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AN ASSESSMENT OF THE NATIONAL SEED SYSTEM IN

S U D A N

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# SEED INDUSTRY DEVELOPMENT IN SUDAN

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## I. EXECUTIVE SUMMARY

### A. Summary Findings

At the invitation of USAID and the Government of Sudan, an ICD mission visited Sudan between August 30th and September 30th, 1987 to assess the potential for establishing a viable national seed system, suitable to the special conditions in Sudan, in which the private sector would have primary responsibility for the production, processing and marketing of high quality seeds of improved varieties.

In its report, the mission was expected to take into account all factors affecting seed production, marketing and research, and present a set of policy recommendations which would result in public-private sector cooperation in establishing a modern seed system.

The mission found that even though large investments in economic resources, training, and other support from government and international aid agencies had been made, only a small fraction, barely 5%, of the total potential demand in the country for high quality seed of improved varieties was being met.

While the potential market for seeds in Sudan is quite large, the participation of the private sector is at present very limited. Except for imports of vegetable seeds, and some recent production of hybrid sorghum seed, all seed production and distribution is carried out by the National Seed Administration (NSA), a semi-autonomous department of the Ministry of Agriculture.

The need to develop a private seed industry in Sudan is generally accepted. A group of local private investors have formed an association, which is the beginning of what in the future could become a well organized National Seed Producers Association. At the present time, however, it is more a project than a fact. While this perception is shared by some in government, it is regarded by others with suspicion, even hostility, especially by those that view the entrance of a private seed sector as an invasion of their territory and a threat to present prerogatives.

Many problems will need to be addressed before significant progress can be achieved, including: a public economy in disarray, with large financial and monetary deficits, price distortions due to government controls and subsidies, lack of foreign exchange, burdensome, self-perpetuating bureaucratic procedures resulting in general disincentives to agricultural production, and particularly in a poor investment climate for agriculture and agri-business. If it is to develop further, the

fledgling seed industry of Sudan will require relaxation of the restrictive environment in which it operates, including the need for support and collaboration from government in developing a partnership to fulfill the ultimate goal of supplying the country with sufficient quantity of locally produced high quality seed of better varieties and hybrids, at fair prices. The assumption by government of a promotional, non-competitive role that fosters private sector activities, is central to the views of the ICD mission on the formulation of a national seed system model for Sudan.

Agriculture in Sudan is the most important economic activity of the country. Three sub-sectors share production responsibilities: (a) an irrigated farming sub-sector formed by several thousand farmers who lease government land and work within large government managed irrigation schemes; (b) a rainfed mechanized farming sub-sector, where farms of large scale operations are found; and (c) a traditional rainfed sub-sector comprised of subsistence farmers with small landholdings. Main crops in the irrigated farming sub-sector are cotton, wheat, and to a minor extent sorghum and groundnuts. The mechanized rainfed sub-sector plants mostly sorghum and shows a great potential for sunflowers. The traditional sub-sector produces sorghum, millets, groundnuts, and other minor crops. Additionally, farmers operating independently along the irrigated banks of the Nile supply vegetables and pulses.

The southern part of the country, which receives greater precipitation, could be an excellent market for maize, rice, and crops adapted to higher rainfall areas, once the present security and political issues are settled.

Precipitation in the northern part of the country is erratic and, consequently, yields in the non-irrigated areas are low. This is due in part to low moisture availability which limits the use of fertilizers, pesticides and high quality seed of improved varieties.

Two departments of the National Seed Administration (NSA) - the Plant Propagation Administration (PPA) and the Seed Certification Administration (SCA) - are responsible for certified seed production and distribution, and seed certification, respectively. The large government agricultural production schemes, such as the Gezira project and Rahad, produce the seed that they require and are supported technically by NSA. Breeder seed is produced by the Agricultural Research Corporation (ARC), which is the government institution responsible for agricultural research

and developing improved plant varieties through breeding research. The private sector has produced up to 50% of new hybrid sorghum seed, and some vegetable and forage seed.

The ARC is poorly funded, which has resulted in loss of personnel and deterioration of research programs and facilities, posing a serious threat to the future flow of new improved plant varieties.

The NSA functions as a department of the Ministry of Agriculture. It does not have the autonomy of a parastatal organization, and must work within the budgetary rationalization of a Ministry department, without the ability to implement its own decisions, and retain its earnings (which revert to the general treasury). It operates several seed plants, reasonably well equipped and in process of expansion. Its seed processing capacity is presently in excess of national needs. It is, however, very short of adequate seed storage facilities.

NSA is the main supplier of certified seed to the mechanized rainfed sub-sector farms, and to a lesser extent to the irrigated schemes, which have no access to seed production facilities. The traditional rainfed agricultural sub-sector has no access to certified seed. NSA is planning to begin serving this area with two new seed processing facilities, under construction at the present time.

Seed sold by NSA is supplied from its own warehouses. Except for vegetable seeds, it does not work through dealers or distributors, therefore limiting its distribution capacity. Prices charged for NSA seed are fixed at about 15% above commercial grain prices. This clearly does not cover the real cost of seed, as overhead, financial costs, debt on seed plants, and various other hidden costs are not included in the price of seed. The degree of seed price subsidization is staggering when foreign grants and loans, which exceed the US\$ 43 million, are taken into account.

Seed certification procedures are standardized and carefully executed. Standards have had to be relaxed since it would be impossible to have any certified seed at all if they were adhered to. Sudan has wild sorghum and millets growing as weeds all over the country, which renders effective isolation impossible. Quality control of seed in the market place after initial certification does not exist. In fact, the seed certification and seed quality control processes are confused, which limits the introduction of private hybrids. Improvement of seed

quality laboratories, and quality control and certification inspectors is urgently needed.

The development of a viable seed industry in Sudan will require not only a better economic and administrative environment, but also a gradual phasing out of the NSA role of seed producer and supplier of those products that could be more efficiently handled by the private sector. The NSA should maintain only a provisional production role in other seed products. Faced with growing budget deficits, high inflation rates, declining per capita GNP and decreasing real budgets, seed subsidies will have to be abandoned or progressively reduced, leaving opportunities for the private sector, as justification for continued government institutional presence in seed production and distribution disappears. Linked to this scenario, new policies on marketing and price support for agricultural commodities which permit farmers to generate significant profit on production would increase the use of inputs such as high quality seeds that would, in turn, feed on the technology to stabilize higher yields.

#### B. Recommendations

Sudan is now at a crossroad in deciding whether and how a private seed industry should be encouraged and supported. The establishment of private seed industry should be viewed within the context of a National Seed System as depicted in Figure I.1. The complementary roles of the public and private sectors in fostering a healthy national seed industry should be well understood by all concerned.

The public sector should play an important role in directing, promoting, organizing and supervising a system in which the private sector is responsible for production, processing, marketing, and distributing seed, and sharing in the research responsibilities. For a joint effort to be successful and ultimately beneficial to the country, the respective roles of the two sectors should be clearly defined and understood. Government should abstain from competing with seed companies in seed production and sales. It may lease its facilities for seed processing to private producers, and provide services with them.

In this model, NSA remains the government organization which administers the full array of activities concerned with seeds, from planning to promotion, regulation, quality control, seed certification, import and other licenses, quarantines, registration of growers and seed companies, and varietal registration and protection. The seed production,

processing and distribution carried out at present by PPA, the division of NSA, would be better concentrated in a new parastatal organization dealing with certified and commercial seed production, processing and distribution, and the provision of seed processing and other services. The facilities of NSA would be transferred to this parastatal organization which, registered as a corporation under the same system as private companies, would be required to operate profitably. It would deal with crop seeds not of interest to the private sector and would operate without special perquisites or subsidies.

A system of private seedsmen in the traditional agriculture rained areas, especially in Kordofan and Darfour, should be established with the support of credit and the extension system, and with support from the NSA and PPA. These private seedsmen would be organized to produce and sell to their neighbors certified seed of improved crop varieties adapted to their type of agriculture. They would be members of the private sector, although their cottage industries will initially require assistance, but otherwise they should have full freedom of operation.

Certified seed should be produced by both public and private seed growers. The SCA, or succeeding agency, should certify all seed of publicly originated varieties which passes minimum standards, and which is in certifiable categories. The appropriate NSA Department of Quality Control, through its inspectors and seed laboratories, should monitor seed quality and truth in labelling in the market place for all seed, certified or not. Privately developed varieties and hybrids should be subject to voluntary certification by the originators. In any event, all seed of registered varieties should be subject to quality control and truth in labelling. Variety registration may require the demonstration of novelty, but not necessarily that of competitive performance tests, although NSA should require that field performance is at least at the same general level of existing varieties. The concept of variety release should not apply to private varieties or hybrids, which should simply require registration.

The government should retain the right to deny entrance of seeds which may bring diseases or pests not found in Sudan, but the import of seed for testing purposes or early multiplication purposes should not be denied to either private or public agencies which exercise due restriction and care. Private seed firms registered in Sudan, either foreign or local, should be allowed either directly or

through their agents to import and test seed of new varieties, directly or in collaboration with ARC.

Present seed legislation is insufficient and is not designed to recognize the existence and functions of a private seed industry in Sudan. A new seed law is required, which recognizes the coexistence of a public and a private sector in a seed system. To be realistically drafted, it must consider the views and expectations of government and private investors, experienced seed technicians, and of the Ministries of Agriculture, Finance and Economic Development and Commerce.

The technical capacity of private seed firms worldwide, in both the developed and developing countries, has grown at a very fast pace in the last quarter century. They are better prepared to produce, process, and market seeds than government agencies. Furthermore, they have proven that they can meet the demand for seeds. Sudan has room and potential for a number of seed companies, but it has yet to provide the right environment and incentives for a number of them to become established. Initial mistrust and misunderstanding of government and seed companies must give way to an atmosphere of partnership and cooperation. This can best be accomplished if the government takes the initiative to establish effective and appropriate legislation, and the so-called "rules of the game" under which private sector participation in the seed industry is to develop. Government promotion of the seed industry may help the government meet its objectives and goals of increasing agricultural productivity, nutrition, rural income, standards of living and food security in the country.

As the elements of a new National Seed System emerge, so will the need to establish an advisory National Seed Council, with appropriate representation from the public and private seed sectors, and a representative National Seed Industry Association.

The mission recommends that USAID support a seed project, the major goal of which would be to create the proper conditions for the major policy recommendations presented above to occur and permanently take hold. To achieve these ends it will be necessary to effect a number of changes in the legal, administrative, and economic environment surrounding the seed industry. The required actions are primarily educational, should be immediately followed by political action, and should be designed to: (1) restructure institutional functions; (2) establish a private seed industry; (3) build a system of seedsmen at the

village level in the traditional agricultural sector; (4) support extension activities in seeds; (5) support the reorganization and reassignment of functions in NSA; (6) support the development and reorganization of PPA; (7) support ARC in developing a testing and evaluation system; (8) support the Food Research Center activities in studies related to the utilization of sorghum, millets, and other crops in agro-industry.

It is envisioned that a three year program and the participation of an in-country team and specialized consulting activities would be required to achieve these objectives.

## II. PROJECT DESCRIPTION

### A. Background of the Present Study

The United States Agency for International Development (USAID) Mission in Sudan views continued development of the seed industry as an integral part of the development of the agricultural sector. USAID has initiated and financed programs and projects in the Sudan over a number of years, with the aim of facilitating the growth and development of a private seed industry, the development of local sorghum hybrids, and the supply of seed or improved varieties, in order to offset scarcity in the local market.

The present study was undertaken by a team fielded by Industry Council for Development, a non-profit, non-commercial development service supported by international industry and based in New York, under contract with USAID/Sudan<sup>1</sup>. The purpose of the mission was to formulate recommendations concerning the options for development of a healthy and vigorous seed industry in Sudan, including identifying ways in which government agencies and the private seed sector can work together to build a modern national seed system.

Industry Council for Development (ICD) fielded a reconnaissance mission in Sudan for 10 days during February 1987. The present mission was carried out from August 29 to September 22, 1987.

The Council was also active in Sudan during 1984, when ICD was contracted by USAID/Sudan to help develop a training program in Seed Technology. At that time, ICD sent Dr. Michael Turner, Professor Seed Technology at the University of Edinburgh, who developed and established a "train the trainers" program. The training methodology developed by Dr. Turner is still being employed at this time.

For over 20 years, seed production and development programs have been conducted in Sudan by the National Seed Administration (NSA), a department of the Ministry of Agriculture and Natural Resources (MANR). The NSA emerged as both a seed production and regulatory entity responsible for variety registration and seed certification. It has not evolved beyond the initial stage of government seed

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1. The ICD Team: Dr. Alexander Grobman, ICD Senior Associate and team leader; Mr. Duane Ericksmon, and Dr. George Johnston.

institutions, that of a department of the Ministry of Agriculture. As such, it has all the problems and limitations found elsewhere in the world associated with public seed production and marketing. This status is not in line with the large amount of donor assistance accorded to the Sudanese seed industry (U.S. \$43 million in grants and loans to NSA alone, without counting additional seed commodity support to the overall Sudanese economy over the last 15 years). Despite this aid, seed production and distribution remains at a very low level, meeting less than 10% of potential demand in most crops.

The NSA, being a public agency, has focused its attention primarily on the needs of other public sector entities such as the Sudan Gezira Board, the Rahad Scheme and the Mechanized Farming Corporation. It has completely ignored the needs of the private agricultural sector, which represents by far the largest segment of the farming population.

Recently a fledgling private seed industry has emerged, but it is facing very serious economic, political, and policy constraints. In an effort to develop a program of assistance to the seed sector and, in particular, to the private seed industry, USAID has provided short-term technical assistance and conducted several studies of various components of the seed industry since 1982. In 1987, USAID prepared a Project Identification Document (PID) for a Private Sector Seed Initiative Project (650-0081) which, when submitted for review in Washington, D.C., was not approved pending more complete assessment of the following issues:

- o Who is suffering from declining yields and seed quality, and why?
- o What will be the impact of the project on the structure of agricultural production in Sudan?
- o Does the Government of Sudan (GOS) have a real commitment to liberalizing seed production?
- o How many elements of a national seed multiplication program (National Seed System) do we really have at present? and
- o Are the proposed PP design schedule and resources sufficient?

Information relevant to these issues is found throughout the report. The questions are addressed directly, however, in Annex IV to this document.

Under the Sudan Seed Industry Development Study, Grant Number 650-0510-G-SS-6059-00, USAID requested the Industry Council for Development (ICD) to provide assistance by analyzing the potential and constraints for development of a private seed industry and to assist USAID/Sudan in developing a revised PID and background information for a draft project paper. The grant statement of work included specialists in Agricultural Economics, Finance, Seed Production, and Seed Marketing. The terms of reference for each specialist included:

Economist

- o With other team members, review all pertinent background information and documentation on the project and on the seed industry in Sudan, and help conceptualize and define the overall project.
- o Identify, analyze, and evaluate all micro- and macro-economic factors which will have an impact on the potential success of the project, and make recommendations where needed.
- o Assess the pricing and subsidization policies of the NSA to determine their impact on the profitability of private seed growers.
- o Assess credit needs of private seed growers and the ability of existing financial institutions to meet those credit needs, given the Bank of Sudan's restrictive regulations. Advise how credit can best be provided.
- o Assess the foreign exchange requirements for expanding private sector seed output.
- o Determine production costs for the NSA and for private seed growers.
- o Estimate the potential seed market at present and for each of the next five years. Be sure to include in the analysis the effects of an overvalued foreign exchange rate, a market-determined foreign exchange rate, and a GOS pricing policy for agricultural commodities in general.
- o Conduct a cost-benefit analysis of the project.

Seed Specialist

- o With other team members, review all pertinent background information and documentation on the project and on the seed industry in Sudan, and help conceptualize and define the overall project.

- o Identify and examine private sector seed production problems and constraints and recommend ways to develop a full-scale, self-sustaining private sector seed industry in Sudan.
- o Examine the role of the NSA in seed certification, regulation and production, and recommend ways to improve its technical and administrative capabilities.
- o Assess the cleaning, processing, packaging and storage facilities available to public and private sector seed producers, and make recommendations regarding needed improvements.
- o Analyze the present relationship between the NSA and the private sector seed growers, and outline changes needed in order to strengthen private sector seed production.
- o Review present and proposed seed legislation and the regulatory environment in general, and assess their impact on the seed industry.
- o Examine and evaluate the seed research and development capabilities of the Agricultural Research Corporation (ARC).
- o Examine and evaluate the provisions and actual practices for the importing and exporting of seeds.

#### Seed Marketing Expert

- o With other team members, review all pertinent background information and documentation on the seed industry in Sudan, and help conceptualize and define the overall project.
- o Analyze and assess the current marketing and distribution of seeds in Sudan, including the roles of both the private seed growers and the NSA, and make recommendations regarding what the roles of the two groups should be in the future.
- o Identify and analyze private sector seed marketing and distribution problems and constraints, and recommend ways of overcoming present difficulties.
- o Identify and profile the existing and projected market for improved seeds in terms of volume and value, particularly for grain and forage sorghum, millet, groundnut, sesame, sunflower and vegetable seeds.
- o Determine the role which seed cooperatives, trade associations, or similar organizations might play in marketing seeds grown by private sector producers.

- o Estimate the expected rate of adoption of new varieties of improved seeds by the irrigated, mechanized rainfed, and traditional rainfed agricultural sectors.
- o Assess the role that extension activities could play in developing the market for improved seeds, and make recommendations for increasing seed demand through better extension work.

#### B. Agriculture in Sudan

Sudan, geographically the largest country in Africa, has a total land area of about 2.5 million square kilometers. It has a population of 21.5 million people, which is growing at a rate of about 2.8% annually. Nearly 77% of Sudanese live in rural areas, the majority of whom are subsistence cultivators or nomadic pastoralists, and contribute in only a limited way to the market economy (see Table II.1). With over 50% of the population under the age of 20, the population growth rate is expected to continue at a rapid pace. Food production will need to expand at the same rate in order to keep pace with population expansion, and must increase by an even larger margin if a reduction in malnutrition is to be achieved (see Table II.2). From a total land area of just under 600 million feddans<sup>2</sup>, about 200 million are considered as agricultural, 200 million as forests, and 200 million as uncultivable.

Sudan is overwhelmingly dependent on agriculture, which accounts for about 98% of foreign exchange earnings, mainly from cotton, oil seeds, gum arabic, and livestock and animal products. The volume and value of exports is shown in Tables II.3 and II.4.

The agricultural ecology of Sudan is varied. Annual rainfall ranges from zero in the north to 1,500 mm in the south. Soils vary, including heavy cracking clays, highly weathered ironstone soils, and light sands. Temperatures in the north are low enough to grow winter crops such as wheat, winter legumes, and potatoes, but truly tropical temperatures are found in the south.

Agriculturally, Sudan is divided into six regions:

- o Central and Eastern Irrigated
- o Northern Irrigated
- o Flush Irrigated
- o Central Rainfed Clay Soil Plains
- o Western Savannah
- o Southern Region

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2. Feddan = 0.42 Hectares or 1.04 Acres

Because of the current political situation, the mission was unable to analyze the state of agriculture and the seed industry in the south of the country.

The principal crops produced in the Sudan are cotton, wheat, sorghum, groundnuts, sesame, millet, kenaf, castor, rice, maize, sugar and vegetables.

In spite of its tremendous potential for basic food production, Sudan has lately not been able to feed itself. The country was self-sufficient in basic foods up until 1983, but since 1983 it has experienced severe shortages of food in several areas, including areas of famine in 1984 and 1985. Although the food situation has improved, pockets of food shortage persist. The importance of agricultural exports and the effect of the drought (as well as some agricultural policies) are discussed in the next three chapters.

The continued inability of the nation to feed its people can be attributed to several factors. Chief among these is drought (1982-84 and 1984-85) and the continuing desertification, especially in the northwestern province of Darfur. The second major reason is the low production and yields of most food crops in virtually all subsectors of agriculture. Thirdly, the mission encountered a disorganized marketing system which discourages risk investment in agriculture. To this is added a poor road system, lack of adequate grain storage facilities, and inadequate marketing credit and information.

The persistent low yields are attributed to uncertain precipitation, lack of production inputs such as improved seed, fertilizer, and pesticides, and the continued use of poor agricultural practices. The opportunities to improve yields through greater use of production inputs and higher levels of management are very significant.

According to a recent study regarding provincial shares and instability of food crop production, decreases in food production, notably sorghum, millet, sesame and groundnuts have occurred in areas of the west and, surprisingly, in the Gezira. On the other hand, however, sorghum production and yields have substantially increased in the east, notably the Blue Nile and Kassala provinces. Tables II.5 through II.10 provide region specific area, production and yield information for sorghum, sesame and groundnuts.

At the national level, it was noted that there is a very large amount of variability in the production risk between crops and provinces as measured by the coefficients of variation. The national coefficient of variation of total food production for the 14 year period 1973/74 to 1986/87 is 21.3 percent. This is much higher than inter-

national standards, indicating large fluctuations in yearly food production. The fluctuations at the provincial levels are even larger.

Sudan has one of the four largest areas in the world planted in Sorghum. Yields are very low, however, representing only 38% of average world yields (Table II.12). For millet, Sudan achieves 40% of average yields of those countries with significant areas (Table II.13). Wheat yields, largely due to irrigation, are 66% of the world average (Table II.14). Sudan is one of the largest producers of sesame, and its yields are 81% of the world average (Table II.15). The same situation applies to groundnuts, of which Sudan is the fourth largest producer with yields 89% of the world average (Table II.16). This information is based on 1983 data.

### C. The Political Milieu

From 1899 to 1955, Sudan was governed by an Anglo-Egyptian Condominium. This included all the territory south of the 22nd parallel. Egyptian sovereignty was retained while government authority was vested in a Governor-General of Sudan, appointed by decree of the Egyptian Khedive on the recommendation of the British monarch, and who could be removed by decree of the Khedive only upon consent of the Crown. There was no clear juridical relationship between the two powers in Sudan.

During the years of the protectorate, agricultural development in Sudan took place mainly through the Jazirah (Gezira scheme), inaugurated in 1910. This project was a joint venture of the Sudanese Government and the private Sudan Plantation Syndicate, whose shareholders were British. Local farmers participated as landowners; these were Ansars<sup>3</sup>. A larger area of the Gezira was brought under cultivation in 1925. The Gezira scheme grew mostly cotton for the Empire Cotton Growing Corporation, which marketed it in Britain and other countries. Telegraph and rail lines were the other two additional infrastructure elements developed during the joint Anglo-Egyptian protectorate.

Britain renounced its protectorate in Egypt in 1922. Egypt became independent and Prince Ahmad Fuad assumed the title of king. The Egyptian Constitution of 1923 made no claim of Egyptian sovereignty over Sudan.

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3. The Ansars are members of one of the two largest religious Islamic sects in Sudan. They were led by the Mahdi in the 19th century revolt against the Anglo-Egyptian government.

Britain treated the three southern provinces of Sudan -- Equatoria, Bahr el Ghazal, and Upper Nile -- as a separate region. Its climate, racial group, and religion (mostly Christian, due to Catholic and Anglican missionary activities) made the region distinct from the culturally and geographically Arab north. A policy of separate development was implemented by the British Administration in the 1920s, through the so-called "Closed Door" ordinances which prohibited northern Sudanese from entering or working in the South.

Egyptian civil service personnel were removed from Sudan in 1924. Sudanese civil servants were trained to take over their positions, and gradually became experienced in government under the British Administration. Greater participation of Sudanese in local government was prevented by the disagreement between the British and the Egyptians on making changes in the Condominium agreement.

After Britain and Egypt signed the Treaty of Alliance in 1936, setting a timetable for the end of British military occupation in Egypt, the status and future of Sudan were unsettled, and no agreement could be reached.

At this time, educated groups in Sudan began striving for self determination. Reminded by the British that they represented insignificant numbers in their country, they appealed to the general population through religious groups, which were the only groups commanding widespread loyalty. Two groups in particular emerged, one led by the Mahdi's son, Abdal Rahman el Mahdi, who advocated political independence and a separate country, and the other led by Ali Al Mirghani, who favored union with Egypt. The Mahdi group was formed mostly by Ansars while the other group was formed by the Khatmiyas. The Ansars were the nationalist religious sect that formed the core of resistance in the Mahdi's uprising against the British and formed the Mahdist state in 1881-1898.

The Second World War brought a halt to political activities regarding the transformation of the country. After the war, the Labor government of Britain authorized a partially elected "consultative" legislative assembly. The pro-Egyptian National Union Party (NUP) boycotted the 1948 elections for the Legislative Assembly, which was then controlled by pro-independence groups. A few years later, when Colonel Mohammed Naguib gained power through an army revolt, he separated the issue of British withdrawal from the Suez Canal from the issue of Sudanese self determination.

In 1953, the NUP gained a majority of parliamentary seats. They realized that popular sentiment had moved in the direction of independence from Egypt. Independence was declared by consensus on December 19, 1955.

Departed British Civil Service Officers were overwhelmingly replaced by northern Sudanese civil servants. Southerners became concerned that a policy of arabization and islamization would deprive them of local and national opportunities. From the earlier days of the state, problems arose which, through the years, shaped the north-south conflict. This resulted in the present situation, where there is open subversion and armed confrontation between the GOS and a Southern movement led by the Southern Sudan Liberation Front and associated political groups.

A coup of army officers (perhaps emulating the Egyptian officers' coup that brought Gamel Nasser to power) brought Colonel Jafaar al Nimeiri to the head of the government. During his government, which lasted from 1969 to 1986, a socialist system was established in the country, Sharia laws were enacted, and the economic climate of the country deteriorated. Economic and political ties were made with the Soviet Union and Eastern European countries, but a communist-led coup in 1971 led to a cooling of relations with them. In 1967, Sudan broke diplomatic relations with the U.S.A. because of the Arab-Israeli War. Relations were re-established in 1972. The assassination of the U.S. ambassador to Sudan in 1973 at the hands of PLO terrorists (the GOS was not implicated) caused another break in relations, which were later re-established.

During the Numeiri Era, the Sudan Socialist Party became firmly established in the Army and in the civil service. After a number of years, the political support of the Numeiri government eroded, and a bloodless coup ensued. The political and economic problems that followed in its wake were inherited by a coalition of the two parties which now dominate Sudanese politics. One party, linked to the religious sect of the Ansars, which is led by Sadiq al Mahdi, great-grandson of the Mahdi, is more independent and leans more toward ties with the West. The other party, led by Ahmad al Mirghani, leader of the Khatmiyas, pro-Arabist, stands for stronger links with Egypt and emphasizes Islam as the state religion. This party became heir to the National Union Party, which divided in 1956. The coalition was broken before the ICD mission arrived in Sudan, and had not yet re-established the government, although discussions were in process, holding out the possibility of a new coalition.

The political situation in Sudan, a coalition of two political adversaries which excludes the leftist parties and the ultra-conservative Muslim Brotherhood, is an uneasy equilibrium. However, the continuation of the present situation may be required to avoid a tilt toward any of the extremist parties. This situation is compounded by the stalemate with southern opposition forces, who demand, among other things, that Sharia laws be eliminated. As long as this situation prevails, there does not seem to be

leadership strong and capable enough to directly tackle the serious economic problems confronting the country.

D. The Macro-Economic Environment as it Affects Agriculture and Agro-Industry

1. Overview

The macro-economic problems of Sudan are severe and worsening. The situation is characterized by growing budget deficits, high inflation rates, excess liquidity and declining real per capita GDP. Selected macro-economic indicators are summarized in Table II.17. The problems represented are intricately related to the financial performance of the large public and parastatal sectors in Sudan. While a thorough analysis of these factors is not attempted here, it is necessary to sketch the critical macro-economic interrelationships which affect performance of the agricultural sector and the potential for development of agro-industry.

It suffices to say, as an introduction, that the Sudanese economy is highly distorted by policies and subsidies which inhibit production of agricultural export crops, and the near term development of agro-industries which depend on imports and exports (e.g., those requiring foreign exchange or export markets). Other medium- to long-term options, though limited, might be available.

The root problem in the economy is the large and subsidized public sector which subsidizes or controls prices for many urban-oriented commodities. The following is a very partial list of agricultural subsidies: 1) the price of land, water and other inputs on government owned farms; 2) imported consumer commodities; and, 3) credit from the Bank of Sudan and the Agricultural Bank of Sudan. Since the public sector uses much of the available credit, low prices charged for public services are financed by budget deficits, monetary expansion and inflation.

The investment climate in Sudan can be summarized by a list of problems of concern to investors: the lack of infrastructure, high import duties, no markets, lack of security for the investment, lack of qualified personnel, shortages of foreign exchange, lack of private sector access to official credit, etc. For example, the lack of foreign exchange in the banking system (it is likely to be in the parallel economy) may preclude an individual enterprise with a large export potential from developing, because inputs cannot be secured. Furthermore, while the investment law of Sudan can be construed to encourage activity, it has been claimed by some members of the private sector that actual regulations and circulars run counter to the intent of the law.

Currently, foreign corporations are not interested in investing in Sudan. There are no guarantees that they can take money out at the same exchange rate at which they brought it in. Indeed, the current official exchange rate situation precludes outside investment in Sudan. Within the country, the investment climate favors very short-term investments and trade, and little investment in longer term, production-oriented enterprises.

## 2. Exchange Rates

Sudan has a multiple exchange rate regime which overvalues its currency. As a consequence, official imports are (implicitly) subsidized and official exports (implicitly) taxed by an amount equal to the overvaluation. Therefore, the production of export commodities or import substitutes is discouraged because the prices (in domestic currency) received by producers are below those they would receive if the exchange rate were at its (world) market equilibrium. Indeed, exports have declined (even taking into account the three-year drought) in proportion to imports, so that the value of imports is three times the value of exports. The overvalued exchange rate causes price distortions favoring urban consumption of imports, and (cheaper) food due to artificially low consumer prices, while mostly rural exporters and producers face depressed producer prices because of the implicit tax represented by the overvalued exchange rate.

According to the World Bank (1987, Part I, p. XIV), "In industry, private activities are in a desperate state due to the high cost levels and a lack of credit, rigid price regulations, disruptions in the supply of utility services and imported inputs and uncertainty about the future business climate." This characterization was also confirmed by ICD interviews with private sector businessmen. In this case, the competitive environment favors short turnaround profits by traders over longer-term efforts by producers. While producer and (legal) importers' prices are controlled, traders can reap enormous windfall scarcity profits in the parallel economy. For example, the prices charged for imported vegetable seeds are often hundreds of percent above what has been legally presented as the allowable mark-up at the retail level.

There is also a severe shortage of foreign exchange for both public and private productive efforts. Foreign exchange is generated by exports, remittances from Sudanese living in other countries, and donor assistance. Remittances are only partially captured by the government. Official exports have been declining at an annual rate of 1.2 percent since 1980-81. Because of the overvalued official exchange rate, most foreign exchange finds its way into the parallel economy. Since official exports have declined, the Bank of Sudan, which controls official agricultural

exports (such as cotton, sesame, sorghum and groundnuts) is left with fewer resources to cover the import bill. Most of the foreign exchange is made available to public entities, which still do not get enough to service their deteriorating capital stock.

The private sector is particularly constrained. Private businesses with high export potential, for example, cannot achieve their potential because of the unavailability of foreign exchange to purchase inputs. (Seventy-five percent of export earnings must be converted at the artificially low official rate, currently LS 2.5 per 1 US\$). Capricious decisions about import licenses also create a poor environment. In one case, an import license for one company was granted for an aerosol spray and not for vegetable seeds.

Foreign exchange rates and foreign exchange availability have different effects on the three generalized subsectors of agriculture, as well as within subsectors in Sudan. While the irrigated and mechanized subsectors benefit from implicit subsidies for imports such as petroleum and equipment, and a priority status for credit and foreign exchange, the scarcity of foreign exchange, given the implicit and sometimes explicit taxes on exports, has contributed to declining conditions of capital stock and some output declines. It is, in effect, impossible to profitably export agricultural products from Sudan legally. The traditional rainfed sector depends much less on imported inputs, but also suffers from low producer prices for exportable cash crops such as groundnuts. An analysis of the potential price and production effects is discussed elsewhere in this report.

### 3. Credit

The aforementioned budget, monetary expansion, and inflation problems have placed significant constraints on the availability of credit for the private sector, because of the increased use of the available credit by the public sector to finance operational losses. Presently, approximately 60% of available credit officially goes to the public sector, and 40% to the private sector. But even within the 40% allotted to commercial banks, an unknown but presumably large share of the credit is used by parastatals. It is likely that only 20% of the available credit is in circulation within the private sector which, among other things, contributes to disincentives to domestic savings, and ill-formed, fragmented capital markets. This does not account for credit in the parallel economy.

Heavy government control further compounds the situation by the use of credit ceilings and sectoral credit targets. Credit ceilings established by the Bank of Sudan are poorly defined and arbitrarily applied, and have little or no economic justification. There is no relationship

between a commercial bank's ability to generate deposits and the credit ceiling it must conform to. The effect of the high (approximately 35%) inflation rate further reduces, in real terms, credit availability to private enterprises. The increase in bank credit to the private sector has been only one-third of the rate of domestic inflation.

Government banks lend at heavily negative rates (22%) in real terms. These low-priced funds are in high demand and are allocated primarily to parastatals. Commercial banks, under the Islamic banking system, charge around 30 to 35% - close to the real cost of capital in the inflationary economy of Sudan. Credit is also available in the parallel economy at rates reflecting its opportunity cost. The implications and performance of credit, administered through upper limits, have been to put a ceiling on private credit while exhibiting no effective controls on the public sector.

Sectoral credit targets and other government regulations also circumscribe commercial bank behavior. Specific loan portfolio targets state that 30% of loans are for exports, 25% for industrial imports, 10% for trade, and 35% for medium- and long-term loans. Most loans granted are in the first four categories, are low risk with quick returns, and favor trading rather than production.

The banks have great difficulty achieving the target for medium- and long-term loans, which further reduces funds available for productive activities. In one bank's case, only one-third of the medium- and long-term loan targets had actually been reached. The problem stems from the highly uncertain economic environment and high rate of inflation which favors low-risk and high turnover loans. Thus, medium and long-term loans require solid security, which completely eliminates risk for the commercial banks.

Other regulations which impede private sector access to credit include 1) required screening by the Bank of Sudan for medium- and long-term loans in excess of LS 100,000 and all loans over LS 300,000, to determine whether they are for priority items like financing state enterprises; and 2) restrictions on import financing to specified priority commodities, as well as high financing requirements.

The World Bank concluded (1987) that lack of credit is a significant limiting factor in agricultural production. Funds would be needed for the full range of agricultural activities, including financing recurrent inputs, purchase of tools and equipment, storage, infrastructure, etc. The World Bank (1987 p.72) suggests the following program to reorient and expand the Agricultural Bank of Sudan's (ABS) lending program:

- The ABS should be more selective in its seasonal lending, some of which can be handled by the Shail system (the traditional credit system in rural areas) and the commercial banks and should divert funds to medium-term loans.
- The ABS should widen its range of loans to commercial enterprises and mechanized farmers.
- The ABS should accept leases as collateral for loans to tenant farmers on irrigated schemes. The existing trade in leases would therefore have to be legalized.
- The cost of ABS loan capital should be higher than annual inflation or, in other words, positive in real terms.

