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WESTERN SUDAN

AGRICULTURAL RESEARCH PROJECT

EVALUATION TEAM MIDTERM REPORT

To

U.S. Agency for International Development

and

The World Bank

January 24, 1983

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GLOSSARY OF ACRONYMS

<u>Acronym</u>	<u>Organization</u>	<u>Location</u>
ARC	Agricultural Research Corporation	Sudan
CGIAR	Consultative Group for International Agricultural Research	USA
CIAT	Centro Internacional de Agricultura Tropical	Colombia
CID	Consortium for International Development	USA
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo	Mexico
CRSP	Collaborative Research Support Program (USAID)	USA
GOS	Government of the Sudan	Sudan
GtZ	Development Assistance Agency	West Germany
IBRD	International Bank for Reconstruction and Development	USA
ICARDA	International Center for Agricultural Research in Dry Areas	Syria
ICAR	International Centers for Agricultural Research	USA
ICRISAT	International Crops Research Institute for the Semiarid Tropics	India
IITA	International Institute of Tropical Agriculture	Nigeria
ILCA	International Livestock Center for Africa	Ethiopia
ILRAD	International Laboratory for Research on Animal Diseases	Nairobi
INTSORMIL	International Sorghum and Millet Research Program (CRSP)	USA
ISNAR	International Service for National Agricultural Research	Netherlands
IADS	International Agricultural Development Service	USA
IDA	International Development Association	USA
MS	Master of Science Degree	---
SATEC	Societe D'Aide Technique Et De Cooperation	France
USAID	United States Agency for International Development	USA
WSARP	Western Sudan Agricultural Research Project	Sudan
WSU	Washington State University	USA

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

SUMMARY AND RECOMMENDATIONS

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

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

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

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

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

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

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

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

Integration Into ARC and Coordination with GOS Institutions

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

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

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

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

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

Project Management and Support

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

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

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

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

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

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

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

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

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

The WSARP Research Approach and Work Plan

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

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

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

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

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

Proposed Research Programs

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

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

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

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

Administration

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

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

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

I. INTRODUCTION

The Western Sudan Agricultural Research Project (WSARP) is designed to increase the capability of the Sudanese Agricultural Research Corporation (ARC) to improve the standard of living of subsistence farmers and pastoralists in the arid and semi-arid areas of the West. This is to be accomplished through the use of a systems approach for the development, testing and transfer of improved technologies for crops and animals and for the rehabilitation of the natural resources of the region.

1. Genesis of the Project

The origin of this project dates to 1975 when the Minister of State for Agriculture, Food and Natural Resources of the Government of the Sudan requested the Ford Foundation to make a review of selected crop and disciplinary research capabilities and to study future requirements for research. These studies were made by 20 consultants who issued reports on 10 basic crops, seven disciplines and four administrative services.

An integrated summary of these reports was prepared and discussed at an International Workshop on Agricultural Development in the Sudan in 1976. In addition to Sudanese Government (GOS) officials and staff of the ARC, representatives of the international agricultural research institutes (IARC'S) and other national and international agencies were invited to participate.

Following the workshop, the GOS and the Ford Foundation agreed that the reports of the special studies and the information provided through the workshop should be integrated into a master plan for strengthening agricultural research capabilities in the Sudan, with focus on the ARC. The International Agricultural Development Service (IADS) in New York City was invited to undertake this task. Accordingly, a joint team of IADS and senior Sudanese agricultural scientists made its review in July-August 1977. The review resulted in 33 recommendations directed at staffing, functions, goals and objectives of the ARC to make it more effective in utilizing its research resources for a continuous flow of agricultural technology for the varied farming systems and ecosystems of the country.

This team excluded the Western Regions of Darfur and Kordofan from its studies and recommendations since they were being reviewed at that time by the World Bank. This World Bank study of the research needs for Western Sudan resulted in a plan to augment the Sudan's agricultural research capabilities in the Regions. In support of this plan, the GOS requested the International Development Association (IDA) of the World Bank group to develop and finance an agricultural research project for the rainfed arid and semi-arid areas of Western Sudan.

In July, 1978, the GOS and IDA signed a loan agreement for financing the project. Subsequently, because of the scope of the proposed project, and inability of the IDA-GOS agreement to meet all emerging needs, USAID designed and approved a companion project that interfaced with the activities to be provided and supported by the IDA-GOS agreement. The combined project documentations defined activities and responsibilities for the various participants in the total project. The World Bank finances the construction program and the purchase and operation of an aircraft. USAID'S components support technical assistance, training, the purchase of commodities and equipment, research supplies and station operational costs, including 70 percent of the Sudanese salaries. As project implementation developed, the need for additional financing became evident and was subsequently provided by USAID. Included in this additional component was the provision of support for part of the construction program.

Under Title XII of the Foreign Assistance Act, Collaborative Mode, USAID in August, 1979, entered into a contract with the Consortium for International Development (CID), based in Tucson, Arizona, for implementation of the AID portion of the Western Sudan Agricultural Research Project (WSARP). Subsequently, Washington State University, Pullman, was designated the lead university in CID to implement the program.

2. Goals

The purposes and goals of the World Bank, USAID and the GOS are similar for improvement of the standard of living and productivity of farmers and pastoralists in Western Sudan through the planning, development and institutionalization of an agricultural research station network as a part of the ARC. A systems approach to research is being used to define and alleviate the constraints of three primary production systems - sedentary farmers, seasonal transhumants, and nomads.

3. Evaluation Team

In addition to periodic evaluations by the World Bank and CID (prime contractor), USAID project documents called for a formal review and evaluation in year three, involving international scientists and representatives of the World Bank, GOS and AID. It was agreed that this midterm evaluation would serve the needs of all three contributing agencies. Members of the evaluation team were:

Dr. Michael Collinson, USAID Representative
Regional Economist, East Africa
International Maize and Wheat Improvement Center
Nairobi, Kenya

Dr. John E. Vercoe, IBRD Representative
Assistant Chief, Division of Tropical Animal Science
Tropical Cattle Research Centre
CSIRO, North Rockhampton, Australia

Dr. Hussein Idris, GOS Representative
Director, Technical Cooperation Among Developing Countries
United Nations Development Program
New York, N.Y., USA
(Former Minister of State for Agriculture, Food and
Natural Resources, GOS)

Dr. Kenneth L. Turk, Representative-at-Large - Team Leader
Professor Emeritus, Animal Science
Cornell University
Ithaca, N.Y., USA

In addition, Mr. Stuart Marples, Project Officer, World Bank, and Ms. Joyce Turk, Project Manager, USAID/Khartoum, participated actively with the evaluation team throughout its assignment.

The major part of the review was undertaken during the period November 13-29, 1982. Dr. Vercoe participated, November 6-18, and Dr. Collinson, November 14-25. It was unfortunate that scheduling problems did not permit all team members to function simultaneously throughout the review.

Terms of reference provided to the team leader included:

- (1) Coordinate team efforts in implementing evaluation scope of work.
- (2) According to evaluation team's findings, review project design with respect to current GOS and USAID agricultural strategy, project assumptions, time frame, financial resources and alternatives to project's strategy.
- (3) Review administrative logistics, technical aspects, adequacy of technical assistance, short and long-term training, and proposed research program.
- (4) Prepare report of evaluation team's findings and recommendations.

4. Evaluation Plan

Prior to assembling in Khartoum, members of the team received copies of background documents for study covering all aspects of the history and development of the project and reports of preliminary research. Additional documents received upon arrival described general research program and plans, project history and functional structure, as well as research plans for the Kadugli station. Quarterly reports and individual research proposals were available for review.

Briefing and background sessions were held with representatives of the GOS, ARC, USAID and World Bank. Program activities were discussed fully with all key members of the WSARP staff, project coordinators, director and visiting scholar of CID, and with the senior scientists at Kadugli.

Visits were made to research stations at Kadugli, El Obeid, El Fasher, Ghazala Gawazat, the present ARC headquarters and Gezira Station in Wad Medani, and the new headquarters under construction at Shambat, Khartoum North.

The complete schedule for the team, including places visited and key people who contributed, is summarized in Annex A.

II. INTEGRATION INTO ARC AND COORDINATION WITH GOS INSTITUTIONS

1. Relationships to ARC

To ensure smooth incorporation of the WSARP into the ARC after termination of the project, there is need now for development of the WSARP as an integral and complementary system. Stronger institutional links need to be developed including proper communications and harmonization of policies. A complicating factor, of course, is the special funding status of WSARP and its relationships with the donors.

It is suggested that stronger institutional linkages and working relationships be carried out in the following ways.

a. Research Planning Approval and Coordination

The proposed research administrative structure of the WSARP, elaborated in Vol. II, pages 11-17 and Figure 7, would be improved with some modifications to facilitate integration of research planning, approval and monitoring into the ARC.

The annual research planning meetings of the station research committees should include (in addition to those already proposed) the ARC Deputy Director General for Programming and the relevant ARC national research coordinators. This will be in conformity with the ARC procedure with regard to research planning in other research stations and will facilitate early inputs from the national coordinators in the research planning of the WSARP stations. It is envisaged that there will emerge three national systems coordinators from the WSARP.

Meetings of the Systems/Program Committee should include (in addition to those already proposed) the ARC Deputy Director General (Programming), the WSARP Project Director, relevant ARC national coordinators, representatives of the regional ministries of agriculture and ministries of services, representatives of farmers' unions, and representatives of the National Council for Research. After the establishment of the Sudan University at El Obeid and the Darfur University at El Fasher, representatives of these institutions should be added.

Meetings of the Project Research Committee would consist of the Project Director, the Deputy Project Director, the WSARP research stations directors and the three national systems coordinators. The purpose of the committee would be to harmonize research plans with available resources and prepare a final draft before presentation to the ARC Technical Committee by the Project Director.

