	Fisher	KAD
1168	Harrow, Disc, Bog Type	Modern Inc	KAD
1350	Harrow, Disk, Blanton 10-24" blades	Dalton/Coop/Gates	KAD
1351	Harrow, Disk, Blanton 10-24" blades	Dalton/Coop/Gates	KAD
1352	Harrow, Disk, Blanton 8-24" blades	Dalton/Coop/Gates	ELO
1353	Harrow, Disk, Blanton 8-24" blades	Dalton/Coop/Gates	KAD
1175	Harrow, spike tooth	Dalton/Coop/Gates	In ELO (temp)
1359	Hoist, Hand, Cyclone, 4000 lb.	McMaster-Carr	ELO
1681	Hoist, hand, 4000lb, Cyclone	McMasters-Carr	ELO

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1339	Hotplate, L240	Pacific Scientific	ELO
1340	Hotplate, L240	Pacific Scientific	ELO
1318	Hotplate, Sybron Thermolyre 12" x 24"	Sybron Thern.	ELO
1752	Incubator, Forced Air Circulating(#31487)	Central Pac	SHMBT;for ELO
1752	Incubator, Forced Air Circulating(#31487)	Central Pac	SHMBT;for ELO
1664	Incubator, Forced Air Circulating(#31487)	Central Pac	SHMBT;for EF
1665	Incubator, Mdl 31575	Central Pacific	SHMBT;for ELO
1666	Incubator, Mdl 31575	Central Pacific	SHMBT;for GG
1107	Jack, floor, 4-ton, Blackhawk	McMaster Carr	KHRT
1114	Jack, floor, 4-ton, Blackhawk	McMaster Carr	KAD
0086	Jack, floor, H.D., 4-ton	Sears	KHRT
0243	Lathe/Spindle Machine	Oliver Van Horn	ELO
1387	Loader, Industrial with Bucket	Adams Tractor Co.	KAD
1388	Loader, Industrial with Bucket	Adams Tractor Co.	ELO
1171	Loader, fron end, Mdl 021063	Dalton/Coop/Gates	KAD
*	Loveseat, #1841, Bradston	Hurricane Int'l	KAD
*	Loveseat, #1841, Bradston	Hurricane Int'l	KAD
*	Loveseat, #1841, Bradston	Hurricane Int'l	KAD
0600	Loveseat, Bradston	Hurricane Int'l	SHMBT
0354	Loveseat, Whitecraft	Perry & Scudder	KAD
1544	Loveseat, Whitecraft		KAD
0708	Loveseat, brown/rust/white, Whitecraft	Perry & Scudder	KAD
0092	Machine, key cutting, Mdl 1327A999	McMasters-Carr	KAD
0798	Manifold, Mdl 700-123	Soil Moisture	ELO
1563	Meter, Soil Moisture #MC14C04		SHMBT, for ELO
1564	Meter, Soil Moisture #MC14C04		SHMBT, for ELO
0068	Meter, moisture, Mdl Mc-302	Pac. Scientific	ELO
1818	Microfiche Reader, Mdl MDI 935	Highsmith	SHMBT,for ELO LIBRARY
1819	Microfiche Reader, Mdl MDI 935	Highsmith	SHMBT,for ELO LIBRARY
1820	Microfiche Reader, Mdl MDI 935	Highsmith	SHMBT,for ELO LIBRARY
1821	Microfiche Reader, Mdl MDI 935	Highsmith	SHMBT,for ELO LIBRARY
1822	Microfiche Reader, Mdl MDI 935	Highsmith	SHMBT,for ELO LIBRARY
1823	Microfiche Reader, Mdl MDI 935	Highsmith	SHMBT,for ELO LIBRARY
1833	Microfilm/Fiche File-Search Reader/Printer	Bell & Howell	SHMBT,for ELO LIBRARY
1919	Micrologger Printer CR 56	Campbell Sci	SHMBT,for ELO (MekkiOmer)
1920	Micrologger, CR21 Format II	Campbell Sci	SHMBT,for ELO (MekkiOmer)
1306	Micrologger, formal II, Mdl CR21	Cambell Scient.	SHMBT,for ELO (MekkiOmer)
1162	Microscope, AO "	Am. Optical	SHMBT, for ELO Lab
1696	Microscope, AO Microstar	VWR	SHMBT for ELO
1531	Microscope, AO Microstar XH100BUA	Central Pacific	SHMBT,for GG LAB
1532	Microscope, AO Microstar XH100BUA	Central Pacific	SHMBT,for EF LAB
1533	Microscope, AO Microstar XH100BUA	Central Pacific	SHMBT,for ELO LAB
1534	Microscope, AO Microstar XH100BWA	Central Pacific	SHMBT,for ELO LAB
1535	Microscope, AO Phase contrast H120TG-PP4	Central Pacific	SHMBT,for ELO LAB
1536	Microscope, AO Phase contrast H120TG-PP4	Central Pacific	SHMBT,for ELO LAB
1537	Microscope, AO Phase contrast H120TG-PP4	Central Pacific	SHMBT,for ELO LAB
1665	Microscope, AO Sterostar Zoom	Central Pacific	SHMBT,for ELO LAB
1666	Microscope, AO Sterostar Zoom	Central Pacific	SHMBT,for ELO LAB

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1163	Microscope, AO binoc, Mdl L150BGAFW	Curtin Mathesin	KAD
1164	Microscope, AO binoc, Mdl L150BGAFW	Curtin Mathesin	KAD
1161	Microscope, AO w/illuminator (#ASP 363H)	Am. Optical	SHMBT, for ELO Lab
1165	Microscope, phase-contrast	Leitz	KAD
1160	Microscope, phase-contrast B & L	VWR	KAD
0837	Microwave Oven	Intl Appliances	ELO
1317	Microwave Oven	Intl Appliances	ELO
1167	Mower, rotary, brush cutter	Modern Inc	KAD
1372	Mower, sickle bar	Dalton/Coop/Gates	KAD
1373	Mower, sickle bar	Dalton/Coop/Gates	KAD
1174	Mower, sickle bar, Mdl 451, Sperry	Dalton/Coop/Gates	KAD
1371	Mower, sickle bar, Sperry	Dalton/Coop/Gates	KAD
1344	Neutron Probe (hydroprobe) 503-2	Campbell Pacific	ELO
0053	Nightstand		SHMBT
0134	Nightstand	Perry & Scudder	KHRT
0674	Nightstand	Hurricane Int'l	KHRT
0738	Nightstand	Hurricane	KAD
0751	Nightstand		KAD
1368	Nursery Thresher, Vogel	Bill's Welding	ELO
1667	Objective, Flauter, Phase 40X	Central Pac	SHMBT
1668	Offset Press/Copier/Duplicator, Mdl # 1330	AM Multigraphics	SHMBT; to ELO
1401	Offset Press/Copier/Duplicator, Mdl # 1330		SHMBT; to ARC Hdqtrs
1102	Outifit, welding, cutting, & heating	McMasters-Carr	KHRT
0057	Oven, 23"x21"x36", gvtv convx, Mdl L-18-4	Pac. Scientific	ELO
0058	Oven, 23"x21"x36", gvtv convx, Mdl L-18-4	Pac. Scientific	ELO
1144	Oven, 240V, Mdl 630, NAPCO	A.M. Thomas	KAD
1506	Oven, Catalog # 34791	Labline	SHMBT
1507	Oven, Catalog # 3480 M-1	Labline	SHMBT
0802	Oven, Drying	Sci Supply	KAD
0803	Oven, Drying	Sci Supply	KAD
1313	Oven, Labline Mdl. 3980M-1;	Thomas(Labline)	SHMBT
1314	Oven, Labline Mdl. 3980M-1;	Thomas(Labline)	SHMBT
1312	Oven, VWR Mdl. 3479-1; Imperial IV	Thomas(Labline)	SHMBT
1315	Oven, VWR Mdl. 3479-1; Imperial IV	Thomas(Labline)	SHMBT
1486	Oven, VWR Mdl. 3479-1; Imperial IV	VWR	SHMBT
1488	Oven, VWR Mdl. 3479-1; Imperial IV	Thomas(Labline)	SHMBT
1477	Oven, VWR Mdl. 3480M-1; Thermo Circulating	VWR	SHMBT
1487	Oven, VWR Mdl. 3480M-1; Thermo Circulating	Thomas(Labline)	SHMBT
1585	Oven, VWR Mdl. 3480M-1; Thermo Circulating	VWR	SHMBT
1586	Oven, VWR Mdl. 3480M-1; Thermo Circulating	VWR	SHMBT
0527	Oven, drying, 1333	Grieve Corp.	KAD
0399	Oven, drying, Lab Line Mdl L-C	VWR	KAD
1572	Oven, drying, large cap, Mdl 1333	Grieve Corp	KAD
0686	Pan, evaporation, class A, Mdl 6821	Weather Tronics	ELO
1826	Paraplow, Howard Rotavator 500 Series	Howard Rotavator	SHMBT; for ELO
1827	Paraplow, Howard Rotavator 500 Series	Howard Rotavator	SHMBT; for ELO
1825	Paraplow, Howard Rotavator 500 Series	Howard Rotavator	SHMBT; for KAD
1525	Ph Meters, Mini-Digital		KAD