Within the context of Sudan's macro-economic situation, notably very scarce credit resources available to the private sector, credit programs to aid agriculture and agro-industry will be difficult to implement. Subsidization of credit by the public sector is not feasible, while commercial banks may need absolute security or guarantees (principal plus interest) by donor agencies before considering even medium-term loans of one to two years. Some risk sharing "might remotely" be possible between public and commercial banks. The current situation facing both sectors seems to preclude any possibility of innovation in this area. Any progress will need to be preceded by an improved and stabilizing macro-economic environment.

### III. ANALYSIS OF THE CURRENT SITUATION

#### A. Crop Production and Distribution Systems

The agricultural crop production sector in Sudan is composed of three major subsectors: large-scale irrigated government schemes, rainfed mechanized farms, and rainfed traditional farms. (See Figure III.1). Figures III.2, III.3, III.4, III.5, and III.6 each subsector's role in the production of sorghum, millet, sesame, groundnuts and wheat, respectively. Each of the above subsectors operates under very distinct sets of circumstances, utilizing their own unique sets of inputs and markets.

##### Irrigated

This subsector consists mainly of the very large government owned and operated entities such as the Gezira (1.8 million feddans with upward of 100,000 tenants), New Halfa Agricultural Production Corporation (330,000 feddans with approximately 20,000 tenants), Rahad Irrigated Agricultural Corporation (200,000 feddans with over 10,000 tenants) Suki Agricultural Corporations (80,000 feddans with 8,000 tenants), Gash Corporaton Irrigation Scheme (700,000 feddans of which 240,000 are under "command"), Blue Nile Agricultural Corporation (60 schemes of 300,000 feddans and about 17,000 tenants), White Nile Corporation (400,000 feddans with 18,000 tenants), Northern Agricultural Production Corporation (170,000 feddans with 14,000 tenants) and the Khartoum Agricultural Schemes (20,000 feddans with about 2,000 tenants), and a large number of private farms located in narrow belts adjacent to the Nile, Blue Nile, White Nile and other major rivers. The irrigated subsector accounts for about 18% of the total land area under cultivation. An estimated 250,000 tenants are active in production in the irrigated schemes.

The schemes developed and operated by the government in this subsector were designed and built to produce the strategic export crop, high quality long staple cotton. During the early "post-colonial period" cotton provided 80% of the foreign exchange earnings. More recently production of cotton has decreased due to pests affecting quality and to aging and deterioration of the irrigation schemes.

Tenant farmers are provided the basic inputs of tillage, water, seed, fertilizer and pesticides. The scheme collects and markets the cotton, deducting the costs of inputs and fees, and pays the farmer the balance. The usual crop rotation for a tenant farmer on 20 feddans in the Gezira scheme, for instance, is 10 feddans of cotton, 5 feddans of wheat or sorghum, 2-1/2 feddans of peanuts, and 2-1/2 feddans of vegetables or fodder. Yields on the non-cotton crops also tend to be low because irrigation water may be short and other inputs are not always available.

Long staple Pima-type cotton cultivation has been accompanied in recent years by a substantial area of Acala medium size staple cotton which, even though it does not command as high a price as the long staple fiber, still requires less time (5-6 months against 8-9 months) than the longer staple types, thus lowering costs and reducing time of land occupation.

Seed supply and distribution in this subsector follows a rather formal arrangement between government agencies. The Agricultural Research Corporation (ARC) is charged with the primary responsibility of developing new varieties of the major crops including: cotton, wheat, and a few other crops such as castor. In the past, the Gezira Board received the improved varieties directly from ARC, multiplied the seed for its own use, and supplied other cotton producing irrigated schemes.

NSA has collaborated with the Gezira, Rahad and New Halfa schemes; in particular, providing them with technical assistance and basic seed, as well as inspections of the seed production fields managed by the schemes. Wheat, sorghum, and groundnut seed production has thus been organized in the schemes. The Seed Certification Administration (SCA), a constituent division of NSA, certifies this seed. SCA is preparing to certify cotton seed produced by the schemes, an activity which it has not undertaken before.

It is envisioned that the ARC will continue to produce new varieties of cotton for which the NSA will produce the foundation seed for the government owned schemes. Private seed companies should be allowed to compete openly if they can introduce superior lines.

Included in this subsector is a very large tenant farmer population, producing wheat, sorghum, groundnuts, beans, forage crops and vegetables. Seed distribution for these crops is presently provided by NSA through the schemes. The private seed sector should be permitted and encouraged to supply improved seeds wherever possible, including sorghum, sunflower, forage crops and vegetables.

Private seed companies have not entered the market of the irrigated agricultural schemes. If allowed to operate in this market, and if the possibility of offering seed products appropriate for this market of thousands of small tenants exists, private seed companies may become a major factor in supplying seed to this farming subsector, which enjoys the benefits of better soils and abundant and cheap irrigation water.

#### Rainfed Mechanized

This subsector represents upwards of 10 million feddans of clay soils in the savanna belt located predominantly in Kassala and Blue Nile provinces south of Gedaref, with lesser areas in Kordofan. Farms in this subsector are large, ranging in size from 1,000 to 500,000 feddans and have been developed on

Government owned land under the auspices of the Mechanized Farming Corporation (MFC).

Farms in this subsector were developed according to three categories or divisions:

Demarcated Schemes are farms that were allocated to farmers on the basis of an application to the MFC. The process of farm allocations gave consideration to land capabilities, forest reserves, nomadic stockroutes, and rainfall zones. From 1,000 to 1,500 feddans of land were allocated per family head so a farmer could accumulate 5,000 or more feddans in a unit by including other family members. The farms are provided on a 25-year lease which can be revoked for non-payment of rent, use of soil-depleting growing practices, or inability to continue farming. These farms are known as "Directed Farms" because the MFC provides supervisory and technical support. Present rental charges, which are collected by the MFC, are LS 1.00 per feddan. In addition, farmers are able to obtain medium-term loans for machinery and long-term loans for land clearing from the MFC, funded by the IDA (Irrigation Development Authority).

Undemarcated Farms are developed on lands obtained by individuals from commissioners, provincial officials, or even local officials. These farms were often started by individuals who were unsuccessful in obtaining a demarcated farm, or even by farmers who may also operate demarcated farms. Since these farms have not been officially surveyed, they are often on lands which may not be appropriately located in terms of soil composition or adequate rainfall and, therefore, constitute the division at greatest risk from erosion.

It is in this division that the GOS needs to focus its attention on preventing over-expansion into marginal lands with low capability soils, and high erosion hazards. A strong and more restrictive government policy is needed to control future expansion of this activity.

Agricultural Companies are usually very large farming/development projects funded by private and/or external individuals or governmental agencies. Very large companies include: Damazine Agricultural and Animal Production Company (500,000 feddans), Sudanese Egyptian Integrated Agricultural Company (250,000 fd), Green Valley Company (100,000 fd), AAAID-Agadi Farm (500,000 fd), Sim Sim (70,000 fd), the Arab Sudanese Blue Nile Agricultural Company (200,000 fd), and the Blue Nile Livestock and Crop Production Company (1,000,000 fd) which is not yet operational. The location and allocation of these farms were selected according to land use criteria, feasibility studies, and availability of adequate financing. Farms in this division provide their own infrastructure, highly-trained agricultural technicians and managers, and follow long-term management and production programs. These farms produce the highest yields in the subsector, with a few exceptions.

There are two types of farm owners/operators in the demarcated and undemarcated divisions (i.e., active and absentee owners). Absentee owners are characterized as individuals, usually residing in Khartoum, who acquired farms through influence, investment or other means, and who rent to other active farmers.

Often these farms are located in the poorer rainfall areas and are rented only after the rains have occurred. Rental rates therefore correspond to the amount of rain received, and in 1985/86 ranged from LS 4.19 in Damazine to LS 9.01 in Gedaref, per feddan.

Main crops grown in this subsector are sorghum and, though far behind, sesame and millets. In recent years some upland cotton (U.S. varieties) has been introduced into cultivation, mostly in central Sudan, and in restricted locations.

A very important recent development is the introduction of hybrid sunflower into cultivation in eastern Sudan. This crop is well adapted, and its projected area of cultivation - barring unforeseen problems and availability of hard currency for seed imports - is expected to grow geometrically.

Yields per feddan of the three main crops grown in this subsector have been low, compared with yields obtained at the research stations or in countries with similar soils and climatic conditions.

Low yields are attributed to:

- o Drought (although not in 1985/86)
- o Inadequate land preparation
- o Areas of marginal land
- o Absence of well defined ownership
- o Ineffective mechanized technology, especially tractor size and planting methods
- o Poorly trained and unskilled operators
- o Shortages of spare parts, fuel, lubricants
- o Inadequate weed and pest control
- o Poor seed quality
- o Absence of crop rotation and fertilization
- o Poor harvest techniques

Because the total land area includes land unsuitable for cultivation, and idle fields in a fallow rotation, only 70-80% of the area represents land actually in production.

This subsector represents approximately 24% of the area under cultivation.

The mechanized rainfed farmer is presently obtaining certified sorghum and sesame seed directly from the NSA, while some farmers produce their own seed either under a contract arrangement with the NSA, on their own, or simply by keeping grain for use as seed.

The mission believes that the private seed sector will have a keen interest in this subsector, because (1) most modern varieties are developed for mechanized operations, (2) size of potential sales are large and the decision by a single manager can result in tons of seed sold, and (3) crops tend to be commercial and/or industrial, and thus are more responsive to the benefits of higher yields.

#### Rainfed Traditional

This subsector covers approximately 9-10 million feddans and represents about 58 percent of the cultivated land area, predominantly in the western provinces but to some extent in the eastern Blue Nile province, as well. This subsector is characterized by small subsistence farmers, using primitive cultivation methods, lacking agricultural inputs, and subjected to low and erratic rainfall. The principal food crops produced are sorghum and millet. The cash crops are sesame and groundnuts.

This subsector is difficult to characterize because it contains a vast area of differing soils and climatic conditions utilizing different crops, cropping patterns, and farming systems. Within each traditional rainfed farming community, there is a wide variation in degrees of wealth and subsistence.

Two USAID projects have provided assistance to farmers in Eastern Blue Nile Province near Damazin, and in the western province of Kordofan near El Obeid, Dilling, and Kadugli. General infrastructure and communication to and from this subsector is very poor. Many areas are completely isolated for extended periods every year. Government services are virtually non-existent. Markets are generally very small with a local merchant providing a few consumer items such as coffee, spices, cereals, oil, soap, cloth, shoes, and basic utensils.

The poorest farmer is truly subsistent for his own food, selling any surplus during the good years, and having to buy from the local merchant or neighbors during the poorer years. He will raise some sesame or peanuts as a cash crop, which he will sell to a merchant, from whom he will later buy consumer items for his home and family. These farmers have a very limited impact on the market. A few of the wealthier farmers do produce both marketable food and cash crops, but because of their limited numbers and great distances from Khartoum, also have very limited impact on the market economy.

Crop yields in this subsector are extremely low, resulting from the following:

- o Low quality seed of poor genetic stock. Farmers saving their own seed, even of improved varieties, experience a decline in the genetic quality of sorghum and millet seed due to outcrossing with the wild relative seed indigenous to Sudan.

- o Low and erratic rainfall coupled with poor seed and crop husbandry.
- o Primitive cultural practices in planting, weeding and disease control.
- o Low and erratic rainfall. A perceived probability of high risk of crop failure or, at best, low yields - one out of so many years - limits investment in advanced technology for crop production. In the face of a high probability of poor rainfall situations, risk aversion will be significant.
- o Small farm size limits capital accumulation.
- o High price uncertainty in some markets for the commodities. This is due to lack of organized markets, poor road infrastructure, inadequate grain storage facilities, and lack of price support policies.
- o Poor soil fertility, shifting cultivation practices, and large areas of sandy soils, with low water and nutrient retention potential. As soil fertility decreases through nutrient depletion, after years of continued cropping and inadequate fallow rotation due to population pressure and demand for more continuous land use, crop yields may tend to decrease gradually. Fertility decrease may, in turn, increase weed infestation (wild jowars, mallow and striga) and severely reduce crop yields.
- o Primitive traditional cultural practices in planting, weeding and disease control.
- o Low or limited access to improved crop varieties. Research by the ARC of these areas is minimal, and new varieties of crop plants adapted to low or "unfavored rainfed" agriculture are almost non-existent or have had limited diffusion.
- o Lack of an active and effective extension system.

Normal seed selection, production, and distribution follows a very complex pattern which has been studied and documented by Edward B. Reeves and Timothy Frankenberger: "Farming Systems Research in North Kordofan" in 1981, and C. Milton Coughenour's study, "Recent Change in Villages and Rainfed Agriculture in North Central Kordofan" in 1985 (AID/IDSAN-G-0149).

The most common practice of traditional farmers is to save seed of the present crop, if there is adequate yield, for planting the next season. In the case of sorghum and millet, the best heads are selected on the basis of color, shape, size of head, size of kernels, etc. The heads are threshed separately and saved in a tight container. If the quantity is large it is stored in a burlap bag in the farmer's house and protected from insects and rodents. A farmer can ordinarily obtain seed

from another farmer in the village if the quantity needed is small.

Of interest to the development of a rudimentary seed industry, however, is the observation that one of the incentives farmers have for participating in variety trials is the possibility of discovering a successful variety which would be noticed and desired by other farmers. "The seed from the crop thus would bring a very good price. The possibility of profiting from the sale of seed was mentioned by many farmers when asked what they would do if they obtained some seed which might be superior to existing varieties." (Coughenour, 1985.)

The Coughenour report also discussed the probability of merchants distributing seeds. It concludes that farmers tend to distrust merchants, particularly in terms of quality and exploitation, and that any merchant dealing in seed would need to overcome those suspicions. Farmers tend to prefer other farmers to merchants as a source of seed. They believe the local farmer has more direct experience with the particular seed, is more flexible in the quantity sold, and is less likely than merchants to cheat or to sell a mixture of seeds rather than "pure" seed. From these observations, it is more likely that the most reliable private enterprise in seed production/distribution in the traditional sector for field crops will be the farmer producer/seedsman. A different system is envisioned for vegetable seed sales and distribution. The wholesale sources of vegetable seeds are and will continue to be specialized vegetable seed producers, NSA, and importers. Distribution will be encouraged through merchants or through NSA and possibly private seed company kiosks targeted at farmers' markets. Both mobile and permanent kiosks are envisioned, with the mobile kiosk moving from village market to village market.

The proportion of production from each subsector of the main food crops for 1986/87 (i.e., sorghum, millet, sesame, wheat and groundnuts) is found in Table III.1.

It is apparent that each subsector contributes differently to the total food crop production of the country.

The mechanized rainfed sector supplies 73% of sorghum, the principal food crop, with the irrigated and rainfed traditional farmer producing nearly equal amounts of the balance. Because sorghum for the traditional farm is a subsistence food crop, less is marketed by traditional farmers than by irrigated tenant farmers.

Ninety-four percent of the millet crop is produced by the rainfed traditional sector. This represents, however, only 28% of the total rainfed traditional production (for all crops) in metric tons. Production of millet, in both the irrigated and mechanized rainfed sectors, is insignificant.

Groundnut production is about equally divided between the traditional rainfed and the irrigated subsector. No groundnuts are produced by the mechanized rainfed subsector, because of the clay soils which prevail. On the other hand, no sesame is produced by the irrigated sector. Approximately 1/3 of sesame production is provided by the mechanized and 2/3 by the traditional rainfed sectors, respectively, with areas of the same proportion. In the past two seasons, areas have generally converged, with the result that 2/3 of the production is now in the mechanized rainfed subsector.

Wheat is produced entirely by the irrigated subsector.

The average percentage of all crops produced is nearly equally divided between all three subsectors, with the irrigated providing 33.8%, the mechanized 28%, and the traditional providing 38.2% (crop reporting statistics for 1986/87).

#### B. Sources of Seed Supply

Seed in Sudan is supplied from local production and from imports. Locally produced seed comes from the NSA or from the schemes, as well as from farmers who save their own seed. As mentioned above, the latter constitutes the largest source of the supply of seed in Sudan. See Table III.2.

The largest single supplier of seed of high yielding varieties (HYVs) is the Plant Propagation Administration (PPA), which is one of the two divisions of the NSA. All seed produced by the PPA is intended for sale. The principal customers are the large irrigated and rainfed agricultural production corporations and individual farmers. In theory, seed can also be sold to merchants; however, this is rarely the case except for vegetable seed. Lesser amounts of seed are also sold to public agencies and projects.

Because production and marketing activities are not well coordinated and executed, some seed stocks may not be sold even though there is a general shortage of seed in the country.

The PPA does not have a seed distribution system outside of the seed production stations. Any customer desiring seed must go to a PPA seed production station, pay in cash or certified check, and provide his own transportation. See Table III.3, Seed Distribution 1982-83, for PPA distribution to farmers by stations.

The agricultural schemes have undertaken their own seed production, with technical assistance and basic seed supplies from NSA. The varieties in all cases are either locally developed, or imports adapted by the ARC. Seeds produced by the schemes are cotton, wheat, sorghum, and minor quantities of maize, castor and other crops.

A few private producers and importers, who sell on a wholesale and/or retail basis from shops located in major cities and villages, also supply seed in Sudan. This market provides the principal source of vegetable seed used by farmers throughout Sudan, and appears to be a viable and profitable business.

At best, 1.8% of the seed requirements of Sudan, depending on the crops, originate in seed produced by NSA and/or the schemes. The rest of the supply comes from farmers and from a few small, local unidentified seed producers.

Some grain and fodder sorghum and sunflower seed has been imported by the large agricultural companies directly for their own use.

In recent years, USAID has facilitated, through funding support, the acquisition of seeds, especially wheat, hybrid sorghum and hybrid sunflower by the NSA. This seed was supplied mainly by Pfizer-DeKalb, Pioneer, Seed Tec, Tropical Seed Co., and Funk, and was marketed primarily in the irrigated and mechanized rainfed subsectors.

### C. The Present Institutional Framework

#### 1. The National Seed Administration: Origin, Evolution, Organization and Functions

The seed industry in Sudan was formalized in 1965, when the Ministry of Agriculture, Food and Natural Resources entrusted the production, processing and quality control of improved seed for all crops (except cotton) to the Plant Propagation Administration (PPA), first located at the Hudeiba station of the Agricultural Research Corporation (ARC), and later moved to Sennar in 1975.

Under a joint project sponsored by FAO and UNDP, seed farms or "stations" were established at:

- o Sennar Main (PPA Headquarters)
- o Sennar West
- o Khashm el Girba
- o Hudeiba
- o Sim Sim
- o Tozi
- o New stations at El Obeid, Dongola  
(See Figure III.7.)

In February 1982, PPA was reorganized. The National Seed Administration (NSA) was established with headquarters in Khartoum, and reporting to the Undersecretary of Agricultural Services (see Figure III.8).

The specific objectives of the NSA are to:

- o Function as national agency for planning and coordination of seed programs
- o Implement seed production programs through PPA and certification programs through the SCA
- o Advise GOS on all aspects of the seed industry and assist in the formulation and enactment of seed legislation
- o Advise on release of new crop varieties through the Technical Committee for Variety Release
- o Advise GOS on the import and export of seed
- o Prepare project proposals for seed development programs with or without external assistance.

These functions are performed through the two services or divisions of NSA, the Plant Propagation Administration (PPA) and the Seed Certification Administration (SCA).

The main functions of the PPA are to:

- o Implement and coordinate production programs of seed of all crops at all stations, and in various agricultural schemes
- o Maintain quality standards of all seeds produced at farms
- o Design and administrate training programs for all categories of staff
- o Plan and organize seed storage, marketing and distribution
- o Operate seed processing plants
- o Administer all farms under the NSA.

The PPA is subdivided into four divisions:

1. Production and Training Division
2. Marketing, Storage and Publicity Division
3. Engineering and Seed Processing Division
4. Administration and Finance Division

The eight stations are under the direct responsibility of the Director of PPA and are supervised by station chiefs. The stations are subdivided into three sections:

1. Seed Production
2. Seed Processing and Engineering
3. Storage and Marketing

The main functions of the Seed Certification Administration are to:

- o Organize certification work

- o Assist in the formulation and enactment of seed legislation
- o Maintain economic crop registers and records for the Technical Committee for Variety Release
- o Train seed analysts, and field and seed inspectors
- o Design and issue certification tags
- o Prepare publicity and technical materials.

The SCA is subdivided into three divisions:

1. Field Inspectorate Division
2. Seed Testing Division
3. Quality Control Division

Seed testing centers (with seed quality control laboratories) are located within the four PPA stations at:

- o Sennar Main
- o Hudeiba
- o Khashm el Girba
- o El Obeid (moved from Tozi)

Certified seed production is quite insufficient when compared to potential national demand. Certified seed production has been increasing but at a slow pace. Plans (Sudan Seed Plan) to increase seed production have been drafted, and the NSA expects to implement them. If success is to be achieved, better coordination and greater availability of economic, physical and human resources are required. At present, the individual seed stations make their own short-term plans (about one year), which are based on their own personal experiences and on the currently available facilities. The only existing planning exercise is the General Meeting of all Stations Heads, Section and Senior Officers, which normally takes place twice a year at PPA headquarters. In these meetings, short-term production programs for the coming season are discussed, and decisions are made by general agreement. Lack of reliable marketing information and strategy are major contributing factors to deficiencies in seed production.

Responsibilities for seed production in the public sector are divided as follows:

Breeder Seed - The ARC is responsible for the production and release of all breeder seed used by the PPA.

Foundation Seed - The PPA is responsible for producing all foundation seed of varieties developed and released by the ARC.

Certified Seed - The PPA stations and selected government schemes are responsible for the production of all certified seed varieties produced and released by the ARC.

Since 1985, NSA has resolved to support a number of seed growers, determined to become seedsmen, in the production and distribution of Hageem Dura (HD-1 hybrid) sorghum seed. This project was made possible through the support of USAID/Sudan.

## 2. Government Agricultural Corporations and Schemes

Sudan has a long history of government involvement in agricultural development and production.

According to the World Bank (Report No. 5496-SU, Sudan - Prospects for the Rehabilitation of the Sudanese Economy), most of the government-owned or controlled agricultural corporations and schemes are technically bankrupt. One hundred corporations and components in nine sectors were listed, including 18 in the agricultural sector. Out of 16 public enterprises analyzed, six were agricultural corporations and none showed a profit. The Agricultural Corporations analyzed were:

- o The Gezira Board
- o Mechanized Farming Corporation
- o Rahad Agricultural Corporation
- o Blue Nile Agricultural Corporation
- o White Nile Agricultural Corporation
- o New Halfa Agricultural Corporation

The World Bank concluded that seed production, processing and marketing activities which are better performed by the private sector, and which do not necessarily have to be performed by the public sector, should be transferred to the private sector. If the private sector is not interested in purchasing such enterprises, they should be liquidated.

### D. The Research Component: Agricultural Research Corporation (ARC)

The Agricultural Research Corporation (ARC), created by the Agricultural Research Act of 1967, has primary responsibility for all agricultural research activities in Sudan. It is a semi-autonomous body administered by the Sudan Agricultural Research Council and is directly responsible to the Minister of Agriculture and Natural Resources. The ARC, which is based in Wad Medani, operates five regional stations and twelve substations. Its organigram is presented in Figure III.9.

The ARC was originally established to support research needs of the so-called modern sector, particularly in cotton, other irrigated crops and later mechanized rainfed crops. As a result, research activities were not oriented toward the traditional rainfed sector. The ARC recently added a research component in traditional rainfed agricultural research at El Obeid and Kadugli, supported in large part by the World Bank and USAID.

Scientific research is pursued by the ARC in the following disciplines: Soil Science, Agronomy and Crop Physiology, Botany and Plant Pathology, Entomology, Horticulture, Statistics and Agricultural Economics, Food Technology, Forestry Research, Fish Research, Wildlife Research, Range and Pasture, and Plant Breeding.

Research at the ARC is conducted through the following committees and councils:

- o The ARC Council
- o Administration and Finance Committee
- o Technical Committee
- o Varietal Release Sub-Committee
- o Crop Husbandry Sub-Committee
- o Pesticides Sub-Committee

From the standpoint of the seed industry, the most important functions of the ARC are research on breeding and development of new crop varieties, research on release and introduction of new varieties, and maintenance and supply of breeder seed stocks.

Reduction in funding at ARC and the subsequent deterioration of plant breeding programs and facilities is a serious constraint to the public component of the seed industry. More than half of the ARC plant breeders in all crop disciplines have left the country, and many of the remaining ones are planning to do so. Equipment is old and outdated. Funds for carrying out plant breeding and testing are diminishing. Central government budget support is barely sufficient to cover salaries. For operating funds, ARC is dependent on external sources of aid to Sudan.

Research on variety improvement is based on national commodity programs managed by national coordinators. Breeding material is introduced in primary, advanced, and national tests prior to selection, approval and release.

#### E. The Regulatory Environment for Seeds

Seed quality-related regulations are overseen by the National Seed Administration, through the SCA. Quarantine and import regulations are administered by the Ministry of Agriculture, through the Crop Protection Administration (CPA).

SCA performs its duties under the provisions of the Office Order or Seed Act of 1982. This was revised by the African Development Bank, but not approved by GOS. A set of "Seed Regulations, 1980" exists and incorporates testing, inspection, variety release procedures and seed certification standards for a number of crops. None of these, however, has been legally approved. Seed certification is, therefore, conducted in Sudan with no legal basis. The present structure of the National Seed Administration comes from an Office Order (No. SCR/A/5/9/3/A) of February 8, 1982, of the Minister of Agriculture. The FAO/UNDP Sudan Seed Project (Plan, April 1975) included among its objectives the organization of a national seed certification and quality control agency.

## 1. Seed Certification

Seed Certification has been equated with seed quality control in Sudan as, mistakenly, it has been in other developing countries. The following activities of the Seed Certification Administration (SCA) properly fall within the area of seed certification: (a) organization of certification work; (b) design and use of the certification tag; (c) certification training; and such general administrative matters related to seed certification as: (d) assistance in the formulation and enactment of seed legislation; (e) keeping minutes of the Varietal Release Sub-Committee meetings; (f) maintaining an economic crop register with released variety characteristics; and (g) preparing technical and publicity materials. All these activities are centered around publication of a list of varieties approved by the variety release sub-committee. The SCA, then, in principle, insures that seed of such varieties which are in the market is properly produced and identified as "certified seed."

SCA oversees certification activities from the basic seed level (produced by the Plant Production Administration of NSA) through the commercial seed level. Commercial seeds, as well as basic or foundation seeds, are termed certified seed when they comply with the standards set in the "Seeds Regulations Document, 1980." Normally, however, basic seed of PPA when certified is only referred to as "basic seed," although it should properly be known as "certified basic seed." The label "certified seed" is reserved exclusively for first and occasionally for second generation seed, resulting from propagation of "certified basic seed" that has been inspected and approved under the existing standards.

The standards in use, when first formulated, resembled very closely those of other countries. It was soon discovered that under conditions prevailing in Sudan it was difficult, if not impossible, to comply with such official standards and still channel reasonable amounts of certified seed to the marketplace. Therefore, standards had to be changed, and presently certified seed is produced under more relaxed standards.

The essence of these standards is not understood in Sudan. For example, an isolation distance of 200 to 500 meters might be sufficient in the U.S. or Argentina for sorghum seed production. In Sudan, cultivated volunteer and wild sorghum is present everywhere, and the air is often saturated with pollen coming from short and medium distances. Under these conditions, effective isolation may be impossible. Seed companies in the U.S.A. may use isolation distances of up to 3 kilometers, which would be very difficult indeed to accomplish for sorghum seed production under the present conditions in Sudan.

Inspection of seed production fields and of processed seed is carried out by SCA officials, working out of Sennar West and

Sennar Main Seed Stations of the NSA, and from the three outlying seed stations at Huseiba, Khashm el Girba and Tossi. Additionally, technical staff provide inspection service and technical assistance in seed production and roguing at the seed units of the following government-managed corporations: Gezira, New Halfa, and Rahad. Inspection of fields and seed leads to certification if the seed has been produced according to official standards. As mentioned above however, in the case of cross-pollinated cereal seeds such as millet and sorghum there is no assurance that high quality seed can be produced within high levels of purity - as certified seed is usually described - under the prevailing conditions.

After seed is inspected in the field and the seed processing plant, samples are taken to a laboratory at Sennar or Hudeiba. The samples are analyzed and results of these analyses are included as components of the certification tag. This quality control data is then included as a component of seed certification.

Seed Certification by definition is not quality control. The process of seed certification, as defined in the seed industry, refers only to the process of arriving at the assurance of the preservation of genetic identity within established limits. It bears no resemblance to the definition of "certification" in its wider generic sense.

Seed quality control refers to permissible percentages of: germination, weed seeds, foreign matter, purity, and moisture. Variety uniformity or genetic identity, although a component of seed quality, is the only one definable through the seed certification process.

Quality control measures and limits may be established both for certified and uncertified seed. In countries where certification is non-compulsory, particularly where a private seed industry exists, private seed companies guarantee levels of genetic identity for their own seed. Labels containing quality control information such as percentages of germination, foreign matter, other seeds, and weed seeds, may be compulsory for both certified and uncertified seed. The two systems may run in parallel, and private seed companies may or may not choose to certify their seed. Seed certification is thus a service, and not a compulsory measure used erroneously to designate only certified seed as "good" seed, as is done in Sudan and certain other developing countries.

Seed of proprietary varieties and hybrids produced under the internal quality control standards of registered seed companies have been proven - all over the world - to be of as good, or often better, quality than certified seed of public varieties. This seed company guarantee is widely accepted by farmers, even when no certification tag is attached to the seed bag.

Seed certification and quality control processes emerged in Sudan as a single, joint process (under the name of seed certification) at a time when a private seed industry did not exist, and was not soon expected to develop. The persistence of this confusion may be a serious deterrent to those private seed companies which have developed private hybrids. This certification process, as currently applied, results in the following: private companies must divulge to SCA the parental lines of their hybrids, which negates the biological protection and effective proprietorship of their varieties, or else their hybrids are subjected to a meaningless "pseudo-certification" process which amounts to nothing more than an unnecessary control measure.

If, however, an independent quality control program not linked to the seed certification process is established (as is the case in the U.S. and many other countries), compulsory for private hybrid and non-hybrid seed of improved varieties, consumer protection and protection of the proprietary rights of private seed companies will be assured. A grow-out system - where private seed companies check the quality of their seed lots before putting them on the market - is proposed by SCA as a system for certifying private hybrids in the future. Private companies do this on their own. Repetition by the SCA, without knowledge of the structure of the hybrid, its mutation rate for plant height genes, its level of accepted heterozygosity (which in double- and triple-cross hybrids and in some single-cross hybrids may be high) would be a counterproductive use of public quality control authority.

Companies assess the market response to their products after having properly identified and test-marketed them. If the product - a hybrid, in this case - is accepted by consumers, repeat sales will be achieved by the company only if it can insure, through grow-outs, that the product is reproduced accurately each and every generation. Only the seed company can accomplish this through control of its own parental lines, and by applying proper isolation and roguing procedures.

Compulsory certification of private hybrids would amount to harmful interference with the private sector, and might impede its participation the Sudanese seed industry. On the other hand, compliance with fundamental quality control factors such as germination percentage, foreign matter percentage, noxious weed content, and moisture content, should be made part of a compulsory quality control process.

Seed that could be certified on the basis of basic seed produced in 1986-87 includes 4 varieties and 1 hybrid of grain sorghum, 6 varieties of groundnuts, 4 sunflower varieties, 6 sesame varieties, 3 wheat varieties, 1 Roselle variety, 2 chili pepper varieties, 1 cowpea variety, 1 anise variety, 1 eggplant variety, 1 Fenugreek variety and 1 Kamoon Aswad variety.

NSA indicates that the total amounts of its own production of seed certified were, respectively: 1193 MT in 1982/83, 1681 MT in 1983-84, 1710 MT in 1984-85 and 2620 MT in 1985-86.

## 2. Seed Quality Control

As noted above, seed quality is controlled at the time of seed certification, and only on certified seed. There is no system of continuing quality control for seed "in the market" which is stored and distributed throughout the country after it is produced or imported and certified. In other words, there is no system in place to determine whether seed offered for sale in Sudan is fit to be planted.

None of the seed regulations define clearly what quality control is, or what mechanisms are needed to enforce it. The revised seed law provides for quality control activities including: seed labelling requirements for various types of seeds, identification of the agency responsible for verifying and monitoring the process, inspection and inspectors, and assurance that the difference between quality control and seed certification is clearly understood.

## 3. Variety Introduction

The variety introduction process in Sudan has been managed by the Agricultural Research Corporation according to existing phytosanitary control regulations. Generally, the sources of high quality seed are the CGIAR network centers, particularly ICRISAT for sorghum, millet, chickpeas, and groundnuts; INTSORMIL for sorghum, CIMMYT for wheat, ICARDA for wheat and Faba beans, and some national research programs.

The private sector is beginning to introduce hybrids and breeding materials in Sudan. There is no clear indication as to how free seed companies will be to introduce breeding material, advanced lines and hybrids, and finished hybrids for testing. Whether they will be able to breed and test material on their own cannot be discerned from any of the existing regulations.

Pioneer Overseas Corporation has recently entered into a private agreement with the ARC of Sudan, which enables it to introduce genetic material for breeding and testing in Sudan. Pioneer has also established a breeding company in Sudan, and has been allotted 100 feddans inside the ARC's Gezira Research Station at Wad Medani. In 1987, Pioneer was testing sorghum and sunflower hybrids. There are no indications as to how other seed companies will proceed prior to enactment of general legislation on this point.

#### 4. Variety Testing and Approval

Variety tests are conducted by the ARC at research stations and substations in various regions of the country. Coordinators of the various crop programs at the ARC send plans and seeds to their collaborators, and their technicians and breeders try to visit the test fields at least three times during the growing season. Data is collected by the collaborator or by ARC, and analyzed by the ARC.

There are three types of tests for sorghum, groundnuts and wheat: primary, advanced, and national. These crops are also placed in variety tests at locations selected in cooperation with collaborators at the GOS agricultural schemes or production corporations. Wheat is of particular interest to the latter, in addition of course to cotton, which is also the crop of primary interest to the government-administered crop production corporations. Horticultural crops are tested at the Shambat Research Station located at Khartoum North, and at the Shendi and Hudeiba research stations.

On the basis of advanced trials at the national level, carried out over several years, data on variety performance is accumulated to support the recommendation of the variety regarding registration and release. It is recommended that the new seed law stipulate a two year period for this type of testing.

The Varietal Release Sub-Committee (VRSC) is responsible for examining the information supplied by breeders in their application for approval of variety registration and release.

VRSC members include the director general of the ARC, the director general of NSA, the coordinators of the national crop programs, some production scheme managers, representatives of the university faculties of agriculture, the research stations, extension services, and a representative from the Ministry of Finance and Planning.