The Project Director and the three national systems coordinators would represent WSARP in the ARC Technical Committee.

b. Administrative and Financial Procedures

The Project Director of the WSARP is a member of the ARC Administration and Finance Committee. The Director General of the ARC and his Deputy for Administration and Finance recognize fully the special circumstances of the WSARP with regard to funding sources. But it would contribute to mutual understanding for the Project Director of the WSARP, like other main station directors, to present his budget and facilitate its discussion in the ARC Administrative and Finance Committee. Once the WSARP's budget is reviewed by the ARC Administration and Finance Committee, the Project Director should have full autonomy in managing it following the well-known project systems approach. The WSARP is expected to conform to normal ARC monitoring procedures of unannounced internal auditing of GOS funds.

c. Recruitment, Training and General Manpower Development

Selection of young scientists to work in the WSARP is being conducted through the normal ARC procedures implemented under the guidance of the Assistant Director General for Training. It is necessary that the WSARP should work closely with the ARC in further staff career development. Adherence to ARC procedures should be maintained by WSARP as far as possible. While it is anticipated that ARC procedures for staff selection and promotion are sufficiently flexible to accommodate the special needs of a systems approach (IV, 2,) WSARP may need to advise the ARC on ways in which this could be achieved. ARC should be kept informed on a continuous and permanent basis about academic and professional progress of staff working in the WSARP.

d. Transfer of ARC Headquarters to Khartoum

Difficulties of communications between Wad Medani and Khartoum have contributed to some unsatisfactory relationships between the ARC and the WSARP. Communications would be improved with the transfer of the ARC headquarters to Khartoum. This would also give to the ARC a national posture and outlook that would ensure continuous liaison with officials concerned with national development planning and donor agencies. Further, it would be in keeping with the ARC's nationwide responsibilities as the technical arm of the Ministry of Agriculture, Food and Natural Resources. This transfer would be consistent with a recommendation of the Joint Team in its report in 1977 (section D, pages 53-55).

The transfer of the ARC leadership to Khartoum will help to develop and strengthen the WSARP stations, as well as the agricultural research units in Khartoum Province. These include Fisheries, Forestry, Food Processing, Cotton Genetics and Germ Plasm, Soil Salinity in Soba, Wildlife and Game, and Publications and Documentation. Also, opportunities for interaction between the ARC and the Faculty of Agriculture, University of Khartoum, and Shambat Agricultural Institute would be greatly enhanced.

Office facilities are nearing completion at Shambat, Khartoum North, for the ARC headquarters and temporarily for the WSARP before final transfer to El Obeid. The only obstacle for the transfer of the ARC headquarters is lack of housing to accommodate the ARC Director General, his deputies and other senior and middle level staff. Six senior houses and five middle houses estimated to cost under one million dollars are required. Sizeable investments in research of more than seventy million dollars in the Western Regions, and several million dollars more in other regions, will not be fully utilized for the benefit of agricultural research and development in the Sudan if the national agricultural research nerve center (ARC HQ) is kept handicapped by distance and communications at Wad Medani.

e. The WSARP Coordinating Committee

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

2. Linkages to other ARC Stations and Scientists

Linkages can be forged by the following:

a. Reciprocal representation of ARC relevant national coordinators in WSARP research planning committees and WSARP national systems coordinators in the research planning committees of other ARC stations in other regions.

b. Participation of relevant scientists of the WSARP in the meetings of the nationally coordinated commodity and factor problems-oriented teams.

c. Participation of relevant WSARP scientists in meetings of joint national technical committees chaired by the ARC Director General. The main national technical committees are:

- (1) Crop Husbandry
- (2) Cotton Varieties
- (3) Pests and Diseases
- (4) Rainlands Agriculture
- (5) Propagation

LIVESTOCK!

Relevant scientists and representatives of agricultural production schemes and service departments of the Ministry attend meetings of these committees which serve the dual purpose of adoption of research findings and feedback and defining of research priorities.

d. Representation of the WSARP in the annual agricultural meeting.

3. Coordination of Project Activities with other GOS Agricultural Activities

Representation of the regional ministries of agriculture and services in the Systems/Program Committee of the WSARP helps to feed interests and concerns into regional governments. Eventually WSARP scientists would be called upon to contribute to meetings of development planning of the regional governments.

The project is expected to play an important role in the transfer of technology and agricultural extension. To help fill this role the staffing pattern for the stations presently includes several positions for extension specialists. Project management might consider using the title of production specialists for these staff members utilizing them for service both in field research and transfer of technology. This would give them greater status in working with extension workers and farmers. It is recommended that WSARP should appoint a sufficient number of production specialists (minimum of three specialists in every station) to cooperate with the research scientists and the provincial extension services in the conduct of on-farm trials and the training of extension personnel and farmers.

* The WSARP through its Ghazala Gawazat Station should cooperate closely with the three experimental units of the Savannah Development Corporation in Southern Darfur with the view of serving fully the research needs of the Corporation in the foreseeable future.

The project should also maintain its close collaboration with activities of SATEC, GtZ, and INTSCRMIL in the Western Regions.

4. Methods of Continuing Project Activities After Termination of External Assistance

As in the case of the ARC it is expected the Central Government will continue to support the general budget and the development budget of the WSARP. In view of past and current experiences of the ARC, however, the government sources of funding have not been able to cope well with the pressing needs for effective use of the present limited physical facilities or of the research scientists trained by government at very high cost.

Besides government support the user organizations or corporations that benefit from research results should contribute to WSARP's financing.
→ The Savannah Development Corporation as well as any future semi-autonomous, joint venture or private corporations should be eligible to contribute.

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

III. PROJECT MANAGEMENT AND SUPPORT

1. Central Administration

a. Accomplishments

In the face of many problems, logistical and otherwise, the project administration has made remarkable progress in the initial phases of this project. An administrative structure, with a project support unit, has been established and is now functioning. Good working relationships exist between administration, the donors, project staff at headquarters, and the coordinating staff at Washington State University (WSU). The liaison officer (senior ARC advisor) continues to make substantial contributions to relationships between the project and the ARC and to overall project development; however, his talents and capabilities could be utilized more fully in the management of the ARC.

The development and initial functioning of the Kadugli Station are significant. Some research has been initiated and further projects are in various stages of planning (see next section). Construction of facilities is proceeding at the El Obeid, El Fasher and Ghazala Gawazat stations and research plans are being developed.

Some Sudanese scientists have been identified and are in place at Kadugli, along with well qualified visiting scientists. Essential equipment to improve the effectiveness of all scientists and support staff is gradually being provided.

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

The evaluation team recognizes these and other achievements in the administration of this unique and fairly complex project. At the same time, its observations and discussions have revealed some constraints and deficiencies, alleviation of which would improve overall project management.

b. Some Constraints and Deficiencies

The Project Director has a difficult job with many responsibilities ranging from policies and relationships to donors and GOS agencies to the logistical details of everything involving research, station management and operation. With all these demands, it is essential that the Project Director be able to delegate many of the routine things to subordinate staff in order to allow him the time for a better overview and administration of project needs and basic policy decisions. Control of delegated responsibilities should be achieved by a reporting system, monitored by the Project Director.

Better definition of the responsibilities of the Deputy Project Director in relation to those of the Director would be helpful. The

line between the duties of the Deputy Project Director and his dual role as Chief of Party for technical assistance should be clearly defined and clear to all, especially the expatriate technical assistance staff.

Delegation of responsibility for more mundane details to junior staff would allow both the Director and Deputy Director to spend more time with the field staff at the stations. It is important to recognize the isolation of the scientific staff in the Western Sudan and that good administrative support is essential for good morale and high quality work. At the same time the field staff need to appreciate the stresses and responsibilities of the Director and his staff.

Relatively little budget information has been offered the evaluation team, but it appears that improved budgeting procedures would be helpful to station operations. It would be desirable to establish mechanisms so that budget projections and disbursements could be reviewed on a line item basis quarterly or semi-annually. Scientists need to put cost estimates in research proposals and, as a group at each station, need to know what funds are available for operation and maintenance.

Resources in vehicles and other equipment provided need to be efficiently utilized if the project operations are to be successful in attaining goals. While it is true that the question of maintaining recurrent budgets when financial support from external donors is no longer available is problematic, two things are clear: (1) a systems approach in research will not build credibility with ARC unless it is seen to operate effectively, and (2) the systems approach raises the proportion of the budget which needs to go to transport.

Careful assessment of working life of American vehicles might be made over the next few years. If working life is being overestimated, then either a modified replacement policy or purchase of different make of vehicles via a waiver, could be considered.

It is recognized that motorbikes are widely used for farm surveys in other countries to reduce cost of transport. With the present fuel shortage, and with some reluctance to provide the vehicles that field staff need, it would seem logical to use some motorbikes, at least on an experimental basis.

The eventual move of the administration staff to El Obeid should be helpful in dealing with the operations and maintenance of all stations in the Western Regions. Further, the integration of functioning within ARC are likely to be improved when its headquarters staff are transferred from Wad Medani to the new facilities at Shambat at some future date.

2. Role and Relationships with Contractors and Donors

The team was pleased to observe the keen interest and support for the WSARP by the two major donors - USAID and the World Bank. The project manager and project officer of these two institutions are fully informed on progress of all aspects of the project, including the constraints and problems. Personal and working relationships appear

to be quite satisfactory. (Relationships to GOS institutions are presented in previous section.)

The architects have worked effectively with project management and the contractors. Delays in construction have been due to many factors - delays in delivery of materials, shortage of wood for firing of bricks, problems in transport, and shortages of fuel - mostly beyond the control of the architects and project administration.

The team is favorably impressed with the work of the architects in the design and structure of the research facilities, houses for the staff, guest houses, other buildings, and in the quality of construction.

3. Administration of Research Stations

Administration of the research stations in the WSARP is the responsibility of the Project Director, and Deputy Project Director, with a scientist in charge at each station. The administrative structure presently lists the title of the person in charge of each station as Superintendent of Station, which is at variance with the long-standing policy of the ARC that each station be headed by a Director. It would seem logical, therefore, that the title be changed to conform with ARC policy. At the same time the team recognizes that functions of the WSARP station heads may be different from those of other ARC stations because of the nature of the research approach. A relatively large proportion of the WSARP research will be done on farms with villagers and transhumant groups which will require special arrangements in the allocation of vehicles, fuel, staff and other resources.

The Director in charge of the station should assist the research staff with their on-station and on-farm research requirements by providing the best possible physical and psychological environment for their work so their time can be efficiently utilized. Each systems team should be allocated transport, staff and other resources on a program basis so they and the Director are free from day-to-day negotiations and decisions on these matters. The station Director should be an experienced scientist and to the extent possible be directly involved in personal research.

Functioning under the Station Director should be a farm superintendent or farm manager who is responsible for the day-to-day operations. These include the general farming activities, maintenance of equipment and buildings, supervision of farm laborers, mechanics, plumbers, and other support staff.

