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WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

REVIEW OF SEED PROGRAMS IN SUDAN

WSARP PUBLICATION No. 16

OCTOBER 1983

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

REVIEW OF SEED PROGRAMS IN SUDAN

James D. Maguire

Seed Physiologist and Technologist
Department of Agronomy and Soils
Washington State University

WSARP PUBLICATION No. 16

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J. D. Maguire

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List of Acronyms

ABS	Agricultural Bank of Sudan
AfDB	African Development Bank
AfDF	African Development Fund
ARC	Agricultural Research Corporation
CID	Consortium for International Development
FAO	Food and Agricultural Organization of the United Nations
GOS	Government of Sudan
GTZ	Deutsche Gesellschaft für Technische Züsamminarbeit (German Technical Assistance Program)
ICD	Industry Council for Development
ICRISAT	International Crops Research Institute for the Semi Arid Tropics
INTSORMIL	Sorghum/Millet International Research, The Management Entity of the Sorghum/Millet Collaborative Research Support Program (CRSP)
IPDO	International Program Development Office
MAFNR	Ministry of Agriculture, Food and Natural Resources (Government of Sudan)
MFC	Mechanized Farming Corporation
NSA	National Seed Administration
PPA	Plants Propagation Administration
PPS	Plant Propagation Service
SCA	Seed Certification Administration
SOC	Sudan Oil Seeds Company
USAID	US Agency for International Development
WSARP	Western Sudan Agricultural Research Project
WSU	Washington State University

I. Introduction

Quality seed of high varietal purity and good viability is essential for productive agriculture. In Sudan, quality seed of both grain and vegetable crops in sufficient quantity to supply the needs of farmers has not been readily available. Traditionally, Sudanese farmers have maintained their own seed supplies through home storage of a portion of the previous year's crops, or through purchase of seed at local markets. Inherent in such a system are potential losses of seed due to disease, spoilage, and rodent damage, and poor quality of seed due to poor storage conditions. Varietal purity cannot be guaranteed under such circumstances, and seed borne diseases can flourish. Limited transportation networks, and years of poor crops and food shortages can combine to make some seed unavailable at proper planting times. These problems have been compounded in recent years by the gradual shift from pastoralism to cultivation--particularly in the Kordofan and Darfur provinces (WSARP, 1981, Second Annual Report).

Since 1965, the Government of Sudan (GOS) has officially recognized the need for an improved seed program which could provide Sudanese farmers with reliable seed in sufficient quantity to increase agricultural productivity. However, productivity is still low, and annual production of improved seed amounts to only 3-5 percent of the country's requirements (FAO, 1981). A brief review of past and current governmental, and other agency programs, is included in this report.

The Western Sudan Agricultural Research Project (WSARP) was established in 1979, with financial support from GOS, USAID, and the World Bank. The Consortium for International Development (CID) has the contract for this project from USAID, with Washington State University (WSU) responsible for its implementation. Primary goal of the WSARP is to develop an integrated crop and livestock production program in the traditional rainfed agriculture region, which is comprised of the Darfur and Kordofan Regions (North and South Darfur Provinces, and North and South

Kordofan Provinces) in Western Sudan. Seed is a critical part of such a system, and WSARP and ARC scientists are cooperating with ongoing seed improvement programs as well as initiating research activities which will augment other programs. Washington State University, lead university of the WSARP, is a world leader in the development of improved varieties of wheat, barley and other crops, and has a long established seed program. In addition, WSU has recognized seed production and technology as an important focal point in international development and participation, and seeks to strengthen its faculty expertise in this area. In 1982, the Strengthening Grant Committee at WSU designated Dr. James Maguire, Professor, Agronomy and Soils, as a short-term advisor to the WSARP. His tour of seed facilities and research stations in Sudan in August-September of 1982 was expected to result in benefits to both the WSARP seed programs, and the WSU domestic and international educational and research programs. Specifically the objectives of his tour were to:

A. Interact with the national seed program under the National Seed Administration, Ministry of Agriculture, Food and Natural Resources (MAFNR) concerning their activities directed toward the provision of seed for Sudan, particularly in the Kordofan region.

B. Evaluate the inputs of FAO into the national seed program through their past and current programs involving seed production, technology and distribution.

C. Discuss with ARC plant breeders their activities relative to development and provision of genetic materials and basic seed stocks in WSARP crop areas (especially sorghum, millet, sesame, groundnuts and vegetable crops).

D. Discuss with the Regional Minister of Agriculture for Kordofan Region the needs and activities for the provision of seed to farmers in that region.

E. Visit the Kadugli Research Station of the WSARP for the purpose of examining seed needs and mechanisms for defining and supplying genetic materials to the farmers in the project area. Work with WSARP scientific staff there to determine research approaches to meet the farmers' needs and to provide seed stocks for these research activities.

