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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

SIXTH ANNUAL REPORT

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THE WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

IS SUPPORTED BY

THE GOVERNMENT OF SUDAN

THE AGRICULTURAL RESEARCH CORPORATION

US AGENCY FOR INTERNATIONAL DEVELOPMENT

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I. EXECUTIVE SUMMARY

The sixth year of implementation of the Western Sudan Agricultural Research Project was characterized by both significant progress in the research program and frustration in the planning and implementation of activities related to the institutionalization of Project progress into a permanent research capacity. USAID (See Appendix L for a list of WSARP acronyms and abbreviations) and World Bank external reviews of the Project were highly supportive of the research program. Despite the second consecutive year of severe drought, research results from the 1984-85 season have identified several promising interventions with the potential to positively impact production in the near future. Research in the current year will take some of these interventions onto farmers' fields for verification and initial dissemination under producer conditions, while others will undergo refinement on-station or in researcher controlled trials with producers.

Uncertainty about future support of the Project and the roles and responsibilities of the various stakeholders beyond Project Year 6 became a major constraint to Project planning and implementation during the year. This was compounded by a number of external events such as the change in government and the drought with associated famine, which put unprecedented demands on the donors and Government. A major result was the further delay in completion of construction, which impacted all Project activities from recruitment of Sudanese personnel to procurement and shipping.

The construction program was reviewed at the onset of Project Year 6, and the recommendation was made that all stations be completed. Concerted efforts were made by donors, the Government, Project Sudanese and contract personnel, and the construction contractors themselves to resolve issues and remove the constraints causing delays. Progress was made on many of the issues prior to the change in government and to the famine relief-associated transportation problems. However, because of the latter developments and continued management problems on the part of the construction contractors, it is apparent that the the previous scheduled completion times will not be met. At this time, it appears feasible for El Obeid to be completed before the end of the CID contract, with the Darfur stations completed early in 1987.

All long-term CID/WSU contract personnel, with the exception of the Livestock Production Specialist and Agricultural Economist, departed from Sudan during the past year. The latter two will continue until 31 December 1985. Both administrative positions and those of the Project Engineer and Sr. Advisor to the Director General of the Agricultural Research Corporation were terminated in April 1985 by USAID, although originally scheduled to continue through the end of the contract. This was part of an effort by USAID to focus Project activities on the research program. Despite the hiring of local administrative personnel to fill the gap, the resulting decrease in experienced personnel at a time of accelerated needs for such personnel has resulted in a decrease in Project effectiveness.

Several short-term advisors served with the Project over the past year, including specialists in facilities maintenance, farm machinery maintenance and operations, marketing, water conservation, propagation of hybrid sorghum, extension/technology transfer, seed storage and propagation, and water resource management.

Year 6 marked the return of some of the Sudanese scientists from training programs in the U.S. However, inadequate transitional time between their arrival and the departure of technical assistance personnel resulted in a loss of momentum in several critical areas. Long- and short-term training programs continued over the past year, including the conduct of a joint ARC/WSARP farming systems workshop at Wad Medani, in conjunction with CIMMYT, Nairobi. Long-term training programs will all be completed approximately on schedule. However, some of the trainees are not scheduled to return until 1987.

Attention must be focused in the next few months on those activities which are necessary to ensure continuity of the Project's research program and its associated support requirements beyond December 1985. These include appropriate levels of administrative and support personnel, including engineering and maintenance staff, as well as scientific and technical staff. The transition of the new facilities at El Obeid and the Darfur stations, from the status of a construction program to that of operational research stations, will require a coordinated effort by the participating donors, the Project, and others as necessary.

II. INTRODUCTION

The Sixth Annual Report is required by USAID and has been prepared by Washington State University/Consortium for International Development in cooperation with WSARP Management in Sudan. August 14, 1985 marked the end of Year 6 of the WSARP and the end of the bulk of WSU/CID technical assistance activities. The CID contract has been extended until 31 December 1985 to allow for continuation of the research activities of the Animal Production Specialist and Agricultural Economist, continuation of construction supervision, conduct of various previously delayed short-term advisory activities, completion of procurement activities, and related home-office activities. All other CID U.S. technical assistance personnel completed their Project service and returned to the U.S. during the latter stages of Project Year 6.

Numerous events occurred during the past year which impacted Project activities. Among the most important were the continuation of the drought until June/July 1985, continued economic stresses, and the overthrow of the long-time President Nimieri-led Government by the military in April 1985. Despite the impact of these and other events, the Project's research and construction programs made significant progress during the year. Both progress and constraints will be described in later sections.

Quarterly reports, prepared by the Deputy Project Director/ CID-WSU Chief of Party and submitted to donors and the Government of Sudan, are included as Appendix A of this report and constitute an integral part of the report. The body of the report will summarize activities, accomplishments, and issues of Project Year 6 and make recommendations regarding Project needs in the future, both during and beyond, the tenure of this technical assistance contract.

III. PROJECT STRATEGY AND OVERVIEW

An International Workshop on Agricultural Research and Development in Sudan in late 1976, a Joint Team (U.S. and Sudanese) Review of Sudanese Agricultural Needs in 1977, and an independent World Bank Study of Agricultural Research Needs in Darfur and Kordofan in 1978 resulted in a series of reports that emphasized the potential of the rainfed sector, and specifically of Western Sudan, for contributing to the nation's economy. These studies recommended that substantial changes be made in the planning, conduct and evaluation of agricultural research in Sudan, including changes in the structure and function of the Agricultural Research Corporation (ARC) of Sudan. A major recommended component was the establishment of a research infrastructure in Western Sudan which would develop and test new production technologies for increasing production in the traditional rainfed sector.

While the scope of the recommended changes exceeded that considered acceptable and/or economically feasible by the ARC and potential donors, consensus was reached on the importance of the establishing a research capability for the traditional rainfed sector in the West. As a result, agreements were signed between the Government of Sudan (GOS) and the International Development Agency (IDA) of the World Bank (WB) and between the GOS and the U.S. Agency for International Development (USAID) in 1978 which established the Western Sudan Agricultural Research Project (WSARP). These specific agreements defined the following mandates for WSARP:

1. Establish an agricultural research capability in the provinces of North and South Kordofan and North and South Darfur (now the Kordofan and Darfur Regions).
2. Establish research stations at four sites based upon soil types/ecological zones and associated production systems (Kadugli, El Obeid, Nyala and El Fasher) with the Ghazala Gawazet station to be taken over at the end of Project year three from the Western Savannah Development Corporation.
3. Develop and implement an integrated research program, which would aim to increase production by the traditional rainfed producers of the West while preventing and/or alleviating degradation of the natural resource base.

As a result, a technical assistance (TA) contract to implement the AID funded WSARP activities was signed with the Consortium for International Development (CID) in August, 1979. Washington State University (WSU) was designated the lead university with primary implementation responsibilities. Capital construction, and purchase and operations of an aircraft was to be funded primarily by the IDA/WB. USAID was to fund technical assistance, including commodity procurement, the provision of architectural and engineering services and training, with GOS contributing to both capital and operational components. Later, USAID also increased their commitment to include a portion of the capital construction costs.

During the following six years, WSARP evolved in an iterative and dynamic way into a functional research effort as evidenced by its present status. The success of WSARP in achieving its goals and objectives has been influenced by a number of factors and events, only some of which have been under the control of the Project, donors, the ARC, and GOS. Throughout, however, the Project has been guided by a strategy that has emphasized:

1. The establishment and institutionalization of a research infrastructure in Darfur and Kordofan and a research program emphasizing a systems approach to developing adoptable production increasing technologies for traditional producers.
2. The improvement and/or prevention of degradation of the natural resource base.
3. The provision of information relevant to increasing agricultural production and improving resource utilization to policy makers.
4. Improvement in the livelihood of the Sudanese people resident in the West.
5. Enhancement of the regional and national economies.

The research strategy institutionalized by WSARP stresses an interdisciplinary systems approach which is producer-oriented, and focuses on those crop and livestock enterprises and commodities which have a comparative economic production advantage (i.e., sorghum, sesame, millet, groundnuts and livestock). Research has focused on

important production constraints where technical and/or management interventions can lead to both immediate production increases and long-term sustainability of agricultural production improvements. Cooperative efforts between the ARC and Project scientists, WSARP and the International Agricultural Research Centers (IARC's), and WSARP and other Sudanese national and international organizations have been emphasized. Information and technologies from the ARC, University of Khartoum, the IARC's, (CIMMYT, ICRISAT, ILCA, ICARDA, AVRDC, ISNAR and IITA), the Collaborative Research Support Projects (CRSP's) and the Project's own findings have been adapted to producers' needs. Thus, the WSARP research program is based upon Sudan's production needs and utilizes the disciplinary capabilities and commodity expertise of WSARP, ARC and other cooperating institutions' scientists. The research program is production-oriented and, by keeping the producer foremost in consideration, targets research to technologies and management practices which can and will be adopted. The research program also retains sufficient flexibility to meet evolving producer needs and to seize opportunities to exploit comparative economic production advantages when they become evident.

Research in Sudan and other countries has demonstrated the necessity of testing potential interventions within the producers' environment and context. This was the rationale for establishing stations in four geographic locations by the original Project planners. Such an approach still has validity. While the research program has emphasized the traditional rainfed subsector, many research results are also appropriate for the ~~mechanized~~ rainfed subsector, as emphasized in a proposal submitted to USAID by the Project and CID/WSU in March 1985, defining potential activities beyond August, 1985.

The ARC has historically had a cadre of highly trained scientists with both disciplinary and, more recently, commodity specialization. However, a high percentage of resources for agricultural research in the Sudan has been used to develop and test technologies under research station conditions, conditions which are frequently not appropriate for the producers. WSARP has stressed the concept that their scientists must have a direct responsibility for the adoption of

improved technologies and practices. Thus, scientists work together to prioritize research and emphasize technologies which have the highest potential for adoption as well as technical feasibility under present and projected future producer conditions. A foundation for further long-term improvements is thereby established. WSARP research program emphasis has been on adaptive research efforts through the initiation of on-farm and in-herd trials.

This research approach can and should interrelate with other activities of the ARC and with other organizations in a mutually beneficial way. On-station WSARP research can be limited to those activities which are in direct support of the adaptive research program. Much so-called "basic" and "applied" research of a disciplinary and commodity nature can be conducted more cost-effectively at research stations in more central locations, such as at ARC headquarters in Wad Medani or at the IARC's. Conversely, feedback from the WSARP adaptive programs can assist the commodity and disciplinary specialists in defining their own priorities. An example is the identification by WSARP scientists of the need for deeper rooted varieties of millet, groundnuts, and other crops, to access the water now known to be available below the surface of the goz sands in El Obeid. Identification and propagation of such varieties may require extensive on-station trials over a long time span. Perhaps the ultimate answer will include development of varieties with specific root lengths, utilizing genetic engineering. While WSARP could not afford to undertake such programs, feedback to ARC and the IARC's will allow for incorporation of the need for specific root-lengths into their research programs. Meanwhile, by utilizing root length as an important evaluation criterion for testing and introduction of existing improved varieties, WSARP may be able to impact production in El Obeid in the immediate future.

Incorporation of the WSARP adaptive research approach into the overall ARC system has begun, but additional time and effort is required. Improved communication between ARC scientists and between WSARP, ARC and other research entities will be necessary to develop full complementarity between basic, applied and adaptive research efforts.

The Project has recognized the importance of effective research-extension linkages and has sought to capitalize on the producers' own capacities to disseminate successful technologies, an especially important mechanism where extension resources are limited. In this regard alternative dissemination mechanisms through marketing channels, community leaders and other linkages are being explored.

The WSARP and its strategy for agricultural research has been consistent with AID and World Bank sub-Saharan African development strategies, as well as to the present "Plan for Supporting Agricultural Research and Faculties of Agriculture in Africa," especially in the areas of:

- (1) Institution development;
- (2) Human resource development;
- (3) Technology development and transfer;
- (4) Networking, including close working relationships with the IARC's and other national and local organizations; and
- (5) Concentration of efforts in countries with high agricultural potential, such as Sudan.

WSARP's institutionalization within the ARC and its sustainability, given the present economic environment of the Sudan will require long-term support and efforts. Significant progress has been made by the Project in spite of: (1) many changes in personnel in all the associated organizations and some consequent changes in priorities and strategies; (2) the 1983-1985 drought; and (3) an unstable economic and political climate. Nevertheless, the dedication and efforts of both the Sudanese and U.S. staff have enabled the Project to achieve many of its objectives. However, relevant organizations and individuals must not allow the programmatic momentum to stop. If such occurs, a negative impact on the consolidation of present progress and on future success possible through building on this foundation would result. The research approach is sound and the establishment of a research capability in the West is a reality. This capability needs to be consolidated and fine-tuned to address the

evolving needs and the economic and operational environment of the Sudan, the ARC and the Kordofan and Darfur Regions.

If the successful start can be sustained, the impact of WSARP should go far beyond Sudan, both in terms of technologies generated and/or tested, and as a model for adaptive research programs for sub-Saharan Africa.

IV. PLANNING, MONITORING AND EVALUATION

The WSARP has a number of planning, monitoring and evaluation systems and mechanisms in place. (See ARC/WSARP Fifth Annual Report, February 1985, WSARP Publication No. 33, for details.) Specific activities during the current Project year were as follows:

Donors

Ms. E.S.F. Martella (USAID Project Officer), USAID Khartoum Director W.R. Brown, and incoming Agricultural Officer Dr. Ken Lyvers, who arrived in-country in late March, interacted with Project, contractor and World Bank representatives throughout the year. Results of some of the interactions with contractor representatives are indicated under "CID/WSU" below.

A formal review of WSARP and other agricultural research in the rainfed sector of Sudan, commissioned by Dr. Brown for July-August 1985, was completed and the final report accepted by USAID in October 1984. This report was highly supportive of Project activities to date and of its potential for future contribution to Sudan's agricultural development. This report is included as Appendix B.

A formal review of the construction program was carried out by USAID evaluators from 3 November to 15 December, 1985. Reviewers concluded that the quality of construction was high and that with a concerted effort by donors, Project and both technical assistance and construction contractor personnel, completion of construction within a reasonable period was possible. The report recommended that construction continue at all sites. (See Section V. "Construction and Facility Development" for additional discussion.)

Personnel in AID, Washington D.C. also monitored Project progress and issues during the past year.

World Bank representatives, Mr. Stuart Marples (Washington D.C.), Ms. Ingrid Foik (Khartoum), and others continued to monitor Project progress and interacted with USAID/Khartoum, AID/Washington, with Project and with contractor personnel on numerous occasions throughout the past year.

CID/WSU

The disparity between the termination of technical assistance under the CID contract (14 August 1985), the PACD (final USAID Project termination date) of 14 August 1987, and the WB/IDA loan agreement termination date of 31 December 1985 has remained a planning and monitoring concern to CID/WSU. Without a clear definition of what funds can be spent for what purposes within specific time-frames, scheduling and planning of Project activities have remained difficult.

At the request of USAID, Khartoum, WSU Coordinator Dr. Jan Noel served as a resource person for the USAID research review by Drs. Gotsch and Wright that ended in early Project Year Six. This trip to Sudan was combined with other CID/WSU monitoring activities. Deputy Coordinator Dr. J.B. Henson and CID Deputy Executive Director, Dr. Jean R. Kearns and Senior architect Mr. Joachim Grube served as resource persons for the USAID construction review in October-December 1984.

In January 1985, Dr. Noel returned to Sudan to discuss potential extension of the technical assistance contract beyond August 1985, to monitor a number of Project activities and to assist in the planning and conduct of the ARC/WSARP CIMMYT Farming Systems Workshop in Wad Medani. During this visit, USAID proposed; 1) that three of the current technical assistance positions be eliminated prior to the end of the current contract, and 2) that CID/WSU submit a formal proposal for extension of research technical assistance beyond August 1985.

At the request of USAID, CID Executive director Dr. John Fischer and Dr. Noel traveled to Sudan in February 1985 to discuss the proposed extension of CID technical assistance beyond August 1985 and the proposed deletion of the positions of CID/WSU Administrative Officer, Senior Advisor to the Director General, ARC and Project Engineer. Despite strong statements by both the Project Director and CID/WSU representatives that the proposed deletions of the positions would have negative impacts on the program, the decision was made by USAID to terminate the positions. It was agreed by all parties that the termination was not due to any deficiency of performance by the persons occupying the positions. USAID/Khartoum and USAID/Sanaa and

USAID/Nairobi subsequently offered and/or approved positions for each of the involved individuals. As a related result, a fourth position, that of Associate Administrative Officer, was also effectively terminated, as the individual occupying this position was the spouse of the Project Engineer.

In initial discussions during this visit between Drs. Fischer and Noel and USAID, it was indicated that extension of all research-related technical assistance positions (Livestock, Economics, Agronomy, and Soil/Water) would be made until December 1985, to ensure continuity of research program activities through the 1985 growing season. A decision was subsequently made by USAID during the latter stages of the visit that this continuation of technical assistance personnel would be limited to two of the CID/WSU personnel, Drs. Cook (Livestock Production Specialist) and Gillard-Byers (Economist).

Subsequently, each of the remaining CID/WSU technical assistants was approached individually by USAID to ascertain whether they would accept a direct personal services contract with USAID for an additional 2 year period. To date, none of the CID/WSU technical assistants have accepted USAID's offer, and all have returned to the U.S.

Deputy Coordinator Ms. Genevieve Smith traveled to Sudan in late March 1985 to assist in the transition between the departing administrative personnel and the identification and training of in-country replacements.

Project/ARC

During Project Year 6, the Director General of ARC, Dr. Mohamed Bakheit Saaed, departed his position to become head of the Farming Systems Training Program at ICARDA, Aleppo, Syria. After a lengthy interim period, his successor, Dr. Hassan Khalifa, formerly Deputy Director General for Programs, ARC, was formally named as Director General. In the interim, Dr. Hassan Khalifa and Dr. Osman Gameel, Deputy Director for Finance and Administration, alternated as Acting DG. ARC monitoring was therefore shared by the above individuals.

Project internal planning, monitoring and evaluation mechanisms utilizing the WSARP Station Research and Systems Research Committees continued to function. The WSARP Advisory Committee also met on schedule this year to plan, review and approve the research plans for 1985/86.

V. CONSTRUCTION AND FACILITIES DEVELOPMENT

A. MAJOR CONSTRUCTION CONTRACT

As indicated above, a USAID evaluation (Value Engineering Study) of the construction program was performed from 3 November to 15 December 1984. The Burns and McDonnell Value Engineering (VE) team, consisting of Rod D. Staker and Gary Robertson, reviewed existing documentation, interviewed key people associated with the Project and toured the Project construction sites. It is noteworthy that the time demands on Project and A/E personnel during this six week period were heavy. Findings of the VE team are summarized below:

1. Quality of construction was good.
2. The Sudanese construction contractor had not adequately planned and scheduled construction activities, despite repeated requests and assistance from the Grube-Zimmer (supervisory CID Architectural and Engineering firm) representatives. Many of the delays were, however, the result of factors beyond contractor control. The team recommended that additional monitoring mechanisms be implemented so that funding agencies as well as WSARP and the Supervising Architect can provide improved assistance to resolve bottlenecks.
3. Delayed procurement, logistic problems, and a shortage of construction contractor personnel have resulted in delays.
4. Based on the status of construction and material purchased, only a limited amount of cost savings would result from terminating any elements of the facilities remaining to be constructed.
5. Termination of the El Khidir/Deraige contract was not recommended as it would result in neither time nor cost savings. Financial incentives to speed up completion could be explored by donors and the Project, but enforcement of financial disincentives (liquidated damages, withholding payments, etc.) were likely to negatively impact contractor performance.
6. Additional mechanisms to improve the contractors' cash flow situation were recommended.
7. No construction cost overruns were projected, but additional A/E and resident site supervision costs will be incurred.

8. The importance of settling the economic dislocation claim was stressed.
9. With alleviation of present bottlenecks and if no additional problems are encountered, projected completion times were estimated as 1 May 1985 for Khartoum North, 1 October 1985 for El Obeid and 1 April 1986 for Ghazala Gawazet and El Fasher.

In general, the above findings were consistent with those of Grube-Zimmer in its previous regular monitoring reports to the Project and donors. However, in December, Grube-Zimmer felt that completion of the Darfur stations was possible considerably before the VE team estimates, if settlement of the outstanding issues was achieved. Mr. Henry Bergman, Grube-Zimmer Supervising Architect, has implemented an increased level of formal monitoring as per the above recommendations. (See Appendix C for additional details and references.)

Acceleration of construction activities was achieved in early- to mid-Project Year 6. However, subsequent delays have occurred associated with the change in government in early April, by logistics problems associated with the unprecedented demand for transport for drought-related relief commodity shipment; and currently, transport problems associated with the early and very heavy rains. Status of the construction program is as follows:

Khartoum North - With the exception of finalizing the air cooling system, construction is essentially complete, and the Project has now moved into the facilities. Certificate of Completion will be issued at the time the cooling system is completed, and the maintenance period will commence at that time.

El Obeid - After a long period of delays due to drought-related water shortages and a ban on the use of water for construction, the local materials situation is easing. Cement and paint are still in short supply pending release of new price structures. Most imported materials are now on-site, although there are still delays in the on-site arrival of materials. Delays of up to 4 months were encountered in moving imported materials from Port Sudan to El Obeid, from the massive transportation demands of the

food relief efforts. More recently, railroad disruption and impassable roads because of heavy rains have resulted in additional delays.

El Fasher - Construction at El Fasher, which had progressed well in the early and middle portions of the year, has been virtually at a standstill for the past three months due to shortages of imported materials on-site. Loss of the Resident Engineer at both El Fasher and Ghazala Gawazet hampered monitoring during the year. Paving of the roads and parking areas is completed, and the quality of work remains high. However, completion will be delayed due to the delayed arrival of imported materials, many of which are currently in Ghazala Gawazet awaiting shipment to El Fasher in September upon the reopening of the rain-closed roads.

Ghazala Gawazet - Progress at Ghazala Gawazet has closely paralleled that at El Fasher. Lack of imported materials on-site remains the biggest concern, although the local materials situation has been better than at El Obeid, because of adequate water availability. Seven railway wagons of imported materials arrived in mid-August, and work will be able to continue at an accelerated rate. Quality of workmanship remains high, but delayed procurement and shipment of materials, handled by the construction contractors' Joint Venture office in Khartoum, has hampered progress. The performance of the Chinese subcontractor has continued to be of high caliber, although manpower has been decreased during the year by illness at the Ghazala Gawazet site.

An agreement has finally been reached regarding the Economic Dislocation Settlement, implementation of which should assist the contractor with the cash flow situation. The timeliness of USAID construction payments has been greatly improved during the past year. The contractor continues to encounter delays in receipt of IDA funds.

Major concerns which remain are the lack of arrival on site of the imported materials, lack of adequate contractor operating capital, finalization of the devaluation settlement and liquidated damages

issues, and the need for Resident Engineer supervision at both Ghazala Gawazet and El Fasher.

Senior Architect Joachim Grube and Dr. Noel will visit Sudan in early September to address the status of the construction program and related issues with in-country Project and donor personnel.

For additional details, see Appendix A (Quarterly Reports) and Appendix C (Construction/Force Account) and Appendix I.4.

B. FORCE ACCOUNT

Force Account activities for the Kadugli station were completed during the past year, and planning and implementation focused on the El Obeid station. Project Engineer Dr. David Higgins' position was terminated by USAID effective 15 April. After a brief period of overlap, the duties of the Project Engineer were assumed by Syd. Shawgi Amin. Details of the Force Account activities are included in the individual Quarterly Reports in Appendix A and in Appendix C.

Major outstanding Force Account needs include the provision of an adequate backup water supply at El Obeid; the construction of crop and livestock support facilities, including a water distribution system, at the El Obeid research farm site; and development of an all weather air strip at Ghazala Gawazet. The major constraint to Force Account progress remains the timely provision of manpower resources and, to a lesser extent, transportation.

VI. STAFFING AND TRAINING

A. SUDANESE SCIENTIFIC, ADMINISTRATIVE AND SUPPORT STAFF

Staff projections have been revised a number of times since the initiation of Project planning activities in 1979, based upon clarification of Project needs and time-frames. While the Project has continued to fill positions over the past year, full staffing at El Obeid is contingent upon completion of construction. Likewise, the Project has long recognized that staffing at Ghazala Gawazet and El Fasher was extremely important and would require adequate facilities and lead time for staffing and planning. However, the uncertain nature and level of support to be provided to the Darfur stations has severely constrained efforts to recruit staff. Current staffing progress, issues, and constraints include the following:

1. At Kadugli, deficiency in scientific staff is now present due to the departure of four of the six U.S. staff and the Sudanese economist, and to the fact that Sudanese staff in training have not yet returned to fill these vacancies. Having a sufficient number of adequately trained technicians available for Project activities remains a problem, especially in the plant sciences. The lack of a sufficient cadre of skilled physical plant and vehicle maintenance personnel remains a critical staffing shortage, which was exacerbated by the termination of the TA vehicle maintenance officer position in mid-August. A lack of skilled secretarial assistance, especially for the preparation of English language documentation, continues to be a problem.

2. At El Obeid, increased numbers of Sudanese scientists have arrived on site (See C. below). An ARC scientist has recently been identified to operate the agronomy/soils laboratory at El Obeid, but has not yet joined the Project. The U.S. Soil-Water Specialist finished his tour and returned to the U.S. The Project Librarian has returned to the Project after completing short-term training in the U.S. and various other administrative and support staff have been

hired. A Senior Maintenance Engineer has been identified, but arrangements for his secondment from the NAW have not been finalized. The projected staffing patterns for technicians, administrative personnel and skilled workers have not yet been reached, pending completion of the station and movement of Project Headquarters to El Obeid.

3. At El Fasher and Ghazala Gawazet, it has not been possible to effectively staff for the Darfur stations during the past year due to incomplete facilities and questions posed by the Mission regarding support. At this time it appears that support will be provided to these stations via a cooperative agreement with the WSDC and funded by WB/IDA. The loss of the Site Engineer at these sites during the past year also remains a concern.

4. The Project Engineer, Syd. Shawgi Amin, has functioned in support of Force Account and other engineering activities since early March. Since this position is currently funded from the CID £S Trust Account, mechanisms for continuation of his activities beyond December must be addressed.

5. Staffing requirements for the Project Support/ARC Liaison Office at Shambat after the move to El Obeid have not yet been finalized.

Senior Project personnel (including selected cooperating and non-senior personnel) and a personnel listing of additional Sudanese staff are listed in Appendix D.

B. TECHNICAL ASSISTANCE PERSONNEL

The following Technical Assistance Personnel completed their tours of duty as scheduled during Project year six:

- 1) Ms. Barbara Michael, Research Associate, Anthropology, (Kadugli), departed on 8 October 1984 after a two year tour;
- 2) Dr. Trent Bunderson, Range Ecologist (Kadugli), departed on 17 April 1985 after a four and one-half years;
- 3) Mr. John Hannum, Chief Administrative Officer, (Khartoum), departed on 14 April 1985 after a two year tour;
- 4) Dr. Lalit Arya, Soil and Water Specialist, (El Obeid), departed on 23 July 1985 after a two year tour;
- 5) Dr. Tsegazeab Woldetatos, Production Systems Agronomist, (Kadugli), departed on 14 July 1985 after 13 months;
- 6) Dr. LeMoyne Hogan, Deputy Project Director and Chief-of-Party, (Khartoum-Kadugli), departed after 15 months;
- 7) Mr. Anthony Cenidoza, Vehicle Maintenance Engineer (Khartoum) completed his duties in August 1985 after nearly four years; and
- 8) Ms. Perlita Sulit, Senior Secretary, departed in March after over 2 years.

In addition, Dr. James J. Riley, Senior Advisor to the Director General, ARC (Khartoum) and Dr. David T. Higgins, Project Engineer (Khartoum), terminated their WSARP tours on 15 April 1985 instead of the scheduled date of 15 August 1985. This was a termination requested by USAID under the contractual clause entitled "termination for the convenience of the government." USAID indicated that this was part of an effort to limit technical assistance to those positions directly involved with the conduct of research and in no way implied any lack of satisfactory performance on the part of the individuals terminated. Dr. Higgins had a brief period of overlap with Mr. Shawgi, who has assumed the duties of the Project Engineer. The duties of Senior Research Advisor to the Director General have not yet been assumed by other Project or ARC personnel. Dr. Higgins departed from Sudan on April 15, while Dr. Riley remained in country and served as a special consultant to USAID on water management issues in Western Sudan.

Scientific personnel remaining in Sudan at the end of Project Year 6 include Dr. Richard Cook (Livestock Production Specialist and U.S. Chief of Party) and Dr. Thomas Gillard-Byers (Agricultural Economist) both located in Kadugli. In addition, locally hired expatriates, Mr. Steven A. Horton and Mr. Ben Arejola were hired in April and May to replace departing Administrative Officer John Hannum and Associate Administrative Officer Ms. Shirley Higgins (the latter departed post with her husband Dr. Higgins in April). At this writing, it appears that Mr. Arejola may soon be departing the Project, and a replacement will have to be sought to assist in the clearing and materials control of the incoming commodities and equipment. Ms. Dolly Reynolds was hired as Project Senior Secretary in March and resigned in June. She has been replaced by Mr. Arnel Cruz Montoya.

The remaining CID/WSU Technical Assistance Staff (the two scientists at Kadugli and the locally hired administrators in Khartoum) will continue through the remainder of the CID contract, which terminates 31 December 1985. A total of 114.5 person months of long-term technical assistance has therefore been provided during Year 6. Projected totals for long-term field technical assistance in Year 7 include 9 person months of scientific expatriate technical assistance and approximately 9 months of administrative local hire technical assistance. A summary of CID/WSU staffing is included in Appendix D.

Short-term technical assistance advisors are indicated under Section VII. below and in Appendix F.

C. TRAINING

Dr. Hassan Osman Ahmed El Awad completed his Ph.D. studies in agronomy at the University of California at Riverside during the past year and arrived in Khartoum on 10 November 1984. He assumed duties at El Obeid in early 1985. Mr. Babiker Abdalla Ibrahim completed his Master of Science Degree in Soil Science at Washington State University in January of 1985 and has assumed his duties at the El Obeid research station. Mr. Mohamed Mukhtar Sadek Bilal also

completed an M.S. Degree at the University of Gezira (not funded by the Project) and is now in the forestry research section at El Obeid.

Two trainees, Mr. Tigani M. El Amin and Ahmed El Wakeel, were in Sudan during Project year 6 to conduct their field research. Both completed their research activities and returned to the U.S. to complete their dissertation preparation during the year.

While it appears that all long-term training will be completed as scheduled, it is noteworthy that all personnel will not be back in Sudan until August 1987. This, combined with the absence of technical assistance and/or seconded personnel has had, and will continue to have, a negative impact on the research program. A summary of the status of long-term trainees is included as Appendix E.

Other WSARP scientists completed short-term, non-degree training programs and attended conferences and workshops in various parts of the world. Mr. Osman Abdalla Mohamed, Assistant Director for Administration, completed a two-month intensive training course at Washington State University in administration and management from 14 June to 19 July 1985. Mr. Mekki Mohammed Al Eid completed an intensive, short-term, non-degree training program in library management at Washington State University from 1 June to 19 July, 1985. Mr. Mohamed Abu Sabah, Social Scientist at Kadugli, attended the second half of the Farming Systems Diagnostic workshop at the University of Zimbabwe September 5 through September 17, 1984. Dr. Osman Adam Osman, Horticulturalist at El Obeid, attended the 11th African Horticultural Symposium in Cairo from December 9 to 16. Dr.

Dr. Ibrahim Ahmed Babiker, Dr. M. Saeed Ali, and USAID Agricultural Officer Mr. Ken Lyvers.

The question of extension of the GOS approval for trainees whose programs have taken in excess of five years total remains an issue. The Project has been able to obtain individual exceptions for affected Project students to date, but three WSARP students now completing Ph.D. programs in the U.S. may be potentially affected by this new government regulation.

D. WORKSHOPS

The Project and CIMMYT co-sponsored a Farming Systems Workshop in Wad Medani, January 19 through 24, 1985. The workshop was attended by WSARP, ARC, GTZ, University of Gezira scientists as well as those from other organizations. Dr. Michael Collinson, CIMMYT, Nairobi; Dr. Ed Reeves, Morehead State University; Dr. Fred Palmer, CIMMYT, Mexico; and Dr. Guido Grissel, ILCA, Addis Ababa, Ethiopia, served as instructors. The program and participants are included under Appendix A (Quarterly Reports - January 1, 1985 to March 31, 1985). The workshop proved especially valuable in continuing dialogue between ARC, WSARP and other cooperating agencies and organizations regarding potential roles of the adaptive research focus of farming systems and how it might best be integrated with the commodity and discipline research performed at research stations by ARC, the IARC's and elsewhere.

WSARP scientists Dr. Babo Fadlalla and Dr. Richard Cook presented papers at the ICARDA/IDRC workshop on "Livestock on Farm Trials" in Aleppo, Syria in March of 1985.

VII. SHORT-TERM ADVISORS AND VISITORS

During the current report period, 11 short-term advisors spent time on the Project. The total number of ST person-months funded under the CID contract during the life of the Project is now 36, although the total number of person-months of short-term advisors, including those funded partially or wholly by other sources, is much higher. As in the past, several of these advisors were made available to the Project at no or limited expense to the Project. The majority of these have been provided by the WSU Memorandum of Understanding Program Support Grant and/or from WSU resources. During the past year, the University of Arizona Strengthening Grant, and Bean/Cowpea CRSP also provided some of the support for Dr. Cluff and Dr. Hall, respectively. A list of the consultants during the past year is included as Appendix F.

In addition to the above mentioned short-term advisors, a large number of individual visited and/or consulted with the Project during the past year. These visitors and their activities are included under the section "Consultant and Visitors" in the individual Quarterly Reports in Appendix A.

Several of the short-term advisors scheduled for Project Year 6 were delayed pending completion of the stations. These include a Library Specialist, a Station Development Specialist, and a Scientific Equipment Operations and Maintenance Specialist. These plus a Computer Training Specialist and administrative personnel for activities associated with contract closedown are tentatively scheduled for September-December 1985.

VIII. RESEARCH PROGRAM

A. OVERVIEW

The WSARP research program during the report period included finalization of activities for the 1984-85 season and planning and implementation of the 1985-1986 research program. The program itself has become increasingly focused as research results have enabled the Project to identify high priority areas of research and move interventions showing a high potential of adoption from the station onto producer's fields. Because WSARP research to date has clearly demonstrated the importance of defining research needs and interventions based on the production systems of the producers, the research program continues to be organized along systems lines. Emphasis to date has been on the sedentary production system and the transhumant production system in North and South Kordofan. In addition, preliminary reconnaissance surveys on the economically important sheep production systems, primarily nomadic in nature, in North Kordofan have been conducted.

A Preliminary WSARP Research Strategy for the Darfur Region was also prepared during the current year. It builds on research results from the Kordofan Region and will also utilize the WSARP Production Systems approach. The research strategy emphasizes collaboration with the Western Savanna Development Corporation (WSDC), the Jebel Marra Rural Development Project (JMRDP), and others working in the Darfur Region. It is expected that funding for the WSARP Darfur research program will be obtained from IDA/WB in association with the WSDC.

B. 1984-85 RESEARCH PROGRAM RESULTS

1. KADUGLI

The Kadugli Station has focused its research program on the two predominate production systems in South Kordofan. The first of these is the traditional sedentary system of the Nuba Mountain area, and here, research efforts have been directed at exploiting the potential

for development of an integrated, mixed-farming production system. An interdisciplinary research program, utilizing both on-station and on-farm trials, has focused on: (1) testing new and improved varieties and identifying improved cultural practices for sorghum, sesame, and cowpeas, the principal crops grown in the area; (2) examining new and improved dual-purpose legumes for incorporation into the existing cropping system; (3) using conserved forages, crop residues, and modified animal husbandry practices to improve livestock productivity; (4) initiating on-farm trials, in cooperation with the Nuba Mountain Rural Development Project, with draft animals to exploit the potential for incorporating animal traction into the existing cropping system; and (5) 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 of the area is the Baggara, transhumant livestock production system. The research program addressing production constraints in this system has focused on: (1) evaluating rangeland productivity and identifying potentially adoptable improvements in natural resource management practices; (2) evaluating the productivity and seasonal nutritional status of livestock under traditional management practices and initiating in-herd/flock supplemental feeding trials; and (3) providing socioeconomic data to evaluate producer-market interactions, marketing strategies, and elasticities for the output of cattle, sheep, goats, and livestock products.

Traditional Sedentary Production System Research Results:

1. Cultural practice trials have concentrated on using improved, short-maturing varieties of sorghum, specifically examining weeding practices, plant populations, seed dressings, fertilizer responses, and improved soil and water conservation practices. Results to date indicate that sorghum yields can be maximized by using improved, short-maturing varieties (eg. Dabar, Gadam El Hamam); weeding 2 and 4 weeks after plant emergence; using 20 cm between plants within rows

and 60 cm between rows; and using phosphate fertilizer at the range of 40 kg/ha. Mulching was shown to increase yields 2.3 times over traditional practices; however, analysis showed that mulching must be adapted to farmer conditions to be economically feasible.

2. Variety screening trials have been substantially reduced in number during the past several years, with the present focus of screening trials concentrating on the most important crops grown in the area (sorghum, sesame, and cowpeas), as well as several crops considered highly promising for introduction (eg. mungbeans). Selection for advancement to the next cropping season to on-farm trials was based not only on yield, but also on: Striga-resistance (sorghum); low pod shattering (sesame); and bean and forage yields and degree of nodulation (cowpeas and mungbeans). Several varieties of cowpeas and mungbeans have been included in on-farm trials for 1985.

3. On-farm trials have shown that: (1) Hageen Dura 1 hybrid sorghum performed well under farmer-managed conditions and farmers are willing to increase their acreage provided seeds are available in a timely manner; (2) 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 with the long-term average yields for South Kordofan ranged from 268% to 404%.

4. 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 high potential. On-farm trials with cowpeas (1985) indicated that early planting (June 15-30), 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 being intercropped with sorghum and sesame.

5. On-farm livestock trials have concentrated on the introduction of draft power and improvement of nutrition using bovine animals. Economic analysis of animal draft trials demonstrated benefit/cost ratios ranging from 1.15 to 3.45 over a five year period, when only rental benefits were considered, and 4.92 to 11.24 over a similar period with the addition of welfare benefits. Supplemental feeding trials have shown that quite high levels of good quality forage are required to make a significant impact on production and such forage is scarce and expensive in the areas. The conservation of native grass as hay is presently not feasible because of a poor quality product resulting from problems in harvesting, curing, and storage.

Baggara Transhumant Livestock Production System Research Results:

1. Rangeland productivity and utilization studies in the Nuba Mountains have shown that: (1) most rangelands are in only 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; (2) wood vegetation on most rangelands is declining in abundance and in diversity in response to existing pressures from selective browsing, frequent burning, and a rising demand for land and wood products; (3) fires annually consume an estimated 25-30% of the net primary production and prevention of these fires would be sufficient to support a 43% increase in livestock biomass; the latter would have no adverse impact on range during the dry season; and (4) approximately 30% of rangelands are unutilized by livestock during the dry season because of absence of water.

2. Inefficient utilization of the natural resource base is a fundamental problem for all livestock producers in South Kordofan, and

is primarily the result of: (1) inability and/or unwillingness to cope with physical (mud) and disease factors associated with rainy season use of cracking clay plains; (2) widespread burning and limited sources of water during the dry season; (3) land-use conflicts among producer groups over land and water resources; and (4) absence of effective land-use policies to allow interventions for improved grazing management and rangeland improvement.

3. 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 migratory practices, providing that: (1) animals are given at least one year to adapt to climatic conditions; (2) year-round sources of natural forage and water are available; and (3) the strategic control of ectoparasites is practiced.

4. In-herd studies of the seasonal nutrition status of transhumant cattle and sheep have shown that: (1) for cattle, phosphorus content of the graze ration ranges on a seasonal basis from 0.05-0.13%; adult animals are in a negative energy/nitrogen balance and 95% of lactating animals are clinically deficient in phosphorus during the dry season; adult animals are in a positive energy/nitrogen balance while the majority of lactating animals are clinically deficient in phosphorus during the rainy season; and (2) for sheep, energy and phosphorus appear to be the most limiting nutrients for pregnant ewes during the rainy season; energy, crude protein, and phosphorus were limiting for lactating ewes during the mid dry season; and energy was apparently the most limiting nutrient for adult ewes during the late dry season.

5. Researcher-managed, in-herd, dry season supplemental (sesame cake at maintenance levels) feeding trial with adult, female, transhumant cattle (1984/1985) showed that: (1) supplemented cattle gained significantly more weight, produced significantly more milk, had calves with significantly higher birth weights, and maintained significantly higher plasma phosphorus levels, than did unsupplemented

cows; (2) during the subsequent rainy season, previously unsupplemented cows gained more weight than previously supplemented cows, and there was no difference in milk production between groups; (3) lactating cows showed the lowest phosphorus levels in the rainy season; and (4) 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.

6. Researcher-managed, in-flock, dry season supplemental (sesame cake at 1/2 maintenance levels plus a phosphorus supplement) feeding trial 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 areas as a result of the 1984 drought. 16% of all lambs less than 3 months old died of respiratory infections; ewe losses ranged from 12-20%, being highest in unsupplemented, control animals.

7. Livestock marketing studies indicated that producer strategy was quite complex, depending on rainfall patterns, commodity prices, demand for liquidity, and scale on anticipated purchases. The rapid increase in the market price of sorghum, resulting in a price ratio of male cattle/sack-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.

2. EL OBEID

As of this time, the formal reports documenting research results from the 1984-85 season at El Obeid have not been received, with the exception of the report of the Soil/Water Specialist. Results of the Soil and Water Management/Conservation Research are summarized as follows:

Shortage of water is the chief limitation to crop and livestock production in Kordofan Region, and especially in North Kordofan. This shortage results both from climatic considerations and the soil

conditions themselves. The major soil types in Kordofan include stabilized sands (goz), noncracking low infiltration soils (gardud), and fine textured clay soils (cracking clays or vertisols), with goz soils predominating in North Kordofan. The latter have very poor water and nutrient holding capacities, and rapid drying of the upper surface appears to be the chief cause of seedling failure. Gardud soils are extremely hard and are difficult to cultivate with traditional hand tools. In addition, rainwater is lost through runoff, due to the low soil permeability. The cracking clay soils are potentially productive, but surface sealing on wetting and extreme cracking on drying cause significant runoff through evaporation and runoff.

Soil/water research activities focused on the testing of various soil and water conservation technologies. These included mulching and residue management, inter-row tillage, soil amendments, ridge-furrow cultivation, planting in seed cradles, and depth of planting trials. Other activities included studies of soil properties and dryland hydrological processes, introduction of drip irrigation and instrumentation for collection of weather data.

Mulching on cracking clays increased sorghum biomass and grain yields significantly and on goz sands was equally effective. Cost/benefit analyses of the utilization of grain residues for mulching vs. its utilization for livestock feed are still needed, but the practice of mulching, rather than burning, residues appears promising.

Ridge-furrow cultivation did not prove effective in gardud soils or cracking vertisols, but increased both millet biomass and grain yields by 168 and 83 percent, respectively, in goz sands. However, such ridges were difficult to maintain on the unstable goz sands. Seed cradles could not be maintained in goz sands, but proved dramatically effective in increasing seedling emergence, survival and early growth in gardud soils. Soil amendments, such as ground clay and gum arabic showed promise on-station, but yielded disappointing and inconclusive results under field conditions.

Depth of planting studies in goz sands showed that millet emergence and seedling growth were better for a planting depth of 10 cm than for the traditional depth of 5 cm. There is apparently

significant water available in the >5 <15 cm range of the goz sands. The latter allows water to percolate rapidly to greater depths, while drying on the surface, thus acting as a natural mulching agent itself. This water is not being presently utilized because of the shallow planting depth and shallow rooted character of the plants. The potential for exploiting this water through improved methods of seedling establishment (accessing and utilizing the water near the 10 mm depth) and through use of deeper rooted crops will be explored further.

The use of agro-forestry crops and intercrops as windbreaks to decrease erosion and conserve moisture have shown promising initial results.

Several varieties of millet, groundnuts and horticultural crops have shown promise under the 1984-85 drought conditions. In addition, on-farm horticultural trials using limited drip irrigation techniques have shown early success.

Further El Obeid research results will be detailed in a later publication.

C. 1985-86 RESEARCH PROGRAM

As in the past, research activities can be characterized as being of four different types: (1) research necessary to understand key parts of the system which are constraining production (so called diagnostic activities); (2) on-station research activities, technologies identified as being of high priority are either developed or tested by station researchers; (3) researcher managed on-farm trials where technologies or interventions showing high potential are tried on actual farm conditions with researcher supervision and management; and (4) farmer managed on-farm trials, the final stage of testing and a mechanism of farmer to farmer dissemination of successful new technologies/management practices. Progress has been made to more effectively focus on-station activities to directly support field activities and to those which cannot be more effectively done by other research station staff at ARC, IARC's, etc.

As indicated above, the 1985-86 Research Program has been based to a considerable degree on research findings from the 1984-85 research season with the programmatic emphasis to move the research and testing of interventions to farmers' fields as rapidly as possible. One notable exception has been the last minute addition of National Variety Trials for both sorghum and millet to the Kadugli research station plan. As in the past, the Project has not had either an opportunity for input into which of the varieties are to be tested, nor have they had access to the information from previous National Variety Trials that would help them to narrow the focus to those showing potential under the agroclimatic conditions in the Kadugli area and which meet perceived producer needs. As a result, it appears that a substantial amount of resources and manpower will be devoted to this rather traditional set of station variety trials. This is in contrast to other variety trials in the WSARP workplan, which are limited to varieties showing particular promise for the production systems in the Kadugli area. It is hoped that future variety trials can be modeled after the latter situation with a broader traditional varietal trials to be conducted at the IARC's and, within Sudan, under a coordinated ARC sorghum commodity program.

The research programs focus on achieving increases in the major commodities of the area (sorghum, sesame, groundnuts, etc.) within the context of the production system. While cotton was excluded from the WSARP mandate early in the history of the Project, collaborative efforts with other cotton research programs such as the Nuba Mountains Development Corporation, continue. As a result of previous years' research, it has become evident that improvements in these cash crops are also dependent upon successful interventions in other parts of the production system. An example is the work that has been completed and others that are being planned for the use of legumes for intercropping and for rotation. The result is a food and fodder crop with the potential to improve soil fertility which will assist in sustainable production of sorghum.

Details of the 1985-86 research program for the Kordofan Region are included in WSARP publication No. 36, May 1985. For this reason,

this annual report only summarizes the major research thrusts and examines the rationale for selected individual activities.

1. KADUGLI

Future Research Activities for the Sedentary Production System:

- ◆ Expand researcher/farmer-managed trials to examine the adoptability of: (1) introduction of improved varieties of sorghum (Gadam El Hamam, Hageen Dura 1) and (2) improved cultural practices (weeding, plant populations, phosphate fertilizer and seed dressing) in relation to labor availability and to 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, focusing on sorghum, sesame, cowpeas, mungbeans, guar, pigeon peas, maize and groundnuts.
- ◆ On-station development and analysis of on-farm feasibility of improved soil/water management practices for both far field and jubraka production activities.
- ◆ Expand on-farm draft trials and include pilot study designed 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 initiate strategic supplemental feeding trials which focus on improving the utilization of low quality crop residues and natural forages through the provision of high quality forage legumes and supplemental phosphorus. Both large and small ruminant species will be utilized in these trials.

Discussion:

Preliminary trials of cowpea varieties (previously screened by the IARC's and CRSP's), mungbean variety trials, (previously screened by cooperating agencies), and preliminary pigeonpea variety trials are underway on the research station. Cowpeas as an intercrop and rotational crop is being tested on the cracking clay soils and the sandy soils to select varieties with comparative advantage.

Preliminary trials with mungbeans showed that they have better storage characteristics, higher yield, and remain greener for a longer period of time as a forage by-product. Since they are not a traditional food/forage crop in the Kadugli area, however, a parallel on farm palatability study will be held this season to determine acceptability by producers. A third crop/forage legume to be tested is pigeonpeas. Pigeonpeas are grown in some areas of Sudan, and producers have adopted it in others. Since pigeonpeas exhibit characteristics which would appear to make it a good intercrop with sorghum, variety trials are being held this year. It should be noted that trials on nonfood legume forage crops have been de-emphasized. Sedentary producers appear not to accept these crops because the lower priority of livestock within this system and the labor constraints already facing the producers make it unfeasible from a benefit/cost standpoint.

This year preliminary variety trials will be carried out to match CIMMYT maize varieties with the agroclimatic conditions and producer preferences. These trials have been added because of the research results showed the importance of maize as a jubraka/near farm crop which can provide an early supply of food to assist the producers through the "hungry period." Other on-station trials which focus on sedentary system constraints include the continuation of research on cultural practices which showed high promise during the last year. These include phosphorus and nitrogen-phosphorus application trials with sorghum; plant spacing trials with sorghum, cowpeas and sesame; date of planting trials (with sorghum, cowpeas and sesame); sorghum intercropping with sesame and legumes; weed control trials on sorghum; and soil and water conservation trials.

Last year's results that showed phosphorus and seed dressings as having a high probability of success on farmer's fields have been moved directly to four villages in the Kadugli area. Also Hageen Dura 1 demonstration trials have been moved directly to the fields, but with close researcher supervision. This is important in the case of the hybrid Hageen Dura because of the tradition of saving seeds from the previous year's crop. It will be critical to success of introduction of this or any hybrid that producers recognize that saving of seeds from year to year will result in drastically reduced

yields. For this reason farmer-managed trials are being conducted on Hageen Dura, but under close supervision of the research staff. Also, varieties of sorghum, cowpeas, and groundnuts which appear to show high potential have been moved to farmer's fields under their own management practices. Researcher managed on-farm trials include those which showed high potential from last year, including:

- (1) effects of seed dressing and timely weeding and planting practices on sorghum;
- (2) phosphorous and phosphorus/nitrogen fertilization;
- (3) sorghum intercropping with sesame and legumes;
- (4) initiation of traditional trials with sorghum and high potential legumes;
- (5) Striga control trials using shelf technology generated by other Striga researchers in Sudan and elsewhere (nitrogen and phosphorus suppression of Striga, increased spacing, and intercropping);
- (6) Striga-resistant variety trials; and
- (7) a cooperative project with Nuba Mountain Development Corporation involving improved cultural practices on sorghum and cotton.

Variety trials on a number of horticultural crops deemed of actual and potential importance are underway based on the reconnaissance surveys of the jubraka and of commercial sedentary horticultural farmers in South Kordofan. Work continues on the introduction of animal traction (ox-carts) as an intervention to alleviate labor constraints. The latter is a good example of the potential rapid adoption of improved technologies achieved by working directly with producers. At present, demand for the ox-cart considerably outstrips supply. It is hoped that by the end of the current cropping season, this technology can be recommended for much broader dissemination.

Future Research Activities for the Baggara, Transhumant System:

- ◆ Proposed feasibility study, in collaboration with the Regional Government, for introducing water on a limited basis to increase the availability of dry season grazing, accompanied with an improved system of grazing management and strategic measures for animal disease control.
- ◆ Studies on the marketing of livestock by transhumant producers and milk production, consumption and sales, contribution to transhumant household income.
- ◆ Analysis of forage plants selected by grazing ruminants in relation to their seasonal nutritional status.
- ◆ Implementation of improved management and husbandry practices for the research station's sentinel herd to assess potential productivity of traditional cattle maintained continuously on southern ranges.
- ◆ Phosphorus supplementation of transhumant cattle during the rainy season.
- ◆ Phosphorus supplementation of pregnant ewes during the rainy season and supplemental feeding of early-weaned lambs during the dry season.

Discussion:

Research in the transhumant system at Kadugli is focusing on interventions which have shown promise such as livestock supplementation with phosphorus and protein at critical times; strategic control of disease and parasites; and supplemental feeding trials for livestock in both the sedentary and transhumant systems using legume forage by-products and surplus stalks. Additional research on key areas where additional information is required will be conducted. Among these is a clearer definition of the causes and focus for conflict between sedentary farmers and transhumant pastoralists with respect to critical resource base utilization. Additional research to pinpoint the critical times for nutritional supplementation continues, and an investigation of marketing of livestock to assist in developing strategies to increase offtake are ongoing. Related to this are investigations of the patterns of milk production and consumption. The latter is primarily a function of the

women in the transhumant Baggara system and appears to play a key role in determining animal by-product offtake. There is an increased focus in this year's research program in both North and South Kordofan on sheep production, based on last year's reconnaissance survey that showed the importance of sheep from an economic standpoint, and preliminary identification of apparent areas where interventions could make significant production increases.

2. EL OBEID

Research at the El Obeid station has been designed to be complementary to that ongoing in Kadugli. The ecological conditions in El Obeid are considerably different from Kadugli and the sedentary production system is organized along different lines than in the Nuba Mountains. High potential varieties of pearl millet (identified and tested in collaboration with the ICRISAT millet breeder) are continuing. A number of on-station trials to assess the adaptability of numerous varieties obtained from the IARC's and other cooperating agencies is also ongoing. On-farm trials continue with Hageen Dura, under close supervision of the research staff. Assessment of several varieties of groundnuts is being done in collaboration with a groundnut breeder from the Gezira Research Station, Wad Medani. Sesame national variety trials are also ongoing this year. Based on last year's performance cowpeas, pigeonpeas, watermelon, guar, and a selection of vegetable and fruit crops showing high productivity under recent drought conditions, will be conducted. Also, trials on improvement of cultural practices and soil and water management and conservation adapted to the sandy soils of El Obeid will be continued. Based on last year's research results, activities are underway regarding potential interventions for pest control and crop protection.

4. RESOURCES REQUIRED FOR FUTURE ACTIVITIES

- ◆ Provision of inputs for research trials on a timely basis, eg., seed, seed dressings, fertilizers, livestock supplements (phosphorus), etc.

- ◆ Logistical support for field activities, eg., vehicles, technical staff, etc. (including formal agreements for sharing resources with extension, veterinary/livestock production, Nuba Mountain Rural development Project, Nuba Mountain Agricultural Production Corporation personnel).
- ◆ Adequate scientific research staff, including technicians.
- ◆ Establishment of an information network to facilitate the collaboration/sharing of research results among organizations involved in rainfed agricultural production in the Sudan and outside the country.
- ◆ Long-term commitment of funding to allow for the continuity and development of research programs.
- ◆ Establishment of a research station training and information service oriented towards producers, local merchants, and the local private sector at large, and aimed at disseminating information on proven technologies developed at the station or at other stations under similar production conditions.