The station Director should have the administrative authority to approve expenditure of funds allocated to the maintenance and operation of the station, and the systems research teams for their extra-mural activities, once the budget has been approved by the Project Director and the ARC.

The Director of the station should also initiate seminars and arrange for appropriate exchanges of scientists at that station with scientists at other WSARP and ARC stations. He should hold regular

meetings with systems groups, team leaders and the station staff as a whole to discuss progress, problems, new directions of research, budget preparations, and future resource requirements.

WSARP management has projected the staff requirements at all levels for each of the four stations. Based on the Kadugli Station, which is the only one now operating, and the project requirements of the other stations, it is clear that the major constraint to the future of the project is a lack of experienced Sudanese staff at all levels. For example, at the time of the team's visit to Kadugli, the scientific staff totalled 14, including nine Sudanese and five visiting scientists. Of the Sudanese, seven are scheduled to go abroad early in 1983 for advanced degree training, which will leave only two, one of whom is the present Director. Recruitment of additional staff was delayed due to a lack of adequate housing on the station and in the town. It is recognized that the harsh environmental conditions and lack of an adequate infrastructure of roads, transportation systems and communications make it difficult to attract good Sudanese scientists and technicians. Nevertheless, replacement and additional scientists must be recruited.

It is equally important that increased numbers of qualified technicians be recruited, or trained, to provide the necessary support for efficient utilization of the scientists.

Another major constraint in the operation of the experiment stations is maintenance of equipment, vehicles, and facilities, including staff houses.

Proper maintenance requires mechanics, plumbers, carpenters, electricians, engineers, etc. properly supervised and directed by the farm foreman or farm manager. The traditional ARC stations have learned from experience of the necessity for qualified staff for maintenance of facilities and equipment.

4. Training

The Government's program of staff development since 1958 has provided a steady stream of well-trained young scientists for the ARC and other government agencies. Unfortunately, many of them have been attracted to work for higher salaries in other countries leaving shortages of scientists and technicians. As a consequence, it is necessary for the government and WSARP to continue sending some of the most promising young scientists abroad each year for post-graduate studies at the Ph.D. level in selected disciplines. Unfortunately, those being sent now will not be returning for service in the WSARP during its present duration.

It can be argued that young scientists should obtain their M.S. degrees at the University of Khartoum, with thesis research at one of the ARC stations, rather than going abroad. This training would be more appropriate for work in the Sudan and their thesis research can contribute to the objectives of the WSARP.

Greater efforts in recruiting M.S. graduates from the University of Khartoum might be profitable. Also, some junior staff and technicians

might be available from the Shambat Institute of Agriculture and other similar institutes in the Sudan.

Recognizing the critical need for qualified personnel, the WSARP is constructing facilities at El Obeid to carry out in-service training. Also, some training activities will be conducted at other stations. This will require training officers, plus cooperation of senior staff. In addition, the project expects to provide, as appropriate, workshops and short courses to upgrade the staff, and external training for the benefit of farmers and extension personnel. Good short course training for junior staff might well precede Ph.D. level of education abroad.

As a part of their training, young researchers in the WSARP should be given opportunities to obtain work experience in commercial agriculture. Such experience would enable them to identify more closely with farmers and understand more clearly the central and support thrusts of systems research development.

It is suggested that the WSARP follow up on preliminary discussions that have been held with representatives of CIMMYT's East African Economics Program and arrange for participation of some staff training workshops on farming systems. These would involve training for survey, as well as on-farm experimentation and extension work. Additionally, CIMMYT would offer in-country training programs extending over a full farming system research cycle if a minimum of 12-15 nationals can be involved.

Also, the WSARP could take advantage of training courses of varying length offered at the International Centers, i.e. ICARDA, ICRISAT, IITA and ILCA, for selected members of the staff. European donors of the CGIAR support a 9 months training course, ICRA, at Wageningen, Netherlands, at which development oriented research procedures, based on a systems approach, are taught. A course on research management is being offered by the Economic Development Institute, sponsored by the World Bank and the International Service for National Agricultural Research (ISNAR). The first workshop will be held in Washington, D.C., during the second half of 1983.

All of these opportunities, and others, should be explored as sources of training of present and potential staff for the WSARP.

5. Library

Good library materials of scientific journals and books are essential for an active research program. A library and facilities to reproduce reports and extension materials is being established at El Obeid to serve the entire project. Also, smaller units will be established at the other stations, but these facilities will not be available until some time in 1984, except for Kadugli. The administration building there has a room for a small library, but no shelves, books, or periodicals were observed. The team was advised that relevant journals have been ordered and some have arrived in Khartoum but others have been lost in transit. Books have been and will continue to be ordered to build up the resources. In addition, during the life of the project,

scientific staff will have access to some of the world literature held by the International Section at Washington State University which was specifically established to provide services to overseas projects.

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

6. Communications

Good communications are very essential in any cooperative endeavor, especially in a complex program like the WSARP that involves many agencies. There can be many opportunities for slippage in communications between CID, WSU, GOS and ARC. Add to them USAID Washington, USAID Khartoum, World Bank, Project Management, Project Support Unit, Research Stations, scientists at the stations, and finally farmers. It is surprising perhaps, that communications between all of these agencies and services have been maintained as well as they have.

In its discussions with project management, staff at headquarters, field staff, and coordinators, however, the team became aware of a few instances where communications may not have been the best. To what extent these have affected the progress of the project cannot be assessed. As a consequence, the team urges that the administration define channels of communication and procedures and that those involved recognize the importance of adequate communication and make an honest effort to achieve this objective.

As mentioned briefly earlier, it is felt that greater interaction between Project Administration and field staff will improve communications. Likewise, better appreciation by the field staff of the work and responsibilities of the headquarters staff would also be helpful.

The radio network will make it much easier for communications with the research stations. Also, the use of the aircraft can be more effective in this respect. It is recommended that Project Management proceed, as early as feasible, to arrange a schedule for regular aircraft flights to the stations. This would make possible closer working relationships between the field staff and the headquarters staff.

Communications among scientists and between project administration and stations could be improved with an addition to the staff of the WSARP of a program information officer. This officer would work closely with the librarian and help organize a communications and information infrastructure for distribution of news items of research

developments, research reports, library materials and information from IARC's, and for linkages with other national agricultural organizations and universities. Further, the person in this position could possibly assist as an in-service training officer.

If funds are available and if a qualified Sudanese can be recruited, the team recommends that consideration be given to the addition of a program information-communications officer to the staff of the WSARP.

7. Transfer to El Obeid

In the early stages of planning for the WSARP, the decision was made to make El Obeid the headquarters station rather than Nyala as had been recommended by the World Bank Mission. This move of the headquarters staff will be at the completion of the El Obeid facilities now projected for February 1984.

All of the present senior administrative staff in Khartoum will move to El Obeid, except a WSARP Sudanese administrator at the level of Assistant Project Director for Administration, who will be responsible for the Project Support Unit and a liaison officer. The relationship between this unit and the ARC and the make-up and staffing of the ARC liaison activities have not been defined. It has been suggested, however, that it would be appropriate for the senior advisor to the ARC to remain in Khartoum.

When the headquarters building for the ARC in Shambat is completed it will be occupied by the WSARP staff until the move to El Obeid is made. This means that the Project Administration and Support Staff will make two physical moves in a period of 15 to 18 months. This is bound to make some interruption in the difficult job of getting the three new stations staffed and operating. Substantial sums of money can be saved, however, by this move since rent for the present headquarters is quite high.

IV. WSARP RESEARCH APPROACH AND WORK PLAN

1. Introduction

The team was impressed by the close cooperation between the scientists on post at Kadugli, and the enthusiasm for the implementation of a systems approach as a new tool of agricultural research. In the Western Sudan, with its nomads and transhumants, with the strong interface of crops and animals, both within and between farming systems, the project has tremendous opportunity for impact on the orientation and methodology of the systems research approach. It is a rapidly developing interdisciplinary field and the potential contribution from WSARP scientists is unlimited. To those imbued with the philosophy this should provide motivations strong enough to subordinate frustrations from the inevitable logistical problems of their remote postings.

2. Research Leadership in the Project

The WSARP work plan, including the systems approach, and the operational model as well as the research proposals for the project were recently and hurriedly prepared. The major administrative difficulties faced by the project with management staff having to involve themselves in detailed logistical organization, and the recent arrival of some of the technical assistance scientists no doubt account for this situation. Nevertheless, questions on research leadership for the project produced enough variety of answers to reflect the uncertainty of staff on this important issue.

Smooth and effective functioning of interdisciplinary teams is difficult to achieve. Much is required of the research leader. He/she must obviously be committed to a systems approach and must also command the respect of other team members by virtue of expertise and competence in a particular discipline. If the team functions democratically it is common for it to be dominated by the most forceful member.

Disciplinary satisfaction may be subjugated or limited by the perception of the team as a whole and cause frustration to individual members. More detailed, worthwhile observations or experimentation may be sacrificed through compromises (which are inevitable in a team effort) in describing the system at the chosen level of the farmer.

Reward, merit and promotion issues are more difficult in team efforts which implies multiple authorship publication with scientists unknown in the discipline for which recognition is deserved from one's peers. This is especially true for Sudanese scientists working under the existing ARC rules on promotion and incentives. Young local scientists need recognition in a particular discipline under most present formulae for promotion or advancement. This may gradually change although the criteria by which a revised scheme might operate are not yet clear.

It is desirable therefore, that in designing the systems studies there is reason for the members of the team to publish some aspects as individual authors as well as the multiple authorship systems publications. This should not be too difficult.

Any staffing procedures need to be flexible enough to cope with the possibilities that some good disciplinary scientists may be more committed to a systems approach than others. Obviously, it is desirable to have scientists who combine both characteristics. However, despite the natural inclinations of experimental scientists to adopt a reductionist method it is easier to convert a disciplinarian to systems than vice versa.

The team has no final recommendation on research leadership for the project, but would emphasize the need for all staff to be clear about the leadership responsibilities. Uncertainty must inevitably detract from project effectiveness. The prospect of increased visits to the field by Project Management from Khartoum may provide the leadership needed.

In any case, it is suggested that an individual professional be given the responsibility of research leadership. He/she should be acceptable both to ARC and to Project Management and the mandate should be clear to all parties.