F. Interact with USAID mission staff in agriculture regarding seed matters, particularly concerning vegetable seed.

Visits and conferences were scheduled in the following cities and surrounding areas: Khartoum, Kadugli, El Obeid, Wad Medani, and Sennar (See Figure 1 for map of region and route of tour). On the basis of discussions with farmers, governmental, WSARP and other project personnel; (See Tables I and II for List of Individuals and Agencies Contacted and itinerary of consultant), assessment of public and private resources and needs; and reports and selected literature pertinent to the seed program in Sudan, the following review and recommendations were prepared. These recommendations are made for the purpose of improving seed production and technology activities in Western Sudan. Such activities are considered to be a critical part of the WSARP research and extension of programs designed to increase agricultural productivity in the Western rainfed regions.

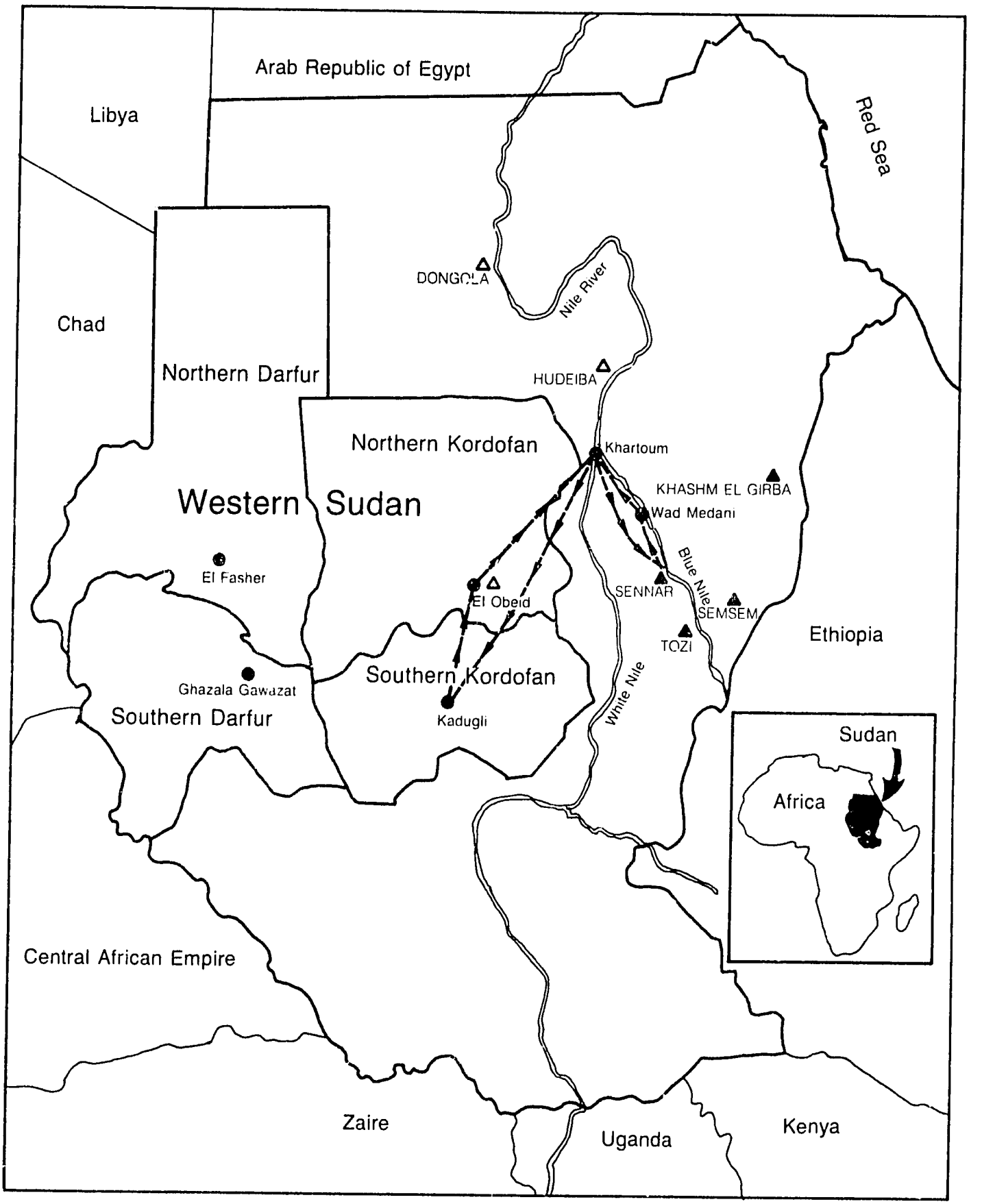


Figure I. Map of Region, Seed Stations, Route of Consultant's Tour

- ● Seed Research Station
- → Route of Consultant James C. Maguire August 14-September 7, 1982
- ▲ Existing Seed Farms/Stations
- △ Proposed Seed Farms/Stations