As indicated above this brief review of the research program for the coming season attempts to demonstrate the relationship of past and current research activities. Details of the actual research program are contained in the aforementioned WSARP publication No. 36.

IX. PROJECT ADMINISTRATION AND SUPPORT

A. PROJECT SUPPORT UNIT

The Project Support Unit (PSU) in Khartoum incorporates both the activities of the temporary Project Headquarters and the permanent logistical and administrative support services of the PSU. The PSU has now moved into the new PSU/ARC Liaison Office in Shambat. Permanent activities of the PSU will include: procurement; clearing; travel arrangements; coordination of aircraft scheduling, maintenance and operation; external and internal communications linkages; transport of equipment and commodities to research stations; assistance with liaison with Khartoum-based government, donor and other organizations; construction and force account support; and other support activities. Currently the staff of the PSU supported by the CID/WSU technical assistance contract (under the CID trust fund) include: Administrative Officer, Mr. Steven Augustu Horton; Senior Secretary Arnel Montoya; and Procurement/Materials Assistant Mr. Abdel Maged Mahgoub. Head of the PSU and Assistant Director for Administration is Mr. Osman Abdalla Mohamed. Other key staff include Purchasing Officer, Mr. Abbas El Nour, and Storekeeper Mr. Khalid. Because of the extremely large volume of incoming equipment and commodities which must be cleared, entered in the materials control system, and transported to the appropriate station, the level of administrative support in Khartoum available to handle these activities remain a concern.

Also, the delineation of roles and responsibilities of members of the PSU and their interface with members of the ARC Liaison Office remain a high priority. Because of the proximity of the new Shambat office to other Khartoum-based ARC activities, the opportunity for increasing effective interaction exists, but will have to be further developed. ARC/WSARP programmatic and support liaison assistance previously conducted out of the PSU by the Sr. Advisor to the Director General/ARC, is not currently being provided by other individuals. This linkage within ARC, between ARC and the Project, and between Project, ARC, and IARC's and other cooperating organizations within

and outside of Sudan is deemed critical. Future success of Project activities and institutionalization of the adaptive systems research approach within ARC are a part of these concerns.

B. TRANSPORTATION AND COMMUNICATION

The Project has been effective in obtaining adequate fuel supplies over the past year, even in the face of fuel shortages. The aircraft has experienced significant down times due to delayed maintenance service availability over the past year. As a result, the Project Director has decided to seek and employ a qualified mechanic who would assume the maintenance responsibilities for the aircraft. Aircraft operations, especially to the Darfur stations, have not been as regular as is necessary for adequate construction supervision over the past year. The radio system has experienced a number of difficulties over the past Project year. Recent service of the radio and associated aerial systems has been carried out with considerable improvement in radio communications. The radio allocated for ARC headquarters at Wad Medani is still not functional. It is extremely important that this radio communication linkage be established. In the absence of any progress in this regard, assistance by the donors in establishing this critical communication linkage is requested.

As the vehicles have been in service for up to five years at this time (the average vehicle age in Western Sudan is slightly over two years), vehicle maintenance assumes a greater importance than ever. However, at this time, the CID vehicle maintenance technical assistant, Mr. Cenidoza, has completed his tour. An extension of Mr. Cenidoza's tour of service service was requested by the Project. Since the Mission specified that his salary be changed from dollars to Sudanese pounds for such an extension, Mr. Cenidoza elected to terminate his employment. At this time, a replacement has not been identified.

The purchase of fifteen replacement pickups and two vans requested during the previous Project year has not yet been approved by USAID. A number of pickups have been identified in Port Sudan which could be available to the Project, but final negotiation for

transfer of their title to the Project has not been completed. A request for permission to procure the vans has not yet received a reply from USAID. All Project vans are now in a state of terminal disrepair, and if they are to be replaced under the CID contract, it is necessary to order them immediately. The vans are essential to transport larger groups of passengers to and from the aircraft, to meetings, etc. The lorries have continued to be used extensively over the past Project year for transportation of fuel and Project commodities to the stations.

Considerable amounts of vehicle and station maintenance materials and spares have been procured over the last year. The lack of sufficient cadre of trained vehicle mechanics at Kadugli and El Obeid remains a concern.

C. EQUIPMENT AND COMMODITIES

Because of the revised completion dates for the El Obeid and Darfur stations, and the limited storage facilities available at either Khartoum or El Obeid, commodity procurement and shipment of commodities has been slowed. A large amount of equipment, especially relating to station maintenance spares, maintenance equipment, and field and laboratory research equipment is now in Khartoum in containers awaiting transport to final destinations in the West. A considerable amount of this equipment has been moved to Kadugli over the past year, and additional equipment identified by the scientists for this year's research program has now arrived or is in transit. It is anticipated that most of the equipment will be on-site prior to the occupation of the El Obeid laboratory. A summary of the status of the CID/WSU procurement activities is included in Appendix G.

Procurement for the Darfur stations was halted by USAID in early Project year 6 pending the final determination of whether USAID would fund these stations. The Darfur equipment and commodities which were ordered prior to that "hold order" time are now containerized and being held in Khartoum.

A large amount of office furniture and laboratory support furniture items have been procured locally. Some of these have been

delivered and are being stored at the Shambat facilities, while the Project has not yet received others. Imported items such as furniture for the library, conference and meeting rooms, etc. are now in Shambat. (See WSARP 4th Annual Report for details regarding types and amounts of procurement.) The Project is still experiencing significant delays in the clearing of both construction and other Project commodities and materials.

Approval for a short-term advisor specializing in scientific equipment maintenance and operations has been requested to assist in setting up the new equipment (See also D. below).

D. MAINTENANCE PROGRAM

A Facilities Maintenance and Operation Specialist, Mr. Michael Mannion, served as a short-term advisor to the Project in Sudan from November 1984 through May 1985. During this period, he both identified and assisted with the ordering of maintenance spares, shop equipment and other maintenance items for the new facilities in the major construction program and for Kadugli. In addition, he assessed and made recommendations on the maintenance programs for all the stations and worked with available maintenance personnel at Kadugli, El Obeid and Khartoum. However, because the permanent WSARP Project Maintenance Officer was not available (He has been identified, but not hired) during Mr. Mannion's tenure, it was not possible for him to jointly establish a comprehensive maintenance program to be implemented by the Project Maintenance Officer. In the most recently approved CID TA budget, two-hundred thousand dollars (\$200,000) have been budgeted for station maintenance spares. Since the vast majority of the station equipment is of non-U.S. manufacture, it has been necessary to request a waiver of source origin from USAID for procurement of these items. All items have been identified, and AID has approved a seventy-five thousand dollar (\$75,000) waiver. These materials have been ordered, but the balance of one-hundred twenty-five thousand dollars (\$125,000) remains pending because of lack of an additional waiver. It is critical to resolve this issue in the near future so that the maintenance spares can be procured before

termination of the contract. It is also imperative that the maintenance engineer join the Project as soon as possible, so that a maintenance program will be in place before the El Obeid and Darfur stations come on-line.

As indicated under the section on transportation above, vehicle maintenance remains problematic.

As indicated under the equipment and commodities section above, a U.S. individual has been identified to serve TDY to establish maintenance and operational training programs for Project equipment as well as assist in its installation.

E. CID/WSU CAMPUS SUPPORT ACTIVITIES

Dr. Jean Kearns, Deputy Executive Director at CID, has continued to provide monitoring and assistance to the Project. Dr. Kearns traveled to Sudan on two occasions during the past year to meet with Project and donor personnel in-country. In addition, Executive Director Dr. Fisher, also visited Sudan in February. The CID central office has continued to provide its contractual backstopping services.

Washington State University has continued in its role as lead university. Specific duties are detailed in the 4th and 5th Annual Reports. Dr. Jan Noel continues to serve as the Project Coordinator. Effective 15 August 1985, Ms. Genevieve (Smith) Thompson has assumed the responsibilities of Deputy Coordinator for the Project, and Dr. James B. Henson, former Project Coordinator will continue monitoring the Project through his WSU position as Director of International Program Development. In this regard, Dr. Noel's percentage appointment on the Project decreased to 40% in August and Ms. Thompson's appointment is 50%. A full-time secretary has continued to support the Project on WSU campus and will continue through December 1985. With the decreased administrative personnel in Khartoum, it has been necessary for the campus office to assume some responsibilities formerly handled in the field. Therefore, a full-time secretary and half-time purchasing assistant will continue for the balance of the CID contract.

In addition to the direct costed support provided on the WSU campus, WSU continues to provide additional support in purchasing, finance, personnel, training, library, and others at no cost to the Project. Support for these activities has come from Washington State University funds and from the Program Support Grant of the Memorandum of Understanding between Washington State University and USAID.

During the past year the Project activities in country and at WSU have adopted parallel computer systems. The computers are now functional in Khartoum and Kadugli, and are in use by research and administrative staff. The Project has requested that computer training be provided by CID/WSU to Project personnel in Sudan to increase effective utilization of this new equipment.

A scheduled visit to WSU in August by Project Director Dr. Dafalla had to be postponed, but is tentatively rescheduled for October, 1985.

F. LIBRARY AND INFORMATION

As indicated in the training section above, WSARP Senior Librarian, Mr. Mekki Mohamed Al Eid, completed a short-term intensive training course in library sciences at Washington State University during Project Year 6. Mr. Al Eid worked closely with library personnel at Washington State University to devise a library system that would be closely integrated and coordinated with the ARC library at Wad Medani and with other library capabilities in Sudan. Mr. Al Eid returned to Sudan in late July and will be working with the librarian/radio operator in Kadugli as well as setting up the library at El Obeid. The necessary equipment has been purchased, and library materials identified in association with Project scientific staff, Mr. Al Eid, and WSU Campus Support Staff. In addition, Mr. El Eid spent time with a number of units on campus to familiarize himself with the uses and operation of the library and informational equipment to be used in Sudan.

It is anticipated that the setting up of the library at El Obeid will require a concerted effort, and qualified personnel available to assist with this effort are limited. It is recommended that the

Project consider utilizing WSU library personnel in a short-term advisory capacity for assistance. This has proven well worthwhile in similar WSU projects in other countries.

Washington State University has continued to provide library materials to the Project on request. This mechanism is discussed in more detail in Annual Report No. 5. and is supported by the Program Support Grant under the auspices of the MOU between USAID and WSU.

X. COOPERATIVE ACTIVITIES WITH IARC'S AND OTHER ORGANIZATIONS

The WSARP and ARC continue their policy of cooperative work and networking with relevant organizations in Sudan and elsewhere. In this regard, the Project has a number of collaborative activities ongoing with CIMMYT (maize for the jubraka, farming systems and training), ILCA (livestock and farming systems), ICRISAT (pigeonpeas, sorghum and millet), IITA, and ICARDA. The Project also uses material from the above centers and from the Sorghum-Millet CRSP (INTSORMIL), the Bean/Cowpea CRSP and Groundnut CRSP. In addition, the Project continues to work closely with GTZ, the Nuba Mountain Development Corporation, the Western Savannah Development Corporation, the University of Khartoum, The University of Gezira, the Range Department, the Kordofan Regional Extension Department, the Regional and National ministries and others. Dr. Riley, in his position as Senior Advisor to the Director General of ARC, served as a primary liaison between the Project and many of these collaborating organizations. Following the termination of his position in April, no alternative mechanisms have yet been established to continue these activities. The Project considers it imperative that these networking activities continue so that WSARP's activities can complement rather than duplicate those of other organizations. In this regard, short-term advisor in Agricultural Extension, Dr. Tom Trail, has recommended that a new position entitled Information Officer be established to work with the Training/Extension and Liaison Officer (currently in training in the U.S.) and the Librarian in El Obeid. This position was part of the most recent WSARP staffing list, but has never been filled. It could be reactivated to help meet this critical need.

XI. WSARP PUBLICATIONS

Currently, journal subscriptions cannot be renewed because of the termination of the CID contract in December, 1985. After exploring possible mechanisms with USAID, they indicated that such subscriptions would have to be terminated. Therefore, at this time only prioritized lists of desired journal subscriptions are available. It is hoped that subscriptions to journals will be a part of the follow-up activities.

A large volume of Project publications have been completed and/or are in process during the past year. A list and status of the WSARP publications is given in Appendix H.

As the 1985-86 research results will not be available until approximately February, 1986, the final CID/WSU Project report will not be able to include this information. As was the case for the technical assistance staff who departed in August, those leaving in December will have little complete data from the current cropping season, although they will have conducted most of the activities with the exception of the final data collection and analyses. Because of the critical nature of this information with regard to future Project planning, a request will be going forward to USAID, Khartoum from CID/WSU to explore mechanisms to provide support for the writing up of these results.

XII. BUDGET/FINANCE

A comprehensive summary and discussion of the complex budgets of the WSARP are included in the WSARP Fourth Annual Report. Discussion here will be limited to those developments and issues occurring during the past Project Year. Expenditures during Project Year 6 are summarized in the financial reporting section of the Quarterly Reports in Appendix A.

The current CID technical assistance budget for the WSARP, including expenditures and projections, is summarized in Appendix I. This budget was revised from the former level of U.S.\$19,940,306 to \$17,501,443 in consultation with the Project and USAID, and the CID contract is amended accordingly. This resulted in a de-obligation of \$2,438,863. This budget was revised in consultation with the Project and USAID, and the CID contract is amended accordingly. This resulted in a de-obligation of \$2,438,863. Major revisions have included the deletion of the line item for dollar force account expenditures, elimination of the administrative positions, elimination of the 15 replacement pickups, and reflection of cost savings in various other categories. For Project Year 7, architectural and engineering supervision, the Livestock Production Specialist, the Agricultural Economist, and a decreased level of campus backstopping are included through 31 December 1985. Other expenditures anticipated during Project Year 6, but delayed due to various circumstances, will be carried out in Year 7. Examples include the delayed short-term advisors, procurement and shipping of equipment and commodities for which waivers are still in process, and Project closedown activities.

A revision of the CID SF Trust Fund budget has been requested to reflect the additional costs to be incurred for local hire personnel, architectural and engineering services, and other related expenses. Trust Account expenditures through August 1985 are included in Appendix I-2.

The total amount of IDA funds unexpended at this time is substantial. It is anticipated that additional station maintenance spares, construction variation orders reflecting previous recommendations for the paving of roads, erosion control landscaping,

and others will be considered for funding by this balance. A summary of the construction budget is included in Appendix I.4.

As indicated in previous annual reports, the disparity between the various "Project Termination Dates" (CID contract on 14 August, 1985 vs. WB/IDA funding in December 1985 vs. USAID PACD of approximately August 1987), has continued to cause great difficulty in planning and implementing activities over the past year.

XIII. ISSUES AND RECOMMENDATIONS

Most of the issues identified in the WSARP Fifth Annual Report remain equally valid at the end of Project Year 6. The primary issue facing the Project is the maintaining of the impetus and progress gained to date to provide the foundation for future Project activities, based upon the needs of agriculture in Sudan. In this regard, the USAID Mission requested in early 1985 a proposal from the Project for extension of support beyond August 1985. The proposal went forward from the Project in cooperation with WSU/CID in February, 1985. A copy of this extension request is included in Appendix J. However, subsequent discussions indicated that such an extension would not be possible, with the exception of the extension of the two technical assistance scientists in Kadugli until 31 December, 1985.

The Project has established a firm foundation upon which to build a comprehensive research program for rainfed agriculture in Western Sudan and has the potential to influence how agricultural research is planned and implemented on the national level. Extension of the research approach to the mechanized sector (which is in fact only mechanized to the extent of the initial seasonal plowing in most parts of Sudan) is recommended and could be easily initiated. Most of the constraints and many of the research findings and interventions identified in the traditional sector are equally applicable to the mechanized sector. Thus, the Project feels the research approach is equally sound for the commodity production problems of the entire rainfed sector.

The Project is already experiencing severe manpower constraints because of the departure of key technical assistance staff and the fact that many Sudanese scientists have not yet returning from their degree training in the U.S. In addition, many of the current WSARP scientific staff have indicated an interest in positions outside of the Project and outside of Sudan, because of uncertainties in future Project support. It is essential for donors to provide continuity as well as guidance for future activities.

Another critical issue involves the long-term staffing of research stations. Such an exercise will demand an adequate cadre of

trained personnel within the ARC and within Sudan to meet the needs of the Project's research program. However, since this research approach requires scientists to spend an appreciable amount of time in the field with producers rather than on the more familiar and comfortable research stations, innovative incentives for attracting and keeping scientists are needed. In this regard, streamlining of presently cumbersome secondment procedures from other organizations and establishing mechanisms for collaborative efforts with the University of Khartoum and other donor activities are needed. Mechanisms to more effectively access ARC's own pool of trained personnel must be implemented. Publicizing the excellent facilities at the new stations, with new scientific equipment and the opportunities to contribute to challenging research programs are incentives that have not yet been fully exploited.

The establishment of an effective maintenance program for both physical plant and vehicles has yet to be implemented, despite the recent tour of duty of the short-term maintenance consultant. A comprehensive maintenance program is not in place at any of the stations, and it is recommended that the mechanisms to supplement current capabilities, such as utilization of PVO organizations be considered by the Project. It is also suggested that further consideration be given to identifying other supplementary mechanisms until a resident maintenance capability for both physical plant and vehicles can be established.

Equally important is the establishment of maintenance and operational programs for the new scientific equipment, to ensure it remains operational. Experience in Sudan and elsewhere has shown that a certain amount of scientific equipment is essential on-site for the conduct of applied and adaptive research. It is not possible to rely on distant facilities for routine analyses, the lack of which can cause delays affecting of an entire year's research.

A significant amount of progress was made in the past year to resolve those problems which have resulted in construction delays. However, due to a number of unforeseen circumstances, including the change in government, continuation of the drought with its associated famine relief activities, and subsequent extremely heavy rainfalls, it

has not been possible to complete the construction program. A detailed plan for provision of AID construction supervision support beyond the current CID contract must be formulated. Also, it will be necessary to finalize procurement of the station maintenance spares as soon as possible. Either USAID must approve the waiver for the additional one-hundred twenty-five thousand dollars (\$125,000) or an alternative mechanism must be established so that these may be procured out of the World Bank Construction Contingency Funds.

The future nature and level of support for the Darfur stations and the mechanisms whereby programmatic continuity can occur with different donors funding the different stations should be established immediately in order for activities at the stations to move forward and be complementary. For instance, operation of the aircraft, the radio support system, transportation of fuel and commodities to the stations, and many other support systems have been jointly planned. These, in addition to the development and implementation of the research plans themselves, must continue to be closely coordinated. Without this coordination, Project manpower and resources cannot possibly meet the needs of both Regions.

Force Account activities remain far behind schedule. All activities in Darfur at Ghazala Gawazet and at El Fasher have been discontinued. If the Darfur stations are to be functional, and if the station at El Obeid is to function optimally in support of the research activities, the essential Force Account needs, many of which were planned by Dr. Higgins before his departure, must be completed. To implement these, additional assistance must be provided to Mr. Shawgi, and a mechanism for continuation of his support beyond the current year must be established.

USAID has advertised for technical assistance staff to join the Project on direct personal services contracts to USAID from August 1985 to PACD August 1987. Currently, Tereke Berhe, an INTSORMIL scientist, has joined the Project in Kadugli. Clarifications of expectations regarding his and others' support by the CID/WSU contract, and by USAID after the CID contract is completed, is still needed. In this regard, Dr. Jan Noel will be travelling to Sudan in early September to pursue this with the Mission.

At the request of donor personnel, WSU prepared a paper entitled "WSARP Status, Issues and Recommendations in February 1985." Many of the included items relate directly to Project needs as its 7th year begins. Excerpts from this paper are therefore included as Appendix K.

APPENDIX A

WSARP QUARTERLY REPORTS

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WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

QUARTERLY REPORT

October 1, 1984 - December 31, 1984

I. GENERAL

Most of the activity of the WSARP plant scientists this quarter was directed toward harvesting, recording and analyzing data from this season's research plots. Those working with livestock continued normal research activities.

Meetings were held in both Kordofan and Dafur with Regional Governments to promote better coordination of research efforts between WSARP and Regional Governments.

Project scientists participated in technical meetings in Saudi Arabia and Egypt during this quarter.

A value engineering study of the construction component of WSARP by the Durns and McDonald Engineering Company was initiated during this quarter. The team consisted of Rodd D. Staker and Gary Robinson who reviewed pertinent project information, interviewed key individuals associated with the project and visited all four project sites to observe current completion status, activity and construction management for the period November 6 through December 14. A report of recommendations will be submitted in the next quarter.

Equipment and supply needs were assembled from scientists and orders were placed locally and through Washington State University.

Station construction seems to have been speeded up but not sufficiently to remain on the last schedule - unless additional steps are taken by the contractors to provide imported materials and operating funds on a more timely basis.

Greater than normal activity occurred in the construction portion of the project; an Engineering Review Team brought in by AID/Sudan was active in November and December. Visits were made to Sudan to participate

in these studies by J. Grube, Grube-Zimmer, supervising architect, and Dr. Jim Henson, Director of the International Program, Washington State University.

Morale of all WSARP personnel, both Sudanese and expatriate, has been adversely affected during this quarter due to the indecision by AID/Sudan regarding project continuation.

A. Consultants and Visitors

Dr. Anthony Hall, University of California at Riverside, completed a visit to Sudan on October 13. During his stay, sponsored by the cowpea CRSP, he visited Kordofan, conferred with WSARP scientists and visited with many others concerned with cowpea research in the Sudan.

Mr. Lynn McDonald, Texas Tech University, completed his assignment to the Hybrid Sorghum Seed Production Program on November 20.

Mr. Michael Tannion, WSARP consultant for Equipment Maintenance and Training, arrived in Khartoum on November 21.

A World Bank team of agriculturists visited the Kadugli and El Obeid Stations and discussed research programs in October.

AID/Sudan personnel visiting project research stations this quarter included Director W. R. Brown, Eric Witt, Lili Martella, Amar Anlaka and Carlos Pascual.

Dr. Jim Henson, Director of the International Program, Washington State University, visited the project from October 13 to 22. He participated in meetings with AID, project personnel and with the construction evaluation team.

Joachim Grube of Grube-Zimmer visited the project from October 13 to October 20 to participate in the construction review.

Many other individuals visited with contract personnel during the quarter and will be mentioned in following sections of the report.

B. Trips and Meetings

The scheduled two-week administrative visit to the U. S. by Drs. Dafalla and Bakheit was delayed and will be rescheduled at a later date.

Osman Adam Osman, Horticulturist at El Obeid, attended the Eleventh Africa Symposium in Cairo from December 9-16. The subject of the symposium was "Tomato Production in Arid Lands".

Babo Fadalla attended a meeting in Riyadh, Saudi Arabia on "The Needs of Livestock Production in Arab Countries" from November 11-14. He presented a paper "Cattle Production among Transhumant Baggara Tribes in the Kordofan Region, Western Sudan".

On December 4, 5, and 6, a Regional Research Planning Meeting for WSARP stations in Darfur was held at El Fasher and attended by personnel from WSARP, Darfur Ministry of Agriculture, Jebel Marra and the Western Savannah Project.

In early December, WSARP scientists from Kadugli and El Obeid met with the Regional Minister of Agriculture for Kordofan in El Obeid to discuss ways to improve and strengthen linkages between WSARP activities and efforts of the regional government.

Director Brown, Eric Witt and Carlos Pascual met with WSARP administrators and scientists at Kadugli on November 15 to discuss research programs, activities and to view facilities.

Drs. Dafalla, Henson and Hogan, Mr. Grube and Mr. Bergman met with personnel from AID and World Bank on November 15 on station construction matters.

Drs. Dafalla, Henson and Hogan met with Director Brown on November 21 on contract matters.

Drs. Dafalla, Hogan and Riley met November 5 with members of the INSORMIL Evaluation Panel: Drs. Gonzalez, Gebisa, Brhane, Kirleis and Rosenow in Khartoum.

On November 27 and 28, Dr. Hogan, Dr. Riley and Mr. Lynn McDonald attended a field tour of hybrid sorghum seed production plots on the Gezira scheme followed by a meeting with representatives from the National Seed Administration, Plant Propagation Unit, USAID and Dekalb.

II. ADMINISTRATION

Ms. Barbara Michael, Research Associate in Anthropology, completed her assignment in Sudan and departed on October 8.

Dr. Hassan Ahmed Elawad completed graduate studies in agronomy at the University of California at Riverside and arrived in Khartoum on November 10. He will assume duties with the project at El Obeid.

Contract personnel on annual leave during part of this quarter included Dafalla, Hogan, Cook, Bunderson, Arya, Mills and Cenidoza.

Dr. Bunderson's daughter, Michelle, was evacuated for medical treatment to Paris on November 16 and returned to post on November 23.

III. STATION DEVELOPMENT

A. Construction - Contractors

GENERAL

There appears to be an effort on the part of the Contractor to speed up the work. This is apparently more successful in El Obeid and ARC HQ where simultaneous operations are occurring and real progress seems to be made. El Fasher is hampered by lack of imported materials as is the case in Ghazala Gawazet. Ghazala Gawazet is also plagued by chronic shortages of materials and operating funds which are more the result of inept management than remoteness of site or difficulties of transport.

EVALUATION TEAM

Meetings, review of files and documents, and informal conversations with the evaluation team

continued throughout early December. On December 12 a meeting was held at WSARP offices with AID, WSAPP, and World Bank representatives at which the team gave an oral review of the main points of their report. On the basis of this brief review, there appeared to be no startling disclosures or conclusions. In general, it recommends completion of the construction contract at all sites and continuation of consultant services through construction. Though complete, the report has not yet been released for detailed perusal.

ACTIVITIES BY SITE:

EL OBEID: Excavation for sewage force main in progress. Sewage lagoons 95% complete.

Water distribution nearing completion. Water tank and tower on site and ready for erection.

Underground fuel tank assembly and welding in progress.

Doors, windows, verandah screening, and floor tile continuing.

EL FASHER: Roofing crews working double shifts to utilize only two power screwdrivers in working order. Completion of all roofing by January 10.

Installation of doors started. Remainder of doors reported in transit.

No windows on site. Still in transit between Port Sudan and site.

Local materials on hand are sufficient to sustain work level. Twenty-two tons of cement on site, 50 tons in transit from Nyala.

Sufficient funds on site to last approximately one month.

Agreement for erection of power poles and cabling reached with N.E.C. Work to start January 3.

GHAZALA GAWAZET: Work virtually stopped since December 25 due to lack of money and therefore gravel, sand, and cement. Contractor reports

20,000 sent by wire but not received yet. This is less than a month's normal requirement.

Plasterwork nearing completion in Administration/Research buildings. Very good workmanship.

Petrol shortage causing delays in shipment of sand and gravel from Nyala which is nearest suitable source.

ARC HQ: Painting to start in warehouse. The only major item requiring completion before this building is ready for use is the electrical service.

Drainage piping in progress at office building. All materials needed for completion of plumbing are now on site.

Windows complete except for glazing and fixed panels. One or two mirror units still need fastening in place.

Plaster virtually complete at first floor. Some patching needed at junction box repairs. Plaster proceeding at ground floor and exterior.

Floor tile 75% complete at first floor.

Survey Department has finally laid out ARC South property line adjacent site access road. Road alignment issue can now be resolved and roadwork started.

Chainlink fence compound in progress.

B. Force Account Activities

GENERAL

Visits were made by the project engineer to El Obeid on October 27 and November 6 and 7, to El Fasher and Ghazala Gawazet on November 3 and 4 and to Kadugli on November 15 and December.

At the Quarter's end there were more than 30 orders for equipment and material purchase or shipment still unfilled. Largest was the 300 tons of materials for building fences at Ghazala Gawazet.

ACTIVITIES BY SITE:

EL OBEID: Most of fencing contract was completed. NAW began installing a pump and storage tank at Beno.

Hashim Mukhtar raised the question of seed storage facilities. NAW bid LS 94,000 and supply of fuel to excavate a water storage pond. Collecting rain runoff from station roofs would yield over 1 million gallons a year.

EL FASHER: No physical Progress.

The Chinese contractor has agreed to store fence materials. CAA Khartoum provided some information guiding us in well site development near the runway.

GHAZALA GAWAZET: No physical progress.

Water supply piping plans were coordinated with contractor. Two water point systems were designed: one for off-station villagers and one for the on-station cattle herd. DeHavilland was contacted for advice on the airstrip. Farouk said that he would prepare animal facility recommendations. The station school rehabilitation program is 'on' again. An airstrip site requiring very little development is being sought.

KADUGLI: Force account work beyond that presently under construction is to stop.

PLANNED ACTIVITIES:

EL OBEID: Order pond liner-cover system. Fabricate farm gates.

EL FASHER: Install pump in supplementary well. Buy and ship pipe for well-station pipeline. Order pool liner-cover system.

GHALALA GAWAZET: Begin building 48km of fence. Install well site piping. Install additional 10,000 gallon steel tank. Build the two water points. Search for new airstrip site. Install windsock. Order materials for rehabilitating school.

KADUGLI: Move on-farm road bids as far as the Ministry of Finance. Order lightning rod hardware.

Several conditions within the project slow force account progress unnecessarily:

1. Role of project engineer is advisory only with no authority to implement.
2. The chain of command responds sluggishly.
3. Station scientists for whom some of the force account facilities are specifically constructed rarely respond to requests for information.

These conditions will change only if project management wants them to change.

IV. FINANCE

The quarterly financial statement is attached.

V. PROJECT IMPACT

A. Kaduqli Research Station

1. Agronomy Section

GENERAL

The major activity of the Agronomy Section in the last quarter was basically harvesting and collecting all necessary data of the 1984 research trials.

The Agronomy and Range/Livestock Sections met with the Regional Minister of Agriculture, Dr. Bashir El Tahir, at El Obeid on December 6, 1984. The Agronomy Section was asked to provide the minister with high-yielding, drought-resistant and short-maturing varieties of sorghum, sesame, groundnuts and pearl millet. Sorghum varieties recommended to fulfill the minister's

requirements were Gadam el Hamam, Dabar, and Hageen Dura #1, provided the timely availability of Hageen seed is guaranteed. For pearl millet, Ugandi was recommended, although in this year's trial there were some breeder's seed that outyielded Ugandi. Since information on varietal performance of sesame and groundnuts was not complete at that time, we sustained our recommendation until the 1984 data is analyzed.

SCIENTIFIC AND TECHNICAL ACTIVITY

a. On-Station Trials

The rainfall in the past crop season was low and poorly distributed. To this effect, the yields of our trials were, in general, below average and in some cases were even total failures. The trials that may be deleted from the 1984 research report as a result of the inadequate rainfall, pest damages, and their combinations are as follows:

Soybean national variety trial

Freely nodulating soybean trial

Effect of delayed harvest on sorghum grain yield and stover quality

Intercropping of sorghum with legumes

Hageen seed production

Pearl millet variety trial-8C

Variety Trials of sorghum, sesame, sunflower, cowpeas, mungbeans, pearl millet 3A, and groundnuts are being evaluated. In general, the low rainfall was the major constraint of production. Additionally, the sesame plots lacked uniformity in germination, the cowpeas were sporadically damaged by termites and insects, the groundnuts suffered from thrips, and the pearl millets were badly damaged by birds, ants and flooding at seedling establishment stage.

The details and results of these variety trials will be published in the 1984 Agronomy Annual Research Report.

Cultural Practices included nitrogen and phosphorus methods of application effect on sorghum, nitrogen and phosphorus rates of application effect on Hageen, sorghum yield trials, time and frequency of weeding effect on sorghum, plant spacing trial, and soil and moisture conservation trials.

Sorghum seedling vigor response to the fertilizers was in the order of $N + P > N > P$. This was further substantiated by the Hageen grain yield. Nitrogen application inside furrows gave consistently higher grain yield of Cadam el Hamam, Hageen, and local sorghum compared to that of surface dressing of nitrogen.

The sorghum yield trial data, although nonsignificant, indicated that Hageen out-yielded Cadam el Hamam and local sorghum (Eryann).

In the sorghum spacing trial, in spite of the low total rainfall (71.7mm), the results showed that 20 cm spacing between plants within the row gave relatively higher stover weight than the 10 cm, 30 cm, and 40 cm spacings.

Among the soil and moisture conservation trials, mulching had the highest soil moisture retention capacity with the highest tissue moisture content at harvest. Consequently, the grain yield and total dry weight biomass from mulching were higher than those of surface cultivation, ridge and furrow, and standard practices. In the land preparation trials, surface chopping residues retained higher soil moisture than burning and plow residue incorporation method.

b. On-Farm Trials

Farmer Managed

Among the nine farmers who participated in this program (refer to Third Quarterly Report), Monammud Abdella (Shaer) and Bakeker's wife (Bilenya) failed to weed and thin out their sorghum plots and they would not yield any useful information so the two trials were abandoned.

In Bilenya the rainfall was very low (268.5mm) and thus none of the local varieties flowered while Gadam el Hamam and Dabar were able to produce seed. Furthermore, Gadam el Hamam followed by Dabar gave consistently higher yield in all three locations. These results are good indications that early-maturing sorghum varieties with improved cultural practices would provide with the best solution to improve dura production in the Nuba Mountain region.

Researcher Managed

In Bilenya, due to the low rainfall, the sorghum plants in the fertilizer trials were stunted with only 15% of the total 48 plots bearing small heads. Similarly, Gadam el Hamam and Dabar in the timely practice and seed dressing trials were stunted and unevenly distributed with approximately 30% of the plants bearing heads. In both trials, the heads were stolen prior to harvesting. However, early seedling vigor rating in the fertilizer trial was in the order of $N+P > P > N$.

In Kululu, the timely practice and seed dressing trial plots were highly infested with Striga and so the grain yields of Gadam el Hamam and Dabar were considerably lower than those of the local farmers in adjacent plots which were planted earlier and with wider spacings.

Phosphorus and phosphorus + nitrogen at 40 and 40+40 kg/ha gave significantly higher sorghum yield of Gadam el Hamam and Dabar compared to the untreated check and nitrogen treatments. It was also observed that phosphorus and nitrogen + phosphorus induced (9-10) days earlier flowering of Gadam el Hamam and Dabar. The local sorghum could not reach 50% level and thus we could not detect any significant effect of the fertilizers on its grain yield.

In the sorghum and pigeon pea intercropping trial, neither of the crops flowered and set seed because of their late-maturing characteristics. Therefore, stover weights are considered for comparison with the total biomass of sorghum grown in the adjacent farmer's field. The data for the remaining intercrops are being analyzed and will be published in the upcoming Agronomy Annual Research Report.

Two sets of National Striga Resistance Trials were conducted at Elafein, which is known for its high degree of Striga infestation. Set #2, composed of 8 sorghum varieties, had less degree of Striga infestation compared to Set #1 with 25 sorghum varieties. IS 9830 was included in both sets of trials and was found to be early flowering with low degree of Striga infestation and eventually gave the highest grain yield.

c. Hageen Dura #1 Demonstration on Farmers' Fields

Our field observation and yield data indicate that Hageen Dura #1 is an early maturing, high yielding, and drought tolerant hybrid sorghum. In most of the farmers' plots Hageen outyielded the local sorghum varieties. The farmers who participated in this program were asked (1) if Hageen is acceptable as a food crop, (2) if they would increase Hageen acreage in the next crop season and (3) if they would be

willing to pay for Hageen more than the local market price. Their answers were unanimously positive. However, the guarantee of its continuous and timely availability cannot be overemphasized.

d. Miscellaneous Research-Related Activities

Post-Harvest Plowing

About six fedans of the Seraf Experimental Farm was chisel-plowed by GTZ tractor in December. The objectives of the post-harvest plowing are (1) to reduce cracking, (2) to control any moisture loss from the soil, and (3) to save time in land preparation during the critical time of planting.

Local Sorghum Germplasm Collection

Sorghum heads of different agronomic characteristics were collected from farmers' fields around Kaduqli. The objective of this collection is to develop sorghum varieties with drought-tolerance and high yield potential.

Soil Profile Study

Three pits of 1½m depth, 1½m length and 1m width were dug at different sites in the Seraf Experimental Farm. Soil samples were taken at different depth layers by Dr. L. Arya's technicians and were sent to El Obeid for laboratory analysis.

Training

Ahmed K. and Adil M, senior technicians in Agronomy, received a brief training on how to operate a desk calculator which is now being used in running analysis of variance and other statistical computations of our research data.

ACTIVITIES PLANNED FOR THE FOLLOWING QUARTER

- a. Complete the 1984 Agronomy Annual Research Report

- b. Prepare detailed planting plan and field layouts for the 1985 crop season which will include the following:

- (1) Plant spacing and planting date trials on sorghum, sesame and cowpeas

Plant spacing is determined by soil fertility, moisture availability, and growth nature of the plant. Last season, the sorghum plants were too dense for our environments and thus the seedlings were initially stunted and chlorotic. We conducted more preliminary spacing trials on Gadam el Hamam and Hageen with 10cm, 20cm, 30cm and 40cm spacing between plants within the row. Our results indicated that 20cm spacing gave relatively higher stover weight in spite of the severe rainfall constraint we had after planting (71.7mm).

Therefore, the objective of this trial is to determine the optimum plant population for each crop. In the 1984 crop season, we observed that earlier planted sorghum in the farmers' fields was growing more vigorously than the late planted ones because they had the advantage of making use of the total available rainfall. Therefore, the objective of the date of planting trial is to determine the best time of planting according to the maturity characteristics of the crops.

- (2) Variety trials of sorghum, cowpeas, sesame, early maturing pigeon pea, mung beans, sunflower, groundnut, and pearl millet. The objective of these trials is to evaluate promising varieties of each crop for future use in the Nuba Mountain region.
- (3) This trial will include different rates of nitrogen and phosphorus application effect on Dabar, Gadam el Hamam, Hageen

Dura #1, and traditional sorghum variety. In the 1983 and 1984 crop seasons, phosphorus and nitrogen + phosphorus at 40 and 40+40 kg/ha, respectively, increased sorghum yields significantly and induced earlier flowering of sorghum. Therefore, rate of N and P application effect on sorghum will be executed in order to determine the most economical combinations of nitrogen and phosphorus application.

- (4) Sorghum and sesame intercropping and long term rotation with legume crops

The main objective of this trial is to test the compatibility of legume crops with early maturing sorghum and sesame varieties planted with different row combinations. The experiment will be conducted at Seraf Experimental Farm and Kululu in a randomized complete block design with four replications.

- (5) Two sets of cowpea variety trials to be conducted on the heavy cracking clay soil and on the coarse-textured footslope soils in order to determine the adaptability of cowpea to the two soil characteristics.

- (6) Delayed harvest effect on sorghum yield and quality.

This trial will include four varieties of sorghum to be harvested at three different periods after physiological maturity. A randomized complete block design with four replications will be used.

The 1984 soil and moisture conservation trial will be repeated for further testing with some modifications on the experimental design.

Problems. Our experience in the last crop season demonstrated that the Agronomy Section cannot

operate its field activities normally with only one truck during the peak season of activity (June through early January). Our research trials were simultaneously carried out at five different locations (Seraf, Bilonya, Kululu, Shaer, and Elafein) and thus one truck alone could not fulfill the required transportation service effectively. We anticipate that our activity will be expanded in the 1985 crop season. Therefore, the need of a second truck in the Agronomy Section becomes necessary so that we will be able to make the timely needed field visits during the experimental execution, field data collection, and harvesting periods of the plots.

2. Range Management Section

GENERAL - CONSULTANTS, VISITORS, AND TRIPS

- a. In early October, Professor A. E. Hall from the cowpea CRSP in Riverside visited Kadugli for a few days. He discussed cowpea research with Drs. Bunderson and Woldestatios and visited field sites at the WSARP farm, Kululu, and the CPZ Farm at Elafein. Dr. Hall prepared a report on this visit which should be available soon for circulation along with a supplementary report written by Drs. Woldestatios, Bunderson and Gillard-Byers.
- b. Dr. Brown, Mission Director USAID, and other representatives from the Khartoum AID office, visited Kadugli in October to review and acquaint themselves with the research program and the project's future plans.
- c. In early December, senior staff representing the Kadugli and El Obeid Stations participated in meetings with the Regional Government in Darfur. The Western Savanna and Jebel Marra projects in the Province also participated. The meetings were designed to set up guidelines for WSARP research in the region by providing some prioritization of the problems. The Regional Government was extremely enthusiastic and were looking forward to WSARP's involvement in the near future.

- d. On December 6, a meeting was held with the Regional Minister of Agriculture, Dr. Bashir El Tahir, in El Obeid to discuss:
- (1) A WSARP proposal to examine the feasibility of implementing a dry-season grazing system for Baggara Transhumants in Southern Kordofan along with some limited disease-control strategies
 - (2) Relevant results of agronomic research by WSARP which could have immediate impacts on traditional farmers in the Province.

The Minister's response to both concerns was highly positive, and the meeting emphasized the necessity for improving and strengthening links between the research activities of WSARP and the efforts of the Regional Government. Minutes of the meeting were written and distributed in January.

- e. On December 14, my family and I took two weeks leave over Christmas and New Years

ADMINISTRATION

- a. Dr. Ibrahim Hashim, a range scientist originally slotted to go to El Fasher, came to Kadugli with his family until a decision is made on when the El Fasher Station will be ready for him to start his research. In the meantime, Dr. Ibrahim will be coordinating some research activities with other members of the Range-Livestock Section at Kadugli.
- b. A list of equipment and supplies to support research activities over the next year was ordered from Washington State University through the Khartoum administration.

STATION DEVELOPMENT

A new bore hole and pipeline are under construction to boost the diminishing supply of water on the Station. Currently, water is available for 7-8 hours per day.

SCIENTIFIC/TECHNICAL ACTIVITIES

a. Forage Agronomy

- (1) A number of forage legumes and grasses were evaluated under screening and production trials, both on-station and on-farm. Despite the very low rainfall this season, several species and varieties showed high promise for forage with other desirable characteristics including drought tolerance, resistance to disease and insect attack, good nodulation, and rapid establishment. The best performing forages were (a) mung beans (Vigna radiata-local), (b) guar (Cyamopsis tetragonolobus), (c) cowpeas (Vigna sinensis-local), (d) Clitoria ternatea, (e) Macroptilium atropurpureum, and (f) pioneer grass (sorghum-sudan grass hybrid). In addition, the mung beans, guar, and cowpeas demonstrated high potential as dual purpose crops in terms of food grain for humans and forage for animals. The resin from guar can also be used as a commercial cash crop.
- (2) An animal draft experiment was conducted in Kululu with the Socio-Economic Section to evaluate the effectiveness of and interest in ox-drawn carts for transporting sorghum grain, crop residues, and thatching from distant field sites on the cracking clays. Approximately 15 households have been participating in the experiment, and many others have expressed great interest in being involved in the future. Some individuals want to purchase their own carts and train their animals in a collaborative effort with other farmers. A cost-benefit analysis of the technology is being made to determine how it can be integrated effectively into the agricultural and socio-economic structure of the system.
- (3) Data analysis of the forage agronomy

experiments are being carried out and the results will be presented in the 1984/85 Annual Report of the Range Section. A paper entitled "The use and Potential of legumes in the Nuba Mountain Agro-pastoral System" is in preparation with the Agronomy and Socio-Economic Sections and should be published by July 1985.

- (4) A supplementary report to Dr. Hall's report on cowpea production in Western Sudan was written to rectify some serious omissions and misconceptions contained in Dr. Hall's report. The supplement will be published by Woldetatisios, Bunderson, and Gillard-Byers with Hall's report.

b. Range-Animal Ecology

- (1) In October, a feeding study of sedentary Nuba goats was initiated with four herds in two villages. The study focused on lactating females as the most important physiological class of animal in the herd. The objectives of this study will:
 - (a) identify key forage species of goats on a seasonal basis in relation to forage availability
 - (b) quantify trends in the nutritive quality of the key forage species selected by goats in the Nuba Mountains
 - (c) quantify trends in diet quality of goats on a seasonal basis
 - (d) quantify absolute forage intake by goats on a seasonal basis in order to relate diet quality with range conditions and how these influence one another along with changes in animal weights
 - (e) provide information necessary to

determine optimum carrying capacities for different vegetation-soil communities on a seasonal basis

- (f) provide information to enable a better evaluation of the current condition and trend of rangelands in the area in relation to their potential productivity and use
 - (g) identify critical nutrients and periods most limiting to goat productivity and how human activities impact on this in terms of rangeland improvement and development
 - (h) provide information to design range management practices and strategic forms of supplemental feeding for ameliorating nutritional stress and improve animal productivity
- (2) A study to assess herd productivity and kid growth in sedentary Nuba goats was initiated in mid-December with two herds totalling 20-25 animals each. The purpose of this study is to complement information contained in the study above by providing an evaluation of animal growth, weight change, mortality, and female productivity over the year. All individual animals are identified with numbered neck bands. Kid growth is measured by weighing at birth, 30 days, 90 days and 180 days. Other animals in the two herds are weighed on a quarterly basis. Female productivity and goat mortality is also evaluated on a quarterly basis.
- (3) An experiment designed to examine the availability of forage to livestock over the year was continued and is due for completion on April 1, 1985. It involves measuring the biomass and loss of herbage from various causes on a monthly basis. The primary function of the experiment is to determine how much of the forage produced on an annual basis is actually available to livestock as food. Information gathered thus far shows that only 6-10% of the

total herbage production in the Nuba Mountains is consumed by livestock. The remainder is either unavailable, unpalatable or lost through herbivorous insects, detritivores, small mammals and fire. The seasonal pattern and intensity of grazing by livestock also has important influences on the quality and quantity of available forage.

The results of this study will isolate and quantify the factors responsible for the loss of herbage over the year which can then be used for management decisions on:

- (a) the determination of proper carrying capacities for different rangelands at different seasons
 - (b) introducing changes in traditional grazing practices to maximize the quantity and nutritional quality of forage available to animals
 - (c) introducing management strategies and technologies to minimize forage losses attributable to unproductive causes
- (4) Harvest and transport of cowpea hay and sorghum-crop residues were carried out with two pairs of ox-drawn carts on farmers' fields at Kululu. About 3 tons of forage were transported and stored on a hay rakuba at a station-managed field site in Kululu. The forage is planned for use in a supplemental feeding trial of lactating cows with Nuba farmers during the late dry season.

ACTIVITIES PLANNED FOR THE FOLLOWING QUARTER

a. GENERAL

- (1) Participate in a Farming Systems Workshop hosted by WSARP and CIMMYT in Wad Medani from January 19-24.
- (2) Present a paper entitled "The Production and Supplemental Feeding of Native Forage to Sedentary Cattle in the Nuba Mountains" at the Farming Systems Symposium to be hosted by ICARDA in Syria March 25-28.

b. ADMINISTRATIVE

Provide overlap with Dr. Ibrahim Hashim who will be replacing me in Range-Animal Ecology by mid-April. The Fanderson family will begin packing to leave in late April.

c. STATION DEVELOPMENT (None)

d. SCIENTIFIC/TECHNICAL ACTIVITIES

(1) Forage Agronomy

- (a) Complete data analysis and associated reports on forage trials conducted during the 1984 season, with recommendations for future research
- (b) Complete the data analysis and reporting on the animal-draft experiments at Kululu

(2) Range-Animal Ecology

- (a) Complete studies on the feeding habits and productivity of sedentary Nuba goats
- (b) Complete range evaluation studies on major rangelands in the Nuba Mountain ecosystem
- (c) Complete the collection and preparation of plant specimens for the Herbarium representing South Kordofan. Included will be an organized filing system of all plants collected with comprehensive annotated notes for each specimen. Notes will include Latin and vernacular names, plant description, habitat characteristics of soils, vegetation and associated species, abundance and distribution, uses and forage value, site of collection, date and name of collector.
- (d) Preparation of a report listing the names, life form, habitat, abundance, uses and forage value of all plants identified in South Kordofan
- (e) Continue the assessment of forage avail-

ability and loss on the cracking and non-cracking clays in the Nuba Mountains and how this can be altered to maximize animal productivity in the region

- (f) Initiate data analysis and writing up of results for activities conducted in 1984/85

MAJOR PROBLEMS AND STEPS TO RECTIFY PROBLEMS

- a. Provision should be made for the training of technicians in short courses and workshops in Research Institutions such as ILCA and ICRTSAT. There are certain gaps in the level of training and expertise of WSARP technicians, and these could be overcome easily and inexpensively by short-term training programs which WSARP cannot undertake. It would also improve the morale and motivation of technical staff who have little opportunity for scientific advancement. Support for such training could be proposed through USAID.
- b. A decision on the extension of the project, for both Sudanese and technical assistance, should be made by USAID as soon as possible. Details concerning the specific nature and content of the extension should be included. The long delay in making these decisions has had a very negative impact on WSARP morale.
- c. A printer for the IBM portable computer is urgently needed, along with additional computers to serve the needs of the growing demands for computer time.

2. Livestock Section

GENERAL

Dr. Michael Harrington, O.D.A., from the Veterinary Research Laboratory, El Obeid, visited the Station during the 24th and 25th of November to discuss potential areas of collaboration. During these discussions, it was agreed that our laboratory would assist the Veterinary Department in Kadugli in performing agar-diffusion diagnostic techniques for evaluating suspected cases of Rinderpest. The Veterinary Research Department agreed to supply all the necessary reagents and supplies to carry out the procedure.

We attended a regional meeting in El Fasher, with other WSARP staff and resource people, and the Regional

Ministry of Agriculture, to discuss program guidelines for the two WSARP stations in Darfur. These meetings took place on December 3 and 4, 1984.

We attended a meeting with the Regional Minister of Agriculture and the Director General, Kordofan Region, to discuss a WSARP proposal for the establishment of a dry-season grazing reserve pilot study in South Kordofan for transhumant producers. We also discussed WSARP's recommendations for sorghum varieties to be planted this cropping season (1985), particularly in the light of the current drought. The Ministry gave considerable support for our pilot study proposal, and it was decided that specialists from WSARP/Regional Ministry would have a meeting to discuss details for implementing a feasibility study. A copy of the minutes of this meeting has been sent to WSARP headquarters, Khartoum.

Dr. Cook was on leave from the 10th - 31st of December, 1984.

SCIENTIFIC/TECHNICAL ACTIVITIES

An IBM personal computer arrived on the Station during this quarter and considerable time has been spent learning how to use the analysis package which was provided, and in the analysis of laboratory and field data. Disc storage appears to be an excellent method for organizing and storing station data for future use by other scientists.

Problems have arisen in acquiring an appropriate phosphorus supplement for our researcher-managed trials with producers in Demek despite the fact that requests for this material (di-calcium phosphate) were initiated in August, 1984. Attempts may be made to use limited amounts of superphosphate fertilizer, but implementation of a complete trial looks doubtful at this time.

The Range/Livestock Report for 1982/83 has been published (WSARP Publication #29) and is now available for distribution.

A paper entitled, "Seasonal Disease Incidence in a Sedentary and Migratory Sentinel Herd" has been submitted to the Journal of Tropical Animal Health and Production.

A paper dealing with the quantification of milk production by cattle and sheep in pastoral systems has been started

and will be completed by the end of the 1985 rainy season, once adequate field data has been collected.

Critical reagents for the continuation of blood phosphorus analyses have been received and the analysis of forage phosphorus levels has started.

A paper for the ICARDA Farming Systems Workshop to be held in Aleppo, Syria the last week in March, 1985, entitled, "Implementation of In-Herd Trials, The Role of Sentinel Herds" is in preparation.

Preliminary studies on the nutritional and disease status of camel production systems in Southern Kordofan is being postponed due to the lack of adequate resources and a re-prioritizing of section activities.

A paper entitled, "Dry-Season Supplementation of Cattle with Local Crop Residues in Kordofan Region, Sudan", has been submitted to the Journal of Tropical Animal Health and Production.

Fadlalla attended a meeting on "The Modes of Livestock Production in Arab Countries", held in Riyadh, Saudi Arabia, 11-14 November, 1984. A paper entitled, "Cattle Production among Transhumant Baggara Tribes in Kordofan Region, Western Sudan" (in Arabic), was presented.

A voluntary intake, diet quality, diet composition study was initiated with transhumant sheep in October, 1984.

ACTIVITIES FOR THE COMING QUARTER

A protein/phosphorus supplement trial, commenced in April, 1984, is scheduled to commence its second phase in April, 1985.

Efforts will be made to initiate a phosphorus trial with transhumant sheep in February.

A trial focusing on the seasonal control of ectoparasites of transhumant sheep will be continued during the 1985 dry-season.

Two in-herd trials assessing the efficacy of Ivermectin in the treatment of demodectic mange and penicillin/streptomycin in the treatment of streptothricosis in transhumant cattle will continue.

Monitoring of the migratory sentinel herd will continue.

Studies to evaluate the seasonal diet quality of transhumant sheep which were initiated last quarter will continue.

CONSTRAINTS TO RESEARCH EFFORTS

The absence of adequate secretarial assistance is still with us.

Problems were experienced (COOK) in transmitting radio messages to the Khartoum Office. The inability of the Khartoum radio operator to speak and understand English or Arabic well makes efficient communications with Khartoum very difficult.

This past quarter has seen a decrease in staff morale, in large part, due to the indecision regarding Project continuation. What should have been a period of constructive discussion appears to have been one of devisiveness and inappropriate allegations about the focus of the research program in an attempt to justify dramatic changes in basic Project objectives. Hopefully, this situation will not continue.

3. Socio/Economic Section

GENERAL

This quarter's work was characterized by a continued high level of activity in the Socio/Economic Section. The section received Dr. Milton Coughenour from the University of Kentucky, who presented a seminar dealing with transfer of technology to traditional farm households. Along with WSARP scientists, six agriculturally oriented groups from Kadugli were present for the seminar. Additional seminars are planned in the future to provide a flow of information to and from the agricultural community.

The Socio/Economic Section was visited by a number of other individuals and groups reviewing and consulting on project activities. None of these visits were directly related to activities of the section.

The Socio/Economic Section was represented in meetings with government ministers and employees in El Fasher in November of 1984. The trip to El Fasher was design-

ed to show support for activities in the North Kordofan Region. A trip to Khartoum was undertaken to consult with USAID and World Bank economists and farming system specialists. Discussions with USAID centered around the distribution of food in the Nuba Mountain area. The subject was discussed at length and it was concluded that dara (sorghum) should not be distributed in the Nuba Mountain area around Kadugli until March of 1985. In addition, posters explaining that the food aid should be used for consumption only were to be distributed in the Kadugli market and other villages where our section is conducting interviews.