3. The Project's Production Systems Research Approach

a. Systems Research as an Innovation for AFC

The WSARP work plan (Vol. I, Part A, Page 4-6, Table 1) discusses alternative approaches to agricultural research. It concludes that the farming systems research (FSR) approach, with modifications, is the most appropriate to the needs of Western Sudan. The work plan goes on (Vol. I, Part A, Page 8) to distinguish between applied and adaptive research and here effectively the discussion on alternatives has come full circle: the applied research described is of the reductionist (classic) tradition along disciplinary and commodity lines. The team believes that presenting production systems research as an alternative to traditional applied research threatens the effective implementation of the project and particularly its sustainability after the termination of donor support. It is suggested that the production systems research approach that is adopted should be more closely tailored to the institutional objectives of the project.

The future use of a systems approach in the Sudan depends on its adoption by ARC, the major national institution responsible for agricultural research. Only if the ARC can be convinced of the efficacy of the approach, during the life of the project, is it likely to be sustained as a useful addition to the inventory of agricultural research techniques. The team recommends that the project systems approach be defined as complementary to the present commodity and disciplinary research activities of ARC.

The team believes that ARC will readily identify its present activities with the applied research role, and that those of its scientists who are unfamiliar with systems will feel less threatened by such a characterization of the approach. Further, the team recommends that the project adopt a three stage strategy to encourage a sustained use of a systems approach by ARC after donor withdrawal:

- (1) Identification with ARC and the full use of ARC procedures.
- (2) Build up of credibility in the eyes of ARC management and scientists by its fieldwork.
- (3) Modification through convinced ARC channels of those procedures not wholly consistent with the organization and management of a systems approach in research.

In addition to the barriers raised to integration with ARC by posing the systems approach as an alternative to classic research procedure, the team believes the self-contained nature of the existing approach and operating model encourages isolation of project scientists. The implication is that the project will generate its own interventions,

and that project researchers will be involved at both applied and adaptive levels of research. The team recommends an open approach and an operative model which clearly draws on applied research done by others, particularly from past and present ARC programs, but also from international applied research efforts in the IARC's and the CRSP's. If the systems approach is presented as complementary to applied research efforts, rather than as an alternative, the desirable openness will be achieved.

Although appreciating that a systems approach, and the operating model it implies, cannot be final, with the rapidly evolving state of the arts, the project should reconsider aspects of the approach in the light of these comments and then finalize a detailed operating model. Once such a model (ref: WSARP Work Plan Vol. I, Part A, Fig. 1, Page 7) is finalized, the team then recommends a 2-3 day workshop with two objectives:

- (1) To familiarize all project scientists new to a systems approach with its operational characteristics and interdisciplinary needs.
- (2) To brief available ARC administrators and researchers, particularly available national commodity coordinators, on the role and operation of the WSARP systems approach and the vital linkages with ARC institutions and scientists, and with other GOS agencies.

Given interest in a systems approach in the Southern Region, and perhaps in other parts of the country, a larger audience may be useful. A wider workshop may be best organized and hosted by ARC supported by project funds. It should be chaired and orchestrated by the project's research leader.

The team recommends the development of a revised operating model as a management tool for planning and monitoring research activities. Each system focused program should be bar-charted by the stage of the operational model to be covered and the calendar period involved, as a central core of the work plan. Research proposals from disciplines should be related to an approved systems program and be used to draw up further bar charts, again by stage and time, to show the activities of each contributing disciplinary section to the program, interdisciplinary activities appearing on several bar charts. All bar charts would be used by Project Management to monitor and evaluate the progress of the research programs.

b. Priority Objectives for the Project Systems Approach

The raison d'etre of a systems approach as an agricultural research tool is that it provides close and direct links between research scientists and farmers. Emphasis is placed on the circle from farmers through researchers back to farmers, and farmer participation is seen as a major element in a successful program. To gain and maintain credibility with farmers the circle has to be complete; the farmers have to get something out of the process, and the sooner the better.

Thus, the systems research approach should be seen to have a central thrust and support thrusts. The central thrust has four stages:

- (1) Identifying relatively homogenous groups of farmers for whom a research effort would be cost effective.
- (2) Understanding their farming systems through anthropological and economic surveying techniques.
- (3) Selecting and combining components 'off the shelf' of applied research results which will apparently solve farmers' problems or better exploit their biological opportunities, and be within their capacity to absorb.
- (4) Testing and adapting these components, sometimes packaged, under the range of environmental and management conditions in which they will be used if adopted as recommendations by farmers.

In this thrust researchers interact with farmers who, as decision makers on what they grow and how they grow it on their farms, are the final arbiters of what interventions are good for them. The central thrust is focused at the level of the system hierarchy influenced directly by the farmer as decision maker. This central thrust should dominate the operation of the project. An 'open' operational model, in which past and present work of the ARC, as well as international applied research, is seen as providing 'off the shelf' components, is essential to minimize the cycle time in getting something back to the farmers.

To exploit such a model the technical scientists of the project need a wide knowledge of applied research relevant to the climate, soils, crops and production methods of the Western Sudan giving them as broad a perspective as possible on potential interventions to tackle problems identified in local farming systems. The project should encourage and facilitate exposure of its technical scientists to the literature, and to scientists doing relevant applied research identified inside the Sudan and in other countries.

Support thrusts within the approach should be closely dictated by the needs of the central thrust. They may be technical or socio-economic in nature and may be motivated within the project or by scientists in linked institutions. Support thrusts are of three main types:

- (1) Where an understanding of the biology of present practice at a sub-system or component level is required to formulate a strategy for intervention. This has to be done within the area and is properly within the brief of project or other locally based scientists.

- (2) Where technical problems important to farmer development are identified for which either:
(a) there are no available technical solutions,
or (b) the technical solutions available are outside the resource endowments of local farmers.

In both cases an applied research effort is required and the technical problems posed are properly passed to the appropriate national disciplinary and commodity coordinators to bring the ARC network to bear on the problems. When ARC does not have applied capacity focused on that area of research, or when the problems require applied research within the local environment of the Western Sudan, they will properly become part of the applied research brief of the project or other locally based scientists.

- (3) Where economic, social factors, for example, market prices, input-sources or cultural tradition, are identified as key factors in either the understanding of system constraints, or as key constraints to the success of an identified intervention, special investigations may be justified as support thrusts. Where disproportionate amounts of project professional time would be required to carry out such support investigations, outside resources, for example, University of Khartoum professionals, should be considered for involvement.

The success of a systems approach in complementing traditional commodity and disciplinary orientations in agricultural research depends on an effective central thrust. The team recommends that all research activities proposed for the project be evaluated as 'central' or 'support' thrusts and that through the project period, central thrust activities dominate the research program. It is clear that in the long term, applied research in the West is equally as important as adaptive research. The mandate of the project however, is also clear. Given some problems of staff orientation and the relatively short remaining project period, there is a danger that what should be seen as support thrusts will take priority over the implementation of the systems approach proper. This concern is also reflected in some of the comments on the research proposals in Section V. Nevertheless, because the reward structures of the ARC are oriented to disciplinary performance, the team accepts it will be important for local scientists in particular to be also involved with support thrusts.

4. Replicability of the Project Systems Approach

Whether the systems approach and operative model to be specified and developed by the project is sustained when implementing responsibility is fully absorbed by ARC is dependent, not only on their conviction as to the efficacy of the approach, but also on the replicability of the operative procedures. In common with most other developing country agricultural research institutions, ARC has limited

numbers of professional and technical staff and a limited budget to cover a massive and varied geographical area. Close attention should be paid to the cost of the organizational format and research methods adopted for the project systems research approach in terms of both professional time and recurrent budget. Low cost organizational modes and low cost but effective research methods will enhance the replicability of the operative model for other parts of the Sudan. This is particularly true of surveys which may be done by single visits to a relatively small sample of farmers or by daily visits throughout the season to a large sample. Because professional and recurrent costs increase with the number of visits it is important to choose the lowest sample size and the low visit frequency consistent with meeting research objectives. The team recommends that all research programs are reviewed for the importance of their objectives to the central 'interventionist' thrusts and the appropriateness of the methodology to achieve those objectives at the lowest possible cost. The desirability of an intervention must be judged on its relevance and its likelihood of success.

Annex B sets out a sequence of low cost procedures for the central thrust recommended by the International Maize and Wheat Improvement Center (CIMMYT). These will need modification for survey work amongst transhumants and nomads but the informal survey should still be appropriate as the pivotal step in the diagnostic sequence.

Annex C also sets out different modes of experimentation running through both applied and adaptive research. The appropriate mode for project experimental work will depend on the confidence of the technical scientists in systems teams, that relevant technical relationships are known from past experimental work, and will hold under local farmers environmental and management conditions. The further down the list of modes that experimentation can begin the lower the overall cost of development, adaptation and testing of the interventions, and the faster the intervention is brought to the farmer.

5. Other Aspects of the Work Plan

a. Identification of Local Farming-Systems

The distinction drawn between sedentary, transhumant and nomadic farmers is a very useful basic typology of target groups. It is clear however that further sub-groups will emerge throughout the project area. INTSORMIL's work and that of ICRISAT staff in Northern Kordofan demonstrate the dominance of millet in that area. Consumption patterns are said to differ between ethnic groups and in subsistence dominated farming systems, this will usually imply different cropping patterns. While some research effort will be valid across such groups, other work will need to be adapted to such differences. Both diagnostic understanding and farmer assessment of interventions may be badly confounded by the differences. A more detailed zoning into farming systems would avoid subsequent confounding of survey or experimental work. Annex D shows a questionnaire which attempts to cover the potential sources of variation between farming systems. It can be administered to local people knowledgeable about farming as a rapid zoning survey, or questions covering the aspects expected to be important in the West could be incorporated into the proposed baseline survey.

b. Organization and Staffing for Systems Work

The team notes the decision to have project scientists doing both adaptive (central thrust) and applied (support thrust) research. This has clear advantages for the local scientists who must survive in an institution geared to disciplinary merit. Presumably the technical assistance scientists, having committed themselves to a system oriented project, are less vulnerable on that score. One potential disadvantage has been noted in paragraph 3 b above, that applied research may dominate the programs by default.

The team notes that the allocation of scientists between stations is not yet finalized (WSARP Work Plan Vol. II, Page 23, Table 2). It recommends that Project Management ensure that at least one animal production scientist, one socio-economist and one crop agronomist be allocated to each station (with the possible exception of El Fasher if a crop agronomist is superfluous there). These are the core of any adaptive research team where both animals and crops feature in the system. It is the interactions between them, during the diagnostic survey work, which ensure appropriate and technically sound interventions.