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INV #	DESCRIPTION	MFR/VENDGR	LOCATION/ DESTINATION
1526	Ph Meters, Mini-Digital		KAD
1527	Ph Meters, Mini-Digital		KAD
1528	Ph Meters, Mini-Digital		KAD
1529	Ph Meters, Mini-Digital		KAD
1530	Ph Meters, Mini-Digital		KAD
1600	Planimeter, K&F, Paragon		SHMBT; for KAD
1377	Planter, Powell/Cole 2 row	Dalton/Coop/Gates	KAD
1378	Planter, Powell/Cole 2 row	Dalton/Coop/Gates	KAD
1379	Planter, Powell/Cole 2 row	Dalton/Coop/Gates	KAD
1176	Plow, chisel	Dalton/Coop/Gates	KAD
1374	Plow, chisel, lift type	Dalton/Coop/Gates	KAD
1375	Plow, chisel, lift type	Dalton/Coop/Gates	KAD
1376	Plow, chisel, lift type	Dalton/Coop/Gates	KAD
1177	Plow, disc	Dalton/Coop/Gates	KAD
1394	Plow, disk, Big Ox	Dalton/Coop/Gates	KAD
1395	Plow, disk, Big Ox	Dalton/Coop/Gates	KAD
1370	Post hole digger	Dalton/Coop/Gates	KAD
1169	Post hole digger, w/6" auger, Mdl PH63T	Dalton/Coop/Gates	ELO
0087	Press, bench, hydraulic, Mdl 351-22618	McMasters-Carr	SHMBT
1904	Printer, Computer, Texas Instrument Mdl 865	Prof.ComputerSys	SHMBT;for ELO
1905	Printer, Computer, Texas Instrument Mdl 865	Prof.ComputerSys	SHMBT;for ELO
1906	Printer, Computer, Texas Instrument Mdl 865	Res.Foundation	SHMBT;for KAD
1542	Printer, FX-100 (for IBM-PC)	Proline/Epson	SHMBT
1543	Printer, FX-100 (for IBM-PC)	Proline/Epson	SHMBT;for ELO
1544	Printer, FX-100 (for IBM-PC)	Proline/Epson	SHMBT;for ELO
1545	Printer, FX-100 (for IBM-PC)	Proline/Epson	SHMBT;for KAD
1546	Printer, FX-100 (for IBM-PC)	Proline/Epson	SHMBT;for KAD
1307	Printer, w/CA1600, Mdl CR56	Cambell Scient.	ELO
1824	Projector, Movie 16 MM; Elmo 16-AL	Elmo (?)	SHMBT;for ELO LIBRARY
0322	Projector, Slide, Kodak	VWR	KAD
0471	Projector, slide, Kodak Mdl AV310ZARF	VWR	ELO
1149	Projector, slide, Kodak Mdl AV310ZARF	VWR	SHMBT;for ELO LIBRARY
1921	Projector/Audio Viewer, Kodak Mdl 260	Highsmith	SHMBT;for ELO LIBRARY
0793	Pump, GCA/precision Mdl S-35	Fisher	ELO
1672	Pump, Heavy Duty, Electric		SHMBT
1640	Pump, Industrial Deluxe Hand	Thomas	SHMBT
1641	Pump, Industrial Deluxe Hand	Thomas	SHMBT
1747	Pump, Vacuum Pressure	Precision	SHMBT;for KAD (Wakeel)
1748	Pump, Vacuum Pressure	Precision	SHMBT;for GG
1749	Pump, Vacuum Pressure	Precision	SHMBT;for ELO
1750	Pump, Vacuum Pressure	Precision	SHMBT;for ELO
1751	Pump, Vacuum Pressure	Precision	SHMBT;for EF
1578	Pump, vacuum Mdl 535	Precision Sci	ELO
1145	Radio, transceiver, HF/SSB, w/power supply	Cubic Commun.	W.Med.
1301	Radio, transceiver, HF/SSB, w/power supply	Cubic Commun.	SHMBT
1305	Radio, transceiver, HF/SSB, w/power supply	Cubic Commun.	SHMBT
1323	Radio, transceiver, HF/SSB, w/power supply	Cubic Commun.	SHMBT
1324	Radio, transceiver, HF/SSB, w/power supply	Cubic Commun.	SHMBT

All Equipment >\$500, With Select <\$500

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\* < \$500

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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0510	Radio, transceiver, w/power sply, antenna	Cubic COMMUN.	ELO
0514	Radio, transceiver, w/power sply, antenna	Cubic COMMUN.	SHMBT
0516	Radio, transceiver, w/power sply, antenna	Cubic COMMUN.	GG
0520	Radio, transceiver, w/power sply, antenna	Cubic COMMUN.	KAD
0201	Range	Kentwell (LCL)	SHMBT (Guesthouse)
1670	Range, 4-Burner, Cat. # T153062	GE	KAD (1 of new "30")
1671	Range, 4-Burner, Cat. # T153062	GE	KAD (1 of new "30")
1572	Range, Cat. # T153062	GE	SHMBT;for ELO
1573	Range, Cat. # T153062	GE	SHMBT;for ELO
1574	Range, Cat. # T153062	GE	SHMBT;for ELO
1575	Range, Cat. # T153062	GE	SHMBT;for ELO
1576	Range, Cat. # T153062	GE	SHMBT;for ELO
1577	Range, Cat. # T153062	GE	SHMBT;for ELO
1578	Range, Cat. # T153062	GE	SHMBT;for ELO
1579	Range, Cat. # T153062	GE	SHMBT;for ELO
1580	Range, Cat. # T153062	GE	SHMBT;for ELO
1581	Range, Cat. # T153062	GE	SHMBT;for ELO
1582	Range, Cat. # T153062	GE	SHMBT;for ELO
1583	Range, Cat. # T153062	GE	SHMBT;for ELO
1584	Range, Cat. # T153062	GE	SHMBT;for ELO
1585	Range, Cat. # T153062	GE	SHMBT;for ELO
1586	Range, Cat. # T153062	GE	SHMBT;for ELO
1587	Range, Cat. # T153062	GE	SHMBT;for ELO
1588	Range, Cat. # T153062	GE	SHMBT;for ELO
1589	Range, Cat. # T153062	GE	SHMBT;for ELO
1590	Range, Cat. # T153062	GE	SHMBT;for ELO
1591	Range, Cat. # T153062	GE	SHMBT;for ELO
1592	Range, Cat. # T153062	GE	SHMBT;for GG
1593	Range, Cat. # T153062	GE	SHMBT;for GG
1594	Range, Cat. # T153062	GE	SHMBT;for GG
1595	Range, Cat. # T153062	GE	SHMBT;for GG
1596	Range, Cat. # T153062	GE	SHMBT;for EF
1597	Range, Cat. # T153062	GE	SHMBT;for EF
1598	Range, Cat. # T153062	GE	SHMBT;for EF
1599	Range, Cat. # T153062	GE	SHMBT;for EF
0687	Range, electric, 4-burner, 30", glass door	General Elect.	SHMBT (storage)
0740	Range, electric, 4-burner, 30", glass door	General Elect.	ELO (Expat-LA)
1673	Range, electric, 4-burner, 30", glass door	General Elect.	KAD
0284	Range, electric, 4-burner, Md1 JBS16	General Elect.	KAD (Expat-JT)
0534	Range, electric, 4-burner, Md1 JBS16	General Elect.	KAD (Expat-BM)
0579	Range, electric, 4-burner, Md1 JBS16	General Elect.	KAD (Expat-LH)
0779	Range, electric, 4-burner, Md1 JBS16	General Elect.	KAD (Expat-DC)
0928	Range, electric, 4-burner, Md1 JBS16	General Elect.	KAD (Expat-TB)
0020	Range, electric, 40", Md1 JCS66	General Elect.	SHMBT(Riyadh Guesthse)
0060	Range, electric, 40", Md1 JCS66	General Elect.	KHRT (Expat-DH)
0100	Range, electric, 40", Md1 JCS66	General Elect.	KHRT
0152	Range, electric, 40", Md1 JCS66	General Elect.	KHRT (Expat-JH)
0250	Range, electric, 40", Md1 JCS66	General Elect.	ELO (Guesthouse)