ADMINISTRATIVE

- a. The Socio/Economic Section has been hindered by procedures used to control the use of benzine. The system in place at the present time required three or four allocations of benzine per week. This results in many hours of wasted time each week.
- b. Supply of equipment has not been timely and is worsened by the appropriation system. Requests for field materials were delayed six to eight weeks. This has restricted field work activities.
- c. The per diem for field expenses for staff is insufficient. There needs to be a supplemental per diem to pay for food and durable items used in the field. This is especially true due to the propensity of food prices increase as supplies dwindle.
- d. Staffing of the Socio/Economic Section is problematic. At the present time, there is one senior technician, one junior technician and two staff members working in the section. During the coming quarter, two of these staff members have been informed that they will not be retained. The proposed reduction of staff, which has taken six months to build up to a minimum requirement, is untenable. Reduction in staff will result in severe cutbacks in the activities of the section.

SCIENTIFIC AND TECHNICAL ACTIVITIES

The Socio/Economic Section has undertaken two additional projects during this quarter. They include an animal draft experiment in Kululu and a survey describing and detailing the importance of the Jubraka (house garden), both experiments having been part of the 1984 workplan.

- a. The draft experiment is a continuation and expansion of the draft experiment undertaken in Bilenya during 1983 by the Range/Livestock Section. The Socio/Economic Section initiated the survey in the Kululu area using technical assistance from both the Socio/Economic Section and the Range/Livestock Section. To my knowledge, this is the first attempt at integrated work among sections impacting directly on the farm household. The results are expected to lead Kululu toward the use of animal draft for transportation and at a later date animal traction.

The objectives include estimating costs of the new transportation technology and comparing these with traditional methods of transportation. The primary commodity to be transported is sorghum which is taken from the field to a threshing area. However, the decision on type of usage is left to the farm household. Sociological constraints to the introduction of animal draft will be investigated. This research dovetails nicely with work being carried out by Mohamed El Amin and his enumeration staff in Kululu. Furthermore, it adds to the visibility of the WSARP staff in areas where a good relationship is being developed with the farm households.

- b. The Jubraka survey was started toward the end of this quarter. Thirty farmers, in three villages, will be interviewed. This survey is being undertaken and managed by Mr. Abu Sabah, who has done a fine job with development of the questionnaire, selection of the sample group and interviewing farmers. This will provide a valuable addition to the Sedentary Survey carried out in 1983. It should also be used by the Agronomy Section as a guide to research on crops produced during the food gap period of August through October. The Jubraka provides the main source of food during this period and has not been investigated in detail to determine the contribution to family consumption.
- c. Commodity price information has been collected from Kadugli, Katcha, Kululu and Dobebat markets. This information pertains to staple foods both processed and unprocessed. A monthly price series is being developed to trace price trends and for use in evaluating differences between farm-gate prices and the market prices mentioned above. Transaction costs

will be developed which will provide information on the opportunity cost of labor used in the transportation activity.

- d. Livestock price information is being collected on a daily basis from the Kadugli livestock market. This data is being developed and used as an information base for both producers and consumers in the Kadugli and surrounding villages. Trends will provide general information useful in timing of livestock sales. The livestock price information will provide data for use with the livestock marketing survey to be undertaken next quarter.
- e. A supplementary information survey is being undertaken in three villages: Kululu, Katcha and Dobeabat, to provide additional information on cultural constraints as well as to provide some insight into the consumptive practices and preferences of the traditional farm household. Thirty farmers are being interviewed in these villages. This information will fill gaps which exist in the sedentary survey undertaken in 1983. Additional information on religious constraints pertaining to the Kujur's (religious leader) role in planting and harvesting activities as well as his impact on the potential to introduce new mechanical technology is investigated. Consumption activities of the farm households, especially wild plants and animals, are examined and preferences associated with type of foods consumed are investigated.
- f. The section is passively working on the sociological and economic analysis of the transhumant production system. This is done in support of the Range/Livestock Section activities pertaining to supplementary feeding experiments. The intent of the Socio/Economic Section is to foster cooperation among the sections while at the same time developing a partial budget analysis of feed supplementation activities. This would be done to assess the economic viability of supplemental feeding given exogenous mineral supplements.
- g. The Socio/Economic Section is actively participating in support activities for Mr. Mohamed El Amin and his enumerators. The latter is supervisor for the data collection activities of a Ph. D. student currently at Washington State University. Support

activities include transportation, provision of water, kerosine and other field supplies as well as providing backstopping for the activities of the group. The enumeration team is moving toward its final field assignment which is the collection of credit information from the farm households in their respective samples.

It is clear that the continuation of the entire enumeration staff is needed for at least two additional months after the original contract period has expired. Three reasons lead to this conclusion: (1) the coding of the data should be done in the presence of the team having done the enumeration if not done by them, (2) overlapping of staff returning to Sudan with staff carrying out research in Sudan is a necessity if continuity of research is expected or desired and (3) the coding of the information entails a minimum of .8 man years of labor. It is important that this information be available to other sections before planning begins for the 1985/86 projects which require the use of farm household resources. This means that analysis must be carried out in the first quarter of 1985. This will not be possible unless staffing in the Socio/Economic Section is maintained at present levels. Furthermore, at present staffing levels the Socio/Economic Section will not be able to undertake more than the livestock marketing survey of the Transhumant production system during the first quarter of 1985.

- h. The senior scientist in the Socio/Economic Section developed and carried out a training course in the use of the IBM Portable Computer. The course consisted of six, two-hour meetings of senior scientists. The first hour provided information on operation of the computer and trouble-shooting. The second hour consisted of hands-on training with the computer.

Training sessions and computer usage have been hampered by lack of supplies. A printer is a necessity as are diskettes for storage of data. Neither of these items have been received, although they are expected. This reduces the productivity of computer use considerably.

Each section's senior scientist was provided the training opportunities. It is now up to each senior scientist to choose the proper training activities to provide for other members of their staff.

ACTIVITIES PLANNED FOR THE FIRST QUARTER - 1985

The Socio/Economic Section will expend most of its resources on the analysis and publication of data generated in the third and fourth quarters of 1984. Due to staffing and supply shortages, only one major field activity will be undertaken during this quarter. The experiment will consist of the documentation and analysis of marketing activities undertaken by the transhumant population in the Nuba Mountain area.

The section will work closely with the Agronomy Section to develop on-farm trials which provide clear information on the economic acceptability of new microbiological technology. It is important that clear distinctions be made between farmer-managed, researcher-farmer-managed and researcher-managed on-farm trials in the coming year.

The Range/Livestock Section and the Socio/Economic Section will coordinate the second phase of the introduction of animal draft to Kulula. This will entail training of animals, purchase of equipment and development of a credit interface.

B. El Obeid Research Station

GENERAL

During this quarter, a number of visitors and missions visited the Station, including the following: Professor Anthony Hall, Professor of Plant Physiology, University of California, Riverside, visited El Obeid from October 2 - 7, 1984. His visit pertained to cowpea production and research program. He visited a number of cowpea fields in the area around El Obeid and also visited the market and had discussions with the scientists.

A World Bank mission headed by Mr. S. Marpels visited El Obeid on October 8, 1984, accompanied by Dr. Dafalla A. Dafalla, Director of WSARP. The mission reviewed the research programs in a meeting with the scientists and toured the Station.

Dr. Mohamed Musa Ali, Deputy Director, Western Savannah Development Corporation, accompanied two teams of specialists from the World Bank who visited the Station

during the third week of October. They toured both the construction site and the Research Farm and they were exposed to the on-going research programs.

Mr. Edward Spriggs, Director of the East Africa Division of the Agency for International Development, visited El Obeid accompanied by Mr. Carlos Pascual, Project Development Officer, JSATD/Khartoum. An overview of WSARP activities was given during their tour of the construction site and Research Farm.

An INSORMIL Project evaluation committee visited the Station and Research Farm on November 6, 1984. The committee consisted of the following:

Dr. Nancie Gonzalez, University of Maryland
 Dr. Berhane Gebrekidan, SAGRAD/OAU, Nairobi
 Dr. Darrell Rosenow, Texas A&M University
 Dr. Gebisa Ejeta, Purdue University
 Dr. Allen Kirleis, INSORMIL country coordinator
 for Sudan

The WSARP scientists participated in the presentations and discussion in the meeting that was held in the morning of November 6, 1984 regarding INSORMIL Program in the Sudan.

Dr. Hassan A. Dinar, Horticulturist, ARC Mudeiba Research Station, was invited to visit El Obeid November 10 - 15, 1984 to contribute to the planning of pomology research to be conducted at the horticultural farm now being developed at Bano, South of El Obeid.

On November 24 - 26, a World Bank mission accompanied by Mr. Abuelgasim Seif El Deen, former Head of the Gum Research Division, visited El Obeid to discuss projects and potential for forestry development in Western Sudan. They were accompanied in a visit to GozAshgar Central Reserved Research Forest, where they were briefed on the gum research program of the Station.

ADMINISTRATIVE

Dr. Hassan Osman A. El Awad joined El Obeid research staff as agronomist after completing his Ph.D. study at the University of California, Riverside.

STATION DEVELOPMENT

Instead of a formerly rented house, two adjacent

government houses, recently evacuated and belonging to the Station, were maintained, modified and used as laboratories and offices for the Soil Conservation, ICRISAT and Entomology staff of the Station. A standby generator has been relocated for these offices to provide standby power.

The fencing of the whole research farm and the eight range enclosures has essentially been completed. Fixation of the elevated water tank and pump at the horticultural farm at Bano is nearly completed.

SCIENTIFIC AND TECHNICAL ACTIVITY

1. Agronomy - Crop Improvement

Activities during this quarter centered around collection of data from various experiments. All the experiments were drastically affected by the severe drought encountered during this season. The total amount of rainfall received at Kaba Farm ('gardud' soil) was only 155.5mm, and all the experiments at this site had to be abandoned. At WSARP Farm - El Obeid (60% sands), the total amount of rainfall received was only 175.5mm, with 142mm effective rainfall. Some yield data, though not complete, has been collected from variety trials on sesame, guar, cowpea and sunflower. No yield data was possible from variety trials on the other crops, especially sorghum and soybean. The season, however, provided extreme conditions for selection for drought tolerance. In this regard, a bristled population of pearl millet developed by mass selection, in cooperation with ICRISAT millet breeder, showed very good promise as a drought tolerant material with good performance.

ACTIVITIES PLANNED FOR THE FOLLOWING QUARTER

Activities planned for the following quarter include the following:

- a. Analysis of the data obtained from the various experiments
- b. Preparation of the annual reports
- c. Planning and discussion of the next season's research program

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2. Groundnut Improvement

SCIENTIFIC AND TECHNICAL ACTIVITIES

The main activities carried out during the previous period were as follows:

- a. Harvesting of the 1984 experiments
- b. Results analysis of 1984 research

A visit to Ennhoud and Kadugli was organized during October to observe the groundnut fields and the Variety Trials conducted there.

3. Horticultural Crops

SCIENTIFIC AND TECHNICAL ACTIVITY

The following on-farm trials were carried out on farmers' fields at El Rhor El Abiad (6 miles from El Obeid)

- a. Tomato variety trial
- b. Eggplant variety trial
- c. Sweet pepper variety trial
- d. Okra variety trial
- e. Cucumber variety trial
- f. Squash variety trial
- g. Watermelon variety trial
- h. Muskmelon variety trial
- i. Onion variety trial
- j. Effect of seedbed preparation and irrigation interval on onion
- k. Effect of plant spacing (inter and intra row spacing on watermelon)
- l. Effect of plant spacing on tomato

- m. Effect of plant spacing on eggplant
- n. Effect of plant spacing on sweet pepper
- o. Effect of NP fertilization on tomato
- p. Effect of NP fertilization on eggplant
- q. Effect of NP fertilization on sweet pepper

Data collection on flowering, fruit-setting and yield is in progress.

Broadbeans, garden peas, chick pea and lentil varieties were grown in small plots to test their growth and adaptability.

MEETINGS

I attended the Eleventh Africa Symposium held in Cairo from December 9 - 16, 1984. The Symposium was about tomato production on arid lands. The papers presented covered the following aspects:

- a. Plant material (variety, breeding)
- b. Propagation (production and quality aspects, transplant and growing media)
- c. Soil/Water/Nutrition (practices related to soil type and nutritional requirements - irrigation techniques)
- d. Climatic modification (plant shelter techniques - plastic houses intercropping)
- e. Post-harvest studies
- f. Plant protection (insect pests and disease control, weed control)

I also joined WSARP staff in attending the Farming Systems Worksnop held in Wad Medani from January 19 - 24, 1985.

4. Soil and Water Research

GENERAL - VISITS AND MEETINGS

On October 7, 1984, Dr. Anthony Hall of the University

of California, Riverside, visited El Obeid. I met with him and had discussions on drought tolerant cowpeas. We also discussed problems of increasing water intake in 'qardud' soils.

On October 8, 1984, a visit was made by World Bank team and members of the Western Savannah Development Corporation. The team visited WSARP Farm, El Obeid and viewed experimental plots. There were discussions on water conservation problems.

On October 18, 1984, Mr. Chris Giles and Mr. Allan Robertson of the Australian Agricultural Consulting and Management Company and members of the Western Savannah Development Corporation visited El Obeid and held discussions on crop, soil and water problems in Western Sudan. They also visited the WSARP Farm in El Obeid.

On November 5, 1984, I visited the Soil Conservation Department in El Obeid and attended a seminar on rangeland vegetation survey using low level aerial photography given by Bill Astle of FAO.

On November 6, 1984, I visited Kadugli to view the soil and water conservation plots and discussed problems with Dr. Woldetatis.

On November 22, 1984, I visited Kadugli once again and photographed soil and water conservation plots.

On December 3 - 5, 1984, I attended WSARP research planning meeting for El Fasher and Ghazala Gawazet. The meeting was held in El Fasher. At this meeting, I had the opportunity to meet with a number of scientists working with the Darfur Regional Ministry of Agriculture and Jebel Marra and Western Savannah Development projects. We had several useful discussions.

On December 11, 1984 - January 15, 1985, I was on vacation in the United States.

ADMINISTRATIVE

The soil and water office and laboratory were moved to a new location on November 15, 1984. This unit is now located in a house meant to be a residence for a Gum Arabic research personnel.

SCIENTIFIC AND TECHNICAL ACTIVITY

a. Soil and Water Management

- (1) Experimental plots were harvested during the third and fourth weeks in November. Tabulation of data was completed.
- (2) GOZ sands at WSARP Farm exhibited a marked spatial variability in terms of plant growth. Observations showed that poor growth was associated with patches that were smooth and crusted. Penetrometer data showed high mechanical impedance on the crusted surfaces. The cause of impedance in sands is not known. A large number of spatially distributed samples was taken for analyses to determine spatial variation of soil properties. Tillage of some sort may be necessary to homogenize the soil. However, wind erosion problems will have to be dealt with.
- (3) Three soil profiles at each of the three WSARP farms (Banou, El Obeid, and Kadugli) were sampled to a depth of 150 cm. Samples were taken at increments of 5 to 15 cm. After air drying, crushing, and passing through a 2mm sieve, the samples were bagged and shipped to ARC, Wad Medani, for analyses for physical and chemical properties.
- (4) Attempts were made to monitor soil moisture in GOZ and 'gardud' soils. Sampling with an auger was not successful. In GOZ sands, samples could not be held in the auger. In 'gardud' soil, augering was most difficult due to excessive hardness. With four people working, only two holes of 60 cm each could be drilled in three-quarters of a day. Moisture content at the 60 cm depth was found to be 3%. Apparently, little or no water had penetrated the 'gardud' soil during the rainy season. It was concluded that a non-destructive sampling is the only means of monitoring soil moisture in these soils.
- (5) Equipment for installation of neutron access tubes was designed and fabricated.

(6) A solar still was designed for production of distilled water for laboratory work.

(7) Bulk densities for the three soil profiles mentioned in (3) above were determined by a combination of core and clod methods. Gum arabic was used as a coating material.

ACTIVITIES PLANNED FOR THE FOLLOWING QUARTER

- a. Past season's data will be analyzed.
- b. Plans for 1985 cropping season will be prepared.
- c. Neutron access tubes will be installed and field calibration of the neutron probe will be carried out.
- d. Drip irrigation will be installed on at least two farms in Bangladesh.
- e. Moisture loss patterns and erosion will be studied in ridge-furrow vs. flat beds on GOZ sands. Ridge-furrow beds appear to be the only short-term solution to wind erosion in cropped fields. They are also effective in moisture conservation. Information gained will be utilized in planning field trials for the 1985 cropping season.
- f. Field/laboratory trials will be carried out on methods of seedling establishment and survival. Information gained will be used in planning field trials for the 1985 cropping season.
- g. Soil properties will be measured.
- h. Weather data will be analyzed.

MAJOR PROBLEMS

Water, electricity, and space remain a problem. Also, additional technical assistance is needed. An increase in the budget for local purchases will be helpful.

5. Entomology

SCIENTIFIC AND TECHNICAL ACTIVITY

Routine observations were carried out to inspect insects on Variety Trials of eggplant, tomato, onion, cucumber, squash, muskmelon, sweet pepper, and watermelon on weekly visit basis from January 2, 1984. In addition, legume crop lines were similarly observed. These include: peas, chick pea, faba bean and lentils.

6. Range/Livestock Section

GENERAL

Professor Hall had visited El Obeid Station and was accompanied in a field visit to villages west of El Obeid where cowpea and other crop fields were observed.

ADMINISTRATIVE

Mr. Abd Alla Hassan, the Range/Livestock Technician, will be on his annual leave until the end of January.

SCIENTIFIC AND TECHNICAL ACTIVITY

- a. Sheep study - A report on the constraints to sheep production in the nomadic and the sedentary systems of North Kordofan was completed for the wet season period. The report was a detailed description of the husbandry systems with regard to: flock composition, mode of grazing, watering, range utilization, breeding techniques, lambing seasons and percentages, weaning, castration and kulling. Constraints were divided into two categories: those which can be alleviated through extension and those for which interventions or research is needed.

Another separate report on sheep health survey was finished in collaboration with the Veterinary Research Laboratory. The report covered the wet season period for blood parasites and the digestive system parasites through analyses of blood and feces. Generally, disease was found not to be a constraint for this period. The survey will continue until the two flocks complete their breeding cycle.

- b. Plant introduction and evaluation - Introduced seed material (grasses and legumes) was tested

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for pasture development in El Obeid ('gardud' and sandy soil) and Kadugli (clay soil). Seed material was selected according to: moisture requirements and drought resistance, grazing quality, persistence under grazing, disease resistance, seed production and natural regeneration, adaptability to woreda conditions and adaptability to soil type. The detailed report about this study is being typed.

- c. Crop residue production and utilization system - A study which covered four villages in the El Obeid area was carried out to determine the constraints to utilization of millet, sorghum, cowpea, and millet stover. The study covered: the agronomic practices, residue yields and method of harvest, means of transportation and average cost, system of storage, utilization, constraints, and recommendations. The report is being typed.
- d. Food habits of sheep - Fecal and plant reference material for the determination of the diet composition of the sedentary and the nomadic sheep in North Kordofan is being collected since July, 1984 and will continue until June, 1985. A microhistological analysis technique will be used. Equipments and materials were ordered from the United States for that purpose but have not been received yet. It is suggested that these samples be sent to the Composition Analyses Laboratory at Colorado State University for analysis on a cost basis (about \$2,400 for the whole study).
- e. Vegetation measurements and desertification - The construction of eight exclosures, four on the sandy soil at Um Keriedim and four on the 'gardud' soil south of the Ban Jadid, was completed. Vegetation and soil measurements will be started immediately after the handing over between the contractor and the project is finished.

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RESEARCH ADVISOR TO DIRECTOR GENERAL, ARC

OCTOBER

- 1 Requested publication from ILCA requested by R.H. Cook, WSARP Animal Production Specialist
- 1 Wrote Brian Kerr, Land-use Planner WSDC, re : WSDC plans for aerial photography in Darfur.
- 1 Met with Dr. M. T. Abuamara, Faculty of Veterinary Science re : request for publications on domestic range in cattle from R. H. Cook. (Returned several times during quarter but never received papers).
- 2 loaned WSARP papers on Range and Livestock activities to Chris Howse, Training Technical Service for use by Dr. Allastair Mackay, IIPS Range and Livestock Consultant with Jebel Marra Rural Development Project.
- 2 Met with Drs. Mahmud El-Mula and El Tag Bago, Dept. of Agronomy, University of Khartoum regarding appointment with WSARP consultant Dr. Tony Hall, Bean and Cowpea CRSP.
- 2 Met with Mohamed El Amin and Prof. Nasser, Librarians at Shambat and Khartoum Campuses of the University of Khartoum, respectively, regarding establishment of a training program for Adam Dayin Kadugli Radio Operator who is to serve as Station Librarian.
- 3 Met with Ed Lippert, Dept. of Statistics and Agricultural Economics, Ministry of Agriculture and Irrigation re : plans for aerial photography of Kordofan traditional and mechanized crop protection areas.
- 4 Met with Dr. David W. Howes, Fulbright Scholar from E. Kentucky University visiting Prof. University of Khartoum, who is remote sensing specialist, re : means of implementing his program to quantify intensity of rainy season in Western Sudan.
- 5 Sent complete Daily Rainfall Records for WSARP stations since record keeping initiated to USA, for analysis with Dr. Brian D'Silva, USDA employee completing assignment in Sudan with the Development of Rural Economy, University of Khartoum.
- 6 Transmitted slides and photographs of Trip to Jebel Marra to Hume Horan and Judy Shinn, American Ambassador and wife of American DCM.

- 7 Held discussion with Dr. Tony Hall, U of California, Riverside, and Bean and Cowpea CRSP regarding his visit to Kordofan. He recommends WSARP establish research farm between Dubeibat and Dilling to evaluate in erplanting of legumes (especially cowpeas with millet and sorghum).
- 8 Met with Dr. El Imam El Khider, Dean Faculty of Agriculture, University of Khartoum, and Dr. El Finay, Food Chemist, Faculty of Agriculture with Dr. Tony Hall, Bean & Cowpea CRSP.
- 8 Dr. T. Hall and I met with Drs. El Tag and Mahmoud, Dept. of Agronomy, U of Khartoum, re : cowpea research at University of Khartoum.
- 3 Forwarded letter and technical paper to Dr. Simon Kenyon, Soba Veterinary Research Labs for R. H. Cook, WSARP Animal Protection Specialist.
- 8 Dr. T. Hall and I met with Dr. Farouk Ahmed Salih, Legume Breeder, and Mr. Mohamed El Hassan Mohamed Salih, Range and Pastures Specialist, Shambat Research Station, Agricultural Research Corporation in regard to ARC cowpea research.
- 8 Dr. T. Hall and I met with Prof. Maimoud Ahmed Mahmoud, Senior Agronomist, Mechanized Farming Corporation re : cowpea trials conducted in rainfed areas of Western Sudan by MFC.
- 9 Dr. T. Hall and I met with the Director General of the ARC; Dr. Hassan Mohamed Ishag, National Coordinator for Groundnut Research; Dr. Saeed Mohamed Farah, Physiologist, Agronomy and Crop Physiology Section, Gezira Research Station, and Dr. Osman Ahmed Ali Ageeb, Head of Agronomy and Crop Physiology Section, Gezira Research Station, regarding cowpea research in Sudan.
- 10 Dr. T. Hall and I met with Dr. Mirghani Khogali Ahmed, Head of Horticultural Research Section, Gezira Research Station, ARC re: cowpeas as a horticultural crop.
- 10 Dr. T. Hall and I met with Dr. Abdel Monelm Beshir El Ahmadi, Head of Plant Breeding Section, Gezira Research Station, ARC re legume and groundnut breeding work being carried on by ARC particularly that related to introduction of improved cultivars for the rainfed areas (i.e. Western Sudan).
- 10 Dr. T. Hall and I met with Dr. Ahmed Nasir Balla, National Coordinator for Entomological Research re : major pests of cowpeas in the field and in storage and means of controlling them.

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- 10 Dr. T. Hall and I met with Dr. Abdalla Mohamed Hamdoun, Head of Botany and Plant Pathology Section, Gezira Research Station, ARC re : striga host spectrum. Striga gasthanoides which was reported to be in the Kadugli area by Dr. Musselman, attacks cowpea in West Africa. Cowpea can act as a false host for striga hermonthica.
 - 10 Dr. T. Hall and I met with Dr. Abdel Maged Yassin, National Coordinator for Botany and Plant Pathology research re : nematodes in Sudan and susceptibility of cowpeas to nematodes.
 - 11 Wrote S.K. Singh, Legume Improvement Program Leader, IITA re : cowpeas for evaluation in Western Sudan. (T. Hall handcarried letter to IITA and D. A. Dafalla handcarried seeds to Khartoum).
 - 11 Met with S. Tahir Qadri, CARE based in Gedaref re : vegetable production in Eastern Sudan and project to plant shelterbelts for Agro-Forestry development, including vegetable crops, in Eastern Sudan. Gave him copy of Kordofan Horticultural Survey Report and suggest he contact ARC horticulturists to do similar study in Eastern Sudan. Gave him names of ARC horticulturists in Wad Medani and Kassala.
 - 17 Accompanied WSARP staff and Dr. and Mrs. W. R. Brown to Kadugli to review research program. Participated in field tour and discussion that followed.
 - 21 Dr. David T. Higgins, WSARP Project Engineer, and I met with Dr. Hassan Ali Dinar, ARC horticulturist and Mr. Abdin N. Hassan, Chairman and Managing Director of Technical Transport Service International Ltd. re : informal evaluation of proposed Irrigation project in the Northern Province of Sudan.
 - 21 Arranged for Dr. Hassan Ali Dinar, Horticulturist, Hudeiba Research Station ARC, to go to El Obeid in November to provide assistance to WSARP Horticulturist, Dr. Osman Adam Osman on pomology program development.
 - 21 Met with Dr. Hassan M. Hassan et al of Resource Surveys and Engineering Co. regarding flight plan for taking aerial photos of Kordofan agricultural production areas.
 - 22 Participated in panel discussion for Peace Corp Volunteers on Development in Sudan.

- 22 Met with Dr. Tareke Berhe, INTSORMIL Agronomist, El Obeid, regarding cowpea seed for Dr. El Almadi, Head of Breeding Section Gezira Research Station, ARC. Later I talked to Nancy Gillard-Byers in Kadugli via radio and she will relay message to Dr. Bunderson, who will send seed to me for Dr. El Almadi.
- 23 Attended WSARP staff meeting.
- 23 Reminded Dr. Rosenow, Sorghum Breeder, Texas A & M of our request for sorghum seeds from W. African graduate student at Texas A&M.
- 25 Met with Dr. Gebisa Ejeta, INTSORMIL, Purdue University (formerly with ICRISAT program in Sudan and breeder of Hageen-Dura, newly released hybrid sorghum in Sudan) and Dr. Tareke Berhe, INTSORMIL agronomist Kansas State University posted in El Obeid re : hybrid seed production program in Sudan.
- 27 To Sennar to review Sorghum Hybrid Seed Production Program. Met with representatives of National Seed Administration, Plant Propagation Unit, USAID, Dekalb. Meetings and field review also attended by Dr. LeMoyné Hogan, WSARP Deputy Director and WSU Chief of Party and Mr. Lynn McDonald, WSARP consultant to Hybrid Seed Production Program.
- 28 Attended field tour of Hybrid Sorghum Seed Production plots on the Gezira scheme followed by meeting in conference room at Sudan Gezira Board, Barakat. Prepared summary of main points of latter meeting (appended).
- 28 Met informally with Dr. L.D. Swindale, Director General ICRISAT at home of Dr. R.P. Jain, ICRISAT Millet Breeder posted in El Obeid. Discussed WSARP program, Hybrid Sorghum Development, and future ICRISAT involvement in Sudan.

NOVEMBER

- 1 Met with Dr. Pierre Marzell, International Trade Center, UNTAD/
GATT re : potential for Korkodeh and Acacia seyal gum in Western
Sudan.
- 5 Drs. Dafalla and Hogan, WSARP Director and Deputy Director and I
met with members of the INTSORMIL Evaluation Panel, namely
Drs. Gonzalez, Gebisa, Brhane, Kirleis and Rosenow. INTSORMIL
past and possible future contribution in Sudan was discussed.
- 6 Loaned several publications on post harvest grain losses and
storage techniques to Dr. Mohamed Hassan El Shazali, Stored
pest entomologist, Chambat Research Station, ARC and requested other
publications for him.
- 8 Distributed invitations to resource people for Research Planning
Meeting to be held in El Fasher 4 December 1984.
- 10 Met with Alistair McKay, Livestock and Range Consultant, RRS, re :
range and livestock development in Darfur Region and potential
interaction between Jebel Marra Rural Development Project and
WSARP.
- 13 Met with Charles Tapp, USAID consultant on forestry and Dr. Khogal
Ishay, Dept. of Biochemistry and Soil Science, University of Khartoum,
re : forestry research and development in Sudan.
- 14 Met with Ms. Susan Holcombe, UNICEF consultant on Home Gardening
for Nutrition Improvement re : Horticultural Resources in Kordofan,
international sources of information and expertise on vegetable
crops (AVRDC and IITA), and possible means of increasing awareness
of the importance of vegetable crops to the diet in Kordofan.
Gave her copy of WSARP publication No. 6, Reeves and Frankenberger
Report No. 2 and AVRDC Annual Report. (met again Dec. 2).
- 15- Assisted in arranging for medivac of Michelle Bunderson with parents
16 and infant brother,
- 17 Prepared and forwarded to Dr. W.L. Astle, FAO Expert on Grazing
Resources Inventory Project in Kordofan bibliography of WSARP
publications at request of Mahmoud Fadel El Mula Idris and Il Ham
E. Ahmed of the Range and Pasture Administration.

- 18 Met with Ms. Somia Ahmed Hamid, Dept. of Rural Economy, University of Khartoum re : her thesis proposal. Requested data from Frankenberger, U of Kentucky via telex for her (she worked with Reeves and Frankenberger, INTSORMIL in El Obeid area in 1982) she needs additional funds to carry out thesis research. Later I met with her Major Professor Dr. Gafer Beshir and arranged for her and her advisor to meet with Dr. Comhencur, INTSORMIL sociologist to discuss her proposed work. Also, advised Ms. Holcombe at UNICEF of Somia's interest, as her topic related to consumption patterns in North Kordofan.
- 27 Met with Drs. Dafalla and Rogan, WSARP Director and Deputy Director re : Regional Research Planning Meeting for WSARP stations in Darfur December 4, 1984; PSR workshop to be held in January 1985; and review of Dr. Dafalla's visit to IITA, ICGRAF, CIMMYT Economics Program (Nairobi) and IICA.
- 27 Delivered book to Dr. Abdulla Mohamed Ali, Dept. of Horticulture University of Khartoum. (I ordered book from AVRDC and sent US dollar check on his behalf). It was Proceeding of a Symposium on Sweet Potato (Ipomea batatas).
- 29 Helped L. Martella, USAID Agricultural officer reply to cable on contribution of International agricultural research centers in Sudan.

DECEMBER

- 1 Collected leaves from several trees in the Horticultural Garden in Shambat for R. H. Cook, Kadugli to assist him in standardizing of phosphorus analysis method.
- 2 Wrote Director General ARC requesting seed samples of Bambara Groundnut for Abdelrahman El Khider Osman, WSARP Agro-breeder, El Obeid. (seed received from Dr. El Ahmadi in January 1985 and forwarded to Abdelrahman).
- 8 Reported to WSARP scientists re : Final Status of Requests for Agricultural Inputs (mostly seeds) for 1984 season.
- 11 Mr. Brian Kerr, Land-use Planner and Dr. James Ogborn, Agronomist, Western Savannah Development Corporation re : topics of mutual interest to WSDC and WSARP. Dr. Ogborn indicated an interest in visiting Kadugli in late January or early February. I advised the Director WSARP and he agreed it would be a good idea.
- 11 Mr. Adam Hassan Mahmoud, Integrated Agricultural Corporation (Sudanese-Egyptian) came to my office. He expressed an interest in soybean production and I gave him some extra copies I had of INTSOY publications.
- 12 Arranged for Dr. Ahmed Ali Geneif, Horticulturist, Sennar Research Station, ARC to obtain support from GtZ to attend Horticultural meeting in Cairo.
- 13 Wrote memo to Drs. Dafalla and Hogan, WSARP Director and Deputy Director re : suggested papers to be submitted to international conference on Arid Lands - Today and Tomorrow.
- 15 Wrote Director General ARC requesting appointment for Mr. Michael Mannion, WSARP Maintenance Consultant to visit Gezira Research Station and ARC Headquarters to assure the WSARP maintenance program is compatible with ARC program and policy.
- 15 Attended Planning meeting for FSR Workshop to be held 19-24 January 1985, with Dr. Dafalla, Mr. Hannum, Mr. Osman Abdalla, and Mrs. Shirley Higgins.
- After this meeting I drafted letters of invitation and tentative agenda and supervised their dispatch.

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- 16 Met with Dr. Brian Armitage, World Bank Forestry Consultant and Charles Tapp, USAID Forestry Consultant re : Sudan Forestry Assessment.
- 16 Met with David Howes, Remote Sensing Expert and Fulbright scholar re : Development of Greenness Index that would be proportional to the total biomass.
- 17 Met with Fadialla El Mana, graduate student in Range and Pastures, University of Khartoum, interested in information on ranges of S. Kordofan. (Mr. El Mana is employed by the Range and Pasture Administration in Fadingli). He borrowed several WSARP publications and internal reports. I arranged for him to meet Dr. Bunderson when he returned from leave in early January.
- 17 Met with Hexnar Committee (USAID consultant) at the Institute of Environmental Studies. I provided them with information on Hybrid Sorghum, Limitations of Seed Propagation Program in Sudan, and suggested pilot study on introduction of water points and controlled grazing in S. Kordofan.
- 23 Sent WSARP publications to Ms. Scott-Villiers, Resource Assessment Program - Kordofan.
- 30 Attended WSARP staff meeting. Received information on estimated times of arrival of CIMMYT resource personnel for workshop.
- 31 Wrote Director General ARC re status of analysis of previous soil samples collected by Dr. Arya in El Obeid and forwarded new samples.

PAPERS DRAFTED

Completed final draft of "Increasing Crop Productivity in Western Sudan - Results of Selected Agronomic Trials." (Compilation and summarization of key agronomic research studies done in Western Sudan from 1964 through 1984 by WSDC, MRDP, ARC, WSAEP, Dioxladis, CCZ, MFC. Approximately 80 pages of text, 80 pages of tables and 30 pages in Appendix.

Prepared summary of mainpoints of Hybrid Sorghum Seed Production meeting held 28 October, 1984, in Barakat Guesthouse.

Prepared initial draft of paper on "Agricultural Research for the Semi-Arid Lands of Western Sudan" for Dr. Dalalla. Paper is to be published by the Institute of Environmental Studies, University of Khartoum in volume entitled "An Arid Land Management Program for Northern Kordofan" Volume I : Resource Papers on Northern Kordofan.

PAPERS REVIEWED AND/OR EDITED

M.S Thesis Proposal by Ms. Somia Ahmed Hamid, Dept. of Rural Economy, University of Khartoum. Topic "Economic Analysis of the Factors Affecting the Consumption Pattern in the El Obeid Area" (Ms. Hamid worked with Reeves and Frankenberger, INTSORMII. Anthropologists in the El Obeid area).

Paper by Dr. Ahmed Ibrahim Yousif, Director General, Ministry of Agriculture and Natural Resources, Darfur Region presented at Research Planning Meeting held 4 December 1984 in El Fasher. The paper is entitled "The Role of the Western Sudan Agricultural Research Project in Darfur."

Papers Reviewed and/or Edited (cont.)

Horticultural Report for El Obeid Station 1983/84 season. Written by Dr. Osman Adam Osman.

Annual Report to ICRISAT on ARC/ICRISAT Pearl Millet Improvement Program in Sudan 1984/85. Written by Dr. B. P. Jain.

Paper by T. Woldetatis, W. T. Bunderson and F. Gillard-Byers, WSARP (Kadugli) entitled "The Importance of Cowpea Production in Western Sudan- A Supplement to Prof. Hall's Report.

Paper by B. Fadlalla and R. H. Cook on "Dry-Season Supplementation of Cattle with Local Crop Residues in Kordofan, Sudan." (Also arranged for paper to be reviewed by APC Range and Pasture Scientist and Director of the Institute of Animal Production, University of Khartoum).

Provided Dr. Dafalla with my comments on thesis proposal by WSARP Ph.D. candidate (Forestry) Farouk El Hadi.

Sent my comments and those of Dr. F. E. Winch, Agricultural Economist USAID on Beteik's thesis proposal to Dr. Roy Rogers, WSU.

MISCELLANEOUS

Completed INTSORMIL questionnaire on effectiveness of program in Western Sudan.

Obtained local publications from the University of Khartoum, Ministry of Agriculture, Dept. of Statistics, Bank of Sudan etc. for WSARP staff and graduate students at WSU.

Miscellaneous (cont.)

Facilitated collection of gum Arabic seed for Farouk El Hadi, WSARP graduate student.



**KEY POINTS MADE AT
HYBRID SORGHUM SEED PRODUCTION
MEETING
28 OCTOBER 1984
Barakat , Sudan**

1. Poor Land Preparation and Management can cause a variety of problems with Hybrid Seed Production (Nicking etc)
2. Seed Productivity is affected, also, by Micro- and Macro - environmental factors.
3. The "A" Line and "R" line are from different genetic backgrounds hence they are bound to react differently to any stress (water logging, drought, etc). Therefore, any stress in the field may cause a problem with nicking.
4. The "R" line is from yellow endosperm germplasm which are generally more drought tolerant. Therefore the "R" line is more drought tolerant than the "A" line.
5. There is a need to examine the variability of the "R" line. A head to row grow out was suggested possibly with replications.
6. Correct planting date is critical to good seed production. Studies should be done to determine the optimum planting date.
7. A sample will be taken from every 5 fd. of seed production plots. These samples will be planted and grown out in off-season (before next season) to determine seed purity. This will be the only true test of whether roguing was adequate. The seed should not be bagged until the grow out results are known.
8. It was suggested that Dr. Mohamed El Hilu Omer, Pathologist, ARC, be asked to screen the "A", "B" and "R" lines for susceptibility to long smut.
9. Although Hageem dura # 1 and the "A", "B" and "R" lines are susceptible to stem borer, long smut, and striga they are no more susceptible than other sorghum cultivars. No resistance to any of these pests has been found, yet.
10. The high level of infestation with Adar is difficult to overcome since there are many Adar seeds in the soil which germinate after each irrigation.
11. Plants with flag leaves with more than one node difference from the expected should be rogued.
12. The Project should see that easily accessible and highly visible demonstration plots are established and managed well.
13. Experimental plot size must be increased to a minimum of 1 Hawsaha (5 fd) since that is the minimum size seed production plot. Unevenness and the economics of land preparation must be studied on that scale.

14. Row orientation had no effect on nicking this year.
15. The nicking problem may have be overemphasized this year. A wide range of differences in flowering dates between the "A" line and "R" line were observed but most differences fell within acceptable limits.
16. There is no competition between private and public sectors in seed production. The public sector cannot hope to meet the demands for grain, vegetable and forage seeds. The private sector will be needed to assist in providing the needed quantity and quality of seed. The public sector should concentrate on production of foundation seed.

HYBRID SORGHUM SEED
PRODUCTION MEETING
28 OCT 1984
BARAKAT

<u>NAME</u>	<u>POSITION</u>	<u>ORGANIZATION</u>
Le Moyne Hogan	Deputy Director	WSARP
Ahmed Abu Elgasim Ahmed	Chairman advisory Committee for H.S. Project	NSA
M.S. Joshi	Project Co-Ordinator Seed Project	FAO
Omer A/Fadeel Yousif	Project Leader,	HSP
M.F. El Mufti	Director (Former head of SGB's Seed Propagation Section)	Gezira Trading House PO Box 149
Ahmed El Beshir Ahmed	Acting Manager Seed Prop. Dept. Sudan Gezira Board	SGB
Abd El Latif M. Nour	Agricultural Research Corporation	ARC
George I. Ghobrial	Senior Agronomist	USAID
Omer Mohd. Elfaki Marzoug	Seed Production Specialist	S.G.E.
Mustafa Mohamed Mahmoud	Seed Propagation Officer	NSA
S.K. Banerjee	Seed Technologist Seed Project - Sennar	FAO
Awatif Abd El Rahim	Seed Production Inspector	SGB
Hassan Abdel Hafeiz	Asst. Seed Production Officer	SGB
Ahmed Abdel Aziz	Asis. Director for Programming	NSA
Eric Witt	Agricultural Officer	USAID/ Khartoum
A. Beshir El Ahmadi	Head, Plant Breeding Section	ARC
Ed Uhland	Production Manager	Dekalb - Pfizer Geneti
Lynn McDonald	Hybrid Sorgh. Prod. Consultant	USAID, WSARP, WSU.
James J. Riley	Sr. Advisor ARC	WSARP / WSU
Gebisa Ejeta	Sorghum Breeder	Purdue University

WSARP FINANCIAL REPORT
01 March 1979 - 31 December 1984

FUNDS EXPENDED AND ENCUMBERED (ROUNDED APPROXIMATE FIGURES)*

<u>BUDGET CATEGORY</u>	<u>\$ AID/IDA NSC</u>	<u>\$ AID/ID</u>	<u>£ PL 450 TRUST</u>	<u>£ PL 450</u>	<u>£ 60s</u>	<u>£ LB</u>	<u>\$ WB (HARD CURRENCY)</u>	<u>\$ TOTAL</u>	<u>£ TOTAL</u>
<u>Salaries, Wages, Benefits</u>									
Home O. WFF	396,962.							396,962.	
Field	2,134,641.		101,486.					2,134,641.	101,486.
In-Country				1,322,037.	565,578.				1,887,615.
<u>Travel</u>									
Home O.	109,638.							109,638.	
Field	451,989.		134,382.					451,989.	134,382.
In-Country				237,480.					237,480.
<u>Goods, Services (Operations)</u>									
Home O.	38,405.							38,405.	
Field	2,002,584.		674,220.					2,002,584.	674,220.
In-Country				2,005,702.	126,958.				2,132,660.
<u>EQUIPMENT</u>									
Vehicles	589,040.							589,040.	
Other	789,644.		33,483.	433,684.				789,644.	467,167.
<u>DEVALUATION LOSS ON TRUST ACCOUNT</u>									
			32,874.						32,874.

A55

<u>BUDGET CATEGORY</u>	<u>\$ AID/CID</u> <u>WSU</u>	<u>\$ AID/CID</u>	<u>£ PL 480</u> <u>TRUST</u>	<u>£ PL 480</u>	<u>£ 60s</u>	<u>£ WB</u>	<u>\$ WB</u> <u>(HARD CURRENCY)</u>	<u>\$ TOTAL</u>	<u>£ TOTAL</u>
<u>EDUCATIONAL TRAINING</u>									
Wages & Benefits	3,354.							3,354.	
Goods Services	160,186.							160,186.	
Grants & Subsidies	181,742.							181,742.	
Travel	39,409.							39,409.	
Equipment	578.							578.	
<u>CONSULTANTS</u>	78,560.							78,560.	
<u>U.S. E. CONTRACT</u>	17,070.	2,787,597****	104,433.					2,804,667.	104,433.
<u>INDIRECT COSTS</u>	1,594,458.							1,594,458.	
<u>PROJECT EXPENSES - PART I</u>							2,372,103.	2,372,103.	
<u>PROJECT EXPENSES - PART II</u>					194,435.	291,621.	118,682.	118,682.	486,056.
<u>ADMINISTRATIVE</u>									
CAF				407,303.	817,609.		3,764,743.	3,764,743.	1,224,912.
El Shidra & Dirige		1,081,626.		1,939,097.	1,939,097.		2,546,987.	3,628,613.	3,878,194.
<u>NON-CONTRACTUAL SUPPORT SECTION</u>				1,089,224.					1,089,224.
<u>IND ADMINISTRATIVE COSTS</u>		796,789****						796,789.	
TOTAL :	8,588,260.	4,666,012.	1,080,878.	7,434,527.	3,643,677.	291,621.	8,802,515.	22,056,787.	12,450,703.

* Because of differing exchange rates, the total will be expressed in Sudanese pounds and US dollars.

** Canadian dollars, 2,078,692 (US dollars 1 to 1), Pounds Sterling 2,160 (US dollars 1 to 2), total converted to US dollars.

*** WSU Campus, Pullman, Wash. (Project Support).

**** Latest figures available.

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WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

QUARTERLY REPORT

January 1, 1985 - March 31, 1985

I. GENERAL

Work continued by scientists at the research stations completing data analysis and planning for next season's research programs.

The second Farming Systems Workshop sponsored by WSARP and CIMMYT was held at Wad Medani January 19-24. Seventy-five scientists and administrators attended the sessions.

Project scientists attended workshops in Syria and Ethiopia during this quarter.

Numerous discussions were held by C.I.D. and W.S.U. officials with AID/Sudan and World Bank officials as to details of a contract extension past August 14, 1985.

A directive from AID/Sudan for the project to replace expatriate project support staff in Khartoum with local hire personnel was met with great reluctance by W.S.U.

Equipment and supplies arrived in large quantities during this quarter. Receiving and shipment to the stations became a major activity of John Hannum and his replacement, Elias Diocera.

The Project Engineer position was eliminated from the contract and Syd. Shawgi Amin was employed as the Force Account Engineer.

A. Consultants and Visitors

Several individuals associated with W.S.A.R.P. from the U.S. visited the project during this quarter.

Dr. John Fischer, Executive Director of C.I.D. in Tucson, Arizona, visited and discussed extension of the contract with A.I.D. and Sudanese officials.

Dr. Jean Kearnes, Deputy Director of C.I.D., visited

in January to meet with C.I.D., Sudanese and A.I.D. personnel.

Dr. Jan Noel, Project Coordinator, W.S.A.R.P., W.S.U., visited on two occasions: in January and in March.

Dr. Jim Henson, Director of International Program Development, W.S.U., visited the project in January and attended the Farming Systems Workshop at Wad Medani.

Dr. Jim McGuire, Professor of Agronomy at W.S.U., visited the project in March and early April as a short-term consultant. He worked with the National Seed Administration and W.S.A.R.P. plant scientists on seed processing and storage matters.

Mr. Joachim Grube of Grube-Zimmer Supervising Architects visited in February to determine construction progress and attempted to speed-up construction.

Mr. Stuart Marples of the World Bank visited Sudan and discussed project concerns with W.S.A.R.P. administrators.

Many other individuals visited scientists and others on the project to discuss various project activities.

B. Trips and Meetings

Dr. Babo Fadlalla and Dr. Richard Cook attended an ICARDA/IDRC Workshop on livestock on-farm trials in Aleppo, Syria March 25-28 and presented research papers on their research in South Kordofan.

Adam Hashim and Adam Mohamed Ali participated in a six-week training course at ILCA in Addis Ababa, Ethiopia on laboratory techniques.

The project co-sponsored a Farming Systems Workshop in Wad Medani with CIMMYT January 19-24. Scientists from W.S.A.R.P., ARC, GTZ, University of Gezira and other organizations attended. Instructors for the workshop were: Dr. Michael Collinson, CIMMYT, Nairobi; Dr. Ed Reeves, Morehead State University; Dr. Fred Palmer, CIMMYT, Mexico and Dr. Guido Grissel, ILCA, Addis Ababa, Ethiopia. (See attached program and participants).

II. ADMINISTRATION

Two W.S.A.R.P. scientists returned after graduate training to initiate research programs. Mr. Babiker Abdalla Ibrahim received a Master of Science degree in Soil Science at Washington State University and is now stationed at the El Obeid Research Station. Mr. Mohamed Mukhtar Sadek Bilal completed a Master of Science degree at the University of Gezira and is at the El Obeid Research Station in forestry research.

Mrs. Perlita Sulit, long-time administrative secretary, resigned to join her husband in Liberia. Mrs. Dolly Reynolds was hired as her replacement.

C.I.D. personnel on leave during part of this quarter were: LeMoyne Hogan, Thomas Gillard-Byers, Lalit Arya, and Hank Bergman.

Tigani Mirghani El Amin, participant trainee in Agricultural Economics at W.S.U. arrived in the Sudan on March 10 to work in Kadugli on his dissertation research.

III. STATION DEVELOPMENT

A. Construction - Contractors

GENERAL

A site visit on February 19, 20 and 21 of USAID, WSARP, Grube-Zimmer and Karplen consultants was an opportunity to review construction progress in the field and to discuss related issues.

Imported materials arriving in January allowed some improvement in construction progress. Installation of doors, windows and verandah screening frames allowed the completion of interior plastering, application of undercoats, setting of floor tiles and interior wiring in laboratories, administration and senior housing and some of the middle and junior houses.

Distribution of sewers, domestic water and irrigation water lines is 95% complete.

Roofing of all buildings has been completed.

Following the site visit the estimated schedule of completion was revised. (Copy attached).

In March El Obeid began to experience a severe water shortage and all water for construction was hauled in from outlying wells. If the shortage continues, the use of water for construction will probably be banned.

Construction has been hampered by shortages of operating capital. Mr. Diraige has not provided the necessary funds promised.

The ARC office building at Shambat has been promised to the owner for occupancy on June 1, 1985.

B. Force Account Activities

GENERAL

Five visits were made to El Obeid Research Station and two visits each were made to Kadugli, El Fasher and Ghazala Gawazet during this quarter by the Project Engineer to coordinate force account activities.

ACTIVITIES BY SITE:

EL OBEID: The well was completed, pump and water tank installed at the Horticultural Farm at Beno. However, masonry base for the water tank cracked during the first filling; therefore, a new base will have to be constructed, the tank disassembled and erected on the new base.

NAW agreed to drill an additional water well at the Felaata during April.

EL FASHER: NAW agreed to install a pump and engine in the supplementary water well during the first week of April. The purchase of steel pipe to link the well and the new station was requested.

GHAZALA GAWAZET: Materials were requested to construct a midstation watering point. The design of the well site piping was redesigned.

KADUGLI: Representatives from the Ministries of Finance and National Planning visited Kadugli to discuss the on-farm road contract with the bidders.

C. Station Maintenance Activities

GENERAL

Enquiries to manufacturers continue to be made in order to determine maintenance and spare parts requirements. Most enquiries are through the international mail and are subject to long delays. Follow-up telex messages do not seem to speed the process. Most manufacturers of equipment at the Kadugli Station have been contacted as have companies supplying generic items common to all stations. It has not been possible to obtain complete lists of the equipment being supplied to the new station from the contractor; it seems that all equipment orders have not been placed. In an attempt to speed this process, the contractor's export agent in the U.K. has been contacted, so far without result.

Early in the quarter, weekly trips were made to Kadugli to introduce maintenance-related suggestions for various items. There has been little or no response to these suggestions. Continued trips were not possible throughout the quarter due to the project airplane being down for maintenance. A station maintenance outline has been started; several draft sections were forwarded for review, input and comment. There has been no response at this time and a follow-up visit in person has not been possible as yet. A partial order of immediately required tools and maintenance equipment was forwarded to W.S.U. in January. These are to be sent via air freight for distribution to various personnel at Kadugli to enable them to perform maintenance tasks. A complete order to equip all stations was requested in March.

One visit to Kadugli was made by the service manager of Harath (Sudan) LTD. to inspect the generator sets. Harath is the Rolls Royce representative in Sudan. His report indicates that the engines are not being cared for adequately and, that as engine hours accumulate, neglect will lead to downtime and costly repairs. Harath has proposed a maintenance contract for the units providing for monthly checks and the performance of regular items of maintenance. The project has not yet signed the agreement. The

spare parts of the units were reviewed and have been subsequently updated.

Several requests have been made to USAID for the purchase of non-U.S. manufactured goods. These requests were delayed as "USAID cannot concur in the procurement of any spares until sufficient personnel have been identified and hired to ensure the efficient management and use of such spare parts". Position descriptions for a senior maintenance engineer and a station maintenance engineer were written and the vacancies advertised nationally. Response was generally poor. However, a senior maintenance engineer was identified by the project; he is to be seconded from the N.A.V. After identification of the engineer, a waiver request was re-submitted. There has been no response at this time.

A meeting was held with the field director of Voluntary Service Overseas concerning the possibility of the project obtaining technical teaching staff on two-year contracts in the maintenance sections at both El Obeid and Kadugli. After completion of the application and job description, the project felt it could not extend its budget to support these volunteer positions.

IV. FINANCE

The quarterly financial statement will be forwarded at a later date.

V. PROJECT IMPACT

A. Kadugli Research Station

1. Agronomy Section

GENERAL

1. The Agronomy staff attended the Farming Systems Workshop hosted by WSARP and CIMMYT in Wad Medani from January 19-24. It was a good opportunity to meet and discuss with colleagues on their respective professional experiences in relation to farming systems research.

2. In January, Dr. Jan Noel, Project Coordinator, visited the Agronomy Section and discussed the on-going research activities, future work plans, and materials needed for agronomy research (seeds, chemicals, equipment, supplies, etc.) In March, Dr. Noel came to Kadugli and met with the expatriate senior scientists and briefed us with the standing contract situation before final decision for extension was made by USAID.
3. On March 4, Dr. J. Riley and I visited with Dr. F. Bebawi, striga specialist, University of Khartoum. We had lengthy discussions on striga control measures using resistant varieties and cultural practices.
4. On March 5 and 6, Dr. L. Hogan, Dr. J. Riley and I visited with Dr. Mahmoud Ahmed Mahmoud, Mechanized Farming Corporation Director, and their farm machinery section head. We discussed the effects of cultural practices on sorghum production, introduction of early-maturing varieties of sorghum to the Kadugli surroundings, and the effect of seed size and use of appropriate farm machinery on seedling establishment and yield.
5. Dr. Jim McGuire, Washington State University, visited the Agronomy Section and discussed the current agronomy research activities. He was interested to see seed storage facilities around Kadugli. We visited two storage facilities but with no seed being stored in them due to the 1984 drought.
6. Mrs. Scott Villiers, CARE/El Obeid, met with us briefly. She was interested to know which varieties would be recommended for the Nuba Mountain region in order to overcome the existing drought problems. Gadam el Haman, Dabar, Hageen Dura #1 were the recommended varieties of sorghum for this region.

ADMINISTRATIVE

1. In the last quarter, 4 senior technicians, 4 field assistants and 5 laborers were on their annual leave.

2. The hut at Kalulu WSARP camp was reconstructed by the agronomy employees. Grass collection was made for mulching trials at Seraf Experimental Farm.
3. We received seeds, equipment and research supplies for the Agronomy Section.