The VRSC has released two sorghum varieties and one hybrid in addition to several cotton varieties. It is interesting to document the release of hybrid Hageen Dura-1, approved at the January 24, 1983, meeting of the VRSC at the ARC headquarters. Information on yield and agronomic performance for three elite sorghum hybrids was presented for test years 1979-1981. At this time, these three hybrids emerged as candidates out of 3,033 tested in Sudan. Two hundred and two experimental hybrids, including the elite ones, were selected during the period 1980 to 1982. The number of elite experimental hybrids was reduced to 28 during advanced yield trials in 1981 and 1982. This would indicate that the testing period required for release of a hybrid is two years. There were three locations in 1981 (Wad Medani, Gadambalia and Agadi), all in the central clay-soiled area, and five (Sennar Main, Sennar West, Samsam, Gadambalia, and Abu Naama) in 1982.

The length of the testing period appears reasonable for preliminary and final variety approval. It should allow for culling of varieties not fit for planting, which is about the most valuable information obtainable through these plot tests.

A different type of testing, known as "on-farm research trials," has been organized by GLOBAL 2000, Inc., a non-profit organization which is conducting research on technology use at the farm level. This type of testing is based on on-farm research tests conducted on large plots employing only a few technological innovations (such as improved varieties). The following organizations are cooperating with GLOBAL 2000: Central Agricultural Services Administration, Western Sudan Agricultural Research Project (WSARP), ARC, NSA, Gezira Scheme Board, and the Ministry of Planning and Economic Development. This program provides an opportunity for researchers, extension workers, and farmers to work together and establish linkages among themselves while providing a framework in which to facilitate the adoption and flow of new technology.

#### F. The Private Seed Sector

The private seed sector in Sudan is made up of seed producers, seed importers, international seed companies operating directly or indirectly in Sudan, seed distributors, and dealers and local seedsmen. The industry is in the process of evolution, and its future transformation into a stable and healthy component of the national seed system will depend on its own performance, and the future economic and political environment. The private seed sector is still embryonic, with the exception of seed importers (especially of vegetable seeds), who have been in the market for a number of years and are experienced in this type of business activity.

##### 1. Seed Producers

Seed producers are mostly medium-sized companies which have undertaken seed production in Sudan. With the release of sorghum hybrid HD-1, and the official price of hybrid seed set 5 to 6 times higher than the price of ordinary open-pollinated sorghum varieties, a number of firms decided to begin production and marketing of HD-1 seed. Twelve of these firms began production of HD-1 sorghum seed in 1985 on 1350 feddans of land, producing slightly over 50% of the total seed obtained for this hybrid. The balance is being produced by NSA. Ten of these firms are listed in the roster of the newly-formed Sudan Private Seed Producers Association. One company has produced commercial seed of grain and forage sorghum from basic seed provided by a foreign firm (Pioneer Overseas Corp.), while several are producers of wheat, open-pollinated sorghum, fodder and vegetable seed.

None of these companies has a seed plant of its own. They use small scale equipment for seed cleaning, or utilize the facilities of NSA for the HD-1 sorghum seed processing. In the case of HD-1 seed, most producers have been selling certified sorghum seed "as is" out of the combine, without further cleaning.

Pioneer Seed Company recently entered a joint venture to produce and distribute seed of improved varieties. Pioneer Overseas Corp. owns 51% of the shares, while three Sudanese companies (Gandul Livestock Co., Wad El Hag Enterprises, and Sambio Enterprises) hold 44%, and 5% of the shares are outstanding. Other seed producing ventures that started in 1985, such as Tenneco Sahara Co., Egyptian Integrated Co., and Islamic Development Co., Ltd., may have foreign investment participation as well.

At least 3 other foreign companies are exploring the Sudan seed market for sorghum and sunflower hybrids. These are Ciba-Geigy (Funk's Seeds), Pfizer-DeKalb, and SeedTec. None of them, however, is contemplating a major investment in seed production at this time. Ciba-Geigy is already established in Sudan through chemical and pharmaceutical distribution.

## 2. Seed Importers

There are several private vegetable seed importers, including:

- Ticad
- Shell
- Elswahli Seed Co.
- Shawgi Seed Co.
- Elgosi Seed Co.
- Mufti Seed Co.

These companies import seed of foreign origin in 0.5 or 1 kilo tins, while one of them, Ticad, imports in bulk and repackages the seed in polyethylene bags weighing 0.5 or 1 kilo. Importers are allowed a mark-up of 30% on the CIF price of seed, which includes 10% and 20% for their wholesaling and importing profit, respectively. Importers sell seed to retailers or to wholesalers, as well as to government schemes.

The total value of vegetable seed imports in Sudan during the last three years, in US\$ have amounted to: 1984 - 883,000; 1985 - 843,000; 1986 - 614,000. One of the companies interviewed indicated it imported vegetable seed last year valued at US\$ 75,000, but this year (1987) it had not yet received a vegetable seed import license, after 10 months of waiting for approval. Its vegetable seed imports for 1987 were consequently reduced to zero.

Import of sorghum and sunflower seeds is also limited by the availability of hard currency. Sorghum and sunflower seed has been imported from the U.S. with hard currency made available by USAID in exchange for Sudanese Lbs. for the express purpose of importing such seeds. The type and volume of these transactions appears in Table III.4.

### 3. International Seed Companies

Three international companies with seed departments are presently established in Sudan: Pioneer Overseas Corp., Ciba-Geigy Corp. (Funk's Seeds Corp.) and Shell Sudan, whose parent company owns Nickerson-Zwaan, International Plant Breeders Inc., and North American Plant Breeders, Inc. Only one of them, Pioneer, has initiated variety testing. It is doing so through a government contract. The other two have technical personnel in their respective seed departments, but do not appear to be planning local production at this time.

Other local or visiting company representatives interviewed during our mission were Pfizer-DeKalb and Seed Tec, both of which have sold seed in Sudan. Neither of them is planning local production at the present time.

### 4. Seed Distributors and Dealers

Seed distributors, dealers, and agents can be found throughout Sudan. Vegetable seed dealers were interviewed in Wad Medani and Senar. Although their number is unknown, a recent study estimated that 68 seed distributors, dealers and agents are found in the country. In addition, at least one of the companies - TICAD - has agents who sell other products, such as construction materials, pesticides, and fertilizers on a commission basis.

A typical seed dealer sells various brands of vegetable seeds in tins (Peto Seeds, Royal Sluiz, IPZ, Niagara), with the major volumes going to tomato, onion, eggplant and watermelon. Snake cucumber seed from National Seed Co., Cairo, is sold in opaque plastic bags. Imported bulk vegetable seed is sold in transparent plastic bags, as is locally produced seed from NSA, which is distributed wholesale by TICAD.

There is no dealer network for NSA produced field crop seeds, such as sorghum, millets, groundnuts, and sesame, as NSA has yet to work out marketing channels. In any case, the 15% mark-up in prices over grain, established by NSA, is not sufficient to develop such distribution channels through commercial operations when effective interest rates are taken into account. Vegetable seed dealers sell, on the other hand, vegetable seed originating in NSA because the price of NSA vegetable seed mirrors the price of imported seed. Vegetable seed distributors for imported seed are officially permitted a mark-up of 50% (30% importer/wholesaler, plus 20% retailer) on

imported seed prices. Seed prices in the market place may be much higher.

#### 5. Local Seedsmen

Farmers who have acquired good reputations for tending crops and selecting the best fields for their own seed production, tend to become resource persons for seed production and distribution among their neighbors, either on a permanent or occasional basis. This is a system that is emerging in the traditional rainfed areas for sorghum, millet, groundnut and sesame seed and, to some extent, in the irrigated areas for certain vegetable seeds.

Present systems of seed distribution, whether private or public, are ineffective in reaching farmers in western traditional rainfed agricultural areas and in the south. Information on new seeds is conveyed more often by merchants interested in buying grain, as is the case of sesame for oil milling, because they demand high quality products. Farmers in these marginal areas are accustomed to saving seed each year. If, however, a new variety should come into the area, which is demonstrably better yielding and would enable the farmers to command high prices in the market for surplus production, farmers will undoubtedly accept it. They will pay a higher price for the initial seeds, provided they can then save seed of the succeeding crop of the new variety for themselves. Every 3 to 5 years these farmers will be ready to replenish the seed with a fresh, pure lot, paying a higher price for it.

Local seedsmen could clearly do this job. At present, documented cases of local adoption of sesame varieties (2) are known. The Wad Sandoog variety of sesame spread quickly among the Bideriya tribe at el-Timaïd in 1981. Aish Bornu and Dawaji are millet varieties grown by the Bornu and Dajo peoples. They have not spread to other ethnic groups due to poor channels of communication. The establishment of nuclear seedsmen in these communities may be of great effectiveness in the future for distributing seed of high yielding varieties.

#### G. Import and Export of Seeds in Sudan

Very small quantities of seed are presently being imported on a commercial basis. Vegetable seed is imported by the private sector. Grain and forage sorghum and sunflower seeds are imported by seed distributors, and large end-user companies, mainly through hard currency financing made possible by USAID. USAID provides dollars from the CIP program under agreement with the GOS, so that letters of credit can be opened by importers; USAID receives Sudanese pounds in return. In this manner, 500 MT of sorghum (hybrid) seed was imported in 1985-86 and 143 MT in 1986-87. Again, 146 MT and 75 MT of hybrid sunflower seed were imported from two seed companies in 1987. Through a 1985 grant, USAID made possible the importation of 7,500 MT of wheat seed for NSA from Egypt.

The main public importer of seed is the Agricultural Bank of Sudan. It imports about two tons of potato seed annually, plus three tons of different vegetable seeds from Holland under a loan program between Dutch and Sudanese governments.

Agricultural companies such as AAAID import seeds of all types. Because of their external funding, allocation of foreign exchange poses no problem. Also because of inter-Arab associations, they are not subject to customs and tariffs.

Seed may also be imported by foreign donors, such as USAID for projects or for special purposes, usually under a bi-lateral agreement.

Private seed companies import substantial quantities of selected vegetable seed for vegetables such as tomatoes, onions and watermelons. International seed companies such as Pioneer, DeKalb and Funk are also permitted to import seed of certain hybrids and hybrid parental lines for grain and forage crop seeds.

Seed exports are in such small quantities as to be insignificant.

Future seed exports, which must compete on the international market, will need to be produced more economically than they are now and must compete on the basis of superior quality. In view of the present seed production situation, an export-based seed industry is not considered likely to develop in the near future. However, some international seed companies may find it advantageous to use a base in Sudan for research and for export of seed to neighboring countries, provided they receive the right incentives.

#### H. Infrastructure for Seed Processing and Storage

New and improved crop varieties become an important agricultural input only when seed of such varieties is available to farmers in a reasonably pure state, in a viable condition, free of contaminating weed seed, and in adequate quantities at the right place and time.

The National Seed Administration/Plant Propagation Administration have excellent processing facilities established through various seeds projects. Seed processing capacity for the various seed production stations, assuming 180 operating days per year, is shown in Table III.5.

A list of the seed processing equipment at the NSA Agricultural Production Scheme and Corporation plants is shown in Tables III.6 and III.7.

## I. Marketing and Distribution of Seeds in Sudan

The distribution system for seeds in Sudan is a product of the peculiar agricultural systems that co-exist in the country. The large number of tenant farmers of the irrigated agricultural production schemes are a captive market and are served by their respective schemes. The medium to large farms of the rainfed mechanized agricultural subsector constitute a market for NSA seed and, to some extent, for the private sector. The traditional rainfed agricultural subsector has no major suppliers of seeds. It is a large fragmented market of impoverished farmers who use their own grain as seed. Vegetable farmers, located on the banks of the Nile, produce crops of high economic value and, therefore, understand and demand high quality seed, local or imported, and are willing to pay higher prices for it.

Seed distribution in Sudan for sorghum and millet is primarily an internal operation for individual farmers, or a "farmer-to-farmer" process. Estimated seed supply by sectors for 1987 as reported by Khalifa (1987) is as follows:

	Sorghum (Tons)	Millet (Tons)
Public Sector	1900	2.0
Private Sector	1000	0.0
Importers	150	2.5
Farmers	<u>26398</u>	<u>9529.5</u>
TOTAL	29448	9534.0

(These figures assume a seeding rate of 3.0 kg/feddan.)

It is clear that the public sector plays a relatively small role in the supply of sorghum and millet seed.

The NSA sells seed at points of production. In addition to the logistic problems associated with seed being distributed from a small number of central locations, the government's bureaucratic system of selling is frustrating for farmers. In order to purchase seed, the farmer must see the station manager, and make out an order which when approved must be taken to the cashier, who then issues a receipt. The farmer then takes his receipt to the store where he expects to receive the seed. It is a complicated procedure, and during the busy season means standing in line three or four times. In contrast, the private seed retailer handles all three functions - taking the order and payment simultaneously - and issues the seed on the spot. This is a simple procedure that the farmer understands and appreciates.

Seed distribution to and within the public schemes and corporations is well defined. Breeder seed developed and maintained by the ARC is funneled to the NSA for multiplication.

The PPA of the NSA produces basic (foundation) seed from the breeder seed stock. The foundation seed follows either of two channels. It may be multiplied and certified at the PPA seed stations which will be sold to the schemes directly for their own operations or for use by their tenant farmers.

The agricultural schemes have developed obligatory rotation programs for their tenants. Predetermined planting areas are allocated to wheat, sorghum, and groundnuts each year in the irrigated schemes, which are rotated with cotton areas. Therefore, it is quite simple to estimate seed demand long in advance for each scheme and to plan seed production accordingly. Seed is delivered to tenant farmers according to size of holdings and predetermined planting plans, and charged at cost.

Recent production of sorghum and groundnut seed by schemes is shown in Table III.8.

It is apparent that the PPA and agricultural corporations have considerable excess seed processing capacity. This capacity should be made available on a fee basis to private seed producers which may be located in the vicinity. The extent of private seed processing facilities is believed to be virtually nil.

Seed cleaning equipment supplied to non-seed production projects, such as the Damazine Agricultural and Animal Production Company Ltd. (Petkus 100) and the Blue Nile Integrated Agricultural Project, may be available. A survey should be conducted to identify idle seed processing equipment which could be utilized by the private sector.

Storage facilities for seed at PPA stations is inadequate. Warehouses are presently used to store seed, fertilizers, chemicals and equipment side by side. The Sennar facility, in addition to the warehouse, has a battery of silos with a capacity of 1300 MT. The silos, however, are not suitable for storing bagged seed. All stations should have storage capacity equal to the annual capacity of their cleaning/grading equipment. Conditioned dry/cool storage, particularly for oil seeds, vegetables and legumes, is also needed.

Other facilities should be examined as potential seed storage units strategically located near consumers (farmers), including the agricultural bank loan grain storage warehouses. Seed storage rooms installed in such facilities would need to be completely separated from other grain stocks.

Grain storage facilities have been built by the Agricultural Bank of Sudan in various provincial centers to hold grain collateral for outstanding loans. The large agricultural production companies have some storage facilities, although they would be of little significance to either private or public seed distribution.

The USAID-supported Western Sudan Project plans to build seven large bagged grain storage facilities in the Kordofan and Darfus regions, each with a capacity of 3,000 MT. These are to be operated by the Agricultural Bank of Sudan, as part of its grain marketing/financing operation. It would be useful to future seed distribution systems in the two regions if small areas inside these warehouses were separated by internal walls and used to store seed, in association with an Agricultural Bank of Sudan-supported credit scheme.

Most of the very limited storage capacity at the village level is owned and controlled by local merchants. The mission was not able to obtain reliable data on storage capacity.

Distribution and marketing activities of private farmers vary significantly according to the product and location. Producers are often wholesalers and retailers of their own product. Some of the private seed producers both farm and market their products. In other cases, the producer either sells to a retailer or wholesaler, perhaps through a contract arrangement.

Sudanese producers have also sold seed to the New Halfa Agricultural Corporation which, in turn, distributed the seeds to farmers. In other cases producers sold to the Agricultural Bank of Sudan, which then distributed the seeds.

Private sector seed producers, whose activities include those noted above, have a smaller number of cultivated feddans (see Table III.9). Market conditions would indicate a potential decrease of this amount in 1987.

Seed production by the PPA for the period 1978-79 to 1982-83 is shown in Table III.10 by stations and years, including area, production and yield. Table III.11 gives the production of certified seed by PPA for the period 1982-83 to 1986-87, as totals per crop. An increase in seed production for sorghum, wheat, and groundnut would be particularly welcome.

There is a strong demand for imported vegetable seeds. One retailer in Sennar sold in ratio of 75% imported seed to 25% domestic. Popular imported seeds include tomatoes, okra, eggplant and watermelon. All onion seed is produced domestically. Onions comprise 32% of the area planted in vegetables while 23% is in tomatoes. Because of strong demand and relative scarcity, prices for imported seeds are very high, far exceeding Ministry of Commerce guidelines (70% mark-ups between importers, wholesalers and retailers).

#### J. Cost Structure and Pricing of Seed

The cost of producing seed in Sudan is a confusing issue. Seed companies do not generally grow their own seed, but rather contract and supervise seed growers. This is equivalent to

producing it, which is why the process is referred to as "seed production." Seed companies working through contract growers are known generically as "seed production companies". The contracts specify conditions for growing the seed, minimum quality thresholds, a pricing system and in many cases - especially in growing hybrid seed - a bonus payment. This payment may cover transportation cost to the seed processing plant, or the seed firm may assume this cost reducing the amount of the bonus payment. The cost of production for a seed firm starts with delivery of the basic seed to the farmer. It charges overhead or general expenses to the functions of basic seed delivery, contracting and field inspection, and carrying out grow-outs and laboratory analysis (which it conducts on its own), regardless of whether a governmental institution establishes an independent quality control mechanism. These general costs are added to administrative costs. Research costs are amortized through basic seed charges and royalty payments on the final crop produced.

The ability of private seed production to compete with the NSA will depend upon NSA's own activities, and on the subsidies implicit in the prices charged for NSA seed. At present there is no economic or financial criteria used by the NSA to price the seed it produces. There are a number of reasons for this.

The seed firm does not employ cost accounting for growing seed, as this is a purely agricultural operation and is the business of the farmer, not of the seed firm.

For a government entity such as the NSA, the cost of producing seed is not viewed in an economic context. Since NSA has been provided with land, it farms as well as processes seed. But farming is a legitimate activity of a farmer and not of a Department of the Ministry of Agriculture. Therefore, the NSA is competing not only with seed companies but also with farmers who produce seed. As NSA's accounting system does not separate farming operations from seed processing operations, the profits (or losses) of farming operations become confused with those from processing and distribution of seed.

NSA's accounting system also does not include nearly US\$ 40 million received through grants and foreign loans (see Table III.12) without adding all the budget support and operating losses accumulated since the inception of the Plant Production Administration in the early 1970's. For example, an African Development Bank loan for seed production activities amounts to US\$ 18.6 million, but the repayment of principal and interest does not concern NSA as a Department of the Ministry of Agriculture. Repayment of this loan is not included in the NSA budget, having been transferred to the central government where it becomes a de facto subsidy of the price of seeds which NSA sells.

Experience in similar situations in other countries shows that for a private seed firm the break even price of open- or self-pollinated seed is about twice the price of grain. NSA has been charging about 15% more than prevailing grain prices for its seed. This pricing level obviously could be the marketing opportunity price for a seed grower, but is far from covering direct costs of producing seed.

A comparison of production costs and seed prices between NSA and private seed companies (including growers) is somewhat like comparing "apples and oranges". The NSA is a government agency, and many of its seed production costs are simply not accounted for. The costs shown (Tables III.13, III.14, III.15) for rainfed sorghum, irrigated sorghum and sesame on NSA land, do not include ground and water rates, cost of chemical inputs and their application, storage costs, losses and overhead for administration, building maintenance and staff transportation. Even so, the management consulting survey conducted for NSA in 1983 concluded that "The production costs appear so high that it would seem impossible to sell PPA-produced seed at a cost-covering price" (1983, p.64).

In addition, due to poor isolation, NSA seed has been badly contaminated by crosses with local varieties. In effect, most of the seed produced and used in Sudan involves the large government schemes and private mechanized farms. This is not only because of a lack of confidence in the NSA, but also the result of the inherent autonomy of the schemes. Some production costs for hybrid sorghum are reported in Table III.16, but costs are stated in financial and not economic terms; excluding appropriate overhead categories. Production costs of sorghum seed produced in the Gegira scheme are presented in Table III.17.

As discussed earlier, the schemes do not charge full cost, since many if not all of their inputs and operating losses are covered by drawing on both public and private sources of credit (given their de facto priority status). Because of the large subsidies within NSA and the low prices charged to tenants by the schemes, it will be difficult if not impossible for the private sector to compete in those markets. For example,

In 1986 XXX company's projected minimum viable price for HD-1 was LS 6.75/kg. By comparison, the official (NSA) price for certified HD-1 was LS 3.00/kg, and possibly as low as LS 1.50/kg. At these prices, therefore, XXX company could not sell its HD-1 seed.

Unquestionably, private enterprise directed at the irrigated subsector will have significant, if not prohibitive, difficulties. Tables III.18 and III.19 illustrate the farming production costs of the Tawakul Company. Again, the reader should note items which are not included in the NSA and scheme budgets, especially land use and water costs (NSA), and subsidies (Gezira).

Table III.20 exhibits the estimated production costs for hybrid sorghum seed, basic seed imported from a foreign company (including royalty payments), the amortization (without interest) of a US\$ 250,000 investment in a seed processing plant over 10 years, and general expenses (overhead) of only 20% of the budget. The bonus payment to the grower includes insurance against crop loss, and transportation expenses of shipping bagged seed to the processing plant. The total cost of seed comes to US\$ 0.90 per kilo, or US\$ 900 per MT - or LS 324.07 MT per sack (90 kilos) of Hageen Dura HD-1 hybrid seed.

The cost figures for seeds of other open-pollinated crop species should be calculated in more or less the same way. If seed companies are to make a profit, depending on their respective costs, they would have to sell seed at mark-ups over grain prices of from 1.7 to 2.3 times greater than in countries with viable private seed industries.

It is clear, then, that the NSA and government agricultural schemes have not been constrained by economic or financial considerations in pricing their seed farming and seed production activities. Costs vastly exceed what is charged when the implicit and explicit subsidies are taken into account.

#### K. Variety Adoption and Demand for High Quality Seeds of Improved Varieties

The demand for high quality seeds of improved varieties and the variety adoption process vary significantly in the three subsectors. The mission focused at the subsector level, taking into account other issues as appropriate. The critical issues of seed cost, risk aversion and agricultural product markets and prices are common elements to the following discussion of the various subsectors.

##### Mechanized Farming

Mechanized farming is comprised of three kinds of operations in which farming and market behavior overlap: 1) areas officially demarcated and "controlled" by the government; 2) areas undemarcated and used by "trespassers;" and 3) areas used by large private corporations such as AAAID.

The undemarcated areas are the principal focus of environmental concern, although some deleterious practices are also employed in demarcated areas. Briefly, large tracks are converted by clean-cutting trees and eliminating natural vegetation. Once planted, these areas obtain increasingly declining yields (often from monocultural planting of sorghum which represents 80% of mechanized farming production). When failure occurs due to drought, uncontrolled weed infestation, or soil exhaustion, the farmer moves elsewhere. If rainfall is adequate, the abandoned land will regenerate; but if drought persists, desertification can set in.

Excluding the large private corporations and some demarcated farms, farmers in this subsector are short run optimizers who do not directly bear the long run consequences of their behavior. This is primarily the result of low land charges demanded by the government (LS 1 per feddan for demarcated and private corporations, no charge for trespassers). When there was an effort some years ago to raise the charge, powerful mechanized farmers were able to lower the increase. In effect the land charges have dropped in real terms, leaving the sector undercapitalized and with an incentive to "protect" the cheap land input. In the undemarcated trespasser areas, de jure government ownership is de facto an open-access, "free" resource to users. There is thus no incentive to conserve land, and a large incentive to use it as quickly as possible (before someone else gets it).

Farmers in the mechanized rainfed subsector are generally responsive to new crops and improved varieties. This is especially true of the agricultural companies and certain private mechanized farmers who actively farm, and who often hire professional farm managers who employ modern farm management techniques. This is less true of those farmers who are exploitative in nature and who view their farming operations as a gamble, using the lowest cost inputs possible. They often farm marginal land, wait for the rains to fall before planting, plant relatively large amounts of grain (for seed) as quickly (and inaccurately) as possible, use little or no weed control, and harvest whatever grows. If yields increase substantially to overcome risk factors, then more technology will be employed.

However, improved seed can be viewed as part of a complementary set of practices which can also improve yields. The relationships estimated below come from observations of both the traditional and mechanized subsectors and attribute a 20% potential yield increase to the use of improved seeds alone.

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Mechanized

a) High level of management and inputs:

<u>Practices</u>	<u>Index</u>
o Plant in narrow rows	20
o Plant improved varieties	20
o Follow three course rotation	30
o Use balanced N-P fertilizer	90
o Use deep tillage every third year	30
o Plant on time	5 *
o Effective pest control	5 *
TOTAL IMPROVEMENT	200%

The farmer can expect to increase his production by 200% by adding these practices.

b) Intermediate level of management and low inputs:

<u>Practices</u>	<u>Index</u>
o Plant improved varieties	20
o Follow three course rotation	30
o Plant on time	5 *
o Effective pest control	5 *
TOTAL IMPROVEMENT	60%

(This might be typical for a farmer utilizing only a wide-level disk.)

Non-Mechanized

a) Intermediate level of management and low inputs:

<u>Practices</u>	<u>Index</u>
o Plant in narrow rows	20
o Plant improved varieties	20
o Follow intercrop pattern or three course rotation	30
o Plant on time	5 *
o Effective weed control	5 *
TOTAL IMPROVEMENT	100%

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\* These practices have not been quantitatively verified by the project. The index is arbitrarily selected and, it is believed, extremely conservative.

Source: Experience, Inc.

Whether this is sufficient depends upon the adaptability of the seed to local conditions, the inherent risk, market conditions and the cost of the seed. Successful seed adoption will require higher yields to account for the higher degree of risk in the rainfed sectors.

The costs of sorghum and sesame production for a demarcated mechanized farm in the Blue Nile Integrated Agricultural Development Project are shown in Tables III.21 and III.22. Seed costs for sorghum and sesame are approximately 3 and 10% higher, respectively. Improved varieties with higher proven yields should not be constrained by an increase in prices. Experience elsewhere in Sudan (for vegetable seeds) and in other countries shows that farmers are not reluctant to pay higher prices as long as other criteria are met. It will be necessary to examine the production economics of the different sized mechanized farms and the different landownership patterns to accurately relate the costs of various inputs, including improved seeds, to economic conditions affecting adoption and quality of technology. Without adequate information on cost and the interactive effects of different technology, the analysis is purely speculative.

There are several ways to examine the environmental issues associated with seed adoption. It is generally accepted that use of improved (and higher priced) seed provides an incentive to increase the levels of farm management in order to optimize the potential of the investment. This usually includes better seed bed preparation, better seed placement, weed control, fertility management, etc. The farmer using a higher level of farm management is almost always a better steward of the land and environment. However, improved seeds can be nutrient positive, negative or neutral compared to local varieties. That is, the improved variety may consume approximately the same amount of nutrients (neutral) while producing greater yields, because local varieties waste nutrients due to longer stalks, etc. If the seeds are appropriately tuned to the drought conditions in Sudan they will likely be close to neutral, thereby increasing yields with little soil depletion. Of course, nutrient depleting varieties could be used by the short-term optimizers in response to market conditions. But the overriding factors in the environmental equation are the low cost of land and the price responsiveness of this subsector. The recent experience with rapid expansion to undemarcated land was triggered by higher prices for sorghum. Producer prices are therefore likely to overshadow technology issues. Availability of improved seed alone will not significantly affect existing detrimental behavior. To understand the economics of this process requires a closer examination of the production patterns and institutional issues in both the demarcated and undemarcated areas.

The large private corporation farmers are the earliest adopters of improved technology. Many of these farms have invested large amounts of capital, and are testing and using imported seeds, especially sunflowers. One company also expressed an interest in establishing its own seed operations, believing that its costs would be reduced by 50% over costs of importing seeds. Cooperative efforts are also a possibility between large operations or through a union or cooperative arrangement similar to that for petroleum importing activities. These large agricultural companies in the rainfed subsectors have research divisions and, in cooperation with the seed producing companies, will devise appropriate technological packages for their own circumstances. Private mechanized rainfed farmers will copy practices developed and adopted by the progressive rainfed agricultural companies. The mechanized farming corporation extension services will also actively develop appropriate technology packages for the various farming systems.

This subsector produces much of the marketable and exportable sorghum and sesame which are affected by the macro-economic policies which hurt exports, are dependent on imported inputs (fuel, etc.) and the associated foreign exchange problems. This subsector's role in the economy will likely continue to increase if it is able to take advantage of economies of scale and improved technologies.

To a large extent this market will respond to the availability of seeds of crops that can be planted extensively and mechanized with ease. Sorghum and sunflower are two such crops. They can also produce significantly good yields under normal rainfed conditions, and still hold their own in years of lower than normal rainfall. Maize may have some limited acceptance in this subsector for specialized industrial uses. Soybeans could be planted, but the main problem has been finding a variety tall enough to bear pods sufficiently high above the ground to be combine-harvested under Sudanese conditions. A soybean variety which is adapted to dry conditions in Sudan, and which possesses the traits permitting direct mechanical harvesting, has not yet been developed. The system of harvesting being used in this subsector consists of using the combines as stationary machines, and having labor cut heads and feed them manually. The reason for this is the unsuitability of Sudanese varieties and the HD-1 hybrid for direct mechanical harvesting.

This subsector will respond to better grain sorghum hybrids and to sunflower hybrids that are high yielding, drought and disease resistant, white grained, easily mechanized, and have other desirable market qualities. It is doubtful whether other crops will immediately find a way into this market. A possible exception is hybrid millets, some of which are being grown commercially for the first time. Sesame presents shattering and mechanical harvesting problems, and is highly labor intensive. Groundnuts are not well adapted to the heavy clay type soils.

Sorghum seed from the NSA, and to a limited extent with U.S. origin, has found its way to the mechanized farm operations. Sunflower hybrid seed was introduced for planting in the 1987 planting season, but it arrived too late and only part of it could be planted. Of the 221 MT tons of hybrid sunflower seed imported in Sudan in 1987, probably less than half may be planted. A similar situation occurred with sorghum seed importation from Argentina, where HD-1 hybrid seed had been produced by U.S. companies under contract with USAID. The seed arrived late and part of it could not be planted in time. This indicates a need for careful logistical forward planning in marketing imported seed of field crops in Sudan. Long transportation distances, the need for cargo transfer at intermediate ports in Europe, and the Port Sudan discharge and proper warehousing and internal transportation problems, must be given due and detailed consideration.

Foreign-originated field crop seed has been purchased in the past by Sudanese mechanized farming corporations, by using foreign funds retained outside Sudan. They have also benefitted in 1987 from the supply of hard currency made available by USAID through the Commodity Import Program (CIP) to the ExIm Bank of Sudan, which in turn opened letters of credit and signed contracts with farmers. Farmers then applied for seed import permits, depositing 50% of the contracted value of their respective quota of seed imports with the Bank. The limited availability of foreign currency in Sudan would make it difficult at this time for smaller farmers to import foreign-produced seed. To a certain extent, it also presents problems for larger farmers. The latter group might be more capable of using foreign resources, especially as they cooperate with industrial feed and oil companies, and can prove to the GOS that they may save on grain imports by producing the raw materials locally.

As local seed companies become established and operational they have a great opportunity to provide this market with the types of seeds mentioned above. Initially this may involve imports from foreign producers, which at the present are located in the U.S. and Australia. Seed imports for this market from foreign sources will continue as long as hard currency is available. If this reserve becomes difficult to tap as the need for seed of specific hybrids increases, it may be necessary for the GOS and the seed companies to acknowledge the situation and negotiate terms for local seed production.

#### Traditional Rainfed Sector

Farmers in the traditional rainfed sector are the most risk averse and least price sensitive of those in the three sectors. While this will make the adoption of well-adapted seed varieties (probably non-hybrid, replicative) slow, the variation in size of operations will allow for the further development of seedsmen

within local communities, perhaps independently of transportation needs.

The traditional rainfed farming subsector is dominant in the areas of Western and Southwestern Sudan. Comprised of smaller scale farmers who employ traditional methods of low-technology agriculture, constrained by rainfall and market uncertainties, this subsector offers the lowest potential as a market for international, national or regional, or local seed companies. It is possible that some 10% of the area located in more favorable rainfall areas, south of the 500 mm isohyet, may be receptive to some advanced technology including seeds, but it appears that the rest of the subsector will react very slowly to new technology. Nevertheless, the traditional rainfed farmers of the Darfur and Blue Nile Provinces have demonstrated a willingness to adopt improved inputs and techniques, but at a very slow and cautious rate. Studies conducted by USAID of agronomic trials in the Western Sudan Agricultural Research Project (WSARP) at Kadugli, indicate that farmers are interested in improved varieties of sorghum, millet and groundnuts, but were universally disinterested in new seed that could not be saved from their own fields for planting the next season.

Yet, the ICD mission believes that inroads could be made into this subsector by seeds of appropriate, well-adapted varieties. These varieties would have to be either open-pollinated or hybrid, similar in growing habits and quality factors to the ones being grown today. They will have to be readily available, and the seed must be traded according to local community traditions and requirements. Farmers may pay higher prices if they perceive that these new varieties are more popular, command a higher market price, or have a higher yield potential and above all a markedly improved yield stability. Such products are not available today except for certain sorghum, millet and groundnut varieties which are being farm-tested and demonstrated through the WSARP/Global 2000 program. The 1987 Global 2000 Report details significant increases in yields for sorghum and millet varieties under rainfed conditions.

The NSA plans to have a seed processing plant operating in El Obeid within a few months; the equipment is already in-country. This plant could supply basic seed and some commercial seed to the surrounding area. The majority of farmers will require, however, a system of independent seedsmen more capable of trading their improved seed with farmers through traditional means of kinship and bartering, and offering of local credit. Knowledge of tayrab (good seed) and its value exists in the farming community, and there are higher values attached to transferring tayrab. The super-imposition of the local system of seed production, processing, storage and distribution from seedsmen to farmers may solve this problem. These seedsmen, who undoubtedly exist, could be "up-graded" from advanced farmers to true seedsmen. They would establish

linkages through the extension system with NSA for basic seed and technical advice. The participation of Global 2000, WSARP and the central extension system would be secured in this marketing system.

Tables III.23, III.24 and III.25 illustrate the cost and returns for producing of sorghum, sesame, groundnuts and millet in three of the western provinces of Sudan. While there is some variation in seed costs they generally represent a low percentage of total cost to production. The current practice represents a slow, steady technique for improving seeds which yield stable if low yields in the face of a wide range of conditions. Since much of the seed is grain saved from the previous years' production, it is an estimated opportunity cost, as is the cost of labor. If this process required cash expenditures, it would represent a higher opportunity cost. Nevertheless, it seems likely that the adoption of improved varieties will depend on risk averse behavior in areas that have suffered severe drought within recent memory. Experience in other countries suggests that a minimum 50% increase in yields is required; and even then the adoption process will be slow. Even rapid adoptors in this environment will convert only a fraction of their area per year to new varieties, stretching the process out to cover a range of environmental conditions.