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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0324	Range, electric, 40", Mdl JCS66	General Elect.	KAD
0364	Range, electric, 40", Mdl JC366	General Elect.	KAD (Guesthouse)
0611	Range, electric, 40", Mdl JCS66	General Elect.	KHRT (Expat-HB)
1692	Range, electric, 40", Mdl JCS66	General Elect.	KAD (Expat)
0809	Recorder, Tape		SHMBT
0812	Recorder, Tape		SHMBT
1642	Refractometer, AI, Mdl 010423	American	SHMBT
1643	Refractometer, AI, Mdl 010423	American	SHMBT
1279	Refrigerator	Ariston	KAD (Guesthouse)
0659	Refrigerator, 13cu-ft	General Elect.	KHRT (expat-HB)
1738	Refrigerator, Flammable	Precision	SHMBT;for EF
1739	Refrigerator, Flammable	Precision	SHMBT;for GG
1740	Refrigerator, Flammable	Precision	SHMBT;for ELO
1741	Refrigerator, Flammable	Precision	SHMBT;for ELO
1844	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1845	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1846	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1847	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1848	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for GG
1849	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for GG
1850	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for GG
1851	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for GG
1852	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for GG
1853	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for EF
1854	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for EF
1855	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for EF
1856	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for EF
1857	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for EF
1858	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1859	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1860	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1861	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1862	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1863	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1864	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1865	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1866	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1867	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1868	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1869	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1870	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1871	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1872	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1873	Refrigerator, Kelvinator 23cu in w.freezer	Appli. Overseas	SHMBT;for ELO
1732	Refrigerator, w/ Freezer (for LABs)	Precision	SHMBT;for EF LAB
1733	Refrigerator, w/ Freezer (for LABs)	Precision	SHMBT;for ELO LAB
1734	Refrigerator, w/ Freezer (for LABs)	Precision	SHMBT;for ELO LAB
1735	Refrigerator, w/ Freezer (for LABs)	Precision	SHMBT;for ELO LAB

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1736	Refrigerator, w/ Freezer (for LABs)	Precision	SHMBT;for ELO LAB
1737	Refrigerator, w/ Freezer (for LABs)	Precision	SHMBT;for GG LAB
0160	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	KHRT (Expat-JR)
0200	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	SHMBT(Expat-guesthouse
0251	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	ELO Guesthouse
0326	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	KAD (Guesthouse)
0366	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	KAD Stores
0610	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	KHRT (Expat-JH)
0777	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	KAD (Expat-LH)
1543	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	KHRT (Expat-GO)
1693	Refrigerator/freezer, 21cuft, Mdl KNT21PME	Kelvinator	KAD
0283	Refrigerator/freezer, Mdl KNT215MEW4	Kelvinator	KAD (Expat-JT)
0286	Refrigerator/freezer, Mdl KNT215MEW4	Kelvinator	KAD (Expat)
0926	Refrigerator/freezer, Mdl KNT215MEW4	Kelvinator	KAD (Expat-DC)
1043	Refrigerator/freezer, Mdl KNT215MEW4	Kelvinator	KAD (Lab)
0050	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	ELO (Office)
0082	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	KHRT (Expat-JR)
0245	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	KAD (Stores)
0285	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	SHMBT (Storage)
0293	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	KAD (Expat-TB)
0688	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	ELO (Office)
0689	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	SHMBT (Storage)
0739	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	ELO (Expat-LA)
0890	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	KAD (Expat-TW)
1046	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	KHRT (Expat-HB)
1047	Refrigerator/frzr, Frig. Mdl FP-I-21-TJ25	Gen. Supply	KHRT (Stores)
1052	Refrigerator/frzr, frost-free, Mdl KNT21SME	Kelvinator	KHRT (Expat-DH)
1354	Ridger, Ferguson, 4 row	Dalton/Coop/Gates	KAD
1355	Ridger, Ferguson, 4 row	Dalton/Coop/Gates	KAD
0095	Safe,	Boise Cascade	SHMBT
0096	Safe,	Boise Cascade	SHMBT
0788	Sampler, w/tubes 4" dia, Mdl CW1031	Pac. Scientific	ELO
0789	Sampler, w/tubes, 3" dia, Mdl CW1030	Pac. Scientific	ELO
0709	Saw, arbor, tilting, 10", Mdl CTAS-10-3	Philippe	ELO
0710	Saw, band, 14", Mdl JBS-14	Philippe	ELO
0711	Saw, power, hack, Mdl 370	Philippe	ELO
1608	Scale 1600 lb cattle - Platform for		SHMBT;for ELO
1609	Scale 1600 lb cattle - Platform for		SHMBT;for ELO
1610	Scale 1600 lb cattle - Platform for		KAD
1694	Scale Instant Weigh Small Animal (Inv #:1611-1620)		SHMBT
1605	Scale, 1600 lb cattle		SHMBT;for ELO
1606	Scale, 1600 lb cattle		KAD
1607	Scale, 1600 lb cattle		SHMBT;for ELO
1930	Scale, Beam/Holding Pen	Farnum	KAD
0319	Scale, Ohaus Field Test, 16 kg-35 lb	Ohaus	ELO
0801	Scale, balance, HD, 20kg, Mdl 119D, Ohaus	Markson Science	KAD
0505	Scale, beam, portable, Precision Scale	NASCO West	KAD
0901	Sedan, 4-door, Malibu 1979	GM-Chevrolet	SHMBT

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1644	Sedan, Chevy Citation	GM	SHMBT
0244	Seed Cleaner, w/bagger attach., Mdl 859.1	Sears	KAD
0797	Seeder, HD, 10-bushel capacity	Sears	KAD
1170	Seeder, grass, McConnell	Dalton/Coop/Gates	KAD
0129	Set, bedroom, queensize, Whitecraft	Perry & Scudder	KHRT
0374	Set, bedroom, queensize, Whitecraft	Perry & Scudder	KAD
0117	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHT
0118	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHT
0135	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHRT
0136	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHRT
0143	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHRT
0144	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHRT
0188	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHRT
0189	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHRT
0193	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHRT
0194	Set, bedroom, twin complete, Whitecraft	Perry & Scudder	KHRT
0101	Set, dining room, Whitecraft	Perry & Scudder	KHRT
0102	Set, dining room, Whitecraft	Perry & Scudder	KHRT
0103	Set, dining room, Whitecraft	Perry & Scudder	KHRT
0104	Set, dining room, Whitecraft	Perry & Scudder	KHRT
0105	Set, dining room, Whitecraft	Perry & Scudder	KHRT
0162	Set, dining room, Whitecraft	Perry & Scudder	KHRT
0311	Set, dining room, Whitecraft	Perry & Scudder	KAD
0362	Set, dining room, Whitecraft	Perry & Scudder	KAD
0367	Set, dining room, Whitecraft (chairs)	Perry & Scudder	KAD
0373	Set, dining room, Whitecraft (chairs)	Perry & Scudder	KAD
0107	Set, living room, Whitecraft	Perry & Scudder	KHT
0353	Set, living room, Whitecraft	Perry & Scudder	KAD
0666	Set, living room, Whitecraft	Perry & Scudder	KHRT
0836	Set, living room, Whitecraft	Perry & Scudder	KAD
1202	Set, living room, Whitecraft	Perry & Scudder	KAD
1558	Set, living room, Whitecraft	Perry & Scudder	ELO
1688	Set, living room, Whitecraft	Perry & Scudder	KHRT
0748	Set, living room, Whitecraft (orange sofa)	Perry & Scudder	KAD
0046	Set, pipe threading, 1/8" to 2", Rigid	McMasters-Carr	SHMBT
0722	Set, socket, 3/4" drive, 24 pcs	McMasters-Carr	SHMBT
1131	Shaker, 8-flask, Burell	A.M. Thomas	KAD
0056	Shaker, sieve, Ro-tap, Mdl CL-309-8	Pac. Scientific	ELO
1304	Shaker, wrist action, Labline	VWR	KAD
0795	Shaker, wrist action, w/4 sidearms & clamps	VWR/Labline	ELO
0639	Shelving, Library	Gaylord	KAD
0640	Shelving, Library	Gaylord	KAD
0641	Shelving, Periodical Display	Gaylord	KAD
1012	Sofa	Hurricane Int'l	KAD
0174	Sofa set, living room, Whitecraft	Perry & Scudder	KHRT
0538	Sofa, Bradston	Hurricane Int'l	KAD
0601	Sofa, Bradston	Hurricane Int'l	KHRT
0601B	Sofa, Bradston	Hurricane Int'l	KHRT