SCIENTIFIC AND TECHNICAL ACTIVITIES

1. The major agronomic activity in the last quarter was preparation of the 1984 Agronomy Annual Research Report. It is now being typed in Khartoum. On the basis of overall agronomic merits, we advanced 8 varieties of sorghum, 7 of cowpeas, 5 of mungbeans, 3 of sesame, and 5 of groundnuts into the 1985 crop season. The following results were obtained from the cultural practice trials:
 - a. Nitrogen soil incorporation gave higher sorghum yield than N-surface stover weight
 - b. Twenty cm spacing between plants in the row gave higher sorghum stover weight
 - c. Delayed weeding up to 4 weeks after sorghum emergence significantly decreased sorghum stover weight than earlier weeding.
 - d. Mulching retained higher soil moisture than the rest of treatments. It eventually gave significantly higher total dry biomass and grain yield.

The on-farm trial results indicated that (1) improved varieties with improved cultural practices outyielded the local sorghum varieties with traditional practices. (2) Hageen Dura #1 was well adapted to the Nuba Mountain region and was accepted as food crop by all farmers who cooperated in the demonstration trials, (3) Phosphorus and nitrogen at 40 + 40 Kg/ha gave significantly higher grain yield and induced earlier flowering of sorghum compared to the

untreated check. Nitrogen had depressing effect on sorghum and (4) IS-9830 has proved to be early-maturing and relatively striga resistant, thus detailed agronomic studies should be made on IS-9830 in the 1985 season.

2. Germination test was made on the 1983 and 1984 harvested seeds of sorghum, mungbeans, sesame, and pearl millet. The objective was to determine the germination percentage of the seeds right after the harvest and one year after being stored. The result showed that there was no significant difference in germination percent between 1983 and 1984 harvested crops.
3. Prepared the 1985 Agronomy Research proposals as shown in the attached sheets of papers. The proposal includes (a) on-station trials and (b) on-farm trials with farmer- and researcher-managed trials. The objective of the variety trials is to evaluate promising varieties under the prevailing agro-ecological conditions in the Nuba Mountain Region and eventually release the outstanding varieties to the local farmers.

The cultural practice trials are conducted in order to determine the best practices that would optimize crop production under the Nuba Mountain Region environments.

The objective of the on-farm trials is to evaluate the suitability of a given technology agronomically and economically under conditions representative of a target group of farmers under the same recommendation domain.

ACTIVITIES PLANNED FOR THE FOLLOWING QUARTER

1. Will attend the Annual Research Committee meeting hosted by WSARP at the Kadugli Research Station. I will present the Annual Agronomy Research results of Kadugli and, at the same time, present research proposals for 1985 crop season.
2. Visit with farmers at Kululu, Bilenya, and

Shaer and select sites for the 1985 on-farm trials.

3. Land preparation at Seraf Experimental Farm.
4. Prepare detailed planting plan and field plot layouts for the proposed research trials.

1985-86 AGRONOMY RESEARCH PROGRAM (KADUGLI)

ON STATION TRIALS

A CULTURAL PRACTICES TRIALS

- Nitrogen and phosphorus Rate of Application Effect on sorghum (16)
- Plant spacing Trials on sorghum (18), Cowpeas (18), and sesame (18)
- Date of planting Trials on Sorghum(10), Cowpeas(10) and sesame (10)
- Sorghum and sesame Intercropping trials with Cowpeas (6)
- Weed Control Trials on Sorghum (10+)
- Soil and Water Conservation Trials (5)

B VARIETY TRIALS

1) SERAFF EXPERIMENTAL FARM

- Kadugli selection Advanced sorghum variety trials (13)
- " " " Cowpeas " " (7)
- " " " Mungbeans " " (5)
- " " " Sesame " " (3+)
- Local sorghum collection preliminary trials (28)
- Cowpea preliminary variety trials (IITA) (66)
- Mungbean " " (AVRDC) (12)
- Pigeonpea " " (ICRISAT) (21)
- International Maize " (CIMMYT) (16)

2) ARC/WSARP COMPOUND

- Kadugli selection Advanced groundnut V.T. (5)
- " " " Cowpea " " (7)
- International Maize preliminary V.T. (16)

II On FARM TRIALS

A Farmer-Managed Trials

- Hageen Dura 1 Demonstration Trials (Subject to seed availability)
- The Effect of Phosphorus and seed dressing on sorghum (3 Villages)
- Observation trial of improved varieties of sorghum, cowpeas, and groundnut in Jubraka.

B Researcher-Managed Trials

- Nitrogen and Phosphorus Effects on Sorghum (2 Villages)
- Effect of seed dressing and timely practices on sorghum (2 Villages)
- Sorghum and sesame Intercropping with Legumes and long-term rotation
- Striga control trials (a) using Varieties and spacings (24) and (b) using varieties, atrazine, and fertilizers (16)
- Striga Resistance Trials
- The effect of improved cultural practices on sorghum and Cotton Production in the Nuba Mountain Agricultural Production Schemes.

2. Range Management Section

The following are the activities for this quarter:

1. Workshop - Workshop on farming systems sponsored by WSARP and CIMMYT was attended from 19-24 January at Wad Medani.
2. Research Activities - Nutritive evaluation of Nuba Mountain Ranges is being conducted through the chemical analysis of feces collected from the sedentary and migratory cattle relative to changes in their liveweights. This relationship is expected to reveal any deficiency of nutrients in the Nuba Mountain Ranges and fix critical periods of season in which the ranges are deficient in these nutrients as well so that appropriate supplementation can be provided.

An experiment on dry season supplemental feeding for Nuba and Baggara cattle using legume hay and sorghum stalk is started since April 1, 1985. It was intended to introduce legume crops to the region to improve and stabilize the agronomic resource base, while providing the household with high quality food during the peak hunger season and supplemental feed to cattle during the late dry season. Specific objectives relating to the use of legume hay in combination with sorghum stalk for livestock feed are the following:

- a. To improve the dry season nutritional status of Nuba and Baggara cattle in the Nuba Mountain by providing a supplement to meet the protein maintenance requirements of lactating and late pregnant cattle whereby survivability, productivity and growth rates of calves is improved.
 - b. To accomplish the (1) above by feeding legume and sorghum residues at the ratio of approximately 2:1.
3. A workplan for the El Fasher research station is under preparation.

3. Animal Science Section

GENERAL

- A. WSARP and CIMMYT co-sponsored a Farming Systems Workshop from January 19-24 in Wad Medani. Participants were invited from the ARC and other research institutes in Sudan as well as from WSARP research staff. Although most discussions centered on basic FRS methodologies, considerable attention was given to how WSARP was implementing its crop-livestock FSR research program in Western Sudan. Considerable interest was shown by ARC research staff in FSR programs as a complimentary extension of their present commodity-oriented research activities.
- B. ICARDA/IDRC sponsored a FSR Workshop in Aleppo, Syria from March 25-28, focusing on the methodologies employed in the implementation of livestock on-farm trials. Drs. Bunderson, Fadlalla, and Cook were invited to present several papers, eg.;
- "The Design and Implementation of In-Herd/On-Range Trials: The use of Sentinel Herds by B. Fadlalla and R. H. Cook - presented by B. Fadlalla.
- "Production and Feeding of Conserved Forages to Traditional Cattle in the Nuba Mountains, Sudan", by W. T. Bunderson and R. H. Cook - presented by R. H. Cook.
- "Criteria for Evaluating Livestock On-Farm Trials", by R. H. Cook - presented by R. H. Cook.
- Participants were drawn from throughout ICARDA's mandate region as well as from Kenya, West Africa and Indonesia. A proceedings of the workshop is due to be published by IDRC in the Fall of 1985.
- C. Dr. Cook returned from leave on January 15.

SCIENTIFIC/TECHNICAL ACTIVITIES

1. Protein/Phosphorus Feeding Trial for Baggara Sheep: Initial evaluation of transhumant flocks in early 1984 indicated the likelihood that phosphorus deficiency was an important nutritional constraint limiting traditional sheep productivity. Preliminary phosphorus analyses from selected flocks of traditional sheep showed low plasma phosphorus levels during the rainy season, indicating that clinical phosphorus deficiency was probably during the lambing period, from November through March. Therefore, phosphorus supplementation of lactating ewes, during this period, was considered a highly promising intervention. The principal objectives of this trial are to:
 - a. Increase the number of weaned lambs by improving milk production in lactating ewes, thereby improving lamb growth, weaned lamb weight, and decreased mortalities due to severe nutritional stress during the early post-weaning period.
 - b. Improve the nutritional status of ewes during the early post-weaning period through supplementation during the last 2/3 of lactation, followed by early lamb weaning, thereby decreasing mortalities during the late dry season and improving conceptions during the subsequent rainy season.

It was anticipated that a typical phosphorus supplement, such as de-flourinated rock-phosphate or di-calcium phosphate, would be fed during this period. These supplements are extremely inexpensive, usually about equal in price to common salt which is fed by traditional producers in this region, and therefore they were considered to be within the "reach" of the traditional producer. However, after extensive searches (including requests to AID), no such supplements were found and therefore triple super phosphate was used in limited quantities with sesame cake. This fertilizer, phosphate supplement was included to evaluate the impact of phosphorus on lactation and reproductive efficiency, but because of its high flouride con-

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tent, an alternative source of phosphorus would have to be found for producers. This trial was initiated in February and will continue at least until the end of 1985 in order to assess the supplement's impact on conception rates.

- c. Protein/phosphorus supplementation of Baggara cattle: This trial, which began in March, 1984, has been continued this year. Preliminary results indicate substantial increases in milk production, a major production objective of traditional households, and a shortening of the traditional calving interval (from 21/22 months to 16/18 months). The fundamental problem this year has been the high price that producers have had to pay for sesame cake (over 100% higher than in 1984) and the relatively lower price livestock producers are getting for their animals in the traditional market.

To accurately assess the impact of this supplementation on reproductive efficiency, this trial has been continued this dry season with supplementation commencing in March, 1985.

- d. The Ivermectin trial has been continued and is scheduled to terminate the end of the 1985 rainy season.
- e. Ecto-parasite control of small ruminants is being evaluated in conjunction with the protein/phosphorus feeding trial (1) using locally available acaricides.
- f. Blood phosphorus analyses for both the small ruminant feeding trial and the cattle feeding trial are progressing well, and the present stock of reagents appears sufficient to last until the end of the year.

ACTIVITIES FOR THE COMING QUARTER

No new activities are planned for the coming quarter. Project research meetings, now scheduled to be held April 20, 21 and 22 will focus and prioritize future activities. Accordingly, the initiation of new research activities will have to await the consensus of

these meetings. With regard to on-going activities, those items referred to in the previous section will be continued through the 1985 rainy season.

CONSTRAINTS TO RESEARCH EFFORTS

1. The absence of adequate secretarial assistance is still with us.
2. The need for additional agronomy scientific staff is highlighted this year for the range/livestock section because of an agreed need to focus considerable research effort on dual-purpose forage crops for the sedentary system. These activities will require considerable additional resources over and above those required for the agronomy cereal/cash crop program.
3. Anticipated problems in securing diesel for station operations could present a major problem for the laboratory. Presently, range/livestock staff are functioning on a "shift-basis" for analytical laboratory work and any cut-backs in the present support services would severely impact on the research program.
4. Security for senior houses has again become a problem which needs to be addressed by Project/Station management.
5. Distilled water is a problem. Additional stills were ordered, but have not arrived.
6. Additional muffle furnaces are needed for expanded laboratory work. They also have been ordered but not delivered.

4. Socio/Economic Section

The quarter ending March 31, 1985 represented a period in which research results were recorded, support activities for other sections and organizations were carried out, training of staff was continued and new projects implemented. During the first quarter, the Socio/Economic Section increased its collaborative activities with other sections and provided basic socio/economic information for incorporation in research results.

Meetings were held with Dr. Will Bateson of the Ministry of Agricultural Economics and Statistics and Dr. John Strauss of Yale University on several occasions. The latter are implementing a consumption survey in North and South Kordofan. The section provided them with information about the sedentary and transhumant systems as well as taking them on several field trips.

Mr. Jim Stearn, CARE, visited with members of the section to gather information about efficiency of American food aid distribution as well as commodity and livestock price information.

Mr. Malcolm McClain, OXFAM, visited with the Socio/Economic staff about the nutritional status of groups in the Nuba Mountain area. Price level and production information was provided to Mr. McClain for his organization's use.

Meetings were held with members of the Nuba Mountain Rural Development Project (NMRDP) to discuss results from the "Animal Transportation-Phase I" Experiment carried out by the Socio/Economics and Range/Livestock Sections.

Ms. Susan Holcrumb, UNICEF, met with the senior scientist to discuss revilalization of the Jubraka, house-garden, in Kordofan.

ADMINISTRATIVE

1. During the first quarter, additional

supplies arrived for support of section activities. These included office, computer and field supplies. This alleviated some time spent doing administrative activities trying to acquire these items and has resulted in improved efficiency of the computer.

2. Streamlining of the distribution system needs to be accomplished. Delays occur with procurement and supplies arriving in Kadugli for a section that are seldom identified properly.
3. Staffing of a Socio/Economic Section in El Obeid should be undertaken. A small staff in El Obeid would support agronomic and horticultural activities.

SCIENTIFIC AND TECHNICAL ACTIVITIES

The Socio/Economic Section undertook a new project titled "Marketing of Livestock by the Transhumant Producer of the Nuba Mountain Area". This project has been ongoing since early March. Three projects were completed during the quarter with respect to field work. These were the Jubraka survey and animal transportation experiment, phase I. Partial results of these activities will appear in the combined annual report. The supplementary information survey was also completed and the results are being formulated for inclusion in the annual report.

1. The marketing study is designed to provide information on a variety of subject areas which affect the transhumant producer in an area approximately 40 km Northwest of Kadugli. The results will provide background information for the Range/Livestock Section when undertaking future project work. It will also provide insight into methods for increasing efficiency in the market, social and economic constraints to increasing offtake and marketing strategies of the transhumant producer.
2. The 1985-86 Socio/Economic Research Program

was prepared during the last quarter. Finalization of the program will be completed during the second quarter.

3. Collection of price information in Kadugli commodity and livestock markets is continuing. This information is being continued in Kululu, Katcha and Dobeibat, Sudan when our section is in the area. This is done on a sporadic basis due to section resource constraints. Demick, Sudan has been added as a target village for collection of prices due to the project undertaken by the Socio/Economic Section in that area.
4. The animal transportation experiment, carried out collaboratively with the Range/Livestock Section, shows a great deal of potential both for short-run and long-run benefits. The Socio/Economic Section is carrying on discussions with the NMRDP prior to instituting phase II of the program which is to begin in August 1985.
5. The "Supplementary Survey" results, which have been compiled, will be useful in providing recommendations pertaining to pre-screening of producers which may participate in on-farm trials. It is important that this be done to insure that cultural barriers do not stand in the way of appropriate production practices and harvest activities.
6. Support activities for the Agronomy Section have included economic analysis of mulching, ridge and furrow, standard practice and surface cultivation activities. These were undertaken as part of the soil moisture conservation and management studies. Additional analysis covering fertilizer trials will be completed when price information on fertilizer and transportation costs are provided by staff in Khartoum.
7. Field work associated with "Credit/Risk" position of small farm households in the Nuba Mountain area was completed during the first quarter. This is the research undertaken by Tighani and implemented by Mr. Mohamed El Amin, Nuba Mountain Agricultural Production

Corporation, and the Socio/Economic Section. The Socio/Economic staff produced results pertaining to labor requirements for agricultural production activities. These should be used as a basis for screening and choice of participants for on-farm trials.

8. The final training course in computer usage for other sections was carried out by the Senior Scientist of the Socio/Economic Section. The Socio/Economic staff is becoming proficient in the use of the computer and available software. However, if the computer is to be utilized after December 31, 1985, a minimum of two permanent members of the ARC should be trained to take on this responsibility. The alternative is to hire, permanently, one of the Socio/Economic staff already trained and station that person in El Obeid. Subsequently, he would be able to train senior scientists at both locations, in Kadugli and El Obeid. Additional training would need to be provided so that the individual would be familiar with software more useful to other sections.

ACTIVITIES PLANNED FOR THE SECOND QUARTER-1985

1. The Socio/Economic Section will finalize its 1985-86 research program during the second quarter.
2. Work will continue on the analysis of Agronomy and Range/Livestock Section results.
3. Preparation of the annual report will continue.
4. The field activities for the marketing project will continue and be completed during the quarter.
5. Commodity and livestock price information will be collected in Demick, Kululu, Katcha and Kadugli.
6. The groundwork for phase II of the animal transportation project will be completed.

7. A trip will be made to El Obeid to discuss data requirements for economic analysis of section activities.
8. A case study proposal will be submitted for consideration in the Intra-Household Dynamics and Farming Systems Case Studies Project.
9. A paper will be sent for consideration in the annual farming systems seminar held in Kansas, U.S.A.

B. El Obeid Research Station

GENERAL

Two new scientists joined the El Obeid research staff: Mr. Mukhtar Bilal and Mr. Babiker Abdalla Ibrahim.

SCIENTIFIC AND TECHNICAL ACTIVITY

1. Soils and Water Research

RESEARCH

1. Results of the soil and water management/conservation trials for the 1984 cropping season were compiled and analyzed. Mulching, ridge-furrow planting, and clayey soils as an amendment appeared to be effective in increasing biomass and grain yields on the goz sands. Depth of planting trial showed that millet seedling emergence and survival were better for a planting depth of 10 cm than for 5 or 15 cm depths. Crusting in goz sand was found to be a widespread feature of the land surface. Seedling emergence was adversely affected by crusting, and occurrence of crusted patches appeared to be responsible for a high degree of spatial variability.

On the gardud soil, planting in seed cradles was most beneficial for emergence and early seedling growth. Ridge-furrow beds appeared to impound water but did

not improve emergence and crop establishment. Subsoil hardness appears to have affected seedling emergence; water infiltration in uncultivated areas was extremely poor. Bulk density measurements showed extreme hardness of the soil. Soil depth varied from about 70 cm to 120 cm.

On cracking vertisols (Kadugli), mulching was most effective in conserving water and increasing sorghum biomass and grain yields. Both the moisture conservation and crop production were poorest in plots where residue was burnt and traditional practices were employed.

Soil samples from goz, gardud, and cracking vertisols were collected and sent to ARC (Wad Medani) for analyses. No results have been obtained so far.

2. Moisture measurements were begun in goz sands in early March. Five neutron access tubes were installed using a frame that was designed to facilitate vertical installation. The neutron probe was calibrated using data from a plot that was irrigated and sampled gravimetrically. Weekly measurements of the soil moisture to a depth of 180 cm indicate a significant amount of moisture present at the lower depths in the soil profile. Gravimetric measurements of the surface zone soil moisture indicate rapid drying of the surface, a condition most unfavorable to emergence and early crop establishment. Moisture loss patterns indicate that most of the moisture is conserved in goz sands, but distribution patterns favor deep-rooted crops. Management practices for moisture conservation in the surface zone appear to be most important for crop establishment and utilization of subsurface moisture.

Results of the moisture measurements also indicate that fallowing coupled with weed control and residue cover (of some sort) should be most effective in increasing soil moisture supply for crop production.

VISITS AND MEETINGS

1. I was on vacation in the United States from December 11, 1984 until January 15, 1985.
 2. Attended farming systems research workshop in Wad Medani from January 19-24, 1985.
 3. I made several visits to Bangdeed and Khor El Abyad areas to locate horticultural farms for installation of drip system of irrigation.
 4. Drs. Hogan and Riley visited El Obeid on February 16 and reviewed research results for the 1984 cropping season.
2. Range/Livestock Section

GENERAL

A meeting was held at El Obeid between the Range Scientist at El Obeid and Dr. Babo Fadlalla, the Animal Nutritionist at Kadugli Research Station. The research activities in Range Management and Livestock in North Kordofan were discussed. The details of research proposals for 1985-86 season, in which Dr. Babo's cooperation is expected, were discussed.

A meeting was held with Drs. Hogan and Riley. During this meeting, research results for 1984-85 and planned activities for 1985-86 were discussed.

NEW STAFF

Dr. Hassan (Agronomy), Mr. Babiker (Soils), and Mr. Milhtar Bilal (Forestry) have joined the station recently. Now El Obeid Station has a team of nine scientists. Mr. Hashim Mukhtar left on his annual vacation during March.

STATION DEVELOPMENT

The station buildings seem to be going with a considerable pace recently; however, the need for imported materials and cement brought

the work almost to a stop recently.

SCIENTIFIC AND TECHNICAL ACTIVITIES

A number of scientific reports on research results and constraints were finished and handed to the Station Director. These included the following:

1. Constraints to desert sheep production in the nomadic and the sedentary system of North Kordofan.
2. Constraints to crop residue utilization in North Kordofan.
3. An introduction to pasture development in Western Sudan.
4. Hay supply and marketing to El Obeid town.
5. The nomadic and the sedentary sheep disease survey.

The research activity in the nomadic system is going smoothly. The sedentary sheep flock will be moved to El Obeid Research Station due to food constraints. Supplementary feeding of hay and concentrates will be started in a way not to bring a major change to the study. The plan for research activities for 1985-86 season was finished. The plan for research activities included the continuation of research activities from the last season. New research proposals for 1985-86 will be mainly on sheep production. The plan will generally cover the following activities:

1. Grazing dynamics and desertification.
2. Plant introduction and evaluation.
3. Desert sheep production.
4. Sheep food habits.
5. Sheep disease survey.

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MAJOR RESEARCH NEEDS AND PROBLEMS

1. The exclosures for grazing dynamics and desertification study were finished. Lack of equipment requested from U.S.A. will be a major constraint. Employing two guards for Um Kiredim site and one for Shiekan site is requested to be done as soon as possible. If no guards are assigned soon, a serious damage to the exclosures is highly expected.
 2. Construction of sheep housing facilities at El Obeid Research Farm is greatly needed. The plan for the holding pens and yards was submitted more than a month ago.
 3. The familiarization of El Obeid community, and particularly the technical staff of the Ministry of Agriculture about El Obeid Research Station is thought to be useful. An orientation program should cover the following:
 - a. A visit to the station site and the research farm.
 - b. A seminar on the objectives of the station and the scientific approach.
 - c. Seminars on the research program and the results of the previous seasons.
 - d. Provision of simple and useful services such as seed testing and inspection of farmer's stored seed for the coming season by the station Agronomists. This activity is expected to increase the contact between the station and the farmers.
- C. RESEARCH ADVISOR TO DIRECTOR GENERAL, ARC.

JANUARY

- 5 . Interviewed candidates for laboratory chemist and another position with Project Director, Dr. Dafalla Ahmed Dafalla.
8. Met with Dr. Gordon Potts, IDRC Representative, based in Cairo. We discussed several IDRC sponsored projects in Sudan, two of which may be of interest to WSARP:
- (1) Multidisciplinary study of Tenant Animal Production Potential on Rahad Scheme,
Project leader, Abdul Fattah Nour,
Animal Nutritionist
University of Gezira
(Team also includes Cereal Breeder and
Agricultural Economist)
 - (2) Development of New Ration for Khartoum Cattle Feed-lot.
Project leader, Dr. Mangoub Gaftar El Hag
Animal Nutritionist
Institute of Animal Production
University of Khartoum
- Evaluating feed composed of sorghum, groundnuts, wheat bran and urea compared to traditional feed of dura and cotton seed
14. Met with Dr. Kabil Sobahi Yousif
ARC Food Research Center
re: information on market diseases of horticultural crops.
Sent request to Postharvest Institute for Perishables.
14. Met with Alistair McKay - Livestock Specialist
Paul Devitt - Social Scientist, Hunting Technical Services.
re: development of forage potential in S. Darfur.
16. Met with Dr. David Howes - Fulbright Fellow,
University of Khartoum
re: High resolution thematic mapping available for Kordofan Province.

JANUARY (cont.)

16. Met with Dr. George Ghobrial - Asst. Agricultural Officer
USAID - Khartoum
re: Obtaining 2000t of cereal seed for distribution to
farmers in Western Sudan in 1985/86
I gave him copy of chapter on Cultivar Evaluation
from draft of WSARP publication on "Increasing Crop Pro-
ductivity in Western Sudan - Results of selected Agronomic
Trials" for indication of which cultivar do best in the
west.
16. Saw Will Bateson,
Agricultural Statistics and Planning Project
Ministry of Agriculture
re: Data required by Sid Ahmed Hassan Sid Ahmed Beteik,
WSARP graduate student
17. Attended meeting re: Planning for FSR Workshop with Drs.
Dafalla and Hogan, WSARP; Dr. Noel, WSU; Dr. Reeves,
Morehead St. University and Dr. Palmer, CIMMYT.
- 19-24 Attended and participated in second WSARP/ARC Farming
Systems Research Workshop at ARC Headquarters in Wad
Medani
27. Met with Dr. Gerd Walter-Echols, gtz
Leader of Sudanese-German Plant Protection Prog.
re: Suggested replacement for Aldrex-T seed dressing
- 30 Met with Dr. E. El Desougi, President, Agricultural
Research Council, National Council for Re-
search, and Dr. Jan Noel, WSARP Campus Co-
ordinator
re: University of Sudan - Kordofan Branch.

JANUARY (cont.)

30. Met with Dr. Ted Fuller, Sociologist, VPI serving as consultant for UNDP on resettlement of people from N. Darfur to S. Darfur. Dr. Tom Gillard-Byers, WSARP - Agricultural Economist, joined the meeting in progress.

FEBRUARY

3. Met with Tom Gillard-Byers, Agricultural Economist, WSARP and Ms. Susan Holcombe
re: Mungbean evaluation by consumers.
10. Met Abdelrahman El Khinder Osman, Agro-breeder, El Obeid Station, WSARP and Dr. L.M.Hogan, 1985 researcher, Khartoum
re: Results of 1984 research and plans for groundnuts and sesame.
13. Met with Dr. Tsega Woldetstios, Agronomist, Kadugli, WSARP and Dr. L.M.Hogan
re: Results of 1984 Agronomy Research Trials in Kadugli and plans for 1985 trials.
14. Dr. Hogan and I met with the following Kadugli Research Station scientists regarding their research results from 1984 and plans for 1985:
Mukhtar Kenani, Kadugli Station Director
Mohamed Azim Abu Sabah, Social Scientist
Dr. W. Trent Bunderson, Range Management Specialist
Ibrahim Mohamed Hashim, Range Scientist
16. Dr. Hogan and I met in El Obeid with the following El Obeid Scientists regarding results of 1984 research and plans for 1985:
Dr. Lalit M. Arya, Soil and Water Specialist
Hashim Khider Mukhtar, Asst. Range Management Specialist

FEBRUARY, (cont.)

17. Continuation of meetings in El Obeid with:
Dr. Osman Adam Osman, Horticulturist
Dr. Ahmed El Beshir, Entomologist
18. Continuation of meeting in El Obeid with:
Dr. El Hag Hassan Abu El Gasim
Director El Obeid Station,
Millet Breeder and Sedentary Systems Coordinator
19. Drs. Hogan and Riley met in Kadugli with the following
Kadugli scientists regarding results of 1984 research and
plans for 1985:
Dr. R.H.Cook, Animal Production Specialist and
Nomadic Systems Coordinator
Dr. Babo Fadlalla Mohamed, Animal Nutritionist
and Transhumant Systems Coordinator
Ahmed Suliman Mohamed El Wakeel, Range Scientist
Dr. Thomas Gillard-Byres, Agricultural Economist
24. Met with Stuart Marples and Ingrid Foik, World Bank
re: WSARP present and future.
28. Visit by Dr. P.J.Kemp, IDRC Information Consultant
re: Strengthening grant to ARC.
28. Field visit to DR. R.P.Jain's winter millet nursery in
Shambat

MARCH

2. Reviewed paper by Dr. F.F. Bebawi, University of Khartoum, on Striga control with Ethylene in El Obeid area.
4. Dr. Woldetates and I met with Dr. Faiz Bebawi, Department of Agricultural Botany, University of Khartoum.
re: Plans for 1985 trials in Kadugli on controlling Striga and screening sorghum cultivars for resistance to striga.
5. Drs. Hogan and Riley met with Dr. Hassan Osman Ahmed El Awad, Agro-breeder (cowpeas) El Obeid, WSARP in Khartoum, re: Research plans for 1985 season.
5. Drs. Hogan, Woldetates and Riley met with Professor Mahmoud Ahmed Mahmoud, Senior Agronomist, Mechanized Farming Corporation:
re: plans for 1985 research in Kadugli.
6. Meeting with Professor Mahmoud continued.
13. Met with Brian D'silva USDA
re: analysis of Western Sudan rainfall records.
14. Met with Dr. David Howes, Fulbright Scholar,
re: Results of field trip to Darfur and development of Green Index.
14. Met with Drs. Hogan and Noel
re: Determination of most critical staff for Aug. 16 - Dec. 31 extension.
16. Met with INTSORMIL Agronomist based in El Obeid, Dr. Tareke Berhe
re: Results of Annual INTSORMIL meeting particularly points relevant to research program in Sudan.

MARCH (cont.)

18. Met with Dr. W.R. Brown, AID Mission Director, Sudan and with Ms. L. Martella, Asst. Agricultural Officer, USAID Sudan
re: Possible extension of assignment
21. Met with Wadie Magar, Chairman Agricultural Research Council, National Council for Research.
re: National campaigns to increase agricultural production.
21. Reviewed paper by Dr. F.F. Behawi on Germination Response of Striga to Differing Periods of Conditioning.
23. Took Dr. J. Maguire to National Seed Administration and ARC Shambat Research Station to set up appointments for his consultancy.
26. Met with Dr. P.J. Kemp, Information Consultant, IDRC.
re: Arid Lands Information Center.
26. Met with Dr. Hassan M. Ali-Dinar, Horticulturist, ARC Hudeiba Research Station.
re: Technical support for grants from IBPGR, IFAD and World Bank.
26. Peter Marzell, International Trade Centre.
re: Kerkadeh action program
(Program to promote increased production and export of Kerkadeh)
27. Met with Dr. Leinius, gtz representative regarding information on phosphate deposit in S. Kordofan. Mr. Matthias, Mining Advisor, Ministry of Energy and Mining joined the meeting. Mr. Matthias said that deposit probably was not economically exploitable, but, he asked that I meet with him in a few days.

MARCH (cont.)

30. Met with Peter Marzell, ITC consultant on Kerkadeh action program and local entrepreneur Ahmed Nasir Ahmed re: Sources of information on Kerkadeh agronomy.

Organized WSARP slide and photo collection.

Prepared new list of International Agricultural Research Organizations

Made first draft of revised (updated) WSARP Directory.

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WORKSHOP ON ON-FARM RESEARCH WITH A FARMING SYSTEM PERSPECTIVE

WSARP/CIMMYT AT ARC HQ WAD MEDANI, SUDAN
JANUARY 19-24, 1985

P R O G R A M M E

19th, Saturday

1. 8.00 am - Registration of participants
2. 8.30 am - Opening of the workshop
 - Welcome to participants and vote of thanks to opening Speaker
 - Introductory comments
3. 9.30 am - Characteristics of small farmers systems
 - 10.30 am - Tea
4. 11.00 am - The Rationality of small farmers; the influence of their priorities on their decision making and management practices.
5. 12.30 noon - Conceptual model of a (small) farm system.
 - 12.30 pm - Tea
6. 1.00 pm - How small farm systems change
7. 1.30 pm - Examples of small farm systems
 - 2.30 pm - Break
 - Excercise --- for individual work
 - 'Case study - small farmer decisions'
8. 6.00 pm - Group meetings on excercise:- problems faced by the farmer

- 7.00 pm - Plenary discussion :- small farmer problems - highlighted by exercise
 8.00 pm - Close

20th, Sunday

10. 8.00 am - The slow pace of agricultural development; causes, including inappropriate technology.
11. 9.00 am - FSR, a means to understanding the farmers perspective on the choice of new technology.
12. 10.00 am - Exercise; characteristics of classical agricultural research institutions and methods contributing to inappropriate technologies - individual work.
- 10.30 am - Tea
13. 11.00 am - Group work on exercise
- Presentations of identified characteristics
14. 12.00 - An overview OFR/FSP as a missing link in technology development.
- 12.30 pm - Tea
15. 1.00 pm - CIMMYT diagnostic manual - an introduction
16. 1.30 pm - Target grouping; concepts and methods
- 2.30 pm - Break Exercise for individual work. Target groups in an area of farming well known to participants.
17. 6.00 pm - Individual presentations, changes in local farming systems and causes of change.
18. 7.00 pm - Learning about farmers circumstances - a first step in diagnosis. Sources of information.
- 2.00 pm - Close

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21st, Monday

19. 8.00 am - Informal Survey - objectives and content; the guidelines
- approach, procedure and output
20. 9.30 am - The art of the Informal interview
10.30 am - Tea
21. 11.00 am - Identified problems, causes and approaches to solutions.
22. 12.00 - Individual work - Read casestudy, list problems, causes and array solutions.
12.30 pm - Tea
23. 1.00 pm - Group work; Agree 2 main problems, causes and as wide an array of approaches
to solution as possible.
24. 1.30 pm - Group presentation - major problems, possible approaches to solution.
2.30 pm - Break

22nd, Tuesday

25. 8.00 am - Prescreening possible solutions; technical and economic.
26. 9.00 am - Special considerations in diagnosis with animals.
27. 10.00 am - Objectives of the Formal Verification Survey
10.30 am - Tea
28. 11.00 am - Questionnaire development
Sampling and field organisation,
Non-sampling errors and enumerator training.
Data analysis and interpretation.
12.30 pm - Tea

- Eh
29. 1.00 pm - Actions on diagnostic results.
 30. 1.30 pm - Introduction to On Farm Experimentation - differences from station experimentation.
 31. 2.00 pm - Stages in On Farm Experimentation.
 - 2.30 pm - Break
 32. 6.00 pm - Decisions on types of experiment.
 33. 7.00 pm - Design considerations in On-Farm Experiments.
 - 8.00 pm - Close

23rd, Wednesday

34. 8.00 am - Special considerations in designing animal experiments
35. 9.00 am - Planning the OFE programme and organizing fieldwork
36. 9.30 am - Group work - planning an OFE programme for the case study area.
- presentations
- 10.30 am - Tea
37. 11.00 am - Farmer and site selection, arrangements with farmers.
38. 11.30 am - Implementation; managing and monitoring of OFE.
- 12.30 pm - Tea
39. 1.00 pm - Special considerations in implementing OFE with animals.
40. 1.30 pm - Introduction to the evaluation of OFE.
41. 2.00 pm - Farmer criteria.

- 2.30 pm - Break
42. 6.00 pm - Statistical evaluation by type of Experiment - pooling of data
43. 7.00 pm - Economic evaluation, CIMMYT Blue Manual
- 8.00 pm - Close

24th Thursday

44. 8.00 am - Special considerations in evaluating animal experiments
45. 9.00 am - Farmer assessment of experiments and participation in the OFR/FSP process.
46. 10.00 am - Action on the results of experiments.
- 10.30 am - Tea
47. 11.00 am - Linkages - OFR and technical research
48. 11.45 am - Linkages - OFR and extension.
- 12.30 - Tea
49. 1.00 pm - Institutionalising OFR in research services
- 2.15 pm - Closing of Workshop.

P A R T I C I P A N T S

WSARP / A. R. C.

2nd. FARMING SYSTEMS

RESEARCH WORKSHOP

(In collaboration with CIMMYT)

19th. - 24th. Jan. 1985

WAD MEDANI

<u>No.</u>	<u>Name</u>	<u>Nationality</u>	<u>Organization</u>	<u>Address</u>
1.	Lalit M. Arya	Indian	WSARP	WSARP P.O. Box 5141, Khartoum
2.	James J. Riley	USA	WSARP	P.O. Box 699 WSARP/USAID Khartoum, Sudan
3.	Dafalla A.Dafalla	Sudanese	WSARP	P.O. Box 5141 Khartoum
4.	Mohd Azeem A/Sabah	"	WSARP	WSARP, P.O. Box 5141, Khartoum
5.	A/Rahman Khidir Osman	"	WSARP	El Obeid Station WSARP
6.	Hashim Khider Mukhtar	"	WSARP	WSARP P.O. Box 5141, Khartoum
7.	Ahmed S.El Wakeel	"	WSARP	WSARP P.O. Box 5141, Khartoum
8.	Ibrahim M.Hashim	"	WSARP	WSARP, Kadugli P.O. Box 5141
9.	Mukhtar M. Kenani	"	WSARP	Station Director Kadugli
10.	LeMoyne Hogan	USA	WSARP	WSARP/Kadugli
11.	Dick Cook	USA	WSARP	WSARP/Kadugli
12.	W.Trent Bunderson	USA	WSARP	K. Res. Station WSARP
13.	Jan C. Noel	USA	WSARP	WSARP/W. State Univ. USA
14.	El Hag H.Abu Gasim	Sudanese	WSARP	El Obeid Res. Station P.O. Box 429, El Obeid
15.	Babo Fadlalla	"	WSARP	P.O. Box 5141 Khartoum South Kadugli Station
16.	James B. Henson	USA	WSARP	WSARP, W. State Univ. Pullman, Washington, USA
17.	Thomas Gillard-Byers	USA	WSARP	WSARP, Kadugli

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<u>No.</u>	<u>Name</u>	<u>Nationality</u>	<u>Organization</u>	<u>Address</u>
18.	Tsega Woldetatos	US Resident	WSARP	WSARP. P.O. Box 5141, Khartoum Kadugli Station
19.	Ahmed Kheir El Seed	Sudanese	WSARP	WSARP/KADUGLI P.O.Box 5141 Khartoum
20.	Salah bahr Ali	"	WSARP	El Cbeid Ag. Res. Corp, P.O. Box 42
21.	Bakheit Adam Azrag	"	WSARP	WSARP/Kadugli
22.	Suliman Abdalla	"	WSARP	WSARP/El Obeid Ag. Res. Corp. P.O. Box 429
23.	Osman Adam Osman	"	WSARP	P.O. Box 429 El Obeid
24.	Hassan Osman Ahmed El Awad	"	WSARP	WSARP/El Obeid
25.	Ahmed El Bashir	"	WSARP	ARC, El Obeid P.O. Box 429
26.	Osman A/alla Mohamed	"	WSARP	P.O. Box 5141 Khartoum South
27.	Mohd Abu El Azaiem Medani	"	M. of Agric.	Animal Resources P.O. Box 293, Kh.
28.	Farouk Ibrahim Shomo	"	M. of Agric.	El Obeid, Min. of Agric.
29.	Samira Hashim	"	M. of Information	Sudan News Agency Wad Medani
30.	Abdel Moneim B. El Ahmadi	"	A.R.C.	Plant Breeding Section P.O. Box
31.	M. A. Fattah	"	A.R.C.	ARC, Wad Medani P.O. Box 126
32.	Osman I. Gameel	"	A.R.C.	ARC P.O. Box 126
33.	El Tigani M. Elamin	"	A.R.C.	Director Gezira Res. Station P.O. Box 126 W/M.
34.	Nasr El din Sharf-El din	"	A.R.C.	G.R.S. Medani
35.	Mohd Badr Ahmed Saleem	"	A.R.C.	Agric. Res. Sta. G.R.S.W/Medani
36.	Abdel Mageed Yassin	"	A.R.C.	P.O. Box 126 W/M

<u>No.</u>	<u>Name</u>	<u>Nationality</u>	<u>Organization</u>	<u>Address</u>
37.	Osman A A. Ageeb	Sudanese	A.R.C.	Agronomy Section GRS/P.O. Box 126
38.	Hamid El Faki	"	A.R.C.	State Agric. Econ. Section, ARC
39.	Asim Ali A/Rahman	"	A.R.C.	ARC, Entomology
40.	Morid Girgis Mansi	"	A.R.C.	ARC, W/Medani
41.	Mirghani Khogali Ahmed	"	A.R.C.	Hort. Res. Section GRS/Medani P.O. Box 126
42.	M. Bakheit Said	"	A.R.C.	ARC, W/Medani
43.	Ibrahim A. Babiker	"	A.R.C.	ARC, W/Medani
44.	Abdalla M. Hamdoun	"	A.R.C.	GRS, W/Medani
45.	Ahmed Nasir Balla	"	A.R.C.	GRS, Entomology Section, W/Medani
46.	Hassan M. Ishag	"	A.R.C.	ARC, W/Medani
47.	S.A. El-Nasieh	"	A.R.C.	ARC, W/Medani
48.	Ibrahim Khalid	"	A.R.C.	Agric. Res. Corp. P.O. Box 126 W/Medani, Sudan
49.	Sam L. Laki	"	A.R.C.	Yambio Agric. Res. Station USAID P.O. Box 699 Khartoum, Sudan
50.	Samson A. Koi	"	A.R.C.	Yambio Res. Sta. USAID Office, Juba
51.	Babiker Omer Kanan	"	A.R.C.	Agric. Res. Corp. W/Medani, Sudan
52.	Faisal Mirghani Ali	"	A.R.C.	ARC, W/Medani Sudan
53.	Ali Taha Ayoub	"	A.R.C.	ARC, W/Medani Sudan
54.	Sitt El-Banat Khidir	"	Extension Dept.	ARC Agronomy Section W/Medani
55.	Hassan Khalifa	"	A.R.C.	P.O. Box 126 W/Medani, ARC
56.	R. P. Jain	Indian	ICRISAT	Millet Breeder (El Obeid) P.O. Box 913 UNDP Khartoum

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<u>No.</u>	<u>Name</u>	<u>Nationality</u>	<u>Organization</u>	<u>Address</u>
57.	Nelson Lorombu	Sudanese	ERAP Equatoria	D/Senior Research Officer-Yei
58.	Jan Adamec	USA	USAID/SRAD	Yambio Agric. Res. Station
59.	G.M.A. El Rofaiee	Sudanese	Extension Inspector	Kordofan Agric. Ministry
60.	M. P. Collinson	British	CIMMYT	P.O. Box 25171 Nairobi
61.	A.F.E. Palmer	British	CIMMYT	CIMMYT Londres 40, APDO Posta 6-641
62.	Tareke Berhe	Ethiopian	INTSORMIL	P.O. Box 149 El Obeid
63.	Mirghani Saeed	Sudanese	INTSORMIL- CRSP El Obeid	INTSORMIL-CRST
64.	Gerd Walter-Echols	German	GTZ/Sud. German Plant Protection P.	P.O. Box 8192
65.	Mohd Mudathir Mohd Ahmed	Sudanese	Sud. German Plant P.O.	Kh. North, Plant Plant Protection
66.	Abdel Sadig Osman	"	Sud. German P.P.P.	Kh. North, P.O. Box 13
67.	Ed Reeves	USA	Morehead State Univ. Morehead, Kentucky, USA	Morehead State Univ., UPD 285
68.	Hassan H. Abdalla	Sudanese	Soil Survey	P.O. Box 388 Wad Medani
69.	Osman A/Rahman Mohd El Tom	"	Soil Survey	Soil Survey P.O. Box 388
70.	Kamal El Fadil Fadul	"	Soil Survey	P.O. Box 388 Wad Medani D.R. of Sudan
71.	A/Hamid Ezat	"	Soil Survey	P.O. Box 388
72.	Osman A. Fadl	"	U. of Gezira	F. of Agric.
73.	Fathi M. Khalifa	"	U. of Gezira	F. of Agric. Science, U. of G.
74.	Faisal Awad Ahmed	"	U. of Gezira	F. of Agric. P.O. Box 20
75.	Satti Mohd El Zein	"	U. of Gezira	F. of Agric. Science P.O. Box 20, W/M.

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STATION: EL OBEID

ESTIMATED SCHEDULE OF COMPLETION (Revised Feb 15, 1985)

MONTHS:	Feb. 85	March	April	May	June	July	Aug.	Sept.	Remarks
SEWERS / LAGOONS	95% compl.	-----	-----▶						98% materials on site
WATER LINES	90% compl.	-----	-----▶						98% materials on site
ROADWORKS			installation -----		-----▶				
GRADING			installation -----		-----▶				
WATER TOWER	65% compl.	-----	-----▶						mat. on site except pumps, valves, control.
DOORS & WINDOWS	65% compl.	-----▶							all materials on site
GLASS		site -----▶	installation -----▶						local purchase considered
VERANDAH SCREENS	40% compl.	-----	-----	-----▶					all materials on site
ELECTR. WORK, int.	int. wiring 80% compl.	-----▶	fixtures installation -----▶		-----▶				fixtures in Kht. and on site
O.H. DISTR. CABLES		P.S. -----▶	site -----▶	install -----▶					L.C.
INT. PLUMBING	80% compl.	-----	-----▶						all materials on site
PLUMBING FIXTURES		P.S. -----▶	site -----▶	installation -----▶					L.C.
PLASTER	75% compl.	-----	-----▶						
PAINTING	undercoat	1st. coat -----▶		2nd. coat -----▶		-----▶			all materials on site
SLABS / TILES	55% compl.	-----	-----	-----▶					
SUSPENDED CLG.		P.S. -----▶	site -----▶	installation -----▶		-----▶			L.C.
LAB CABINETS		P.S. -----▶	site -----▶	installation -----▶					L.C.
KITCHEN CABINETS		manufactured in Kht.		-----▶	site -----▶	install -----▶			
GENERATORS	manufactured in U.K.		-----▶	P.S. -----▶	site -----▶	install -----▶			L.C.
AIR COOLING		manufact. in Kht.	-----▶	site -----▶	installation -----▶				

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STATION: EL FASHER

ESTIMATED SCHEDULE OF COMPLETION (Revised Feb 15, 1985)

MONTHS:	Feb. 85	March	April	May	June	July	Aug.	Sept.	Remarks
SEWERS	P.Sudan →	site →	installation of pipes →						septic tanks compl.
WATER LINES	P.Sudan →	site →	installation →						L.C. L.C.
ROADWORKS				installation →					
GRADING				installation →					
WATER TOWER	P.S. →	site →	install →						L.C.
DOORS & WINDOWS	Khartoum →	site →	install. →						L.C.
GLASS			site →	install →					local purchase considered
VERANDAH SCREENS		P. Sudan →		site →	installation →				L.C.
ELECTR. WORK, int.		fixtures:	Kht. →	site →	installation →				int.wiring 65% compl.
G.H. DISTR. CABLES	65% compl →								L.C.,
INT. PLUMBING		Kht. →	site →	installation →					L.C.
PLUMBING FIXTURES		P.S. →	site →	installation →					L.C.
PLASTER	75% compl →								
PAINTING		site →	undercoat	1st c. →	2nd coat →				materials in Kht.
SLABS / TILES	60% compl →								
SUSPENDED CLG.		P.S. →	site →	installation →					L.C.
LAB CABINETS		F.S. →		site →	installation →				L.C.
KITCHEN CABINETS		manufactured in Kht.			site →	install →			
GENERATORS	manufactured in U.K.			P.S. →	site →	install →			L.C.
AIR COOLING		manufact. in Kht.		site →	install. →				

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STATION: GHAZALA GAWAZET

ESTIMATED SCHEDULE OF COMPLETION (Revised Feb 15, 1985)

MONTHS:	Feb. 85	March	April	May	June	July	Aug.	Sept.	Remarks
SEWERS	F.Sudan →	site →	installation of pipes →						septic tanks compl. L.C.
WATER LINES	F.Sudan →	site →	installation →						L.C.
ROADWORKS				installation →					
GRADING				installation →					
WATER TOWER	P.S. →	site →	install →						L.C.
DOORS & WINDOWS	Khartoum →	site →	install. →						L.C.
GLASS			site →	install →					local purchase considered
VERANDAH SCREENS		F. Sudan →		site →	installation →				L.C.
ELECTR. WORK, int.			Kht. →	site →	installation →				int.wiring 65% compl.
C.H. DISTR. CABLES	poles 50% compl. →		install →						all materials on site
INT. PLUMBING		Kht. →	site →	installation →					L.C.
PLUMBING FIXTURES		F.S. →	site →	installation →					L.C.
PLASTER	60% compl. →								
PAINTING		site →	undercoat/1st c. →	2nd coat →					materials in Kht.
SLABS / TILES		installation →							
SUSPENDED CLG.		P.S. →	site →	installation →					L.C.
LAB CABINETS		F.S. →		site →	installation →				L.C.
KITCHEN CABINETS		manufactured in Kht. →		site →	install →				
GENERATORS	manufactured in U.K. →			P.S. →	site →	install →			L.C.
AIR COOLING		manufact. in Kht. →		site →	install →				

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STATION: ARG. HEADQUARTERS

ESTIMATED SCHEDULE OF COMPLETION (Revised Feb 15, 1985)

MONTHS:	Feb. 85	March	April	May	June	July	Aug.	Sept.	Remarks
SEWERS	95% compl.	----->							
WATER LINES									complete
ROADWORKS	30% compl.	----->							
GRADING		install. >							
WATER TOWER		install >							tank is in roof
DOORS & WINDOWS	80% compl.	----->							all materials on site
GLASS		install. >							local purchase
ELECTR. WORK, int.	75% compl.	----->	----->						all materials on site
O.H. DISTR. CABLES		install >							variation order pending
INT. PLUMBING	95% compl.	----->							all materials on site
PLUMBING FIXTURES			install >						all materials on site
PLASTER	95% compl.	----->							
PAINTING	33% compl.	----->	----->						all materials on site
SLABS / TILES	95% compl.	----->							
KITCHEN CABINET			install >						local purchase
AIR COOLING		manuf. >	install >						local purchase

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QUARTERLY REPORT
OF PROFESSIONAL ACTIVITIES
JANUARY - MARCH 1985

by

DR. JAMES J. RILEY
SENIOR ADVISOR, ARC

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JANUARY

- 5 . Interviewed candidates for laboratory chemist and another position with Project Director, Dr. Dafalla Ahmed Dafalla.
8. Met with Dr. Gordon Potts, IDRC Representative, based in Cairo. We discussed several IDRC sponsored projects in Sudan, two of which may be of interest to WSARP:
- (1) Multidisciplinary study of Tenant Animal Production Potential on Rahad Scheme,
Project leader, Abdul Fattah Nour,
Animal Nutritionist
University of Gezira
(Team also includes Cereal Breeder and
Agricultural Economist)
 - (2) Development of New Ration for Khartoum Cattle Feed-lot.
Project leader, Dr. Mangoub Gaffar El Hag
Animal Nutritionist
Institute of Animal Production
University of Khartoum
- Evaluating feed composed of sorghum, groundnuts, wheat bran and urea compared to traditional feed of dura and cotton seed.
14. Met with Dr. Kahil Sobahi Yousif
ARC Food Research Center
re: information on market diseases of horticultural crops.
Sent request to Postharvest Institute for Perishables.
14. Met with Alistair McKay - Livestock Specialist
Paul Devitt - Social Scientist, Hunting Technical Services.
re: development of forage potential in S. Darfur.
16. Met with Dr. David Howes - Fulbright Fellow,
University of Khartoum
re: High resolution thematic mapping available for Kordofan Province.

JANUARY (cont.)

16. Met with Dr. George Ghobrial - Asst. Agricultural Officer
USAID - Khartoum
re: Obtaining 2000t of cereal seed for distribution to
farmers in Western Sudan in 1985/86
I gave him copy of chapter on Cultivar Evaluation
from draft of WSARP publication on "Increasing Crop Pro-
ductivity in Western Sudan - Results of selected Agronomic
Trials" for indication of which cultivar do best in the
west.
16. Saw Will Bateson,
Agricultural Statistics and Planning Project
Ministry of Agriculture
re: Data required by Sid Ahmed Hassan Sid Ahmed Beteik,
WSARP graduate student
17. Attended meeting re: Planning for FSR Workshop with Drs.
Dafalla and Hogan, WSARP; Dr. Noel, WSU; Dr. Reeves,
Morehead St. University and Dr. Palmer, CIMMYT.
- 19-24 Attended and participated in second WSARP/ARC Farming
Systems Research Workshop at ARC Headquarters in Wad
Medani
27. Met with Dr. Gerd Walter-Echols, gtz
Leader of Sudanese-German Plant Protection Prog.
re: Suggested replacement for Aldrex-T seed dressing
- 30 Met with Dr. E. El Desougi, President, Agricultural
Research Council, National Council for Re-
search, and Dr. Jan Noel, WSARP Campus Co-
ordinator
re: University of Sudan - Kordofan Branch

JANUARY (cont.)

30. Met with Dr. Ted Fuller, Sociologist, VPI serving as consultant for UNDP on resettlement of people from N. Darfur to S. Darfur. Dr. Tom Gillard-Byers, WSARP - Agricultural Economist, joined the meeting in progress.

FEBRUARY

3. Met with Tom Gillard-Byers, Agricultural Economist, WSARP and Ms. Susan Holcombe
re: Mungbean evaluation by consumers.
10. Met Abdelrahman El Khinder Osman, Agro-breeder, El Obeid Station, WSARP and Dr. L.M.Hogan, 1985 researcher, Khartoum
re: Results of 1984 research and plans for groundnuts and sesame.
13. Met with Dr. Tsega Woldetstios, Agronomist, Kadugli, WSARP and Dr. L.M.Hogan
re: Results of 1984 Agronomy Research Trials in Kadugli and plans for 1985 trials.
14. Dr. Hogan and I met with the following Kadugli Research Station scientists regarding their research results from 1984 and plans for 1985:
Mukhtar Kenani, Kadugli Station Director
Mohamed Azim Abu Sabah, Social Scientist
Dr. W. Trent Bunderson, Range Management Specialist
Ibrahim Mohamed Hashim, Range Scientist
16. Dr. Hogan and I met in El Obeid with the following El Obeid Scientists regarding results of 1984 research and plans for 1985:
Dr. Lalit M. Arya, Soil and Water Specialist
Hashim Khider Mukhtar, Asst. Range Management Specialist

FEBRUARY, (cont.)