Table I. INDIVIDUALS AND AGENCIES CONTACTED

El Obeid

Dr. Eltag Fadalla.....	Regional Minister of Agriculture
Mr. Zakaria Abdalla Saad.....	Head Research Station
Dr. Tareke Berhe.....	Agronomist, INTSORMIL
Mr. Ibrahim El-Miergham Rizig..	Director, Public Relations, Ministry of Agriculture
Mr. Ahmed Majid Khogari.....	Director, Agricultural Bank of Sudan
Mr. Farouk Mohamed Elhadi.....	Forestry Research Office (currently at WSU)

Kadugli

Dr. Neil A. Patrick.....	Deputy Chief of Party and Agricultural Economist, WSARP
Mr. Mukhtar Mekki Kenani.....	Director, Research Station
Dr. Joe Gingrich.....	Agronomist, WSARP
Mr. Ibrahim Mohamed Daw Medani.	Agronomist, WSARP
Dr. Joel M. Teitelbaum.....	Social Scientist, WSARP
Dr. Richard Cook.....	Livestock Production Specialist, WSARP
Mr. Ahmed Bilal Eldin Salah....	Cotton Breeder (Wad Medani) ARC
Mr. Ibrahim Abdulla Babiker....	Soil Scientist, WSARP (Currently at WSU)
Mr. George Winter.....	GTZ Representative
Mr. Neils Hansen.....	Agronomist, GTZ

Khartoum

Dr. Dafalla A. Dafalla.....	Director, WSARP
Dr. Gerald P. Owens.....	Deputy Project Director, WSARP
Dr.James J. Riley.....	Senior ARC Advisor
Mr. Lee Stenquist.....	Chief Administrative Officer, WSARP
Mr. Osman Abdalia Mohamed.....	Assistant Director, Administration, WSARP
Dr. M. S. Joshi.....	AfDB/AfDF Seed Project Coordinator
Mr. Floyd McGrath.....	Agronomist/Horticulturalist, Blue Nile Project (Damazin)
Mr. Ken Eubank.....	Economist, Blue Nile Project (Damazin)
Mr. Eric Witt.....	Head Food and Agriculture Officer, USAID
Ms. Joyce Turk.....	Assistant Agricultural Officer, USAID
Dr. Earl L. Leng.....	Director, INTSORMIL (University of Nebraska)
Dr. Richard Vanderlip.....	Agronomist, INTSORMIL (Kansas State University

Dr. A. M. Bebawi.....	Botanist, University of Khartoum (Shambat)
Dr. L. J. Musselman.....	Old Dominion University, VA (On sabattical leave at University of Khartoum)

Sennar Seed Station

Mr. Mohammed Aziz Ahmed Abdel..	Director, Plant Propagation Administration (PPA)
Mr. Mohammed Abdul Farrag.....	Director, Seed Certification Administration (SCA)
Mr. Mohammed Ahmed Yousif.....	Head, Storage and Marketing Section (PPA)
Mr. Mohammed El Naman Osman....	Head, Production and Training Section (PPA)
Mr. Mohammed Sharif Suliman....	Head, Sennar (Main) Station
Mr. Mohammed Abdul Gabbar.....	Head, Sennar (West) Station
Mr. Roy F. Hudgins.....	President, Paul Hathaway Co.
Mr. M. A. Elmufti.....	Director, Gezira Trading House (Sudan Representative for Pioneer Hibred International)

Wad Medani

Dr. Tigani Mohammed ElAmin.....	Director, Gezira Research Station
Dr. Mohammed Bakheit Said.....	Director General, ARC
Dr. A. B. M. El Ahmadi.....	Head, Plant Breeding Section, ARC
Dr. Abdel Latif El Nonr.....	Sorghum Breeder, ARC
Dr. Ejeta Gebisa.....	Sorghum Breeder, ICRISAT
Dr. R. P. Jain.....	Leader ICRISAT Project, Millet Breeder ICRISAT
Mr. Ahmed Eldin Bilal Salah....	Cotton Breeding Section, ARC (Wad Medani)

(S1.6)

Table II. ITINERARY OF JAMES D. MAGUIRE, SEED CONSULTANT

AUGUST - OCTOBER 1982

Itinerary:

8-10 August	Conference with International Program Development Office and preparation for departure
11 August	Departed for Paris enroute to Khartoum
12 August	Arrival in Paris
13 August	Conference with Dr. Y. Maury, INRA, Versailles regarding seed pathology problems in developing countries. Tour of seed research facilities. Conference with Dr. C. Anselme, GEVES, La Miniere regarding seed technology programs for sub-Saharan Africa. Tour of seed testing facilities.
14 August	Departure from Paris; arrival in Khartoum
15 August	Orientation and conference with Drs. J. J. Riley and G. Owens and WSARP staff. Research conference with representatives INTSORMIL and Blue Nile Project.
16 August	Conference with E. Witt, USAID Agricultural Mission. Conference with Dr. Ibrahim, Seed Physiologist, University of Khartoum.
17 August	Travel to Kadugli via WSARP plane. Conference with Dr. N. Patrick and WSARP staff.
18 August	Tour of WSARP research station. Tour of WSARP and GTZ field research trials.
19 August	Conference with WSARP staff regarding seed needs and seed facilities for research station.
20 August	Tour of Nuba Mountain Corporation facilities for cotton seed conditioning and storage.
21 August	Conference with Cotton breeder and tour of local cotton gin and seed facilities.
22 August	Tour of local farm seed storage and planting operations. Conference with GTZ representatives regarding farming systems
23 August	Travel to El Obeid via truck. Visit with Z. Saad, Head of Research Station.