Project Management is further asked to consider, in view of the need eventually to institutionalize a systems research approach within ARC, as a complement to its present applied programs, whether this trio of disciplines could be designated the production system team. The evaluation team believes that, again, it would aid clearer promotion of concepts and organization to ARC. It is acknowledged that production system team members within the project would also have applied research responsibilities.

c. Constraints Identified and Listed for Research

Of the ten most important constraints to agricultural production detailed in WSARP Work Plan (Vol. I, Part B, pp. 57-67), the five listed below embrace practically the whole agricultural research field:

- (1) Inadequate water availability, conservation, and management.
- (2) Low soil fertility.
- (3) Poor genetic stock - crops and livestock.
- (4) Crop pests and diseases.
- (5) Poor livestock nutrition and health.

Many of the failures in the history of the transfer of technology to traditional farmers are due to 'final' technical solutions to these five problem areas being researched and offered to farmers whose priorities are much more immediate, and resource base much too modest, to contemplate adoption. Changes in these areas must be long term goals and,

together with government policy, remain central to project orientation. However, changes offered to farmers must first and foremost bring immediate receivable benefit through improved satisfaction of their own priorities and also be within their ability to implement in their seasonal work plan. Seasonal activity is constrained by the land, labor and cash at their immediate disposal, and by their access to markets and inputs. The nature and balance of these short term constraints on farmers' seasonal activity changes from system to system. Understanding a particular system allows an assessment of which interventions, from a wide array of possibilities, will improve farmers' satisfactions of their priorities and be feasible within their seasonal resource constraints. Understanding the long term constraints and government policy objectives, the researcher is seeking for interventions which are both acceptable to the farmer for their short term benefits and contribute to the achievement of long term government and environmental goals.

The diagnostic survey sequence, and particularly, the interaction of disciplines in the informal survey, is directed towards identifying interventions which will play these roles. Possible interventions may give short term benefits but adversely effect long term goals. Early in project life, to build credibility with local farmers, emphasis can justifiably be placed on realizing short term benefits.

V. PROPOSED RESEARCH PROGRAMS

1. Progress to Date

Project research efforts to date have been based at the Kadugli Research Station. Systematic application of an interdisciplinary approach has not been possible with most of the technical assistance scientists who arrived only this year, 1982. Research efforts were initiated earlier in range management and social anthropology. Much of the range management work and all the social anthropology work has been investigative and has built up a strong base of description and understanding of the local range environment and of household, farm and community organization. This, together with the build-up of information from secondary sources in Kordofan and Darfur, has clearly been of great value to incoming scientific staff allowing their rapid orientation to the local situation. The team commends the project scientists for their thorough involvement with farmers and their level of knowledge of traditional farming practice. Building from this base, three disciplinary sections; range management and animal production, socio-economics, and cropping systems and agronomy have proposed research programs for the next season 1983/84 and in some cases 1984/85.

A general criticism of the experimental proposals is the preponderance of applied research (support thrusts) and the absence of on-farm experimentation in the modes characteristic of interventions introduced through a systems approach (listed in Annex C). The team feels it is imperative that a better balance be achieved for the experimental program in the next (1983/84) season and is confident that practical,

relevant interventions can be identified using rapid diagnosis techniques and by drawing on past technical research done in the Sudan or elsewhere. It recommends, therefore, this work be undertaken immediately with a view to including more on-farm experiments, derived from a systems approach, in the 1983/84 seasons proposals. It is important for many reasons to oil the disciplinary interactions within the team and the project, to begin to demonstrate the characteristics of a systems approach to ARC, and to give the team experience both in operating procedures for putting experiments onto farmer's fields, and in drawing farmers and extension worker into participating with team scientists at on-farm sites.

2. Socio-Economic Proposals

a. Agricultural Markets of Kordofan Province

It is an important support thrust to provide consolidated information on the market opportunities facing Kordofan farmers and the costs, to them, of exploiting these opportunities through available market channels. It is useful to monitor seasonal price data with a view to interventions that allow farmers to exploit seasonal scarcities. It is also useful to monitor price trends over years with a view to understanding changes observed in local farming systems.

The methods proposed for employment of a short term consultant and setting up of a recording system for operation by junior staff seem appropriate.

Understanding Kordofan markets is a justifiable support thrust subject to the discussion in the report at Section IV, 3. The use of a consultant should give consolidated information. He/she should be briefed to cover input availability, prices and sales while on the survey. It is less clear that the establishment of a market information service is a valid support thrust for team efforts in developing appropriate new technologies. Given the problems of communication in the Region, the indefinite collection of monthly price information could prove expensive and is of limited value to agricultural research. Unless a radio service can be established these same communication problems are likely to inhibit provision of timely market intelligence to producers.

Overall, given the commitment of a consultant and routine work for junior staff, the program should not occupy more than 10% of the time of the agricultural economist.

b. South Kordofan Sedentary Production Systems Survey

This program is fundamental to the central thrust of the project. Although a social scientist and an economist are listed as principal researchers the close involvement of both a crops agronomist and an animal production scientist are also imperative if the survey work is to identify appropriate interventions.

While it is clear that socio-economists have principle responsibility for formal survey work where questionnaires are the data collection instruments used, the key feature of the informal survey work should be the disciplinary interaction between social and technical scientists. At least one crop or animal scientist should be named as a principal researcher in programs using informal survey methods.

The team has detailed comments on the methodology. Overall it is recommended the proposed methodology be reviewed to include a much greater use of informal survey methods to identify possible interventions which can be included in central thrust adaptive research programs, and less dependence on formal surveys. This puts greater weight on understanding and less on the quantification of parameters on individual farms.

The team has some more detailed comments on methodology. Care should be taken to avoid working across different farming systems. As recommended elsewhere more emphasis is needed on the zoning exercise intended as a preliminary in the reconnaissance survey. The present methodology proposed places heavy reliance on the formal survey work (Phase 1, Stage 2) to identify constraints to increased agricultural output, and highlight the points and linkages in the production system where appropriate interventions can be performed (WSARP Work Plan, Vol. III, Part B, Page 96).

Understanding the system is a prerequisite to identifying the constraints; it is a sequential process, one level of description and understanding leading to the next. Disciplinary interaction in the field and in talking to farmers is essential to identifying appropriate interventions. Both these functions are best done in a progressive informal survey sequence with direct interaction between researchers and farmers. A formal survey with a pre-designed questionnaire cannot elicit the understanding required. An effective informal survey is needed to frame appropriate questions for the formal survey. A formal survey is made across the population of an identified farming system to test hypotheses of the informal survey; on the understanding of the system; the relative importance of constraints on seasonal activities; and the apparent feasibility of identified interventions. Extra information can be obtained to allow better design and interpretation of the experiments planned around the interventions. The main aim is to verify the validity of the informal survey. Annex B offers some guidance on the timing of such a sequence.

These procedures should allow the identification of interventions to form the basis of an on-farm experimental study among farmers of two production systems for the 1983 growing season. Informal work should be done separately within the identified production systems and separate questionnaires developed if necessary (often with much in common) to meet their special needs. The formal survey can be administered to samples of members following both systems in the same field exercise. Ideally, survey work is done during the cropping season but it is feasible at any time. With the emphasis on the informal survey for understanding and the identification of interventions, and formal survey for verification, experimental plans are not contingent on full processing of the formal survey data, often a

cause of major delays. Key verification data are: farmers' identification with priority constraints; the apparent acceptability of non-rejection of the proposed interventions; and the willingness of farmers to host experiments. These can be extracted by hand to justify experimental programs centered on interventions identified by the informal survey.

c. Transhumant Production Systems Panel Study

This program parallels the sedentary system study and is equally fundamental to the central systems thrust of the project. With the transhumants farming systems, research experience is on much shakier ground, and the desirability of research with transhumance farmers within their different seasonal environments is clear. Nevertheless, the team believes that the comment on re-weighting the balance of methods towards the informal survey, made in relation to the sedentary proposal, are also relevant to work among the transhumants. Additionally, the team would point out that the concept of project evaluation by comparing data collected at the beginning and the end of the project has a miserable history in practice, especially in highly variable environments such as the Western Sudan. It is, however, a project requirement that data are collected for evaluation. The team recommends that: (1) evaluation criteria be kept as simple as possible; (2) data to monitor these criteria are collected in the course of formal surveys essential to the central thrust of the project; and (3) the need for these data do not dictate the collection methods used or the size of samples to be covered. (Cases have been known in which collecting data to evaluate the project has absorbed all resources, precluding the collection of data to operate the project.)

3. Range Management and Livestock Production Proposals

Excellent work has been done to quantify the primary production of the rangelands and is being continued to investigate the effects of bushclearing and fire on rangeland productivity. Goats will be used to evaluate these practices. In addition, range use patterns and livestock productivity in all different grazing systems are being studied for sedentary and migrating herds. As well as production indicators, the status of the herds for parasitic and other diseases will be monitored.

Dry season nutrition is undoubtedly a major constraint in the target systems, although which classes of livestock are affected most in terms of their contribution to overall livestock production have yet to be defined. Experimental work using rangeland hay and other crop by-products as supplements to various classes of animals is planned and their effect on weight gain, milk production, fertility and disease status will be measured. This is the major link of the animal with the crop subsystem. Some work will be done at the station and some with cooperating farmers.

More detailed studies on the nutritive value of the rangeland grasses and shrubs is planned which, although not of immediate relevance to possible intervention in the existing system, should help to interpret

seasonal variations in production of the herds. Monitoring of three sentinel herds for the prevalence and severity of parasites and other diseases is an important aspect of the program and ways are being investigated of identifying major disease constraints experimentally.

The strength of this component is that it has three capable senior scientists; however, there is an urgent need for them to be supplemented with more Sudanese staff. The rangeland productivity studies are well advanced and many of the proposed studies will be made under simulated or control management situations. Facilities for handling cattle have been completed (but could be upgraded) and sentinel herds at the station and with the transhumant herds are operating.

Relatively small numbers of cattle are available for observation or experimentation; no small stock are yet available. On-station facilities for generating technical information under controlled conditions, e.g. animal house, feeding pens, metabolism cages are not yet available.