A more empirical analysis provides further insight on this critical issue. Tables III.26 and III.27, based on a sampling of farmers' responses in the areas indicated, contain preliminary results from the June 1985 survey based on farmers' price and yield expectations. Sizes of farms average 12.6, 18.4 and 37.19 feddans in Darfur, Southern Kordofan, and Northern Kordofan respectively for the farmers included in the sample (Table III.28). Their seeding rate is given in Table III.29. At the low seeding rates used by farmers in the traditional agricultural area, charging for seed (which they save) a full agricultural cycle and for the entire farm, cost is under LS 140/kilo.

For example, a farmer who plants sorghum in Southern Kordofan may have a normal yield of 260 kg/FD with an expected likely yield of 421 kg/FD. His expected price is 50.7 LS/sack. Therefore his expected yield of 4.6 sacks would give him an expected revenue of 233 LS/feddan. If he were to get a 20% increase in yield from the use of improved seed, that would mean 1 more sack/feddan, or an additional LS 50.7 income per feddan. Wages for harvesting the extra yield of 1 sack would be less than the daily wage of LS 3.40, and the costs of bags and strings would reduce the additional income by another LS 1.50. Still the LS 45.8 additional income could easily pay up to ten times the price of LS 1.14 that is the cost of grain, if he were to get good seed that would give him an increase in income of LS.45.8 per feddan. The profit to cost ratio, assuming improved seed is 3x price of grain, for a seed investment would be:  $42.38/3.42 = 1239\%$ . At a price assuming improved seed is 10x

the cost of grain, the profit to cost ratio for the seed input would still be  $34.4/11.4 = 301\%$ .

Another factor which will dictate a slow adoption process is the different taste, texture and color preferences for millet and sorghum varieties. There are at least thirty varieties, six of which are considered primary varieties. This will make the testing of varieties vis-a-vis market characteristics an important feature. New products, introduced in non-drought conditions, will be accepted slowly by local markets, though an improvement in export markets could widen new product acceptance.

For illustrative purposes, consider the likely outcome of the availability and adoption of new millet, sorghum and groundnut varieties. Millet and sorghum are staples in the diet of western Sudan and an increase in their yields will initially result in a dietary improvement since the crop is primarily used for home consumption. Once consumption needs are met, greater areas will be planted to cash crops. Groundnuts and sesame could pass into the cash economy as they now do. Current market conditions for oil crops in Sudan are favorable. This has triggered a rapid expansion of sunflower and sesame production in the mechanized rainfed sector and, given the widespread under-utilization of oil processing capacity and the large unmet demand in Sudan, the price effects of increased production should not immediately be significant. There seems to be a large local demand for groundnuts. Therefore, increased cash income from groundnuts and sesame could be a welcome consequence of introducing new sorghum and millet varieties.

#### Irrigated Subsector

The Irrigated Farming Subsector principally grows cotton for the government-managed schemes. To a lesser extent, at the tenant level, it produces sorghum, groundnuts, and minor quantities of other crops (vegetables, cowpeas, etc.). Wheat is a special crop handled by these schemes, and it appears that the ARC, with the assistance of Global 2000 Inc., is in the process of developing a wheat production program for irrigated land. It is questionable whether it is appropriate to use irrigated land to produce wheat in Sudan. If, however, the GOS decides to go ahead with the project, both the NSA and government-managed schemes will commit the full capacity of their seed conditioning plants to handle the wheat seed needed for the Sudan Seed Project.

Seeds for hybrid sorghum, hybrid sunflower, hybrid maize, hybrid millet, groundnuts, pulses, and vegetables could be sold in this subsector. Some fodder seed ("barseem," hybrid sorghum x sudan grass) could be used in areas of intense cattle finishing for the Khartoum market.

The potential size of this market subsector would depend on the policy of the Government managed schemes toward the areas allotted to cotton growing, the assignment of the remainder of areas to other large scale crops, and accepted crops in the tenants' rotations in their respective areas.

Independent farmers in the irrigated areas not belonging to any scheme would usually prefer to plant high value crops such as fruits and vegetables, as well as GOS price supported crops. If wheat becomes a price supported crop, larger areas of irrigated land of independent producers might move over to wheat to become clients of the NSA. The mission does not believe that the private sector will become interested in producing wheat seed at this stage.

The subsector presents a complex set of economic and social issues involving the large state-owned schemes, their tenants, share-croppers and laborers. Analysis is complicated by the inefficiencies of the schemes and the highly subsidized inputs which the schemes and tenants employ. This situation creates a strong resistance to changes in seed supply. For example, the World Bank conservatively estimated the difference in actual and full cost land and water charges on three of the large schemes (see Table III.30).

While all inputs are charged to the farmer, the subsidized prices do not reflect the actual cost of the credit that is often used to purchase the inputs. See, for example, the debts of some government entities reported in Table III.31. Both the irrigated and mechanized subsectors subsidize imported inputs (when they can get them). Since both sectors are tuned to the export market, the exchange rate problems and highly variable export policies contribute to an uncertain and unprofitable business climate. Even with the subsidies, the returns from cotton and wheat production on scheme cropland is still quite small after the charges for inputs have been taken out. (The low returns from the exports of schemes also feed back to the tenants.) The tenants, and their even more dependent share-croppers, then have to meet their consumption needs and cash earnings from the mere ten feddans allocated to personal use.

Adoption behavior and yields depend very much on the decisions made by the scheme managers. Under the current structure, seeds (and possibly high quality seeds) are subsidized by the schemes and/or the NSA. But new varieties would come through this subsidized distribution system. Given that distribution system, adoption should be faster than in other sectors because of the lower level of uncertainty of the irrigated versus the rainfed sector. But, acceptance of unpopular varieties cannot be forced, as demonstrated by recent tenant resistance to Gezira scheme HD-1. Indeed, the little available HD-1 sorghum seed was used primarily in this sector. The availability of other inputs at least initially should be greater in the irrigated subsector than most of the mechanized

rained subsector, where fertilizer is difficult to acquire and not presently used. As noted elsewhere, inputs are also scarce for this sector, therefore maximum yield potentials cannot be expected.

Development of future varieties will require improvement over the HD-1 experience in the irrigated subsector. Table III.32, originally appearing in Khalifa (1987), shows the consequences of applying HD-1 fertilizer, etc. In this case, the combination of increased costs and lower prices resulted in lower net returns, even though yield doubled.

The cash crop analysis for this sector would also be interdependent with the price signals and responses from the mechanized subsector. For both tenants of irrigated schemes and traditional farmers, the availability of export markets and/or alternative crops will need to be considered as the domestic market becomes saturated.

#### Potential Seed Market and Macro-Economic Conditions

A World Bank/USAID analysis of the effect of an overvalued exchange rate, and the effect on prices and production of a simulated devaluation to a unified rate partially applies to the potential market for seeds. Table III.33 and III.34 illustrate the 1985/86 situation and a hypothetical change, respectively. As has been stated and reiterated earlier, the role of price incentives can have a dramatic effect on production responses, especially in the mechanized subsector. It should also be noted that the devaluation process can positively affect the cash crop production of the traditional rained sector. This results from the negative effects of higher import content on the mechanized and irrigated sector, which do not affect the traditional rained sector.

The model consists of the following: "a matrix of supply, demand and income elasticities (both own and cross-price) that simulate the relationships in supply and demand of all major agricultural product markets to changes in one or more agricultural prices. Based on the variation in prices, supply and domestic demand, imported inputs and exportable surpluses will change." (World Bank, 1987, p.74). The table shows what price effects would occur if the benefits of the devaluation were passed on to farmers. A discussion of agricultural price policies follows below. The changes also positively affect the export commodities, as predicted. But remote areas would still not engage in export production or import substitution activities. On the other hand, production of oilseeds could produce a secondary round of benefits on livestock production. Obviously, an improved export market has positive effects on the performance of all three sub-sectors and is a principal constraint to expansion of agricultural production. With an improved economic environment and better market prices, adoption of improved seed varieties should be stronger. Under the

current situation, adoption could be very slow. This, again, will depend on the macro-economic environment in which the farmer exists.

An analysis of agricultural price policies in recent years in Sudan is perhaps best approached anecdotally. Previous descriptions of price policies have seemed dismal and contradictory. The fact is that the policies which have affected sorghum, for example, have led to contradictory but often negative signals and discouraging results. For example:

- o Export taxes in 1982 of 25% for sorghum and 15% for oils.
- o The export of sorghum was banned in 1985 as a result of the drought.
- o The Agricultural Bank of Sudan entered the grain market as a purchaser in early 1986 in order to raise low sorghum prices after a bumper harvest. This would primarily have helped the large mechanized farming schemes and the powerful and wealthy portion of this subsector.
- o At the end of April 1987, the export rate for groundnuts, sesame and sorghum was devalued to the level of the fixed (and overvalued) commercial import rate (price). For other exports, the rate remained well below the commercial rate (price), thus continuing the anti-export bias of exchange rate policy.
- o Presently, the FOB price for sorghum at Port Sudan required by the government is US \$108/MT while the world market price is US \$70/MT. While sorghum is reported to be leaving the country, most of it is not through legal channels. Barter is also often involved. Domestic sorghum prices exceed U.S.\$ Gulf Port prices by a significant amount (see Table III.35).

This partial sequence of activities affecting sorghum prices also occurs within the context establishing relatively high floor prices for sesame and millet. It is apparent that the government will not be able to control prices through this mechanism because it cannot afford to pay the bill. This again will affect farmers' decisions on adoption of new technology, including high-yielding seeds. Uncertainties of weather compounded by uncertain markets and unpredictable government policies are neither conducive to experimentation by farmers, nor to the potential development of an agro-industry for which improved seeds could be a catalyst.

## L. Market for Seeds in Sudan Over the Next 5 Years

An estimate of total demand for seeds in Sudan has been formulated and is shown in Table III.36. Assumptions used in the table are percentages of each area planted in a given crop estimated to be under advanced technology by 1990. To each area an average rate of planting was assigned, densities of planting increasing with available soil moisture and the more intensive use of other technological inputs, such as herbicides, fertilizers and machinery.

### 1. Seeding rates

Average seeding rates are shown in Table III.37. In some cases, farmers tend to use higher seeding rates than would be otherwise normal under dry-farming conditions. They knowingly plant sesame or millets very early in North Kordofan or North Darfur, hoping that the early rains will provoke germination of the seeds. Use of the early rain water is important to increase crop yields when total rainfall expectation is low. Waiting for the rainy season to "settle" may be safer for the establishment of a date of planting, but missing the few early rains may be critical for the attainment of higher yield levels. On the other hand, early planting runs into the problem of uneven germination with little initial soil moisture, or loss of a great part of the planting if a dry spell follows the few initial rains. For this reason farmers in dryer regions tend to plant early to profit from the first rains. Then they may replant their fields if there are missing hills, or even entire missing fields. This increases the use of seed over what would be normal for other areas. The mission has taken this into account for millets and sesame when estimating seeding rates. The estimate allowed for a small or nil reseeded percentage, depending on the areas, but much less than for millets and sesame, the reseeded percentage for which could be as high as 90%.

### 2. Area expansion

Areas planted to crops other than cotton expand in Sudan when the prices of the previous crop were high or when government intervention to firm up prices occurs. Figures III.10 through III.13 show how, for a series of 11 years ending in 1986-87 sorghum areas - as an example - increased when previous one or two years yields were lower than normal. As the areas peak in some years and high yields coincide with large areas (because either there were good years, more use of higher technology or both), a quick decline in areas planted in the succeeding year to this crop is observed. This is most likely due to increased grain production following the high yield x high area multiplier, resulting in downward pressure on market prices. This affects production disincentives for the next season. The reverse process accounts for the opposite effect in successive periods. This type of market behavior is normal in

economies with low price buffering potential due to deficient marketing structure and infrastructure. Decisions to increase or reduce area based on previous commodity prices produce wide fluctuations in areas from year to year. Continued dry spells also have a negative impact on areas planted.

Predictability of (planted) area growth, and therefore total potential seed demand, is thus very low in Sudan for crops in internal demand.

For crops with a defined export capacity such as groundnuts, sesame, and roselle (karkadeh), planted areas may expand if markets are assured and a certain continuity and stability developed. This would require the development of appropriate policies to stimulate exports.

Sorghum is the crop with the greatest current area. Unless major macroeconomic adjustments occur to make exported sorghum competitive, the mission does not foresee major area expansions. Scarcity of machinery, fuel and other inputs impede major area increases in this crop.

The area devoted to wheat has diminished over the last 20 years. It is all irrigated crop, planted mostly by the government schemes. It could increase in area dramatically if the GOS accepts advice currently being given to produce more wheat internally. The Sudan Seed Production Plan envisions an increase in annual demand of wheat seed from nearly 15,000 MT, which the mission estimates would be normally needed, to 71,500 MT contemplated in the plan because of an increase of nearly 5 times the present area. This added area would most likely come at the expense of sorghum and some cotton in the irrigated schemes, although some double cropping sorghum-wheat could not be ruled out.

Sunflower areas are the most likely to expand in the coming years. As determined by the intentions of two the largest potential users of sunflower grain, also involved in mechanized rainfed farming, their combined planting program might reach 200,000 feddans. This area could possibly be reached by 1990. If they represent 2/3 of the total mechanized farming area that might go over to sunflower, total area in the next 5 years in this subsector could approach 300,000 feddans. It is assumed that some irrigated farming subsector plantings could be also induced by attractive and stable market prices offered by industry and that these could reach 50,000 feddans, with a grand total of 350,000 feddans by 1990. This area contrasts with the estimated 55,000 feddans that would have been planted had the seed that was imported for 1987 plantings arrived on time. Total area planted in successive years might remain at levels already indicated, possibly varying upwards to 500,000 as a first guess. Being a new crop, farmers have experienced some problems with self-compatibility of the initial hybrids grown (which has varied from one season to the other). The first two

years in the adoption process may require care on the side of both the seed companies and the farmers, and moderation in area expansion until the technology of production is well-established, and problems of precision seed planting - which requires the imported planting equipment - and crop growth habits are understood and solved.

Vegetables are produced for the Khartoum 3 - city market, for other major city markets and for local village consumption. Most of the plantings are located on the banks of the Nile. AAAID is developing a fresh vegetable export production unit on 3,000 feddans with a cold packing facility near Khartoum. If the unit is successful in its exporting endeavors, it might stimulate further expansion of vegetable production for export and increase the demand for imported seed. As for now, the limitations in foreign exchange have prevented one of the largest seed importers from obtaining an import license during 10 of the last 11 months, and have therefore effectively stopped imports of vegetable seeds.

Millets are grown for local consumption in the traditional rainfed area mostly by small holders. One of the mechanized rainfed corporations has imported a small lot of hybrid grain millet seed from Australia. Results obtained will determine how this crop may fare in this subsector in the future.

Forages are required for the 14 to 18 million head of cattle, 15 million head of sheep, and 12 million head of goats in the country. This area has been neglected in research and development at ARC. Some "barseem" (Alexandrian clover and alfalfa) is planted under irrigated conditions along the Nile. Sorghum x Sudan crosses and Sudan grass hybrids and varieties and millet hybrids and varieties for forage or double purpose crops contribute to the fodder resources provided by grain millet and sorghum.

The possibilities of developing grazing areas in Sudan should be studied. This will require a clarification of the legal status of pastoralists/grazers, who would have to change from nomadic activities in rangelands to more sedentary grazing. Technical, sociological, and legal problems must be tackled first before an improvement of rangelands with overseeding of grasses such as Andropogon gayanus and legumes such as Stylosanthes guyanensis in areas south of the 500 mm. Isohyet could take place.

Potatoes are planted in small areas. The seed is imported and distributed directly by Agricultural Bank of Sudan. No major increases in seed demand or importation appear likely in the future.

Limited area in Sudan is devoted to maize, which is mostly found in the south. No expansion of areas or major change in

introduction of new varieties or hybrids is foreseen for this area, unless the unsettled political and security problems in the area improve. Tests conducted by AAAID in the rainfed mechanized area, have given encouraging results for maize. Yields in maize test plots have been superior to yields obtained with the best sorghum hybrids, even with hybrids from temperate areas, unadapted to the tropics. Some research and development is required, and the possibility of some increase in the maize area is not discounted.

Rice is a crop that may have a future in the south of Sudan where extensive areas are flooded. Major research and introduction of rice varieties from IRRI, IITA, and other research centers in Africa should be undertaken. Southern-grown rice might be one of the major crops capable of solving famine problems associated with drought in northern Sudan, once political stability is achieved.

Pulses and legume grains including cowpeas, chickpeas, haricot beans, fava beans, lab-lab, mung beans, green grams and pidgeon peas constitute a very small percentage of the food crops produced. Most of these crops are now grown by the traditional and tenant farmers in their "Jubraka" or home and kitchen gardens for their own consumption, with surpluses sold for cash. There may be a limited opportunity for commercial production in the private pumped and flush irrigated areas. Several of the species are relished during the "Ramadan" feasts and command a very high, but seasonal price. Improved varieties of cowpeas have been introduced from IITA for trials at both Kadugli and Damazin and have produced very interesting results. Cowpeas (Vigna unguiculata) are a traditional sector crop that could be exploited greatly with improved varieties over the next 5 years.

In general, technical, research, and marketing problems, and above all the present and future availability of foreign currency, are the major limiting factors to the expansion of use of local and imported seed for a number of crops. These factors are likely to persist for a number of years.

#### IV. FUTURE DEVELOPMENT OF THE SEED INDUSTRY IN SUDAN

##### A. Integrated Agricultural Planning and Seed Industry Development

Seed programs constitute an important element of agricultural development policies. The primary aim of such programs is the supply of a high yield input with which to increase agricultural production. Other goals include reducing risk of crop failure and improving crop quality. It is expected that high quality seeds of improved varieties will be catalytic to increased crop production. But seed programs isolated from other programs, such as credit and production price support, have not proven to be effective in increasing agricultural production.

Price stabilization and assurance that prices will provide attractive returns to labor and capital investments by farmers, as well as reduction of physical, economic and environmental risk, are just as important, if not more so, than improved seeds of high yielding varieties.

Policies in some African countries (Ivory Coast, Tunisia, Sudan) based on providing the farmer with subsidized seed have not proved successful. Furthermore, these policies may impede establishment of a private seed industry capable of developing a consistent supply of high quality seeds of improved varieties. The introduction of subsidized seeds as a catalyst for improved crop production will lead nowhere if market forces are not capable of stabilizing production prices. For example, prices fall at harvest time because of higher production levels. In some other cases - such as Sudan's HD-1 hybrid sorghum - the discovery of a new product leads to a negative consumer reaction.

An integrated approach to agricultural development is recommended in conjunction with the launching of a seed program. The goal of a seed program should be development of a National Seed System with complementary support functions built in between public and private sectors, as well as simultaneous improvements in areas such as extension, marketing, credit and crop utilization. The whole system will then be well integrated, and should lead to a higher level of agricultural productivity in targeted crops.

While market forces should be the catalyst of development, experience has proven that in developing countries manipulation of crop prices by government intended to improve farmers' take at the farm gate has been one of the important factors in the adoption of improved varieties and use of high quality seed technology. Under these conditions, the price of improved seeds is not a constraint, and is of little or no consequence to farmers. Except for crops such as potatoes, seed prices for most field crops are about 5% of grain prices. Therefore, seed

cost should not be the most significant factor on farmers' decisions to employ higher levels of technology.

Advocacy of integrated agricultural policies leading to yield improvements and commodity price security, including fair (i.e., not subsidized) pricing of seed, has proven to be a successful stimulant of agricultural development.

## B. A National Seed System Model for Sudan

A National Seed System is composed of the following elements: a private seed industry - firms that produce, process, import and market seeds; representative organizations of seed firms, growers, and farmers; a network of government organizations overseen by a national seed administration or agency as part of the surrounding political, economic, agricultural and business climate. An array of interacting motives, incentives, impediments, institutions, people, and laws determine whether the availability of high quality seed of improved varieties becomes a reality.

### 1. Role of the Public Sector

The public sector plays an important role in promoting, organizing and supervising a system in which the major actors are the private sector companies. The government should abstain from competing with seed companies, and should see to it that the industry operates according to clearly understood rules. Rules and laws should be agreed upon before seed production begins. There should be penalties, but there should also be incentives for efficient and intelligent use of resources. All these elements are found within the following components:

Administrative Component - This is an agency of the Ministry of Agriculture which, in the case of Sudan, would be the National Seed Administration (NSA).

Legal Component - The seed law and its regulations, as well as other elements of Sudanese legislation which directly and indirectly affect the seed industry.

Operational Component - research, testing, and variety registration; basic seed production, technical advice and assistance; support in the areas of processing, land, machinery and storage infrastructure; credit and marketing; seed quality control and seed certification are legitimate activities of the state.

Another essential component is a National Seed Council, an advisory body of seed related organizations whose members are drawn equally from both the public and private sectors.

### 2. Role of the Private Sector

In the administrative area, private sector activities consist of internal decisions made by seed firms. However, a National Seed Industry Association, which represents private seed companies, helps shape seed policies through the National Seed Council with advice at the Ministerial level.

See again Table I.1, which illustrates the National Seed System Model and its reference to Sudan.

C. Interrelationships Among Private and Public Research and Development Activities

In countries where seed industries have developed and matured, both the public and private sectors have played an active role. For the most effective development of new crops and improved varieties, crop breeding research is supported by:

- o Government (including universities)
- o Regional organizations
- o International centers
- o Seed companies
- o Farmers' associations

In Sudan, the mission proposes that the Agricultural Research Corporation (ARC) continue to provide crop research and plant breeding services. The ARC should strengthen its approach to providing services to the traditional farmer who historically has had less access to improved crop production materials and techniques.

While international research centers (e.g., INTSORMIL, ICRISAT, CIMMYT, CIAT and ITTA) have provided some assistance over the years, the ARC should increase initiatives to bring additional scientists to Sudan, to send Sudanese scientists abroad to participate in international conferences, and to import new varieties and materials from regional and international research centers for trials and parental line selections.

Private Sudanese seed companies such as Tawakul Enterprises, Ltd., Elgandonl Co., Ltd., Todaman Islamic Co., and others should be encouraged to develop improved varieties of crops, as was done with onions and karkadee.

International (multi-national) seed companies such as Pioneer, DeKalb and Funk's can introduce sophisticated and well-developed plant breeding techniques, and a wide variety of breeding materials to Sudan if, among other things, they can be assured that their proprietary rights will be protected by law.

The government must foster a desire within the ARC to facilitate a public/private collaboration that would benefit farmers by increasing the amount and diversity of new and improved seeds.

D. Variety Introduction, Testing, Approval, Registration and Protection

The mission recommends that the government retain the right to deny entry to seeds of varieties coming from areas which have diseases or pests not found in Sudan, and that seed which is allowed into the country be accompanied by a phytosanitary certificate issued by a recognized government authority in the country of origin.

Import of seed for testing purposes by both private and public sector institutions, and firms should be permitted. Private seed firms registered in Sudan, or other firms, both local and foreign, interested in entering the Sudan market should be able to import and test new varieties or hybrids directly, or in collaboration with the ARC or other agencies of their choosing.

Tests conducted by public or private agencies are planned independently at the preliminary or advanced trial levels. The number of seasons of these tests depends on the type of crop, location, seasonal variations encountered, stability parameters designed or required for each crop, production region and type of agriculture for which it will be recommended. At the national variety trial level, tests will be coordinated, organized and conducted by the ARC at ARC stations, as well as by private firms interested in conducting their own trials at the locations where they expect their products to be eventually marketed. These locations will be identified to the ARC, so that ARC agronomists may visit them at any time to take notes and in general discuss the performance of the candidate varieties or hybrids.

Preferably, the seed firm and the ARC will discuss and analyze the performance of each variety that might be presented for registration. New varieties should not have to prove themselves totally superior to any other variety, but should at least be equal in total performance to the "control" varieties, and superior in at least one or more agronomic or quality characteristics. In any event, it shall be the responsibility of the seed firm to conduct its own marketing and to test farmer acceptance of its product.

It is proposed that variety registration be a function of a Department of NSA. This is different from ARC variety release. This should continue to apply to the ARC varieties, but not for private varieties or hybrids which will simply be registered following internal release procedures, at company responsibility. The ARC will have the opportunity to monitor the performance of the varieties or hybrids of the private sector, but will not have the power of refusal, unless serious problems affecting variety performance in farmers' fields are identified at the time of trial. Furthermore, the true performance of all

new varieties, whether public or private, shall be monitored in farmers' fields. The ARC will be empowered to retire varieties or hybrids which after two seasons under normal climatic conditions fail to perform efficiently in farmers' fields. In any event, the National Seed Council should be empowered to conduct hearings and provide recommendations.

The seed law of Sudan will have to address variety protection. This is the ability of plant breeders to develop and register new varieties, clones or hybrids, and be protected from unlimited propagation by unauthorized persons. It is doubtful whether that provision is pertinent at the present time in Sudan, but careful consideration shall be placed on its eventual interest or applicability.

#### E. Reorganization of the National Seed Administration (NSA)

The NSA is presently an administrative organization which functions with relative autonomy as a department of the Ministry of Agriculture. It has promotional, production and distribution responsibility. Furthermore, the NSA is responsible for certifying and testing seed quality, but lacks the means to inspect seed in the market. This incomplete status brings about a number of internal incompatibilities which must be corrected.

The NSA should be the government organization in charge of administering the full array of seed programs. It should develop a new promotional and regulatory outlook, retaining service components while gradually de-emphasizing its production role.

The new functions - leading to new administrative subdivisions at NSA - might be the following:

##### 1. Promotional Functions

Promoting new seed enterprises and facilitating their establishment and growth should be entrusted to NSA, which could dispense necessary assistance through the respective administrative departments. The development of farmer-seedsmen as "cottage industries," particularly in the traditional rainfed sector and in the South, shall also be activities undertaken by this department in conjunction with the national extension system and collaborating institutions.

##### 2. Administrative Functions

All matters related to seed imports, exports, statistics, registration of seed producers, growers, seed companies, importers, licenses, varietal registration, and eventually varietal seed protection, as well as commercial questions and seed campaign design shall come under the supervision of this department.

### 3. Quality Control Functions

Management and operation of seed laboratories, inspection of seed lots for seed quality control, enforcement of standards and regulations concerning commercial and certified seed quality, and eventual laboratory support for the Seed Certification Department should be functions of a Department of Seed Quality Control.

### 4. Seed Certification Functions

The process of seed certification from field inspection to issuance of certification tags, including training functions, should be the responsibility of a Seed Certification Department.

### 5. Seed Production Functions

At present, these functions are being carried out by the Plant Propagation Administration (PPA). They will be the most difficult to "re-assign" within a new administrative context, as they involve land and production facilities, responsibility for inspection of seed production fields, technical advisory services, and (eventual) plant processing services, as well as some marketing activities. These functions could be removed from the scope of NSA operations. A parastatal firm should be established, with initial assigned capital provided by GOS represented by physical assets as well as the transfer of liabilities of some debts to the African Development Bank. If backed by the government, these shares might eventually be saleable to private firms. The parastatal would retain whatever facilities might be needed for continuing the production of basic seed and those crop seeds which will not be of interest to the private sector.

An advantage of a parastatal organization would be dependence on a board of directors, where financial and technical supervision might be forthcoming and policy orientation assured. It would enable the organization to retain its profits, and be accountable for its losses, easing the process of moving seed prices to commercial levels, and eliminating hidden subsidies. The GOS could also transfer at least part of the burden of repayment of the African Development Bank loan to the new parastatal.

The parastatal corporation would gradually evolve into a fully competitive corporation, with no privileges or subsidies. It would have to produce basic seed and sell it at realistic prices, taking into consideration the genetic quality of the seed. Such an approach would be similar to that of the basic seed corporation in the U.K. which is responsible for the production of basic seed derived from public plant breeding research. The PPA "Corporation" would, theoretically, stop expanding its commercial seed production and turn its attention towards basic seed production and technical and plant processing

support. It would also maintain production of commercial seed at levels required to complement that of the private sector.

Further, the property of a parastatal corporation can be transferred to private sector entities through sale. This is easier than disposing property of a central government department acting within a Ministry, and should be the ultimate objective.

The new parastatal corporation might have direct links with the Ministry of Agriculture. The majority of the members of the board of directors could be approved by the Minister of Agriculture, with some of them from the Ministry of Finance and Planning, some from the Ministry of Commerce, and some from the private sector via the Sudan Private Seed Producers Association.

#### F. Reorganization of the Seed Production System of NSA and the Public Agricultural Schemes and Corporations

Under the reorganization of NSA described above, NSA will receive, according to a regular and predetermined schedule, supplies of basic seed stock from the ARC.

NSA will provide basic seed stock to the Plant Propagation Administration for production of foundation seed. It should be noted that the breeders at the ARC centers should not be responsible for the actual production of foundation seed, but should be responsible for ascertaining the purity of material multiplied at PPA stations.

Foundation seed produced at the PPA stations would be sold to producers of certified seed.

Certified seed would be produced by public and private seed growers in all of the major agricultural crop subsectors, consisting of the agricultural corporations, private seed companies, agricultural companies, and seedsmen.

The Seed Certification Administration should:

- o Certify varietal purity of all publicly produced seed as eligible foundation and certified seed.
- o Test and analyze samples of seed stock available for sale and distribution in the seed market; enforce the seed law as it applies to seed quality and truth in labeling.

#### G. New Seed Legislation

New seed legislation in Sudan to redefine the relationships between a private seed sector and the government is urgently required. Present legislation is insufficient and does not recognize the existence (and functions) of a private seed industry, as it was conceived in another era in the absence of a private seed industry.

Before detailed seed legislation is drafted, a policy context with clear objectives must be established. The philosophy, articles and "spirit" of the law should be clear and easy to interpret.

The law should be as simple as possible, with as few articles as are needed to define its structure. As the articles will be difficult to change, they must be carefully considered. Regulations should not conflict with the principles of the law. Both the NSA and the private sector, through the National Seed Council, should be empowered to take up issues, study problems and make recommendations to the Minister of Agriculture - who should not be a member of the Council - so that he may determine whether and how to transform them into directives or regulations.

Because of the importance of the seed law, it would be a mistake to approve it hastily, without taking into consideration the views of the private seed industry, and before a public discussion of its contents. To exclude potential investors, experienced seed technicians, elements of the private seed sector, farming community, agro-industrial users, the state planning board, and Ministries of Finance and Commerce might result in legislation inimical to the interests of government, and deter private sector participation. (A proposed bill has been sent to the legal adviser of the Minister of Agriculture. This bill was drafted by a committee of four persons: two from the ARC, and two from the NSA. It is unclear whether the private sector and some elements of the public sector in Sudan were consulted.)

In Annex V, an analysis of the present seed legislation is presented, and recommendations concerning some of the problems that must be addressed are made.

#### H. Recommended Policy Measures for the Development of a Modern Seed Industry in Sudan

The design of the national seed system of Sudan - like that of many developing countries in Africa, Asia, and some parts of Latin America - evolved in the absence of a well organized private seed industry capable of delivering high quality seeds. Government activities in this area thus appeared completely justified.

This strategy was accepted by some staunch supporters of the market system who chose to make an exception in the case of seeds. The argument was that seeds are a strategic agricultural input, and the sufficient and timely supply of high quality seeds of improved varieties ought to be a government priority. Having established the seed industry within the government sphere, backed by public research and the government's own certification system for its seeds, the Sudanese government now

finds (after 20 years) that it has a large organization, but one incapable of supplying more than a small percentage of the potential demand for seeds in the country.

As science progresses and as new opportunities appear for the application of improved technologies, private companies will become interested in large potential markets for seeds in Sudan. These are usually international seed companies, but also include local companies which develop joint ventures to link themselves through some sort of association with the former.

The technical capacity of private seed firms has grown at a fast pace during the last ten years. In most cases they are as well equipped to carry out research, and are better prepared to produce, process, and market seed than government organizations. Furthermore, they have proven that they are capable of meeting the demand for seeds of several crops.

Sudan is now at a crossroads in deciding whether and how the private sector in seeds should be promoted, not simply tolerated. Decisions must be clear and the policy that emerges must be firm and consistent. The fledgling private seed sector has recently formed an association, and is just beginning to deal with the government, and vice versa.

Because of the lack of experience in dealing with private seed producers and in recognizing their needs, government policymakers may be uncertain as to what constraints and policies are detrimental to the growth of a dynamic seed industry. They may not realize that present policies and concepts are inadequate to facilitate participation of the private seed sector in the National Seed System.

Continuing the expansion of the government-administered system entails the risk of building an entrenched bureaucracy with strong vested interests, which may limit future growth possibilities for the private sector. If government is truly interested in the development of a modern national seed industry, the time to redefine and clarify roles and responsibilities is now.

Recommended policy measures and objectives are presented in Annex VI. These objectives will be easier to obtain if they are supported, by consensus, by the Ministries of Agriculture, Finance, and Commerce.

#### I. Development of Private Seed Companies

The development of private seed companies will be a slow process in Sudan. As in other countries in the developing world that have undergone this process, private companies will face initial mistrust and misunderstanding of their objectives, methods and behavior vis-a-vis the government institutions. The confrontation may be eased and the evolution of the system

accelerated if government planners, decision-makers and operating officers come to understand that collaboration with the private sector will help meet the national objectives of increasing agricultural productivity, nutrition, standards of living, and improvement of food security.

This process could be accelerated if the GOS actively promotes participation of the private sector in the seed industry. Not doing so will leave it with the alternatives contained in scenarios I and II below. Advancing and promoting private sector participation would result in scenario III.

#### Scenario I

A central GOS authority (NSA) is engaged in providing seed at low prices to farmers. It is capable of meeting from 1-8% of national seed demand, while maintaining hidden subsidies and transferring obligations with foreign lending agencies to the Ministry of Finance. This closely approximates the present situation.

#### Scenario II

Expansion of NSA activities to meet a larger proportion of potential seed demand. This would require a phase II loan from the African Development Bank so that more funds (subsidies) are available from the GOS central budget. This ultimately affects reserves in the Central Reserve Bank and adds to inflation and the national debt. If the NSA decides to increase the price of seed to offset subsidies, its behavior becomes like that of a private seed company, and the reasons for the continued participation of the GOS in seed production activities diminish. It could turn over this activity to the private sector, which would be more efficient.

#### Scenario III

The government provides the private sector with incentives to enter the seed industry. The government turns over to the private sector many functions, in the belief that they will be better performed by the private sector. The government supports, supervises and complements private sector activities.

Under this system, a phase II loan from the African Development Bank might be reoriented, and directed toward making it possible for the Agricultural Bank of Sudan to lend both hard currency and local funds to the private sector, for the purpose of enhancing seed production in Sudan. Part of the loan (less than 25%) could also be directed to the government to pursue control, extension, research, and administrative activities. The loan could be constructed in such a way that it could be repaid by the aggregate returns of the seed companies.

A number of companies, with different orientations, could be established. Their objectives and nature of operation are described below:

#### Importing and Distribution Companies

Companies dedicated to importing and distributing seed are most likely, as they are today, to be concentrated in the areas of vegetable seeds, potato seeds, and some forage seeds. They could have their own distribution networks, or work through the marketing efforts of other firms (wholesalers and retailers) or even engage freelance sales agents.

#### Production, Processing and Marketing Companies

These are companies which contract seed growing, process the seed in their own or in leased facilities, or have it processed by others as a service. They conduct their own marketing. A number of Sudanese companies may evolve into "seed producers," performing the activities outlined above. They may utilize basic seed bought from the NSA or its successor, from private seed companies, or from both. This is expected to be one of the largest groups of companies.