17. Continuation of meetings in El Obeid with:
Dr. Osman Adam Osman, Horticulturist
Dr. Ahmed El Beshir, Entomologist

18. Continuation of meeting in El Obeid with:
Dr. El Hag Hassan Abu El Gasim
Director El Obeid Station,
Millet Breeder and Sedentary Systems Coordinator

19. Drs. Hogan and Riley met in Kadugli with the following
Kadugli scientists regarding results of 1984 research and
plans for 1985:
Dr. R.H.Cook, Animal Production Specialist and
Nomadic Systems Coordinator
Dr. Babo Fadlalla Mohamed, Animal Nutritionist
and Transhumant Systems Coordinator
Ahmed Suliman Mohamed El Wakeel, Range Scientist
Dr. Thomas Gillard-Byres, Agricultural Economist

24. Met with Stuart Marples and Ingrid Foik, World Bank
re: WSARP present and future.

28. Visit by Dr. P.J.Kemp, IDRC Information Consultant
re: Strengthening grant to ARC.

28. Field visit to DR. R.P.Jain's winter millet nursery in
Shambat

MARCH

2. Reviewed paper by Dr. F.F.Bebawi, University of Khartoum, on Striga control with Ethylene in El Obeid area.
4. Dr. Woldetatos and I met with Dr. Faiz Behawi, Department of Agricultural Botany, University of Khartoum.
re: Plans for 1985 trials in Kadugli on controlling Striga and screening sorghum cultivars for resistance to striga.
5. Drs. Hogan and Riley met with Dr. Hassan Osman Ahmed El Awad, Agro-breeder (cowpeas) El Obeid, WSARP in Khartoum, re: Research plans for 1985 season.
5. Drs. Hogan, Woldetatos and Riley met with Professor Mahmoud Ahmed Mahmoud, Senior Agronomist, Mechanized Farming Corporation:
re: plans for 1985 research in Kadugli.
6. Meeting with Professor Mahmoud continued.
13. Met with Brian D'silva USDA
re: analysis of Western Sudan rainfall records.
14. Met with Dr. David Howes, Fulbright Scholar,
re: Results of field trip to Darfur and development of Green Index.
14. Met with Drs. Hogan and Noel
re: Determination of most critical staff for Aug. 16 - Dec. 31 extension.
16. Met with INTSORMIL Agronomist based in El Obeid, Dr. Tareke Berhe
re: Results of Annual INTSORMIL meeting particularly points relevant to research program in Sudan.

MARCH (cont.)

18. Met with Dr. W.R. Brown, AID Mission Director, Sudan and with Ms. L. Martella, Asst. Agricultural Officer, USAID Sudan
re: Possible extension of assignment
21. Met with Wadie Magar, Chairman Agricultural Research Council, National Council for Research.
re: National campaigns to increase agricultural production.
21. Reviewed paper by Dr. F.F. Bebawi on Germination Response of Striga to Differing Periods of Conditioning.
23. Took Dr. J. Maguire to National Seed Administration and ARC Shambat Research Station to set up appointments for his consultancy.
26. Met with Dr. P.J. Kemp, Information Consultant, IDRC.
re: Arid Lands Information Center.
26. Met with Dr. Hassan M. Ali-Dinar, Horticulturist, ARC Hudeiba Research Station.
re: Technical support for grants from IBPGR, IFAD and World Bank.
26. Peter Marzell, International Trade Centre.
re: Kerkadeh action program
(Program to promote increased production and export of Kerkadeh)
27. Met with Dr. Leinius, gtz representative regarding information on phosphate deposit in S. Kordofan. Mr. Matthias, Mining Advisor, Ministry of Energy and Mining joined the meeting. Mr. Matthias said that deposit probably was not economically exploitable, but, he asked that I meet with him in a few days.

MARCH (cont.)

30. Met with Peter Marzell, ITC consultant on Kerkadeh action program and local entrepreneur Akmed Nasir Ahmed re: Sources of information on Kerkadeh agronomy.

Organized WSARP slide and photo collection.

Prepared new list of International Agricultural Research Organizations

Made first draft of revised (updated) WSARP Directory.

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ADDENDUM TO
JANUARY - MARCH 1985
QUARTERLY REPORT
FOR J.J. RILEY

(INCLUDES ACTIVITIES RELATED TO POSITION AS
SENIOR ADVISOR TO DIRECTOR GENERAL OF THE ARC FROM
1 - 15 APRIL 1985. APRIL 15 IS TERMINATION DATE
FOR POSITION)

APRIL

3. MET WITH HASSAN ALI-DINAR, HORTICULTURIST, ARC
HUDEIBA RESEARCH STATION AND AN AGRICULTURAL
ECONOMIST WITH THE REGIONAL GOVERNMENT OF THE
NORTHERN REGION, RE: SOURCES OF AGRICULTURAL
INFORMATION AND PLANNED VISIT TO USA BY DR. ALI-
DINAR TO STUDY VIRUS-FREE BUD WOOD PROGRAM FOR
IMPROVING SUDANESE CITRUS. DRAFTED TELEX TO
WSU REQUESTING THEM TO CONTACT DR. KREZDORN
WHO IS TO SEND INVITATION FOR TRIP TO DR. ALI-
DINAR.

11. DRAFTED COMMENTS ON AID PLAN FOR IMPROVING
AFRICAN AGRICULTURAL RESEARCH ENTITLED:
"PLAN FOR SUPPORTING AGRICULTURAL RESEARCH AND
FACILITIES OF AGRICULTURE IN AFRICA"

13. ACCOMPANIED WSARP SEED CONSULTANT, DR. JAMES
MAGUIRE TO SEE DR. SHAZALI, STORED -PEST
ENTOMOLOGIST, ARC SHAMBAT RESEARCH STATION.

14. MET WITH GEORGE ARMSTRONG, LILI MARTELLA,
KEN LYVERS, WIL BATESON AND LEMOYNE HOGAN AT
USAID TO DISCUSS: "PLAN FOR SUPPORTING
AGRICULTURAL RESEARCH AND FACULTIES OF
AGRICULTURE IN AFRICA"

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

QUARTERLY REPORT

April 1, 1985 - June 30, 1985

I. GENERAL

The second quarter of 1985 was characterized by a number of events which impacted various activities of the Western Sudan Agricultural Research Project.

In April the government was overthrown by the military after civilian riots in the country. The change in government resulted in numerous personnel changes in government ministries at the national and regional levels, which affected those with whom we worked; changes in procedures and more than normal delays also resulted. The Khartoum airport was closed for two weeks and the project plane was unable to fly to the stations as normal. Fortunately, there were no serious emergencies during this period.

The serious drought continued through most of this quarter. Lack of adequate rainfall for crop production and for filling water reservoirs in Western Sudan resulted in seriously reduced crop production and shortages of food and water for both human and livestock consumption. Both people and livestock had to go long distances to obtain water. Emergency food programs were initiated throughout Western Sudan, although logistic difficulties resulted in limited impact of such programs to this time. There was loss of both people and livestock from malnutrition as well as the abandonment of many villages. Many villages and towns were completely without sources of water. El Obeid, the capital of Kordofan, used its last water from the city reservoirs, and in May and June the city was totally dependent on a few wells located in favorable locations and on water transported from Kosti by railroad tank cars. This rail transport was in direct

competition with the food relief effort which also depended on rail transport.

The impact of these conditions on WSARP construction and research activities was significant. The use of water for construction purposes was banned in El Obeid during this period, resulting in additional delay. The major construction constraint, however, was the failure of the contractor to provide construction materials to the sites, which was greatly exacerbated in-country by the lack of available lorry and rail transport due to food aid and water taking priority. The water shortage forced WSARP scientists and staff in El Obeid to spend a large portion of their time arranging for water for scaled back project activities and for personal use.

The construction program continues to lag behind schedule due to a number of factors, including those discussed above. However, the Project Support Unit/ARC Liaison Office in Shambat is nearing completion.

The morale of WSARP personnel continued on its downward trend due to uncertainty about the future of the project and the perception by all that much remains to be done. A decision by USAID, Sudan to terminate, prior to the completion of their contracts, three expatriate positions and to send the individuals home early contributed to the morale problem. Also, both expatriate administrative positions were terminated, effective at the onset of this quarter. This was done to reduce the number of expatriates not directly responsible for research activities and to replace them with local hire people. Individuals were located and hired locally for the Force Account Engineer position and Administrative Officer position. Back-up support and training for the latter was provided from WSU. Dr. James Riley's position as Senior Advisor to the Agricultural Research Corporation was terminated, but he was reassigned by USAID to undertake a water management survey for Western Sudan through August 15, 1985.

Indecision as to how the USAID/Sudan Mission would continue to provide technical assistance to the project after August 14, 1985 was of great concern to all members of the project. Several methods were proposed and studied before it was finally decided to renew contracts for the Animal Production Specialist and Economist through December, 1985. All other positions were terminated on August 14, 1985. The area most severely affected by this action was the agronomic program at Kadugli. There was barely time for this season's planting to be completed before the agronomist had to pack and leave the Sudan. The possibility of moving the INTSORMIL agronomist from El Obeid to Kadugli is being explored. However, the interruption of the agronomic activities at Kadugli as well as impact on Dr. Berhe's activities in El Obeid can be expected to detract from this year's research program.

During the quarter, final research results from 1984-85 were analyzed, and preparation of research reports was initiated. Summarized results will be available during the following quarter. Also, the research program for 1985-86 was developed, reviewed and approved, and 1985-86 research activities were initiated.

Large quantities of project equipment, materials and supplies continued to arrive. There is concern that storage space and manpower are not adequate to meet materials control needs. Procurement of Ford vehicles locally was initiated.

A. Consultants and Visitors

Dr. J. D. Maguire, agronomist and seed physiologist from Washington State University, visited the project and conferred with agronomists at El Obeid and Kadugli on seed storage matter. He also discussed storage and seed quality matters with scientists of the National Seed Administration. Dr. Maguire's consultancy was funded by WSU at no cost to the project.

Dr. Thomas Trail, Professor of Extension Education at Washington State University, spent 2 months in the West as a short-term

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consultant on Extension Education. He surveyed the needs of extension activities in the Kadugli and El Obeid areas.

Mr. Michael Mannion, WSARP consultant for equipment and maintenance, completed his assignment and departed Sudan. En route to the U.S., Mr. Mannion spent time in the U.K. to facilitate procurement of the source/origin waiver-related station maintenance spares. The approval of the waiver is still pending, but is expected soon.

Dr. Brent Cluff, hydrologist from the University of Arizona, began a 10 day short-term consulting visit on water harvesting and water conservation in Western Sudan. Dr. Cluff's visit was sponsored jointly by the project and the AID Strengthening Grant Program.

Dr. Mark Speece, Market Economist, and Dr. W. Symons, Agricultural Engineer, from Washington State University, arrived to begin work during the last part of this quarter.

Mr. Ken Lyvers, USAID Agricultural Development Officer, and Ms. E. S. F. Martella, USAID Project Officer, visited all four research stations with the Chief of Party, Dr. LeMoyne Hogan to discuss future needs with scientists and administrators and to review station construction problems.

Dr. Phil Wandschneider, Water Resource Economist from WSU, consulted with Dr. Riley and others in Sudan regarding constraints and potentials for water resource management. Dr. Wandschneider's consultancy was funded by WSU.

Joachim Grube of Grube-Zimmer visited the project during the quarter to review construction activities and work with donors, the project and the construction contractor in resolving construction issues .

B. Trips and Meetings

Dr. Dafalla A. Dafalla, Director, WSARP, completed a six week course in Agricultural Research Management conducted in Washington, D. C.

Dr. L. Hogan visited research stations at Wad Medani, Sennar and Abu Nama to confer with Agricultural Research Corporation officials and scientists and to make arrangements for seed for the season's research program.

Dr. Babo Fadlalla and Dr. Richard Cook returned from attendance at technical meetings at ICARDA, in Aleppo, Syria.

II. ADMINISTRATION

ARC Director General, Dr. Mohamed Bakheit Saad, departed from Sudan to assume a post at ICARDA, and Dr. Hassan Khalifa was confirmed as the new Director General.

Two participants, Mr. Ahmed El Wakeel and Mr. Tighani Mirghani El Amin, completed graduate research programs at Kadugli and returned to Utah State and Washington State University, respectively, to complete requirements for graduate degrees.

Mr. Mekki Mohamed Al Eid, WSARP Senior Librarian and Mr. Osman Abdalla Mohamed, Deputy Director for Administration, completed short-term training programs at Washington State University during the quarter.

Dr. Hassan El Awad, agronomist, and Mr. Babiker Abdalla Ibrahim, soil scientist, who returned to Sudan during the previous quarter, joined the research program in El Obeid.

Dr. Trent Bunderson completed his contract as Range Management Specialist at Kadugli and turned over his research activities at Kadugli to Dr. Ibrahim Hashim.

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Mr. John Hannum, Chief Administrative Officer, completed his contract and departed in April on the first flight after the airport was re-opened.

Dr. David Higgins and Shirley Higgins departed during this quarter after early contract termination by direction of USAID, Sudan. Mr. Shawgi Amin El Sayed was hire to assume the responsibilities of Force Account/Project Engineer.

Ms Genevieve Smith, Washington State University, arrived in Khartoum on an interim basis until a local hire administrative officer could be hired to replace John Hannum and Shirley Higgins. Mr. Steven Horton was hired to handle these administrative matters. Additional administrative personnel in stores and materials control is being sought.

Ms. Dolly Reynolds, secretary, resigned and was replaced by Mr. Arnel Cruz Montoya.

Mr. Benjamin R. Arejola was hired to assist with procurement and materials control.

Arrangements were made to purchase 13 Ford pickups for the project from a large number of vehicles imported privately and stored at Port Sudan. On-site mechanical inspections were performed to facilitate approval of the purchase. USAID personnel have initiated the process for source/origin waiver approval. Final approvals are still pending. The purchase of these trucks is expected to result in considerable savings to the contract.

The lease on the WSARP office building in Khartoum expired during the present quarter. A concentrated effort was made to have the contractor complete the new ARC/WSARP office building at Shambat prior to expiration of the lease. However, the building was not completed by the end of the quarter. Arrangements were therefore made with the landlord to continue using the WSARP office building on a

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month-to-month basis. Delays have been encountered in the installation of the telephone, electrical, cooling and water systems at Shambat. However, the new facilities are expected to be completed and occupied within 30 days .

Large quantities of equipment and supplies were received by the project from the U.S. Stores personnel received these, logged them into property records and distributed those where appropriate. Those items procured for the stations at El Fasher and Ghazala Gawazet prior to the USAID decision not to equip these stations are being separately inventoried, containerized and stored in Khartoum until these stations are completed and staffed. Due to limited storage availability in Khartoum and at the stations, and because of the turnover of administrative staff, the inventory and materials control system is problematic.

III. PHYSICAL PROGRESS

A. Construction

GENERAL

Station construction in Kordofan and Darfur was stalled during the quarter, although the Project Support Unit/ARC Liaison Office at Shambat is nearly completed. Supplies were not delivered by the contractors to western sites as promised, as a result of a number of factors including failure to resolve the devaluation issues, delayed payments to contractors, the drought related transportation shortages, current transportation delays due to the onset of the rains and continued management deficiencies by the construction contractors.

Remaining to be completed at the office building at Shambat are the cooling system, installation of the back-up generators, the telephone and electrical connections, and small finishing activities. Occupation is anticipated within 30 days.

Many attempts were made by project administrators and donor agencies to influence the construction contractors to speed up station construction in the West by timely purchase and shipping of supplies and by providing for payment of subcontractors. The delays in construction, coupled with the uncertainty of future project funding, has severely hampered the recruiting of Sudanese scientists for the uncompleted stations, has adversely influenced AID's overall opinion of the contract and had severely restricted the primary purpose of the project - that of agricultural research. At the end of this quarter, construction was essentially at a standstill. Of continued high priority are activities in process to resolve the devaluation settlement/increased taxes and duties/liquidated damages issues; finalization of external procurement; and arrangements to get construction materials delivered to sites in the West.

B. Force Account Activities

During this quarter, the position of Dr. David Higgins, whose primary function was force account activities, was terminated early. Prior to his departure, a Sudanese engineer, Mr. Shawgi Amin El Sayed, was recruited as his replacement, and there was an overlap of several weeks before Dr. Higgins left Sudan. The Sudanese hired as his replacement is well qualified; he has previously worked in Western Sudan so he knows the region, the government agencies and the people he will work with.

Force activities during this quarter included the construction of a gravel road on the Kadugli Research Farm which permits access to the agronomy plots during the rainy season.

The foundation of the new water tank tower at the Horticultural Research farm at El Obeid cracked badly during the first tank filling. It was necessary to construct a new pad, dismantle the tank tower and tank and move them to the new location. All irrigated research for the season had to be moved off-station where water was available.

Work has not yet begun on farm facilities for the El Obeid station. Also, the development of an alternative water system to supplement the city water supply at El Obeid remains critical, as clearly demonstrated during the recent shortage.

None of the force account activities previously projected for the Darfur stations are underway. Most critical is the rehabilitation or replacement of the air strip at Ghazala Gawazat to allow for access in the rainy season.

IV. FINANCE

The quarterly financial statement is attached.

V. PROJECT IMPACT - THE RESEARCH PROGRAM

The 1984-85 Annual Research Committee Meeting was held in Kadugli from 20-22 April to review the previous season's results and discuss proposed 1985-86 research activities. In attendance were WSARP scientists from Kadugli and El Obeid, Drs. Dafalla and Hogan from Khartoum, Dr. Tareke Berhe (INTSORMIL, El Obeid), and Dr. Jain, ICRISAT breeder. Results of the 1984-85 research program are being prepared for publication at this time and will not be summarized in detail here.

The Kadugli Research Committee subsequently met on 27 April to further develop the 1985-86 research plans. The program was reviewed and refined with input from Mr. Ken Lyvers, USAID Agricultural Officer and E. Martella, USAID Project Officer, in an additional research planning meeting with the Kadugli Station Committee in May. The 1985-86 research program was subsequently finalized and approved at a meeting of the WSARP Research Advisory Council. Details are included in WSARP Publication # 36, "Research Program for the Kordofan Region: 1985-86".

Research activities were initiated accordingly in the latter part of the quarter. However, the decreased number of scientists is expected

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to result in serious manpower shortages in the final portions of the 1985-86 program. Shortages of personnel in the plant sciences at Kadugli are especially critical.

Examples of research results and planned future activities showing high potential include:

1. Increasing soil fertility/production of sorghum and other core commodities through crop rotation and intercropping with selected varieties of cowpeas, guar, and mungbeans.
2. Improved water conservation/management through mulching, use of seed cradles and other practices.
3. The definition and planning of a controlled grazing management scheme to bring unutilized areas of Southern Kordofan into production and decrease environmental pressure on currently overused areas.
4. Increased use of animal traction to alleviate labor bottlenecks and allow for improved market access in Southern Kordofan.
5. Introduction to farmers of short-maturing varieties of sorghum and millet to increase production in below-average rainfall years.
6. Strategic supplementation of phosphorous and protein for improving livestock productivity.
7. Strategic control of parasites in sheep to increase productivity.

Details are included WSARP Publication #41, "Summary of Research Results for the Sedentary and Transhumant Production Systems, Kordofan Region - 1984-85" (in preparation).

Drs. Cluff and Riley's studies of water management needs and strategies have yielded information of potential immediate

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applicability. Among these activities was the definition of an improved compartmentalized hafir/water reservoir system for El Obeid.

Further cooperative efforts were conducted with the Nuba Mountain Rural Development Project and the Mechanized Farming Corporation, including sharing of seed materials and germination testing of sesame and sorghum.

Gadam El Hamam, a short-maturing sorghum variety showing potential in previous research trials, especially under low rainfall conditions, was distributed to cooperating farmers in the Kadugli area at no charge. Because many farmers had no seeds left from the previous year, this effort built a great deal of good will.

On-station and limited on-farm trials with Hageen dura had to be deferred due to lack of availability of seeds.

With the departure of Dr. Riley from the position of Sr. Advisor to the Director General of ARC, information exchange between WSARP scientists, the ARC, the International Agricultural Research Centers and other cooperating organizations has been curtailed. An alternative means to replace this vital function is needed.

WSARP CID TECHNICAL ASSISTANCE BUDGET SUMMARY
 Quarterly Report - April-June 1985

All figures given as \$U.S. X 1000

LINE ITEM -----	CONTRACT BUDGET* -----	TOTAL EXPENDED -----	BALANCE -----
I. Salaries	3357.415	2299.923	1057.492
II. Fringe Benefits	[Incl. above]	440.380	
III. Short-term Advisors	262.927	69.845	193.082
IV. Indirect Costs and C & A	4816.519	2960.295	1856.224
V. Travel and Transportation	1958.024	625.100	1332.924
VI. Differential and Allowances	1900.347	824.403	1075.944
VII. Other Direct Costs	1828.514	550.165	1278.349
VIII. Equipment and Materials	1828.514	3157.444	-1328.930
IX. Participant Training	567.283	469.677	97.606
X. Subcontracts (A & E)	1750.369 -----	3032.283 -----	-1281.914 -----
TOTAL	19940.306	14429.515	5510.791

*Note that contract budget figures are prior to amendment 13 and are contract figures, not working budget figures; Contract Amendment 13 will revise budget to match working budget, previously submitted to USAID.

CID TRUST ACCOUNT BUDGET - JUNE 1985

Figures given in LS X 1000

CATEGORY	TOTAL LOP BUDGET	EXPENDED THRU 6/85	BALANCE
-----	-----	-----	-----
Salaries:			
Secretary	111.600	102.020	9.58
Hourly	35.000	26.257	8.743
Engineer			
Consultants	17.000	13.800	3.2
Travel/Transportation:			
Car Rental/Taxi/Other	10.000	7.531	2.469
R and R/Home Leave	1.000	0.154	0.846
Emergency	4.800	2.925	1.875
Sr. Admin. to U.S.	2.900	2.872	0.028
Conferences/Meetings	16.000	12.323	3.677
Coord./Air Charter	110.000	104.128	5.872
Allowances			
Quarters	366.000	355.748	10.252
Utilities	30.000	27.491	2.509
Security	15.000	12.353	2.647
Maintenance	120.000	103.090	16.91
Temporary Lodging	15.000	13.153	1.847
Supplementary Post	4.000	2.870	1.13
Per Diem	50.000	64.670	-14.67
Other Direct Costs			
In-country Communication	36.500	35.306	1.194
Office Incidental	3.000	2.761	0.239
Reports/Duplication	1.000	0.298	0.702
Clearing/Shipping	135.000	163.113	-28.113
Vehicle Insurance	12.000	5.811	6.189
Conference Expenses	15.000	13.110	1.89
Other Direct Costs	2.000	1.235	0.765
Karplen Contract	169.768	162.280	7.488
Supple. Constr. Sup. Support	34.846	14.577	20.269
Purchase Lorries/Busses	175.000	173.000	2
AID Direct Expenditures	102.000	93.070	8.93
Exchange Loss	32.874	31.251	1.623
Contingency	135.000		135
	-----	-----	-----
[Office Rent-WSU will reimburse]		[43.315]	0
	-----	-----	-----
TOTAL	1762.288	1547.197	215.091

BUDGET CATEGORY	PL 480 L. CURRENCY	G.O.S. L. CURRENCY	W.B. L. CURRENCY	W.B. F. CURRENCY
Salaries and wages etc. in country	1,509,917	646,098		
Travel in country	240,202			
Goods and service in country	2,529,815	144,557		
Equipment & others	516,166			
Aircraft Purch.LS parts				2,394,278
Aircraft Operations		254,547	381,788	141,182
Construction CAT	407,303	817,609		3,674,743
Khidir and Draige	2,185,147	2,185,147		2,660,155
Non. Cont. Construction	1,418,108			
	8,806,658	4,047,958	381,788	8,870,358

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

QUARTERLY REPORT

1 July, 1985 - 30 September, 1985

I. GENERAL

Work continued at the Kadugli and El Obeid Research Stations, with scientists concentrating on the implementation of agronomic trials for the 1985 cropping season and continuing on-going livestock trials. Security problems in southern Kordofan presented some minor problems for the continuous stationing of field staff in some villages of cooperating producers. Presently the situation has returned to some degree of normalcy.

The Project Support Unit and Project Management moved from rented quarters into the new ARC Shambat office building in August.

Project scientists and management officers attended conferences and workshops in the United States, Syria, and Swaziland during the quarter.

A CID/WSU contract amendment, extending CID/WSU's contractual responsibilities for the WSARP until 31 December, 1985, was signed during the quarter. As a result of this amendment, Dr. T. Gillard-Byers' and Dr. R. Cook's contracts were extended until 31 December, 1985.

With the departure of Dr. L. Hogan on 13 July, 1985, Dr. R. Cook assumed the duties of the CID/WSU Chief of Party until the end of the CID/WSU technical assistance contract.

All CID/WSU technical assistants, except for Drs. Gillard-Byers and Cook, and Mr. H. Bergman, completed their contracts and departed the Sudan during the quarter.

Equipment and supplies continued to arrive in large quantities. Concerted efforts are underway to inventory and handover materials to the Project in the most expeditious manner possible. This activity has been a major responsibility of Mr. Stephen Horton, CID/WSU senior administrative officer.

A. Visitors and Consultants

Dr. Jan Noel, WSARP campus coordinator, visited the Sudan during the month of September to meet with Project and U.S.A.I.D. personnel. The focus of her activities was to establish the guidelines and policies to be followed for the phase out of CID/WSU Project involvement and the assumption of technical assistance responsibilities by the Mission.

Mr. Jaycox, Regional Vice-President of the World Bank, visited the El Obeid Research Station in September. He was accompanied by Dr. Dafalla, WSARP Director; Mr. J. Singh, IBRD/Khartoum; Mr. R. Nooter, Senior Loan Officer; Mr. D. Wai, Personal Assistant to the Vice-President; Ms. I. Foik, IBRD/Khartoum; and Mr. Y. Gabr, Undersecretary. They visited the research farm and were briefed on WSARP's research program.

Mr. Joachim Grube, Grube-Zimmer Supervising Architects, visited the Sudan in September. The major purpose for his visit was to evaluate construction progress, establish revised construction schedules, discuss the mechanism for providing consultancy activities during and after the completion of the CID/WSU contract extension, and to finalize negotiations between the contractors and the Ministry of Economic Planning on behalf of W.S.A.R.P.

Ms. E.S.F. Martella, W.S.A.R.P. Project Officer, U.S.A.I.D., visited the Kadugli Research Station for a day during the quarter and discussed programmatic activities with the scientific staff.

Dr. Pheru Singh, ICRISAT millet breeder, visited the El Obeid research station. He had discussions with the resident ICRISAT and National millet breeders as well as with other station scientists.

Dr. William Symons, Professor of Agricultural Engineering, Washington State University, visited the Project for several weeks during the quarter. Dr. Symons spent most of his time with the staff of the El Obeid and Kadugli research stations assembling farm machinery and discussing maintenance and operational procedures with station staff.

Dr. Mark Speece, Professor of Marketing Economics, Central Washington University, spent several weeks with Project staff during the quarter. Dr. Speece worked with scientists

at both the El Obeid and Kadugli stations. His brief specified that he address the following issues; (1) the present and projected market context within which producers, using proposed interventions generated by WSARP research, would be operating; (2) an identification of the most promising inputs for traditional producers and their potential benefit/cost ratios; and (3) ways to make WSARP's research program better meet the needs of producers.

Dr. T. Trail, Professor of Extension, Washington State University, visited the Project for several weeks during the quarter. Dr. Trail met with project staff at both the El Obeid and Kadugli stations, and with the staff of the Project Support Unit in Khartoum in an attempt to better define the extension/information service needs of the Project.

Many other individuals visited Project scientists and other Project staff during the quarter to discuss various Project-related activities.

B. Trips and Meetings

Dr. D.A. Dafalla, W.S.A.R.P. Director, visited the United States on two occasions, the first to attend a senior research management course held in Washington, D.C. and the second to attend a tour of dryland extension stations sponsored by the U.S.D.A.

Dr. Babo Fadlalla attended a conference on livestock production sponsored by GTZ, IDRC, and UNESCO, and organized by the Arab Organization for Agricultural Development. He presented a paper entitled; " The Dry Season Nutritional Status of Transhumant Baggara Sheep", in Damascus, Syria.

Mr. Mukhtar Kenani, Director of the Kadugli Research Station, attended an INSTAR workshop on the management of agricultural research which was held in Swaziland.

II. ADMINISTRATION

Mr. Stephen Augustu Horton was employed by CID/WSU as the Senior Administrative Officer for the Project Support Unit (PSU). Mr. Horton has chief responsibility for U.S.A.I.D. accounts relating to the technical assistance contract, re-

conciliation of all accounts for CID and WSU, the design and implementation of equipment inventory and handover procedures, and technical assistant support.

Mr. Arnie Montonya was employed as an administrative secretary, replacing Mrs. Dolly Reynolds who resigned last quarter.

Mr. Ibrahim Daw El Medina returned to the Project after completing his M.S. degree in agronomy at the University of California at Riverside. Mr. Medina has been assigned to the El Fasher research station.

CID/WSU personnel on leave during the quarter included Dr. T. Gillard-Byers and Mr. H. Bergman, both of whom were absent during part of the month of July.

III. STATION DEVELOPMENT

A. Construction Program - Contractors

On September the 14th a meeting was held between the Ministry of Economic Planning and the WSARP, represented by Grube Zimmer, Inc. and Karplen Consultants, to discuss the settlement of claims for the contractor under Clause 70 - Economic Dislocation. It was agreed that the consultants would submit a complete package, including variation orders, tabulations of contract amounts, including amounts billed to date and balances, and the contractor's liability for damages as specified in the contract, to the Ministry for consideration. Such was submitted on 15 September by Mr. Joachim Grube, Grube Zimmer, Inc.

As of mid-September, 1985, on the average, 71.5% of the contract amounts have been paid to the contractor for work at the El Obeid, Ghazala Gawazat, El Fasher, and Shambat, Khartoum, sites.

Because of the massive food relief efforts in the Sudan during the past months, it has been very difficult to move construction materials within the country. Accordingly, the delays encountered in moving imported items from Port Sudan to the building sites in the West have seriously hampered construction efforts.

El Obeid: Due to water and cement shortages and the lack of new imported materials (most of which arrived in mid-

August) construction has been minimal. Before the end of the quarter, however, the contractor had begun overtime work and increased his labor levels.

Present estimates, assuming a recruitment of sufficient laborers, place completion of the El Obeid Station at approximately 31 December, 1985.

Ghazala Gawazat: On 10 August, seven of ten railway wagons arrived on site, having left Port Sudan four months earlier. Most new imported materials were on site by the end of the quarter. The major items remaining are acoustic ceilings, pumps, controls, and piping, much of which will have to be air freighted in order to maintain the revised construction schedule.

El Fasher: Imported materials should begin to arrive on site in October when overland transportation from Ghazala Gawazat becomes feasible. The contractor's site personnel have gone as far as they can until the new materials arrive.

Ghazala Gawazat & El Fasher: Operations at both stations are now almost entirely a Chinese operation, including interim financing. They still have no control over procurement which is in the hands of the Khartoum JV Office. Workmanship is of a high standard at both sites. Present estimates place completion of both stations at approximately 1 April, 1986.

B. Force Account Activities

General

A Force Account Budget Proposal and Schedule of activities for 1985-86 has been prepared (see Appendix I). In a meeting with the Ministry of Finance and Economic Planning, £S 750,000 was approved from a proposed budget of £S 1,625,000.

Plans were made for initiating a landscape plan for the ARC, Shambat office building.

Kadugli: Repairs to the research farm road which were required as a result of flooding are approximately 60% completed. Work continued on the animal pens, hay shed, and feeding troughs.

El Obeid: A survey of town water supplies was undertaken with Dr. Cluff to assess seepage and evaporation losses.

El Fasher: The radio set was repaired. A cheque paid in respect of the clearing, developing, and testing of the Station well was located in M.H.W. and P.U.'s books, and it was agreed with the Director, Ministry of Housing and Water and the Public Utilities to transfer the money to the Director of NAW to complete the work.

IV. FINANCES

The financial statement for the quarter is contained in Appendix II of this report.

V. PROJECT IMPACT

A. Kadugli Research Station

General

Most research activities during the quarter involved the maintenance of on-station and on-farm agronomic trials and of on-going livestock trials. The rainfall has been good throughout the quarter and most trials are expected to give good yield data.

The security situation in southern Kordofan has improved during the latter stages of the quarter. However, in the interest of personal safety, all permanently stationed field technicians were recalled to the research station in July, and only essential trips were made to monitor the researcher- and farmer-managed trials.

Efforts are underway to organize the Station's first Farmers' Day, scheduled for 5 October. The purpose of this "open house" will be to enlighten potential consumer groups about research activities being undertaken on the research station and on cooperating farmers' fields. It will also provide research staff with an opportunity to become better acquainted with the Station's clientele, their problems, expectations, and production objectives.

Agronomy Program

General

Agronomic trials for the 1985 cropping season involve over 30 experiments focusing on sorghum, sesame, and cowpeas, the principal crops grown in the area (details of individual

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trials can be found in WSARP publication number 36, " Research Program for the Kordofan Region 1985-1986 ") In addition, trials have also been initiated with groundnuts, millet, maize, mung beans, and pigeon peas. For the major crops, trials have emphasized cultural practices, specifically; (1) plant populations, (2) fertilizer responses, (3) Striga control, and (4) intercropping practices.

On-farm trials, both farmer- and researcher-managed are being conducted five villages, ie. Bilenya, Katcha, Elafein, Kululu, and Shaer.

To date the rains have been good, both in terms of quantity and distribution. The rainfall totals to 15 September, 1985, excluding the month of May were as follows; WSARP farm 399.5 mm; WSARP compound 313.8 mm; Bilenya, 407 mm; Katcha, 372.8 mm; Kululu, 241.0 mm; and Shaer, 247.6 mm. Good agronomic data is expected from most of the trials this cropping season.

Trials/Observations

Members of a farmer's union at Kadugli heard about the station's activities and sent an application requesting the station to show them the on-station trials. They will be invited to the Farmer's Day, scheduled for 5th October, 1985.

At Shaer, one farmer's field had a stand of Gadam El Hamam almost as good as that on an adjacent, researcher-managed plot. He saved the seed from his on-farm trial of 1984.

Evaluation of a North Kordofan sorghum germplasm collection, consisting of 51 varieties, has indicated that several varieties show promise for South Kordofan. Of particular interest is one entry, ZINNARI HIREHREE, collected from Um Hijlij, West of El Obeid. This variety looks more like a good hybrid rather than a local cultivar.

Important crop pests during the season have been identified as; (1) insect pests on cowpeas, mungbeans, and pigeonpeas; (2) termites on all crops; (3) birds on millet; and (4) Striga on sorghum, especially at the on-farm trials in Bilenya and Shaer.

Range/Livestock Program

General

Dr. Babo Fadlalla was acting director of W.S.A.R.P. from 6 August until 2 September, 1985. Dr. Fadlalla was also on leave from 10 July until 6 August, 1985.

Mr. Ahmed Salah, senior technician in the range unit was on leave during the months of August and September, 1985.

The heavy rains in southern Kordofan have somewhat hampered field activities during the quarter by making transport, at times, virtually impossible.

Dr. Cook completed a field trip from Kadugli to the North, including the villages and towns of Dilling, Abu Zabat, En Nahud, Sodiri, El Obeid, returning to Kadugli. The trip began on 20 July and concluded on 9 August. In most places visited the rains were very good and the crops, especially millet, were doing well. However, the grass cover in most places was very sparse and in many areas significant numbers of Acacia had died. North of En Nahud, the rains were very unevenly distributed, while in Sodiri itself, less than 50 mm had been received by the first week in August. The town hafir was less than half full and water for human consumption was being trucked in from Um Kiriwa. Crops were very poor. It appeared that if relocation efforts were to be considered for people in these most northern areas, they should be implemented as soon as possible.

Trials/Observations

Range studies evaluating the seasonal nutritive value of

the indigenous herbaceous and woody vegetation on rangelands in southern Kordofan are continuing.

The range scientist is designing a research project to evaluate the impact of poisonous plants on grazing livestock in southern Kordofan. As palatable and nutritious plants become increasingly less available as the dry season progresses, the incidence of livestock losses attributable to the ingestion of poisonous plants increases. The proposed study is being designed to provide information on the incidence of poisonous plants, their toxic effects on livestock, and possible measures for reducing the incidence of livestock losses associated with the ingestion of such plants through improved rangeland management practices.

The range scientist is also preparing a research proposal for evaluating "sacrifice" areas, i.e. those areas adjacent to permanent sources of water and therefore subjected to intensive use by livestock every year. This research is intended to provide information on the trends associated with changes in the composition of herbaceous communities of these areas in terms of percentages of palatable and unpalatable species and the factors determining these changes in composition.

A flock of approximately 49 ewes has been purchased by the station as a nucleus sentinel flock to be used for initiating seasonal nutritional studies and supplemental feeding trials for the 1985/86 dry season.

Efforts have begun to purchase a sentinel goat flock to facilitate similar studies as those planned for sheep.

Final sampling for the dry season supplemental cattle feeding trial was completed in September. All animals on experiment for the past 2½ years were sampled and weighed. Laboratory analyses are now being performed to determine PCVs, serum/plasma protein levels, plasma phosphorus levels, helminth burdens, and incidence of hemoparasites. In addition production data on seasonal weight changes, daily milk production, reproductive performance, and growth and performance of young stock are being evaluated. This data will complete this phase of the study which was designed to make specific recommendations for future supplemental feeding trials, as well as recommendations for strategic disease control measures. A draft paper summarizing this study will be prepared during the fourth quarter of 1985.

Final sampling was completed for the supplemental feeding

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trial with Baggara sheep, which focused on identifying potential strategies for increasing sheep productivity by strategic supplementation and disease control. Blood and fecal samples were collected in addition to production data, forage intake and quality data. Laboratory analyses are presently underway.

Future Activities

Small ruminant sentinel flock studies will be initiated to examine the seasonal nutritional status of sheep and goats as a means to identify potential nutritional interventions for transhumant and sedentary producers. Studies will initially focus on diet botanical composition, diet quality, and voluntary intake.

Studies on the nutritive value of herbaceous and woody vegetation on rangelands in southern Kordofan will continue.

Monitoring the productivity for sentinel herds and flocks, including cattle, sheep, and goats, will continue.

Dr. R. Cook will be completing his contract and leaving the Sudan on 26 November, 1985.

Socio-Economics Program

General

During this quarter the following activities have been continued from the previous quarter; (1) implementation of phase II of the transhumant livestock marketing survey; (2) development of baseline information for an animal transport/credit study ; (3) analysis of data from commodity price information studies; and (4) initiating on-farm trials focusing on the introduction of several new varieties for inclusion in jubraka (housegarden) production trials.

Dr. Mark Speece, a marketing economist, spent several weeks in the Section preparing a report on markets and marketing procedures for livestock and crops produced in the region.

Dr. Bill Symons, an agricultural engineer, spent time consulting with the agricultural economist on appropriate designs for ox-carts to be used in on-farm animal transport.

lation activities being undertaken in the Kadugli area.

Dr. Tom Trail, an extension specialist, spent several days discussing possible designs for establishing an extension system to disseminate WSARP research results to consumer groups.

Dr. John Strauss, an economist from Yale University, and Dr. William Bateson, an agricultural economist with the Ministry of Agricultural Economics and Statistics, consulted with staff in preparation for implementation of a consumption survey for northern and southern Kordofan.

Dr. Gillard-Byers travelled to Khartoum the second week of September to discuss project related business with Dr. Jan Noel, W.S.A.R.P. campus coordinator.

Trials/Observations

Data collection and analysis are continuing for the live-stock price information and commodity price information data bases.

Data encoding and analysis are underway for; (1) phase I of the transhumant livestock marketing survey; (2) the 1984-85 credit/risk survey; and (3) livestock and commodity price information.

A survey questionnaire was developed for implementing phase II of the transhumant livestock marketing study. Included in this questionnaire were the following areas; livestock inventories, production costs, transportation activities, market structure, purchases and sales of livestock during the rainy season. This study compliments phase I which was implemented during the 1985 dry season.

Cooperating producers in the villages of Kululu, Katcha, Bilenya, and Shaer were enumerated to ascertain whether or not they were experiencing any difficulties and/or problems during their cooperation with the Project during this cropping season. The results of this survey will be completed during the fourth quarter and included in the 1985-86 agronomy research report.

Harvests from the jubrakas (housegardens) look good for this season, especially for sorghum, groundnuts, and sesame. A mid-season dryspell appeared to reduce the yields of maize. Jubraka vegetable harvests also looked promising.

On-farm, farmer-managed trials using two improved varieties of cowpeas and three varieties of groundnuts (based on recommendations from the 1984 agronomy trials) were initiated on jubrakas with six farmers in two villages. Cowpeas, planted the last week of May, were harvested during the second week of August, almost a month before the local varieties. Groundnuts were planted late because of the late arrival of seeds.

Gadam El Hamam seeds were distributed to 42 farmers in two villages in an attempt to alleviate the seed shortage problem. In other on-farm trials comparing Gadam El Hamam with several local, short-maturing varieties of sorghum, the Gadam El Hamam appears to have out yielded many of the local varieties because of larger more uniform head size.

Jubra on-farm trials have stimulated a great deal of interest among farmers, with many more expressing a desire to participate in on-farm trials next season.

Support of livestock production studies continued with the initiation of a survey to quantify the role of milk production in generating household incomes for transhumant families. Twenty producers will be interviewed by completion of the survey in November, 1985.

Administrative coordination has continued between WSARP and the Nuba Mountain Rural Development Project to continue the animal draft/credit trials for a third year. The objective of this season's trials will be to test the implementation, by local councils of sheiks, of a rental program for ox-carts in the villages of Katcha and Quaik. The revenues from this program will be re-invested in the village to establish a village-level revolving credit system to support the adoption of ox-cart transportation technology by local producers.

On the job training of station staff continued in the use of micro-computers. Many technical staff are now competent in the use of micro-computers and the associated statistical software.

A paper entitled; " Improved Integration of Legume Crops in the Agro-Pastoral System of the Nuba Mountains, Sudan", by Bunderson, W.T., Gillard-Byers, T.E., and Woldetatis, T. has been accepted for presentation at the annual FSR Symposium, Kansas State University, 6 October, 1985.

A paper entitled; " Introduction of Animal Transportation in the Nuba Mountains, Sudan", by Gillard-Byers, T.E.,

Azarag, B.A., and Bunderson, W.T. has been accepted for poster presentation at the annual FSR Symposium, Kansas State University, 6 October, 1985.

Future Activities

With the departure of Dr. T. Gillard-Byers on 26 November, 1985, the direction of research activities for the Section will be under the supervision of Mr. M. Abu Sabah. Dr. Gillard-Byer's contract expires on 31 December, 1985.

Livestock and commodity price information data base studies will continue through the next quarter as will data analysis for the animal transportation/credit trial and the encoding of data from phase II of the transhumant marketing study.

The extension of junior staff contracts through the 1985 cropping season has assured the continuation of technical staff sufficient to complete on-going studies.

B. El Obeid Research Station

General

During the 1985 crop season there were eight scientists participating in the research program, in addition to the ICRISAT millet breeder and the INTSORMIL program.

The rainfall was generally good in northern Kordofan during this crop season, although distribution was a problem in some areas such as the WSARP research farm where only 177 mm had been received through the month of September. The low rainfall in August (44mm), which coincided with the time of crop establishment adversely affected all crops. Accordingly, some trials were discontinued, i.e. roselle, sesame, mungbean, and cowpeas. Trials in other locations were generally much better.

The majority of trials were planted on the WSARP research farm which has been organized into 30 one-hectare experimental plots. Other experimental sites included, the Gardud Farm (14 miles South of El Obeid), the Kaba Farm, the Bano Farm, En Nahoud area, Kadugli, and several farmers' fields near El Obeid, Kazgail, Um Arda, and El Hamra.

About 75 trials and nurseries were planted, with trials specifically focusing on, (1) variety testing, (2) cultural practices, eg. plant populations, weeding, planting

depth, mulching, and harvesting techniques; (3) intercropping, (4) fertilizer responses, (5) range forage improvement, and (6) pest control.

Agronomic trials emphasized the following crops; pearl millet, sorghum, groundnuts, sesame, roselle, watermelon, cowpeas, pigeon peas, mungbeans, guar, and a number of pasture grasses and legumes.

Gum arabic trials concentrated on, (1) experiments to evaluate the growth and performance of A. senegal in relation to sowing date and irrigation regimes; (2) studies on the natural regeneration and phenology of A. senegal (3) studies on the viscosity of gum arabic; and (4) evaluation of tapping methods.

Agronomy Program

General

The overall objective of the agronomy program is to identify technologies for overcoming existing constraints which are limiting crop yields in northern Kordofan.

Main activities concentrated on; (1) the preparation of germ plasm, land preparation, layout of experiments, sowing, scoring of germination and survival, weeding, thinning, scoring of flowering and maturity, visits to farmers' fields, and training laboratory technicians in field and laboratory procedures.

Many trials were carried out on the WSARP research farm which was ment to represent the light textured soils, commonly cultivated in northern Kordofan. However, these soils are highly susceptible to wind and sheet erosion causing unpredictable fertility and moisture gradients. This has made it very difficult to establish treatment effects among trials planted on these soils. Moreover, the erratic rainfall on this site resulted in very poor crop establishment for most trials. The unstabilized nature of these soils has also brought into question its representativeness of the common, stabilized sand dunes (Qoz soils) which are generally cultivated in the area.

The other agronomy research site is the Gardud Farm. Even here, the soils are not typical of the general gardud soils

found in the area, being deep red in color and having a high clay content. These soils have also been worked for several seasons by the Rural Development Corporation. However, crops at this were well established and growth to date has been good.

Trials

Population density trials on both the WSARP and Gardud Farms have been initiated to identify the optimum population densities which will make the most efficient use of soil nutrients and available rainfall, while securing reasonable yields. Trials have focused on sorghum, millet, sesame, cowpeas, and roselle.

Cowpea trials, using local varieties and cultivars from the University of California, Riverside, IITA, and ISRA (Senegal), are screening for earliness of flowering, adaptability, and yields.

Fertilizer trials with sorghum, millet, cowpeas, sesame, and roselle, are examining yield responses with respect rate and time of application.

Intercropping trials planted on the WSARP farm involve different combinations of sorghum, millet, cowpeas, and sesame.

Weeding trials were initiated to determine the effects of weeds and frequency of weeding on the yields and growth responses of two local cultivars of sesame.

Constraints

Additional technical assistance is required to effectively execute and manage the Station's agronomy program. In addition, permanent laborers need to be recruited and trained to carryout field work, which cannot be dependent on casual labor staff.

Crop Improvement Program

General

The crop improvement program includes variety trials on sorghum, millet, sesame, roselle, pigeon pea, mungbean,

guar, and groundnut.

Three sorghum variety trials, as well as the National Sesame Variety Trial, were grown in collaboration with ARC sorghum and sesame breeders. Millet breeding trials were implemented in collaboration with the ICRTSAT millet breeder.

An on-farm trial, involving two varieties of millet and Hageen Dura-1, was planted at Werail, West of El Obeid.

Small amounts of several millet varieties were distributed to some farmers; however, the Hageen Dura-1 requested from the ARC was not received, and therefore could not be distributed.

Trials

Variety screening trials involved a total of 12 strains of sorghum, 8 strains of millet, 14 strains of sesame, 5 strains of roselle, 14 strains of pigeon pea, 9 strains of mungbean, and 11 strains of guar.

A selection program, using mixed populations of local field watermelon seeds was begun in an attempt to improve the local watermelon as a traditional field crop.

In addition to trials planted on the WSARP research farm, variety trials on sorghum and millet were also planted on the Gardud Farm.

Groundnut variety trials, including most of the widely grown Spanish and high-yielding varieties from the United States and other groundnut producing countries, were initiated to screen for potential new varieties.

Trials examining cultural practices on groundnut production were planted, emphasizing plant population, intercropping, and fertilizer response studies.

Nitrogen fixation trials utilizing strains of groundnuts supplied by North Carolina State University were planted.

Three on-farm trials were initiated at En Nahoud, Kazgail, and Um Arada to compare the performance of local varieties with several promising new ones.

Soil and Water Management Program

General

Continuous monitoring of weather data has been initiated and weather monitoring equipment is functioning well.

Trials

Planting method and mulching trials with millet were initiated on the WSARP research farm. Due to the dry spell in August, plants in the first of these trials failed to survive, even after reseeding. The mulching trial with millet stalks, however, looks good and soil moisture measurements are continuing.

A trial to examine the sand stabilizing effects of local grasses during the summer months had poor establishment.

Trials at the Bano Farm examined the ridge-furrow and seed cradle techniques for the establishment of millet. Poor rainfall resulted in erratic germination of plants in the ridge-furrow trials; however, seed cradle trials look good and soil moisture measurements are continuing.

Laboratory Experiments

Due to the lack of space and electricity, it has not been possible to initiate laboratory experiments at this time.

Visitors

Dr. Riley, Dr. Cluff (University of Arizona), and Mr. Shwagi, WSARP engineer, visited the section and discussed the possibilities of using floating ceramic plates on Khor Buggara reservoir to reduce the evaporation rate.

Horticultural Program

General

Seedling preparation for winter vegetable trials is in

progress.

Rainy season horticultural trials were initiated on the WSARP research farm.

Trials

A watermelon variety trial was planted using ten varieties, including both local and imported strains. Plant growth was very slow due to the low and erratic rainfall. Observations on growth will continue and yield data will be reported.

A trial to examine the effects of plant spacing and farm-yard manure on watermelon yields was planted using the variety Congo. Growth was similar to that observed in the variety trial reported above. Observations on growth will continue and yield data will be reported later.

Entomology Program

General

During July three trials were initiated on the WSARP research farm examining; (1) methods to control bird infestations on pearl millet; (2) genotype susceptibility to stem borer and " Naffasha " infestation on pearl millet; and (3) monitoring sesame web worm infestations using the wild sesame, S. alatum.

Trials

The experiment on methods to control bird infestations on pearl millet was abandoned due to the poor performance of the sweet sorghum which was being used to distract the birds.

The sesame web worm monitoring trial was also abandoned because the S. alatum failed to germinate.

The trial to examine genotypic factors related to stem borer and " Naffasha " infestation on pearl millet and intercropping trials initiated on the Gardud Farm are continuing.

Routine pest monitoring studies have been initiated in collaboration with Mr. Abdel-Rahman at three sites of on-farm groundnut trials and with Dr. Hassan Osman at the cowpea trial on the Gardud Farm.

Lepidopterous larvae have been collected from the field and raised under laboratory conditions in order to monitor the level of plant destruction produced from known levels of infestation.

Range/Livestock Program

General

The Nuba Mountain Rural Development Project, Kadugli, has agreed to loan the WSARP, El Obeid Research Station four animal draft carts which will be used for on-farm trials this season.

Mr. Abd Alla Hassan, the only technician in the section, terminated his secondment to WSARP, returning to the Range and Pasture Administration.

A temporary holding pen was constructed at the El Obeid Research Station to assist in implementing sheep research studies.

Trials

The diet habit studies of desert sheep concluded this quarter. Samples are in storage awaiting analysis, either at El Obeid, when facilities are completed, or overseas, which will require an expenditure of funds.

Pasture legume trials were initiated at three locations; El Hamra (50 kms. East of El Obeid), El Odieya (250 kms South-west of El Obeid), and on the WSARP research farm. Results from the WSARP research farm were poor due to the low and erratic rainfall; however, good results are expected from the other sites. In addition, storage millet and sorghum hybrids obtained from Australia which were planted in observation plots look promising.

Data collection for the study on the biological indicators of desertification is continuing. However, collection of data on edaphic indicators has been hampered by the lack

of equipment (appropriate augers) and facilities (electricity).

The nomadic sheep flock began lambing in August, while the harsh conditions last year delayed breeding and, consequently, the lambing period in the sedentary flock. This flock is expected to begin lambing in October.

Future Activities

The animal transportation study, scheduled to commence in October, will require the provision of some technical staff to be implemented. Carts have already been acquired.

One hundred ewes and eight breeding rams have been purchased for a study examining the effects of strategic supplementation on the productivity of desert sheep (in collaboration with Dr. Fadlalla, WSARP Kadugli). However, handling pens, which were requested months ago, need to be constructed at the WSARP research farm for this trial to be initiated.

An observation trial examining the effects of docking on the growth and reproductive performance of desert sheep, originally scheduled to be undertaken in the nomadic flock will now be delayed and the sedentary flock used. Lambs in the sedentary flock will be of a more appropriate age for this study.

Gum Arabic and Forestry Program

General

Tentative arrangements have been made with staff of the Restocking of the Gum Belt Project and the Conservator of Forests- Um Rawaba District, to rejuvenate the Um Rawaba forest, which has been reserved for research activities of the WSARP gum arabic research program.

Trials

Trials examining the growth and performance of A. senegal are progressing and are expected to clarify the optimum plantable size of nursery seedlings. Such information

could decrease the costs associated with establishing nurse seedlings, a potentially important savings for large-scale reforestation efforts.

Seeds of A. senegal, collected from various locations within the Gum Belt, are being evaluated as to shoot height and survivability under nurse conditions.

Studies on the phenology of A. senegal and on the productivity and performance of natural regeneration and proliferation of this species in the Demokeya Forest Reserve are continuing.

Future Activities

A study to identify new phenotypic characteristics of A. senegal which could be used to select for high-yielding gum phenotypes will be initiated.

A survey of gum arabic garden will be implemented to identify production problems facing farmers. (This survey will be started in December, 1985).

Constraints

A forestry technician, preferably a graduate from the Khartoum Polytechnic, is required to strengthen our technical staff .

Basic laboratory and field equipment, which are required for on-going activities and has been ordered, has not been received, nor has any word been received concerning its status.

A vehicle or tractor needs to be stationed at the Demokeya Reserve to provide patrolling against trespassers and grazing animals.

APPENDIX I
FORCE ACCOUNT SCHEDULE OF ACTIVITIES
AND BUDGET FOR 1986

hol

SHANGHAI

LOCATION

JANUARY

FEBRUARY

MARCH

1986

SHAMBAT

Completion of the ff:

- a) Fence and gates.
- b) Car shed.
- c) Fuel store.
- d) Labourer's shed.
- e) Guard's kiosk.
- f) Maintenance of rest house.
- g) Water points for irrigation.
- h) Light points for office yard.

FORCES ACCOUNT

SCHEMATIC PLAN

I-A
A149

SHAWGI

LOCATION

APRIL

MAY

JUNE

21
[Handwritten signature]

SHAMBAT

1986

FORCE ACCOUNT

ACCOUNT FOR

I-B
A150

SHAWC?

LOCATION

JULY

AUGUST

SEPTEMBER

3/4

200

SHAMBAT

1750

I-C
A151

SCHEDULE FOR

FORCE ACCOUNT

1986

SHAWG:

LOCATION

SHAMBAT

OCTOBER

NOVEMBER

DECEMBER

-14

I-D
A152

107

SHAWG

LOCATION

JANUARY

FEBRUARY

MARCH

KADUGLI

Redesign and construct Irish bridge on road to farm.

Order materials and equipments for lightening protection from abroad.

Construct 10 # rain water Culverts on the road to the farm.

1986

FORCE ACCOUNT

SCHEDULE FOR

I-E
A153

SCHEDULE FOR

FORCE ACCOUNT

1986

SHANGHAI

LOCATION

KADUGLI

APRIL

MAY

JUNE

Install lightening protection
in all station buildings.