24 August	Orientation Conference with Dr. Eltag, Regional Minister of Agriculture, regarding seed needs for Kordofan. Tour of local grain markets and seed storage facilities with ABS representative.
25 August	Tour of INTSORMIL millet research plots with Dr. T. Berhe. Tour of ARC sorghum, millet and sesame research trials.
26 August	Conference with Z. Saad regarding seed research facilities for El Obeid. Return to Khartoum via charter plane.
27 August	Report preparation and seed program review.
28 August	Conference with WSARP staff on seed research. Review of seed program in Sudan.
29 August	Literature review of relevant seed research.
30 August	Conference with Dr. M. S. Joshi, FAO Seed Program Organizer and National Seed Administration staff regarding seed program.
31 August	Conference with USAID staff about seed problems and program needs.
1 September	Review of Sudan seed program.
2 September	Seed report draft and preparation for trip to Sennar
3 September	Travel to Sennar. Conference with ARCNSA staff on seed production and conditioning operations.
4 September	Tour of seed facilities at Sennar Conference with seed testing and research staff.
5 September	Travel to ARC, Wad Medani. Conference with Dr. Bakheit, ARC. Tour of research trials with ARC staff. Return to Khartoum.
6 September	Conference with Sorghum Breeder, University of Khartoum, and Dr. L. Musselman, Striga Researcher, Old Dominion University.
7 September	Departed Khartoum to London, enroute to Pullman.
8 September	Departed London enroute to Seattle. Arrived in Pullman.
18 October	Presented seminar on seed program in Sudan.

II. Summary/Background of Seed Production in Sudan

In 1965 the Government of Sudan (GOS) established an administrative unit of the Ministry of Agriculture and National Resources (MAFNR) entitled the Plant Propagation Administration (PPA), entrusting to it the seed multiplication and distribution of all crops except cotton. Cotton was exempted from the original mandate as the pre-existing program of the Sudan Gezira Board was sufficiently well organized to meet demands. The Agricultural Research Corporation (ARC), a separate administrative unit of the MAFNR, was responsible for the development, testing and introduction of improved varieties of important crops, as well as the production of breeder seed. Ideally under that system, the ARC, at research stations established throughout Sudan would produce sufficient breeder seed of commonly used or introduced improved varieties of major crops to supply the PPA. The Plant Propagation Administration would then in turn multiply the seed at a series of government owned seed farms/-stations, and distribute the resultant basic seed, graded, and certified, to farmers, or to the large public production corporations in the irrigated agricultural sector, i.e. Gezira Scheme, Rahad Agricultural Corporation and others. Many constraints at local, regional and national levels worked against the fulfillment of these objectives, among them a lack of sufficient facilities for controlled temperature storage, insufficient equipment for cleaning and conditioning, no vehicles or gasoline for field inspections, and limited funds to pay labor; limited transportation networks, particularly in the West; and lack of an independent certification service, and national seed legislation. These factors, combined with the growing demand for quality seed, prevented the attainment of necessary seed production levels.

Due to this inability to achieve national seed production levels, several of the large public farming corporations --primarily Gezira, Rahad, New Halfa and the Mechanized Farming Corporation (MFC) in central Sudan; initiated independent seed production programs. These were concerned chiefly with the production of wheat, sorghum, groundnut, and sesame seed for use by the production corporation tenants.

In 1975, a "Seed Production and Certification Project" (SUP/71/550 active 1975-80) financed by the Food and Agriculture Organization/United Nations Development Programme (FAO/UNDP), assisted the GOS and the PPA in the removal of some of the constraints to seed production. Along with technical assistance in the form of improved facilities at seed farms, and training programs for personnel, a major reorganization plan for the PPA was prepared. The proposal called for the division of plant propagation and seed certification services, creating two independent administrative units, the Plant Propagation Administration (PPA), and the Seed Certification Administration (SCA), which would be reorganized under the direction of a National Seed Administration (NSA), directly accountable to the Ministry of Agriculture and Irrigation. These administrative divisions were implemented in June, 1982, and remain the organizational structure through which current seed programs are channeled. In addition, a draft of a national seed law was prepared.

Further improvements in facilities, particularly for groundnut and sesame seed production at the West Sennar Station, were completed under the "Oil Crops Seed Production Project" (NECP 1502 1IRQ, active 1979-81).