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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0748B	Sofa, Bradston	Hurricane Int'l	KAD
0902	Sofa, Bradston	Hurricane Int'l	KAD
1689	Sofa, Bradston	Hurricane Int'l	KAD
0707	Sofa, brown/rust/white, Whitecraft	Perry & Scudder	KAD
1012	Sofa, serp #2439, Bradston	Hurricane Int'l	SHMBT
1542	Sofa, serp #2439, Bradston	Hurricane Int'l	SHMBT
1668	Soil Moisture Meter, 3252S10 M14C04	Thomas	ELO
1669	Soil Moisture Meter, 3252S10 M14C04	Thomas	ELO
1670	Soil Moisture Temperature Meter Mdl MC 302	SoilTest	SHMBT;for ELO Lab
0269	Spectrophotometer, Bausch & Lomb Mdl 20	Fisher	KAD
1132	Spectrophotometer, outfit, for B&L Mdl 20	A.M. Thomas	KAD
1181	Spectrophotometer, photometric B&L Mdl 710	Fisher	KAD
1834	Spiral Binding Machine, NSC DUO III	Kershaws	SHMBT;for ELO LIBRARY
1835	Spiral Binding Machine, NSC DUO III	Kershaws	SHMBT;for ELO LIBRARY
1519	Sprectrophotometer, Spectronic 20	Central Pacific	for ELO Lab
1520	Sprectrophotomster, Spectronic 20	Central Pacific	for GG Lab
1521	Sprectrophotometer, Spectronic 20	Central Pacific	for EF Lab
1115	Stand, tire changing, Coats	McMasters-Carr	KAD
1466	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for ELO
1467	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for EF
1476	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for ELO
1479	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for ELO
1482	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for GG
1483	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for ELO
1485	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for ELO
1491	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for GG
1494	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for ELO
1497	Storage Cabinet, Acid-Proof, #56610-458	VWR	SHMBT;for EF
1470	Storage Cabinet, Acid-Proof, #56610458	VWR	SHMBT;for EF
1468	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for EF
1469	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for ELO
1472	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for GG
1473	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for EF
1474	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for ELO
1475	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for ELO
1480	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for ELO
1481	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for GG
1489	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for ELO
1490	Storage Cabinet, Fire-Proof, #56610-200	VWR	SHMBT;for ELO
1471	Storage Cabinet, Fire-Proof, #56610-254	VWR	SHMBT;for ELO
1478	Storage Cabinet, Fire-Proof, #56610-254	VWR	SHMBT;for ELO
1484	Storage Cabinet, Fire-Proof, #56610-254	VWR	SHMBT;for EF
1492	Storage Cabinet, Fire-Proof, #56610-254	VWR	SHMBT;for ELO
1493	Storage Cabinet, Fire-Proof, #56610-254	VWR	SHMBT;for ELO
1495	Storage Cabinet, Fire-Proof, #56610-254	VWR	SHMBT;for GG
1496	Storage Cabinet, Fire-Proof, #56610-254	VWR	SHMBT;for GG
1498	Storage Cabinet, Fire-Proof, #56610-254	VWR	SHMBT;for EF
1730	TS Meter, Cat. # 15745-015	VWR	SHMBT;for ELO LAB

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1583	TS Meter, Cat. # 15745-015	VWR	SHMBT;for ELO LAB
1584	TS Meter, Cat. # 15745-015	VWR	SHMBT;for ELO LAB
0467	Table, Conference	Steelcase	SHMBT
0492	Table, Conference	Steelcase	SHMET
0493	Table, Conference	Steelcase	SHMBT
0494	Table, Conference	Steelcase	SHMBT
0495	Table, Conference	Steelcase	SHMBT
1433	Table, Conference, Boat	E&I Coop	SHMBT
1434	Table, Conference, Boat	E&I Coop	SHMBT
1573	Table, Dining		SHMBT
0357	Table, Night		KAD
1690	Table, coffee #2454, Bradstone	Hurricane Int'l	SHMBT
1691	Table, coffee #2454, Bradstone	Hurricane Int'l	SHMBT
1574	Table, dining, 2 leaves, dark wood	-	KAD
0066	Table, dining, 8-place, Bradstone	Hurricane Int'l	SHMBT
0158	Table, dining, 8-place, Bradstone	Hurricane Int'l	SHMBT
0613	Table, dining, 8-place, Bradstone	Hurricane Int'l	SHMBT
0675	Table, dining, 8-place, Bradstone	Hurricane Int'l	SHMBT
1018	Table, dining, 8-place, Bradstone	Hurricane Int'l	KAD
0361	Table, dining, 8-seat, #51-23, w/chairs	Hurricane Int'l	ELO
0734	Table, dining, 8-seat, #51-23, w/chairs	Hurricane Int'l	ELO
0920	Table, dining, 8-seat, #51-23, w/chairs	Hurricane Int'l	KHRT
0602	Table, end	Hurricane Int'l	KHRT
0603	Table, end	Hurricane Int'l	SHMBT
0721	Tap & die set, O.K. Junior	McMasters-Carr	KHRT
1603	Tent, #35674		SHMBT
1604	Tent, #35674		SHMBT
1097	Tent, lodge, Riverside Eureka, 9'x12'	Johnson Camping	KAD
1098	Tent, lodge, Riverside Eureka, 9'x12'	Johnson Camping	KAD
1099	Tent, lodge, Riverside Eureka, 9'x12'	Johnson Camping	KAD
1368	Thresher, Vogel Nursery	Bill's Welding	KAD
1697	Thresher, Vogel Nursery	Bill's Welding	KAD
1698	Thresher, Vogel Nursery	Bill's Welding	ELO
0426	Thresher, nursey	Bill's Welding	KAD
0427	Thresher, nursey	Bill's Welding	KAD
1562	Tool Set, 15 Piece		SHMBT
1561	Tool Set, 45 Piece		SHMBT
1560	Tool Set, 62 Piece		SHMBT
1110	Tool box, 60"x30"x48", complete	McMasters-Carr	SHMBT
1384	Tractor, Ford 70-80 HP	Adams Tractor	ELO
1385	Tractor, Ford 70-80 HP	Adams Tractor	KAD
1386	Tractor, Ford 70-80 HP	Adams Tractor	SHMBT
1147	Tractor, farm Mdl 265	Massey-Ferguson	KAD
1148	Tractor, farm Mdl 265	Massey-Ferguson	ELO
1389	Trailer dump bed, tilt	Dalton/Coop/Gates	SHMBT
1390	Trailer dump bed, tilt	Dalton/Coop/Gates	ELO
1391	Trailer dump bed, tilt	Dalton/Coop/Gates	ELO
1392	Trailer dump bed, tilt	Dalton/Coop/Gates	KAD

INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1393	Trailer dump bed, tilt	Dalton/Coop/Gates	ELO
1173	Trailer, dump bed, tilt	Dalton/Coop/Gates	KAD
1076	Trailer, water tank, 700 gal	USAID	KAD
1396	Trailer, water, Dalton/Knowles	Dalton/Coop/Gates	ELO
1397	Trailer, water, Dalton/Knowles	Dalton/Coop/Gates	ELO
1398	Trailer, water, Dalton/Knowles	Dalton/Coop/Gates	ELO
1399	Trailer, water, Dalton/Knowles	Dalton/Coop/Gates	KAD
1133	Transformer, regulating	A.M. Thomas	SHMBT
1134	Transformer, regulating	A.M. Thomas	SHMBT
0785	Transit, construction, w/tripod	Keuffek & Esser	KAD
0828	Truck PU, 2 wheel drive, F250 1982	Ford	SHMBT
0804	Truck PU, 2 wheel drive, F252 1982	Ford	KAD
0813	Truck PU, 2 wheel drive, F252 1982	Ford	KHRT
0823	Truck PU, 2 wheel drive, F252 1982	Ford	SHMBT
0825	Truck PU, 2 wheel drive, F252 1982	Ford	SHMBT
0941	Truck, HD, diesel, F800, 1982	Ford	KAD
0942	Truck, HD, diesel, F800, 1982	Ford	SHMBT
0943	Truck, HD, diesel, F800, 1982	Ford	KAD
0944	Truck, HD, diesel, F800, 1982	Ford	SHMBT
0945	Truck, HD, diesel, F800, 1982	Ford	SHMBT
0946	Truck, HD, diesel, F800, 1982	Ford	SHMBT
0518	Truck, PU, 2 wheel drive, F250, 1981	Ford	ELO
0921	Truck, PU, 2 wheel drive, F250, 1981	Ford	KHRT
1634	Truck, PU, 2 wheel drive, F250, 1981	Ford	SHMBT
1635	Truck, PU, 2 wheel drive, F250, 1981	Ford	KAD
0914	Truck, PU, 4 wh-dr, supercab, F250, 1981	Ford	KAD
0915	Truck, PU, 4 wh-dr, supercab, F250, 1981	Ford	SHMBT
1636	Truck, PU, 4 wh-dr, supercab, F250, 1981	Ford	SHMBT
1328	Truck, PU, 4 wheel drive	-	SHMBT
1329	Truck, PU, 4 wheel drive	-	SHMBT
1330	Truck, PU, 4 wheel drive	-	SHMBT
1331	Truck, PU, 4 wheel drive	-	SHMBT
1332	Truck, PU, 4 wheel drive	-	SHMBT
1333	Truck, PU, 4 wheel drive	-	SHMBT
1334	Truck, PU, 4 wheel drive	-	SHMBT
1335	Truck, PU, 4 wheel drive	-	SHMBT
1336	Truck, PU, 4 wheel drive	-	SHMBT
1337	Truck, PU, 4 wheel drive	-	SHMBT
0701	Truck, PU, 4 wheel drive, F250, 1980	Ford	KAD
0702	Truck, PU, 4 wheel drive, F250, 1980	Ford	GG
0094	Truck, PU, 4 wheel drive, F250, 1981	Ford	KAD
0830	Truck, PU, 4 wheel drive, F250, 1981	Ford	ELO
0911	Truck, PU, 4 wheel drive, F250, 1981	Ford	KAD
0912	Truck, PU, 4 wheel drive, F250, 1981	Ford	KAD
0093	Truck, PU, 4 wheel drive, F250, 1982	Ford	KAD
0812	Truck, PU, 4 wheel drive, F250, 1982	Ford	ELO
0815	Truck, PU, 4 wheel drive, F250, 1982	Ford	KAD
0816	Truck, PU, 4 wheel drive, F250, 1982	Ford	KAD

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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0817	Truck, PU, 4 wheel drive, F250, 1982	Ford	ELO
0818	Truck, PU, 4 wheel drive, F250, 1982	Ford	ELO
0819	Truck, PU, 4 wheel drive, F250, 1982	Ford	ELO
0820	Truck, PU, 4 wheel drive, F250, 1982	Ford	KAD
0821	Truck, PU, 4 wheel drive, F250, 1982	Ford	ELO
0822	Truck, PU, 4 wheel drive, F250, 1982	Ford	KAD
0824	Truck, PU, 4 wheel drive, F250, 1982	Ford	KAD
0826	Truck, PU, 4 wheel drive, F250, 1982	Ford	ELO
0827	Truck, PU, 4 wheel drive, F250, 1982	Ford	SHMBT
1590	Truck, PU, 4 wheel drive, F250, 1982	Ford	KAD
1179	Truck, PU, F252	Ford	KHRT
0702	Truck, PU, w wheel drive F250, 1980	Ford	ELO
0054	Truck, Pickup, 2 wheel drive, F250, 1981	Ford	ELO
1695	Truck, pickup, Ford 250 2WD, 1981	Ford	ELO
0440	Typewriter	Olivetti	KHRT
1082	Typewriter		KAD
1086	Typewriter		KAD
0499	Typewriter, Electric	Olympia	KAD
0731	Typewriter, Manual	Smith Corona	ARC
0787	Typewriter, SC Manual	Smith Corona	SHMBT
0419	Typewriter, electric 16" carriage	Facit	SHMBT
0409	Typewriter, electric 220 V	ORC Engineering	KRT
0044	Typewriter, elite, manual, 15" carriage	Mdrn Offc Equip	KAD
0407	Typewriter, elite, manual, 15" carriage	Mdrn Offc Equip	KHRT
0412	Typewriter, elite, manual, 15" carriage	Mdrn Offc Equip	KHRT
0419	Typewriter, elite, manual, 15" carriage	Mdrn Offc Equip	KAD
0424	Typewriter, elite, manual, 15" carriage	Mdrn Offc Equip	KHRT
0450	Typewriter, elite, manual, 15" carriage	Mdrn Offc Equip	KHRT
0272	Typewriter, selectric III	IBM	KAD
0275	Typewriter, selectric III	IBM	KHRT
0276	Typewriter, selectric III	IBM	KHRT
0277	Typewriter, selectric III	IBM	KHRT
0278	Typewriter, selectric III	IBM	KAD
0279	Typewriter, selectric III	IBM	KHRT
0280	Typewriter, selectric III	IBM	ELO
0648	Typewriter, selectric III	IBM	KHRT
1122	Vacuum, wet/dry	McMaster-Carr	SHMBT
1123	Vacuum, wet/dry	McMaster-Carr	KAD
1112	Vacuum, wet/dry, Erie steel Mdl 462	McMasters-Carr	KHRT
1113	Vacuum, wet/dry, Erie steel Mdl 462	McMasters-Carr	KAD
0804	Van, 12-pass, Club, E150, 1982	Ford	ELO
0829	Van, 12-pass, Club, E150, 1982	Ford	SHMBT
0913	Van, 12-pass, Club, E250, 1981	Ford	KAD
0921	Van, 12-pass, Club, E250, 1981	Ford	SHMBT
1572	Van, 12-pass, Club, E250, 1981	Ford	ELO
1809	Van, Chevrolet Suburban, 1985	Chevrolet	SHMBT
1813	Van, Chevrolet Suburban, 1985	Chevrolet	SHMBT
0833	Veternry unit, w/refrig unit, fr Ford PU	Bowie Mfr co.	KAD

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INV #	DESCRIPTION	MFR/VENDOR	LOCATION/ DESTINATION
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1923	Video Camera, JVC, Md1 KCR-4921	Photo & Sound	SHAMBT;for ELO LIBRARY
1924	Video Cassette Recorder, Md1 NV-9200E	Photo & Sound	SHAMBT;for ELO LIBRARY
1925	Video Cassette Storage Cabinet, # 1060	Photo & Sound	SHAMBT;for ELO LIBRARY
1926	Video Color Monitor, Panasonic Md1 CT-2000M	Photo & Sound	SHAMBT;for ELO LIBRARY
1927	Video Color Monitor, Portable JVC Md1 TM-22U	Photo & Sound	SHAMBT;for ELO LIBRARY
0059	Voltage Stabilizer		SHMBT
0149A	Voltage Stabilizer		SHMBT
0699A	Voltage Stabilizer		SHMBT
099A	Voltage Stabilizer		SHMBT
0221	Washer		SHMBT
1591	Washer, Automatic	G.E.	SHMBT
1592	Washer, Automatic	GE	KAD
1593	Washer, Automatic	GE	KAD
1594	Washer, Automatic	GE	KAD
0565	Washer, automatic, filter-flow Md1 WWA5412	G.E.	KHRT
0737	Washer, automatic, filter-flow Md1 WWA5412	G.E.	ELO
0927	Washer, automatic, filter-flow Md1 WWA5412	G.E.	KAD
0021	Washer, electric, filter-flow Md1 WWA5412	G.E.	SHMBT
0084	Washer, electric, filter-flow Md1 WWA5412	G.E.	KHRT
0085	Washer, electric, filter-flow Md1 WWA5412	G.E.	KAD
0121	Washer, electric, filter-flow Md1 WWA5412	G.E.	KHT
0161	Washer, electric, filter-flow Md1 WWA5412	G.E.	KHRT
0252	Washer, electric, filter-flow Md1 WWA5412	G.E.	ELO
0295	Washer, electric, filter-flow Md1 WWA5412	G.E.	KAD
0321	Washer, electric, filter-flow Md1 WWA5412	G.E.	KAD
0533	Washer, electric, filter-flow Md1 WWA5412	G.E.	KAD
0621	Washer, electric, filter-flow Md1 WWA5412	G.E.	KHRT
0661	Washer, electric, filter-flow Md1 WWA5412	G.E.	KHRT
0691	Washer, electric, filter-flow Md1 WWA5412	G.E.	SHMBT
0692	Washer, electric, filter-flow Md1 WWA5412	G.E.	SHMBT
0693	Washer, electric, filter-flow Md1 WWA5412	G.E.	SHMBT
1874	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1875	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1876	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1877	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1878	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1379	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1880	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1881	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1882	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1883	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1884	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1885	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1886	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1887	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1888	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1889	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO
1890	Washing Machine, GE, 18 lb cap.	Appli. Overseas	SHMBT;for ELO