#### Production Companies

It is possible that some companies which possess the technical capacity and agronomic know-how for seed production, but lack the capacity to market and distribute seeds, may evolve. These companies may wish to assign the marketing of their seed to one, or several, firms. This is a likely possibility for some mechanized farming organizations.

#### Processing and Service Companies

Companies investing in seed processing and/or storage facilities may choose to make available for a fee to other companies, thereby helping to finance the production and distribution of seeds. This type of operation has been very important to the growth of private seed industries in many countries, and could aid in Sudan, where capital might be distributed among a number of firms better able to secure loans of limited magnitude.

#### Integrated (Research, Production, Processing and Marketing) Seed Companies

This type of company encompasses the complete line of seed industry activities and, consequently, requires larger volumes of capital and more organizational levels. It is more typical of large international companies.

### Research Companies

A company which specializes in research (through the breeding and testing) of its own materials is normally called a "breeding company". Such companies may stock public lines and private lines, combine them in making hybrids, then sell the right to produce these hybrids, and license their production in return for royalty payments. They could, if protected by varietal protection legislation, also engage in developing varieties of self-pollinated species such as cotton, leguminous grains, vegetables, flowers, etc., and sell basic seed with the added protection of voluntary certification.

### Marketing and Distributing Companies

This type of company is a wholesaler or retailer, or both, for all types of seeds. It is usually a large wholesale distributor, or operates with a chain of retail outlets, and understands the problems of distributing agricultural inputs. It would normally carry a full line of agricultural inputs, such as pesticides, fertilizers, tools, and in some cases light or heavy agricultural machinery, lubricants, etc.

### Production and Marketing Seedsmen

A seedsman is an agricultural producer who specializes in producing certain kinds of seeds, normally using publicly bred varieties. He is well known and established in a given agricultural area, is well respected, can move capital and offer some credit at harvest time in the form of seeds, and from time to time renews the stock of seeds of his neighbors with new, high quality, certified or non-certified seed. Seedsmen exist in most countries in large numbers. They may develop local, regional or national associations by crop or other categories.

### Production and Marketing Cooperatives

Seedsmen can join forces by forming cooperatives to sell their products under certain private labels. They produce certain varieties, certify them, and then plan and execute regional and, to some extent, national marketing efforts.

### Seed Growers

Farmers who become specialized in producing seed under contract or who sell it for marketing by others, effectively limit themselves to specialized farming operations. They are called seed growers.

All these types of operations should coexist in a new National Seed System, as each one has a specific role to play. The NSA or its successor organization might continue to meet a small percentage of seed market demand, but would gradually raise its prices to a point where unfair competition with the private sector no longer occurs.

#### J. Role of a National Seed Industry Association

A National Seed Industry Association is the representative institution of the seed trade. It is open on equal terms to all types of seed companies, from producers to trading firms to qualified seedsmen. The association establishes ethical standards for its members, monitors its membership, promotes technical and managerial advancement, establishes public relations campaigns, and strives to respond to the needs of the farming community. It establishes links with government through membership in the National Seed Council. If a successor organization to NSA becomes a true seed corporation, i.e., with GOS control of the shares but operating by private sector standards, it might also become a member of the Sudan Private Seed Producers Association (SPSPA).

It is proposed that statutes be made available from organizations of seed producers from several countries, as examples of what type of organization seed producers in Sudan should seek to establish.

The SPSPA should, at the earliest possible date, urge the Ministry of Agriculture not to promote legislation without careful analysis, including the input of the private sector, and to assure the participation of the SPSPA through its delegates to the National Seed Council.

#### K. The National Seed Council

The National Seed Council should be the most senior institution devoted to seed industry matters. Its activities should be strictly advisory, and should be conveyed directly to the Minister of Agriculture.

A delegate of the Minister at the level of Minister of State or Undersecretary should be the presiding officer of the council. Other delegates of the Ministry of Agriculture at the senior level, including ARC, NSA, Director of Extension, representatives of the Ministries of Commerce and Finance, of the National Farmers Association, Agricultural Bank, as well as a number of representatives of the SPSPA should be invited to participate.

The NSC should meet approximately every three months, and extraordinarily when requested by any of its members. The Minister of Agriculture may attend its sessions at will, but should not vote. His participation would be for purposes of better understanding the most important issues.

#### L. Role of Appropriate Varieties or Hybrids

It has been recognized that farmers worldwide respond to improved inputs and techniques if:

- o They are accessible
- o They provide economic return with low level of risk
- o They are compatible with their present style of life

For the irrigated subsector, commercial farmers seek new varieties and have responded to their introduction. The tenant farmer also has responded by planting HD-1 hybrids and seeking out improved varieties of vegetable seed from the market.

Farmers in the mechanized rainfed subsector are also generally responsive to new crops and improved varieties. This is especially true of the agricultural companies and certain private mechanized farmers who are actively farming, and who hire professional farm managers and practice high levels of farm management. This is less true of those farmers who are exploitative in nature and who view their farming operations as a gamble, using the lowest cost inputs possible. They often farm marginal land, waiting for the rains to fall before planting, planting fairly large rates of grain for seed as quickly (and inaccurately) as possible, using little or no weed control, and harvesting whatever comes up.

#### M. Reduction of Physical Environment Risk

It has generally been noted that use of improved (and higher priced) seed provides an incentive to increase the levels of farm management in order to optimize the farmer's investment. This usually includes better seed bed preparation, better seed placement, weed control, fertility management, etc. The farmer who employs a higher level of farm management is almost always a better steward of the land and environment.

The farmers in Karen Karen, southeastern Blue Nile Province, lost their entire sorghum and sesame crop to drought in 1984. Their local sorghum and sesame varieties were long season maturity types. In 1985, all of the farmers requested Dabar sorghum and Zira 7 sesame seed supplied from the Blue Nile Project through their farm cooperative association. (Ed. note: are these short-season maturity varieties?)

#### N. Introduction of Appropriate Technology Packages

Tenant farmers in the irrigated subsector and farmers in the traditional rain-fed sector will require the assistance of an agricultural extension agency to conduct agronomic field trials and on-farm trials of new crops, and improved varieties in order to determine and demonstrate the most appropriate combinations and levels of inputs. Once appropriate technology packages have

been determined, widespread demonstrations will be conducted by extension components of the Agricultural Corporations such as the Gezira Board, and by projects such as Global 2000 and WSARP.

Large agricultural companies in both the irrigated and rain-fed subsectors have research divisions and, in cooperation with the seed producing companies, will devise appropriate technology packages for their own circumstances. The private mechanized rain-fed farmers will copy practices developed and adopted by the progressive rain-fed agricultural companies. The Mechanized Farming Corporation extension services will also be active in development of appropriate technology packages in line with the practices of the various farming systems.

#### O. Training Component

A training component is important to the development of an understanding of the various areas and interrelationships that exist in a National Seed System.

The NSA has been conducting training seminars for its technical staff on an annual basis. Seminar topics are specialized and cover a different technical area of seed production, processing, quality control, etc. each year. In view of the proposed reorganization of the NSA, which involves placing more emphasis on seed quality control, seed certification, foundation seed production, and seed storage and handling, many of the staff will need to be re-trained to fulfill the responsibilities of their new positions.

In addition, private seed companies and local seedsmen will require a substantial amount of technical training in modern techniques of seed production (including hybrids), seed purity requirements, seed cleaning, storage and sales. Technical training courses will be conducted annually in areas relatively near to where the seed producers live.

This type of training will utilize existing infrastructure wherever it may be located, and will include Agricultural Extension, ARC programs, special projects such as Global 2000, WSARP, and the personnel and facilities of the Agricultural Corporations. The mission envisions USAID assistance in providing short-term specialists in various seed related subjects, training materials and equipment, and local funding support.

Management training at various levels in both the public and private seed sectors is needed.

In the public sector, the reorganized NSA will require much more effective management in the production of publicly produced varieties of foundation seed, which will be utilized by certified seed growers both in the public and also in the private sectors.

In the private sector, seed company managers will need training on how a private seed company is managed, in order to optimize production and distribution, and on how best to utilize its limited resources. Trips to study U.S. and other foreign seed companies are envisioned, along with annual local Private Seed Growers Association conferences.

Training in how the private seed industry functions in the U.S. and other countries would illustrate to Sudanese government officials the benefits which a private seed industry can bring to the economy of Sudan.

Very early in the project, a conference or seminar for all parties in Sudan interested in seeds and development of a seed industry, should be held. It would be patterned after similar ICD-assisted conferences/seminars held in Pakistan and Turkey.

P. Development of a Management Information System for Public Sector Administration in Sudan

In order to help support the administrative elements of the seed system at the government level, it is proposed that both the NSA and the ARC be encouraged and assisted to develop management information systems.

At the ARC, the system should be capable of: maintaining a research database from test sites on various varietal performance trials; producing statistical analyses of results; consolidating results over locations and years; issuing reports; facilitating the generation of new trial designs, labels, and field books, and helping maintain a breeding and general germplasm inventory database for ARC's own use and that of interested private breeders.

At NSA, the system should be capable of: maintaining records of seed growers, seedsmen, and seed firms on import/export licenses; deriving accurate production, market, supply and demand statistics for analysis by other GOS organizations; maintaining control of inspected and certified seed lots; monitoring timing of inspections and analyses and producing estimates of seed production and marketing.

The systems should be designed by a short term consultant whose services are provided for in the project contract. This consultant should work together with staff of USAID/Sudan, NSA and ARC.

The system should be established with independent modules at both NSA and ARC. Each of the modules should consist of an IBM AT compatible computer with a 20 MB hard disk, a printer, and software for statistical analysis, spreadsheets, databases and word processing. Provisions for supplies and local training should be included in the project.

## V. PROJECT COMPONENTS

### A. Background

The development goal of the project is to change the National Seed System in Sudan from a highly government-oriented system to one which provides a gradual and assured shift of seed production and marketing activities to the private sector. The government and private sector will be asked to change their legal and organizational structures in order to achieve greater efficiency in their respective roles. GOS will be asked to restrict its production-oriented activities in order to enhance and facilitate the participation of the private sector in research, production, marketing and distribution of seeds, and to increase the efficiency of its support and regulatory services.

The private sector, once it becomes responsible for seed production and marketing, will form the core of the seed industry in Sudan. It will be composed of the following three groups: (a) seed corporations; (b) large agricultural corporations which produce seed for their own needs and; (c) farmers in the traditional areas who become seedsmen by growing and marketing improved seed to their neighbors.

At the same time, it is expected that government seed production activities will be retained by the NSA, for seeds originating in the ARC research programs, and at the irrigation authorities such as Gezira, Rahad, and New Halfa, to serve their tenant farmers with varieties originating in the ARC research programs.

Under this scenario the market reorientation for seeds would follow the major trends indicated below:

a) Seed production/marketing corporations will introduce and market hybrid seeds of major crops such as sorghum and sunflower, and will expand their area primarily into the mechanized farming areas. To a large extent, they will tend to replace the hybrid sorghum and open-pollinated areas in the irrigated sector, now planted with local and improved open-pollinated varieties and hybrid HD-1.

b) NSA and government irrigated schemes and GOS agricultural corporations will continue to produce seeds of varieties and hybrids developed by the ARC. Their customers will be the present tenant market and GOS corporations for self-pollinated crops such as wheat, pulses and peanuts and, to a decreasing extent, the mechanized farm corporations. As the new plants at El Obeid and Hudeiba become operational, it is expected that NSA will also be present in traditional farming areas.

c) A system of small farmer-seedsmen would be institutionalized and consolidated to serve farmers in their immediate geographical range. They would be organized to produce and market certified seed of improved varieties commercially accepted in their communities.

To achieve these ends, it will be necessary to effect a large number of changes in the legal, political, and economic environment immediately surrounding the seed industry. These changes will be achieved through an educational process carried out at various levels, with constant movement in the direction of new administrative structures in NSA, adoption of new roles and attitudes, and the establishment of new concepts of government-private sector interaction in the seed industry.

Introduction of additional training in relevant technology and seed firm management will help to shape the program and to establish a permanent base of local elements committed to its future support.

Research support extension and the creation of a network of seedsmen in the traditional area are of major importance in serving all Sudanese farming subsectors.

A management information system component is being included for the purpose of helping the GOS institutions which are concerned with the seed industry, to establish appropriate systems of information support in research and seed quality control.

## B. Project Activities

The recommended program activities are the following:

- 1) Restructure institutional functions and encourage a locally receptive environment for the development of a National Seed System based on a partnership between the private and public sectors.
- 2) Establish a private seed industry in Sudan comprised of private seed companies and independent seedsmen serving their respective markets.
- 3) Build a core of 120 local village seedsmen in the traditional sector, serving 120,000 feddans in the first phase of the project.
- 4) Support the extension system, working jointly with Global 2000 operations, in activities concerned with the introduction of improved varieties in the traditional rain-fed agricultural sector.
- 5) Support NSA in developing quality control and seed certification activities.

6) Support the ARC in developing a national seed testing system, including a management information system.

7) Support the Food Research Center in evaluating new and promising grain types from the breeding projects at the ARC and private sector for nutritional quality and industrial utilization.

### C. Project Planning and Design

The project should be designed and implemented according to the following considerations:

#### 1. Method of Operation

Fundamental activities should consist of training, both formal and informal, development of technical support activities, and extension work. Supplementary travel and seminars should be integrated into the project to reinforce training. Improvement of know-how in seed industry management for the private sector and quality control systems for the public sector should be particularly stressed. Extension activities could be included for introduction of improved varieties and farming methods, as well as establishment of a "cottage seed industry" in the western areas of Sudan: Kordofan and Darfur.

#### 2. Choice of Targets

The targets on which these actions should be centered are:

a) National Seed Administration - restructuring and reorientation.

b) Ministry of Agriculture - legal and promotional support to the seed industry.

c) Ministry of Finance and Economic Planning - promotional and financial support to the seed industry.

d) Ministry of Commerce, Agricultural Bank of Sudan, and Bank of Sudan - specific support of the private seed industry.

e) Private seed companies and seed trade associations - organization and improvement of management skills; development of technical and operational linkages with the government institutions.

f) Farmers in the Western Sudan traditional agricultural area - may become leading seedsmen and suppliers of high quality seed of improved varieties in their areas of influence.

g) Farmers (120,000 feddans) of Western Sudan who may become users of better seed in a first phase.

h) Agricultural Research Council - improvement of reference and management information services, specifically in regard to variety testing and germplasm and breeding material information functions.

i) Food Research Center - improvement of its nutritional analysis and utilization support functions.

### 3. Specification of Indicators

Advancement toward the goals of the project will be measured in terms of the number of training courses and attendance; scholarships and their use; seed seminars developed and completed; number of government legal and structural modifications and policy changes brought into effect; number of seedsmen brought into the Western Sudan to seed production project and their seed production and distribution volumes.

### 4. Schedule

It is recommended that the project be conducted over a period of three years.

### D. Program Implementation

It is proposed that the project be implemented through a management contract set up by USAID/Sudan with a contractor from the U.S.

The contractor should be responsible for the full management and implementation of the project according to a schedule of goals to be attained, activities and budget which will be spelled out in the contract.

#### 1. Contractor and Its Obligations

The contractor should field a mission in the Sudan for three years, including a preliminary mission of one month. Total effective period of the contract should be 35 months. The contractor should have the following full time expatriate staff in the Sudan:

a) Chief of party, in charge of management of the project, with the technical skills required to provide technical inputs and leadership.

b) Deputy chief of party, to assist the chief with technical inputs capabilities, skilled in the areas of extension and training.

There should be provision in the budget for maintaining Sudanese support personnel, namely 1 executive secretary, 1 assistant secretary, 1 driver and 2 clerical people.

It is envisioned that the contractor will field, according to a schedule to be indicated in the contract, short-term technical advisory personnel (in the following categories), with a total of 36 man-months over a 3 year period:

- Seed technology training
- Legal advice in seed law and seed industry investment
- Plant breeding research, variety testing and registration
- Seed quality control
- Seed certification
- Seed marketing
- Seed production
- Seed firm management
- Agricultural economics
- Management information systems
- Agricultural extension

The contractor is expected to plan activities and submit proposals to USAID/Sudan for approval within a detailed schedule. USAID/Sudan will designate a Project Coordinator from its own staff for liaison with the project. The Contractor will report periodically on progress - as directed in the contract - to USAID/Sudan.

The contractor would organize the training activities listed below, insuring that appropriate contracts are made with specialized training institutions from the U.S.: international agricultural research centers from the CGIAR group (CIAT-Seed Unit, IITA-Future Seed Unit, ICARDA Seed Training Program, ICRISAT), the Industry Council for Development (ICD), universities, and selected firms or individuals.

The contractor would be expected to establish liaison activities with all the institutions involved in the present project, in order to insure their active participation and collaboration. The contractor should be specifically instructed to establish permanent rapport with members of the Sudan Private Seed Producers Association and permanently advise them vis-a-vis the GOS, and in such matters as may enhance the efficiency, productivity and consistent growth of the seed industry in Sudan.

The contractor should be specifically instructed to establish permanent rapport with the Ministry of Agriculture Extension Service, in order to collaborate in the development of "cottage industry" seedsmen for Western Sudan traditional rain-fed agriculture, and in activities furthering the use of high quality seed of improved varieties.

## 2. Training Plan

The following activities should be included in a training plan. They are indicative of specific initiatives that may need to be addressed in the course of project implementation.

- a) Short term in-country training
  - 1 general commercial seed production, processing and storage course, 6 weeks duration;
  - 1 course on seed marketing and distribution, 2 weeks;
  - 3 courses in seed company management, 2 weeks each;
  - 1 seminar or workshop on development of private (large scale and small scale) seed production, marketing and distribution.
- b) Short-term training in the U.S.
  - Training internships with U.S. seed firms (3 weeks effective, 1 month total) for management level personnel in administration of seed companies, production and marketing. Six scholarships available for internships;
  - 1 Scholarship for one 6-week training internship in food quality laboratory assessment for Food Research Center personnel (Texas A & M Cereal Utilization Lab or USDA Regional Utilization Labs);
  - 1 Scholarship for a 3-week Quality Control/Certification study tour in the U.S.A., for SCA management;
  - 1 Scholarship for a study tour (specific study) of variety testing, extension, and information reporting procedures on varietal trial performance in the U. S.
- c) Country study tours for observation of advances in developing countries in restructuring national seed systems, problems, and results: 6 scholarships for 2 weeks effective travel time each.

## 3. Commodities

The Draft Financial Plan for the Project provides a detailed account of commodities and their budgets.

#### 4. Equipment

Equipment has been selected for the following purposes:

a) Portable seed cleaners (12) for use in developing a seed producing and distributing capacity in the Western Sudan traditional rain-fed area supporting some 120 farmers/seedsman. The seed cleaners will be transported and rented for a fee by the Extension Service of the Ministry of Agriculture with the technical support of NSA, and under supervision and backstopping of the present project.

b) Portable video demonstration kits for extension work on seed distribution by the Extension Service. These are backed up by a facility to produce videos at the Extension Service, under joint agreement with NSA.

c) Microcomputers to support the database and management information system of the ARC and NSA in variety testing and quality control operations.

d) Laboratory equipment for quality control to support NSA work.

e) Amino acid analysis equipment to facilitate the work of the Food Research Center.

#### 5. Vehicles

Pick-up trucks (6) to be used by the Extension Service, with support of NSA to transport portable seed cleaners, to visit farmers and to carry on seed extension work (linked with the present on-farm testing and demonstration project of the Global 2000-Extension System project.)

#### 6. Supplies

A stock of support supplies will need to be maintained. It is proposed that a budget provision, mainly for importing or buying locally spare parts, field inputs, certain unavailable computer and office supplies, be established and be at the disposal of the project manager.

#### 7. Credit

It is foreseen that the private sector will require credit to import farm equipment, capital equipment for seed conditioning plants, storage and other needs as it develops capabilities for seed production and processing. This project does not include a provision for credit at this stage, as it is believed that institutional and policy reforms, as well as training, constitute pre-conditions for any decisive breakthrough toward the establishment of a vigorous seed industry in

Sudan. This theme, as important as it is, should be left for a second phase of the project.

8. Construction

No construction investments are envisioned in the project.

## VI. PROGRAM EVALUATION

A permanent evaluation mechanism should be built into the project to insure that it produces accurate and timely results. As this project aims at establishing a series of policy reforms to encourage development of a private seed industry, results must be precisely recorded and interpreted to guide project actions within a short time framework.

It is proposed that a working committee be established to monitor progress of the project. The committee will report quarterly to USAID/Khartoum on progress, and on any design changes which may be needed. The working committee should include the USAID/Sudan ADO and the Projects Operations, Training, and Economic Policies officers or their representatives. The Executive Officer of the Contractor may participate in these meetings whenever he is in Sudan, or may send a delegate if the subjects to be discussed at a given meeting require it. For all intents and purposes, however, the Project Manager would be fully delegated by the Contractor to represent him at any meeting. The Project Manager would report to and, in turn, receive feedback from the working committee on his quarterly proposals for action. Progress should be evaluated in the following areas:

- a) Magnitude and direction of changes
- b) Achievement of intermediate project goals
- c) Assesment of durability of policy change

The analysis of the progress made by the project would determine, after feedback from the Project Manager and the working committee, the tactics which should be employed on a quarterly basis.

The Executive Officer of the Contractor, or his delegate, would be able to exercise independent judgment on the recommendations of the committee, and should submit his opinions and reservations relating to whatever decisions must be made which might alter the approved contractual goals or which, in his opinion, might bring about difficulties in the execution of the project.

## VII. ANALYSIS AND FUTURE EFFORTS

At the termination of the project a complete analysis of its operations and accomplishments, as well as problems encountered, should be presented in a final report. This would be preceded by annual reports. The final report should contain recommendations on future efforts that might be required to further developments initiated by the project.

VIII. DRAFT FINANCIAL PLAN FOR THE PROJECT

<u>Contractor</u>	<u>Estimated Costs</u>			
	<u>Year_1</u>	<u>Year_2</u>	<u>Year_3</u>	<u>Total</u>
I. <u>DIRECT LABOR</u>				
A. <u>Home Office</u>				
Backstopping/support 2 pm/year @ \$260/day	11,268	11,830	12,420	35,510
B. <u>Field Team</u>				
1. <u>Long-Term Advisors</u>				
Chief of Party - Seed Administrator and Policy Advisor	50,000	52,500	55,125	157,625
Deputy COP - Seed Marketing and Distribution Advisor	40,000	42,000	44,100	126,100
2. <u>Short-term Consultants</u>				
30 person months @\$200/day	52,008	54,608	57,338	163,954
Sub-Total - Field Staff				447,679
TOTAL DIRECT LABOR				483,197
II. <u>FRINGE BENEFITS</u> (15% of long-term salaries)				
Chief of Party	7,500	7,875	8,269	23,644
Deputy COP	6,000	6,300	6,615	18,915
TOTAL FRINGE BENEFITS				42,559
III. <u>OVERHEAD</u>				
Home Office - 100% of base salaries	11,268	11,830	12,420	35,518
Field Staff - 60% of base salaries	54,000	56,700	59,535	170,235
TOTAL OVERHEAD				205,753

IV. TRAVEL AND TRANSPORTATION

	<u>Year 1</u>	<u>Year 2</u>	<u>Year 3</u>	<u>Total</u>
A - International Air Fares To Post and Return (5 x \$1,200), (5 x 1,325) R&R (10 x 1,260)	6,000	-	6,625	12,625
B - Air Freight (450# x 600# each way @ \$15/lb)	5,025	-	5,275	10,300
C - Sea Freight (2,500# each way @ \$4/lb x 2)	20,000	-	20,000	40,000
D - Vehicle (\$3,500 each way x 2)	7,000	-	7,000	14,000
E - Domestic Travel (\$100/wk per individual)	15,600	15,600	15,600	46,800*
F - Per Diem				
Long-Term (\$60 x 10 days/mo x 72 pm)	14,400	14,400	14,400	43,200
Short-Term (\$174/day x 36 pm)	62,640	62,640	62,640	187,920
TOTAL TRAVEL AND TRANSPORTATION				<u>367,445</u>

V. ALLOWANCES

A - Post Differential (25%)	22,500	23,625	24,806	70,931
B - Post Allowances (3%)	2,700	2,835	2,977	8,512
C - Living Quarters (\$1,400 x mo x 72)	33,600	33,600	33,600	100,800*
D - Education	15,000	15,000	15,000	45,000
TOTAL ALLOWANCES				<u>225,243</u>

VI. OTHER DIRECT COSTS

A - Workers Comp. Insurance	300	350	350	1,000
B - Public Liability Insurance	200	250	250	750
C - Medical Evacuation Insurance	800	800	800	2,400
D - Mobilization Costs				
Long-Term	1,000	-	-	1,000
Short-Term	1,200	1,200	1,200	3,600
TOTAL OTHER DIRECT COSTS				<u>8,750</u>

<u>VII. VEHICLES, EQUIPMENT AND SUPPLIES</u> (based on FOB Costs)	<u>Year_1</u>	<u>Year_2</u>	<u>Year_3</u>	<u>Total</u>
A - Portable Seed Cleaners - 20-30 bu/hr capacity 1 HP Engine driven w/bogging elevator @ \$750	9,000	-	-	9,000
B - Vehicles - Pick-up truck - 4 x 4, 1/2 T. capacity - diesel - heavy duty @ each - \$15,000 each + 3 for IA team	90,000	-	-	90,000
C - Amino-acid analyser	20,000	-	-	20,000
D - Seed lab, equipment (probes, scales, moisture meter, dockage sieves)	10,000	-	-	10,000
E - Audio-video equipment (Portable TV monitor, extension kit, VRS cassette set w/color monitor, DC converter, carrying case) 10 @ \$950 each	9,500	-	-	9,500
F - Video production laboratory equipment	9,000	-	-	9,000
G - Management Information System Equipment (2 AT type computers, printers, and software)	20,000	-	-	20,000*
H - Supplies - office, field demonstration, etc.	-	-	-	72,000*
I - Office Support Staff, Drivers, etc. (estimated in US\$ - paid in local currency)	24,000	24,000	24,000	<u>72,000*</u>
TOTAL VEHICLES, EQUIPMENT AND SUPPLIES				<u>251,500</u>

VIII. <u>PARTICIPANT TRAINING</u>	<u>Year_1</u>	<u>Year_2</u>	<u>Year_3</u>	<u>Total</u>
A - <u>In-Country</u> - 60 scholarships for travel and per diem to Khartoum, Wad Medani, and Sennar for conferences and workshops (\$1,250 x 60)	6,250	6,250	6,250	18,750
B - <u>Third Country</u> - Travel, per diem, and fees for training and workshops at International Research Centers and Private Seed companies in other developing countries 20 scholarships (20 x \$3,100)	20,666	20,667	20,667	62,000
C - <u>U.S.</u> - Travel, per diem and fees for training and workshops with 1. seed companies for practical seed company management 2. seed certification agencies on certification procedures 3. USDA and experiment stations on varietal testing and approval procedures. 12 scholarships of 3 months each (\$15,000 + \$6,000 = 3,000) x 12	10,500	10,500	10,500	<u>31,500</u>
TOTAL PARTICIPANT TRAINING				112,250

IX. FIXED FEE

10% OF TOTAL

169,670

X. TOTAL ESTIMATED COST

1,866,367

=====

\* May use counterpart funds if available.

Recap

I.	DIRECT LABOR	483,197
II.	FRINGE BENEFITS	42,559
III.	OVERHEAD	205,753
IV.	TRAVEL AND TRANSPORTATION	367,445
V.	ALLOWANCES	225,243
VI.	OTHER DIRECT COSTS	8,750
VII.	VEHICLES, EQUIPMENT AND SUPPLIES	251,500
VIII.	PARTICIPANT TRAINING	<u>112,250</u>
	SUB TOTAL	1,696,697
IX.	FIXED FEE	<u>169,670</u>
X.	TOTAL	1,866,367 =====

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Human Population Distribution, 1982 (x 1000)

<u>Province</u>	<u>Urban</u>	(1) %	<u>Rural</u>	(1) %	<u>Nomadic</u>	(1) %	<u>Total</u>	(2) %
Blue Nile	843	16.2	4,020	77.4	329	6.3	5,192	27.7
Kordofan	376	15.2	1,686	68.3	405	16.4	2,467	13.1
Darfur	355	12.8	1,940	70.0	475	17.1	2,770	14.8
Kassala	455	31.4	771	53.2	222	15.3	1,448	7.7
Khartoum	1,366	76.6	363	20.3	55	3.1	1,784	9.5
Northern	186	18.3	726	71.4	105	10.3	1,017	5.4
Red Sea	311	52.0	138	23.1	149	24.9	598	3.2
Bahr El Ghazal	336	20.5	1,302	79.5	-	0	1,638	8.7
Upper Nile	98	10.4	845	89.6	-	0	943	5.0
Equatoria	371	41.5	524	58.5	-	0	895	4.8
Country Total	4,697	25.0	12,315	65.6	1,740	9.3	18,752	100.0

Notes: (1) Percentage refers to total by province

(2) Percentage refers to provinces over country total

Source: Data calculated from Department of Statistics, Census Office,  
Six Year Plan Projection.

Sudan Guide. Planning and Management Consultancy, 1980.

Population Distributed by Age, 1980 (x 1000)

<u>Age_Group</u>	<u>Urban</u>	(1)	<u>Rural</u>	(1)	<u>Total</u>	(2)
		<u>%</u>		<u>%</u>		<u>%</u>
0-19	2,231.8	22.5	7,670.2	77.5	9,902	55.5
20-59	1,818.3	25.6	5,420.5	74.4	7,283.8	40.8
60-over	121.9	18.9	5,243.0	81.1	646.2	3.6
Country Total	4,172.0	23.7	13,615	76.3	17,832	100.0

Notes: (1) Percentage refers to total by age group

(2) Percentage refers to age group over country total

Source: Data calculated from Department of Statistics, Census Office,  
Six Year Plan Projection.

Sudan Guide. Planning and Management Consultancy, 1980

TABLE  
SUDAN: VOLUME OF EXPORTS BY COMMODITY, 1975/76-1985/86  
(METRIC TONS, UNLESS INDICATED)

ITEM	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	
COTTON (THOU BALES)	41	1,147	792	749	884	969	465	260	691	1,198	846	586
LONG STAPLE	42	962	592	601	484	512	281	157	406	623	414	240
OTHER COTTON	43	185	200	148	399	456	185	103	285	575	432	346
GUM ARABIC	44	23,834	29,595	31,559	35,400	34,861	25,518	31,345	34,610	46,913	35,115	19,800
SESAME	45	60,413	108,617	93,444	37,265	40,053	45,121	63,542	66,443	77,205	51,746	44,700
GROUNDNUTS	46	279,280	223,971	135,061	40,014	19,375	69,923	118,284	22,957	18,762	15,265	7,500
FOOD GRAIN	47	54,845	134,755	193,585	65,289	351,388	327,261	263,261	389,056	196,764	3,435	3,000
DURA	48	39,117	108,583	58,246	55,521	340,829	320,360	259,785	381,216	180,725	-	3,000
DUKHAN	49	2,007	5,680	1,827	1,639	2,815	1,558	2,486	7,840	1,528	1,932	-
PULSES	50	945	1,285	1,379	1,697	287	0	-	-	-	-	-
WHEAT BRAN	51	12,776	19,207	132,133	6,431	7,457	5,345	990	-	14,511	1,503	-
SENNA PODS & KARKADEH	52	2,485	7,491	3,428	3,113	3,687	3,604	3,611	4,221	6,526	2,836	-
OTHER AGRICULTURE	53	11,083	4,218	4,913	657	820	3,404	5,522	3,982	2,142	3,368	-
SHEEP & LAMBS (HEAD)	55	17,194	144,425	271,990	240,924	268,067	409,969	479,873	607,539	517,065	464,506	441,600
CATTLE (HEAD)	56	50	10,493	10,162	10,967	6,491	9,757	10,368	7,661	11,811	10,814	-
CAMELS (HEAD)	57	4,103	3,009	3,986	2,579	787	562	982	797	513	4,708	-
GOATS (HEAD)	58	-	14,371	18,515	4,152	1,330	2,219	3,280	7,718	6,975	4,225	-
HIDES & SKINS	73	5,653	8,589	5,237	3,850	4,435	4,058	6,443	7,995	14,047	12,691	-
SEEDS	59	22,445	32,689	10,988	15,982	15,712	26,276	33,202	37,397	19,638	12,457	-
OILS	60	5,847	15,520	19,378	41,346	21,688	32,920	18,603	13,883	18,525	21,000	-
COTTON SEED	70	-	-	-	-	-	-	-	-	-	-	-
SESAME	71	501	65	2,615	1,605	2,313	20	730	3,290	2,025	2,000	-
GROUNDNUT	72	5,346	15,455	16,763	39,741	19,375	32,910	17,873	10,593	16,500	19,000	-
CAKE/MEAL	61	224,179	209,645	79,033	185,971	155,110	145,954	105,703	90,722	95,781	75,490	21,300
COTTON	62	130,332	94,317	19,949	62,262	22,534	1,039	593	198	1,668	1,000	-
SESAME	63	49,144	36,651	4,711	28,118	12,423	17,159	24,346	4,157	7,099	6,499	5,000
GROUNDNUTS	64	44,703	78,677	54,373	95,591	120,153	127,746	80,764	86,367	87,014	67,991	16,300
OTHER EXPORTS	65	48,799	40,092	9,569	17,294	14,427	23,562	9,391	21,019	19,261	23,786	-
PETROLEUM PRODUCTS	67	220,500	302,757	240,268	204,036	95,000	132,000	94,900	77,800	40,000	-	-

SOURCE: BANK OF SUDAN, FOREIGN TRADE STATISTICS

TABLE S00/3X/2

SUDAN: VALUE OF EXPORTS BY COMMODITY, 1975/76-1985/86  
(MILLION US DOLLARS)

ITEM		1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/82	1983/84	1984/85	1985/86
• • EXPORTS - VALUES • •												
COTTON	1	300.4	285.8	296.0	320.7	328.8	182.1	69.4	174.6	333.2	245.1	136.0
LONG STAPLE	2	261.5	222.1	230.3	207.4	202.0	126.9	48.4	112.8	191.2	154.2	88.1
OTHER COTTON	3	38.9	63.7	65.7	113.3	126.8	55.1	21.0	61.8	142.1	90.9	47.9
GUM ARABIC	4	30.6	34.1	35.3	39.9	44.4	34.3	43.9	47.4	61.9	41.6	27.3
SESAME	5	32.9	62.1	55.5	27.6	41.9	34.1	43.5	50.5	83.6	42.3	34.3
GROUNDNUTS	6	115.6	103.4	80.2	25.6	12.9	66.2	49.0	15.9	15.4	11.1	4.9
FOOD GRAIN	7	6.3	15.8	9.8	10.2	71.3	70.3	65.8	93.7	23.3	1.0	0.7
SORGHUM	8	5.1	12.9	8.6	8.8	70.3	69.8	65.0	91.0	21.1	-	0.5
MILLET	9	0.2	0.6	0.2	0.2	0.6	0.2	0.6	2.7	0.4	0.5	0.1
PULSES	10	0.1	0.4	0.7	0.9	0.1	0.0	-	-	-	-	-
WHEAT BRAN	11	0.8	1.6	0.4	0.3	0.4	0.3	0.2	-	1.6	0.5	0.1
SEMA POOS & KARKADEH	12	3.0	5.8	2.5	2.7	3.8	3.2	3.4	0.9	5.6	4.7	4.4
OTHER AGRICULTURE	13	4.6	1.9	2.3	0.3	0.2	1.2	3.7	2.6	1.7	3.1	1.4
LIVESTOCK 1/	14	11.4	22.8	26.8	30.0	36.2	94.6	108.6	141.1	145.5	211.5	249.3
SHEEP & LAMBS	15	0.5	7.0	11.4	17.5	20.9	81.6	96.7	119.1	108.9	134.9	103.5
CATTLE	16	0.0	2.3	2.6	3.0	2.0	2.9	3.7	2.6	7.0	5.3	3.6
CAMELS	17	0.8	0.6	1.0	0.5	0.2	0.2	0.8	8.8	17.3	57.1	130.4
GOATS	18	-	0.3	0.4	0.1	0.0	0.1	-	-	-	-	-
HIDES & SKINS	23	10.1	13.6	11.5	8.8	13.1	9.8	7.4	10.6	12.3	14.2	12.3
SEEDS	19	5.0	5.7	3.1	4.4	6.5	6.3	14.2	16.4	11.2	12.9	21.9
OILS	20	2.9	5.5	8.6	26.6	8.6	11.8	10.9	9.1	16.7	5.2	-
COTTON SEED	30	-	-	0.0	-	-	-	-	-	-	-	-
SESAME	31	0.4	0.0	2.4	1.1	2.1	0.0	0.3	2.9	2.5	1.6	-
GROUNDNUT	32	2.4	5.4	6.2	25.5	6.5	11.8	10.6	6.2	14.2	3.6	-
CAKE/MEAL	21	16.2	26.3	8.8	21.1	18.6	23.0	16.4	16.3	16.7	1.5	3.2
COTTON SEED	22	7.9	10.0	2.5	5.3	2.0	0.1	0.1	0.0	0.3	0.1	0.6
SESAME	23	4.9	8.1	0.8	4.5	1.8	4.5	4.4	0.7	1.4	1.1	0.8

SUDAN: VALUE OF EXPORTS BY COMMODITY, 1975/76-1985/86  
(MILLION US DOLLARS)

ITEM		1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
GROUNDNUT	24	3.4	8.2	5.5	11.3	14.9	18.4	11.9	15.6	15.0	0.3	1.8
OTHER EXPORTS	25	6.4	4.3	1.4	1.9	3.2	3.2	1.6	4.2	7.0	8.5	13.1
MISC EXPORTS (PRICE BASED)	34	15.5	20.6	21.0	15.8	17.4	7.1	1.8	5.4	10.5	6.9	0.2
TOTAL EXPORTS	29	550.8	595.0	551.4	526.8	593.9	537.5	432.0	581.1	722.3	595.4	497.2
EXPORT PRICE INDEX	90	87.3	100.6	101.0	112.1	108.6	119.7	100.0	99.9	106.7	113.3	-

SOURCE: BANK OF SUDAN, IMF AND STAFF ESTIMATES.  
1/ FROM 1980/81 ONWARDS INCLUDES UNRECORDED EXPORTS.  
FROM 1981/82 ONWARDS GOATS ARE INCLUDED UNDER CAMELS.