A154

I-F

2/4

209

SHANGI

LOCATION

JULY

AUGUST

SEPTEMBER

3/4

9/2

1986

KADUGLI

FORCE ACCOUNT

LIABILITY FOR

A155

I-G

000000

LOCATION

OCTOBER

NOVEMBER

DECEMBER

2

KADUGLI

000000

I-II

A156

SIWAGI

1986

FOUR ACCOUNT

3000000 FOR

LOCATION

JANUARY

FEBRUARY

MARCH

El-Obeid

Drilling of two water wells at Khor TAAGET by NAW.

- Cleaning.
- Developing.
- Yield test.

Fabricate and construct BENO Farm Nursery.

- NAW install two pumps
- construct two lockable pump houses.

Facilitate and install sheep facilities
Design work completed - part of the material shipped to site.

-design pipeline and size Booster pump from well sites to Station.

- Order lightening protection equipments and materials.
- design sellected already by Dr. Higgins.

-order and ship materials to site.

-pipeline 7 kilometers long.

A157

I-I

2/2

SHAWGI

LOCATION

APRIL

MAY

JUNE

1986

El-Obeid

Design and construct seed and farm equipment store at main farm.

Fabricate and install four farm gates.

Fabricate and install working shed at El-Obeid main farm.

FORCE ACCOUNT

AVAILABLE FOR

I-J
A158

SHAWGI

LOCATION

JULY

AUGUST

SEPTEMBER

3/4

WA

1986

El-Obeid

Complete farm fence for
internal paths.

FORCE ACCOUNT

SCHEDULE FOR

I-K
A159

SIHAWGI

LOCATION

OCTOBER

NOVEMBER

DECEMBER

4/4

WV

El-Obeid

Install lightening protection for all stations buildings.

1986

FORCE ACCOUNT

MONTH FOR

I-L
A160

CHANGE

1/4

1/2

LOCATION

JANUARY

FEBRUARY

MARCH

EL-FASHER

Clean, develop and pump test for yield for the Project. New well drilled by NAW at Airport Area.

NAW to install pumping unit, engine, pump house Guard's room.

Order lightening protection material and ship to site.

NAW to install 10,000 gallon capacity water tank on a 50 ft. tower.

Design, ship materials and install 4" Ø pipe line from well site to El-Fasher station. (2500 metre long)

I-M

A161

1976

1977

SHAW

2/4

LOCATE

APRIL

MAY

JUNE

EL-FASHER

Prepare design work for sheep facilities at El-Fasher farr.

Locate and ship material for sheep facilities:

pipeline cont.....

1986

FORCE ACCOUNT

A162

I-N

SHAWGI

LOCATION

JULY

AUGUST

SEPTEMBER

1986

Install farm fence and gates (materials already located at El-Obeid stores) (total length 6900 metres)

WORKER ACCOUNT

1986

I-O
A163

SUAWG

LOCATION:

OCTOBER

NOVEMBER

DECEMBER

W

EL-FASHER

farm fence continued

Install lightning protection for
all the station buildings.

1986

FORCH ACCOUNT

FOZ

I-P
A164

SIHAWGT

270

LOCATION

JANUARY

FEBRUARY

MARCH

GAZALA
GAWAZET

Rehabilitation of three water yards.

a) Cleaning three wells.

b) Maintenance of three submersible pumps.

c) Overhauling of three lister engines.

d) Maintenance of two high level water tanks.

e) Re-conditioning of three pre-fabricated steel metal room.

Fabricated and install radio antenna.

Facilitate and construct animal facilities.....

Order materials and equipments for lightening protection from abroad.

Construct seed store

Construction of seed store.....

Build airstrip, and install windsock.....
(approximate length of runway 800 metres)

1986

FORCE ACCOUNT

ACCOUNT FOR

I-Q
A165

SIA:7G2

272

72

LOCATION

APRIL

MAY

JUNE

GAZALA

GAWAZET

Installation of farm fence and gates.
(total length 45,000 metres)

Construction of animal facilities.

Construction of airstrip continuation

I-R
A166

1720

1720

SUMMARY

LOCATION

JULY

AUGUST

SEPTEMBER

GAZALA
GAWAZET

Installation of farm fence and gates
continuation

I-S
A167

LOCATION

OCTOBER

NOVEMBER

DECEMBER

GAZALA
GAWAZET

Install lightening protection for
station buildings.

Rehabilitate existing
elementary school.

T-T
A168

FORCE ACCOUNT BUDGET PROPOSAL FOR 1986

ARC HEADQUARTERS AT SHAMBAT

DESCRIPTION	TOTAL	TOTAL	GRAND TOTAL
(1) Fence and gates (1900 metres).	12,000		
(2) Shed for Labourers.	3,000		
(3) Car shed.	5,000		
	<hr/> 20,000	20,000	
GRAND TOTAL			<hr/> 20,000
APPROVED			1,625,000
			<hr/> 750,000

22/

FORCE ACCOUNT BUDGET PROPOSAL FOR 1986

KADUGLI

DESCRIPTION	TOTAL	TOTAL	GRAND TOTAL
(1) Irish Bridge	20,000		
(2) Construction of surface water drains across the on-farm road.	5,000		
(3) Lightening protection for the Station buildings.	10,000		
	35,000	35,000	35,000

225

FORCE ACCOUNT BUDGET PROPOSAL FOR 1986

EL-OBEID

DESCRIPTION	TOTAL	TOTAL	GRAND TOTAL
(1) <u>Supplementary well water supply for El-Obeid Station.</u> Consisting of the following:			
a) Drilling of two deep well at Khor TAAGET Area.	60,000		
b) Installation of submersible pump and engine.	50,000		
c) Erection of 10,000 gallon tank and 50 ft tower.	35,000		
d) Pre-fabrication and installation of two steel room for pump and guard.	20,000		
e) Installation of 4" ϕ pipeline from well site to El-Obeid Station (6 kilometers).	84,000		
f) Installation of Booster pump on the above pipeline (items (e)) complete with two pre-fabricated rooms.	37,000		
	286,000	286,000	
(2) <u>El-Obeid Main farm:</u>			
a) Fabrication and installation of four fence gates.	4,000		
b) Sheep facilities.	36,000		
c) Farm working shed.	6,000		
d) Seeds and tools stores.	8,000		
	54,000	54,000	

226

DESCRIPTION	TOTAL	TOTAL	GRAND TOTAL
(3) <u>BENO Horticultural Farm:</u>			
a) Nursery.	12,000		
b) Construction of protection wall for BENO water supply system.	3,000		
c) Installation of BENO Farm drop - irrigation system.	2,000		
	17,000	17,000	
(4) Lightening protection for all the buildings at El-Obeid Stations.	10,000	10,000	
		367,000	367,000

FORCE ACCOUNT ESTIMATE MEMORANDUM FOR 1966

PL-FISHER

DESCRIPTION	FOUR	TOTAL	GRAND TOTAL
(1) <u>Supplementary Water System:</u>			
a) Cleaning, developing, and yield testing of the Project well already drilled by HAW.	8,000		
b) Supply and installation of submersible pump and motor engine:	25,000		
c) Supply and erection of 10,000 gallon capacity tank and 50 ft. high tower.	35,000		
d) Construction of pump's and guard's room.	15,000		
e) Installation of 4"Ø pipeline from well site to the Stations - (2500 metres).	250,000		
	333,000	333,000	
(2) <u>Farm:</u>			
a) Farm fence and gates.	83,000		
b) Sheep facilities.	36,000		
	119,000	119,000	
(3) <u>Lightening protection for all station buildings.</u>	10,000	10,000	
		462,000	462,000

FORCE ACCOUNT BUDGET PROPOSAL FOR 1986

GAZALLA GAWAZET

DESCRIPTION	TOTAL	TOTAL	GRAND TOTAL
(1) <u>Farm:</u>			
a) Farm, fence and gates (45000metres of fence) (4 # Gates)	454,000		
b) Construction of Seed Store.	5,000		
c) Construction of Animal facilities.	105,000		
	664,000	664,000	
(2) <u>Airstrip:</u>			
a) Airstip and installation of windsock.	100,000	100,000	
(3) <u>Water Supply System:</u>			
Rehabilitation of three water yards at G.G. Farm comprising the following:			
a) Cleaning three wells.			
b) Maintenance fo three submer- sible pumps.			
c) Overhauling of three lister engines.			
d) Maintenance of two high level water tanks.			
e) Re-conditioning of three pre-fabricated steel metal rooms.			
	61,000	61,000	
(4) <u>Radio:</u>			
a) Installation of radio antenna	1,000	1,000	

229

DESCRIPTION	TOTAL	TOTAL	GRAND TOTAL
(5) Rehabilitation of the existing elementary school for the staff kids.	5,000	5,000	
(6) Lightening protection for all the station buildings.	10,000	10,000	
		741,000	741,000

APPENDIX II
QUARTERLY FINANCIAL SUMMARIES

23

A176

221

FINANCIAL SUMMARY

Trust Account

A request for WSARP's Trust Fund advance for the fourth quarter, Fiscal year 1985, was submitted on June 20, 1985. The amount requested was £S191,995.560. On July 8, 1985, the amount of £S183,974.470 was received from USAID.

Certain factors such as the payment of three-month arrears to Karplen - £S50,915.000, an increase in "Construction Supervision" personnel, the move to Shambat, and several problems related to repairing and making functional radio and other equipment at headquarters and outstations, occasioned several large expenditures causing concern that a premature advance request from USAID would become necessary before the end of the quarter.

In August 1985, it was necessary to extend the lease on the Guesthouse basically to accommodate the demands of Hank Bergman who was definitively but understandably opposed to being uprooted from his present location for a stay in Khartoum of another four months. Mr. Bergman occupies the downstairs apartment of the two-apartment Guesthouse which the landlord refuses to lease except as a unit. We were, therefore, obliged to lease the entire building - the upstairs continues to be used by our outstations' scientists when on project business in Khartoum. The lease on the building terminates on January 28, 1986 allowing for an expenditure of £S25,000.000 from August 27, 1985.

Summary of Trust Account

Brought Forward From Period Ending June 30, 1985	£S	14,788.299
Total Receipts In Period Under Review July 8, 1985	£S	183,978.470
Total Expenditures In Period Under Review July 1985 - £S98,184.797 August 1985 - £S65,661.710 September 1985 - £S21,033.750	£S	184,880.257
Total Funds Available As At September 30, 1985 - In Bank	£S	13,886.512
Total Funds Available As At September 30, 1985 - Cash	£S	2,934.023

Dollar Account

The pressures on the Dollar Account are not as pronounced as on the Trust Account though it was heavily burdened during the first half of the period under review due to the departure of most of the scientists - purchasing airline tickets and "point of origin" crating and shipping. WSU continues to make sufficient funds available as circumstances dictate, and the fact that monthly accountability is unequivocally required by her makes for an easy reporting exercise.

Summary of Dollar Account Activity

Brought Forward From Period Ending June 30, 1985	\$ 19,919.15
Total Receipts In Period Under Review	\$ 30,000.00
July 28, 1985 - \$ 20,000.00	
August 24, 1985 - \$ 10,000.00	
Total Expenditures In Period Under Review	\$ 31,451.47
July 1985 - \$ 18,709.55	
August 1985 - \$ 11,385.10	
September 1985 - \$ 1,386.82	
Total Funds Available As At September 30, 1985 - In Bank	\$ 9,998.28
Total Funds Available As At September 30, 1985 - Cash	\$ 29.36

Government of Sudan
The World Bank
Quarterly Budget Summary

March - June 1985

BUDGET C/TEGORY	PL 480 L. CURRENCY	G.O.S. L. CURRENCY	W.B. L. CURRENCY	W.B. F. CURRENCY
Salaries and wages etc. in country	1,509,917	646,098		
Travel in country	240,202			
Goods and service in country	2,529,815	144,557		
Equipment & others	516,166			
Aircraft Purch.LS parts				2,394,278
Aircraft Operations		254,547	381,788	141,182
Construction CAT	407,303	817,609		3,674,743
Khidir and Draige	2,185,147	2,185,147		2,660,155
Non. Cont. Construction	1,418,108			
	8,806,658	4,047,958	381,788	8,870,358

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EL OBEID

- A. Imported materials on site since last report: Generators and accessories, acoustic ceilings, acid resistant piping and fittings, laboratory cabinets and equipment, water and sewer piping (shortages on original order), chain link fencing.
- B. Imported materials in transit: Generator control panels (air freight from UK), water pumps, controls, and piping at Khartoum airport, glass.
- C. Local materials:
Kitchen cabinets reportedly manufactured and ready for painting. Paint held up because of government failure to set new price. Two weeks estimated for painting after receipt of paint.

Cement still in extremely short supply. Factories still not releasing pending agreement on new price structure. Cement ordered and paid for six months ago still not released. Contractor buying on local market as available.

Water shortage has eased due to recent rains but water in mains is very dirty and marginal for concreting. It is OK for compaction of roadways which are in progress.

- D. Construction activities:
Due to water and cement shortages and lack of new imported materials, (most of those listed above arrived in mid-August), Ramadan, Eed, and leave schedules, construction activity has been minimal. Now that there are materials on site, the contractor is starting overtime work and is increasing labor levels. Generator building is complete to roof level, generator foundations are in progress and generators will be set before installing roof. Sewage pumps complete and tested. Water distribution piping nearing completion. Grading about 60% complete. Roads excavated to sub grade and compaction in progress. Acoustic ceilings starting.
- E. Observations:
The massive transport effort involved in the relief programs has very seriously affected the ability of anyone else to move anything. Delays of up to four months have been encountered in moving materials from Port Sudan to site.

GHAZALA GAWAZET

MATERIALS STATUS:

- A. Imported materials on site:
On August 12 seven railway wagons arrived at the site out of the ten which had left Port Sudan four months earlier. Materials aboard were water tanks and towers for both sites, fuel tanks ditto, windows, pipe and fittings. One car of deisel fuel arrived early Sept.
- B. Imported materials in transit:
One car of windows and one car of pipe and fittings reported between G.G. and Babanoosa.
Generators shipped first week August. Control panels to be shipped end August, air freight.
Lab cabinets arrived P.S. April, cleared in July. Not yet shipped due to unavailability of trucks.
Sanitary fittings arrived P.S. in May. Not yet cleared due to lack of documents. Expect to clear early Sept.
Piping (remaining 40% shipped in separate shipment) arrived P.S. in April. Shipping documents not received until Aug. 13. Expect cleared first week in September.
Verandah screening arrived P.S. April. Not cleared due to lack of shipping documents. Exact status uncertain.
Hardware (approx 20%) in P.S. since end April. No shipping documents. Expect cleared early September. 80% of hardware at G.G.
53 door leaves still held at Seba pending clarification of documents. Expect to clear early September. 20 doors approx. still at Shambat will be sent on same truck as Seba doors plus paint and misc. items.
- C. Imported materials on order:
Acoustic ceiling. Order reported ready but not shipped. This will have to be air freighted to make revised schedule.
Pumps, controls, piping ordered. Will ship air freight early Sept.
Flagpoles were to have been shipped in August. Status uncertain.
- D. Construction activities:
Grading of compounds complete. Power pole erection which was to have started in May still not underway due to failure of subcontractor (NEC) to send crew from Fasher.
Setting windows in lab and administration buildings, houses.
Preparation for water tower erection, set anchor bolts, etc.
- E. Observations:
Operations in G.G. and Fasher are now almost entirely a Chinese operation which includes interim financing. They still have no control of procurement which is handled by the Khartoum JV office. Workmanship is of a very high order and the work well organized.

EL FASHER

MATERIALS STATUS:

- A. Imported materials on site:
No new materials on site. All materials for Fasher are first sent to Ghazala for unpacking, sorting, and trans-shipping. Eight cars arrived in Ghazala in mid August but shipment will not take place until after September 20 when the road is expected to be reopened. Extremely heavy rains have virtually paralyzed transport by road.
- B. Imported materials in transit:
See Ghazala.
- C. Local materials:
Adequate stocks of cement are on hand at site and at Ghazala awaiting shipment to complete the job. There is plenty of water but it is dirty and marginal for concreting.
- D. Construction activities:
Roads and parking areas 100% complete. All curbs set ready to receive tile pavers. Concrete work virtually complete except for areas waiting for plumbing to be installed; labs, bathrooms, etc.
- E. Observations:
The contractors site personnel have gone just as far as they can go until new materials arrive at the site. Workmanship is of very high quality. Lack of materials is attributable to poor management on the part of the Khartoum Joint Venture office.

ARC HEADQUARTERS, KHARTOUM

The ARC Headquarters Building is substantially complete and has been occupied by the Project. Work on the evaporative cooling installation is still underway. Contractor is completing or correcting items on the inspection punch list and cleaning up the exterior and grounds. Repainting will be required in many areas following completion of cooling work to restore finishes damaged by Contractor and/or Project personnel during moving operations.

Certificate of Completion will not be issued until cooling work is complete and maintenance period will commence at that time.

APPENDIX B

AGRICULTURAL RESEARCH IN THE SUDAN
WITH SPECIAL EMPHASIS ON THE WESTERN SUDAN PROJECT

by

Carl H. Gotsch and Bill C. Wright

APPENDIX B

Final Report

AGRICULTURAL RESEARCH IN THE
SUDAN WITH SPECIAL EMPHASIS ON
THE WESTERN SUDAN PROJECT

for

United States Agency for International Development
Khartoum, Sudan

by

Carl H. Gotsch
Stanford University

and

Bill C. Wright
Oklahoma State University

October 31, 1984

(Revised and Supplemented)

November 25, 1984

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EXECUTIVE SUMMARY

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.

INTRODUCTION

In the latter part of July, 1984, a two-man team consisting of an economist (Carl Gotsch) and a soil scientist (William Wright) 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 the WSARP research centers at Kadougli and El Obeid and visited the Agricultural Research Corporation (ARC) headquarters at Wad Medani.

The report that follows makes no pretense of being a comprehensive evaluation of the quantity and quality of agricultural research in the Sudan. First, such a report would have been presumptuous considering the limited amount of time that was available for on-site observation. It would have had further problems of credibility because of the lack of disciplinary depth represented by such a small team.

Under any circumstances, questions being raised by the Mission go beyond a narrow research focus. At issue is the renewal of the technical assistance program, not simply the work that a particular group of scientists is doing at the moment. Indeed, as the subsequent discussion tries to make clear, the key decision parameter, at least in our judgment, has more to do with the overall direction of the Mission's Western Sudan development strategy than with the specifics of research project itself.

The lack of a development perspective on the research project is a

weakness that needs to be corrected. However, the perception that the project lacks focus is also a function of rapidly evolving Mission commitments. For example, it is our understanding that a vital component of the movement to open up the Western area, i.e., the building of the El Obeid road, reached its present form only in the past few months. The agricultural marketing and credit project is also of relatively recent origin. With the Mission's strategy only now taking concrete form, it is perhaps excuseable on all sides that the link between the decision to continue to support agricultural research and the decision to undertake other development activities has been less clearly articulated than it might have been.

After presenting some brief comments on the role of technology in the Mission's dryland development strategy, the report turns to the details of the WSARP project itself. Even if there is general agreement on the need for agricultural research, that does not mean that the current activities are necessarily the most appropriate or that the contractor is using resources wisely. These issues are separable from the broader question of the necessity of creating a mechanism for producing improved dryland technology. Our approach is again to focus on the decisions to be made. Sunk costs in buildings and facilities are fixed costs, whatever their magnitude. With hindsight, things might have been done differently. But costs which have already been incurred cannot be undone. They may provide certain evidence on the competence of the contractor, but they do not enter as decision variables.

Impressions regarding the overall competence of the staff and the contractor were obtained from open-ended discussions with the relevant groups followed up by individual consultation with key staff members. The informal approach was chosen in part because a detailed evaluation of the

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program has been made in the last 18 months. Moreover, to repeat earlier comments, it is clear that the AID decision hinges on general issues and not on the specific program of research being undertaken. The latter can be altered in a relatively short time if it is found to have technical shortcomings. (An example of this type of adjustment is the response of the project to the criticisms of the latest review team regarding their proposed field survey work in the social sciences.)

The third section of the report deals with broader issues of research in the Sudan on which we were also asked to comment. The findings are in accord with those presented by several other recent evaluations and are extended only by suggestions for assistance that might provide relief from the short-run problems of recurring costs, and that would accelerate dryland research in the Eastern area.

AGRICULTURAL RESEARCH AND RURAL DEVELOPMENT

This report is not the place for a lengthy treatise on agricultural research in a rural development program. However, most writers put technology generation on a par with investment and appropriate economic and social policies when discussing the development package.

Massive investments in Sudan's infrastructure will be required to initiate rural development activities that go beyond the confines of one or two villages. Similarly, if agriculture is to serve as the "engine" of development, farmers must have the incentives that will prompt them to participate vigorously in the expansion of production. This means, above all, that price policies for outputs and inputs must be consistent with the area's comparative advantage. However, experience in both developed and developing countries strongly suggests that a continuous stream of improved technology will also be required. Infrastructure and "getting prices right" may well be sufficient to create an initial growth spurt; they can not, by themselves, sustain the development process.

While one might readily concede the need for the technological leg on the stool, there are a variety of issues related to the manner in which that is accomplished. For example, it is increasingly clear that, although important contributions can be expected from international research centers, national programs have a significant role to play in insuring a continuing supply of relevant technology. An excellent case in point is the spread of the Mexican wheat varieties to India and Turkey in the mid-60's.

Although the Mexican varieties introduced into India were high yielding, they were unsatisfactory in two major aspects: (1) they were red-seeded which meant that they produced an inferior "chapatti" (local bread), and (2) they lacked resistance to stripe rust, a major wheat disease in

North India. Because stripe rust is unimportant in Mexico, resistance to this disease was not bred into the Mexican varieties. In spite of these two shortcomings, the imported Mexican varieties were grown widely for a few years after their introduction into India, and they contributed significantly to overall production.

At the same time that the large quantities of Mexican varieties were imported, many samples of experimental, segregating lines from Mexico were also being imported. Fortunately, India already had a strong wheat research project in place. Indian scientists immediately set to work selecting lines more suitable for local conditions than the varieties that had been imported. They also began to cross the lines imported from Mexico with Indian lines which, in years to come, would yield varieties with the most desirable characteristics of both the Mexican and Indian strains.

The end result was that the red-seeded, stripe rust-susceptible Mexican varieties were very soon replaced with varieties selected from imported segregating lines that were more suitable for Indian conditions. Within a few short years, these varieties were replaced with others emanating from crosses of Mexican and Indian germ plasm, combining high yields with good quality and disease resistance. Indian wheat production has risen from 12.4 million tons in 1964-65 to 44.6 million tons in 1983-84.

The scenario in Turkey was quite different. In 1967, Turkey imported 22,000 tons of Mexican seed wheat. At first this wheat was highly successful, so much so that the area where Mexican wheat can be grown produced 21 percent of the total national production, up from 10 percent prior to the introduction of Mexican varieties. Soon, however, septoria leaf blotch and stripe rust (two diseases not present in Mexico) began to attack the Mexican varieties, resulting in decreased yields per hectare,

decreased area planted to the Mexican varieties, and decreased wheat production.

Unfortunately, Turkey had no strong wheat research program. No new varieties were developed. As a result Turkish farmers were forced to grow varieties which were subject to attack by diseases, causing yield losses.

It took a number of years and a combined effort by the Turkish government and the Rockefeller Foundation to develop a wheat research organization that could adapt the materials from the international centers to the specific needs of Turkish farmers. Turkey's wheat production has now climbed from an average of 10 million tons per year in the 1960's to 17.3 million tons in 1982-83. However, the grain lost in the intervening years while the research activities were being organized would have paid for the wheat program many times over.

The lessons of the India-Turkey experience are now generally accepted in the agricultural research community, namely, that while the international centers are a key element in the generation of the new technology, they are not a substitute for national programs. It seems clear therefore that what is at issue in the Western Sudan case is not whether there needs to be a dynamic agricultural research activity in the overall regional development plan, but more precisely what that activity should look like.

Research Methodology: A Farming Systems Approach

In Western countries, agricultural research has historically been organized by academic disciplines. The first agricultural experiment station in Europe and in the United States (patterned after Europe) consisted mainly of agricultural chemists. As science progressed and more disciplines were differentiated, departments of plant breeding, soil science, plant pathology, animal science, and others were added. Generally

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research activities were carried out within only one academic field; research involving more than one discipline was rare. In 1925, corn researchers in the U.S., seeing the need for the contributions from more than one discipline, organized a cooperative corn improvement project to apply the newly discovered principle of hybrid vigor to increasing corn yields. This project served as a model for similar joint efforts, or cooperative research projects, as they were called, during the 1930's.

Most early research institutions in developing countries were established by colonial administrations, and the organizational pattern was taken from the colonial power. Invariably these research institutions were organized along disciplinary lines. Sudan's Agricultural Research Corporation (ARC) is a good example.

Unfortunately, agricultural production problems do not necessarily conform to disciplinary boundaries. Constraints to increasing output may be physical or biological; additional factors involving political, policy and administrative issues may also be important. Usually these issues are closely interrelated and the resolution of one problem will be difficult so long as other constraints persist. The ability of the U.S. system to identify and overcome constraints quickly, has been achieved by putting together teams of scientists capable of dealing with such interacting factors as crop yielding ability, soil and water management, diseases, insects. Such teamwork is essential if a continuing flow of yield-promoting, advanced technology is to be provided.

One of the first developing countries to depart from a discipline oriented pattern of research was India. In 1959, India organized the first "All-India Coordinated" crop improvement programs with maize, sorghum and millets. These were multidisciplinary projects, incorporating plant breeders, plant pathologists, entomologists, agronomists, and agricultural

economists, working on a nationwide basis to develop technology to increase crop yields per hectare. Later wheat and rice were added as coordinated projects. Subsequently, the Indian Council of Agricultural Research created more than 80 coordinated research projects. The ability of India to boost production of food grains from the plateau of 80 to 85 million tons annually 20 years ago to approximately 140 million tons in recent years, is to a considerable extent the result of this new form of agricultural research. The Philippines, Pakistan, Indonesia, Malaysia, Thailand, and Turkey are other countries whose agricultural production has been increased by technology produced from "coordinated" research projects.

Until recently, Sudan's ARC was organized by academic department. Because agricultural development in irrigated agriculture has been ARC's primary focus, the departments dealing with crop breeding and improvement, particularly cotton, have been dominant. Primarily as a result of recommendations made by a review of ARC activities in 1976-77, ARC's research has been reorganized into coordinated, multidisciplinary commodity or factor research projects. Although the discipline-based departments have been retained, scientists in the departments are now assigned to various commodity or factor research projects. Also, National Coordinators for the main crops--cotton, sorghum, wheat, sesame, groundnuts, sugar cane, and horticultural crops--and for three disciplines--Entomology, Botany and Plant Pathology, and Soils--have been appointed. Most recently, farming systems research teams have become a part of ARC through the WSARP project.

Farming systems research is, at least formally, a relatively recent development. As conceptualized by its most articulate proponents, its basic thrust is to ensure that the end-user, the farmer, is involved in the research process. In addition, it recognizes explicitly that the use of a

"systems" approach will also help to create researcher awareness of the interactions among the various components of the farmer's social and economic activities.

The problem that gave rise to the systems approach arose out of the high degree of specialization in the research institutions of developed countries. Because of the enormous research infrastructure that has accumulated since the early years of the land-grant colleges, a division of labor has arisen in which the frontiers of knowledge are defined more and more narrowly. Scientists from developing countries, when trained in this system, have tended to absorb its rationale and its values. Often the developing country scientist has returned to his own country and continued to do research similar to what he has done for his Ph.D. thesis. The result has been of little immediate benefit to the local farming population. The farming systems research methodology was created (to a high degree by agricultural economists and sociologists) to assure that farmers have an input into the research process.

Farming systems research is carried out on farmer's fields by multidisciplinary teams comprising socio-economic and biological scientists. After delineating geographic regions with similar ecologies ("recommendation domains" in FSR jargon), the researchers study the farmer and his production system, and then try to induce some change that will improve the farmer's well-being. Such improvements may be increase yields per hectare, improve labor efficiency, reduce drudgery of farm work, or other similar results.

The danger of this more eclectic approach is that by developing an encompassing view of rural development, researchers run the risk of diffusing their areas of expertise to the point where they are blunted as problem solving tools. The farmer and his family may indeed integrate a vast amount of information into a "system," but this does not mean that a

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research strategy that tries to attack all of the identified constraints at once will be effective.

Off-setting the danger of failing to set research priorities and spreading resources too thinly is the farming systems methodology's great strength, namely, getting researchers to work with farmers on developing the kind of resource-augmenting, productivity-increasing technology that both regard as a desirable objective. When viewed from this perspective, the farming systems approach adds a level of complexity to the identification of problems, but it also increases the probability that the ultimate activities are those most relevant to meeting the end-user's needs.

Farming systems research must obviously be supported by other research activities that produce the technology to be injected into the farming system. Improved crop varieties must be forthcoming from the crop commodity projects. Improved breeds of animals must be developed in the animal commodity research projects. New cultivation practices, fertilizer materials, herbicide products and practices, and animal health measures are examples of technology that might be generated in other research projects for subsequent injection into the farmer's production system. Some of the supporting research can be done by the farming systems research team, perhaps on experiment stations, but much of it must come from commodity or factor research projects or from research in a discipline. At all points, the contribution of the farming systems research team to the supporting research projects is to obtain the feedback from farmers that helps keep support research focused on the farmer's most pressing problems.

THE WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

WSARP began officially in 1978. However, the project experienced a number of delays in both construction and staffing. The buildings at El Obeid are just now nearing completion and, while some of the staff have been posted there, the project is still in an early stage of development. Everyone we spoke to observed that the project was just getting to the point where it might be expected to produce research results.

The decision was made early in the project to develop the research station at Kadugli in the first years of the project rather than to wait on the construction of the headquarters facilities at El Obeid. Buildings existed at Kadugli that could be renovated in a short period of time, allowing this station to begin research at an early date.

A good deal of criticism has been leveled at the construction program at El Obeid. For the purpose of future decisions, these buildings are, of course, a sunk cost. Although it has been suggested that the facility is over-built, it should be remembered that it was planned jointly by the World Bank, the Government of Sudan and AID and were financed principally by funds from the World Bank. The intention was to build laboratories and a compound that would attract qualified Sudanese staff.

Whether the headquarters facilities are too elaborate remains to be seen. At this juncture, however, they are clearly a fixed cost. Commitments made and implemented in the past should be treated as constraints and not variables.

Focus of the Project

In the Western Sudan, each of the "legs" of development stool can be readily identified. The most obvious investment activities have already been mentioned: the \$100 million commitment to the El Obeid and the development

of a large marketing and credit program. Although a really coherent plan has yet to be fleshed out, current commitments, if followed through, raise the exciting prospect that the Mission's dryland strategy is being transformed into a regional development strategy whose essence is the integration of Western Sudan into national and international markets.

What do these developments mean for a research strategy? Perhaps the single most compelling point is that all of the above efforts imply a commercialization of agriculture. With this in mind, we questioned WSARP researchers repeatedly about the issues that are suggested by such a perspective. The question is not a straw man since many researchers in developing countries are advocating research efforts that are basically subsistence oriented. Such strategies may make sense in areas whose isolation is such that the cost of using inputs to increase production is prohibitive. However, they obviously limit the extent to which any significant agricultural transformation can be achieved.

In discussion with the WSARP staff, it was clear that they are very much attuned to the commercialization issue. According to the staff at Kadugli and El Obeid, to think in subsistence terms would be to violate what surveys indicate people in the area have historically done. The area has always been "commercialized" in that surplus of cattle, groundnuts, and sorghum have been regularly sold in order to purchase other elements of a consumption basket. (A livestock specialist estimated that roughly L.S. 40 million in cattle moved through the El Obeid market every year.) Moreover, the researchers also indicated that their experience in the field to date gives no evidence that buying and selling is done only by large farmers. Commercialization is very much of function of small farmers as well and there is no conflict between focusing on small-scale agriculture and a

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research program that attempts to increase output by increasing the use of yield increasing inputs.

To date, relatively little attention has been given to the use of purchased inputs because the benefit/cost ratios are likely to be unfavorable. For example, the cost of transporting fertilizer to El Obeid and Kadugli is so high that recouping its cost would be virtually impossible. This is especially true when output is priced at the Government's procurement price instead of at its international price. As far as WSARP is concerned, the result of these investment and price policy constraints has been to suggest to researchers that they ought to concentrate on what are sometime called "low input" technology. Such a strategy is probably the correct focus for the immediate future; however, it will clearly need to be modified as improved transportation facilities bring market costs down.

It was obvious from discussions with the project's scientists that the researchers were aware that successful, sustained infrastructure development will mean the need to pay increased attention to the goal of commercialization as the investment materializes. Evidence of this awareness are the plans to begin a more intensive program of evaluating the impact of fertilizers, fungicides, herbicides and other "high tech" inputs.

Research Methodology

The methodology used in this project is based on the farming systems philosophy described above. The research is, to a considerable extent, carried out on farmer's fields by a multidisciplined research team comprised of biological and socio-economic scientists. As noted previously, the main goal is to involve the farmer in the research process, relying on his help to identify research problems and to actually assist in carrying out some of the research in his own fields. With this type of participation

as background, the farmer can be utilized as an extension agent to disseminate the results of research. Such an approach is in contrast to the role of farmers in the irrigated schemes where research and extension is very much a "top-down" process. The researchers at Gezira, for example, consult with the management staff, conceptualize the research and carry out the trials on the experiment station. When the results have been obtained, ARC recommends the new technology to the Scheme's management. If the management accepts the ARC recommendation, they instruct the extension wing, the "inspectors," to take the new technology to the farmers.

Agricultural research in the Western Sudan simply can not be carried out in that fashion. Little is known about the farmers, the farming system or the ecology of the region. There are no inspectors or extension agents. Under these circumstances, the research methodology will obviously differ from the traditions established in the irrigated areas. It is necessary to utilize the farmer to understand the farming system, to help plan and conduct the research and to help disseminate the results. It is hoped that the farmer's active participation in demonstrations and other extension activities will create sufficient credibility with his neighbors to permit him to act as a catalyst for spreading research results.

None of the comments made above suggest that a farming systems approach can succeed if it is not supported with other research in the commodity and discipline-oriented research projects. These latter projects will develop most of the technology that the farming systems research team will need for successful improvements in the farming systems. For example, new crop varieties of sorghum, millet, sesame, and groundnuts must come from the commodity research programs of the ARC.

We spent a good deal of time discussing farming systems research with

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the staff trying to ascertain how they understood the concept. We came away with the feeling that, while some individuals did not fully appreciate the tension that exists in research between the application of the cutting tools of disciplines and a concern with the admittedly complex interrelations of traditional agriculture, the goal of establishing an effective researcher-user interface was guiding the project's use of the methodology. This is important because, as noted earlier, some proponents of farming systems research have been carried away with the "systems" part of the idea to the detriment of the commodity and disciplinary work (i.e., the pieces) around which the actual research is organized. To reiterate, the farming systems approach does not suggest that agronomist should start trying to do the calculations of the economist. What is at issue is how the agronomist, as part of an overall assessment of the farmer's situation, selects the problems on which he decides to work.

In our judgment, the staff understands these distinctions and consequently there is no real cause for concern about the direction of the project's methodology. It was interesting in discussions with several of the young Sudanese scientists to hear them talk about their "conversion." The growing understanding that the situation that farmers face is complex and interrelated is, for someone trained in a narrow disciplinary mode, a substantial departure from traditional modes of thought. They talk about their new-found faith with the assumption that the listener is taking all of the required disciplinary and commodity oriented technical work for granted--as the scientists themselves do.

The latter observation was evident from the team's visits to the research plots. When we got down to what the individual scientists were actually doing, it was pretty bread and butter stuff. Yield trials were being carried out to measure the impact of cultural practices on sorghum.

Experiments have been designed to try to get a fix on the effect of fertilizers and fungicides. A dozen different legumes were being screened for a viable forage crop. During these field visits we did not once hear the jargon that has sometimes been associated with the farming systems approach. (This whole set of issues was discussed in detail with project personnel during the AID-World Bank review team in January, 1983.)

Recommendations

We came away from the Western Sudan project with a strong feeling that the project ought to be continued. Our reasoning is very straight forward.

(1) It is clear from the magnitude of the investments proposed for the Western Sudan that the technology base cannot be left uncovered. The efforts that AID is making to persuade the Government to pursue sensible price policies in the Western area reinforces the regional development thrust.

(2) The project team that is now in the field seems to be competent and motivated to carry out the necessary task. Many are young and the whole effort could probably benefit from more mature leadership in certain areas, especially the social sciences. But, in general, the contractor has done a good job in staffing the project with the expatriate personnel needed at this stage of the technical assistance program. It would be highly undesirable to change horses in the middle of the stream.

(3) A long-term commitment to the project is the logical route for AID to follow. In the beginning, all parties, including AID, recognized that this project would require a commitment of 10-15 years. The project is now in the "take-off" stage and technology should begin to flow from it. The costs of operating the project from now on will be relatively low--funds will be required only for technical assistance, replacement equipment and

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perhaps some additional equipment and training for Sudanese scientists.

We understand that there are at least two avenues being considered for continued project funding. One would be to utilize approximately \$2.5 million of uncommitted funds to extend the project for about 18 months. A second option would be to obtain additional funds to extend the project for a 5-year period. We strongly recommend funding the project for the 5-year period. Under an 18-month extension, the present contractor would have a great deal of difficulty recruiting qualified scientists. In fact, indications are that the current contractor would not be interested in an 18-month extension.

(4) A question was raised as to whether or not to include support for the research stations at El Fashr and Gazala Gazawat in any project extension. In our judgment, funds should be provided for research at all four western stations. This project was designed after careful study by the World Bank, AID and the Government of Sudan. El Fashr and Gazala Gawazat represent ecologies different from the other locations. Gazala Gawazat, with approximately the same rainfall as Kadugli, is in an area of sandy soils in contrast to the fine-textured clay soils of the Kadugli area. Groundnuts, as well as sorghum and millet, are important crops in the Gazala Gawazat area.

El Fashr, in the low-rainfall zone of the sandy soils, is a millet and livestock area. Camel rearing is also an important enterprise. Moreover, El Fashr represents the desert fringe where environmental issues, especially desert encroachment, are of major concern.

The cost of operating the two stations at El Fashr and Gazala Gawazat would be small. Annual costs for salaries and operating funds for the two stations at full staffing would be approximately \$180,000 for El Fashr and \$166,000 for Gazala Gawazat. Because these stations represent important and

different ecologies, are components of ARC's long-range development program and are not terribly expensive, we believe they ought to be retained in any project extension.

It is perhaps worth noting that the various other actors in the Sudanese development community share the above recommendations. The Minister of Agriculture is positive about the project. Dr. Zaki of the Ministry of Finance and Planning has given his strong support to its continuation. The World Bank, through Mr. Shiva Kumar, has indicated that they would definitely wish to be involved in Phase II.

STRENGTHENING THE SUDANESE AGRICULTURAL RESEARCH SYSTEM

The previous section dealt with our principal concern, namely, the continuation of the technical assistance program in the Western Sudan. However, there are other, general issues relating to the improvements in the larger system to which we address the following comments.

A good deal of thought has already been given to the long-run developments that are needed by the larger research system. For example, there is the problem of donor perspectives versus the overall needs of the national program. A successful strategy requires that some type of long-range plan be adopted into which various individual projects can be fitted. The development of Senegal's Institut Senegalais pour la Reserche Agricole (ISRA) is an example of such an effective assistance effort. In 1979, Senegal approached the World Bank requesting a loan to strengthen the national agricultural organization, ISRA. The Bank urged Senegal to first prepare a long range plan for ISRA's development. Over a 12-month period, ISRA produced an indicative plan which specified research locations, research activities, manpower development requirements, office and laboratory space requirements, and equipment needs, projected over a 20-year period.

After reviewing the long-range development plan, the World Bank suggested that ISRA prepare a more detailed project proposal, including funding requirements and to submit this to the Bank for possible financing. ISRA prepared a national research development project, requesting about \$100 million for a 6-year period. After appraising the proposal, the Bank recommended it for IDA funding.

Subsequently, it became clear that available IDA funds would be insufficient to finance the entire project. At this point, Senegal (with

Bank assistance) approached France, the United States, Belgium, and other donors, requesting that each agree to finance a discrete portion of the comprehensive development plan. Several donors eventually contributed funds toward the fulfillment of the Master Plan.

Because there was a comprehensive, long-range plan for strengthening ISRA, each individual donor was able to finance an identifiable portion of the planned activities while the focus and the cohesiveness of the plan was preserved. For example, USAID is financing the agricultural economics and farming systems research; Belgium funds the research on cattle production; the UNDP contributes toward the provision of scientific equipment. Without a master plan for the long-range development of ISRA, chances of individual donors supporting isolated and hence less effective projects, would have been considerably higher.

Assistance to ARC has followed the process described above. With Ford Foundation assistance, a detailed review of ARC's activities took place over a period of several months in 1976 and 1977. Individual research projects were reviewed by consultants to ARC, a major conference was held in Khartoum in 1976 attended by representatives of donor organizations and international agricultural research centers, and a joint ARC/IADS team in 1977 prepared a comprehensive, long-range plan for the development of ARC. During the same period of time the World Bank was developing plans for the Western Sudan Agricultural Research Project and care was taken to assure that this project became a part of the ARC's master plan. (In the late stages of the planning of WSARP, AID became involved as a co-financer of the project, assuming responsibility for the technical assistance as well as other parts of the project.)

Regretably, other components of the master plan have not been implemented for lack of funding. ARC, for example, was supposed to move its

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headquarters from Wad Medani to Khartoum. This will likely not take place until housing for the headquarters staff has been provided in Khartoum. However, it remains a desirable objective, particularly as the emergence of research in other regions makes it increasingly desirable for ARC to project the image of a national research program as opposed to one devoted almost entirely to irrigated agriculture. It is to be hoped that the World Bank's research, extension and education project will provide the funds necessary to proceed with strengthening ARC in accordance with the long-range plan.

Strengthening Regional Research in the East and South

The major portion of this report has been devoted to an assessment of the decision AID has before it on the technical assistance program currently associated with research in the Western Sudan. However, wherever possible, the team also quizzed knowledgeable people about research in other dryland areas. Although no visits were made to the East and South, our conversations produced the following impressions.

Eastern Sudan: Eastern Sudan may be considered as the area east of the White Nile in the zone of 400 to 800+ mm annual rainfall. This would include the area around Damazine up through Gedaref extending almost to Kassala. Farming conditions in this region are similar to the clay soil regions of Sudan Western but the sandy soils of the West represent a different ecology. Compared to the West there is much more investment in the East (public and private), the infrastructure is more highly developed and markets are closer to one another.

ARC has given some attention to the research needs of the rainfed sector in the Eastern Sudan. A research station for the central rainfed clays was established in 1952 at Tosi. In 1963, this research was moved to the Kenana research station at Abu Na'ama. This station has the

responsibility for research on supplemental irrigation suitable for irrigation schemes on both banks of the Blue Nile as well as for research on rainfed crops of the area. It utilizes off-station research sites at Damazine, Gedaref, Um Benein, and, in the past, Kadugli.

At best the research effort on rainfed crops in the Eastern zone has been feeble. Abu Na'ama is isolated--access is virtually impossible in the rainy season--and the focus of the effort has been on the experiment station itself. Thus, although some research has been carried out by ARC in the Eastern rainfed area, a great deal remains to be done.

If AID wishes to strengthen rainfed research in the East, a promising opportunity now presents itself. AID's financing of the Blue Nile Development Project will soon end. There is little likelihood that the Government of Sudan will continue this project, leaving the headquarters facilities at Damazine without purpose and without funding.

Transferring the facilities at Damazine to ARC for utilization as a regional research station for rainfed agriculture would have several advantages. An excellent physical facility in a reasonable environment for Sudanese and foreign staff would be made available to ARC. Damazine is an urban locality with regular airline service and a major highway connecting it to Wad Medani, Port Sudan, and Khartoum. Attracting Sudanese scientists to Damazine should be relatively easy. Moreover, the adaptive research activities in the Blue Nile Project have utilized four sub-stations that are operated from Damazine. These sub-stations could be utilized by an ARC. A major advantage of locating ARC's regional rainfed research station at Damazine, in addition to its accessibility, is that this move, unlike the current situation at Abu Na'ama, would separate rainfed research from irrigated research.

Shifting ARC's rainfed research from Abu Na'ama to Damazine would no doubt require careful investigation and detailed discussions with ARC and GOS. There would be costs associated with the move and funds for recurring costs of the new facility at Damazine would become an issue. However, the opportunity to create a meaningful rainfed research wing of ARC in Eastern Sudan is sufficiently important to investigate the possibility thoroughly.

Southern Sudan: Agriculture in Southern Sudan is rainfed, albeit at a considerably higher level of rainfall than other parts of Sudan. The potential for crop production is great, both in terms of quantity as well as the wide range of crop species that can be grown. However, the problem of how to dispose of surplus production is a major constraint to the development of Southern agriculture.

Agricultural research in the South has a long history. Research farms were established at Rumbek and Wau in 1903 and at Yambio in 1946. Aweil, Bor and Malakal were proposed as research stations under the regional station at Yambio by the 1977 ARC/IADS Joint Review Team. The station at Bor was proposed as a joint crops/livestock research station. Little actual research has been done in the South in the past 25 years because of the political and civil disturbances. We have no assessment of the potential for achieving progress in agricultural research or agricultural development in the South under current conditions.

If AID chooses to further strengthen agricultural research in Southern Sudan, a more detailed long-range plan than currently exists ought to be developed. This planning process should involve the Ministry of Agriculture of the Southern Sudan as well as ARC. The plan should indicate goals for the development of the research institutions over a 15-20 year period. Such a blueprint is not intended to cast the development process in concrete, but to provide a framework within which source human and material capital can be

rationalized.

Additional Considerations at the National Level

In addition to the general suggestions made above, there are several additional suggestions emanating from discussion held by the team with various individuals concerned with the research problem:

1. AID might wish to investigate the possibility of placing a management consultant at ARC headquarters. In discussions with the Director General of ARC, it seemed that he might be receptive to such an idea. (The World Bank team, on the other hand, indicated that such topics had been explored with the Director but to little avail.) Dr. William Gamble, Director General of ISNAR, will be in Sudan shortly and this subject should come up for discussion.

2. AID should consider the use of PL 480 Sudanese pounds in support of ARC research that backstops WSARP. ARC's commodity research programs on crops grown in the Western Sudan could be partially financed by provision of PL 480 pounds to support some of the recurrent costs of these research activities. Availability of local currency for operations is, as noted above, ARC's biggest headache. Use of local currency in this manner would help alleviate a bottleneck while at the same time supporting a Western regional development strategy.

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SUPPLEMENT

**Agricultural Research in the Sudan with
Special Emphasis on the Western Sudan Project**

November 25, 1984

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Questions and Answers: An Elaboration

Q: How does one give the agricultural research program in Sudan greater focus?

A: The key to giving greater focus to the research program is to link priorities more explicitly to other elements of the AID development strategy. Research objectives are difficult to assign and implement when taken in isolation. What makes the Western Sudan project interesting are the other activities that are being contemplated for the area. Indeed, so important is the general environment that if one were to reconsider, say, the proposed infrastructure investments, then there would be an argument for reassessing the research program also. Similarly, if the proposed policy reforms turn out not to be feasible and the profitability of a more commercially oriented agriculture is in doubt, that would also raise questions about the desirability of committing research resources to areas that are now relatively isolated. Such reconsiderations should, of course, take into account the long lead time between R & D and a set of practices that farmers could implement. But changing the assumptions about the other activities that are slated for the area would have an effect on priorities and focus. Conversely, these assumptions provide the current basis for more explicit suggestions about research priorities.

For planning purposes, the notion of a regional "package" is very attractive. This does not suggest, as did early proponents of integrated rural development, that all the elements of increased productivity need to be administered by some regional development agency. Letting markets process information and using economic incentives to guide choices has proved to be a far more efficient mechanism for delivering technology than a government bureaucracy. However, developing a checklist of the necessary ingredients

of a successful package should be an important objective of the regional planning activity. The research priorities will fall out very naturally from such an exercise.

Articulating a regional development strategy in greater detail ought to be a high priority for the Mission. If a major thrust of the strategy is the development of a market oriented agriculture, certain obvious candidates for increasing the marketed surplus would emerge. For example, an increase in the number of livestock that are likely to make their way to market has been predicted. This suggests that livestock research ought to be given a high priority. Precisely what the research project should address involves a number of technical assessments that go beyond the scope of this report. But the principal of concentrating on those crops that form the basis for a marketed surplus is straightforward.

To summarize, increasing the clarity of focus is very much dependent upon providing a development framework within which to assess research needs. It is hard to imagine how it can be done otherwise. In our view, the touchstone is the commercialization of agriculture. By that we mean the sale of commodities in exchange for productive inputs and consumer goods. Without this incentive mechanism, it is hard to imagine that any type of research will have a significant pay-off. If the core of a Western Sudan strategy makes that concept operational, then the terms of reference for fine-tuning research activities will be in place. One cannot make bricks without straw.

Q: How can one decide what share of recurring costs AID should support?

A: There are three issues involved in the recurring costs problem: (1) how much to provide, (2) which projects to support, and (3) how to institutionalize a new level of domestic expenditures for agricultural research.

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The last issue is, in the Sudan, perhaps the most vexing. Past performance suggests that national programs have a good deal of flexibility in shifting resources from one activity to another. AID's contribution might simply remove the pressures for improving the current funding level. An obvious way of using the carrot to create continued pressures for institutionalization of commodity taxes, contributions for development projects, etc., is to develop some sort of matching scheme. For example, for AID to add an additional unit of local currency to the recurring cost budget, Sudan must do the same. It would not be hard to insure that the Sudanese contribution was incremental funding from domestic resources. The formula by which this was done would be spelled out in the covenants of the agreement.

The device for allocating funds to research organizations in such a way that they do not simply get swallowed up in institutional overhead would be to set priorities in accordance with AID's overall development strategy.¹ As the Final Report suggests, under this approach, the Mission would focus on those activities that are complementary to the dryland development. There are a number of projects that might merit such support. Specific examples mentioned above include sorghum breeding, livestock feeding, storage and marketing, etc.

The remaining issue, i.e., how much to contribute to recurring costs in absolute terms, requires knowledge about the opportunity cost of the funds that would be used. Presumably some scarcity is involved--the question indicates that this is the case--but without knowing what the alternative

¹ The Sudanese may very well argue that such tactics distort their own strategy, but the presence of an AID strategy does that at all levels. If that were not the case, the Mission would simply be in the check writing business.

investments are, it is impossible to say how much should be committed. In a formal sense, what is at issue is the comparison between certain types of AID projects at the margin. Theoretically, the project that has the highest net present value wins. Practically, the "lumpiness" of projects makes it difficult to make such comparisons. Nevertheless, the identification of the marginal project would probably be an instructive exercise and provide a better grasp of the extent to which AID projects really do complement each other.

Q: Is there anything beyond the Mexico/India/Turkey story that might be of significance to the works going on in the Sudan?

A: There are a number of lessons that come out of the CYMMIT/India/Turkey experience that have relevance to the Sudanese situation:²

(1) Both programs were organized as long-term research efforts and not crises responses. This does not suggest that rust epidemics and other types of natural disasters should go untreated. However, it was recognized from the outset that continuous adaptation would be necessary and that therefore a permanent program would be required.

Given a regional development strategy as background, it seems to us that this notion of permanence has relevance for the Sudanese case also. As the body of the report suggests repeatedly, if an agriculturally oriented development strategy makes sense in the Western Sudan, then research needs to be a part of that strategy. (The World Bank will be the first to agree that the Western Savanna project, which is hardly a regional effort, already

² The literature on this subject has also mushroomed in the past decade. Relevant works would include Chapters 8 and 12 of Wortman and Cummings' To Feed a Hungry World, two books by Al Moseman on agricultural research systems and Resource Allocation and Productivity in National and International Agricultural by Tom Arndt, Dana Dalrymple and Vern Ruttan.

has problems resulting from an inadequate research base.) We are not dealing with a zero based budget in which the question is whether to have a research program or not. At least in our minds, the large scale investments that are being contemplated necessitate the creation of research facilities that are capable of providing a stream of new technology. As the Report notes, one could disagree with methodology, staffing, etc., etc., and still come back to that conclusion. Yet it would appear that this global premise is the very point on which the debate has implicitly been focused. Little of substance has otherwise been advanced.

(2) Although the research in both countries (India and Turkey) was organized along commodity lines, it was "coordinated" in that all of the disciplines needed to produce results were forced to work together. Indeed, at least in Turkey, the approach was based on a "farming systems" methodology before that terminology became fashionable. In the early days both projects, the "coordination" of work was not without its frictions. However, as the results began to accumulate (and as younger scientists became part of the research teams), it became the accepted way of dealing with problems. (In India, there are currently over 80 coordinated commodity programs.)

(3) Both programs were lucky to have had experienced expatriate and local leadership. At this point, leadership is obviously a critical problem with the Sudanese research effort. It is precisely this problem that makes the technical assistance effort so important.

The leadership problem also speaks to the conundrum faced in Sudan with respect to training new generations of Sudanese scientists. Without such training programs, the basis for increasing the quantity and quality of local scientists is seriously diminished. Unfortunately, as the Director General of ARC pointed out during our visit, training additional scientists

without being able to provide the local currency needed to carry on a work program, has little to commend it. In the latter regard, i.e., the availability of local currency, both India and Turkey were able to make more generous contributions to the research program than the Sudan has been able to muster. This last point again underlines the need to develop a mechanism for increasing the amount of local currency available for operating costs.

Q: Should we estimate what percentage of El Obeid could be staffed with existing staff and then review the incremental costs of filling the facility in relation to its projected research benefits?

A: The marginal benefits and costs of sending more staff to El Obeid should certainly become the basis for additional research commitments. As noted in the report, the existing housing and laboratory buildings constitute a fixed cost and should be treated as a constraint. Staff can be added until the houses and laboratories are full without incurring any further construction costs. The opposite is not the case, i.e., the buildings should remain forever empty if there are no worth while research projects that will cover the variable costs of their implementation. The suggestion regarding the test that needs to be applied to further staffing is therefore quite correct. Please note, however, that it is the marginal cost, not the average cost that is the appropriate criteria.

Q: How can one assist in the getting the "low plums" on the research tree out to the farmer?

A: Three comments come to mind. First, if the El Obeid market is any indication, there is enough activity going on around the area so that if the "low plum" is indeed profitable, farmers will initiate the contacts necessary to obtain the technology. One need only show up in the market. As you know, fertilizers and seeds in the case of Pakistan and India were spread in spite of the extension service, not because of it.

Second, the farming systems approach with its emphasis on conducting

on-farm trials circumvents part of the communications problem by making extension agents out of the farmers who are involved. The effort to create a closer link with farmers has its pay-off in delivering the message. Farmers who have actively participated in the research program are far better salesmen of research results than those who have simply permitted the research group to "demonstrate" their wares.