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## APPENDIX X

### LISTING OF PROCURED LIBRARY MATERIALS

Title .....	Author .....	Publisher .....	Date .....	Loc. .....	# Copies .....
A Guide to sorghum breeding 2nd ed.	House, Leland R.	ICRISAT		WSU	5
Abridged Dewey Decimal Classifca...		Forest Press		KRT	2
Abridged Dewey Decimal Classifca...		Forest Press		KRT	1
Adapt. of Plants to Water/H. Temp	Turner & Kramer, ed.	Wiley Prof. Books		EO	
Adoption of Ag. innovations in Dev.	Feder, Gersgon	World Bank Pubns	81	EO	1
Advances in Agricultural Microbbio.	N.S. Subba Rao.	Butterworth Academic P	82	EO	1
Advances in Desert & Arid Land Tech.	Intl. Conf. on the	Scientific & Tech. B	79	EO	1
Advances in Infiltration	Paper series	Am.Soc.Ag.Eng.	84	KRT	1
Advances in Legume Science	Summerfield	Royal Bot.Gardens	84	EO	1
Advances in Legume Systematics	Polyhill	Sabbot Nat'l History	83	EO	1
African Callipe	Haagland	Random House	79	WSU	1
African Experi w/ Rural Dev: A Rept	Rachel Weaving	Nat'l Tech Info Svc			1
African Personality		UNIPUB	80	KRT	2
Ag Mono#9,Pti-2,Meth Soil Analysis		ASA,CSSA,SSSA Hdqtr			1
Ag. Compendium for Rural Dev...	B.V. Ila-, ed.	Elsevier Scientific	81	EO	1
Ag. Dev. Projects & Small Farmer ..	Lappia	Uni Microfilm Int'l	79	KRT	1
Ag. Engineers' Handbook	Richéy, C.B., etal	McGraw	61	EO	1
Ag. Experimentation: Design & Analy.	?	John Wiley & Sons	78	EO	1
Agr Sector Planning Model: A Summary	A.C. Egbert	Nat'l Tech Info Svc			1
Agr. Field Experiment: Stat. Examin.	Pearce	Wiley Prof. Books		EO	1
Agr. Math. for PCV'S		NTIS		KRT	1
Agr. Project Analysis: Case Studies	World Bank	ILS	79	WSU	1
Agr. Res. & Tech. in Ec. Dev.	Pinstrup-Anderson	Longman, Inc.		KRT	1
Agr. Research & Productivity	Evenson & Kislev	Yale Univ. Press		KRT	1
Agr. Research & Productivity	Evenson & Kislev	Yale Univ. Press		KRT	1
Agr. in Semi-Arid Environments		Springer-Verlog		KRT	1
Agrarian Reform as Unfinished Bus.	L. J. Walinsky, ed.	Oxford Uni. Press	77	KRT	1
Agri. Ext.: The Training & Visit Sys.	Benor, Daniel	World Bank Pubns	84	EO	1
Agricultural Botany	Gill, Norman Thorpe	Gerald Duckworth	80	EO	1
Agricultural Botany	Gill, Norman T.	Gerald Duckworth	80	EO	1
Agricultural Decision Analysis	Anderson, JOck R.	Iowa State U Press	77	EO	1
Agricultural Development & Econ...	Southworth, H.M.	Cornell U. Press	67	KAD	1
Agricultural Ecology: An Analysis	Cox & Atkins	W. M. Freeman & Co.	79	KRT	1
Agricultural Economics	Goodwin/Drummond	Reston Pub. Co.	81	EO	1
Agricultural Research Policy	Ruttan	U of Minn Press	82	KRT	2
Agricultural Research Policy	Ruttan	U of Minn Press	82		1
Agriculture in Dev. Theory	Reynolds, Boyd G.	LE U. Press	75	EO	1
Agriculture in Development Theory	Reynolds, LLOYDD	Le U. Press	75	KAD	1
Agriculture in the 3rd World:...	Morgan	Westview Press	78	KRT	1
Agroclimate Information for Dev.	Cusack, ed.	Westview Press	83	KRT/WSU	2
Agroclimatology Survey Proceed.		WHO-UNIPUP	71	KRT	1
Agroclimatology Survey S. of Sahara		WHO-UNIPUP		KRT	1
Agronomy of Major Tropical Crops	Williams, C.	Oxford U. Press	82	EO	1
Aims & Methods of Vegetation Ecology	Mueller-Dombois	John Wiley & Sons	84	ALL	5
Aims and Methods of Veg. Ecology	Mueller-Dombois	John Wiley & Sons	74	KAD	1

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Title	Author	Publisher	Date	Loc.	# Copies
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An Analysis of Population Growth...	Lynam	Uni Microfilm Int'l	78	KRT	1
An Issues Paper-by Food Study Group		UNIPUP		KRT	1
Anatomy of Seed Plants	Esau, Katherine	John Wiley & Sons	77	EO	1
Anatomy & Physiology of Farm Animals	Frandsen, R.	Lea & Febiger	81	EO	1
Animal Agriculture:	Pond, ed.	Westview Press	80	KRT/WSU	2
Animal Feeding & Nutrition	Jurgens, R.	WC Brown	82	EO	1
Animal Feeding & Production: New Tech.		OECD	81	EO	1
Animal Genetics		John Wiley & Sons	82	EO	1
Animal Nutrition	Maynard, A. et al	McGraw	79	EO	1
Animal Nutrition	Lassiter, James	Simon & Schuster	82	EO	1
Animal Reproduction: Papers	Hawk, Harold W.	John Wiley & Sons	79	EO	1
Animal Traction		P.D. Press		KAD/KRT	2
Animal Traction in E Upper Volta...		MSU Int'l Dev Press		KRT/WSU	3
Animals, Feed, Food & People	Baldwin, ed	Westview Press	80	KRT	1
Animals, Feed, Food & People:	Baldwin, ed	Westview Press	80	KRT/WSU	3
Application of Remote Sensing Tech.		Unipub	77	EO	1
Applications of Soil Physics	Hillel, Daniel	Academic Press	80	EO	1
Applied Animal Nutrition	Crampton, E.W.	W.H. Freeman	69	EO	1
Applied Climatology: A Study	Hobbs, John E.	Westview Press	80	EO	1
Applied Soil Trace Elements	Davies, Brian, ed.	John Wiley & Sons	80	EO	1
Appropriate Sanitation Alternatives	Kalbe, John M.	John Hopkins U. Press	82	EO	1
Aquaculture Dev. in Less Dev. Count.	Westview Spec.Studies	Westview Press	82	EO	1
Arid Lands in Transition	Dregne	Uni. Microfilms	70	KRT	1
Azolla as a Green Manure:	Lumpkin & Plucknett	Westview Press	81	KRT/WSU	2
Bananas	Simmonds, Norman	Longman, Inc.	82	EO	1
Bedouins, Wealth, and Changes...		UNIPUB	80	KRT	1
Beef Cattle	Neumann, Alvin	John Wiley & Sons	77	EO	1
Beef Cattle Feed & Nutrition	Perry	Academic Press		KAD	1
Beef Cattle Science	Enshinger	Interstate		KRT	1
Beef Cattle Science Handbook #19	Baker, ed.	Westview Press	83	KAD	1
Bib. On Moisture Utilization ...		U.C. Riverside		KRT	1
Biblio on Crop-Animal Systems	Fitzhugh, et al, ed	Winrock Intl	82	KRT	2
Bio Nitrogen Fixation: Tech for...		Publications CIAT	81	KRT	1
Bio. Nitrogen Fixation in Farming Sys	Ayana, A.	John Wiley & Sons	77	EO	1
Bio. of Parasitic Flowering Plants	Kvijt	U.C. Berkley	69	KRT	1
Biol. & Fix in Farming Systems	Ayanaba & Darts	Wiley			1
Biol. N-fixation Technology	Graham & Harris	CIAT		KRT	1
Biol. of the Arthropod Cuticle	Neville, A.C.	Berlin-Springer Verlag	75	KRT	1
Biological Control	Huffaker, C.B.	Plenum Pub	74	EO	1
Biology & Ecology of Weeds	Holzenr & Numata, ed	The Hagve, Netherlan		KRT	
Biology & utilization of Grasses	Younger, V. B.	Academic Press	72	EO	1
Biology of Conidial Fungi V.1	Cole, Gary, ed.	Academic Press	81	EO	1
Biology of Conidial Fungi, V. 2	Cole, Garry, ed.	Academic Press	81	EO	1
Biology of Parasitic...Plants	N/A	N/A		EO	1
Biology of the Arthropod Cuticle	Neville, A.C.	Springer Verlag	75	EO	1