The major weakness is that the work plan and proposals have been developed before the diagnostic survey work at the production system level, and thus without a sound basis for a ranking of farmers' priority problems on the livestock side.

In addition to the rangeland classification and evaluation project, already completed (except for periodic monitoring), nine research proposals have been made. Using the terminology of 'central thrust' and the three types of 'support thrust' described in Section IV, they can be classified as follows:

a. Central thrust proposals

- (1) Preliminary study and evaluation of livestock production systems.
- (2) Supplemental feeding part II: dry season feeding of native grass hay to cattle of cooperating farmers.

b. Support thrusts: investigations for biological understanding

- (1) Nutritional factors affecting livestock production in Southern Kordofan.
- (2) Patterns of range use and response under different grazing systems.
- (3) Burning and control.
- (4) Low level aerial surveys of human, agricultural and range resources of the Nuba Mountain Region.

- (5) Animal production/health evaluation in three sentinel herds.

c. Support thrusts: technical applied research

- (1) Bush control studies (fire and goat)
- (2) Dry season supplementary feeding of livestock
Part I.

It is hoped that participation by the animal scientists in the survey work recommended to precede the 1983 rains (Section V, 1) will produce immediate priority animal interventions which will allow a more balanced program, putting greater emphasis on the early introduction of interventions to producers. The team recommends that any direct interventions which are identified take priority if there are inadequate resources to implement the whole of the revised program.

The team has additional comments on two specific proposals. Proposal a (1) should be achieved in the course of the interdisciplinary informal survey work recommended for early 1983. As observed above, the supplemental feeding proposals are probably focused on a priority livestock problem of sedentary farmers. The proposal listed as a (2) is the only on-farm experiment presently put forward in the animal program for 1983. It is analyzed more closely here to try to illustrate the differences between the rather traditional experimental approach used and the more informal modes characteristic of on-farm experiments in a systems oriented program. Three features illustrate the differences:

- (1) As designed, with hay cut by workers and stored by the researchers on the station, farmers will not experience the costs of the intervention. Unless these are carefully elaborated and understood by farmers they may make a false assessment of the usefulness of the intervention.
- (2) The researchers will direct how the farmers will use the hay. The implication being that they have the correct hypotheses about how it will best benefit farmers. The researchers could let the farmers determine how to use the hay and monitor their decisions on when to feed, which animals are to be fed, how much to feed and whether to substitute or supplement late grazing. The researchers will learn a great deal by discussion with farmers about their choices.
- (3) The researchers will rely on their own measurements of results (at a very great deal of extra effort). They are assuming they know the criteria by which farmers will value extra feeding. As in the approach to management, if they are confident of good technical effects they should be prepared to accept farmer assessments of the practice.

The team suggests that the management options could be left open to farmers and monitored and that the formal data recording is supplemented by farmer assessments of the costs and benefits of the intervention.

To make this exercise as meaningful as possible, the researchers will need to carefully explain to participants where they will have to get the hay from, when they will have to get the hay and how they will have to collect it, as well as the storage requirements. At this stage it will be important to probe farmers for alternatives in source, timing and method. The team feels that the exercise will give the animal and social scientists involved experience in monitoring farmers' opinions and in evaluating them together with the technical data obtained. Such experience is important as the farmer will ultimately arbitrate on whether the intervention is useful or not on his own weighting of costs and benefits. It will be useful for the scientists to assess this decision making process as far as possible.

4. Cropping Systems and Agronomy Program

The technical assistance cropping systems agronomist has only recently arrived in Kadugli and has had very little exposure to the systems orientation around which the project is organized. The Sudanese senior agronomist has been heavily pre-occupied with his duties as Director of the station. It is not clear how much he participated in preparing the agronomy proposals.

Eleven research proposals are made, all of these can be categorized as support thrusts in applied research, and all are experiments in the classic reductionist tradition. The majority, six proposals, are for varietal screening of crops presently important or with potential for the Kordofan area. One of the experiments is proposed for farmers' fields. It is a rotational trial with eight treatments and three or four replications, continuing for a three year period to obtain results. This is a very complex initiation to farmers' field work in the area and the team suggests if after review the trial is to go ahead it be done on the research station or a closely controlled off-station site if more typical soils are sought. The other ten experiments are proposed for research farm sites. Although the proposals review the relevance of the experiments to Kordofan farmers, they have not arisen from a diagnosis of the technical problems associated with key constraints in the farmers' system.

There is still some lead time to the next season. The general team recommendation (Section V. 1), that work is undertaken with a view to including on-farm experiments based on a systems diagnosis, gives the opportunity for the cropping system and agronomy unit to identify direct, relevant interventions, and bring a better balance to its 1983 proposal. Agronomists should carefully review past ARC work on the main crops of the Kordofan area to give a base against which farmers' current management can be evaluated. When agronomists identify a gap offering major potential for yield improvement and when socio-economists verify that closing the gap is consistent with farmers priorities and feasible with their resource endowments, a direct intervention is identified.

As intimated earlier the team fully recognizes the need for technical research support for the central thrust of the adaptive work. A review of ARC on-going programs relevant to the Western Sudan should identify applied research cooperators to undertake some of these support thrusts. When diagnostic survey work shows up technical issues in crops agronomy with no off-the-shelf solutions available, but clearly vital to the solution of farmers' major problems, and for which ARC has no relevant supporting programs, the section must undertake its own applied research support thrust. Much current information, from secondary sources and project surveys already completed, can be brought to bear to give applied experiments close relevance to the priorities of Kordofan farmers, and to allow interpretation of results on the criteria that farmers themselves will use. The case of the proposed sorghum variety trial is taken as an example. Reference is made to the INTSORMIL Report No. 2 (Farming Systems in North Kordofan, Sudan, pp. 110-113), which shows the kind of detail which can be obtained from discussions with farmers, and as the authors (Reeves and Frankenberger) say, indicates the great importance of millets and sorghums locally. It is also clear for the Southern Kordofan that farmers grow several types of sorghum, usually mixed in the same stand. Types will be favored for different use characteristics; fresh eating, good for porridge, good for beer and good for storage, etc, and by their growth habits, early maturing, drought tolerant perhaps at particular stages of growth, bird resistant, etc. Permutations of these and other characteristics will reside in varieties seen as particularly valuable to farmers. Variety trial entries can be chosen and screened very much more effectively with this type of information at the disposal of the agronomist. It is unlikely that one variety will substitute for all that the Kordofan farmer grows, or provide all he expects from his sorghum. Trials are best put together to search for the particular combinations of characteristics farmers value. Some trial varieties could be promoted as substitutes for specific farmer varieties to ensure they are appropriately evaluated by farmers. This kind of information on farmer varieties can be obtained from two or three on-going discussions with four or five good informants and allows much more farmer oriented applied research. Similar information can give closer relevance to all types of applied research thrusts motivated by the project.

The team hopes that the cropping system and agronomy scientists will be able to participate in informal surveys over the next few months and achieve a closer fit for both an on-farm adaptive and an applied 1983 experimental program. As noted earlier, it is suggested that if resource requirements are too high in order to complete both the applied proposals made and the direct interventions identified during survey work, that direct interventions take priority.

Identification of possible interventions which could be carried out in season 1983-84 on farmers' fields would perhaps include: the use of seed dressings of fungicides/insecticides to combat sorghum smut and seed bed losses due to termites; weeding experiments including early removal of weeds (2-4 weeks after plant emergence) compared to late weeding; comparison between ARC recommended varieties of sorghum, millet and sesame and local varieties.

Consultations in the WSARP research station committees with the relevant ARC national coordinators for soils, sorghum and millet, sesame, groundnuts, horticulture, botany and plant pathology, and entomology would contribute to the project.

Further, it is suggested that consultations be held with eminent scientists who contributed to crops and cropping systems research in similar ecological zones and presently operate from outside the ARC, such as:

Dr. Mohamed Osman Mohamed Salih, Deputy Director-General,
Arab Organization for Agricultural Development, Khartoum.

Dr. Musa Mohamed Musa, Consultant, Arab Organization for
Agricultural Development, Khartoum.

Dr. Osman Ahmed Ali, Professor of Soils, Faculty of
Agriculture, University of Gezira, Wad Medani.

Sayed Mahmoud Ahmed Mahmoud, Advisor Mechanized Farming
Corporation, Khartoum.

Consideration may be given to the development of an agricultural engineering research program on the use of hand and bull-drawn implements for soil tillage, sowing, weeding, harvesting and threshing of crops. In addition to collaboration with SATEC and GtZ more links should be forged with the following:

- (1) The Faculty of Agriculture, University of Khartoum, Shambat in the area of bull-drawn implements;
- (2) ICRISAT and the Indian National Research Program for hand tools and bull-drawn implements; and
- (3) IRRI for hand operated grain threshers and winnowers.

5. Research Plans at Other Stations

a. El Obeid

A comprehensive work plan has not been developed for the El Obeid station, but it is anticipated that WSARP activities on preservation of the environment and conservation of water resources will emanate from the station with some studies at El Fasher and possibly other stations.

El Obeid will become the major ARC station for millet breeding after the completion of the facilities. It is anticipated that the millet improvement program, along with the technical assistance from ICRISAT, will be shifted here from Wad Medani as early as possible. This would make good sense since Kordofan is the major millet growing region. Some field trials have been conducted over the past several years and varieties are available to expanded use when the station is completed.

Efforts by INTSORMIL agronomists to improve on-farm crop and water management practices will be continued and expanded upon as the WSARP

program develops.

El Obeid long has been a marketing center for Western Sudan and the significance of marketing to all agriculture dictates that WSARP marketing studies should be centered here.

As mentioned above, WSARP training activities will be based here. It is anticipated that collaboration with the extension service will be most extensive in El Obeid since it is the site of the Kordofan Regional Agricultural Ministry, with a dynamic minister.

Gum research was initiated at El Obeid in 1957 as a division within the Forestry Department. Later the Forestry Research Division along with several other national agencies was transferred to the administration of the ARC. It is assumed this work will be transferred to the new stations' research program.

b. El Fasher

A work plan has not been developed but it is expected that El Fasher will serve as a field station for the El Obeid based research project on water conservation and prevention of desert encroachment. Means of improving range and forestry development will be evaluated on the desert fringe.