TABLE SDD/3X/1

## Sorghum (Dura): Area Planted (x 1000 Feddans)

Production Area	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
<b>A. Under irrigation</b>												
Northern Province	18	15	15	15	15	15	10	1	1	10	25	15
Nile Province	68	25	30	35	30	30	13	8	10	15	40	18
Tokar (Red Sea)	28	12	28	64	10	26	22	15	20	35	40	30
Gash (Kassala)	50	16	32	24	19	29	37	27	54	65	62	45
Gezira	341	324	353	344	270	300	344	321	411	420	580	443
New Halfa	-	-	-	8	15	28	51	51	55	66	140	73
Blue Nile	56	48	50	57	62	54	67	107	111	131	176	150
Kosti-Ra (White Nile)	21	9	7	11	28	24	30	49	57	30	60	19
Dueim (White Nile)	46	22	24	33	3	5	5					
<b>Total (A)</b>	<b>628</b>	<b>471</b>	<b>539</b>	<b>591</b>	<b>443</b>	<b>502</b>	<b>579</b>	<b>579</b>	<b>719</b>	<b>766</b>	<b>1,123</b>	<b>820</b>
<b>B. Rainfed Mechanized</b>												
Khartoum Province	7	10	17	18	10	15	10	5	0	0	0	0
Gezira (Kassala)	2,000	1,910	1,848	2,076	2,150	2,191	2,958	2,961	2,947	2,502	3,400	3,300
Blue Nile	499	524	507	502	400	450	1,568	1,235	1,300	1,171	2,665	-
White Nile	51	110	125	150	170	230	260	241	230	237	1,840	1,445
South Kordofan	182	193	295	227	214	268	226	489	580	624	625	718
South Kordofan Modernized	-	16	24	4	10	10	30	25	25	NA	NA	NA
South Darfur	6	7	6	10	10	5	0	-	NA	NA	7	10
Southern Region (Upper Nile)	317	258	265	314	262	265	480	349	420	NA	NA	NA
<b>Total (B)</b>	<b>3,062</b>	<b>3,028</b>	<b>3,087</b>	<b>3,301</b>	<b>3,226</b>	<b>3,434</b>	<b>5,532</b>	<b>5,305</b>	<b>5,502</b>	<b>4,534</b>	<b>8,537</b>	<b>8,173</b>
<b>C. Rainfed (Traditional)</b>												
Gezira Province	90	210	225	260	122	200	220	115	115	70	170	150
Blue Nile	535	460	455	683	680	680	700	500	450	450	600	600
White Nile	288	89	270	200	70	140	160	195	180	160	430	400
South Kordofan	376	341	280	385	321	350	375	370	407	609	520	505
North Kordofan	329	631	650	600	386	450	450	448	445	303	200	175
South Darfur	338	300	375	400	300	350	360	400	450	300	480	470
North Darfur	55	42	52	52	41	50	50	52	42	45	115	115
Southern Region	610	715	729	730	760	800	800	700	750	750	700	350
<b>Total (C)</b>	<b>2,621</b>	<b>2,788</b>	<b>3,036</b>	<b>3,310</b>	<b>2,680</b>	<b>3,020</b>	<b>3,120</b>	<b>2,780</b>	<b>2,839</b>	<b>2,687</b>	<b>3,215</b>	<b>2,655</b>
<b>GRAND TOTAL (A+B+C)</b>	<b>6,311</b>	<b>6,287</b>	<b>6,662</b>	<b>7,202</b>	<b>6,349</b>	<b>6,956</b>	<b>9,321</b>	<b>8,664</b>	<b>9,060</b>	<b>7,987</b>	<b>12,875</b>	<b>11,658</b>

Table 7. Sorghum (Dura). Yield (Kg/Fed).

Production area	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
<b>A. Under irrigation</b>												
Northern Province	444	400	400	500	400	400	400	600	600	750	600	600
Nile Province	441	460	400	400	400	400	600	600	500	500	500	500
Tokar (Red Sea)	205	166	500	500	100	385	318	227	220	400	400	400
Bash (Kassala)	240	250	250	292	300	360	297	220	260	400	440	400
Bezira	601	543	533	491	300	250	500	405	500	630	690	630
New Halfa	0	0	0	375	407	429	392	353	400	500	360	400
Blue Nile	214	167	500	526	400	467	1211	1050	400	400	400	425
White Nile (Kosti Ra)	142	111	286	455	327	400	400	245	386	400	450	450
White Nile (Duaib)	217	227	460	455	352	375	500	NA	386	NA	NA	NA
Rahad										700	620	650
Sudd										450	610	540
<b>Total (A)</b>	<b>458</b>	<b>450</b>	<b>497</b>	<b>475</b>	<b>379</b>	<b>397</b>	<b>468</b>	<b>492</b>	<b>463</b>	<b>569</b>	<b>580</b>	<b>547</b>
<b>B. Rainfed Mechanized</b>												
Khartoum Province	142	200	118	222	200	200	300	200	0	NA	NA	NA
Gedaref (Kassala)	353	273	300	349	300	354	401	233	196	78	300	250
Blue Nile	309	344	320	349	325	356	400	194	234	95	315	250
White Nile	627	300	280	300	235	364	380	200	126	90	150	270
South Kordofan	379	446	270	300	196	370	377	265	179	92	225	240
South Kordofan (Modern)	0	370	360	250	200	400	350	200	200	NA	NA	NA
South Darfur	166	114	333	300	260	400	0	NA	NA	NA	180	200
Southern Region	0	0	0	0	0	0	0	0	260	NA	NA	NA
Upper Nile	429	326	247	303	275	377	315	NA	NA	NA	NA	NA
<b>Total (B)</b>	<b>359</b>	<b>302</b>	<b>303</b>	<b>338</b>	<b>290</b>	<b>354</b>	<b>390</b>	<b>227</b>	<b>205</b>	<b>86</b>	<b>272</b>	<b>221</b>
<b>C. Rainfed (Traditional)</b>												
Bezira Province	255	180	142	400	197	300	318	212	122	57	150	180
Blue Nile	196	281	275	329	294	294	350	150	200	122	180	200
White Nile	298	275	148	300	71	200	300	200	122	63	120	150
South Kordofan	271	350	321	267	190	229	299	157	135	89	190	200
North Kordofan	164	144	277	300	168	139	309	56	45	25	90	150
South Darfur	263	300	426	300	217	229	276	100	120	134	220	240
North Darfur	218	191	135	192	46	140	218	96	24	22	180	180
Southern	218	270	245	246	184	200	213	143	135	133	180	180
<b>Total (C)</b>	<b>230</b>	<b>241</b>	<b>267</b>	<b>304</b>	<b>211</b>	<b>232</b>	<b>277</b>	<b>187</b>	<b>126</b>	<b>191</b>	<b>174</b>	<b>196</b>
<b>GRAND TOTAL (A+B+C)</b>	<b>315</b>	<b>287</b>	<b>303</b>	<b>334</b>	<b>263</b>	<b>297</b>	<b>355</b>	<b>224</b>	<b>201</b>	<b>137</b>	<b>272</b>	<b>309</b>

Sesame: Area Planted (x 1000 Feddans)

Production Area	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
<b>A. Rainfed Mechanized</b>												
Gedaref (Kassala Province)	347	400	344	206	335	317	253	218	427	343	430	500
Blue Nile	143	117	186	69	90	90	152	304	378	200	655	700
South Kordofan	12	35	18	10	14	24	19	15	22	30	26	78
South Darfur	-	1	-	-	-	-	-	-	-	-	-	-
Rank (Upper Nile)	45	23	34	28	57	59	20	12	15	30	20	6
<b>Total (A)</b>	<b>457</b>	<b>576</b>	<b>582</b>	<b>313</b>	<b>496</b>	<b>490</b>	<b>444</b>	<b>549</b>	<b>842</b>	<b>603</b>	<b>1,134</b>	
<b>B. Rainfed (Traditional)</b>												
Blue Nile	150	309	240	304	300	300	300	250	82	75	175	175
White Nile	122	80	80	70	35	40	40	30	25	15	25	25
South Kordofan	136	80	55	110	75	100	105	150	180	171	250	246
North Kordofan	951	900	950	900	724	725	798	675	695	634	650	690
South Darfur	175	175	262	175	180	175	175	175	185	180	100	80
North Darfur	16	15	20	16	11	11	12	10	10	10	40	40
Southern Region	119	153	160	173	168	170	170	160	165	140	100	60
<b>Total (B)</b>	<b>1,669</b>	<b>1,712</b>	<b>1,767</b>	<b>1,748</b>	<b>1,493</b>	<b>1,521</b>	<b>1,600</b>	<b>1,450</b>	<b>1,542</b>	<b>1,225</b>	<b>1,340</b>	<b>1,316</b>
<b>GRAND TOTAL (A+B)</b>	<b>2,216</b>	<b>2,288</b>	<b>2,349</b>	<b>2,061</b>	<b>1,989</b>	<b>2,011</b>	<b>2,044</b>	<b>1,999</b>	<b>2,184</b>	<b>1,828</b>	<b>2,474</b>	<b>2,612</b>

Sesame Production (x 1000 MT)

Production Area	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
<b>A. Rainfed Mechanized</b>												
Gedaref (Kassala Province)	34	61	46	22	40	48	40	27	47	39	37	63
Blue Nile	14	16	26	10	10	11	24	16	47	26	16	88
South Kordofan	1	5	3	1	1	3	3	3	4	1	2	3
South Darfur	0	0	-	-	-	-	-	-	-	-	-	-
Rank (Upper Nile)	5	3	4	3	6	7	3	2	2	4	-	1
<b>Total (A)</b>	<b>54</b>	<b>85</b>	<b>79</b>	<b>36</b>	<b>57</b>	<b>69</b>	<b>70</b>	<b>48</b>	<b>100</b>	<b>55</b>	<b>55</b>	<b>155</b>
<b>B. Rainfed (Traditional)</b>												
Blue Nile	15	43	33	42	41	39	40	25	9	7	11	18
White Nile	22	10	12	11	4	6	6	3	3	1	1	2
South Kordofan	18	10	6	14	11	12	14	14	22	7	23	30
North Kordofan	71	63	70	70	60	60	70	41	28	6	20	76
South Darfur	16	8	15	12	10	12	17	12	20	21	8	10
North Darfur	1	1	2	2	1	1	1	1	1	1	3	5
Southern Region	21	27	28	28	25	22	24	19	20	17	10	5
<b>Total (B)</b>	<b>164</b>	<b>162</b>	<b>166</b>	<b>179</b>	<b>152</b>	<b>152</b>	<b>172</b>	<b>115</b>	<b>103</b>	<b>60</b>	<b>76</b>	<b>146</b>
<b>GRAND TOTAL (A+B)</b>	<b>218</b>	<b>247</b>	<b>245</b>	<b>215</b>	<b>209</b>	<b>221</b>	<b>242</b>	<b>163</b>	<b>203</b>	<b>130</b>	<b>131</b>	<b>301</b>

Sesame Yield (Kg/Feddans)

Production Area	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
<b>A. Rainfed Mechanized</b>												
Gedaref (Kassala Province)	98	153	134	106	115	151	158	124	110	114	85	125
Blue Nile	98	137	140	145	111	122	150	53	125	130	25	125
South Kordofan	83	143	167	100	71	125	158	200	180	33	90	120
South Darfur	100	100	-	-	-	-	-	-	-	-	-	-
Rank (Upper Nile)	111	130	118	107	105	119	150	167	133	133	25	100
Kosti												
<b>Total (A)</b>	<b>99</b>	<b>148</b>	<b>136</b>	<b>115</b>	<b>115</b>	<b>141</b>	<b>158</b>	<b>87</b>	<b>119</b>	<b>116</b>	<b>49</b>	<b>126</b>
<b>B. Rainfed (Traditional)</b>												
Blue Nile	100	139	138	133	137	130	133	100	115	93	60	100
White Nile	180	125	150	157	114	150	150	100	120	67	50	90
South Kordofan	132	125	110	128	147	120	133	93	120	41	90	120
North Kordofan	74	70	74	77	83	83	97	60	40	10	30	110
South Darfur	91	45	58	69	56	64	97	69	108	117	80	100
North Darfur	62	80	100	125	56	91	83	100	100	100	80	90
Southern Region	176	176	175	162	149	129	141	119	121	120	100	90
<b>Total (B)</b>	<b>98</b>	<b>95</b>	<b>94</b>	<b>102</b>	<b>102</b>	<b>100</b>	<b>108</b>	<b>79</b>	<b>77</b>	<b>49</b>	<b>57</b>	<b>109</b>
<b>GRAND TOTAL (A+B)</b>	<b>98</b>	<b>108</b>	<b>104</b>	<b>104</b>	<b>105</b>	<b>110</b>	<b>118</b>	<b>82</b>	<b>93</b>	<b>71</b>	<b>53</b>	<b>117</b>

Table 10. Groundnuts. Area planted (x1000 feddans)

Production area	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
<b>A. Under irrigation</b>												
Nile Province	1	0	NA	NA	NA							
New Halfa	54	38	67	32	43	35	46	28	40	34	2	25
Gezira	424	250	264	217	267	85	264	148	137	213	103	149
Blue Nile	46	27	11	7	2	1	2	0	0	2	0	0
Blue Nile (El Suki)	24	22	30	25	32	15	15	7	12	12	1	2
Wh. Nile (Kosti-Rank)	4	12	1	36	NA	NA	NA	NA	NA	NA	NA	NA
Rahad	0	0	0	0	64	63	84	47	56	65	40	58
White Nile (Duleim)	0	1	12	0	NA	NA	NA	NA	27	NA	NA	NA
<b>Total (A)</b>	<b>553</b>	<b>346</b>	<b>380</b>	<b>313</b>	<b>408</b>	<b>199</b>	<b>411</b>	<b>230</b>	<b>272</b>	<b>326</b>	<b>146</b>	<b>234</b>
<b>B. Rainfed, traditional</b>												
Blue Nile	15	15	222	22	25	25	25	13	12	8	5	5
White Nile	78	50	51	51	50	60	65	37	30	15	10	10
South Kordofan	133	148	115	192	35	59	50	29	16	18	30	83
North Kordofan	352	149	350	140	772	750	780	562	499	381	130	250
South Darfur	435	627	500	750	700	700	700	700	720	700	460	500
North Darfur	88	99	125	125	165	109	100	75	60	60	50	80
Southern Region	167	196	198	225	247	245	245	225	250	200	120	60
<b>Total (B)</b>	<b>1768</b>	<b>1534</b>	<b>2281</b>	<b>2015</b>	<b>2094</b>	<b>1920</b>	<b>1965</b>	<b>1632</b>	<b>1587</b>	<b>1382</b>	<b>805</b>	<b>988</b>
<b>GRAND TOTAL (A+B+C)</b>	<b>2321</b>	<b>1880</b>	<b>2661</b>	<b>2328</b>	<b>2502</b>	<b>2119</b>	<b>2376</b>	<b>1862</b>	<b>1659</b>	<b>1708</b>	<b>951</b>	<b>1222</b>

Table 10. Groundnuts. Area planted (x1000feddans)

Production area	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
<b>A. Under irrigation</b>												
Mile Province	1	0	NA	NA	NA							
New Halfa	54	38	62	32	43	35	46	28	40	34	2	25
Gazira	424	250	264	217	267	85	264	148	137	213	103	149
Blue Nile	46	23	11	3	2	1	2	0	0	2	0	0
Blue Nile (El Sukki)	24	22	30	25	32	15	15	7	12	12	1	2
Wh. Nile (Kosti-Rank)	4	12	1	36	NA	NA	NA	NA	NA	NA	NA	NA
Rahad	0	0	0	0	64	63	84	47	56	65	40	58
White Nile (Dusse)	0	1	12	0	NA	NA	NA	NA	27	NA	NA	NA
<b>Total (A)</b>	<b>553</b>	<b>346</b>	<b>380</b>	<b>313</b>	<b>409</b>	<b>199</b>	<b>411</b>	<b>230</b>	<b>272</b>	<b>326</b>	<b>146</b>	<b>234</b>
<b>B. Rainfed, traditional</b>												
Blue Nile	15	15	222	22	25	25	25	13	12	8	5	5
White Nile	7	50	31	51	50	60	85	37	30	15	10	10
South Kordofan	133	100	115	102	35	50	50	20	16	18	30	83
North Kordofan	252	448	360	740	772	750	780	562	499	381	130	250
South Darfur	435	527	900	750	700	700	700	700	720	700	460	500
North Darfur	88	90	125	125	165	100	100	75	60	60	50	80
Southern Region	167	196	198	225	247	245	245	225	250	200	120	60
<b>Total (B)</b>	<b>1768</b>	<b>1534</b>	<b>2281</b>	<b>2015</b>	<b>2094</b>	<b>1930</b>	<b>1965</b>	<b>1632</b>	<b>1587</b>	<b>1382</b>	<b>805</b>	<b>988</b>
<b>GRAND TOTAL (A+B+C)</b>	<b>2321</b>	<b>1880</b>	<b>2661</b>	<b>2328</b>	<b>2502</b>	<b>2129</b>	<b>2376</b>	<b>1862</b>	<b>1859</b>	<b>1708</b>	<b>951</b>	<b>1222</b>

TABLE 1: BORGHUM (DURA) AREA, YIELD AND PRODUCTION: WORLD, CONTINENTS, LEADING COUNTRIES AND SUDAN, 1980 AND 1983 .

1980				1983			
Continent/ Countries	Area 1,000 HA a/	Yield Kg/HA	Production 1,000 Metric Ton	Continents/ Countries	Area 1,000 HA	Yield Kg/HA	Production 1,000 Metric Ton
WORLD	44,995	1,240	55,703	WORLD	46,499	1,344	62,483
Africa	14,626	712	11,141	Africa	15,051	597	8,986
N. America	7,120	2,816	20,046	N. America	6,342	3,022	19,167
S. America	1,900	2,166	4,117	S. America	3,152	3,001	9,460
Asia	20,457	914	18,696	Asia	20,891	1,109	23,164
Europe	184	3,573	658	Europe	163	3,287	535
Oceania	521	1,780	927	Oceania	700	1,416	991
U.S.S.R.	98	1,214	119	U.S.S.R.	200	900	180
<u>Leading b/ Countries</u>				<u>Leading b/ Countries</u>			
1.U.S.A.	5,086	2,903	14,712	1.U.S.A.	4,006	3,063	12,270
2.India	15,809	660	10,431	2.India	16,500	727	12,000
3.China	2,696	2,516	6,785	3.China	2,803	3,573	10,014
4.Mexico	1,579	3,048	4,812	4.Argentina	2,520	3,274	8,250
5.Nigeria	6,000	633	3,800	5.Mexico	1,895	3,358	6,367
6.Argentina	1,279	2,314	2,960	6.Nigeria	5,925	449	2,660
7.Sudan	3,000	733	2,200	7.Sudan	3,500	520	1,819
8.Ethiopia	1,014	1,619	1,642	8.Ethiopia	950	1,474	1,400
9.Australia	519	1,778	922	9.Australia	698	1,413	986
10.S.Africa	450	1,544	695	10.U.Volta	1,000	600	600
Total	37,428	1,308	48,959	Total	39,798	1,416	56,366
<u>Sudan</u>	3,000	733	2,200	<u>Sudan</u>	3,500	520	1,819
<u>Percent c/ of world</u>				<u>Percent c/ of world</u>			
10 Leading Countries	83.0	106.0	88.0	10 Leading Countries	86.0	105.0	90.0
Sudan	6.7	59.0	3.9	Sudan	7.5	38.7	2.9

Source: FAO PRODUCTION YEARBOOK. Volumes 35 and 37,  
Published in Rome, 1982 and 1984.

a/ HA= Hectare = 2.4710 acres = 2.38 feddans.

b/ Countries are ranked according to total production.

c/ Calculated by the marketing section, Department of Agricultural Economics.

TABLE 2: MILLETT (DURUM) AREA, YIELD AND PRODUCTION: WORLD, CONTINENTS, LEADING COUNTRIES AND SUDAN, 1980 AND 1983 .

1980				1983			
Continent/ Countries	Area 1,000 HA a/	Yield Kg/HA	Production 1,000 Metric Ton	Continents/ Countries	Area 1,000 HA	Yield Kg/HA	Production 1,000 Metric Ton
WORLD	43,261	645	27,887	WORLD	41,498	712	29,563
Africa	16,762	592	9,920	Africa	15,343	548	8,415
N. America	-	-	-	N. America	-	-	-
S. America	182	1,032	188	S. America	160	1,115	179
Asia	23,377	679	15,865	Asia	23,065	811	18,709
Europe	15	1,811	27	Europe	16	1,875	31
Oceania	19	770	14	Oceania	34	894	30
U.S.S.R.	2,907	644	1,873	U.S.S.R.	2,880	764	2,200
<u>Leading b/ Countries</u>				<u>Leading b/ Countries</u>			
1. India	18,158	514	9,337	1. India	17,500	600	10,500
2. China	3,874	1,406	5,448	2. China	4,102	1,707	7,004
3. Nigeria	5,030	622	3,130	3. Nigeria	4,070	565	2,300
4. U.S.S.R.	2,927	644	1,873	4. U.S.S.R.	2,880	764	2,200
5. Niger	3,072	444	1,364	5. Niger	3,135	423	1,325
6. Mali	1,400	536	750	6. Mali	1,420	449	638
7. Egypt	172	3,688	635	7. Egypt	155	4032	625
8. Chad	1,150	522	600	8. Uganda	360	1,667	600
9. Senegal	1,115	484	540	9. Korea Dpr	420	1,131	475
10. Uganda	279	1,645	459	10. Chad	1,150	391	450
Total	37,177	649	24,136	Total	35,192	742	26,117
Sudan	1,300	346	450	Sudan	1,100	285	314
<u>Percent c/ of world</u>				<u>Percent c/ of world</u>			
10 Leading Countries	86.0	101.0	87.0	10 Leading Countries	85.0	104.0	88.0
Sudan	3.5	53.6	1.6	Sudan	2.7	40.0	1.06

Source: FAO PRODUCTION YEARBOOK. Volumes 35 and 37,  
Published in Rome, 1982 and 1984.

a/ HA= Hectare = 2.4710 acres = 2.38 feddans.

b/ Countries are ranked according to total production.

c/ Calculated by the marketing section, Department of Agricultural Economics.

TABLE 3: WHEAT AREA, YIELD AND PRODUCTION: WORLD, CONTINENTS,  
LEADING COUNTRIES AND SUDAN, 1980 AND 1983 .

1980				1983			
Continent/ Countries	Area 1,000 HA a/	Yield Kg/HA	Production 1,000 Metric Ton	Continents/ Countries	Area 1,000 HA	Yield Kg/HA	Production 1,000 Metric Ton
<u>WORLD</u>	236,873	1,883	446,107	<u>WORLD</u>	230,034	2,166	498,182
Africa	8,077	1,104	8,919	Africa	7,817	1,148	8,974
N. America	40,614	2,136	86,742	N. America	39,616	2,440	96,662
S. America	9,205	1,305	12,012	S. America	9,815	1,581	15,517
Asia	79,952	1,622	129,689	Asia	82,276	2,078	170,931
Europe	26,181	3,797	99,402	Europe	26,890	3,795	102,037
Oceania	11,369	982	11,162	Oceania	12,765	1,728	22,061
U.S.S.R.	61,475	1,597	98,182	U.S.S.R.	50,856	1,612	82,000
<u>Leading b/ Countries</u>				<u>Leading b/ Countries</u>			
1.U.S.S.R.	61,475	1,597	98,182	1.U.S.S.R.	50,856	1,612	82,000
2.U.S.A.	28,727	2,249	64,619	2.China	28,801	2,826	81,392
3.China	29,231	1,889	55,213	3.U.S.A.	24,885	2,653	66,010
4.India	22,172	1,436	31,830	4.India	23,150	1,836	42,502
5.France	4,582	5,169	23,683	5.Canada	13,697	1,965	26,914
6.Canada	11,028	1,738	19,292	6.France	4,828	5,133	24,781
7.Turkey	8,915	1,857	16,554	7.Australia	12,690	1,716	21,780
8.Australia	11,283	962	10,856	8.Turkey	8,840	1,855	16,400
9.Pakistan	6,912	1,536	10,805	9.Pakistan	7,398	1,678	12,414
10.Italy	3,408	2,687	9,156	10.Argentina	6,832	1,713	11,700
<u>Total</u>	<u>187,803</u>	<u>1,811</u>	<u>340,190</u>	<u>Total</u>	<u>181,977</u>	<u>2,121</u>	<u>385,893</u>
<u>Sudan</u>	<u>240</u>	<u>963</u>	<u>231</u>	<u>Sudan</u>	<u>130</u>	<u>1,423</u>	<u>185</u>
<u>Percent c/ of world</u>				<u>Percent c/ of world</u>			
<u>10 Leading Countries</u>	<u>79.00</u>	<u>96.00</u>	<u>76.00</u>	<u>10 Leading Countries</u>	<u>79.00</u>	<u>97.00</u>	<u>77.00</u>
<u>Sudan</u>	<u>0.1</u>	<u>51.00</u>	<u>0.05</u>	<u>Sudan</u>	<u>0.06</u>	<u>66.00</u>	<u>0.04</u>

Source: FAO PRODUCTION YEARBOOK. Volumes 35 and 37,  
Published in Rome, 1982 and 1984.

a/ HA= Hectare = 2.4710 acres = 2.38 feddans.

b/ Countries are ranked according to total production.

c/ Calculated by the marketing section, Department of Agricultural Economics.

TABLE 6: SESAME AREA, YIELD AND PRODUCTION: WORLD, CONTINENTS, LEADING COUNTRIES AND SUDAN, 1980 AND 1983 .

1980				1983			
Continents/ Countries	Area 1,000 HA a/	Yield Kg/HA	Production 1,000 Metric Ton	Continents/ Countries	Area 1,000 HA	Yield Kg/HA	Production 1,000 Metric Ton
<u>WORLD</u>	6,275	281	1,762	<u>WORLD</u>	6,716	309	2,076
Africa	1,512	286	432	Africa	1,545	309	477
N. America	339	629	213	N. America	225	632	142
S. America	138	588	81	S. America	131	494	65
Asia	4,280	241	1,033	Asia	4,813	289	1,391
Europe	6	313	2	Europe	2	534	1
Oceania	-	-	-	Oceania	-	-	-
U.S.S.R.	1	130	-	U.S.S.R.	-	1,000	-
<u>Leading b/ Countries</u>				<u>Leading b/ Countries</u>			
1. India	2,443	179	437	1. India	2,600	227	590
2. China	777	335	260	2. China	962	363	350
3. Sudan	830	241	200	3. Burma	796	257	204
4. Mexico	282	622	176	4. Sudan	800	250	200
5. Burma	631	175	110	5. Mexico	160	620	99
6. Nigeria	235	311	73	6. Nigeria	240	313	75
7. Venezuela	95	600	57	7. Venezuela	108	473	51
8. Afghanistan	50	800	40	8. Korea Rep.	75	571	43
9. Ethiopia	63	571	36	9. Uganda	80	475	38
10. Thailand	37	734	27	10. Ethiopia	63	571	36
Total	5,443	260	1,416	Total	5,884	287	1,686
<u>Sudan</u>	830	241	200	<u>Sudan</u>	800	250	200
<u>Percent c/ of world</u>				<u>Percent c/ of world</u>			
10 Leading Countries	87.0	92.0	80.0	10 Leading Countries	88.0	92.0	81.0
Sudan	13.0	85.8	11.0	Sudan	12.0	81.0	9.6

Source: FAO PRODUCTION YEARBOOK. Volumes 35 and 37,  
Published in Rome, 1982 and 1984.

a/ HA= Hectare = 2.4710 acres = 2.38 feddans.

b/ Countries are ranked according to total production.

c/ Calculated by the marketing section, Department of Agricultural Economics.

TABLE 7: GROUNDNUTS AREA, YIELD AND PRODUCTION: WORLD, CONTINENTS, LEADING COUNTRIES AND SUDAN, 1980 AND 1983.

1980				1983			
Continent/ Countries	Area 1,000 HA a/	Yield Kg/HA	Production 1,000 Metric Ton	Continents/ Countries	Area 1,000 HA	Yield Kg/HA	Production 1,000 Metric Ton
<u>WORLD</u>	18,427	921	16,965	<u>WORLD</u>	18,965	1,044	19,792
Africa	6,248	702	4,388	Africa	6,232	658	4,099
N. America	732	1,662	1,217	N. America	597	2,331	1,625
S. America	680	1,292	879	S. America	404	1,482	598
Asia	10,715	972	10,410	Asia	11,574	1,159	13,410
Europe	11	2,203	24	Europe	11	2,062	23
Oceania	40	1,176	47	Oceania	46	756	35
U.S.S.R.	1	500	1	U.S.S.R.	1	2,000	2
<u>Leading b/ Countries</u>				<u>Leading b/ Countries</u>			
1. India	6,905	727	5,020	1. India	7,500	973	7,300
2. China	2,390	1,542	3,686	2. China	2,429	1,662	4,036
3. U.S.A.	566	1,844	1,044	3. U.S.A.	557	2,668	1,485
4. Sudan	960	844	810	4. Sudan	974	924	900
5. Indonesia	506	1,566	793	5. Indonesia	475	1,600	760
6. Nigeria	600	950	570	6. Burma	623	1,109	691
7. Senegal	1,057	463	489	7. Senegal	1,100	591	650
8. Brazil	313	1,543	483	8. Nigeria	600	750	450
9. S. Africa	280	1,342	375	9. Zaire	524	706	370
10. Burma	456	752	343	10. Brazil	212	1,359	288
<u>Total</u>	<u>14,033</u>	<u>970</u>	<u>13,613</u>	<u>Total</u>	<u>14,994</u>	<u>1,129</u>	<u>16,930</u>
<u>Sudan</u>	<u>960</u>	<u>844</u>	<u>810</u>	<u>Sudan</u>	<u>974</u>	<u>924</u>	<u>900</u>
<u>Percent c/ of world</u>				<u>Percent c/ of world</u>			
<u>10 Leading Countries</u>	<u>76.0</u>	<u>105.0</u>	<u>80.0</u>	<u>10 Leading Countries</u>	<u>79.0</u>	<u>109.0</u>	<u>86.0</u>
<u>Sudan</u>	<u>5.2</u>	<u>92.0</u>	<u>4.8</u>	<u>Sudan</u>	<u>5.0</u>	<u>89.0</u>	<u>4.5</u>

Source: FAO PRODUCTION YEARBOOK. Volumes 35 and 37,  
Published in Rome, 1982 and 1984.

a/ HA= Hectare = 2.4710 acres = 2.38 feddans.

b/ Countries are ranked according to total production.

c/ Calculated by the marketing section, Department of Agricultural Economics.

Some Selected Macroeconomic Indicators  
(1975/76 - 1985/86)

	<u>1975/76</u>	<u>1981/82</u>	<u>1985/86</u>	<u>Annual Growth Rates</u>	
				<u>(%)</u>	
				<u>1975/76</u> <u>1985/86</u>	<u>1981/82</u> <u>1985/86</u>
Real GDP (Lsd M) <sup>a/</sup>	5965.1	6721.0	6247.6	0.5	-1.8
Population (Million)	16.6	19.7	21.9	2.8	2.7
Real Per Cap. GDP (Lsd)	359.3	341.2	285.3	-2.3	-4.4
Resources Gap (US\$M)	-528.1	-1347.0	-636.0		
Current Acc. Deficit (US\$M)	-428.6	-1290.0	-842.0		
Consumer Price Index (1970=100) <sup>b/</sup>	221.4	643.5	2060.6	25.0	33.8
Arrears (US\$M)	n.a.	554.0 <sup>d/</sup>	2657.4 <sup>e/</sup>		
Exchange Rate (\$/Lsd)	2.87	1.12	0.37	-18.5	-24.2
Budg. Deficit (Lsd M) <sup>3</sup>	-73.3	-800.0	-2721.1		
<u>Memo Items (as % of GDP)</u>					
Resource Gap	-10.0	-17.8	-8.1		
Current Acc. Deficit <sup>c/</sup>	-8.0	-17.0	-10.7		
Overall Budget Deficit <sup>c/</sup>	-4.0	-11.9	-12.7		

<sup>a/</sup> Constant 1981/82 market prices.