Presently, a new FAO/UNDP sponsored project, the "Sudan Seed Production Project," financed by the African Development Bank, African Development Fund, and the GOS, is beginning operations. It's primary goal is to assist the NSA in the continued development of a national seed program for Sudan. Specific improvements to be completed during the four-year program include:

Establish three new stations for seed production, conditioning and distribution at Dongola, Hudeiba, and El Obeid.

Strengthen the existing five PPA seed stations for seed production, conditioning and distribution at Sennar Main, Sennar West, Khashm el-Girba, Tozi and Semsem.

Support the reorganization of the National Seed Administration and establishment of a head office in Khartoum.

Support the ARC program for production of breeder seed.

Provide assistance to the existing production corporation's seed programs by supplying credit for equipment purchases.

Provide financial support for the NSA seed program in the form of incremental cost of operation and maintenance for four years.

Provide technical assistance, management consultancy, and training programs - local and abroad - for seed technology personnel.

Seed production targets for major crops have been set (See Table III), and the project is well started.

Table III.

Annual Seed Production Targest Established by the
Sudan Seed Production Project
FAO/UNDP 1982-86
(Joshi, 1982)

Crop	Present Production Tons/Yr	Incremental Tons/Yr	Total at Full Development Tons/Yr
Wheat	4,992	31,088	36,080
Sorghum	1,150	4,145	5,295
Groundnut	428	9,122	9,550
Sesame	125	455	580
Others	190	1,160	1,350
Total	6,885	45,970	52,855

Dr. M. S. Joshi, stationed at Khartoum, is the coordinator for the project which will run through 1986.

Other ongoing activities, publicly and/or privately supported, which relate to seed production in the Sudan include:

Sudan Oil Seeds Company Ltd.

This publicly (58%)/privately (42%) owned company deals specifically with oil producing crops, i.e. groundnuts, sesame seed and castor beans. It estimates export prices and assists the GOS, Ministry of Commerce, Demand and Supply in setting a floor price for the auction market. It is the sole exporter of all oil seed crops. As a part of its efforts to improve production of groundnuts, it is currently coordinating research efforts with ARC to improve the quality of seed, particularly in western Sudan (N. Kordofan province), where production has decreased sharply since 1979. This decrease has been directly attributed to poor quality of seed.

International Research Agencies

International Research for Sorghum/Millet (INTSORMIL) has several programs underway that are designed to increase the productiveness of Sudan's sorghum and millet crops (Jain and Ejeta 1981, Seifelnasr, Y; 1982), Dr. T. Behre, University of Nebraska agronomist stationed at El Obeid directs the INTSORMIL field trials and demonstration plots using seed of improved varieties of millet. Drs. E. Reeves and T. Frankenberger, University of Kentucky, with the assistance of University of Khartoum Sudanese graduate students, are working on a project to identify the constraints to the production, distribution and consumption of millet and sorghum in N. Kordofan Province (Reeves and Frankenberger, 1981, 1982). Personnel in both these programs actively cooperate with the related seed programs of the WSARP and ARC. In addition, the International Crops Research Institute for the Semi-arid

Tropics (ICRISAT) cooperates in a mutually supportive program; ICRISAT supplying seed of improved varieties of both sorghum and millet to INTSORMIL, while INTSORMIL researchers collect Sudanese varieties of both crops to contribute to the germplasm collection at ICRISAT.

Agricultural Bank of Sudan (ABS)

An institution established by the GOS solely to provide financial assistance to farmers, the ABS promotes increased agricultural productivity and development by arranging loans to farmers and cooperatives for farm machinery, land improvement, and other agricultural costs. Specifically related to seed programs are ABS-USAID supported loans for seed, seed storage, and related services, i.e. bags, transportation costs, etc. Its efforts have been of greatest benefit to farmers and tenants in the large public corporations practicing irrigated, mechanized farming methods.

Private Industry

Currently, seed from both expatriate and Sudanese seed companies is in limited supply. In Sudan, 5-6 private companies produce most of the vegetable seed available (See Table IV for list of commonly grown vegetable crops). Foreign suppliers of crop and vegetable seed are only minimally active at present. A potential source forincreasing private industry supplies is the Commercial Seed Industry Development Program sponsored by the USAID funded Industry Council for Development (ICD), 1981.