Title .....	Author .....	Publisher .....	Date .....	Loc. .....	# Copies .....
Body Service Manual ST 335-79	Chevrolet	Helm Publishing	79	KRT	1
Botany: An introduction to Plant Bio.	T. Elliot Weier, etal	John Wiley & Sons	82	EO	1
Breeding Field Crops	Poehlman, John	AVI	79	EO	1
Breeding Plants Resistant to Insects	Fowden, G. Maxwell	John Wiley & Sons	80	EO	1
Breeding Plants for Diseases Resist.		Penn. State U. Press	73	EO	1
Breeding Plants for Less Fav. Env.	Christiansen etc.ed	Wiley Prof. Books		EO	1
Building Construction Handbook	Merritt	McGraw-Hill		KRT	1
Cambridge Controversies: Capital	Harcourt, G.	Cambridge U. Press	72	EO	1
Camel, The	Wilson, R.T.	Longman Inc.	84	KRT	1
Camel, The	Gauthier-Pilters etc	U. of Chicago	81	KRT	1
Cattle Management	May, Cheryl	Simon & Schuster	81	EO	1
Cereal Produc: Proceedings	Gallagher, E.J.	Butterworth Academic P	84	EO	1
Characterization of Soils...	Greenland, D.	Oxford U. Pr., NY	81	EO	1
Chemistry in the Soil Environment	Stelly, M., ed.	Am. Soc. of Agronomy	81	EO	1
Chemistry of Irrigated Soils	Levy, Rachel, ed.	VanNostrandReinhold	84	EO	1
Citrus Industry	Reuthe, W., ed.	U Cal Berk Agri Pbuns	78	EO	1
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Citrus Industry v.3	Reuther, Walter	U CA Agriculture & Nat	73	EO	1
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Reclamation/Disturbed Lands:	Proceedings/Symposium	Soc of Agronomy	78	EO	1
Redesigning Rural Development:	Johnston & Clark	Johns Hopkins	82		2
Renewable Energy Resources & Rural..	Brown, ed.	Westview Press	78	KRT/WSU	2
Research Meth. in Weed Science		S. Weed Society	77	KAD	1
Research on Ag Dev-Subsaharan Africa		MSU Int'l Dev Press		KRT/WSU	3
Research on Crop-Animal Systems		Winrock	82	KRT	1
Research on Crop-Animal Systems	Fitzhugh, et al, ed.	Winrock	82		2
Research on Crop-Animal Systems		Winrock	82	WSU	1
Resource & Env. Economics	Fisher	Cambridge U. Press		KAD	1
Resources for Dev.: Org. & Pbu.		NTIS		KRT	1
Review of Physiological Chemistry	Harper, H.A; Ed.			KRT	1
Risk, Uncertainty & Ag Development	Roumasset, et al	Ag Dev Council			2
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Sample Survey Methods & Theory	Hansen, M.	John Wiley & Sons	83	EO	1
Sample Survey Methods & Theory	Hansen, M.	John Wiley & Sons	83	EO	1
Sampling Methods-Census & Surveys	Yates	MacMillan	60		1
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Selenium in Nutrition		Nat Academy Press		KAD	1
Sexual Stratification:	Schlegel	Columbia U Press	77	KAD	1
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Sheep and Goats in Developing...		The World Bank			5
Simulation Study of Constraints..		MSU Int'l Dev Press		KRT/WSU	3

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Small Farm Development	Harwood	Westview Press	79		4
Small Farm Development:	Harwood	Westview Press	79	KRT	1
Soc. & Env. Apects of Desertifica		UNIPUB	80	KRT	1
Social & Tech Manag in Dry Lands:	Gonzalez	Westview Press	78	KRT/WSU	3
Social Change & Internal Migration		UNIPUB		WSU	1
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Social Env. & Daily Routine-Sudanese	Ismael	Dietrich Reimber	82		1
Socioeconomic Constraints to Dev.		ICRISAT	79	?	1
Soil & Water Conservation Eng.	Schwab, Glenn O.	John Wiley & Sons	81	EO	1
Soil Conservation	Hudson, Norman	Cornell U. press	81	EO	1
Soil Conservation/Man.in the Tropics	Greenland, D.J., ed.	John Wiley & Sons	77	EO	1
Soil Erosion/Conservation in Tropics				EO	1
Soil Fertility & Fertilizers	Tisdale, S.L.,Et	MacMillan Pub.	85	EO	1
Soil Physcial Properties & Crop Prop	Lal & Greenland	John Wiley	79		2
Soil Science: Principles & Practice	Hausenbuiller	C. Brown	78	EO	1
Soil Water		Am Soc of Agronomy	72	EO	1
Soil and Water Conservation Eng.	Schwab/Freuert	John Wiley	81	KRT	1
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Sorghum Insect Id Handbook	N/A	N/A		EO	1
Soya Bean and Weather		WMO-UNIPUB		KRT	1
Sprinkler Irrigation:Equip & Prac.	Kay, Melvyn	David & Charles Inc	83	EO	1
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Statistical Proc. for Ag.Res.	Gomez	Wiley & Sons		KRT	6
Statistical Procedures - Rice		IRRI	76	KRT	1
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Status of...Horticultural Crops	N/A	Am Soc Agri Engrs	84	EO	1
Stnd. Handbook for Civ. Eng.	Merrit	McGraw-Hill		KRT	1
Striga Ident. & Control Handbook	Ramaiah & Musselman	ICRISAT		KRT	5
Structure & Dev. of Meat Animals	Swatland, H.	Simon & Schuster	84	EO	1
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Successful Seed Programs:	Douglas	Westview Press	80	KRT	1
Sudan Area Handbook		Gov Printing Office		KRT/WSU	10
Sudan: Proposals for Grazing Land		UNIPUB		KRT	1
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Supp. 2nd Int. Sym Weeds	Worsham, ed.	NCSU-Raleigh	81	KRT	1
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Systematic Maint. Organization	Priel, Victor	MacDonald & Evans		KRT	1
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Technique of Research in Range-...	Harris/Lofgreen	Utah Ag Exp Station	67	KAD	1
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The Origin&Early Cult.Sorghum Africa	Mann, J.A.	Texas Ag.Exp.Stat.	83	KRT	10
The Science of Animal Husbandry	Blakely, James	Simon & Schuster	85	EO	1
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Training for Agricultureal & Rural Dev.		unipub	81	EO	1
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Tribal Peoples and Econ. Dev.: Human	Goodland, R.	World Bank Pubns	82	EO	1
Trickle Irrigation	Paper Series	Am.Soc.Ag.Eng	85	KRT	1
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Tropics in General and Africa		USAID	75	KRT	2
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Truck Shop Manual 365-326-80A&B	Ford	Helm Publishing	80	KRT	1
Truck Shop Manual 365-329-81A&B	Ford	Helm Publishing	81	KRT	1
Understanding Africa	Murphy	Thomas & Crowell Co.	78	WSU	1
Understanding Crop Production	Stoskopf, Neal C.	Simon & Schuster	81	EO	1
Understanding Nutrition	Whitney/Hamilton			KRT	1
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Vegetable Diseases & their Control	Chopp, C.	John Wiley & Sons	60	EO	1
Vegetation & Soils: A World Pic.	Eyre	Aldine Pub. Co.	63	KRT	1
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Weather, Climate & Human Settlement		WMO-UNIPUB		KRT	1
Weed Control Handbook, 1984		Ag Consultant Pub	84		2
Weed Science: Principles	Anderson, Wood	West Pub Co	83	EO	1
Weed Science: Principles & Practices	Lingman, Gless C.	John Wiley & sons	82	EO	1

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Why Poor People Stay Poor	Libton	Harvard Univ. Press		KRT	1
Woman, Culture, and Society	Rosaldo & Lamphere	Stanford U Press	74	KAD	1
Women & Work in Africa	Bay, ed.	Westview Press	82	KRT	2
Women in Islam		Gem Publications		KRT	2
Women in Muslim Rural Soc: Status	Ginat, Joseph	Transaction Bks.	82	EO	1

LISTING OF PROCURED LIBRARY JOURNALS \*

Title -----	Publisher -----
Agricultural Development Journal	International Agricultural Development
Agricultural Systems	Elsevier Applied Science Publishers Ltd.
Agronomy Journal	American Society of Agronomy
British Journal of Nutrition	Cambridge University Press
Canadian Journal of Agricultural Economics	Canadian Agricultural Economics and Farm Management Society
Crop Science	Crop Science Society of America
Current Contents-Agriculture, Biology and Env. Sciences	Institute for Scientific Information
Current Contents-Life Sciences	Institute for Scientific Information
Experimental Agriculture	Cambridge University Press
Journal of Agricultural Science	Cambridge University Press
Journal of Animal Science	American Society of Animal Science
Journal of Range Management	Society for Range Management
Plant Protection Bulletin	Unipub
Tropical Agriculture	Business Press International USA

\* Journals previously received on a regular basis by WSARP. All subscriptions are currently terminated per USAID instructions, April, 1985.