<sup>b/</sup> Lower income class (calendar years)

<sup>c/</sup> Includes interest payments due, but not paid (accrual basis).

<sup>d/</sup> End of Calendar Year 1981.

<sup>e/</sup> As of June 30, 1986.

Source: Statistical Annex

The World Bank, 1987,

Proportion in absolute and relative terms of  
crop production in each subsector (1000 MT)  
for 1986/87

Product	Irrigated	Rainfed Mechanized	Rainfed Traditional	Total
Sorghum	459	2395	428	3282
(%)	(14)	(73)	(13)	(100)
Millet	5	11	269	285
(%)	(02)	(04)	(94)	(100)
Groundnut	197	0	174	371
(%)	(53)	(0)	(47)	(100)
Sesame	0	165	99	264
(%)	(0)	(63)	(37)	(100)
Wheat	157	0	0	157
(%)	(100)	(0)	(0)	(100)

SEED SUPPLY AND DEMAND IN SUDAN

Seed Supply (Sorghum, Millet, Sesame, G-Nuts) in MT

	Seed Supply (Sorghum, Millet, Sesame, G-Nuts) in MT						Total
	NSA* (PPA)	AG Schemes	Farmer's Own Supply	Seed Producers	Seed Importers	Farmer/ Seedsmen	
NSA (PPA)	Foundation Seeds	0	0	0	3/ 0	2/ 0	0
AG Schemes Irrigated	444	15,886	0	0	3/ 0	1/2/ 0	16,330
Mech. Agric. Companies	1/ -	1/ -	1/ -	1/ -	1/ -	1/ -	-
Farmers Traditional Rainfed	0	0	26,610	0	0	2/ 0	26,610
Mechanized Rainfed	107		34,016	0	0-500+ 0	2/ 0	34,623
Private Irrigated	4/ Vegetable Seed	4/ 0	4/ 0	Vegetable Seeds	Vegetable Seeds	2/ 0	
<b>TOTAL</b>	<b>551</b>	<b>15,886</b>	<b>60,626</b>	4/ ?	<b>500+</b>	<b>0</b>	<b>77,563</b>

- \* NSA seed supplies are calculated from 10 year supply records (1976-1987).  
 1/ Mechanized agric. companies included in mechanized rainfed.  
 2/ Farmer/Seedsmen is not seed supplier yet.  
 3/ Only basic seed supplies and occasional wheat from Egypt.  
 4/ No information available.

Table  
Seed Distributed by PPA Through Seed Stations in 1982-83

Crop	Station	Schemes	Farmers	*Own use	Grain
Wheat	Sennar	0.	135.4	270.6	45.40
	K. El Girba	0.	0.	0.	0.
	Hubeida	0.51	0.45	7.32	0.
	TOTAL	0.51	135.85	277.92	45.40
Sorghum	Sennar	281.30	98.60	412.30	33.50
	K. El Girba	65.0	0.	65.0	0.
	Hubeida	3.87	8.37	66.96	0.
	Tozi	0.	0.	0.	0.
	Khartoum	71.30	0.60	71.90	0.
	TOTAL	421.47	107.57	616.16	33.50
Maize	K. El Girba	0.	0.	2.40	0.
	Hubeida	0.	0.75	0.75	0.
	TOTAL	0.	0.75	3.15	0.
Groundnuts	Khartoum	18.	0.	18.	0.
Castor	K. El Girba	54.7	0.	54.7	0.
Sesame	Tozi	5.	11.	16.	0.
Kenaf	Sennar	15.	0.	15.	0.
Other	Sennar	0.	1.00	1.00	0.
	K. El Girba	0.	0.77	1.77	0.
	Hubeida	0.62	1.12	5.17	0.
	Khartoum	0.16	3.18	3.34	0.
	TOTAL	0.78	6.07	11.28	0.
TOTAL		515.46	261.24	1012.21	78.90

\*Own use includes shifting of seed from one station to another.

Source: Africa Asian Bureau

Table USAID assistance for the import  
of seeds in Sudan, 1985-87

Crop seed	Quantity	Value in US\$	Date of arrival
Sorghum	130 MT	175,472 <u>1/</u>	June 1985
Sorghum	6,600 lbs	26,400 <u>1/</u>	July 1985
Sorghum	200 MT	235,892 <u>1/</u>	July 1986
Sorghum	800 MT	1,124,000 <u>1/</u>	June 1986
Sunflower	215 MT	682,630 <u>1/</u>	July 1987
Wheat	7,500 MT	3,500,000 <u>2/</u>	October 1985

1/ CIP funded, total US\$ 2,244,394

2/ OFDA funded, total US\$ 3,500,000

Table Capacity of Seed Processing Plants in Sudan

1. NSA Facilities

Sennar M & W	-	13,500 MT
Tozi	-	7,200 "
Sim Sim	-	10,800 "
K. Girba	-	7,200 "
Hudeiba	-	7,200 "
Dongola	-	3,600 "
El Obeid	-	<u>3,600 "</u>
Subtotal		62,100 MT

2. Agricultural Production Scheme and Corporation Facilities

Gezira Board	-	14,400 MT
New Halfa	-	3,600 "
Mechanized Farm Corp.	-	<u>21,600 "</u>
Subtotal		39,600 MT
TOTAL		<u>101,700 MT</u>

## NSA/ PLANT PROPAGATION ADMINISTRATION

## Seed Processing Equipment

	Sennar M/W		Tozi		Sim Sim		K. Girba		Hudeiba		Dongola	El Obeid	Total
	Old	New	Old	New	Old	New	Old	New	Old	New	New	New	
<u>Seed Cleaners</u>													
4 screen	1	-	-	-	-	-	-	-	-	-	-	-	1
3 screen	1	2	1	1	1	2	1	1	1	1	1	1	14
2 screen	1	-	-	-	-	-	-	-	-	-	-	-	1
Elevator	5	2	2	1	2	2	2	1	-	1	2	2	22
Holding Bin	5	2	2	1	-	2	2	-	-	1	2	2	19
Seed treating	2	2	1	1	1	1	1	1	-	1	1	1	13
Platform scale	2	2	1	-	-	1	1	1	1	1	1	1	12
Bag closer	2	2	1	-	1	1	1	-	1	-	1	1	11
Platform truck	2	1	1	-	-	1	1	-	-	1	1	1	9
Conveyor	2	1	1	-	1	-	1	-	-	1	1	1	8
Trolleys	4	2	2	-	-	1	2	-	-	1	1	1	14
Compressor	1	-	1	-	1	-	1	-	1	-	1	1	7
Generator	1	-	1	-	-	1	-	1	-	1	1	1	7
Groundnut Separator	1	-	-	-	-	-	-	-	1	-	-	-	2
Disc Separator	1	-	-	-	-	-	-	-	1	-	-	-	2
Gravity Separator	1	-	-	-	-	-	-	1	-	-	1	1	4
Huller for Castor	-	-	-	-	-	-	-	1	-	-	-	-	1
Indent Cylinder	1	-	-	-	-	-	-	-	-	-	-	-	1

Equipment for Production Corporations

	Sudan Gezira Board	New Halfa Agri Corp.	Mechanized Farming Corp.	Total
<u>Processing Equipment:</u>				
Seed cleaner - 4-screen	-	-	2	2
" " - 3-screen	4	1	1	6
Seed treater	6	2	5	13
VB elevator	12	3	10	25
Holding bins	12	3	10	25
Indent cylinder (moveable)	2	1	-	2
Fulcrum bag trucks	8	2	10	20
Fulcrum trolleys	-	10	20	30
Bag closer	4	2	5	11
Compressor	4	2	4	10
Vacuum cleaner	4	1	-	5
Generator	2	-	4	6
Platform scale	4	2	5	11
Groundnut: decorticator	2	1	-	3
Groundnut: grader	2	1	-	3
Groundnut: elevator	6	2	-	8
Fumigation equipment	yes	-	-	
Bag triers, etc.	yes	-	-	
Germination equipment	-	-	yes	
Spares for groundnut processing plant	-	-	-	
Seed drill	-	-	5	5
Exhaust fans	8	-	-	8

Production of Sorghum and Groundnut Seeds by Agricultural Corporations (in Tons)

	New Halfa	Rahad	MFC	Gezira <u>1/</u>
Sorghum <u>2/</u>			60	324
1984/85				
Groundnut	19	240	-	-
Sorghum <u>2/</u>	93	21	80	774
1985/86				
Groundnuts	-	192	-	-

Source: NSA, Sennar (in Khalifa 1987).

1/ Hybrid Sorghum (HD-1)

2/ Sorghum produced by corporations other than Gezira includes small areas under hybrid sorghum (HD-1).

Areas Cultivated by Private Sector Seed Producers  
(Feddans)

Year	Hybrid Sorghum (HD-1) 1/	Pioneer 2/	Hybrid 2/ Sudan Grass	Abu 70 (Sorghum bicolor)	Vegetables 2/
1983	-	-	-	50	20
1984	-	-	5	200	25
1985	1350	-	40	300	25
1986	240	55	120	400	25

Sources: 1) Information provided by USAID, Khartoum  
2) Field Survey in Khalifa, 1987

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Seed Production by the Plant Propagation Administration 1978/79 - 1982/83.

Areas, production and yields by stations.

	78/79			79/80			80/81			81/82			82/83			average		
	feddan	tons	kg/f	feddan	tons	kg/f	feddan	tons	kg/f									
<b>Sennar II</b>																		
Wheat	250	71	284	211	55	262	150	28	187	228	61	270	224	144	524	223	72	322
Sorghum	165	78	472	208	68	324	230	0	0	129	58	446	325	222	684	211	85	403
Groundnut	130	52	402	235	125	532	200	39	197	60	20	209	78	3	35	142	48	337
Castor	5	2	332	0	-	-	0	-	-	0	-	-	0	-	-	1	0	332
Sesame	0	-	-	5	0	32	0	-	-	0	-	-	0	-	-	1	0	32
Others 1)	30	2	-	70	2	-	30	1	-	47	2	-	112	18	-	59	5	-
Total	580	205	-	729	240	-	610	68	-	472	141	-	709	287	-	637	210	-
<b>Sennar W</b>																		
Wheat	815	174	214	647	146	225	420	133	317	387	88	227	570	269	472	568	162	285
Sorghum	202	27	135	400	140	359	500	0	0	110	54	492	409	157	384	324	77	205
Groundnut	215	0	0	400	280	700	325	114	350	230	31	136	60	13	216	246	88	331
Menaf	510	16	31	510	51	100	180	8	46	120	7	62	10	1	64	266	17	64
Total	1740	217	-	1957	625	-	1425	255	-	847	160	-	1049	440	-	1404	344	-
<b>K. Girba</b>																		
Wheat	1185	172	145	987	426	432	700	294	420	520	334	643	740	446	737	826	354	429
Sorghum	0	-	-	0	-	-	15	5	333	94	46	507	150	26	440	52	24	459
Maize	0	-	-	0	-	-	0	-	-	5	3	600	8	0	25	3	1	346
Groundnut	15	1	33	505	23	45	405	24	59	230	73	315	280	19	139	287	32	111
Castor	445	24	53	272	59	217	525	158	301	370	38	103	295	57	193	381	67	176
Others 1)	0	0	-	0	0	-	36	3	-	18	2	-	35	3	-	18	2	-
Total	1645	197	-	1764	508	-	1681	405	-	1237	498	-	1508	511	-	1567	480	-
<b>Hudeiba</b>																		
Production on fields of station																		
Wheat	20	12	606	27	20	756	11	7	651	26	14	529	18	7	361	20	12	587
Sorghum	0	-	-	0	-	-	0	-	-	5	0	24	0	-	-	1	0	24
Maize	5	0	90	4	1	420	0	-	-	5	0	86	8	1	75	4	0	124
Groundnut	0	-	-	5	1	140	0	-	-	0	-	-	0	-	-	1	0	140
Others 1)	48	5	-	76	9	-	11	2	-	40	7	-	29	5	-	41	-	-
Station total	73	17	-	112	31	-	22	9	-	76	21	-	55	13	-	67	18	-
Production on fields of contractors																		
Wheat	0	-	-	0	-	-	294	21	-	147	21	-	348	66 <sup>3)</sup>	-	158	13 <sup>3)</sup>	-
Sorghum	0	-	-	0	-	-	240	21	-	750	21	-	0	-	-	198	21	-
Others 1)	0	-	-	1000	21	-	814	21	-	160	21	-	49	21	-	403	21	-
Contract. total	0	-	-	1000	21	-	1348	21	-	1057	21	-	388	66 <sup>3)</sup>	-	759	13 <sup>3)</sup>	-
Total	73	17	-	1112	31	-	1370	9	-	1133	21	-	463	79	-	826	30	-
<b>Sen Sem</b>																		
Sorghum	730	175	239	675	254	376	560	102	102	600	120	200	455	220	374	604	164	272
Sesame	124	11	101	300	76	220	183	22	112	250	7	72	60	1	40	179	22	122
Total	854	186	-	975	320	-	743	124	-	850	127	-	515	221	-	783	186	-
<b>Tozi</b>																		
Sorghum	1200	97	75	1300	319	245	1060	119	112	1200	634	362	800	0	0	1132	194	171
Sesame	420	51	112	660	48	73	700	16	23	550	60	72	300	0	0	526	32	61
Total	1720	152	-	1960	367	-	1760	135	-	1750	694	-	1100	0	-	1658	226	-

1) "Others" includes seeds other than wheat, sorghum, maize, groundnut, castor, sesame and kenaf.

2) no seed purchased by PPA

3) only seed purchased by PPA

Production of Certified Seed  
Produced by PPA 1982 - 1987

Crop/Season	1982/85	83/84	84/85	85/86	86/87
Sorghum	176	630	741	1624	1542
Sesame	42	44	47	39	66
Wheat	698	800	346	528	1120
Groundnut	84	48	315	174	850
Kenaf	1	2	2	9	8
Castor	57	41	56	50	42
Fodders	79	43	75	190	82
Beans	24	50	77	22	30
Vegetables	6	11	14	13	18
Others	26	12	37	41	26
TOTAL	1195	1681	1710	2620	5214

Source: PPA

Table Foreign financial assistance  
to seed programs in Sudan.  
(in millions US\$)

Source	Recipient	Loan	Grant	USAID Assistance	
				OFDA	CIP and PL480
FAO	NSA		16.0		
African Dev. Bank (Phase I)	NSA	18.6			
Gov. of Austria	NSA		1.0		
Gov. of Irak	NSA		1.0		
USAID- CIP					
Sorghum seed (1985-86)	NSA				.175 .026 .235 1.124
Sunflower seed (1987)	Private sector				.682
Wheat seed (1985)	NSA			3.500	.840
(1983-85)					.342
Total USAID					6.920
GENERAL TOTAL		18.6	18.0		6.92
					<u>43.52</u>

NSA Production Cost Per Feddan: Rainfed sorghum

	Units	No. of LS	Unit Cost LS	Cost
<u>Soil preparation and sowing</u>				
- Tractor	Tr. hrs.	0.5	16.161	8.081
- Sowing	Tr. hrs.	0.4	16.161	6.464
<u>Seed</u>	Kg	3	0.281	0.843
<u>1 Hand weeding</u>	Man hrs.	32	0.183 *	5.856
<u>2.3 Roguings</u>	Man hrs.	9.2	0.183 *	1.684
<u>Harvest</u>				
- Combing	Comb. hrs.	0.6	45.584	27.350
- Hand				
-- Picking	Man hrs.	110	0.183 *	20.130
-- Threshing	Man hrs.	66	0.183 *	12.078
<u>Transportation and processing</u>				
- Transportation	100 kg/2.5 km	2.29 (raw)	0.505 **	1.156
- Seed cleaning	100 kg	2.29	1.528 **	3.499
- Sacks	No.	2.29	1.500	3.435
Production cost of 206 kg clean seed (mechanically harvested)				58.368
Production cost of 100 kg clean seed (mechanically harvested)				28.334
Production cost of 100 kg clean seed (hand harvested)				30.692

\* Assumptions:

- Working days: 263 (without holidays) with 1,841 working hrs.			
- Salaries	LS p.a	Eff. working hrs. p.a.	LS p. eff. hr.
	336	1,841	0.182

\*\* 2.020 LS/t x km

Source: Management Consultancy Study (1983, p. 186).

NSA Production Cost Per Feddan: Irrigated Sorghum

	Units	No. of LS	Unit Cost LS	Cost
<u>Soil preparation (including preirrigation and sowing)</u>				
- Tractor	Ir. hrs.	3.2	16.161	51.715
- Sowing	Ir. hrs.	0.4	16.161	6.464
- Labor	Man hrs.	8.7	0.312 *	2.725
<u>Seed</u>	Kg	3.7	0.422	1.561
<u>7 Irrigations</u>	Man hrs.	14	0.312 *	4.368
<u>1.8 weedings</u>	Man hrs.	115.2	0.183 *	21.082
<u>2.3 roguings</u>	Man hrs.	9.2	0.183 *	1.684
<u>Harvest</u>				
- Mechanical				
-- Breaking	Ir. hrs.	0.25	16.161	4.040
-- Combing	Comb. hrs.	0.6	45.584	27.350
- Hand				
-- Picking	Man hrs.	110	0.183 *	20.130
-- Threshing	Man hrs.	66	0.183 *	12.078
<u>Transportation and processing</u>				
- Transportation	100 kg/2.5 km	3.51 (raw)	0.505 **	1.773
- Seed cleaning	100 kg	3.51	1.528	5.363
- Sacks	No.	3.51	1.500	5.265
Production cost of 316 kg clean seed (mechanically harvested)				133.390
Production cost of 100 kg clean seed (mechanically harvested)				42.212
Production cost of 100 kg clean seed (hand harvested)				42.471

\* Assumptions:

- Working days: 263 (without holidays) with 1,841 working hrs.			
- Salaries	LS p.a	Eff. working hrs. p.a.	LS p. eff. hr.
	451	1,447	0.312
	336	1,841	0.183

\*\* 2.020 LS/t x km

Source: Management Consultancy Study (1983, p. 185).

NSA Production Cost Per Feddan: Sesame

	Units	No. of LS	Unit Cost LS	Cost
<u>Soil preparation and sowing</u>				
- Tractor	Ir. hrs.	0.5	16.161	8.081
- Sowing	Ir. hrs.	0.4	16.161	6.464
<u>Seed</u>	Kg	1.3	0.536	0.697
<u>Hand weeding</u>	Man hrs.	32	0.183 *	5.856
<u>Harvest</u>				
- Cutting	Man hrs.	65.6	0.183 *	12.005
- Threshing	Man hrs.	32	0.183 *	6.002
<u>Transportation and processing</u>				
- Transportation	100 kg/2.5 km	0.76	0.505 **	0.384
- Sacks	No.	0.84	1.500	1.260
Production cost for 76 kg clean seed				40.749
Production cost for 100 kg clean seed				53.617

\* Assumptions:

- Working days: 263 (without holidays) with 1,841 working hrs.

- Salaries	LS p.a	Eff. working hrs. p.a.	LS p. eff. hr.
	336	1,841	0.183

\*\* 2.020 LS/t x km

Source: Management Consultancy Study (1983, p. 190).

Cost of Hybrid Sorghum (Certified) Seed Production on NSA Farms 1985 Season

	<u>Per Feddan</u>
Preparation for pre-watering	LS 6.00
Pre-irrigation	3.00
Heavy discing	15.00
Light discing	10.00
Levelling	8.00
Ridging	7.00
Opening of Abu 6	3.00
Planting	10.00
Cost of seed	10.00
Tagnets and Jdwals	5.00
Herbicides application	4.00
Cost of herbicides	40.00
Application of fertilizers	8.00
Cost of fertilizers	60.00
Weeding	20.00
Cleaning of Abu 6 and Abu 20	10.00
Roguing	20.00
Inspection	2.00
Bird scaring	25.00
Cutting of heads	35.00
Threshing	25.00
Cost of sacks	40.00
Transportation of sacks	5.00
Processing	5.00
Packaging including treatment	45.00
Testing	1.00
Supervision	55.00
Others	15.00
Irrigation/watching, etc.	10.00
TOTAL	<u>LS 510.00</u>
	=====

The expected yield is as follows:

5 sacks female parent per feddan  
1.5 sacks male parent per feddan

Source: Geo. Armstrong files.

Cost of Hybrid Sorghum (Certified) Seed

Production in the Gezira Scheme

<u>Item</u>	<u>Amount LS Per Feddan</u>
Land preparation	41.30
Sowing	8.00
Fertilizer	82.60
Sorgoprim	19.00
4 Irrigations	6.00
Supplemental Weeding	5.00
Cutting of heads	15.00
Rogueing	20.00
Cost of empty sacks	32.00
Harvesting	24.00
Water and Land Charges	32.50
Transport	10.00
Losses in processing	25.00
Seed dressing	8.00
Cloth bags (for packing)	80.00
Cost of processing	8.00
Storage	8.00
Farmer Efforts (labor)	40.00
Supervision fees	50.00
Unforeseen	53.00
	<u>600.00</u>
	=====

The expected yield is as follows:

Female parent	6 sacks per feddan
Male parent	2 sacks per feddan

Source: Geo. Armstrong files.



TAWAKUL CO.

The Operating Budget (Per Feddan Cost) Sorghum, 1985

Hageen Dura 1

Item	Cost/Feddan LS	
1. Land use and water charges	150	
2. Land preparation and sowing	100	
3. Organic manure	75	
4. Seed cost	15	
5. Fertilizer (nirogen)	55	
Fertilizer (phosphate)	35	
6. Field management and transport	100	
7. Permanent labor	50	<u>5 men months x LS 150</u> 5 feddans
8. Temporary labor weeding	60	Two weedings
9. Roguing	30	
10. Tools and equipments	10	
11. Crop protection	80	(4 kg furadan/feddan @ LS 20/kg)
12. Harvest bags and harvesting	50	
13. Transport and handling	25	
Subtotal	<u>835</u>	
14. Contingency 10%	83	
Cost production/feddan	<u>LS 918</u>	

Cost for 250 feddans = (250 x 918) =  
LS 229,500

Participants  
contribution (60 x 918) =  
LS 55,080

Required refinance = LS 174,420  
=====

Estimated yield HD-1 seed = 75 tons  
\* Cost/ton = LS 3006  
=====

-----  
\* This cost doesn't include technical and administrative office support for the duration of 6 months.

Source: Tawakul Company

## Estimated Cost of Production of Hybrid Sorghum Seed in Sudan

Cost Factor	LS/kilo	US\$/kilo	LS/sack
1. Unprocessed seed	0.55	0.14	49.50
2. Bonus to seed grower	0.55	0.14	49.50
3. Processing cost	0.10	0.03	9.00
4. Seed treatment	0.14	0.04	12.67
5. Cost of sack	0.12	0.03	10.80
6. Basic seed cost	0.32	0.08	28.80
7. Labor	0.20	0.05	18.00
8. General expenses	0.40	0.10	36.00
9. Interest on working capital	0.50	0.13	45.00
10. Royalty payment on sales	0.40	0.10	36.00
11. Warehousing 4 months aver	0.32	0.08	28.80
12. Cost (total)	3.60	0.90	324.07

## FARM BUDGET FOR THE PRODUCTION OF SORGHUM USING MECHANIZED TECHNOLOGY ON A PER FEDDAN BASIS

Item	Inputs and Outputs Other Than Labor (kg)	Labor			Cost or Price Per Unit (£S)	Cost or Revenue Per Feddan (£S)
		Family	Hired	Total		
		-----hours-----				
Seed	4.4				0.51/kg	2.24
Tools						0.85
Cooperative Service						20.00
Labor						
January						
February		1.1		1.1		
March		2.0		2.0		
April		2.0		2.0		
May		2.0		2.0		
June		1.2	2.9	4.1	0.75/hr.	2.18
July		1.9	0.7	2.6	0.75/hr.	0.52
August		2.0	5.5	7.5	0.75/hr.	4.12
September		6.6	7.6	14.2	0.75/hr.	5.70
October		2.1	8.8	10.9	0.75/hr.	6.60
November		12.7	23.2	35.9	0.75/hr.	17.40
December		1.0	7.7	8.7	0.75/hr.	5.78
Total Hired Labor						42.30
Sacks--0.4					2.50/sack	1.00
Transportation	270.6				0.03/kg.	8.12
Total Costs						74.51
Production						
Quantity, Consumed						
Quantity, Sold	97.3				1.667/kg	64.90
Quantity, Stored	173.3					113.79
Total Production	270.6					178.69
Net Cash Income						(9.61)
Net Income						104.18

SOURCE: Experience, Incorporated compilations of data

FARM BUDGET FOR THE PRODUCTION OF SESAME USING MECHANIZED TECHNOLOGY ON A PER FEDDAN BASIS

Item	Inputs and Outputs Other Than Labor	Labor			Cost or Price Per Unit	Cost or Revenue Per Feddan
		Family	Hired	Total		
	(kg)	-----hours-----			(£S)	(£S)
Seed	6.1				1.20/kg	8.45
Tools						1.13
Cooperative Service						15.00
Labor						
January						
February		1.1		1.1		
March		2.0		2.0		
April		2.0		2.0		
May		2.0		2.0		
June		0.9	15.6	16.5	0.75/hr.	11.70
July		2.8	3.1	5.9	0.75/hr.	2.32
August		7.4	7.0	14.4	0.75/hr.	5.25
September		7.3	14.9	22.2	0.75/hr.	11.18
October		13.9	25.4	39.3	0.75/hr.	19.05
November		6.7	4.0	10.7	0.75/hr.	3.00
December						
Total Hired Labor						52.50
Sacks--0.53					2.50/sack	1.32
Transportation	95.4				0.03/kg.	2.86
Total Costs						81.26
Production						
Quantity, Consumed	0.0					
Quantity, Sold	90.0				1.495/kg	134.55
Quantity, Delivered Sheil	4.0				0.556/kg	2.22
Quantity, Stored	1.4				1.495/kg	2.09
Total Production	95.4					138.86
Net Cash Income						55.51
Net Income						57.60

SOURCE: Experience, Incorporated compilations of data

(1) Table Budgets of Traditional Sector Crops  
Southern Darfur Survey 1985

Item	Unit	Sorghum	Sesame	Groundnuts	Millet
<u>I. Revenue</u>					
Output	Sack/FD	3.74	2.61	4.15	3.59
Price	LS/Sack	98.29	92.33	53.95	133.00
Value of main products	LS/FD	367.60	240.98	223.06	477.47
Value of by products	LS/FD	1.66	-	0.52	1.43
Gross Revenue	LS/FD	369.26	240.98	223.15	478.90
<u>II. Cost</u>					
1. Labor	LS/FD	116.91	186.55	153.31	157.81
2. Equipment	LS/FD	3.34	3.34	3.34	3.34
3. Materials					
Bags + String	LS/FD	5.70	4.37	10.03	5.44
Fungicides	LS/FD	0.04	0.34	-	-
Seeds	LS/FD	3.86	2.81	5.76	0.59
4. Transport	LS/FD	7.26	4.96	9.03	6.29
5. Huts of Labor	LS/FD	1.97	-	-	0.16
Total costs	LS/FD	139.18	202.37	181.47	173.63
<u>III. Net revenue</u>					
(I - II)	LS/FD	230.08	38.61	42.11 a	305.27
Seeds & of total cost		2.77	1.39	3.17	0.34

a Survey did not cover important areas of groundnuts in South Darfur. Figure appears to be very low.

(2) Table Budgets of Traditional Sector Crops  
Northern Kordofan Survey 1985

Item	Unit	Sorghum	Sesame	Groundnuts	Millet
<u>I. Revenue</u>					
Output	Sack/FD	2.40	62.10	6.87	2.15
Price	LS/Sack	90.78	142.69	43.00	140.93
Value of main products	LS/FD	217.87	299.65	295.41	303.00
Value of By Products	LS/FD	24.78	1.18	8.61	11.52
Gross revenue	LS/FD	242.65	300.83	304.02	314.52
<u>II. Costs</u>					
1. Labor	LS/FD	57.72	49.37	55.05	38.83
2. Equipment	LS/FD	1.50	1.50	1.50	1.50
3. Materials					
Bags + String	LS/FD	6.84	1.74	5.54	1.78
Fungicides	LS/FD	0.01	0.01	0.01	0.01
Seeds	LS/FD	3.23	5.82	2.59	2.10
4. Transport	LS/FD	6.07	4.58	17.18	4.92
5. Huts of Labor	LS/FD	0.63	3.84	2.69	2.32
Total costs	LS/FD	76.00	66.95	84.70	51.53
<u>III. Net revenue</u>					
(I - II)	LS/FD	166.65	233.88	219.32	262.99
Seeds % of Total cost		4.25	8.69	3.05	4.07

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(3) Table Budgets of Traditional Sector Crops  
Survey Southern Kordofan 1985

Item	Unit	Sorghum	Sesame
<u>I. Revenue</u>			
Output	Sack/FD	2.84	3.09
Price	LS/Sack	50.70	71.67
Value of main product	LS/FD	143.99	221.46
Value of by Products	LS/FD	0.18	0.49
Gross Revenue	LS/FD	144.17	221.95
<u>II. Costs</u>			
1. Labor	LS/FD	84.40	105.87
2. Equipment	LS/FD	4.57	4.57
3. Materials			
Bags + String	LS/FD	4.29	4.50
Fungicides	LS/FD	0.01	-
Seeds	LS/FD	1.14	1.21
4. Transport	LS/FD	5.37	7.13
5. Huts of Labor	LS/FD	1.88	0.10
Total Costs	LS/FD	102.66	123.38
<u>Net revenue</u>			
(I - II)	LS/FD	42.51	98.57
Seeds % of total cost		1.11	0.98

Table Sample Farmers' Price Expectations: Survey Result of Traditional Farming Areas, Sudan, 1985

Location/Crop	1985/86 Price Expectations		Price Uncertainty (%) <sup>a</sup>	
	Expected Price (P)	Maximum (P max)	Minimum Price (P min)	
(LS/Sack) <sup>b</sup>				
<u>Northern Kordofan</u>				
Sorghum	90.78	119.53	74.53	24.70
Sesame	142.69	168.49	120.66	16.7
Groundnuts	43.00	55.17	32.00	26.9
Millet	140.93	165.25	111.08	19.2
<u>Southern Kordofan</u>				
Sorghum	50.70	75.0	37.91	36.0
Sesame	71.67	92.78	58.89	23.6
Groundnuts	43.00	49.67	28.67	24.4 <sup>c</sup>
Millet	-	-	-	-
<u>Southern Darfur</u>				
Sorghum	98.29	125.28	78.26	23.9
Sesame	92.33	117.33	72.33	24.3
Groundnuts	53.75	63.33	43.75	18.2
Millet	133.00	153.66	112.72	15.3

Notes: a. Measured by the range of expected maximum and minimum price as a % of the expected price  

$$(P \text{ max} - P \text{ min}) / 2$$

Yield uncertainty = \_\_\_\_\_ x 100

b. Sack weights: Sorghum = 91.50 Kgs.  
 Sesame = 73.725 Kgs.  
 G. Nuts = 45. Kgs.  
 Millet = 94.35 Kgs.

c. Based only on 5 observations

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Table Sample Farmers' Yield Expectations; Survey Result of Traditional Farming Areas, Sudan, 1985

Location/Crop	1985/86 Yield Expectations		Yield Uncertainty (%) <sup>a</sup>		
	Normal Yield	Expected (Y)	Maximum (Y max)	Minimum Y min)	
Kgs/Feddan)					
<u>Northern Kordofan</u>					
Sorghum	220	209	318	123	46.7
Sesame	155	203	285	121	40.3
Groundnuts	309	485	657	320	34.8
Millet	203	309	458	196	42.3
<u>Southern Kordofan</u>					
Sorghum	260	421	494	298	23.2
Sesame	228	282	352	184	29.7
Groundnuts	238	450	734	300	48.2 <sup>b</sup>
Millet	-	-	-	-	-
<u>Southern Darfur</u>					
Sorghum	342	438	582	266	36.0
Sesame	192	211	242	121	28.7
Groundnuts	187	289	482	272	36.3
Millet	339	410	520	265	31.0

Notes: a. Measured by the range of expected maximum and minimum yields as a % of the expected yield

$$(Y \text{ max} - Y \text{ min}) / 2$$

$$\text{Yield uncertainty} = \frac{\quad}{\quad} \times 100$$

Y

b. Based only on 5 observations

Table Crop area and seed expenditure per farm: 1985

Location	Farm Total	Average crop areas per farm (feddans)				
		Sorghum	Sesame	G'nuts	Millet	Cotton
Northern Kordofan	37.19	6.14	12.19	3.77	15.09	-
Southern Kordofan	18.40	13.54	2.05	0.60	0.21	2.00
Darfur	12.60	7.28	0.77	0.72	3.83	-
All sample average	22.73	8.99	5.00	1.70	6.38	0.67

Location	Farm Total	Average seed expenditure per farm (LS)				
		Sorghum	Sesame	G'nuts	Millet	Cotton
Northern Kordofan	137.56	19.83	70.94	15.10	31.69	-
Southern Kordofan	111.01	72.71	38.30	-	-	-
Darfur	56.14	28.10	21.64	4.14	2.26	-

Note: Data extracted and calculated from M.M. Elhanan et al. Pattern and Economics of Crop Production in selected rainfed traditional areas. Survey 1985. Department of Agriculture, Economics and Statistics, Ministry of Agriculture and Natural Resources, Khartoum.

Table Seeding rates and seeding costs for traditional sector farms 1/

Production area	Seeding rates and costs	Crop			
		Sorghum	Sesame	G'nuts	Millet
Northern Kordofan	Seeding rate kg/FD	3.25	3.00	2.60	1.40
	Cost seed/FD	3.23	5.82	2.59	2.10
Southern Kordofan	Seeding rate kg/FD	2.05	1.24	-	-
	Cost seed/FD	5.37	7.13	-	-
Darfur	Seeding rate Kg/FD	3.60	2.35	4.60	0.418
	Cost seed/FD	3.86	2.81	5.76	0.59

1/ Data calculated and extracted from Survey Results 1985. Department of Agriculture Economics and Statistics Report Patterns and Economics of Crop Production in selected rainfed traditional areas, by M.H. Elhanana et al.

LAND AND WATER CHARGES (1982/83)

(LS per Feddan)

	Gezira		Rahad		New Halfa	
	Actual	Full Cost	Actual	Full Cost	Actual	Full Cost
Cotton	29	47	36	61	36	55
Groundnuts	18	29	30	51	30	46
Sorghum	7	12	12	21	12	18
Wheat	14	23	-	-	24	37

Source: The World Bank, 1985, p.13.