Table IV.
SEED CROPS IN THE SUDAN

Popular Name: Sudanese	Popular Name: English	Scientific Name
a. Agronomic Crops		
Soja	Soybean	Glycine max
Dura	Sorghum	Sorghum bicolor L.
Dukhn	Millet	Pennisetum glaucum
Kamh	Wheat	Triticum aestivum
Semsem	Sesame	Sesamum indicum
Cotton	Cotton	Gossypium spp.
Fuul Sudani	Groundnut	Arachis hypogaea
Dora Shami	Maize	Zea mays L.
Abad El Shums	Sunflower	Helianthus annuus
Guar	Guar	Cyamopsis tetragonoloba
b. Fodder Crops		
Barseim	Alfalfa	Medicago sativa
Lurmos	Lupine	Lupinus termis
Philiposara	Philiposara	Philiposara sp.
c. Vegetable Crops		
Bassal	Onion	Allium cepa L.
Felfel	Sweet Pepper	Capsicum annum L.
Shatta	Hot Pepper	Capsicum frutescens
Kheyar	Cucumber	Cucumis sativa
Bazingan Bodongan	Eggplant	Solanum melongena
Banadora	Tomato	Lycopersicon esculentum
Qara	Pumpkin	Cucurbita spp.
Qara Kosa	Squash (marrow)	Cucurbita spp.
Bamia	Okra	Hibiscus esculentus
Fasulia	Haricot bean	Phaseolus vulgaris L.
Figil	Radish	Raphanus sativus L.
Dora Shami	Maize	Zea mays L.
Lubia helu	Cowpea	Vigna unguiculata
Mulokhiya	Jute mallow	Corchorus olitorius
Mulaita	Leafygreen vegetable	Sonchus oleraceous
Khuss	Lettuce	Lactuca sativa
Tum	Garlic	Allium sativum L.
Hummos	Chickpea	Cicer arietinum
Thalig	Swiss chard	Beta vulgaris
Rigla	Purslane	Portulacae oleracea
Battikh	Watermelon	Citrullus vulgaris
	Winged bean	Psophocarpus tetragonolobus
	Mung bean	Vigna radiata
	Amaranth	Amaranthus sp.
Adas Sudani	Pigeon pea	Cajanus cajan
Gazer	Carrot	Daucus carota

Western Sudan Agricultural Research Project (WSARP)

The WSARP, as a part of ARC, bears some responsibility for the development of a breeder seed program at the research stations being established in Western Sudan, i.e. El Fasher, Ghazala Gawazat, Kadugli and El Obeid. As noted in this report, and others (FAO, 1981) most of the earlier seed programs have improved seed production and seed quality for Sudanese farmers in the modern agricultural sector. This remains true of the ongoing programs which are focused to a large extent on the irrigated or rainfed, mechanized farming production corporations. Thus, the programs being developed by the WSARP/ARC are of great significance to the traditional rainfed agricultural sector, where seed production activities have been constrained by climate, custom, and lack of an infrastructure. While some of the research may be specific to crops adapted to Western Sudan, others are of national importance, i.e. millet and sorghum. Thus, coordination of the WSARP/ARC activities with other current programs, particularly the FAO Seed Production Project is essential. Trials in progress under WSARP/ARC direction include: millet, sorghum, guar, soybeans, wingbeans, and other dry beans.