Improvement of husbandry practices and health status of camels, sheep and goats will be program objectives. Cooperation with the Regional Veterinary Services will be fostered. The Darfur Ministry of Agriculture has its headquarters in El Fasher.

c. Ghazala Gawazat

The WSARP research program at Ghazala Gawazat is expected to emphasize improvement of genetic stock through improved breeding programs for cattle. Range evaluation studies will be conducted in cooperation with the Western Savannah Development Corporation. There is presently a herd of more than 500 cattle with two graduates in charge of on-going activities on the farm. It would seem appropriate that the existing professional staff and a selected group of the farm laborers and live-stock should be incorporated into the station when the facilities are completed.

Breeding work will be conducted with groundnuts and the agronomic studies will include cultural management practices to maintain soil fertility and more efficient utilization of water.

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

6. Central Research Support

The role and function of the Central Research Support Unit to be located at El Obeid (Work Plan Vol. I, Part B, p. 110) need to be more clearly defined and the staffing tables should adequately reflect this. At present the policy and planning for this unit appears confused.

Depending on the volume of samples for analyses generated by systems groups in their on-farm, or on-station, research it is likely that this unit will require a chief chemist and an assistant agricultural chemist and 2-5 laboratory technicians.

Central and support thrusts are both likely to generate material that will require some chemical analyses and will certainly require statistical analysis. While it is desirable for as much of this as possible to be done by the station or systems team which generates the material, it is likely that a procedure will have to be developed to establish priorities on the Central Unit's time and resources.

A computer programmer will probably have to be appointed as well as a biometrician to service the data processing requirements of the WSARP. The team recommends that these positions be filled at an early date.

VI. CONSTRUCTION

It is the understanding by the evaluation team that a USAID civil engineer will evaluate the construction program in coordination with Karplen Consulting Architects and WSARP engineers. Therefore, only a few observations will be presented here.

There is every indication that a satisfactory job has been done in identifying facility needs, establishment of sites, and in the selection and functioning of a highly qualified architectural firm for planning, document preparation, tendering and supervision of the main construction program.

It was a wise decision to give priority to one station (Kadugli) to enable research programs to get underway with minimal delay. Some research was initiated while construction was in progress. The buildings were turned over to the GOS on October 15, 1982, only about six months behind the earlier projected date for completion. The quality and appropriateness of the administration building, staff housing, research laboratory and other facilities appear to be satisfactory to meet the needs of this station. Roads, landscaping, and the station farm are yet to be developed.

A major problem of maintenance of the buildings and equipment does exist as pointed out earlier.

The architectural firm seems to have done a good job in designing the buildings and in supervising the construction at other sites - ARC headquarters building at Shambat, facilities for the main station at El Obeid, and facilities at El Fasher and Ghazala Gawazat. The most

extensive facilities are at El Obeid and are just about equal in scope to those at all the other sites combined.

The construction at these four sites is running behind schedule by approximately 18 months due to many factors. These delays will undoubtedly result in some cost overruns, but the team has no suggestions for solution of this situation.

When completed, the four stations in the Western Regions and the headquarters in Shambat, will provide the ARC and WSARP with generally adequate facilities for serving the people of Western Sudan.

VII. FUTURE MAJOR CONSIDERATIONS

1. Strengthening of the ARC

Only a few of the joint teams' recommendations in 1977 for strengthening of the ARC have been implemented. Among these, the ARC reorganized itself into commodity and factor problem research and appointed national coordinators. It separated management of the ARC headquarters from Gezira Research Station management and appointed two Deputy Director Generals concerned with administration and finance and programming.

An expatriate senior research advisor to the ARC Director General in organization and management of agricultural research was appointed. The terms of reference of the senior research advisor are detailed in page 21, Vol. II of the WSARP work plan 1982-1985. It is noteworthy that the joint team (1977) recommended the appointment of a consultant to assist the Director General with the overall organization and management of the ARC (Recommendation 3).

The ARC has not been able to transfer its headquarters to Khartoum and has not integrated crop production and animal production research except in the WSARP.

It is crucial that the ARC headquarters should be transferred to Khartoum. Office facilities at Shambat to accommodate the Director General, his deputies and relevant senior officials are nearing completion. As noted earlier, provision of eleven senior and middle level houses costing less than one million dollars forms the only obstacle for the transfer of the ARC headquarters to Khartoum.

Other important recommendations of the joint team remain to be implemented. Some of these are: strengthening of program planning, budgeting and management systems based on project structure to facilitate program coordination and evaluation; strengthening information, library, documentation, and publication services, particularly the publishing of the Sudan Journal for Agricultural Research; strengthening communications and transport services; and appointment of subject matter specialists at the research stations to conduct on-farm research and to furnish primary liaison with the provincial, area development or production scheme agencies concerned with extension services.

2. Project Sustainability

Besides adequate budgetary provisions to the WSARP the most important consideration in project sustainability is the attraction and retention on a continuing basis of senior Sudanese scientists and technicians.

The Western Regions in general, and particularly some of the stations of the WSARP such as Kadugli and Ghazala Gawazat, are considered hardship locations. Appropriate incentives are necessary to attract and retain senior Sudanese scientists and technicians who are in great demand within and outside the Sudan. The WSARP should consider immediately implementation of incentives which do not contravene Government regulations. These would include, for instance, provision of free fully furnished houses to senior and junior Sudanese scientists and senior technicians. Negotiations with the Ministry of Agriculture and the Ministry of Finance should be stepped up at a high level to implement the 25% increase in salaries of the WSARP and ARC staff on the newly determined basic salaries.

3. Project Replicability

It is imperative that the WSARP should be sustained long enough beyond the projected five or seven years to ensure its permanent effectiveness and success. Several regions in the Sudan with similar patterns and systems of production would benefit from adoption of the WSARP methods and techniques. Some of these are:

a. The Northern and Southern Fung areas (in the Blue Nile Province of the Central Region) which are served presently by the Kenana Research Station at Abu Naama. Traditional rainfed agriculture is practiced by sedentary and transhumant tribes in the high rainfall areas (600-800 mm) of the Southern Fung and light rainfall areas (300-500 mm) of the Northern Fung. Nomadic and transhumant tribes include Rufaa and Kenana. Mechanized farming exists in Agadi-Gerabin, Mazmum and Dali areas. Important joint venture and private schemes exist in the Damazin area.

b. Southern Gedaref, Northern Gedaref Districts and the Butana Plains of the Eastern Region. Traditional rainfed agriculture as well as mechanized farming exist side by side. Nomadic and transhumant tribes roam the area amongst others. Irrigated schemes at Rahad, Khashm El Gerba, the Gash Scheme and Kassala horticultural gardens are important economic projects of the region. The region is served by Khashm El Gerba Research Station and field stations at Gedaref (Sem Sem) and Aroma.

c. The Southern Region: areas worthy of consideration here are:

- (1) Western equatoria mainly sedentary tropical agriculture and served by Yambio Research Station.

- (2) Sedentary and transhumant systems of agriculture along the upper Nile covering the Nilotic tribes' regions and including the Jonglei Project and Malakal area.
- (3) Bahr El Ghazal area including sedentary and transhumant production systems of the Bantu, Jur and Dinka tribes. The area is served by the Halima and Aweil stations.

4. Attainment of Goals

At this stage in the WSARP it is not possible to predict its degree of success in attaining the goals of improvement of productivity of subsistence farmers and pastoralists and their standard of living in Western Sudan through the development and institutionalization of an agricultural research network. A modest amount of research has been initiated at the Kadugli station, and farming systems studies are now being planned for the next cropping season (summer of 1983). These studies will attempt to define and alleviate the constraints of three primary production systems - sedentary farmers, seasonal transhumants, and nomads - in the Central District of South Kordofan.

Research facilities at the other stations (El Obeid, El Fasher and Ghazala Gawazat) will not be ready for occupancy until the first quarter of 1984. It will not be possible to start research at these stations until that summer's cropping season. This will leave only a relatively short time before the termination of present technical assistance. It is difficult to measure any impact on the lives and well-being of farm families in a period of only two or three years.

Under the best of conditions, with the stations fully staffed with scientists, technicians and other personnel and with adequate government budgetary resources, it will normally require a period of at least 12 to 15 years for research on crops-livestock production systems to have a favorable impact on the economy and standard of living of farm families. The biggest question at this time is whether or not the Government of the Sudan will be able to provide the financial support necessary for continuing operation of the research network after external assistance terminates.

As a consequence, it would appear desirable that plans be made for continuation of external technical assistance for at least another six-year period after the present contract terminates. This would be done with the expectation that the financial structure of the GOS would be sufficiently strengthened by that time to provide the necessary support for the network of research stations.

VIII. ANNEXES

ANNEX A. ACTIVITY SCHEDULE, PLACES VISITED AND KEY PERSONS CONTACTED

November

Events

- 12 (F) Team leader arrived and held informal meeting with Dr. James Henson, Project Coordinator, WSU and Dr. Jan Noel, Deputy Project Coordinator, WSU to discuss tentative itinerary and schedule of activities, evaluation team assignments and scope of work.
- 13 (Sa) Welcome and briefing by ARC and WSARP.
- Discussion of scope of work and agenda for evaluation with representatives of GOS, USAID, and IBRD.
Present were:
Dr. Dafalla Ahmed Dafalla, Project Director
Dr. Gerald P. Owens, Deputy Project Director
(Chief of Party, WSU)
Dr. Mohamed Bakheit Said, Director General, ARC
Dr. Osman Ibrahim Gemeel, Deputy Director General
(Adm. and Finance), ARC
Dr. John Fischer, Director, CID
Mr. Stuart Marples, Project Officer, IBRD
Ms. Joyce Turk, Project Manager, USAID
- Team members: Idris, Vercoe and Turk
Balance of day studying documents.
- 14 (Su) Studying of documents; planning of activities schedule. Meeting with USAID Mission Director, Arthur W. Mudge.
Also present:
Dr. Thomas C. Ivers, Acting Agr. Dev. Officer
Dr. Keith Sherper, Deputy Country Director
Ms. Joyce M. Turk, WSARP Project Manager (AID)
- Dr. Michael Collinson arrived to complete the team.
- 15 (M) Team and most of WSARP support staff flew to Kadugli in project plane.
- Met by large group at airport led by Commissioner Sayed Abdel Rahman Idris for S. Kordofan.
- Briefing at the Kadugli Station by Project Director Dafalla and Station Director Mukhtar Kenani.