Arguing for the additional resources needed to develop some kind of specific outreach program would be a third possibility. Like R & D, the development of even a rudimentary extension service requires a substantial lead time. Consequently, it may be desirable to make a small commitment to training the trainers now. Because the principal cadre would undoubtedly be drawn from the local or provincial staff, a lot of preparatory work would be required before the extension approach was defined in way that gave it a real chance of success. Thus it might be worth getting started on this activity in the next year or so, even though the "low plums" are not yet evident.

The idea of adding an extension component to the project has already been discussed within the project. From the Mission's point of view, it would seem clear that this question is not one that can be answered in the abstract but must proceed from the observations of the people on the ground.

GRUBE / ZIMMER : KARPLEN
 Western Sudan Agricultural Research Project

MONTHLY PROGRESS REPORT

Date: Sept. 10, 1985 (For June, July, Aug, 1985)

A. <u>CONSTRUCTION COST STATUS</u> (LS)	EL OBEID	EL FASHER	GHAZALA	ARC HQ	TOTAL
1. Original contract amount	6,471,360.	3,006,105.	2,803,718.	426,036.	12,707,219.
2. Total variation orders	1,012,915.	458,116.	444,655.	19,637.	1,945,408.
3. Adjusted contract amount	7,484,275.	3,464,221.	3,248,373.	436,121.	14,632,990.
4. Total paid thru Cert # <u>21</u>	4,330,200.	1,951,568.	1,884,620.	385,336.	8,551,724.
5. Total remaining to be paid	3,154,075.	1,512,653.	1,363,753.	50,785.	6,090,818.

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B. <u>CONSTRUCTION TIME STATUS</u> IN CALENDAR DAYS	EL OBEID	EL FASHER	GHAZALA	ARC HQ
1. Original contract time	730	730	730	730
2. Time extensions granted	168	168	168	0
3. Adjusted contract time	898	898	898	730
4. Time extension pending, est.	365	305	305	140
5. Overrun beyond adjusted contract time, current	606	606	606	601
6. Overrun beyond adjusted contract time, projected	241	301	301	461

C. <u>CONTRACT COMPLETION DATE</u>	May 12, 84	Mar 31, 84	Mar 31, 84	Aug 7, 83
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Note: No payments processed during report period.

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APPENDIX C

CONSTRUCTION/FORCE ACCOUNT

1. TIME FRAME
2. FORCE ACCOUNT SUPPLEMENT

APPENDIX C - PART 1 - CONSTRUCTION TIME FRAME

STATION: EL OBEID

ESTIMATED SCHEDULE OF COMPLETION (Sept.15, 1985)

	Sept.	Oct.	Nov.	Dec.	Jan.,86	Feb.	March	April	Remarks
SEWERS/LAGOONS	→	install connect fittings	→						all materials on site exc. fittings on truck to s.
WATER LINES	site →	85% compl.	→						acid resist. piping on truck Kht. to site
ROADWORKS	initial compact.	→							trucks and fuel for gravel transp. avail. on site
GRADING	60% compl.	→							
WATER TOWER	compl. except for pump. house.		→						pumps were airfreighted to Kht.
DOORS & WINDOWS	95% complete								
GLASS	site →	install	→						imported glass, in transit Kht. to site.
VERANDAH SCREENS	90% complete	→							all mat. on site except 12 alum. posts.
ELECTR. WORK, inter.	50% fixt. to site	→	install fixtures	→					
C.H. DISTR. CABLES		→							all materials on site
PLUMBING, inter.	85% compl.		→						acid resist. piping in transit to site
PLUMBING FIXTURES	80% compl.	→							tubs to be customs cleared at Shaba
PLASTER	90% compl.	→							
PAINTING	30 % compl.			→					all materials on site
SLABS/TILES	85% compl.	→							
SUSPENDED CEILING	install			→					all materials on site
LAB. CABINETS			install	→					all materials on site
KITCHEN CABINETS	painting & transport from Kht.	→	install	→					
GENERATORS	install	→							control panels airfreighted end of Sept.
AIR COOLING	ducts manuf. Kht	→	inst.	→					A.C. units & coolers to be purchased locally

STATION: GHAZALA GAWAZET

ESTIMATED SCHEDULE OF COMPLETION (Sept.15, 1985)

	Sept.	Oct.	Nov.	Dec.	Jan.86	Feb.	March	April'	Remarks
SEWERS/LAGOONS	Septic tanks & soak-away wells complete,				▶				50% piping on site, balance in transit to site on rail
	install piping								
WATER LINES	install				▶				same as above
ROADWORKS									
GRADING	80% complete				▶				
WATER TOWER	install				▶				materials on site, pumps to be airfreighted
DOORS & WINDOWS	install ▶								all materials on site
GLASS	site		▶ install	▶					glass was locally purchased stored at El Fasher
VERANDAH SCREENS	P.S. to site		▶ install		▶				materials c.cleared at P.S.
ELECTR. WORK, inter.				▶					
C.H. DISTR. CABLES			▶						all materials on site
PLUMBING, inter.	install				▶				50% piping on site, balance in transit to site on rail
PLUMBING FIXTURES	P.S. to site		▶ install		▶				materials c.cleared at P.S.
PLASTER	95% complete ▶								
PAINTING		site		install		▶			material stored at El Fasher
SLABS/TILES	complete except for labs & bathrooms				▶				all materials on site
SUSPENDED CEILING		▶	▶	▶	▶ install	▶			material to be airfreighted
LAB. CABINETS	P.S. to site		▶ install	▶					materials c.cleared at P.S.
KITCHEN CABINETS	site		▶ install	▶					
GENERATORS				▶	install	▶			
AIR COOLING		site ▶	manuf. ducts		▶ install	▶			A.C. units & coolers to be purchased locally

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STATION: El Fasher

ESTIMATED SCHEDULE OF COMPLETION (Sept.15, 1985)

	Sept.	Oct.	Nov.	Dec.	Jan. 86	Feb.	March	April	Remarks
SEWERS/LAGOONS	pipes to site	install	septic tanks compl.,	drain fields 80%					pipes in transit on rail to Ghazala, by truck to E.F.
WATER LINES	pipes to site	install							same as above
ROADWORKS	85% complete								
GRADING	67% complete								
WATER TOWER	from Ghazala to site	install							all materials at Ghazala to be trucked to El Fasher
DOORS & WINDOWS	site	install							60% materials at Ghazala to be trucked to El Fasher
GLASS				install					materials on site
VERANDAH SCREENS	Port Sudan to site		install						c. cleared at Port Sudan
ELECTR. WORK, inter.									
O.H. DISTR. CABLES	complete								
PLUMBING, inter.	pipng to site	install							pipes in transit on rail to Ghazala, by truck to E.F.
PLUMBING FIXTURES	P.S. to site		install						c. cleared at P.S.
PLASTER	90% complete								
PAINTING				install					all materials on site
SLABS/TILES	complete except for labs and bathrooms								all materials on site
SUSPENDED CEILING				install					mat. to be airfreighted
LAB. CABINETS	Port Sudan to site								mat. c.cleared at P.S.
KITCHEN CABINETS	site		install						
GENERATORS						install			
AIR COOLING				Ghazala to site		install			A.C. units & coolers Local purchase

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APPENDIX C

PART 2

SUMMARY OF 1985 FORCE ACCOUNT ACTIVITIES - MR. SHAWGI AMIN EL SAYED

The following summary of Force Account activities during the second half of Project Year 6 supplements the Force Account reports in Appendix A, Quarterly Reports.

March-June 1985:

1. Worked with Ministry of Housing, Water and Public Utilities, Kordofan Region, re reerection of collapsed water tank at Beno farm (now completed) and drilling of the wells for station water supply.
2. Design work for: a) Beno farm nursery shed; b) sheep facilities for El Obeid main farm; and development of Beno farm site plan.
3. Revised material orders made by Dr. Higgins from 1983 to date.
4. Reproduced Ghazala Gawazet main farm site plans from Western Savannah Development Corporation drawings for use in development and implementation of a master plan for the station.
5. Installed new Lister engine at Beno to replace NAW Torpedo engine not in good condition.
6. Supervised start-up of construction of road to Agronomy section of Kadugli station farm. Road is 1441 metres by 6 metres, and requires an extension of 93 metres to access the interior of the Agronomy area.
7. Participated in appointment of Site Engineer Mohamed Salih at El Obeid.
8. Participated in various activities associated with the continued efforts to develop a water system at the El Obeid facilities. The two wells drilled by NAW in the Fiallata area were unsatisfactory. UNICEF has successfully drilled in the Khor Taggatt area, and NAW Director Syd. Abdalla El Hassan has promised the Project one of the new sucessful wells.
9. Worked with Project personnel to procure cement permits (new price £S 280.000/ton and a 37.5 KVA stand-by generator for the PSU/ARC Liaison Office at Shambat.
10. Reviewed tool facilities at Kadugli and El Obeid and recommended order be placed.
11. Assisted in design of antenna for Shambat office building.
12. Worked with departing Maintenance Advisor Michael Mannion on various items related to maintenance requirements in Khartoum (Shambat office and Project Director's house).
13. Developed master plans for El Obeid and El Fasher.
14. Assisted with construction supervision at the Shambat site during Super-
vising Architect Hank Bergman's leave.

APPENDIX D

PERSONNEL

1. SENIOR STAFFING LIST
2. CID/WSU STAFFING SUMMARY
3. STAFFING SUMMARY FROM WSARP
PERSONNEL OFFICE

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APPENDIX D - PART 1

WSARP SENIOR STAFF AS OF 15 AUGUST, 1985

(Includes Selected Cooperating and Non-Senior Personnel)

Khartoum

Project Director Dr. Dafalla Ahmed DAFALLA
Administrative Officer Stephen Augustu HORTON
Materials and Supplies Assistant..... Abdelmaged MAHGOUB Mustafa
Assistant Director - Administration OSMAN ABDALLA Mohamed
Assistant Director - Finance YOUSIF Mohamed TAHA
Personnel Officer SALAH Hag Arabi
Inspector of Accounts Mohamed Yousif BAKRI
Purchasing Officer ABBAS Hassan EL NOUR
Administration Officer Sayed GASIM El-Sayed
Project Engineer SHAWGI Amin El Sayed
Senior Project Architect Henry P. BERGMAN
(Grube-Zimmer-Karplen Representative)
Aircraft Pilot Tom MILLS
Administrative Secretary Arnel Cruz MONTOYA
Director's Secretary Mahasin Suliman AHMED
Clearing and Forwarding Asst. Mohamed Abdel NABI
Radio Operator Hassan Saied OSMAN

El Obeid

Head of Research Station Dr. EL HAG Hassan Abu Gasim
(Plant/Millet Breeder and Sedentary Systems Coordinator)
*Gum Arabic Research Officer ZAKARIA Abdalla Saad
*Forestry Research Officer Farouk Mohamed AL HADI
Gum Arabic Research Officer..... Mohamed Mukhtar SADIK BILAL
Horticulturist Dr. Osman Adam OSMAN
Agronomist/Soils Specialist Babiker Abdalla IBRAHIM
Asst. Research Officer Kamal HAMAD

* In graduate training program in U.S.

WSARP SENIOR STAFF AS OF 15 AUGUST, 1985 (CONTINUED)
(Includes Selected Cooperating and Non-Senior Personnel)

El Obeid (Cont.)

Agro-Breeder (Groundnuts) Abdelrahman El Khidir OSMAN
Agronomist Dr. Hassan Osman Ahmed EL AWAD
Resident Engineer Ahmed HUSSEIN
Clerk of the Works Yousif SULIMAN
Senior Forest Ranger (Inspector H.Q.) Abdul Aziz Ahmed IBRAHIM
Entomologist Dr. Ahmed EL BASHIR
Accountant Abuelgasim ABDELHAI
Range Scientist Hashim Khider MUKHTAR
*Extension Specialist/Economist..... Ibrahim EL DUKHERI
Leader ARC/ICRISAT Project -
Millet Breeder (WSARP Cooperator)..... Dr. R. P. JAIN
Senior Librarian Mekki Mohamed AL EID

Kadugli

Director of Research Station Mukhtar KENANI
Livestock Production Specialist
(Nomadic Systems Coordinator and
CID/WSU Chief of Party) Dr. Richard H. COOK
Administration Officer Ali Mohana MUDEER
*Range Scientist Ahmed S. Muhamed EL WAKEEL
Range Scientist Ibrahim M. HASHIM
Social Scientist Mohamed Azim ABU SABAH
Animal Nutritionist (Transhumant Systems
Coordinator)..... Dr. Babo Fadlalla MOHAMED
Agronomist INTSORMIL (WSARP Cooperator)..... Dr. Tareke BERHE
*Agronomist Ibrahim Mohamed Daw MEDINA
*Agricultural Engineer Mekki Abdelatif OMER
Senior Technician (Agronomy) Ahmed Kehir ES-SEID
Agricultural Economist Dr. Thomas E. GILLARD-BYERS
*Asst. Social Scientist Mahmoud Awad MEKKI
*Agricultural Economist Tigani Mirghani EL AMIN
*Assistant Livestock Specialist Abdel Gadir A. AGEEB
*Asst. Scientist, Agricultural Economics Sid A.H. Sid Ahmed BETEIK

* In graduate training program in U.S.

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WSARP SENIOR STAFF AS OF 15 AUGUST, 1985 (CONTINUED)
(Includes Selected Cooperating and Non-Senior Personnel)

Ghazala Gawazer

Clerk of the Works El Jack MURAT
*Agronomist/Soils Specialist Gadelkarim MADIBO

El Fasher

Resident Engineer
Research Scientist (Forestry) Mohamed EL Mukhtar BALLAL

Wad Medani (ARC Headquarters)

Director General, ARC Dr. Hassan KHALIFA
Deputy Director General (Admin/Finance) Dr. Osman I. GAMEEL
Deputy Director General (Train/Public) Dr. Mhd. Abdul Rahman
ABDUL FATTAH

USAID, Khartoum

Project Officer E.S.F. MARTELLA
Agricultural Officer Ken LYVERS
Director, USAID W.R. BROWN

Washington State University, Pullman

Project Coordinator Dr. Jan C. NOEL
Deputy Project Coordinator Genevieve SMITH
WSARP Senior Secretary Barbara SOURIALI
Sr. Accountant Anna STUTLER
WSARP Purchasing Assistant Stephen BAILEY
Director, International Program
Development Office Dr. James B. HENSON

Consortium for International Development, Tucson

Executive Director Dr. Don D. DWYER
Deputy Executive Director Dr. Jean R. KEARNS
Executive Assistant Ms. Brenda J. PATRICK

* In graduate training program in U.S.

APPENDIX D - PART 2

CID/WSU STAFFING SUMMARY

Position Title	Name	Start Date	Completion Date	PERSON MONTHS/PROJECT YEAR							TOTAL	TOTAL BALANCE THRU 6	REMAINING
				Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7			
Field Staff:													
Deputy Dir/COP	Harwood, R.	01-Oct-79	15-Dec-81	10.5	12	4	-	-	-	-	26.5	26.5	0
	Owens, G.P.	15-Oct-81	21-Mar-84	-	-	10	12	7	-	-	29	29	0
	Hogan, L.	15-Apr-84	14-Aug-85	-	-	-	-	4	12	-	16	16	0
	SUBTOTAL - Dep.Dir/COP:											71.5	71.5
Chief Admin Off	Shurtleff, M.	26-Sep-79	03-Nov-80	11	2.5	-	-	-	-	-	13.5	13.5	0
	Higgins, S.	03-Oct-80	30-Apr-81	-	7	-	-	-	-	-	7	7	0
	Stanquist, L.	01-Apr-81	15-May-83	-	4.5	12	9	-	-	-	25.5	25.5	0
	Hannum, J.	23-Apr-83	22-Apr-85	-	-	-	4	12	8	-	24	24	0
SUBTOTAL - Chief Admin. Off:											70	70	0
Project Engineer	Higgins, D.	16-Jun-80	14-Aug-85 [15 Apr 85]	2	12	12	12	12	12	-	62	62	0
Advisor to DG/ARC	Riley, J.J.	16-Jun-80	14-Aug-85 [15 Apr 85]	2	12	12	12	12	12	-	62	62	0
Range Scientist	Bunderson, T.	15-Sep-80	15-May-85	-	11	12	12	12	9	-	56	56	0
Social Scientist	Araujo, F.	15-Aug-80	02-Sep-81	-	12	0.5	-	-	-	-	12.5	12.5	0
	Teitelbaum, J.	08-Jan-82	07-Jan-84	-	-	7.5	12	4.5	-	-	24	24	0
	Unfilled										0	0	0
SUBTOTAL - Soc. Sci:											36.5	36.5	0
Animal Prod Spec	Cook, R.	22-Jul-82	31-Dec-85	-	-	1	12	12	12	4.5	41.5	37	4.5
Agric Economist	Patrick, N.	20-Mar-82	20-Apr-84	-	-	5	12	8	-	-	25	25	0
	Gillard-Byers, T.	01-Jun-84	31-Dec-85	-	-	-	-	2.5	12	4.5	19	14.5	4.5
SUBTOTAL - Agric. Econ:											44	39.5	4.5
Agronomist	Gingrich, J.	12-May-82	11-May-84	-	-	3	12	9	-	-	24	24	0
	Woldetatos, T.	01-Jun-84	14-Aug-85	-	-	-	-	2.5	12	-	14.5	14.5	0
SUBTOTAL - Agronomist:											38.5	38.5	0
Vehicle Maint Off	Cenidoza, A.	26-Sep-82	14-Aug-85	-	-	-	10.5	12	12	-	34.5	34.5	0
Land-Water Spec	Arya, L.	02-Sep-83	14-Aug-85	-	-	-	-	11.5	12	-	23.5	23.5	0
SUBTOTAL - Field Staff Prof:											540	531	9
Research Assoc	Michael, B.	27-Sep-82	26-Sep-84	-	-	-	10.5	12	1.5	-	24	22.5	1.5
	(Unfilled)	01-Sep-84	14-Aug-85	-	-	-	-	-	6	-	6	0	6
SUBTOTAL - Research Associate:											30	22.5	7.5
Deputy Admin Off	Higgins, S.	01-May-81	14-Aug-85		1.5	8.6	11.6	12	9	-	42.7	42.7	0
Sr. Secretaries	(Various)	(Various)	(Various)	2.4	3.2	7	7.6	-	-	-	20.2	20.2	0
SUBTOTAL-Field Staff Non-Prof:											92.9	85.4	7.5

APPENDIX D - PART 2 CONTINUED

Position Title	Name	Start Date	Completion Date	PERSON MONTHS/PROJECT YEAR							TOTAL	TOTAL BALANCE	
				Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7		THRU 6	REMAINING
Home Office:													
Coordinator	Henson, J.	15-Aug-79	30-Jun-84	7	6.4	7.1	7.3	5.5	-		33.3	33.3	0
	Noel, J.	01-Jul-84	31-Dec-85	-	-	-	-	1.3	7	1.8	10.1	8.3	1.8
Deputy Coordinator	Noel, J.	15-Aug-79	30-Jun-84	6	6.4	7.1	6.8	6.8	-		33.1	33.1	0
	Henson, J.	01-Jul-84	14-Aug-85	-	-	-	-	0.2	1.5		1.7	1.7	0
	Smith, G.	20-May-84	31-Dec-85	-	-	-	-	2	4.8	2.5	9.3	6.8	2.5
Trainee Advisor	Grathwol, E.	01-Nov-80	31-Jan-84	-	2.2	1.8	1.8	0.8	-		6.6	6.6	0
SUBTOTAL-Home Off Prof:										94.1	89.8	4.3	
Secretary	(Various)	15-Aug-79	31-Dec-85	12	12	12	12	12	12	4.5	76.5	72	4.5
Purch/Time-Slip	(Various)	15-Aug-79	31-Dec-85	2.2	0.1	0.2	8.1	8	18	4.5	41.1	36.6	4.5
SUBTOTAL-Home Off Non-Prof:										117.6	108.6	9	
TOTAL HOME OFFICE PERS-MONTHS:										211.7	198.4	13.3	
GRAND TOTAL PERSON-MONTHS										844.6	814.8	29.8	

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APPENDIX D - PART 3

WSARP PERSONNEL SUMMARY - SEPTEMBER 1985 - FROM PERSONNEL OFFICER MR. SALAH HAG ARABI

<u>NAME</u>	<u>POSITION</u>	<u>DISCIPLINE</u>	<u>STATION/POST</u>	
<u>TECHNICIANS</u>				
Ahmed Kheir El Seed	Technician	Agronomy	Kadugli	
Bakheit Adam Azrak	Technician	Ag. Economics	Kadugli	Leaving for training in US
Adam Mohamed Ali	Technician	Animal Nutrition	Kadugli	
Adil Mamon Humeida	Technician	Agronomy	Kadugli	
Ahmed Salah Ambadi	Technician	Range	Kadugli	Will be leaving Project
Berima Babiker Azrak	Technician	Forestry	Kadugli	
Ali Manaa Modir	Technician	Forestry	Kadugli	
Ahmed Hashim Ahmed	Technician	Animal Production	Kadugli	
Mohamed Suliman Hamid	Asst. Technician	Animal Production	Kadugli	
Mohamed Hamad El Nil Mohamed	Asst. Technician	Animal Production	Kadugli	
Khamis Ahmed Ali	Asst. Technician		Kadugli	
Gabir Abdalla Kuku	Asst. Technician		Kadugli	
Ali Sheikh El Din Fadul	Asst. Technician	Range	Kadugli	
Ahmed Ismael A/Rahim	Asst. Technician	Animal Production	Kadugli	
Mubarak Arbab Gibril	Asst. Technician	Agronomy	Kadugli	
Monsour Mamoun	Asst. Technician	Animal Production	Kadugli	
Hazeldin Kuku Tiya	Asst. Technician	Agronomy	Kadugli	
Abdalla Fadul El Mula	Asst. Technician	Animal Production	Kadugli	
Hamid Ibrahim El Riah			Kadugli	
Ahmed Ali Ahmed			Kadugli	
Hilal Tirab El Fadul			Kadugli	Acting Admin. Officer
Monsour Khalifa Monsour	Technician	Agronomy	El Obeid	
El Dirdiri El Tom El Tahir	Technician	Soils	El Obeid	
Abdel Aziz Ahmed Ibrahim	Senior Technician		El Obeid	Acting Assoc. Admin. Officer
Mohamed Abu El Gasim Hamid	Asst. Technician	Horticulture	El Obeid	
Osman Hassan Mohamed	Asst. Technician		El Obeid	
Ibrahim Abdalla	Asst. Technician		El Obeid	
Mohamed Ibrahim Suwar	Asst. Technician	Soils	El Obeid	
Mohamed Ahmed Abu Lasik	Asst. Technician		El Obeid	Acting Purchasing Officer
Salah Bokur Ali	Asst. Technician	Entomology	El Obeid	
Azari Mekki El Mahi	Asst. Technician	Horticulture	El Obeid	
Abdelmoniem Hamad Tamin	Asst. Technician		El Obeid	Acting Farm Manager
Suliman Abdalla	Asst. Technician		El Obeid	
<u>ADMINISTRATORS</u>				
Osman Abdalla Mohamed	A/Dir. Administ.		Khartoum	To head Project Support Unit
Yousif Mohamed Taha	A/Dir. Finance		Khartoum (HQ)	To move to El Obeid
Salah Hag Arabi	A/Dir. Personnel		Khartoum (HQ)	To move to El Obeid
Abas Hassan El Nour	A/Dir. Purchasing		Khartoum	To stay with PSU
Sid Gasim El Said	Inspector HQ		Khartoum (HQ)	Leaving the Project
Mohamed Yousif Bakri	Inspector of Accts.		Khartoum (HQ)	To move to El Obeid
Khalid Hassan Osman	Inspector of Stores		Khartoum	To stay with PSU
Mekki Mohamed Al Eid	Librarian		El Obeid	

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APPENDIX D - PART 3 - continued

WSARP PERSONNEL SUMMARY - SEPTEMBER 1985 - FROM PERSONNEL OFFICER MR. SALAH HAG ARABI

<u>NAME</u> <u>CLERKS</u>	<u>POSITION</u>	<u>DISCIPLINE</u>	<u>STATION/POST</u>	<u>COMMENTS</u>
Abdel Gadir Osman Hussein	Clerk		Khartoum (HQ)	
Valery Alexander Onyalla	Head Clerk		Khartoum (HQ)	
El Amin Hamad El Nil	Head Clerk		Khartoum (HQ)	
Mohamed Yacoub Boroom	Head Staff Clerk		Khartoum (HQ)	
Yousif Mohamed Salem	Head Staff Clerk		Khartoum (HQ)	
Mohasin Suliman Ahmed	Secretary		Khartoum (HQ)	
Musa Abdelgafar Musa	Storekeeper		Khartoum (HQ)	
Ahmed Musa Idris	Asst. Storekeeper		Kadugli	
Ibrahim Galal Eldin	Head Staff Clerk		Kadugli	
Ismael Mohamed Kheir	Storekeeper		Kadugli	
Um El Hassan Ali Modu	Clerk		El Obeid	
Mohali El Riya El Faki	Storekeeper		El Obeid	

ACCOUNTANTS

Mukhtasim Ahmed Ibrahim	Head Accountant		Khartoum (HQ)	
Mustafa Sadig	Senior Accountant		Khartoum (HQ)	
Abdel Aziz Ismael Ahmed	Cashier		Kadugli	
Mohamed Adam Gabir	Head Accountant		Kadugli	
Mahmoud Ibrahim Mohamed	Senior Accountant		Kadugli	
Abu Elgasim Abdelhai	Senior Accountant		El Obeid	

RADIO OPERATORS

Hassan Osman Said	Radio Operators		Khartoum (HQ)	
Adam Dein El Hasha	Radio Operators		Kadugli	Acting Librarian
Mohamed Adam Ismael	Radio Operators		El Obeid	

LABORERS/MECHANICS

Laborers	25		Khartoum (HQ)	
Laborers	71		Kadugli	
Field Laborers	43		Kadugli	
Laborers	17		El Obeid	
Field Laborers	61		El Obeid	

APPENDIX E

TRAINING SUMMARY

APPENDIX E TRAINING SUMMARY

WSARP TRAINEE SUMMARY - 1 AUGUST 1985

Degree	Name	Univ	Project Start Date	Proj. Est. Completion	Comments:	Total funds required post CID contract to complete training
MS	Babiker Ibrahim	WSU	Jan-83	Jan-85	Completed on schedule	\$0
MS	Sid Ahmed Beteik	WSU	Oct-83	Jan-86	Budgeted to Jan 86 (see 1 below)	0
MS	Abdel Gadir Ageeb	WSU	Jun-83	Jan-86	On schedule	0
MS	Mahmoud Mekki	WSU/Miss	Jun-83	Jun-86	Awaiting confirmation fm UM (see 2 below)	\$11,675
MS	Ibrahim Daw El Madina	Cal/River	Jan-83	Jul-85	Completed; returns to Sudan in Sept.	0
MS	Ibrahim El Dukheri	WSU	Sep-84	Dec-86	Requires extra semester (see 3 below)	\$22,680
MS	Mekki A. L. Omer	WSU	Jun-81	Jun-84	Completed MS on schedule	0
MS	Faroug El Hadi	WSU	Jun-81	Jun-84	Completed MS on schedule	0
PhD	Mustafa Rahma	USU	-	-	Training terminated (see 4 below)	0
PhD	Ahmed El Wakeel	USU	Sep-82	Jun-86	Talk to advisor Doug Johnson	\$11,054
PhD	El Tigani El Amin	WSU	Jun-81	Jun-86	Requires extra semester (see 5 below)	\$13,304
PhD	Hassan El Awad	Cal/River	Jul-82	Sep-84	Completed on schedule	0
PhD	Gadelkarim Madibo	Cal/River	Jul-82	Dec-85	Extra semester required (see 7 below)	0
PhD	Mekki A. L. Omer	WSU	Sep-84	Jun-87	On schedule	\$38,413
PhD	Faroug El Hadi	OSU	Jan-84	Aug-87	Maj. of research now to be in US, Sudan; on schedule, otherwise	\$37,839
TOTAL EST. EXPENDITURES 1/1/86 TO COMP						\$134,965

1. Sid Ahmed Beteik (Sidahmed Hassan Sidahmed) Has experienced difficulties with research/thesis preparation; has received additional assistance; will finish as 1st projected.
2. Mahmoud Mekki Experienced academic difficulties with req. statistics course which also negatively affected thesis. 1 addtl. semester or portion required.
3. Ibrahim El Dukheri Make up of language/coursework defic. and effectively combining extension/economics requires addtl. semester.
4. Mustafa Rahma PhD program terminated due to prolonged project absence/rejection of thesis research by USU after repeated efforts to contact/work with student.
5. Ahmed El Wakeel El Wakeel was stranded in Sudan after coup; June '86 completion date required.
6. El Tigani El Amin Also stranded in Sudan by coup; also needs extension of 1 semester as per advisor's letter.
7. Gadelkarim Madibo Severe health problems (eyes) have slowed progress past yr; revision to Dec. 85 required.

APPENDIX F

SUMMARY OF SHORT-TERM ADVISORS

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APPENDIX F

LIST OF SHORT TERM ADVISORS

<u>ADVISOR</u>	<u>DATES</u>	<u>PURPOSE OF CONSULTANCY</u>	<u>PRIMARY/ CONTRIBUTING SPONSOR/S</u>
1. Dr. Anthony Hall, Professor Plant Physiology University of CA Riverside	9-23 to 10-10-84	Review Cowpea Research and Production Practices in El Obeid and Kadugli	Dry bean Cowpea CRSP
2. Dr. Don Dwyer, Department of Range Management, Utah State Univ.	9-13 to 9-29-84 11-20-84	Review of Range-Livestock Program and Monitor Ph.D. graduate student from Utah State	WSARP
3. Mr. Lynn McDonald, Agronomist, Wash. State Univ.	7-9 to 11-20-84	Consultant for the Pro- duction and Performance Evaluation of Hybrid Sorghum (Hageen Dura)	WSARP
4. Mr. Michael Mannion, Maintenance Officer	11-10 to 6-2-84	Facilities Maintenance and Operations Officer	WSARP
5. Dr. James Maguire, Professor of Agronomy and Soils, Wash. State Univ.	3-15 to 4-15-85	Production Processing and Storage of Seed with National Seed Administration and WSARP	Wash. State Univ.
6. Ms. Genevieve Smith, Deputy Project Coordinator, Wash. State Univ.	3-30 to 7-26-85	Assist in the Transition of Administrative Acti- vities in Khartoum	Wash. State Univ./CID WID/WSARP
7. Dr. Phil Wandschneider, Associate Professor of Agricultural Economics, Wash. State Univ.	6-5 to 6-16-85	To Assist in the Review of the Economics of Water Resource Management	Wash. State Univ.
8. Dr. Bill Symons, Associate Professor of Agricultural Engineering, Wash. State Univ.	7-1 to 8-15-85	Advisor on Assembly, Operation and maintenance of WSARP Farm Machinery	WSARP

- | | | | | |
|-----|--|-------------------|--|---------------------|
| 9. | Mr. Mark Speece,
Market Economist,
Wash. State Univ. | 7-3 to
8-15-85 | To Assist WSARP in the
Collection and Analysis
of Marketing and Other
Economic Data | WSARP |
| 10. | Dr. Brent Cluff,
Professor,
Univ. of Arizona | 7-4 to
7-12-85 | Review Water Conservation
Practices | Univ. of
Arizona |
| 11. | Dr. Thomas Trail,
Professor of
Adult & Cont.
Education and
Cooperative Extension,
Wash. State Univ. | 6-9 to
8-4-85 | Analysis and Recommend-
ations for Technology
Dissemination/Extension | WSARP |

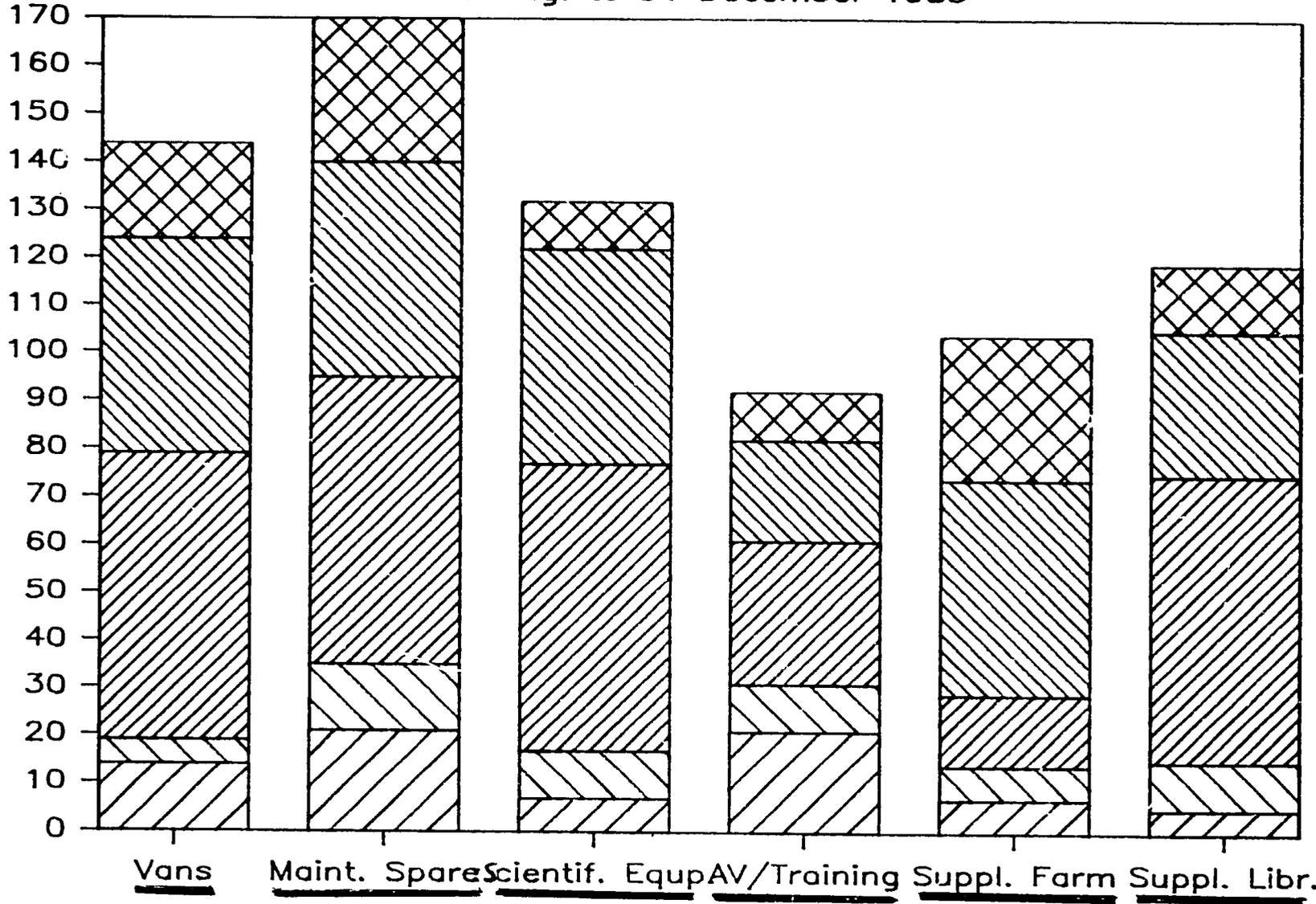
APPENDIX G

EQUIPMENT AND COMMODITY SCHEDULE

FINAL PROCUREMENT SCHEDULE

15 Aug. to 31 December 1985

Number of days from 15 Aug. 1985



Final Procurement Items

 A	 B	 C	 D	 E
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Finalize Orders Obtain Waivers	Place Orders	To Shipping/ Forwarding Agent	Shipping Time to Sudan	Shipping Time to Stations
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APPENDIX G
EQUIPMENT AND COMMODITY SCHEDULE

1985

APPENDIX H

LIST OF WSARP PUBLICATIONS

APPENDIX H

LIST OF WSARP PUBLICATIONS

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

LIST OF WSARP PUBLICATIONS - CONTINUED

<u>Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
15	Henson/Noel	Work Plan, Volume III: Research Plan for the Kadugli Research Station	Oct. 1982
16	Maguire	Review of Seed Program in Sudan	Oct. 1983
17	Krezdorn	Report of Visit to Sudan to Review Fruit Tree Research Program and Related Factors	Oct. 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
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

LIST OF WSARP PUBLICATIONS - CONTINUED

<u>Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
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	Patrick and Abu Sabah	The Sedentary Production System in the Nuba Mountains Area	Oct. 1984
31	Dwyer	Consulting Report: Range/Livestock Research Review and Recommendations	Oct. 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	Riley	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
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

LIST OF WSARP PUBLICATIONS - CONTINUED

<u>Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
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	WSARP 1984-85 Research Program Results - Vol. I. Summary of Kadugli Sedentary and Trans- humant Research Program Results	Oct. 1985
42	Woldetattios	WSARP 1985-85 Research Pro- gram Results - Vol. II. Sed- entary Production System Research Program Results Kadugli Station	In Press
43	Cook, Fadlalla, Bunderson	WSARP 1985-85 Research Pro- gram Results - Vol. III. Transhumant Production System Research Program Results, Kadugli Station	In Press
44	Riley	Final Report of Senior Advisor to the Director General/ARC	In Press
45	Arya	Some Aspects of Moisture De- pletion and Conservation in Goz Sands and Their Implica- tions for Improving Agronomic Practices and Land Use	In Press
46	Hall	The Role of Cowpeas in Agri- cultural Production Systems in Western Sudan	In Press
47	Cluff	El Obeid Water Supply/Water Harvesting Potential in Western Sudan	Oct. 1985
48	Bunderson	Final Report: Range-Livestock Research Results, 1984-85	In Press

LIST OF WSARP PUBLICATIONS - CONTINUED

<u>Number</u>	<u>Authors/Editor(s)</u>	<u>Title</u>	<u>Date</u>
49	Speece	Agricultural Marketing Structures and Marketing Constraints in Kordofan, Sudan: Recommendations for WSARP Research and Implementation	In Press
50	Trail	Extension Short-term Advisor Final Report: I. Strengthening Research/Extension Linkages in Kordofan Region and II. Extension in Darfur Region	In Press

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APPENDIX I

BUDGET/FINANCE SUMMARY

1. WSARP TECHNICAL ASSISTANCE BUDGET
2. CID/TRUST FUND SUMMARY
3. GOS
4. CONSTRUCTION BUDGET SUMMARY

APPENDIX I - PART 1

NSART TECHNICAL ASSISTANCE BUDGET

WSU Expenditures Through SEPT. 30, 1985, CID THROUGH JULY 31, 1985

(Projections Through Dec. 1985)

	EXPENDED TO 9/30/85	ENCUMBRANCES SEPT. 85	TOTAL EXPEND & ENC	TOTAL LOP (7)	BALANCE (THRU 7)
	-----	-----	-----	-----	-----
I. Salaries					
A. US Personnel					
1. Home Office Professional					
a. Coordinator					
b. Assoc. Coordinator					
I.A.1. Subtotal	282.179		282.179	291.1	8.9
2. Home Office Nonprofessional					
a. Secretary					
b. Hourly (Purch/Pouch, etc.)					
I.A.2. Subtotal	101.984		101.984	107.9	5.9
3. Field Staff Professional					
a. Deputy Proj Dir/COP					
b. Advisor to Dir. General					
c. Chief Admin. Officer					
d. Project Engineer					
e. Range Specialist					
f. Livestock Specialist					
g. Agricultural Economist					
h. Soil/Water Use Specialist					
i. Production Sys. Agronomist					
j. Socio-Economist					
k. Maintenance Officer					
I.A.3. Subtotal	1529.288		1529.288	1685.0	155.7
4. Field Staff Nonprofessional					
a. Admin. Assistant					
b. Research Associates					
c. Senior Secretaries					
I.A.4. Subtotal	226.602		226.602	242.8	16.2
I.A. SUBTOTAL	2140.053	0.000	2140.053	2326.8	186.7
B. Host Country Salaries (Not in Tech Asst; See Master Budget)					
WSU SUBTOTAL I.	2140.053	0.000	2140.053	2326.8	186.7
OTHER CID SUBTOTAL I.	220.564	0.000	220.564	109.0	-111.6
TOTAL I. SALARIES	2360.617	0.000	2360.617	2435.8	75.2

 **COP Salary was projected in WSU-LOP (through Year 7); but expended directly by CID; TOTAL I. SALARIES reflects correct overall balance.

Handwritten initials

	Expended Thru 9/30/85	Encumbrances SEPT. 85	Total Expens & Enc	Total LDP (?)	Balance (Thru ?)
II. Short-term Advisors					
A. Within U.S.					
2 ea in yrs 5/6 (3/4 mo ea)					
B. International					
1. Facil Maint (9 mo)					
2. Range Livestock (1 mo/vr) (Dwyer)					
3. Extension/Training (2 mo)					
4. Water Management/Harvesting (1 mo)					
5. Inventory/Stores (6 mo-vr5) (LaRocque)					
6. Station Development Specialist (1.5 mo)					
7. Administration (1 mo/vr)					
8. Library/Inform (1 mo)					
9. Socio-Econ/Marketing (1.5 mo)					
10. FSR Croo Spec (1 mo)					
11. Sci. Equip. Specialist (1.5 mo)					
12. Farm Equip. Specialist (1 mo)					
13. Evaluation (3 @ .75 mo vr 6)					
II.B. SUBTOTAL				118.4	118.4
WSU SUBTOTAL II.	67.313		67.313	124.6	57.3
OTHER CID SUBTOTAL II.	15.560		15.560	37.3	21.7
TOTAL II. SHORT TERM ADVISORS	82.873	0.000	82.873	161.9	79.0

III. Fringe Benefits					
A. Home Office	66.463		66.463	74.5	8.0
B. Field Staff	337.882		337.882	386.4	48.5
C. Short-term Advisors (On-Campus)	(Incl in A)		(Incl in A)		
D. Short-term Advisors (Field)	(Incl in B)		(Incl in B)		
WSU SUBTOTAL III.	404.345		404.345	460.9	56.6
OTHER CID SUBTOTAL III.	48.670		48.670	33.2	-15.5
TOTAL III. FRINGE BENEFITS	453.015	0.000	453.015	494.1	41.1

IV. Indirect Costs and G&A					
A. WSU On-campus	503.024		503.024	469.1	-33.9
B. WSU Off-campus	1523.709		1523.709	1914.9	391.2
IV.A. & B. SUBTOTAL	2026.733	0.000	2026.733	2384.0	357.3
C. Participant Training Long-term	(Incl above)		(Incl above)	25.2	25.2
D. Participant Training Sht-term	(Incl above)		(Incl above)	26.9	26.9
IV. C. & D. SUBTOTAL	(Incl above)		(Incl above)	52.1	52.1
IV.A-D WSU IDC SUBTOTAL	2026.733	0.000	2026.733	2436.1	409.4
E. Other Universities IDC	68.805		68.805	45.4	-23.4
IV.A-E. IDC WSU & OTHER U SUBTO	2095.539	0.000	2095.538	2481.5	386.0
F. CID G & A	981.799		981.799	1071.9	90.1
TOTAL IV. IDC AND G & A	3077.337	0.000	3077.337	3553.4	476.1

	Expensed Thru 9/30/85	Encumbrances SEPT. 85	Total Expensd & Enc	Total LOP (?)	Balance (Thru ?)
V. Travel and Transportation					
A. Travel Within the US					
1. Field Staff					
2. CID Planning					
3. Orientation/Recruitment					
a. Field Staff Long-term					
b. Field Staff Short-term					
V.A.3. Subtotal					
4. Short-term Advisors					
5. Coordinator & Staff					
V.A. SUBTOTAL OFF-CAMPUS	46.845		46.845	55.2	8.4
V.A. SUBTOTAL ON-CAMPUS	12.354		12.354	15.6	3.2
V.A. SUBTOTAL	59.199	0.000	59.199	70.8	11.6
B. International Travel					
1. Predeparture and Miscell.					
a. Field Staff LT					
b. Field Staff ST					
c. Coordinators					
V.B.1. Subtotal					
2. Field Staff					
a. Field Staff Prof to/ir post					
c. RAs to/iron post					
c. R&R					
d. Home Leave					
e. Emergency					
f. Conferences					
V.B.2. Subtotal					
3. Coordinator & Staff					
4. Field Admin Travel					
a. Project Director/DG ARC					
b. Dep Dir (Chief of Party)					
V.B.4. Subtotal					
5. Short Term Advisors					
6. Excess Baggage					
V.B. SUBTOTAL OFF-CAMPUS	245.723		245.723	315.3	69.6
V.B. SUBTOTAL ON-CAMPUS	64.979		64.979	56.6	-8.4
V.B. SUBTOTAL	310.702	0.000	310.702	371.9	61.2
C. Travel Within Sudan	36.060		36.060	49.9	13.8
D. Transport of Personal Effects					
1. Household Effects-Surface					
2. Household Effects-Air (Incls V.D.1)					
3. Consumables					
4. Vehicle					
V.D. SUBTOTAL	215.152		215.152	333.9	118.7
E. Storage of Household Effects	31.567		31.567	44.5	12.9
SUBTOTAL V. OFF-CAMPUS	575.347	0.000	575.347	798.8	223.5
SUBTOTAL V. ON-CAMPUS	77.333		77.333	72.2	-5.1
WSU SUBTOTAL V.	652.680	0.000	652.680	871.0	218.3
OTHER CID SUBTOTAL V.	9.909		9.909	13.2	3.3
TOTAL V. TRAVEL/TRANSPORTATION	662.589		662.589	884.2	221.6

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	Expended Thru 9/30/85	Encumbrances SEPT. 85	Total Expend & Enc	Total LOP (?)	Balance (Thru 7)
VI. Allowances.					
A. Post Differential					
25% Base Salary	337,480		337,480	383.8	46.7
A1. Separate Maint.	15,005				
B. Supplementary Post Allowance	3,289		3,289	3.3	.0
C. Post Allowance (Cost of Living)	34,211		34,211	53.7	19.5
D. Quarters					
1. Housing					
2. Utilities					
3. Security					
VI.D. SUBTOTAL	144,619		144,619	144.6	.0
E. Education, including travel	149,227		149,227	194.3	35.1
F. Temporary Lodging	8,610		8,610	11.6	3.0
G. Per Diem					
1. within US					
a. Field Staff					
b. CID Planning/Monitoring					
c. Orientation/Recruitment					
1) Field Staff Long-term					
2) Field Staff Short-term					
VI.G.1.c. subtotal					
d. Short-term Advisors US					
e. Coordinator and Staff					
VI.G.1. Subtotal					
2. International					
a. Field Staff					
1) US Field Staff to/fr Post					
2) RA's to/fr Post					
3) R & R					
4) Home Leave					
5) Emergency					
6) Conferences (US/Sudanese)					
VI.G.2.a. subtotal					
b. Coordinator and Staff					
c. Administrative Travel					
1) Proj Dir/Dir Gen ARC					
2) Dep Dir (COP)					
VI.G.2.c. subtotal					
d. Sht-term Advisors					
VI.G.2. Subtotal					
VI.G. SURTOTAL OFF-CAMPUS	74,467		74,467	121.7	47.2
VI.G. SUBTOTAL ON-CAMPUS	46,525		46,525	57.5	11.0
VI.G. SUBTOTAL	120,992	0.000	120,992	179.2	58.2
SUBTOTAL VI. OFF-CAMPUS	766,908		751,903	903.0	151.1
SUBTOTAL VI. ON-CAMPUS	46,525		46,525	57.5	11.0
NSU SUBTOTAL VI.	813,433	0.000	798,428	960.5	162.1
OTHER CID SUBTOTAL VI.	31,424		31,424	31.4	.0
TOTAL VI. ALLOWANCES	844,857	0.000	829,852	991.9	162.0

	Expenceo Thru 9/30/85	Encumbrances SEPT. 85	Total Expensd & Enc	Total LOF (7)	Balance (Thru 7)
	-----	-----	-----	-----	-----
VII. Other Direct Costs					
A. Local Leases/Rent					
1. Office Rent					
2. Proj Dir House Rent					
3. Guest House Rental					
VII.A. SUBTOTAL					
P. Utilities for Leased Facilities					
C. Security					
D. Office Support/Supplies					
1. In US					
2. In Sudan					
VII.D. SUBTOTAL					
E. Communications					
1. In US					
a. Postage, Telex, Phone					
b. Courier/Mail Freight					
VII.E.1. Subtotal					
2. In Sudan					
a. Postage, Telex, Phone					
b. Courier/Mail Freight					
VII.E.2. Subtotal					
VII.E. SUBTOTAL					
F. Library Materials					
G. Reports/Publications					
H. Insurance					
1. Liability WSU					
2. Medical Evacuation					
3. WSU Titled Vehicles					
4. Airplane Liability					
5. DBA (Projected-WSU; Paid-CID)					
VII.H. SUBTOTAL					
I. Computer and Library Services					
J. Orient, Language, Predepart					
K. Maintenance					
1. CID Housing/Gen Maintenance					
2. Office/Guesthouse Maintenance					
VII.K. SUBTOTAL					
L. CID House Generator Fuel					
M. CID Adv Planning Mtgs					
N. Fuel Contingency					
O. Other Direct Costs					
VII. SUBTOTAL OFF-CAMPUS	419.454		419.454	527.1	107.5
VII. SUBTOTAL ON-CAMPUS	46.552		46.552	84.0	37.4
WSU SUBTOTAL VII.	466.006	0.000	466.006	611.1	145.1
OTHER CID SUBTOTAL VII.	81.533		81.533	66.3	-15.2
TOTAL VII. OTHER DIRECT COSTS	547.539	0.000	547.539	677.4	129.9

VIII. EQUIPMENT, VEHICLES, MATERIALS/ SUPPLIES	Expended Thru 9/30/85	Encumbrances SEPT. 85	Total Expended & Enc	Total LGP (7)	Balance (Thru ?)
A. Vehicles					
1. Vehicle Purchase					
a. Pick-ups					
b. Vans					
c. Sedans					
d. Lorries					
e. Heavy Equipment					
VIII.A.1. Subtotal	589,040		589,040	609,053	20.0
2. Vehicle Spares	221,855	31,251	253,106	308,864	55.8
VIII.A. SUBTOTAL	810,895	31,251	842,146	917,917	75.8
B. Tractors/ Tractor Equipment	216,468	11,619	228,087	231,348	3.3
C. Non-tractor Farm Equipment	2,842		2,842	32,892	30.1
D. Maint/Shop (Vehic/Farm/Facilit)	113,169	0,058	113,227	127,061	13.8
E. Research/Scientific Equipment					
1. Equipment (06FE+038E)	351,740	33,843	385,583	424,989	59.4
2. Research Supplies	234,819	15,431	250,250	195,061	-55.2
VIII.E. SUBTOTAL	586,559	49,274	635,833	620,050	-15.8
F. Special Lab. Libr. Office Furn	51,672	15,248	67,920	119,417	51.5
G. Training, Inform. Liaison Equip	4,433	5,334	10,767	29,620	18.9
H. Air Conditioners	9,250		9,250	19,250	10.0
I. Duplicating Equipment	45,152		45,152	75,036	29.9
J. Typewriters/Office Equipment	53,913	1,308	55,221	21,775	-33.4
K. Generators	34,855		34,855	46,704	12.0
L. Radios	44,100		44,100	44,150	.0
M. Station Utility Spares	36,348		36,348	38,010	1.7
N. Household Furnishings/Equipment	210,248		210,248	210,452	0.2
O. Other Miscellaneous Supplies			0,000	10,000	10.0
P. Equipment Spares	104,164	36,420	140,584	152,602	12.0
VIII.A. Thru P. SUBTOTAL	2324,079	152,512	2476,591	2696,485	219.9
Q. Addti. Station Maintenance Spares	0,004	59,479	59,483	200,000	140.5
R. Force Account Dollars			0,000	0,000	0.0
VIII.A. Thru R. SUBTOTAL	2,324,083	211,991	2536,074	2896,485	260.4
S. Shipping					
1. Total for A. Thru P. Above			0,000	1192,015	1192.0
2. Total for G. + R. Above			0,000	102,000	102.0
VIII.S. SUBTOTAL	999,375	0,364	999,739	1294,015	294.3
SUBTOTAL > \$500 (No IDC)	1293,862		1293,862		
SUBTOTAL < \$500 (IDC @ 26.5%)	2029,596		2029,596		
WSU SUBTOTAL VIII.	3323,458		3323,458		
OTHER CID SUBTOTAL VIII.	0,351		0,351		
TOTAL VIII. EQUIP/VEHCL/MTLS/SUPPLS	3323,809	212,355	3323,809	4190,500	866.7
(Variable IC so est. that 50% of totals have IC @ 26.5%)					

	Expended Thru 9/30/85	Encumbrances SEPT. 85	Total Expend & Enc	Total LOP (7)	Balance (Thru 7)
IX. PARTICIPANT TRAINING/WORKSHOPS					
A. Long-term Trainees				546.3	546.3
B. Short-term Training/Workshops				159.5	159.5
TOTAL IX. (WSU ONLY)	513.650	0.000	513.650	705.8	192.2
PARTICIPANT TRAINING/WORKSHOPS					

	Expended Thru 9/30/85	Encumbrances SEPT. 85	Total Expend & Enc	Total LOP (7)	Balance (Thru 7)
X. Architecture and Engineering					
WSU SUBTOTAL X.					
CID SUBTOTAL X.	3059.668		3059.668	3406.4	346.7
TOTAL X. A & E	3059.668		3059.668	3406.4	346.7

GRAND TOTAL	14925.954	212.355	14910.949	17501.400	2590.6

KEY:

"Total LOP (7)" = Life of Project funding through 31 December 1985

"Balance (Thru 7)" = New balance thru Dec. 1985

APPENDIX I - PART 2

CID TRUST ACCOUNT BUDGET THROUGH AUGUST 1985

Figures given in LS X 1000

CATEGORY	*TOTAL LOP BUDGET (8/85)	**TOTAL LOP BUDGET (12/85)	EXPENDED THRU 8/85	BALANCE (AUGUST APPROVED BUDGET)	BALANCE (DEC. APPROVED BUDGET)
-----	-----	-----	-----	-----	-----
Salaries:					
Secretary	111.600	125.100	106.687	4.913	18.413
Hourly	35.000	98.000	57.111	-22.111	40.889
Consultants	17.000	22.000	13.800	3.200	8.2
Travel/Transportation:					
Car Rental/Taxi/Other	10.000	10.000	7.551	2.449	2.449
R and R/Home Leave	1.000	1.000	0.268	0.732	0.732
Emergency	4.800	4.800	2.925	1.875	1.875
Sr. Admin. to U.S.	2.900	3.900	2.872	0.028	1.028
Conferences/Meetings	16.000	21.000	12.324	3.676	8.676
Coord./Air Charter	120.000	160.000	110.220	9.780	49.78
Allowances:					
Quarters	366.000	396.000	381.298	-15.298	14.702
Utilities	30.000	33.000	33.079	-3.079	-0.079
Security	15.000	16.000	12.503	2.497	3.497
Maintenance	120.000	120.000	102.432	17.568	17.568
Temporary Lodging	25.000	30.000	14.629	10.371	15.371
Supplementary Post	4.000	5.000	2.870	1.130	2.13
Per Diem	60.000	60.000	77.877	-17.877	-17.877
Other Direct Costs					
In-country Communication	36.500	41.500	41.502	-5.002	-0.002
Office Incidental	3.000	3.250	4.005	-1.005	-0.755
Reports/Duplication	1.000	1.500	0.298	0.702	1.202
Clearing/Shipping	140.000	165.000	163.123	-23.123	1.877
Vehicle Insurance	12.000	12.000	5.811	6.189	6.189
Conference Expenses	15.000	55.000	13.110	1.890	41.89
Other Direct Costs	2.000	3.000	4.261	-2.261	-1.261
Karplen Contract	163.200	334.200	234.901	-71.701	99.299
Supple. Constr. Sup. Support	34.826	53.726	2.869	31.957	50.857
Purchase Lorries/Busses	175.000	173.000	173.000	2.000	0
AID Direct Expenditures	102.000	109.000	93.071	8.929	15.929
Exchange Loss	31.251	31.251	31.251	0.000	0
Contingency	100.000	100.000		100.000	100
	-----	-----	-----	-----	-----
TOTAL	1754.077	2188.227	1705.648	48.429	482.579

* Total Life of Project budget approved through August 1985

** Total Life of Project budget requested through December 1985

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APPENDIX I - PART 3

Government of Sudan

The World Bank

Quarterly Budget Summary

GOS BUDGET SUMMARY

March - June 1985

BUDGET CATEGORY	PL 480 L. CURRENCY	G.O.S. L. CURRENCY	W.B. L. CURRENCY	W.B. F. CURRENCY
Salaries and wages etc. in country	1,509,917	646,098		
Travel in country	240,202			
Goods and service in country	2,529,815	144,557		
Equipment & others	516,166			
Aircraft Purch.LS parts				2,394,278
Aircraft Operations		254,547	381,788	141,182
Construction CAT	407,303	817,609		3,674,743
Khidir and Draige	2,185,147	2,185,147		2,660,155
Non. Cont. Construction	1,418,108			
	8,806,658	4,047,958	381,788	8,870,358

APPENDIX I - PART 4
CONSTRUCTION BUDGET SUMMARY

GRUBE / ZIMMER : KARPLEN
Western Sudan Agricultural Research Project

MONTHLY PROGRESS REPORT

Date: Sept. 10, 1985 (For June, July, Aug, 1985)

A. <u>CONSTRUCTION COST STATUS</u> (LS)	EL OBEID	EL FASHER	GHAZALA	ARC HQ	TOTAL
1. Original contract amount	6,471,360.	3,006,105.	2,803,718.	426,036.	12,707,219.
2. Total variation orders	1,012,915.	458,116.	444,655.	19,637.	1,945,408.
3. Adjusted contract amount	7,484,275.	3,464,221.	3,248,373.	436,121.	14,632,990.
4. Total paid thru Cert # <u>21</u>	4,330,200.	1,951,568.	1,884,620.	385,336.	8,551,724.
5. Total remaining to be paid	3,154,075.	1,512,653.	1,363,753.	50,785.	6,090,818.
B. <u>CONSTRUCTION TIME STATUS</u> <u>IN CALENDAR DAYS</u>	EL OBEID	EL FASHER	GHAZALA	ARC HQ	
1. Original contract time	730	730	730	730	
2. Time extensions granted	168	168	168	0	
3. Adjusted contract time	898	898	898	730	
4. Time extension pending, est.	365	305	305	140	
5. Overrun beyond adjusted contract time, current	606	606	606	601	
6. Overrun beyond adjusted contract time, projected	241	301	301	461	
C. <u>CONTRACT COMPLETION DATE</u>	May 12, 84	Mar 31, 84	Mar 31, 84	Aug 7, 83	

Note: No payments processed during report period.