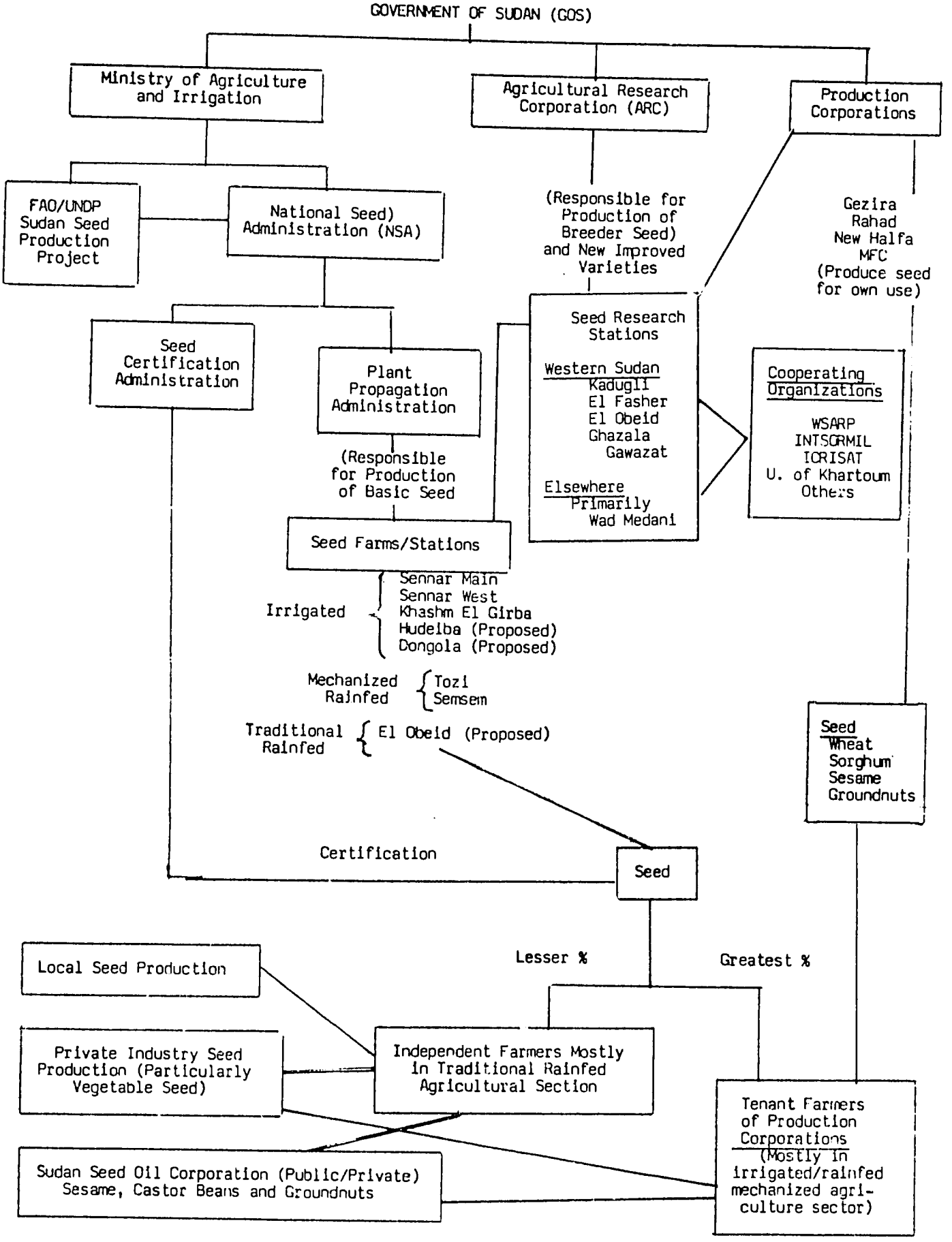
Other Programs/Agencies

A potential source of seed, particularly of vegetable and forage crop seed is the proposed research farm near Soba. In 1979, Tanmiah Consultants developed a plan for an irrigated vegetable seed production farm of 580 feddans. Land has been leased for that program, which will focus on the production of seed for alfalfa, onion, okra, curcurbits tomato, maize and other crops (Tanmiah Consultants, 1979).

The University of Khartoum, already active in cooperative research programs with INTSORMIL, WSARP/ARC, and FAO Seed Projects will probably take an increasingly important role in the development of improved varieties of commonly grown crops, and the application and extension of research results to farmers.

For additional information on the above programs, and a complete review of seed program activities in Sudan, see the Prepartion Report of the Sudan Seed Project (FAO, 1981).

Figure II - SUMMARY OF SEED PRODUCTION ACTIVITIES IN SUDAN (1983)



III. Observations

The following section provides a summary of the observations made by the consultant during his tour of seed facilities in Khartoum, Kadugli, El Obeid, Wad Medani, and Sennar. A map of the location of the seed farms/stations, and the consultant's route while in Sudan is included in Figure I, page 4, while a complete listing of persons and agencies contacted, and an itinerary are included in Tables I and II respectively.

A. Khartoum - WSARP Headquarters

Initial contacts with WSARP staff were directed toward development of an effective seed program which would provide sufficient quantities of high quality seed to farmers in the traditional rainfed agricultural region of Western Sudan. During discussions, the WSARP/ARC staff in Khartoum emphasized the importance of seed in improving agricultural productivity, and their support for seed improvement efforts by researchers at other WSARP/ARC stations. They clearly recognized the need to interface the existing seed production schemes in the irrigated sector with the seed supply and distribution efforts being developed in the Western region.

B. Kadugli - WSARP Research Station

Located in the Nuba Mountains region, this newly developed station is well staffed with crop research scientists and provides land for field studies with good support facilities. Lack of trained technicians, a reference library and limited transportation support could hamper the crops research. Field trials by researchers and

cooperative studies with GTZ personnel were underway, with promising results on improved cultural practices, use of improved varieties and possible new crops. Integration with animal production systems should follow.

Lack of adequate high-quality seed supplies and storage facilities are hampering the research efforts.

C. El Obeid - WSARP Research Station

When completed, this station will provide excellent facilities for crop research in Western Sudan. Current ongoing projects by ARC breeders to select improved varieties of crops adapted to the lower rainfall areas of the western region, and evaluation trials by INTSORMIL on cultural practices, show possibilities for improving agricultural production by local farmers, if they are given adequate support services. Improvements in both the transportation and storage of seed and fertilizers are necessary. Seed is particularly in short supply and of low quality. Without improved supplies of high quality seed, only limited progress will be made. Local production programs must be developed or alternatively, seed stock could be produced, brought to the area and distributed. Suitable transportation and storage for this second option would be essential.

D. Wad Medani - ARC Gezira Research Station

The research program to evaluate crop varieties and import improved varieties and hybrids is well underway. These improved seeds are being sent to other ARC seed stations for increase and distribution. Existing limitations on researchers at this station prevent the production of seed sufficient to supply farmers in other than the irrigated regions. Expansion of ARC breeder seed production would be essential to increasing the supply and quality of seed available to the western rainfed agricultural region.