November

Events

- 15 (M) cont'd. Kadugli staff present:
Dr. Neil A. Patrick, Agr. Economist (Deputy Chief of Party, WSU)
Dr. W. Trent Bunderson, Range Management
Dr. Joel M. Teitelbaum, Social Scientist
Dr. Richard H. Cook, Livestock Production (DVM)
Dr. Joe R. Gingrich, Agronomist
Ms. Barbara Michael, Associate in Research (Thesis study)
Dr. Babu Fadlalla, Animal Nutritionist
Dr. Ibriham Mohamed Daw El Medina, Agronomist
- Research proposals presented:
Range-Livestock Section (Bunderson and Babu Fadlalla)
Socio-Economic Section (Patrick and Teitelbaum)
Agronomy-Crop Section (Gingrich)
- Toured new facilities.
- Evening discussion on farming systems approach to research.
- 16 (T) Early visit to transhumant camp near station.
- Tour to Tiloh plots to observe agronomy plots.
- Visited research farm that is being established.
- Discussions on range-livestock management research proposals.
- 17 (W) Tour to Nuba village and farming areas.
- Discussions of Socio-Economic research proposals.
- Discussions of Agronomy-Crops research proposals.
- 18 (Th) Discussions on Production Systems Approaches of WSARP Program (Riley, Owens, and Kadugli staff).
- Individual sessions with Sudanese and Technical Assistance staff at Kadugli.
- Summary session with staff.
- Returned to Khartoum.
- Vercoe left team late in the evening.

November

Events

- 19 (F) Team held series of individual conferences with some of Administrative and Support Staff:
- Dr. Gerald Owens;
Dr. James Riley;
Dr. David Higgins (Project Engineer);
Dr. James Henson
Dr. Jan Noel;
Dr. John Fischer (CID);
Dr. Jean Kearns (CID);
Ms. Joyce M. Turk (USAID)
- 20 (Sa) Continued with individual conferences. Dr. Dafalla; further discussions with Drs. Owens, Drs. Henson and Noel and Dr. Riley.
- Started preparation of project outline
- Team discussions on project.
- 21 (Su) Travel by car to Gezira Station at Wad Medani
- Discussions with Director General of ARC, Dr. Bakheit Said.
Dr. Osman Gemeel, Deputy Director General, ARC.
Dr. Hassan Kalifa, Deputy Director General, ARC.
- Session with large group of staff, including national coordinators of commodity programs, on farming systems approach.
- Toured station farm to observe research:
Millet - Dr. R. P. Jain, leader, ICRISAT program;
Sorghum - Dr. Gebisa Ejeta, ICRISAT, leader of project;
Sorghum - Dr. Abdel Latif El Mubarak
Groundnuts - Dr. Abdel Moneim El Ahmadi
Cotton - Dr. Ibrahim El Jack
- Had a final private meeting with Dr. Bakheit on ARC-WSARP relationships.
- 22 (M) Reviewed team visit to Wad Medani with: Dr. James Riley; Drs. Henson and Noel; Dr. Fafalla; Dr. Gerald Owens.
- Team discussions on evaluation observations.

November

Events

23 (T)

Travelled by air to El Obeid.

Dr. Collinson stayed in Khartoum in order to write some sections of report.

Met with Zakaria A. Saad, Director of the Gum Arabic Station (ARC).

Tour of Acacia garden.

Meeting with Governor of Kordofan Region Mohamed Bushara (Formerly Ambassador to Saudi Arabia) and Minister of Agriculture (Kordofan) Dr. El Tag Fadalla.

Toured new station facilities now under construction.

Dinner in the evening with Governor Bushara and many government officials.

24 (W)

Travelled by air to El Fasher.

Met at airport by Dr. Ahmed Abdel Rahman, Director of Agriculture.

Team and part of group went to the Governor's house for brief visit with Sayed Ahmed Ibrahim Dereig, Governor of Darfur Region. Later he met with the group for a longer discussion.

Also met Ibrahim Alam Eldin, Regional Minister of Services and Dr. Abdel Rahman Bushara Dosa, Regional Minister of Agriculture.

Toured new facilities under construction for the El Fasher station.

Flew to Ghazala Gawazat for a brief look at new facilities under construction.

Returned to Khartoum in the evening.

25 (Th)

In Khartoum.

Team worked on preparation of report.

In the evening team members joined with WSARP staff (and their spouses) for a bountiful Thanksgiving dinner at the home of Dr. and Mrs. David Higgins.

November

Events

26 (F)

In Khartoum.

Dr. Collinson left team early in morning to return to Nairobi.

Remaining team members (Idris and Turk) work on report preparation.

27 (Sa)

Report preparation.

Turk held consultations with Dr. Charles Bailey, Ford Foundation Representative; and with Dr. Mohamed Osman Mohamed Salih, former Director General of the ARC.

28 (Su)

Completion of draft report.

Turk had consultation in evening with Sayed Mohamed Osman El Sammani, Social Scientist, University of Khartoum.

29 (M)

Oral report by Idris and Turk to representatives of USAID, ARC and WSARP personnel.

Discussion with Minister of Agriculture, Dr. Osman Abdel Rahman Hakim.

Debriefing session with Mission Director, Arthur Mudge and AID staff.

30 (T)

Idris and Turk depart for New York, 12:30 a.m.

Final report to be completed through correspondence with team members who were not present at the end of the evaluation period.

ANNEX B. CIMMYT - SEQUENCE OF LOW COST PROCEDURES FOR
ADAPTIVE RESEARCH

STEPS	TIME REQUIRED
1. Identification of the general region of the country with a priority for adaptive on-farm research.	
2. Collation of secondary information on the natural and economic conditions of the region.	2-3 months
3. Identification of recommendation domains and target groups of farmers operating a homogenous farming system within the region.	2-3 months
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4. Review of available background information on the recommendation domain.	1 week
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5. Informal survey	
- Discussions among farmers	2 weeks
- Conclusions (written)	1 week
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6. Design of formal verification survey	
- Sampling and fieldwork plan	1 week
- Questionnaire development	1 week
7. Enumerator training and questionnaire testing	1-2 weeks
8. Formal verification survey-- administration of the questionnaire to a sample of target group farmers	2 weeks
9. Post coding, tabulation of data and specification of analyses	1 week
10. Data input and processing	1 week
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11. Data interpretation and experiment planning	2 weeks
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12. Selection of representative farmers and sites for on-farm experiments	2 weeks
13. Preparation and layout of experiments (Modes (5)	
14. Supervision and recording of experiments and (6)	crop cycle
15. Harvesting of experiments, measurement and recording of yields referred to in Annex C)	
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16. Statistical and economic interpretation of data	4-6 weeks
17. Planning for the next season's experiments	4-6 weeks

The 'time required' for each step is within an on-going research program. If the work is being done while facilities are being set up and training being done, steps 6 - 10 especially will take longer than shown.

ANNEX C. A HIERARCHY OF EXPERIMENTATION: APPLIED AND ADAPTIVE RESEARCH

LOCATION	OBJECTIVES	CHARACTERISTICS	DESIGN AND INTERPRETATION
(1) On-Station	Measure biological potential of treatment components against non-inhibiting management background. Local soils, climate and biology not important.	Classic reductionist experimentation, much experimentation done in this mode should have been done under (2) Researcher managed	Classic designs, single site, minimizing sources of variation. ANOVA. Misleading for economic interpretation.
(2) Off-Station On-Farm	Local soils, climate and biology essential, otherwise as (1)	Classic reductionist method used for biological adaptation locally	Classic designs, may be several sites across regions ANOVA. Misleading for economic interpretation.
(3) On-Station	Establish biological potential and technical relationships against typical farmer management background. Local soils, climate and biology not important.	Reductionist techniques: to establish technical relationships & response between components against a background of simulated farmer practice- Researcher managed.	Classic designs, single site ANOVA. Preliminary economic analysis may give useful guidance.
(4) Off-Station On-Farm	Local soils, climate and biology essential, otherwise as (3)	Similar reductionist techniques used where farmer conditions both environmental and management cannot be achieved on research station	Classic designs, may be several sites ANOVA. Preliminary economic analysis for useful guidance.
(5) On-Farm	Establish improvement in productivity and stability in returns to resource-limiting; farmers achievements. Farmer practice is control.	Researcher guides farmer on treatments-farmer manages all non treatment variables-researcher monitors management and results and farmer assessments.	10-15 sites with single rep. larger plots, allow variation from climate, soils, management differences to have full effect. Cross site analysis on farmer's criteria. Paired t tests for statistical analysis, stability analysis, farmer assessment
(6) On-Farm	Expose intervention to farmer in comparison with his own practice.	Farmer manages, researcher monitors farmer's assessment on all management aspects as widely and as detailed as possible.	Farmers choice. As many sites as possible, large plots.

APPLIED

APPLIED/ADAPTIVE

ADAPTIVE

ANNEX D. EXAMPLE OF A QUESTIONNAIRE USED FOR PRELIMINARY ZONING OF FARMERS SYSTEMS BY AREA AND HIERARCHICAL GROUPS

DISTRICT _____ WARD NO. _____ HIERARCHICAL GROUP _____

A. Animal kept by <u>most</u> farmers	1. Two main types of animals kept	1		
		2		
	2. If cattle main purposes for keeping	1		
		2		
		3		
B. Foods grown (G) or bought (B) by <u>most</u> households	1. Starch staples ranked in order of importance	1		
		2		
		3		
	2. Relish crops to flavor staples	1		
		2		
		3		
	3. Animal products for food	1		
		2		
	C. Main cash sources for <u>most</u> farmers (rank overall) (1st, 2nd, 3rd)	1. New cash crops and % growing	1	
			2	
		2. Crop sales as cash source	1	
2				
3. Livestock as a cash source		1		
		2		
4. Off farm cash source		1		
		2		
D. Land use methods and time of preparation by <u>most</u> farmers		1. Years cultivated	1	
		2. Typical area (ha)	1	
	3. Main methods of land preparation	1		
		2		
	4. Main months of land preparation	1		
		2		

Overall ranking

ANNEX D (continued)

E. Hire and purchase of resources by <u>most</u> farmers	1. Types of hired labor & payment	1	_____
		2	_____
	2. Work done by hired labor	1	_____
		2	_____
	3. Main inputs	1	_____
		2	_____
		3	_____
		4	_____

Farm System Zoning Questionnaire: Central Province, Zambia