APPENDIX J

PROPOSED PROJECT EXTENSION

APPLICATION FOR CONTINUED SUPPORT OF THE
WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

I. INTRODUCTION

A. PROJECT HISTORY

The Western Sudan Agricultural Research Project (WSARP), a part of the Agricultural Research Corporation (ARC), was established and jointly funded by the World Bank, USAID, and the Government of Sudan (GOS) as a result of the high priority placed on the development of the Darfur and Kordofan Regions by the GOS.

An International Workshop on Agricultural Research and Development in Sudan, a Joint Team (U.S. and Sudanese) review of Sudanese Agricultural Research needs, and an independent World Bank study of agricultural research needs in Darfur and Kordofan resulted in reports that emphasized the potential for the West to contribute more to the economy of the nation. These studies recommended establishment of a research network in Western Sudan to develop and/or adapt technology needed to realize this potential. As a result, agreements were signed between GOS and WB and between GOS and USAID in 1978 to provide external funding for construction of research stations in Darfur and Kordofan, for the purchase and operation of an aircraft, for the provision of technical assistance, for degree and non-degree training, and for the purchase of commodities and equipment.

Under the WSARP, the Kadugli research station was renovated, and additional facilities at other locations constructed. The Kadugli station has been operational for over two years, while the other stations at El Obeid, El Fasher, Ghazala Gawazet and a Project Support/ARC Liaison Office in Khartoum are nearing completion. Delays in construction of these latter sites have been caused by a number of unforeseen and largely unavoidable factors. It is anticipated, however, that the construction will be completed by

August, 1985. Even though the El Obeid Station has not been completed, research activities are being successfully carried out at that site.

B. GEOGRAPHIC LOCATION AND AGRICULTURAL PRODUCTION

The Darfur and Kordofan Regions comprise about one-third of the land area of Sudan, with approximately one-third of the national population. The land and human resources are extensive with agricultural production by the traditional rainfed sector. Mechanized schemes also contribute to production in these regions.

During the last several years, the principal Sudanese exports have been cotton, groundnuts, livestock, sesame, millet, dura and gum Arabic. All of these commodities originate in the West, and with some, the West is the primary site of production. It is estimated that 20.4% of the national total production of sorghum is from Kordofan and Darfur; 89% of the millet, 48.8% of the groundnuts, 44.4% of the sesame, almost 76% of the gum Arabic, 66% of the cattle, 46% of the sheep, 52% of the goats and 68% of the camels are produced in the West. Livestock are produced almost exclusively by the traditional sector with the majority of the other commodities also produced by the traditional sector, although 41.9% of the sorghum and 15.7% of the sesame in Southern Kordofan are grown on mechanized schemes.

The rainfed sub-sector's contribution to net agricultural foreign exchange earnings grew from 57 to 81 percent from 1980 to 1982. In this regard, production of most of the commodities listed above, with the exception of cotton, was greater in the traditional sector than from either the irrigated or mechanized schemes (D'Silva, University of Khartoum). The contributions of the Western Regions to Sudan's agriculture are summarized in Appendix I.

C. CURRENT STATUS OF WSARP

The WSARP, is an integral part of the ARC, and is currently carrying out research to provide the information necessary to:

- improve agricultural production
- improve and/or to prevent degradation of the natural resource base
- provide information relevant to resource utilization to decision and policy makers
- improve the lives of the Sudanese people resident in the West and enhance the regional and national economic productivity

The Project's ability to contribute to the development of the region significantly will be augmented by the completion of the El Obeid, El Fasher and Ghazala Gawazet Stations.

The Project uses an inter-disciplinary systems approach which is producer oriented, taking into account the socio-economic environment in which the producer lives and works and the crops and live-stock which are produced. Constraints are defined and prioritized, as are potential interventions. Information drawn from a wide spectrum of sources, such as ARC, University of Khartoum, the International Agricultural Research Centers (CIMMYT, ICRISAT, ILCA, ICARDA, AVRDC and IITA) and the CRSPs as well as the Project's own findings are adapted to the producers needs for optimal acceptance. The WSARP research approach allows flexibility to meet evolving needs and to use developing information and technology to realize opportunities for significant impacts on production in both the short and long term. Thus, the WSARP is based upon solid disciplinary capabilities of its own and cooperating scientists is action oriented with the producer foremost in consideration is flexible to meet evolving needs and to use improved technology, and is geared to seize opportunities as they occur. In many ways it differs from traditional, research station oriented agricultural research programs, in that the needs, interests and capa-

bilities of the producers themselves, help to determine its programs and priorities. Improved technologies must be adopted by the producers or potential benefits will not be realized. The Project establishes priorities and focuses its activities based upon short and long-term goals, benefits and opportunities. The long-term time frame requires a close relationship and knowledge about project activities by COS and donors in such areas as infra-structure development. As an example, WSARP is currently conducting and will continue research on hybrid sorghum to determine the best package of inputs that can be recommended to the traditional or mechanized producers to enable them to increase production. A reliable source of quality seed is a prerequisite for a program using hybrid sorghum, because the traditional producer is oriented to saving seed for next year's crop. Therefore, the WSARP needs to be aware of steps being taken and their time frame to insure sufficient information is available to the traditional and mechanized farmer to maximize benefits from hybrid sorghum when the seed and other necessary inputs are available.

As a result of project research and collaborative efforts to date, several promising areas for further research are evident. Interventions with a high potential for impact are already being tested with cooperative farmers and pastoralists. The project has established a firm foundation on which to continue research in Kordofan and has begun preliminary planning for future activities in Darfur.

D. RATIONALE FOR CONTINUED SUPPORT

The preceding information indicates the present status and potential of rainfed agriculture in Western Sudan to contribute to the national economy and the current 6-year plan. In order for this potential to be fully realized, the crop and livestock

producers must have access to transportation, roads, seeds, fertilizers, seed dressing, vaccines and medicines, as well as facilities and services to meet human social needs. The above described infrastructure is an important requirement for the development of an effective agricultural research capability in the West, as previously noted as a goal by Government and donors in 1978. However, production increases are already possible under present circumstances, and the project research program is designed to capitalize on infrastructural improvements when they are available.

The WSARP research program has demonstrated promise. The Sudanese scientists are just beginning to return from advanced degree training. A few more years of technical assistance and support are needed to fully establish the research program to integrate returning trainees and to institutionalize the systems approach to solving the problems of farmers and pastoralists in Western Sudan.

The project has identified promising interventions which can bring about short-term benefits while fulfilling the long-term objective of achieving sustainable increases in production, while conserving the environment. These results reflect progress to date on the Project's major research thrusts which are:

- a. Achieving sustainable increases in agricultural production of selected major food and cash crops, in a manner that restores and/or maintains the natural resource base.
- b. Maximizing utilization of the limited water resources for agricultural purposes through harvesting and conservation.
- c. Increasing the complementarity of crop and livestock enterprises to increase the productivity of both.

Technologies identified as promising will be immediately tested under producers' own conditions and then recommended for extension to wider clientele groups. Those problems for which solutions are not evident will be referred to WSARP and ARC for selected on-station research activities. Recommendations to policy makers will be made for results which show high promise, but require infra-structural or policy changes for realization. Examples of promising preliminary results to date include the following:

- a. Phosphorus supplementation in sheep. This has great possibility in terms of improving productivity of sheep in the west. It is estimated that sheep production could be doubled by supplementation. Sheep are important as a commodity for local consumption, ready cash and export. In 1982 sheep and lambs were the third highest valued export commodity. There is not at present an adequate supply of appropriate phosphorous forms in Sudan for extension of this intervention. Facilitation of importation or development of local sources should be encouraged, at least on a trial basis.

- b. Nitrogen-phosphorus fertilization. There is considerable evidence that cereal, legume and forage crop production can be greatly enhanced by the minimal inputs of nitrogen and phosphorus fertilization. The optimal and most cost effective combinations for increased production under Western Sudan's conditions are under study now. The ability of the infrastructure to supply these needs, however, is limited. Therefore these studies have to depend upon the further development of a supportive infrastructure in order for the total benefits to be realized. The Project is examining alternative ways of increasing and/or maintaining soil fertility through use of appropriate crop rotations, incorporations of legumes in multiple cropping activities, etc. as well as investigating the optimal formulation of fertilizer itself for use in Western

Sudan. Such studies could contribute to the reduction or elimination of fallow periods and stabilize crop production.

- c. Seed dressing. The crop producers of Kordofan and Darfur are generally aware of the benefits from the use of anti-microbial seed dressing for seeds that are to be planted. Such products are very limited in availability, however, and this represents an area in which the private sector could provide low cost inputs that could impact favorably on crop production.

- d. Cultural practices. Studies have shown that production can be significantly increased by the incorporation of a package of practices which include improved varieties, planting dates, spacing, early and timely weeding to conserve moisture, etc. WSARP is developing such practices with low-input requirement for immediate application and generation of short-term benefits. Packages that include other inputs not yet consistently available to producers such as hybrid seed, fertilizer, seed dressing, etc; along with improved cultivar practices are being developed for the future. In this regard, it should be noted that the best combination of such practices appear to be highly site specific. This is due to both agro-ecological considerations and socio-economic factors which affect labor availability and market situations that determine economic viability. Evidence of the marked difference between appropriate interventions at El Obeid and Kadugli indicate that Darfur conditions could also be substantially different. This merits a reconnaissance study at an early opportunity.

- e. New varieties. A number of new varieties, especially the early maturing varieties which have a comparative advantage under below average rainfall conditions have shown to have potential for improving crop production. These are exemplified by the Sudan developed Gadam El Hamam and Dabar sorghum varieties and Ugandi millet which are early maturing varieties. Dabar is somewhat later in maturing than is Gadam El Hamam, but has better grain quality and

is more acceptable in terms of bread and assida preparation. Two other true breeding sorghum varieties from ARC/ICRISAT outperformed Gadam El Hamam and Dabar in 1983. These are being examined further and are definitely promising. Another potentially important contributor is the introduction of the hybrid Hageen Dura #1. The use of the new hybrid is dependent on a dependable annual source of seed which is not currently available in the West. Also, tests at the University of Khartoum and the Gezira Research Station have shown Hageen Dura #1 is highly susceptible to striga. Resistance to striga and/or the development of cultural practices to reduce infestation are also important considerations. WSARP is working on overcoming the striga problem in millet and sorghum in collaboration with the IDRC supported program at the ARC and University of Khartoum.

- f. Livestock supplementation. Project research has indicated that the lactation period in cattle can be doubled and milk production increased up to fourfold by the provision of a minimal amount of sesame cake as supplementation. This has the potential of improving food security for pastoral household consumption and increasing family income substantially through sale of lactic products, already a major commercial enterprise in the transhumant system. In addition, the resulting improved nutrition of young livestock can decrease mortality, and increase growth and maturation rates. With animal numbers and lactic product production less at risk, there is mounting evidence that market offtake can be dramatically increased. Other factors such as control of animal disease are also important. The project is currently analyzing the economics of sesame supplementation.
- g. Transportation and animal transport. Cooperative research is being carried out with the Animal Traction Project in Kadugli supported by the EEC. As a result of WSARP project activities to introduce bullock carts into the Nuba Mountain area, local farmers appear to be very receptive to the adoption of these carts which can provide

an important labor-saving device in terms of transport of commodities from the fields, of commodities to market, of water, and many other uses. An important labor constraint can be decreased. Economic studies are now underway. More rapid and effective transport can also open up parts of the clay plains to crop production access to which is currently prohibited by the long distance the villagers have to walk and transport produce on their heads.

- h. Livestock production in Southern Darfur and Kordofan. Livestock production in Southern Darfur and Kordofan is based primarily on a transhumant system with the livestock producers moving their animals out of the southern regions at the onset of the rains to escape mud, flies, etc. and to graze on the high protein grasses that appear on the northern range during the rainy season. The Project has carried out activities which indicate that the southern-most provinces have great potential for increased numbers of livestock produced. This is not being realized, however, because of the adverse impact of fire and because the animals are moved out of this region during the rains. Current research indicates, however, that many of these constraints to the year-round production of livestock in the south can be alleviated, thus increasing the potential for livestock production dramatically. High potential technologies to date include: seasonal mineral supplementation for large ruminants; seasonal control of external parasites, (especially in small ruminants); limited helminth control in young livestock; and the introduction of a dry season controlled grazing system for currently unutilized high potential areas in Southern Kordofan. Current results indicate that introduction of the grazing system alone would increase livestock biomass in Southern Kordofan by 30 to 45%. This could be increased by another 50 to 100% with the incorporation of some of the additional management improvements. A pilot study to test the introduction of the above recommendations is being planned in cooperation with the Regional government. If successful, policy reform for land

use in Southern Kordofan could result, with greatly increased livestock productivity and relief of damaging ecological pressures on northern ranges.

- i. Introduction of legumes into cropping systems. Initial studies have been conducted on the restoration of soil fertility using low input technology. Most promising appear to be the use of multiple purpose leguminous crops for intercropping and rotation. Cowpeas have been shown to be yield beneficial soil fertility results while producing desirable food crop and forage. Pigeon peas and mungbeans appear to offer a high potential alternative in some areas. Interventions such as these should be tested under both traditional and mechanized conditions in the West as the need for attaining increased production on a sustainable basis, while decreasing the current environmental damage by extensive farming practices is great.

Groundnuts, including several lines developed by ARC, have a high potential as a market commodity and yield a high quality forage by-product.

- j. Increasing water-use efficiency. WSARP is giving attention to the identification and testing of various technologies to harvest and conserve the limited water resources for optimal agricultural use. Those showing promise to date have included mulching, weeding and spacing trials. Also under consideration for 1985 are water harvesting to conserve jebel runoff in Southern Kordofan, and non-cracking clay/gardud runoff in Northern Kordofan and Southern Darfur. Although not being given priority to date by WSARP, there appear to be several readily applicable technologies for decreasing evaporation losses from hafirs.

In order to realize the benefits of the research to date, continued external support is necessary for the Project's full potential to be attained. Consequently, based on the results achieved to date and the potential impact the Project can have on agricultural production in the Darfur and Kordofan Regions,

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this request for a 2.4 year extension support for the WSARP is submitted. The Ministry of Finance and Planning, Ministry of Agriculture, Regional governments of Darfur and Kordofan and the ARC place a high priority on the continuation of this Project in its present form and request support from AID for an additional 2.4 years.

E. REQUIRED INPUTS

An outline of the types of required inputs over the next five years is as follows :

1. Degree Training

This is required for degree and non-degree training in specified subject (deficiency areas) as follows :

- (i) Animal Production (three)
- (ii) Economics/Biometrics (one)
- (iii) Soil and Water Conservation (two)
- (iv) Agricultural Economics (two)

2. Non-Degree Training in :

- (i) Animal Production
- (ii) Agricultural Production
- (iii) Crop Production
- (iv) Animal Traction
- (v) Horticultural Crop Production in Semi-Arid Regions
- (vi) Water Conservation and Use
- (vii) Agro-Forestry
- (viii) Planning and Management of Research
- (ix) Monitoring and Evaluation of Research
- (x) Range and Livestock Production
- (xi) Station and Vehicle Maintenance

3. Workshops, Conferences and Seminars

Travel for scientists to attend conferences, seminars and workshops in country and abroad. This also includes travel to International Research Centers to further strengthen linkages in areas of mutual interest.

4. Salaries - Expatriate Staff

Expatriate scientists are needed in the following disciplines (ARC does not have trained personnel in these disciplines) :

- i. Water Conservation and Use Specialist (2.4 years)
- ii. Economics/Biometrics (2.4 years)
- iii. Two Animal Production Specialists (2.4 years each)
- iv. Maintenance Specialists (2.4 years)

5. Consultants

A minimum of two consultants are needed per year. They are needed to provide advice and put forward suggestions in the disciplines of range-livestock production, farming systems, agro-forestry, agricultural economic, extension, agro-climatology and others.

6. Vehicles and Trucks

The Production Systems Research approach which is adopted by the Project requires continuous mobility for access to producer farms and herds. From our experience in this area, it is estimated that useful vehicle life in the West is four years. The vehicles are to replace present vehicles that will be written off. Vehicles with proven suitability to harsh conditions and cost effectiveness in terms of fuel consumption are preferred.

7. Equipment and Supplies (Including Shipping)

Additional equipment to augment and/or replace the present equipment as it wears out is needed. It is estimated that additional equipment

will be wearing out during the extension period and replacement will become a necessity.

8. Spare Parts

Spare parts are needed for maintaining the stations and farm equipment, (generators, tractors, etc.). These will be procured from overseas and shipped to Sudan.

9. Library Materials

Approximately 40 journals will be provided to the Central Library at El Obeid. About 200-300 books will be purchased annually. This library will serve as the primary agricultural reference source for the Project scientists and other agriculturalists in the Western Regions.

10. Other Costs (Communications and Other Costs)

Support is needed here to maintain and/or replace the present radio-telephone sets, to meet expenses to cover international communications and to pay other similar types of costs which require hard currency expenditure.

ESTIMATED BUDGET FOR ADDITIONAL 2.4 YEARS' SUPPORT FOR THE WSNRP

(Costs expressed in U.S. \$ X 1000)

All line items are inclusive of benefits, travel, allowances, and administrative costs.

I.	Training for Sudanese Scientists and Technical Personnel	
	A. Long-term degree training to the MS or PhD level 8 scientists at an average of 3 years each	415
	B. Short-term non-degree training - 10 scientists and 10 technicians each at 3 months	<u>296</u>
		711
II.	Workshops, Conferences and Seminars (in-country and international)	126
III.	Expatriate Technical Assistance and Backstopping	
	A. U.S. backstopping	271
	B. Long-term Field Personnel (9.6 person years)	1,843
	C. Short-term Consultants (2 per year at 1 month each)	<u>68</u>
		2,182
IV.	Vehicle and Lorries	
	A. Purchase of 12 vehicles (10 small pick ups or station wagons and 2 lorries)	190
	B. Spares and Shipping	<u>134</u>
		324
V.	Equipment and Supplies	
	A. Farm Equipment, Spares and Shipping	26
	B. Scientific Equipment, spares, supplies, and shipping	85
	C. Maintenance Equipment, Spares and Shipping (includes generators and station maintenance equipment)	118
	D. Office Equipment and Supplies, Spares and Shipping	<u>26</u>
		255
VI.	Library Materials (Books and Periodicals)	40
VII.	Other Costs (Communications, including operation of the radio network, and other hard currency costs)	<u>200</u>
	T O T A L	<u>\$US 3,838</u>

NOTE :

A line item for Architectural and Engineering supervisory services has not been included since the amount has not yet been determined.

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APPENDIX K

EXCERPTS FROM WSARP STATUS, ISSUES, AND RECOMMENDATIONS

APPENDIX K

EXCERPTS FROM WSARP STATUS, ISSUES, AND RECOMMENDATIONS

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT
STATUS, ISSUES, AND RECOMMENDATIONS

25 February 1985

Washington State University

Pullman, Washington, U.S.A.

EXECUTIVE SUMMARY

The Western Sudan Agricultural Research Project was originally designed and planned by the Government of Sudan (GOS), U.S. Agency for International Development (AID) and the World Bank (WB). Its purposes were to address Sudanese national and regional agricultural development needs and to tap the great agricultural potential for the rainfed traditional sector of the Western regions to contribute to the local, regional, and national economies and food requirements and well-being of the people of the Sudan. The Consortium for International Development (CID) contracted to provide technical assistance with Washington State University (WSU) as the lead institution with primary implementation responsibilities. In addition to technical assistance, AID also supports a part of the construction costs with the WB providing most capital development requirements along with the purchase and operation of a project aircraft. The GOS supports part of the construction, operations, and other needs.

The project is utilizing a unique approach for the design and implementation of research that is relevant to the Sudan and the rest of sub-Saharan Africa. Emphasis is placed interfacing national and regional production priorities with the producers socio-economic environment and capabilities in order to define needs and develop technology that is accepted by the producers and stresses short and long-term benefits. Research on producers' field and pastoralists' herds is emphasized. These efforts are interfaced and coordinated effectively with discipline and commodity research being carried out

by the Agricultural Research Corporation (the project's parent organization), and other national, regional, and international organizations.

Significant progress has been made to refine the agricultural research approach, to develop the necessary supportive infrastructure and to begin the research program. Results are beginning to accrue and relevant data and information are being used by producers and policy makers. Examples of the accomplishments and the validity of the approach are given in depth elsewhere in this presentation and include crop production, livestock production, marketing and related activities. Additional time and support are required, however, for further maturation and institutionalization of the research activities, staff, supportive infrastructure and approach. Needs and problems facing the project are delineated and recommendations to overcome them are presented.

WSARP represents a unique opportunity to test and implement evolving WB and AID strategies addressing food production in the sub-Saharan Africa. Examination of these strategies emphasize the validity of WSARP and the merits of the approach to impact food production in Sudan and elsewhere in a significant way.

SUDAN1/mew

Table 1
TOP TWELVE (BY VALUE) AGRICULTURAL COMMODITIES
EXPORTED FROM SUDAN
1982

RANK (BY VALUE)	COMMODITY	UNIT	QUANTITY	VALUE
				LS. 000's
1.	COTTON	BALES	450,064	121,130
2.	SORGHUM	M.T.	412,768	107,474
3.	SHEEP AND LAMBS	HEADS	560,412	59,053
4.	GROUNDNUTS	M.T.	179,641	53,554*
5.	SESAME	M.T.	76,373	42,864*
6.	GUM ARABIC	M.T.	27,595	38,279
7.	WATER MELON SEEDS	M.T.	42,210	13,678
8.	HIDES AND SKINS	M.T.	5,734	8,913
9.	CATTLE, CAMELS & GOATS	M.T.	17,394	3,115
10.	HARRICOT BEANS	M.T.	3,815	3,035
11.	KERKADEH	M.T.	2,973	2,658
12.	MILLET	M.T.	7,392	2,495

SUB TOTAL				456,248 (94.4%)
OTHER COMMODITIES				26,853 (5.6%)
<u>TOTAL</u>				<u>483,101 (100.0%)</u>

* INCLUDES SEEDS, CAKE, OIL AND MEAL

- SOURCES: 1. APPENDIX III SUDAN FOREIGN TRADE EXPORTS BY COMMODITY 23RD. ANNUAL REPORT, BANK OF SUDAN MARCH 1983.
2. SUDAN GUIDE 1983 - 1984 PLANNING AND MANAGEMENT CONSULTANCY, KHARTOUM

JJR 11 APR. 84

Revised 30 Jan. 85

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT
Status, Issues, and Recommendations

A. Purpose of Presentation

The Western Sudan Agricultural Research Project (WSARP) is jointly funded by USAID, the World Bank and the Government of Sudan. The project has been underway since the AID contract was signed with the Consortium for International Development (CID) in August, 1979. Washington State University (WSU) has had primary implementation responsibilities within CID. During the ensuing time period, the project has made significant progress, but has also encountered problems that have delayed the reaching of its maximum potential. Regardless of this, as indicated by a recent in-country AID research evaluation and by previous evaluations by AID and the World Bank, WSARP has made notable accomplishments and has the potential for making important contributions to Sudan and to Sub-Saharan Africa.

The current AID contract is to be completed on August 14, 1985. This is occurring at a critical time in the project's evolution. This information is provided for the following purposes:

1. To summarize project strategy and the relationship of the present and projected activities with current and projected USAID and World Bank (WB) development strategies.
2. To define project status and accomplishments.
3. To define the requirements for long term sustainability and success of the project.

Bb

4. To address recurrent costs needs and mission projections for same.
5. Provide recommendations for decisions being made regarding the project's future.

B. Project Strategy and Relation to USAID and WB Development Strategies

1. WSARP History and Strategy

A brief summary of the history of the project, followed by a review of project strategy and the interface of project strategy with USAID and the World Bank strategies will be presented.

An International Workshop on Agricultural Research and Development in Sudan, a Joint Team (U.S. and Sudanese) review of Sudanese Agricultural needs, and an independent World Bank study of agricultural research needs in Darfur and Kordofan resulted in reports that emphasized the potential for Western Sudan to contribute more to the economy of the nation. These studies recommended the establishment of a research network in Western Sudan to develop and/or adapt technology needed to realize this potential. These reports coincided with a Government of Sudan (GOS) decision to emphasize the rainfed sector and the development of the West. As a result, agreements were signed between GOS and WB and between GOS and USAID in 1978 to provide for external funding for construction of research stations in Darfur and Kordofan, for the purchase and operation of an aircraft, for the provision of technical assistance, for degree and

non-degree training, and for the purchase of commodities and equipment.

Under the WSARP, the Kadugli research station was renovated and new facilities added. Facilities at other locations were designed and a contract for construction was signed. The Kadulgi station has been operational for slightly over two years, while the other stations at El Obeid, El Fasher, Ghazala Gawazet and a Project Support/ARC Liaison Office in Khartoum are nearing completion. Delays in construction of these latter sites have been caused by a number of unforeseen and largely unavoidable factors. It is anticipated, however, that the construction will be completed by August, 1985. Even though the El Obeid Station has not been completed, research activities are being successfully carried out at that site.

The Darfur and Kordofan Regions comprise about one-third of the land area of Sudan, with approximately one-third of the national population. The land and human resources are extensive with agricultural production primarily by the traditional rainfed sector. Mechanized schemes also contribute to production in these regions.

During the last several years, the principal Sudanese exports have been cotton, sorghum, livestock, groundnuts, sesame, gum Arabic, and millet (See Table 1). All of these commodities originate in the West, and with some, the West is the primary site of production. It is estimated that 20.4% of the national total production of sorghum is from Kordofan and Darfur; 89% of the millet; 48.8% of the groundnuts; 44.4% of the sesame; almost 76% of the gum Arabic; 66% of the cattle; 46% of the sheep; 52% of the goats; and

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68% of the camels are produced in the West. Livestock are produced almost exclusively by the traditional sector, although 41.9% of the sorghum and 15.7% of the sesame in Southern Kordofan are grown on mechanized schemes.

The rainfed sub-sector's contribution to net agricultural foreign exchange earnings grew from 57 to 81 percent from 1980 to 1982. In this regard, production of most of the commodities listed above, with the exception of cotton, was greater in the traditional sector than from either the irrigated or mechanized schemes (D'Silva, University of Khartoum).

The WSARP is an integral part of the ARC and is currently carrying out research to provide the information necessary to:

- improve agricultural production
- improve and/or prevent degradation of the natural resource base
- provide information relevant to agricultural production and resource utilization to decision and policy makers
- improve the lives of the Sudanese people resident in the West and enhance the regional and national economies.

The Project uses an interdisciplinary systems approach which is producer-oriented, taking into account the socio-economic environment in which the producer lives and works and the crops and livestock which are produced. Constraints are defined and prioritized, as are potential interventions. Information drawn from a wide spectrum of sources, such as ARC, University of Khartoum, the International Agricultural Research

Centers (CIMMYT, ICRISAT, ILCA, ICARDA, AVRDC and IITA) and the CRSPs as well as the Project's own findings are adapted to the producers' needs for optimal acceptance. The WSARP research approach allows flexibility to meet evolving needs and to use developing information and technology to realize opportunities for significant impacts on production in both the short- and long-term. Thus, the WSARP research approach is based upon solid disciplinary capabilities of its own and cooperating scientists; is action oriented with the producer foremost in consideration; is flexible to meet evolving needs and to use improved technology; and is geared to seize opportunities as they occur. This approach differs from more traditional, research station-oriented agricultural research programs in that the needs, interests and capabilities of the producers themselves help to determine the programs and priorities. Improved technologies must be adopted by the producers or potential benefits will not be realized. The Project researchers establish priorities and focus activities based upon short- and long-term goals, benefits and opportunities. The long-term time frame requires a close relationship and knowledge about development activities by GOS and donors in such areas as infrastructure development, involvement of the private sector, etc.

Information generated by project research is being provided to regional and national planners and decision makers. The project represents a regional resource that can be utilized as a part of the total development effort for Western Sudan and the entire country.

As pointed out earlier, the rainfed sector of Sudan has high potential for increased production. The traditional rainfed sector has outperformed the

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mechanized schemes in recent years, and has great potential for improvement with minimal foreign exchange inputs. However, the availability of additional inputs may in the short-term require foreign exchange components in order for production increases to be realized. These latter inputs in the short-term may be most effectively provided through donors, and ultimately by the private sector.

Western Sudan is the largest part of the rainfed sector in Sudan, and has still received the least amount of assistance. It therefore has the highest untapped potential. There are four major ecological zones, each of which has some similarities and also considerable differences. Research at Kadugli has shown that concurrent and interrelated different systems exist in Southern Kordofan. Interventions directed to increased production have proven to be specific to the ecological environment in the production systems. This has been recognized in successful research efforts in the U.S. and in India, Turkey and other developing countries, as well as Sudan. Indications are that the most effective research programs focus on the comparative advantages and individualities of ecological zones, but at the same time capitalize on similarities to minimize duplication. In Western Sudan, a focus of activity in each of the four ecological zones has great merit. This was the premise upon which the original design of the project was based and resulted in the definition of four research stations in the West.

Research to date has shown that traditional producers in Western Sudan are highly commercially oriented, but must first meet their food security needs before addressing the market place. In most production systems operating in Western Sudan, including the

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mechanized schemes, production of market crops cannot be considered in isolation from subsistence. Crop and livestock enterprises are closely integrated in all systems. Evidence to date indicates that improved complementarity of these enterprises will lead to greater overall increases in production, and can also lead to environmental protection and improvement. Thus, in order to increase production of desirable market crops and livestock, research must sometimes be done on related enterprises and problems which constrain ultimate desired production increases. It is not always cost effective to base research activities on preconceived notions of what is likely to be the best technology to maximize production of a single commodity. Decades of experience in the Sudan with cotton, sorghum and groundnut production on mechanized schemes, and elsewhere in the world, have clearly demonstrated the fallacy of a "quick fix". Short-term increases in production have not only been marginally cost effective and nonsustainable, but in some instances have led to massive environmental degradation.

The project is pioneering a new way of planning and implementing research in Sudan. This approach melds regional and national production priorities with the socio-economic environment of the producers and interfaces with commodity and discipline research carried out on research stations and by other organizations. It also utilizes effective researcher-extension linkages and capitalizes on the producers' own capacities to disseminate successful technologies, especially important where extension resources are limited. The best technology is worthless if the producers cannot or will not make use of it. The ARC has long had a cadre of highly trained

scientists, with both disciplinary and commodity specialization. However, resources in the Sudan and elsewhere have been spent in developing and testing technologies under research station conditions which are not transferable to the producer. The WSARP has introduced the concept that the scientists have a direct responsibility to focus the resources available for research on those technologies which have the highest potential for impact under present and projected future producer conditions. Thus, the groundwork can be laid for further long-term improvements. Project scientists must work together to screen out approaches and research activities that are superfluous, and concentrate resources and efforts on those few important areas of research that have the greatest potential for payoff (optimal ignorance). The ARC has specialized commodity and discipline-oriented capabilities that can very effectively interface with the WSARP producer-oriented approach. The emphasis on adaptive research on the producers' fields and in herds synergistically relates with project research station efforts, with ARC capabilities, with international agricultural research centers, and other organizations and is the most effective way of utilizing limited resources for optimal gain.

2. Relationship of Project Strategy With That of USAID and the World Bank

Several years ago the Africa Bureau developed and distributed a development strategy for Africa. Recently, a draft revision of this strategy was incorporated into a plan for supporting agricultural research and faculties of agriculture in Africa. Addressed in the draft document is an effort by USAID and other donors to coordinate long-term sustainable

development efforts that emphasizes donor cooperation and coordination in sharply focused efforts. These efforts will be supported in selected countries and will attempt to utilize zonal networks which will link national systems, international agricultural research centers, regional research programs, CRSPs, and other related endeavors. The proposed strategy is directed to circumvent or minimize the adverse physical environment and climate in Africa that has negatively impacted agricultural development, to overcome government policy inadequacies that play a crucial role in agricultural production and to improve administrative capacity for planning and implementing development strategies after relevant ones evolve. The basic institutions required to sustain agricultural development will be addressed since they are weak in most countries in Sub-Saharan Africa. Inherent in all of these considerations and activities is the need for a cadre of trained personnel that can implement appropriate technologies that are either present or will be forthcoming from the research emphasis. Selected countries will be emphasized, with Sudan being one of those countries with the necessary cadre of trained professionals, existing institutions, and a high potential as defined in the draft position paper.

The World Bank published a document on development in Sub-Saharan Africa in August, 1984, entitled "Toward Sustained Development in Sub-Saharan Africa -- A Joint Program of Action". This document defines long-term development constraints as population increases, and inadequate health, education, human resources (as related to more effective planning, policies and management, etc), agricultural research, and conservation.

The World Bank discussion of the inadequacies and needs for agricultural research indicate a failure to provide adequate support for producers of both food and export crops. Emphasized are more effective use of existing research capacity; strategies that raise the returns to agricultural production and give a high priority to support services; the potential for regional efforts; the need for increased, long-term financial support for research; adaptive research emphasizing the whole system of farming and the sustainability of the land; and the need for major research on new crop varieties, techniques for soil moisture conservation, land use, livestock diseases and systems and agro-forestry.

Examination of the previous USAID strategy, the present draft statement of AID Africa Bureau strategy, and the recent World Bank strategy document indicates that the WSARP strategy and approach fits well with all three. The project has in the past and will continue in the future to address institutional development, research, training and the development of high impact technology emphasizing selected, strategic commodities and interactions. A systems approach that emphasizes adaptive research is being applied to focus and interface with more conventional commodity and disciplinary research activities and to provide relevant information to agricultural policy makers. Important consideration is being given to land and water conservation, livestock systems, crop varieties and agro-forestry. This has been the orientation of the project from the outset and is being gradually accepted within ARC.

The necessary project infrastructure has been developed and most elements are now in place to meet the needs of such an approach. Promising research results are

already forthcoming. Continued support over the next several years will ensure the maturation and institutionalization of the approach and its support structure. In this regard, it has been proposed by the project that the project, AID, ARC, World Bank, CID/WSU and other relevant individuals and organizations come together to agree on project long-term support and to establish needs and priorities. Such a coordinated effort would be in agreement with World Bank and USAID strategies.

C. Project Status and Accomplishments

1. Construction Program

The Mission has questioned whether AID will support the completion of construction of El Fasher and Ghazala Gawazet, even though construction support of these stations, plus El Obeid and the Project Support Office in Khartoum, is co-financed by the World Bank (75% World Bank and 25% AID). The construction program as delineated in the WB and AID documentation, including the PP and PP Amendment, indicated the construction of research stations at 4 sites in the West (Kadugli, El Obeid, El Fasher and Ghazala Gawazet) and an ARC liaison and project support office in Khartoum. Principal justification was based upon site-specific research needs and a requirement to provide living, working, and support facilities which would enable the project to attract and retain scientists and technical staff to live and work in the West. In recent months, the project construction program has been stated by the Mission to be excessive and characterized as a housing project.

The construction program, except for Kadulgi, is considerably behind schedule for reasons defined in the Fourth and Fifth Year Annual Reports. These delays have delayed full development of the research program. The cost of the construction, unlike a number of other projects in Sudan, has remained within the original estimates and budget, except for the A&E costs. The latter have escalated due to the longer duration of the supervisory services required.

The Mission recently commissioned a construction value assessment, which has now been completed. The report commends the quality of the construction, reiterates the causes for the delays and recommends that the project, donors and contractor work closely to remedy the causes of the delays. In addition, discussions and planning activities involving the contractor, the A&E firm (Grube-Zimmer, inc), Mission representatives (project officer, engineer and assistant engineer), and World Bank representatives have recently been completed (February 1985). The results indicated satisfaction with the quality of the construction, a completion date of August 1985, and that construction on all stations should proceed without delay. It is our understanding that the latter is the recommendation of the Mission engineer.

2. Research Program

The research program is in its early evolution and will require further support and guidance for it to realize its full potential.

The preceding information indicated the present status and potential of rainfed agriculture in Western Sudan to contribute to the national economy and the current

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6-year plan. In order for this potential to be fully realized, the crop and livestock producers must have access to transportation, roads, seeds, fertilizers, seed dressing, vaccines and medicines, as well as facilities and services to meet human social needs. The above described infrastructure is an important requirement for the development of an effective agricultural research capability in the West, as previously noted as a goal by Government and donors in 1978. However, production increases are already possible under present circumstances, and the project research program is designed to capitalize on infrastructural improvement as they become available.

The WSARP research program has demonstrated accomplishments and potential. The Sudanese scientists are just beginning to return from advanced degree training. Additional years of technical assistance and support are needed to fully establish the research program to integrate returning trainees and to institutionalize the systems approach to solving the problems of farmers and pastoralists in Western Sudan.

The project has identified promising interventions which can bring about short-term benefits while fulfilling the long-term objective of achieving sustainable increases in production, and conserving and improving the environment. These results reflect progress to date on the Project's major research thrusts, which are:

- a. Achieving sustainable increases in agricultural production of selected major food and cash crops, in a manner that restores and/or maintains the natural resource base.

- b. Maximizing utilization of the limited water resources for agricultural purposes through harvesting and conservation.
- c. Increasing the complementarity of crop and livestock enterprises to increase the productivity of both.

Technologies identified as promising are being immediately tested under producers' own conditions and then recommended for extension to wider clientele groups. These currently emphasize low inputs, especially those requiring foreign exchange. Those problems for which solutions are not evident will be referred to WSARP and ARC for selected on-station research activities. Recommendations to policy makers will be made from results which show high promise, but require infrastructural or policy changes for realization. Examples of promising preliminary results to date include the following:

- a. Phosphorus supplementation in sheep. This has great possibility in terms of improving productivity of sheep in the West. It is estimated that sheep production could be doubled by supplementation. Sheep are important as a commodity for local consumption, ready cash and export. In 1982 sheep and lambs were the third highest value export commodity. There is not at present an adequate supply of appropriate phosphorus forms in Sudan for extension of this intervention. Facilitation of importation or development of local sources should be encouraged, at least on a trial basis.

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- b. Nitrogen-phosphorus fertilization. There is considerable evidence that cereal, legume and forage crop production can be greatly enhanced by the minimal inputs of nitrogen and phosphorus fertilization. The optimal and most cost effective combinations for increased production under Western Sudan's conditions are under study now. The ability of the infrastructure to supply these needs, however, is limited. Therefore, these studies have to depend upon the further development of a supportive infrastructure in order for the total benefits to be realized. The Project is examining alternative ways of increasing and/or maintaining soil fertility through use of appropriate crop rotations, incorporation of legumes in multiple cropping activities, etc., as well as investigating the optimal formulation of fertilizer itself for use in Western Sudan. Such studies could contribute to the reduction or elimination of fallow periods and stabilize crop production.
- c. Seed dressing. The crop producers of Kordofan and Darfur are generally aware of the benefits from the use of anti-microbial seed dressing for seeds that are to be planted. Such products are very limited in availability, however, and this represents an area in which the private sector could provide low cost inputs that could impact favorably on crop production.
- d. Cultural practices. Studies have shown that production can be significantly increased by the incorporation of a package of practices which include improved varieties, planting dates, spacing, early and timely weeding to conserve

moisture, etc. WSARP is developing such practices with low-input requirement for immediate application and generation of short-term benefits. Packages that include other inputs not yet consistently available to producers such as hybrid seed, fertilizer, seed dressing, etc., along with improved cultural practices, are being developed for the future. In this regard, it should be noted that the best combination of such practices appear to be highly site-specific. This is due to both agro-ecological considerations and socio-economic factors which affect labor availability and market situations that determine economic viability. Evidence of the marked difference between appropriate interventions at El Obeid and Kadugli indicate that in Darfur, conditions could also be substantially different. This merits a reconnaissance study at an early opportunity.

- e. New varieties. A number of new varieties, especially the early maturing varieties which have a comparative advantage under below average rainfall conditions, have shown to have potential for improving crop production. These are exemplified by the Sudan-developed Gadam El Hamam and Dabar sorghum varieties and Ugandi millet which are early maturing varieties. Dabar is somewhat later in maturing than is Gadam El Hamam, but has better grain quality and is more acceptable in terms of bread and assida preparation. Two other true breeding sorghum varieties from ARC/ICRISAT outperformed Gadam El Hamam and Dabar in 1983. These are being examined further and are definitely promising. Another potentially important contributor is the

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introduction of the hybrid Hageen Dura #1. The WSARP will continue to test this hybrid, and has provided a short-term advisor from the U.S. private sector to assist with seed production. The use of the new hybrid is dependent on a dependable annual source of seed which is not currently available in the West. Also, tests at the University of Khartoum and the Gezira Research Station have shown that Hageen Dura #1 is highly susceptible to striga. Resistance to striga and/or the development of cultural practices to reduce infestation are also important considerations. WSARP is working on overcoming the striga problem in millet and sorghum in collaboration with the IDRC-supported program at the ARC and the University of Khartoum.

- f. Livestock supplementation. Project research has indicated that the lactation period in cattle can be doubled and milk production increased up to fourfold by the provision of a minimal amount of sesame cake as supplementation. This has the potential of improving food security for pastoral household consumption and increasing family income substantially through sale of lactic products, already a major commercial enterprise in the transhumant system. In addition, the resulting improved nutrition of young livestock can decrease mortality, and increase growth and maturation rates. With animal numbers and lactic product production less at risk, there is mounting evidence that market offtake can be dramatically increased. Other factors such as control of animal disease are also important.

- g. Animal-provided Transport. Cooperative research is being carried with the Animal Traction Project in Kadugli supported by the EEC. As a result of WSARP project activities to introduce bullock carts into the Nuba Mountain area near Kadugli, local farmers appear to be very receptive to the adoption of these carts which can provide an important labor-saving device for transport of commodities from the fields, of commodities to market, of water, and many other uses. An important labor constraint can be decreased. Economic studies are now underway. More rapid and effective transport can also open up parts of the clay plains to crop production to which access is currently prohibited by the long distance the villagers have to walk and transport produce on their heads.
- h. Livestock production in Southern Darfur and Kordofan. Livestock production in Southern Darfur and Kordofan is based primarily on a transhumant system with the livestock producers moving their animals out of the southern regions at the onset of the rains to escape mud, flies, and diseases; to graze on the high protein grasses that appear on the northern range during the rainy season; and to access livestock and milk markets in the north. Studies on possible means to redirect or limit this migration are ongoing. The Project has carried out activities which indicate that the southern-most provinces have great potential for increased numbers of livestock produced. This is not being realized, however, because of the adverse impact of fire and because the animals are moved out of this region during the rains. Current research indicates, however, that many of

these constraints to the year-round production of livestock in the south can be alleviated, thus increasing the potential for livestock production dramatically. High potential technologies to date include: seasonal mineral supplementation for large ruminants; seasonal control of external parasites (especially in small ruminants); limited helminth control in young livestock; and the introduction of a dry season controlled grazing system for currently unutilized high potential areas in Southern Kordofan. Current results indicate that introduction of the grazing system alone would increase livestock biomass in Southern Kordofan by 30 to 45%. This could be increased by another 50 to 100% with the incorporation of some of the additional management improvements. A pilot study to test the introduction of the above recommendations is being planned in cooperation with the Regional government. If successful, policy reform for land use in Southern Kordofan could result in greatly increased livestock productivity and relief of damaging ecological pressures on northern ranges. The input-high return interventions discussed above show great promise.

- i. Introduction of legumes into cropping systems. Initial studies have been conducted on the restoration of soil fertility using low input technology. Most promising appear to be the use of multiple purpose leguminous crops for intercropping and rotation. Cowpeas have been shown to yield beneficial soil fertility results while producing a desirable food crop and forage. Pigeon peas and mungbeans appear to offer a high potential alternative in some areas.

Interventions such as these should be tested under both traditional and mechanized conditions in the West as the need for attaining increased production on a sustainable basis, while decreasing the current environmental damage by extensive farming practices is great. Groundnuts, including several lines developed by ARC, have a high potential as a market commodity and yield a high quality forage by-product.

- j. Increasing water-use efficiency. WSARP is giving attention to the identification and testing of various technologies to harvest and conserve the limited water resources in Western Sudan for optimal agricultural use. Those showing promise to date have included mulching, weeding and spacing trials. Also under consideration for 1985 are water harvesting to conserve jebel runoff in Southern Kordofan and non-cracking clay/gardud runoff in Northern Kordofan and Southern Darfur. Although they have not been given priority to date by WSARP, there appear to be several readily applicable technologies for decreasing evaporation losses from hafirs.

In conducting its research program, WSARP has established ongoing cooperative efforts with the IARCs, CRSPs, projects funded by the World Bank and other donors and Sudanese organizations. Effective inter-relationships have been established with the regional governments of Kordofan and Darfur. Thus, cooperation and coordination of efforts have been emphasized.

The project has been continuously monitored by CID/WSU and by the donors. These efforts and the

mid-project external evaluation are described in the Year 4 and Year 5 Annual Reports. A number of recommendations were forthcoming from the mid-project evaluation which were subsequently addressed by the project and CID/WSU. Most of these recommendations have been satisfactorily met, while others have not due to factors taht are beyond the control of CID/WSU and the project.

In addition, the AID Mission contracted for an external evaluation completed in August, 1984. The evaluation report was very supportive of the project's activities, and recommended that support for the present project be extended for an additional five years.

3. Staffing

Sudanese scientists to fill most of the projected scientific positions in WSARP have been identified, some are still in training and a growing number have returned to the project. These individuals have received excellent training, but are inexperienced in the design and conduct of research, especially as being conducted by WSARP. Because of this, TA inputs by experienced U.S. research scientists are needed. This represents one reason for the extension of the current TA activities.

Additional scientists and technicians are required and must be recruited and retained. Uncertainty about future project support influenced by rumours and a lack of communication and coordination between donors and the project have adversely impacted not only recruitment of scientific and technical staff, but also the effectiveness of all associated with the project.

A climate of adversity instead of mutual trust and understanding has been created.

WSARP has had difficulty in hiring technical and trained support staff to live and work in the West. The completion of the research stations, continued donor support, continued development and implementation of a training plan, and internal project training capability will also assist in meeting these staff needs.

U.S. T.A. staff have provided program continuity unusual in most AID projects. Some staff are now in their third tour. Several non-project funded short-term TA inputs have been supported by WSU and other CID universities under the auspices of the strengthening grants and WSU's MOU agreement with USAID, and by university funds.. Additional TDY's would strengthen the research program.

The Mission has recently proposed the immediate elimination of positions for the Senior Research Advisor, the Project Engineer, and the elimination in April of the Administrative Officer position. Since the former two individuals hold AID-approved contracts through 14 August, 1985, and the project will be responsible for salary continuation until that date, this does not seem economically reasonable. In addition, both individuals have nearly five years of experience in their positions in Sudan, and would be invaluable in the training of successors. The administrative position is absolutely essential during the next 6 critical months, when arriving equipment must be cleared, inventoried, and an orderly transfer made of administrative activities to El Obeid and the

new Khartoum office. CID/WSU cannot function without this position adequately staffed.

4. Requirements for Project Success and Sustainability

CID/WSU is concerned about the sustainability of the project beyond the current technical assistance contract, and the smooth and efficient phase down of both dollar and local currency support from the donors. CID/WSU is also concerned about the availability of resources, both human and monetary, to carry out the CID/WSU responsibilities to the end of the contract period. These latter needs are included in the contract. Proposed elimination of the three positions (mentioned above) would jeopardize contract effectiveness. CID/WSU and the Project, through Dr. Dafalla, have indicated that continuation of these positions through August 1985 is necessary. Little monetary savings will be realized and the rationale that elimination of the positions will force the GOS to assume more project responsibility is inconsistent with present project needs and time constraints. CID/WSU is also anxious to work with the donors to assist in the transition from the present contract to an extension, if such occurs.

The following are viewed as essential for long-term project success and sustainability:

- a. Continued donor support over an extended period as articulated in both WB and AID development strategies. The recent external evaluation of the project recommended continued support for an additional five years.

- b. Development and implementation of a strategy involving both central government through the ARC and regional governments for long-term support of the recurrent costs.
- c. Effective project administrative and support capabilities and infrastructure.
- d. Establishment of a stable work environment and funding that are conducive to the recruitment and retention of scientists and technical staff.
- e. Time and activities directed to the integration of returning scientists into the project philosophy and program and for their maturation as established researchers.
- f. Hiring and training of additional scientists and technical staff.
- g. Effective prioritization and conduct of research.
- h. Interface of project activities effectively with other development activities in the West.
- i. Coordination of project activities with the ARC activities, other Sudanese organizations, other projects, IARCs and other national and international organizations.
- j. Mechanisms for dissemination of research findings to the producers through cooperation and coordination with regional and national extension efforts and the private sector.

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APPENDIX L

LIST OF WSARP ACRONYMS AND ABBREVIATIONS

LIST OF ACRONYMS AND ABBREVIATIONS FOR WSARP PUBLICATIONS

Acronym or Abbreviation	Organization or Meaning
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
CGIAR	Consultative Group for International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CID	Consortium for International Development
CIMMYT	Centro Internacional Mejoramiento de Maize Y Trigo (International Maize and Wheat Center)
CIP	Centro Internacional de la Papa (International Potato Center)
COP	Committee of Party
CRSP	Cooperative Research Support Program
DG	Director General
FAO	Food and Agriculture Organization
GTZ	German Technical Assistance Agency
HTS	Hunting Technical Services
IBPGR	International Board for Plant Genetic Resources
ICARDA	International Center for Agricultural Research in Dry Areas
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDA	International Development Agency
IDRC	International Development Research Center
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute for Tropical Agriculture
ILCA	International Livestock Centre for Africa
ILRAD	International Laboratory for Research on Animal Diseases
INTSORMIL	International Sorghum and Millet CRSP
INTSOY	International Soybean Program
fd	feddans (1.04 acres or 0.42 ha.)
ha	hectare (2.471 acres)
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
JMRDP	Jebel Marra Rural Development Project
LS	Sudanese Pounds
LT	Long-term
MFC	Mechanized Farming Corporation
MOU/PSG	Memorandum of Understanding/Program Support Grant (between USAID and universities)
NRC	National Council for Research
RA	Research Associate
ST	Short-term
TA	Technical Assistance
TDY	Temporary Duty
USAID	United States Agency for International Development
VE	Value Engineering
WB	World Bank
WSARP	Western Sudan Agricultural Research Project
WSDC	Western Savannah Development Corporation
WSU	Washington State University

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