E. Sennar Plant Propagation Administration Seed Farm/Station

Seed production and conditioning facilities are adequate to supply reasonable quantities of high-quality seed of improved varieties for farmers in the irrigated sector. The seed testing facilities are functional and well-staffed by trained seed technologists. A lack of suitable controlled storage facilities limits the seed quality evaluation program, as well as the need to expand production to meet the increasing seed demands of this and other areas. Extension activities relating to seed are limited, due to a lack of adequate personnel and transportation.

F. A Note on Vegetable Seed Production

Vegetable seed production stations are planned in the NSA Seed Program. These stations and the resultant production are necessary to improve the availability and nutritional quality of such crops as are now produced primarily in home gardens from seed saved from the previous year, or purchased from the very limited outside sources.

IV. Recommendations

A. General recommendations to improve the supply and quality of seed to the western region of Sudan.

1. The Ministry of Agriculture and Irrigation must expand the seed program from the irrigated sector to the rainfed agricultural region, if improved productivity is to be attained.

2. Consideration should be given to producing and conditioning seed at the existing seed stations, then transporting and storing seed to the western region for timely utilization by farmers.

3. The training of extension personnel for the western region should be given high priority. Well trained extension agents, in conjunction with the seed programs and other activities could do much to promote the use of high quality seed.

4. A germ plasm bank should be established in cooperation with ARC, INTSORMIL, and other organizations within the country in order to preserve viable seed for research and seed stock increases.

B. Recommendations for WSARP/ARC

1. A further assessment of the current phase of the FAO sponsored seed project research activities within ARC/WSARP and the private sector should be made regarding seed quality, availability and distribution, particularly in reference to provision of quality seed for the Kordofan Region.

2. Continued introduction and evaluation of hybrids and improved cultivars should be done among ARC/University Khartoum and WSARP researchers. Seed of these cultivars should be incorporated into the current seed production schemes.

3. WSARP/ARC should cooperate with the MAFNR of Sudan and other agencies in the establishment of a germ plasm bank.

4. A post graduate trainee program has been proposed for short-term practical training programs in the U.S.A. Washington State University seed production and technology personnel would be involved and the program would be integrated with the commercial seed industry development program in the USA.

C. Recommendations for Kadugli Research Station

1. A research study should be initiated at the Kadugli Research Station to evaluate the quality of locally stored seed, examining problems of seed viability and quality and field performance. This study might be done in cooperation with faculty at the University of Khartoum.

2. Seed storage facilities must be developed at the station, and current facilities should be used to their best advantage. Optimal use of the existing facilities would require sheltered seed storage containers and a controlled relative humidity/-reduced temperature storeroom.

3. A Sudanese student/researcher should be sent to Kadugli to assist WSARP in a study of seed storage problems and needs.

D. Recommendation for El Obeid Research Station

1. Production of stock seed of locally adapted and improved crop varieties should be done at this station in cooperation with ARC and INTSORMIL personnel who are presently conducting variety evaluation studies there.

2. Seed conditioning facilities should be established at El beid to handle the stock seed of improved varieties which would be produced there.

3. Seed storage and distribution facilities should be established at the station to handle the increased amounts of seed produced locally, as well as seed brought to the station from other areas for distribution to farmers.

4. Provision should be made to store, transport and distribute the seed of adapted and improved varieties from El Obeid to other areas.

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LIST OF WSARP PUBLICATIONS

Publication No.	Title	Date
1	WSARP General Outline of Early Planning and Implementation Requirements	1979
2	Scope of Work for Initial WSARP Activities	1980
3	Consultant Report on Range-Livestock by Dr. D. Dwyer	1980
4	First Annual Report	1980
5	Summary of WSARP Planning Meeting October - November 1980 including Consultants Reports	1980
6	The Horticultural Resources of the Kordofan Region of Sudan	1982
7	Second Annual Report	1981
8	Consultants Report on Research Station Development by Mr. D. Meinhart	1980
9	Consultant Report on Livestock Production by Dr. T. Wilson	1981
10	Annual Report on Range Research by Dr. W. T. Bunderson	1981
11	WSARP Social Perspectives on Agricultural Research and Development in the Southern Kordofan, Sudan: Systems of Agricultural Production Among the Nuba by Dr. F. P. Araujo	1981
12	Consulting Report on Range Research by Dr. D. Dwyer	1981
13	Work Plan, Volume I, General Research Program and Plans	October 1982
14	Work Plan, Volume II. Project History and Functional Structure	October 1982
15	Work Plan, Volume III, Research Plan for the Kadugli Research Station	October 1982
16	Review of Seed Program in Sudan	October 1983
17	Report of Visit to Sudan to Review Fruit Tree Research Program and Related Factors by Dr. A. H. Krezdorn, Consultant	May 1983

Publication No.	Title	Date
18	Work Plan, Volume IV, Initial Research Proposals -- Kadugli Research Station	August 1983
19	Fourth Annual Report	August 1983
20	A Summary of the Darfur and Kordofan Regional Planning Workshops	April 1983
21	Report of Visit to Sudan to Review the Organization and Development of Research Support for the WSARP Experiment Station	February 1983