APPENDIX XI

WSARP MONITORING AND EVALUATION SUMMARY

Organization/Person	Role	YR 1979	1980	1981	1982	1983	1984	1985	Organization/Person	Role	YR 1979	1980	1981	1982	1983	1984	1985
<b>CID</b>																	
Daines, D.	Deputy Dir.	XX	XX						Ruddy, F.	African Affairs							
Reuss, J.	Deputy Dir.			X					Donotelli, F.	Africa Bureau					Y		
Fischer, J.	Exec. Dir.			X	X		X	X	Harr, T.	Auditor					Y		
Kearns, J.	Deputy Dir.				X	XXX	XX	X	* Brown, W.R.	Dir. USAID/KRT					-M	-M	-M
Various	Auditors			X	X	X	X		Dregne, H.	S & T					Y		
<b>WSU</b>																	
Henson, J.	Coord/Dpty	XXX	XXX	XX	XX	X	XX		Gotsch, C.	Eval. Team						F	
Noel, J.	Dpty/Coord	X	XX	XX	XX	XX	XXX	XXXX	Wright, B.	Eval. Team						F	
Yates, A.	Provost					X			* MacAlear, W.	Eng.						-M	-M
Ozbun, J.	Dean Ag.						X		* Moody, D.	Eng.						-M	-M
Smith, G.	Dpty Coord.								* Aulakh, A.	Eng.						-M	-M
<b>GRUBE-ZIMMER</b>																	
<b>IBRD</b>																	
Goetz, E.	Proj. Officer	Y	Y						Staker, R.	VE Eval. Team						F	
Meyn, K.	EDI		Y	Y					Robinson, G.	VE Eval. Team						F	
Marples, S.	Miss. Appr. Off.		Y	YY	YY	YY	YY	YY	Lyvers, K.	Ag. Off.						F	
Veen, H.	East Afr. Progr.		Y	Y	Y				* Armstrong, G.	Proj. Off.							-M
Falconer, B.	Finance			Y	X				<b>GOS</b>								
Vercos, J.	Mid-term Eval.				F				<b>ARC:</b>								
* Folk, I.	IBRD/Khartoum				-H	-H	-H	-H	* Burhan, H.	DG	-S	-S					
* Tadros, M.	IBRD/Khartoum					-H	-H	-H	* Bakheit, M.	Acting DG/DG			-S	-S	-S	-S	
Various	Review Team						Y		Irdia, H.	Midterm Eval.					F		
Cox, J.	Reg. VP						Y		* Khalifa, H.	Dpty Prog/DG				-S	-S	-S	-S
Nooter, R.	Loan Off.						Y		* Gansel, O.	Dpty Ad/Acting DG					-S	-S	-S
* Singh, J.	IBRD/Khartoum							-H	<b>Min. Finance/Planning:</b>								
<b>USAID</b>									<b>Min. Ag. (MAFNR/MAI)</b>								
* Carpenter, R.	Ag. Off.	-M	-M						<b>Min Const/Public Works</b>								
* Pierson, G.	Dir. USAID/KRT	-M	-M	-M							-S	-S	-S	-S	-S	-S	-S
* Hudge, A.	Dir. USAID/KRT			-M	-M	-M			<b>KEY</b>								
* Turk, J.	Proj. Off.			-M	-M	-M			X	Contractor implementation planning, assistance, monitoring visit							
* Witt, E.	Ag. Off.			-M	-M	-M	-M	-M	Y	Monitoring visits by IBRD and AID							
White, D.	REDSO Eng.		-M	Periodic monitoring activities by USAID personnel													
Turk, K.	Midterm Eval.								F	Formal external evaluation							
Gephart, D.	VE Study/REDSO								-S	Periodic monitoring by various representatives of the GOS							
Collinson, M.	Midterm Eval.								* Indicates individual is based in Sudan								
MacPherson, P.	Admin. AID								NOTE: One letter denotes one visit while two letters denote 2 visits within the time frame.								
Martella, E.	Proj. Off.						-M	-M									

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## APPENDIX XII

### GLOSSARY OF ARABIC WORDS AND LOCAL TERMS USED IN WSARP PUBLICATIONS

Arabic/Local Term	Meaning
ANGORAIB	laced bed
ASSIDA	sorghum porridge
BALADI	local; used to refer to the local longer maturing sorghum/millet varieties
BALILA	sorghum/legume porridge
BAMIA	okra
BEIT	home
BUDA	Striga, a parasitic weed
BAGARA, BAGAR	cow, cattle; (Baggara are cattle owning tribes)
BURNUK	smut
BUTHA	flood plains
DAN	sheep
DAR	home area
DEBOIA	sorghum planting
DERET	harvest season
DUKHN	millet
DUKKAN	shop
DURA	sorghum (generic, but also specific for the grain; the plant is also called mareeg)
FARIG (FERIQ)	members of pastoral household who migrate and camp together
FARIIKH	late doughy stage of sorghum/millet; first stage at which grain is eaten
FETERITA	short-maturing sorghum/millet varieties (se also najaad)
FUL	beans, esp. Fava beans
FUL SUDANI	groundnuts (peanuts)
GARDUD	compact non-cracking soils
GHANUM	goat
GIFAR	traditional communal grazing lands
HABIL	area measurement of 0.5 feddan
HAFIR	man-made water encatchment/storage pond
HAGEEN	hybrid (Hageen Dura 1 is a hybrid sorghum)
HAJ	pilgrimage
HARIGA	grass burning
HASHAB	Acacia senegal (gum arabic)
HUMAR	donkey
JAMAL	camel
JEBEL	small mountain or rocky hill
JELLABI	merchant (regional)
JERAD	grasshoppers
JERAI	traditional push hoe
JUBRAKA	housegarden
KAJJET	short-handled hoe
KARAMA	ceremony for requesting dispensation or assistance as at harvest
KERKADEH	roselle
KHARIF	rains
KHAWAJA	European
KHOR	seasonally dry riverbed
KISRA	unleavened sorghum bread

KUJUR	local religious leader among Nuba and others
MAREEG	sorghum (generic, but also in specific reference to the plant; grain itself is dura)
MARISSA	local fermented sorghum beer
MELWA	volume measurement, approximately 2 quarts
MULAH	vegetable sauce
NAFASHA	moth larva (Rhaquva sp.); important pest of millet
NAFIR	communal work party
NAJAAD	early maturing, as for sorghum/millet varieties (also called feterita)
QOZ (GOZ)	sandy soils
RAKUBA	thatched roofed shelter, open on at least 1 side
REGEBA	water pools
REIKA	wooden container carried on head by women to transport grain/produce
ROTIL (RATIL)	measure of approximately 1.1 lb. or .5 kg.
SERAF	spring, shallow water table or watering site
SHATTA	red pepper
SHEIKH	leader of clan or group
SHEIL	carry; a credit advance by a merchant against future produce (at a fixed price)
SIBIR	traditioanl religious ceremony
SICHI	curved axe-like tool
SILUKAB	pointed planting stick
SIMSIM	sesame
SOUK (SOUQ)	marketplace
TAAJIR	merchant (local)
TABALDI	baobob tree
TAHONA	local mill
TINN	heavy cracking clay soils
TURDA	shallow lake
WEKA	okra
ZARIBA	cattle compound
ZUNAARI	local long-maturing sorghum (usually goose-necked with large seeds)

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