TABLE 6.4  
SUDAN: CREDIT OUTSTANDING TO PUBLIC ENTITIES, 1975/76-1985/86  
(MILLIONS OF SUDANESE POUNDS AS OF JUNE 30)

ITEM		1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
AGRICULTURAL ENTITIES	65	119.8	140.4	136.6	184.5	215.2	315.3	495.5	770.5	779.5	559.9	1,113.4
SUDAN GEZIRA BOARD	9	54.5	50.9	41.2	57.1	53.1	105.9	124.6	165.8	203.5	193.5	287.9
AGRICULTURAL REFORM CORP.	56	33.5	18.5	7.2	7.1	7.1	7.1	7.2	7.2	7.2	-	-
EL SUKI SCHEME	57	9.1	5.5	5.5	5.5	5.3	10.7	18.2	25.3	23.3	15.1	21.6
MECHANIZED FARMING CORP.	10	0.7	1.0	1.0	1.3	2.6	3.6	4.5	8.3	8.3	-	-
ANIMAL PRODUCTION CORP.	11	0.7	0.8	-	-	-	-	-	-	-	-	-
PUBLIC CORP. FOR IRRIG. & EARTH MOVING	14	2.2	2.9	2.5	2.5	2.4	3.0	3.0	3.0	3.0	-	-
OTHER AGRICULTURE	53	-	-	-	-	-	55.3	131.0	199.8	252.5	205.7	300.2
COTTON PUBLIC CORP.	124	-	-	-	-	-	-	75.0	227.3	146.4	145.6	503.7
INDUSTRIAL ENTITIES	88	7.3	7.0	13.5	21.9	28.8	46.6	72.9	97.9	159.4	29.6	32.3
SUGAR AND DISTILLING CORP.	13	7.3	7.0	13.2	21.3	28.2	46.1	72.4	97.3	159.1	29.6	32.3
FOOD INDUSTRIES CORPORATION	15	-	-	0.3	0.3	0.4	0.4	0.4	0.4	0.3	-	-
OTHER	12	-	-	-	-	-	0.1	0.1	0.2	-	-	-
PUBLIC UTILITIES	59	27.2	20.6	22.3	39.0	44.4	48.9	48.9	55.4	56.0	50.5	42.7
SUDAN RAILWAYS	5	19.0	20.6	22.3	37.1	42.0	44.9	44.9	44.8	36.9	19.3	19.2
PEWC	7	8.2	-	-	0.5	1.0	2.6	2.6	9.2	9.1	31.2	23.5
SUDAN AIRWAYS	17	-	-	-	1.4	1.4	1.4	1.4	1.4	-	-	-
OTHER	70	-	-	-	0.3	0.2	9.1	7.0	4.0	20.0	-	-
EXHIB. AND FAIRS CORP.	18	-	-	-	0.1	0.1	0.1	-	-	-	-	-
SUGAR TRADING CORP.	91	-	-	-	0.2	0.1	9.1	7.0	4.0	20.0	-	-
TOTAL 1/	71	154.3	168.0	172.4	245.7	288.4	419.9	624.3	927.8	1,025.0	640.0	1,188.5

SOURCE: BANK OF SUDAN AND IMF.

1/ FOR 1984/85, LS 527.8 MILLION OF DEBT OUTSTANDING FROM PUBLIC ENTITIES HAS BEEN ASSUMED BY THE CENTRAL GOVERNMENT AS LONG TERM LOANS.

TABLE SUD/6A/4

The World Bank, 1987

Cost and Revenue of HD-1 and Traditional Sorghum  
in Gezira in 1986/87

(Yield: 10 sacks HD-1/Fed., 5 sacks Trad. Sorghum/Fed.)

	HD-1		Traditional Sorghum	
	Per Feddan	Per Sack	Per Feddan	Per Sack
Land preparation	15.0	1.50	7.5	1.50
Seeds	9.0	0.90	1.5	0.30
Sowing	5.0	0.50	5.0	1.00
Fertilizer	44.0	4.40	0.0	0.00
Weeding	30.0	3.00	30.0	6.00
Watering	35.0	3.50	35.0	7.00
Harvesting	30.0	3.00	15.0	3.00
Sacks	30.0	3.00	15.0	3.00
Other expenses	<u>50.0</u>	<u>5.00</u>	<u>20.0</u>	<u>4.00</u>
TOTAL COSTS	248.0	24.80	129.0	25.80
Revenue (grain sales)	250.0	25.00	175.0	35.00

Source: Information provided by extension staff, Sudan  
Gezira Board, Khalifa (1987, p.74).

Table III.33

**Simulated Effects of Exchange Rate Policies  
1985/86 on Crops 1**

<u>Changes Compared to Previous Year</u>					
	<u>Price Change<sup>1</sup></u> (% Increase)	<u>Production</u> (Increase in tons)	<u>Exports</u> (US\$M)	<u>Imported</u> <u>Inputs</u> (US\$M)	<u>Government</u> <u>Revenues</u> (US\$M)
<b>Irrigated Subsector</b>					
Cotton MS	-26	-25788			
Cotton ELS	-28	-22876	-47.0	-8.0	-16.0 <sup>2</sup>
Groundnuts	-16	-87192			
Wheat	-15	48810	n.a	n.a	n.a
Sorghum	-20	-19951	n.a	n.a	n.a
<b>Mechanized Subsector</b>					
Sorghum	-18	-6600	-1.1	-6.9	-8.8
Sesame	-11	-4208			
<b>Traditional Subsector</b>					
Sorghum	-7	-12596			
Groundnuts	-16	-81471	-28.0	-	-5.0
Gum arabic	-87	-6468			
Sesame	-11	758			
Millet	-18	-17781	n.a.	n.a.	n.a.
<b>Total Effect</b>			<u>76.1</u>	<u>-8.9</u>	<u>-15.8<sup>2</sup></u>

<sup>1/</sup> Price changes deflated with urban cost of living index.

<sup>2/</sup> This excludes the increase in losses incurred by the cotton marketing agency, amounts which are much more substantial than the losses in tax revenue.

SOURCE: The World Bank, 1987

Simulated Effects of Devaluation to a Unified Rate of Lsd 4.6/3  
on 1987/88 Crops from 1986/88 Base

	Changes Compared to Previous Year				
	Price Change (% Increase)	Production (Increase in tons)	Exports (US\$M)	Imported Inputs (US\$M)	Government Revenues (US\$M)
<b>Irrigated Subsector</b>					
Cotton MS	10 <sup>1</sup>	2200			
Cotton ELS	17 <sup>1</sup>	10000	48.0	1.0	14.0 <sup>2</sup>
Groundnuts	56	00000			
Wheat	-5 <sup>1</sup>	-10000	n.a.	n.a.	n.a.
Sorghum	52	00000	n.a.	n.a.	n.a.
<b>Mechanized Subsector</b>					
Sorghum	52	20000	4.5	0.8	1.2
Sesame	05	20000			
<b>Traditional Subsector</b>					
Sorghum	50	-10000			
Groundnuts	55	20000	46.0		12.0
Cow arable	50	10000			
Sesame	05	0000			
Millet	30	-2400	n.a.	n.a.	n.a.
<b>Total effect</b>			<u>95.5</u>	<u>2.6</u>	<u>27.2<sup>2</sup></u>

1/ Officially posted prices.

2/ Excludes the decrease in losses incurred by the cotton marketing agency.

SOURCE: The World Bank, 1987

Table 6. Comparison of price of sorghum varieties in Gedaref market  
(1985/86) with US sorghum prices at Gulf port.

Year/Month	Variety						All Sudan	Sorghum US No
	Feterita	Mugud	Safra	Deber	Aker	All		
1985				LS/sack			US\$ equiv.	US\$Gulf port
				LS			per MT	per MT
July	108.90	115.20	115.63	119.30	69.17	112.72	450.88	99.00
August	93.00	84.50	83.14	90.00	70.53	87.49	349.92	89.00
September	75.43	62.44	62.53	74.30	NA (1)	69.66	278.64	83.00
October	58.48	48.73	54.01	70.78	45.00	56.70	226.80	88.00
November	33.60	52.70	48.53	48.38	30.38	41.50	166.00	96.00
December	30.30	31.42	33.13	36.55	25.22	32.41	129.64	100.00
1986								
January	33.00	31.35	32.50	37.70	28.35	33.50	134.00	99.00
February	33.42	28.98	31.71	39.00	27.00	32.20	132.80	95.00
March	32.11	27.35	29.96	35.09	26.24	31.31	125.24	94.00
April	33.99	28.64	30.70	34.53	26.59	32.27	129.08	99.00
May	30.78	26.59	24.93	32.09	23.51	28.59	114.36	106.00
June	30.05	25.27	25.89	30.89	24.77	28.00	112.00	86.00

Source: Marketing Section Dept. of Agr. Economics, Ministry  
of Agriculture. From Agricultural Situation and Outlook,  
Annual Report 1985/86, Khartoum.

(1) NA=Not Available. However, during this month a price of LS 19/sack  
for American relief sorghum (believed similar to Aker var.)  
was quoted.

Table 12 - Estimated demand for seeds for major field crops in Sudan

Crop and Cropping System	Area planted (x 1000 fed)	High tech area-%	Seed demand MT	Low tech area-%	Seed demand MT	Total seed demand- MT
<b>1. Sorghum</b>						
Irrigated	1000	55	1750	65	2600	4415
Rainfed mechanized	8500	35	11900	65	19337.5	31302.5
Rainfed traditional	3200	10	1280	90	8640	10010
<b>Total Sorghum</b>	<b>12700</b>		<b>14930</b>		<b>30577.5</b>	<b>45507.5</b>
<b>2. Groundnut</b>						
Irrigated	280	50	6300	50	5600	11900
Rainfed traditional	1500	10	5250	90	4500	9750
<b>Total Groundnut</b>	<b>1770</b>		<b>11550</b>		<b>10100</b>	<b>21650</b>
<b>3. Wheat</b>						
Irrigated	300	0	0			15000
<b>Total Wheat</b>	<b>300</b>					
<b>4. Millet</b>						
Irrigated	15	100	15	0	0	15
Rainfed mechanized	70	20	14	80	56	70
Traditional rainfed	3600	0	0	100	360	3600
<b>Total Millet</b>	<b>3685</b>					<b>3685</b>
<b>5. Sesame</b>						
Rainfed mechanized	1300			100		3250
Rainfed traditional	1300			100		3250
<b>Total Sesame</b>	<b>2600</b>					<b>6500</b>
<b>6. Sunflower</b>						
Irrigated	50	100				80
Rainfed mechanized	300	100				480
Traditional	0					
<b>Total Sunflower</b>	<b>350</b>					<b>560</b>

Note: Estimated to year 1990, seeding rates based on best available estimators.

Source: Estimate by ICD.

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Average Seeding Rates for Crops in Sudan

<u>Crop</u>	<u>Average seeding rate (kg/feddan)</u>
1. Cereals	
Sorghum-rainfed	3.6
Sorghum-irrigated	5.4
Millets	3.5
Maize (grain)	10 - 15
Wheat	40 - 50
Barley	30
Rice (paddy)	35
Elusine	3
2. Oil seeds	
Cotton seed	13
Groundnuts (shell)	30 - 45
Sesame	2.5
Castor	6.5
3. Pulses	
Fasulia	35
Ful Masri	35
Chick peas	25
4. Vegetables	
Onion	4.50
Potatoes	600.00
Tomatoes	0.30
Eggplant	.50
Okra	8.00
Squash	3.00
Melon	1.00
Watermelon	1.50

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Source: 1,2,3 estimates by ICD  
4 Khalifa (1987)

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COMPONENTS OF A NATIONAL SEED SYSTEM

1. ADMINISTRATION COMPONENT
2. LEGAL COMPONENT
3. OPERATIONAL COMPONENT

PUBLIC SECTOR:

2. Legal Component

Seed Law and Regulations

3. Operational Component

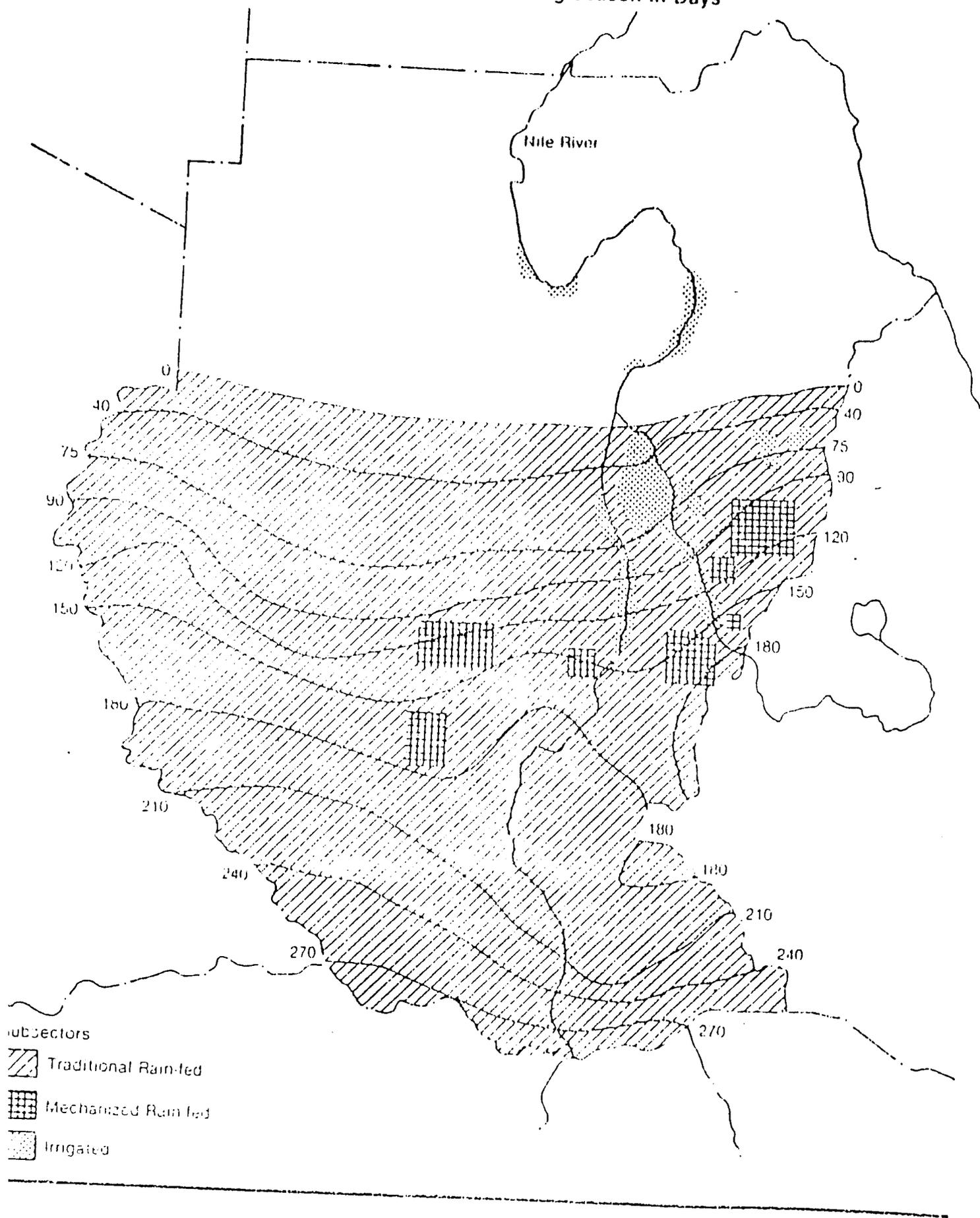
Research on Variety Development	Variety Testing	Variety Registration	Basic Seed production	Commercial Seed production (Certified & non-cert)	Seed Cert- itifi- cation	Seed Proc- essing	Quality Cont- rol	Storage	Distribution	Market Assessment	Plan- ning	Budget Alloc- ation	Exten- sion		
Research on variety development & Introduction	Variety testing		Basic Seed	Commercial Seed Production (Certified & non Cert.)		Seed Proc- essing	Quality Control	Storage	Distribution	Market- ting	Inve- stm- ent of profits & Feedback information	Market Analy- sis	Plan- ning	Finan- cing	Exten- sion

3. Operational Components:

PRIVATE SECTOR

1. Administration Component
  - a) Seed company management
  - b) National Seed Industry Association
2. Legal Component
  - Seed Law and Regulations
  - Investment Promotion Act
  - Commerce and Finance Relative Decree-and regulations
  - Industrial Law and regulations
  - Import, Export, Foreign Exchange regulations
  - Credit and Agricultural Credit regulations
  - Cooperatives Law and regulations
  - Agricultural Laws and regulations

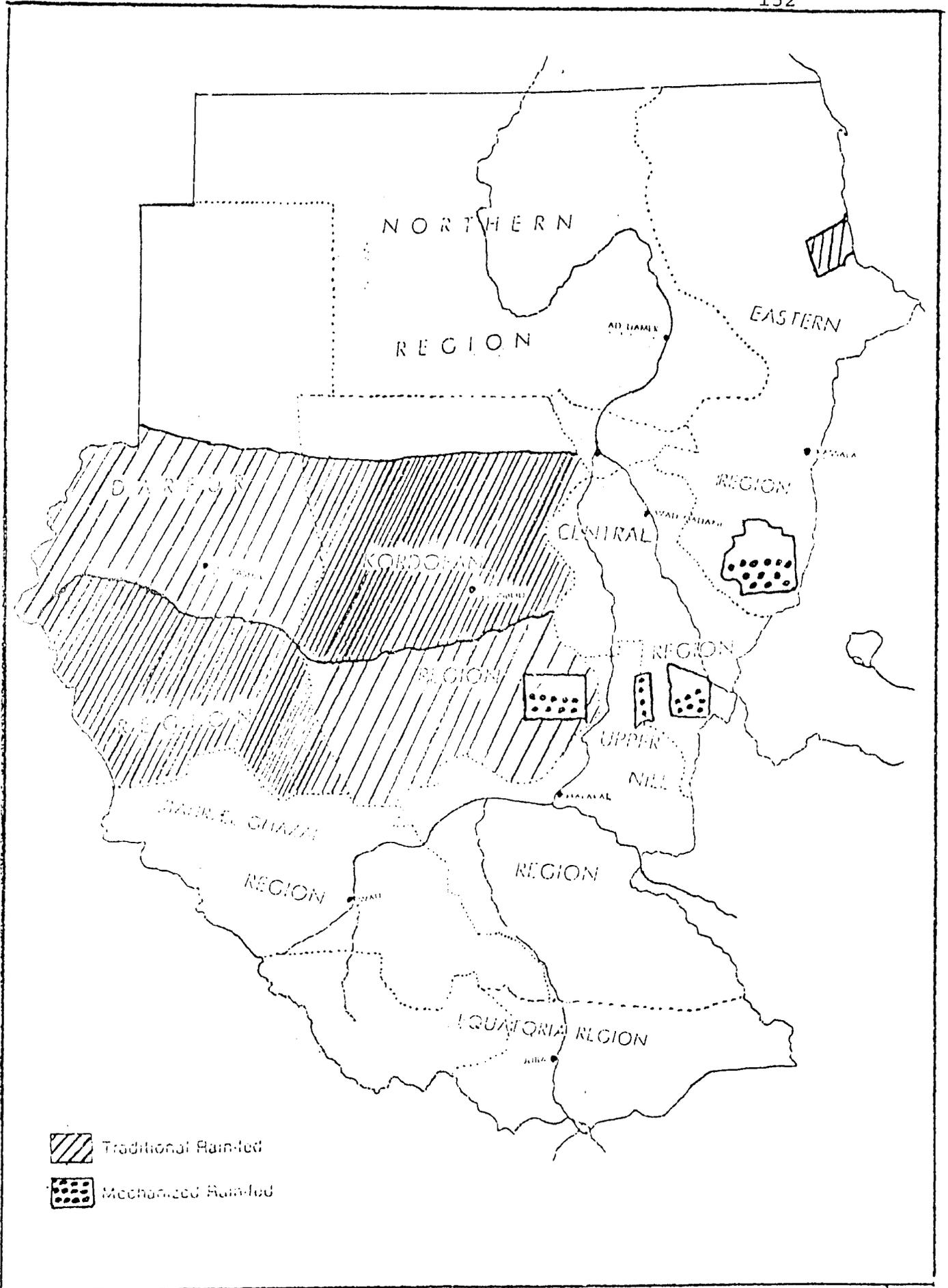
Sudan: Location of Subsectors and Length of Growing Season in Days



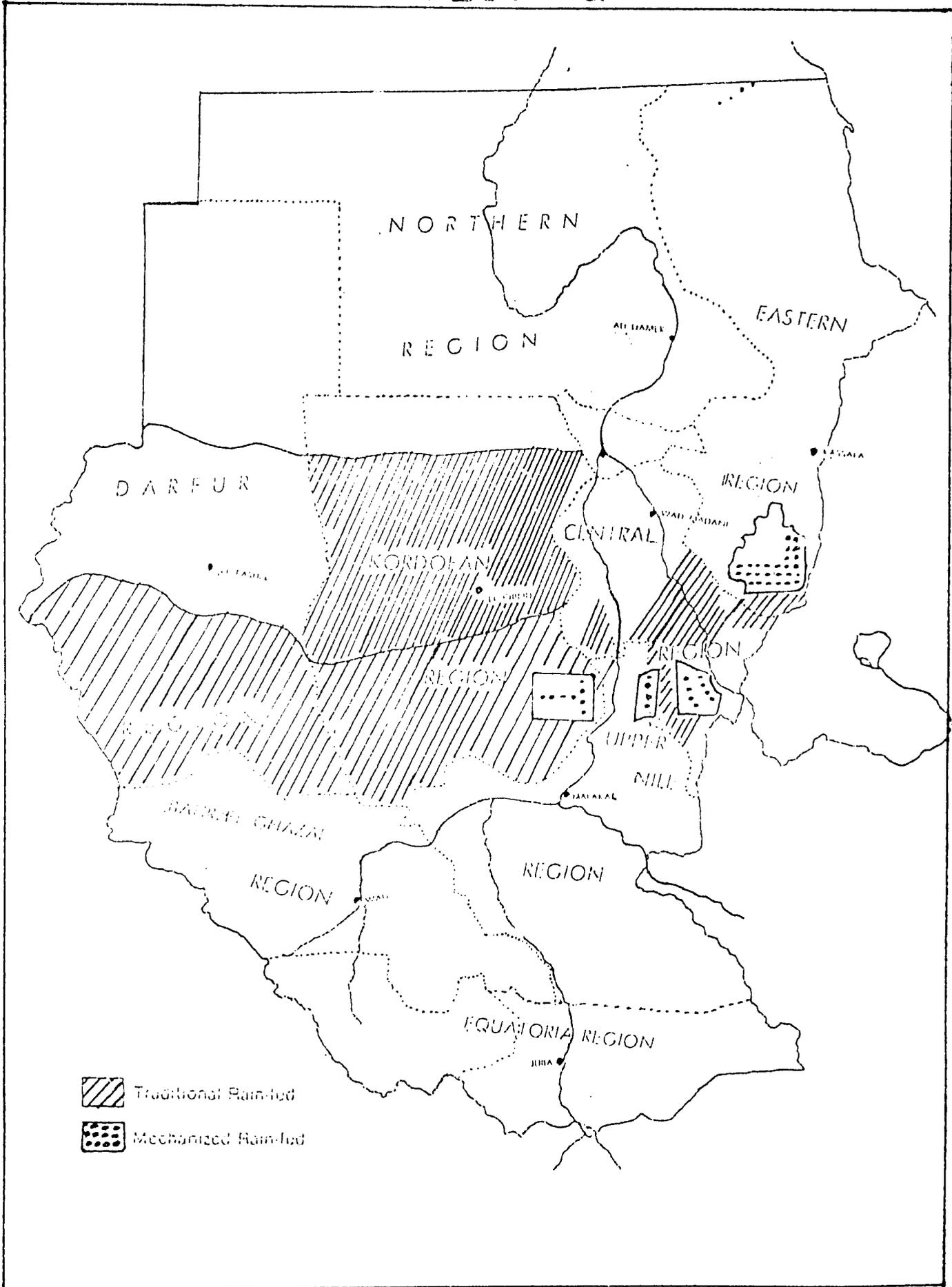


# MILLET

Figure III.3  
152



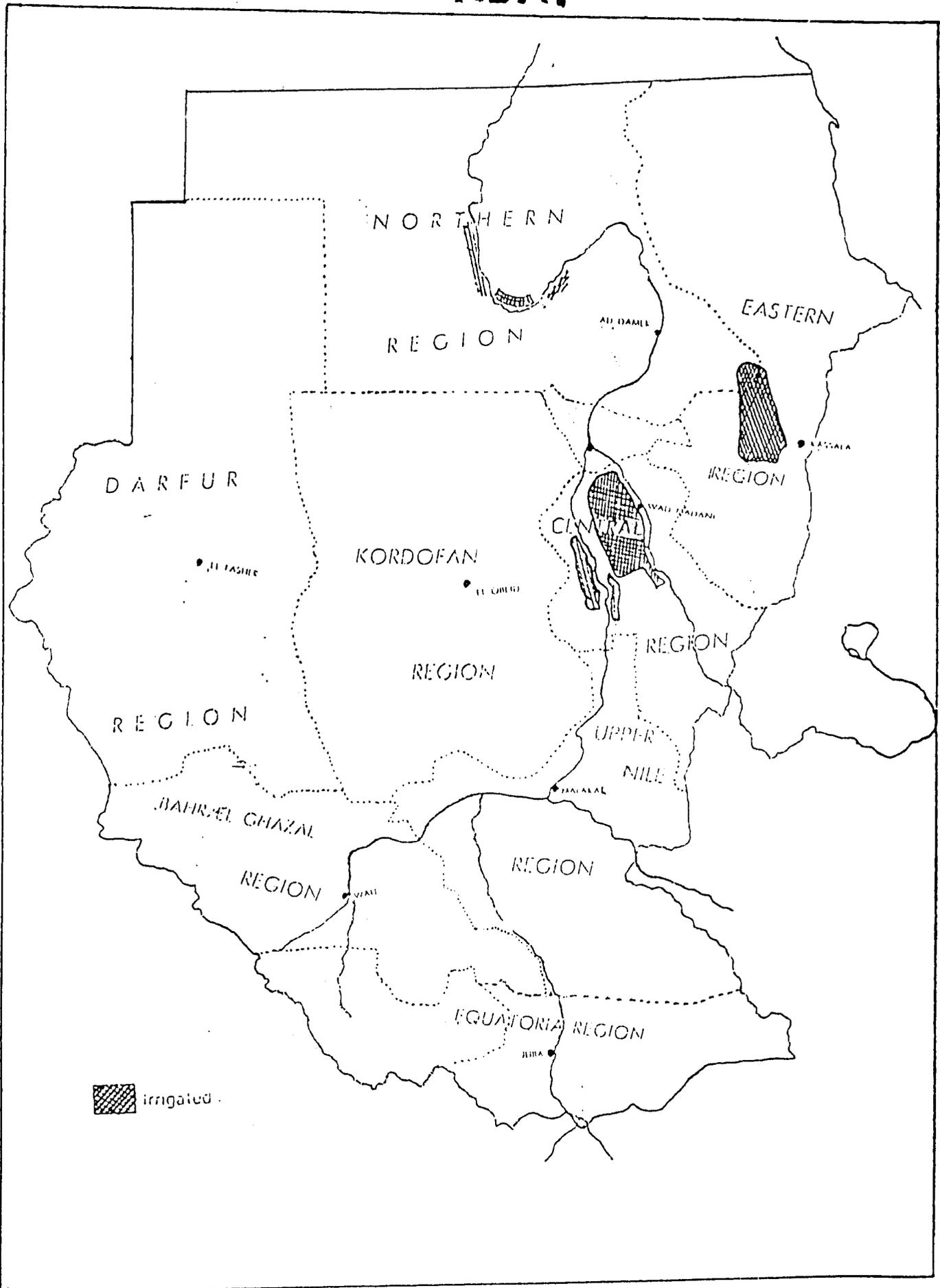
# SESAME



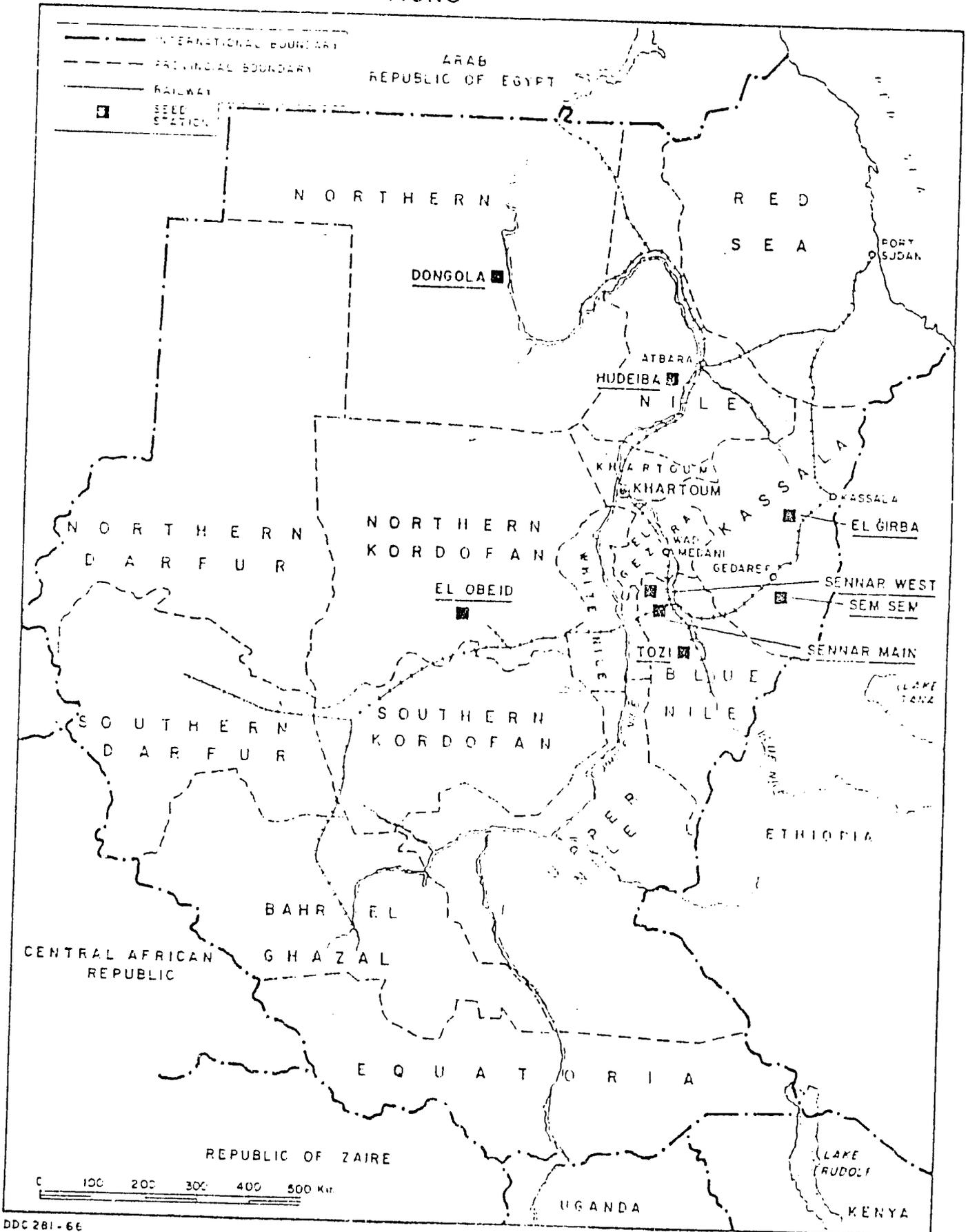


# WHEAT

Figure III.6  
155

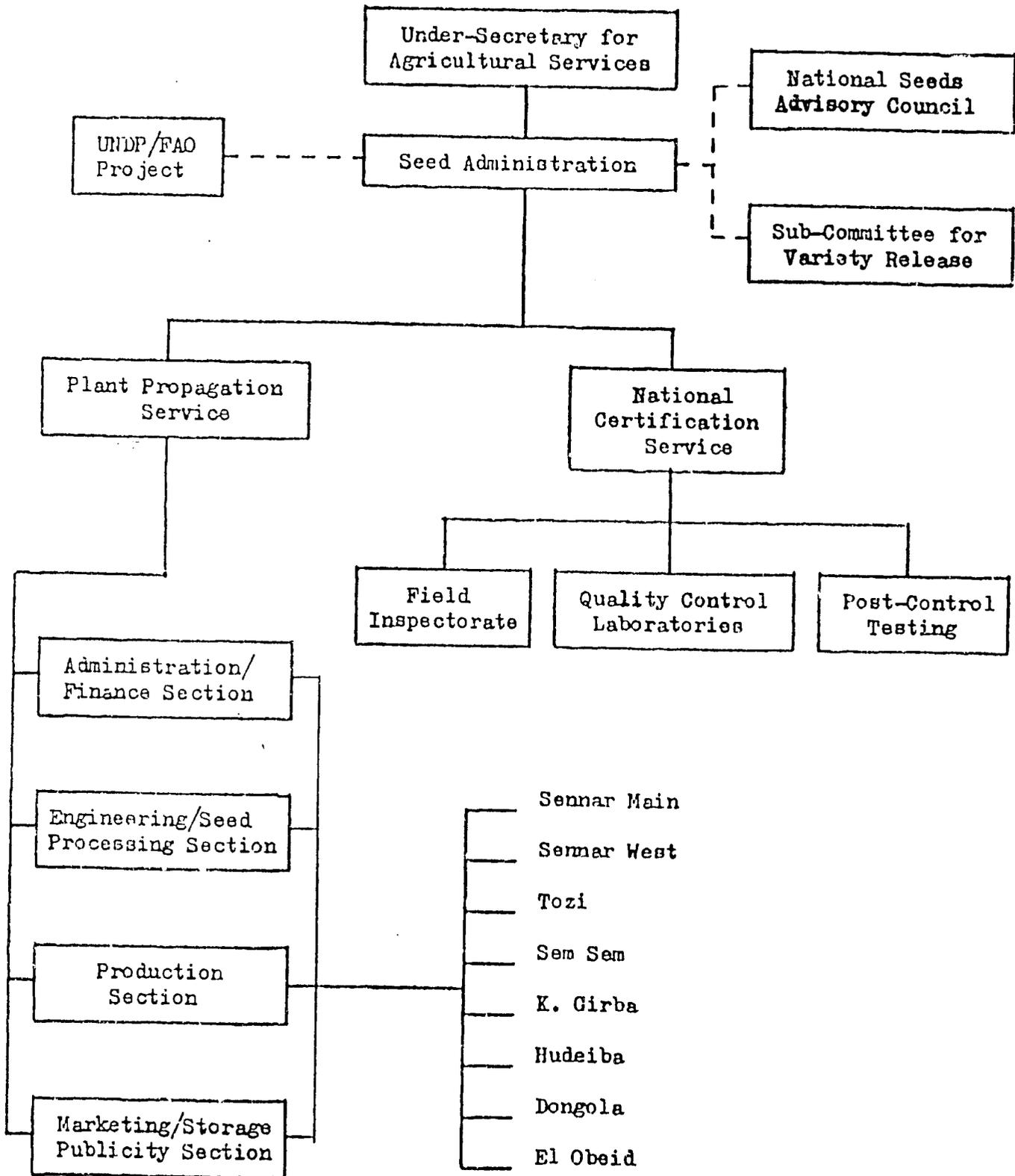


SUDAN ———  
LOCATION OF SEED STATIONS



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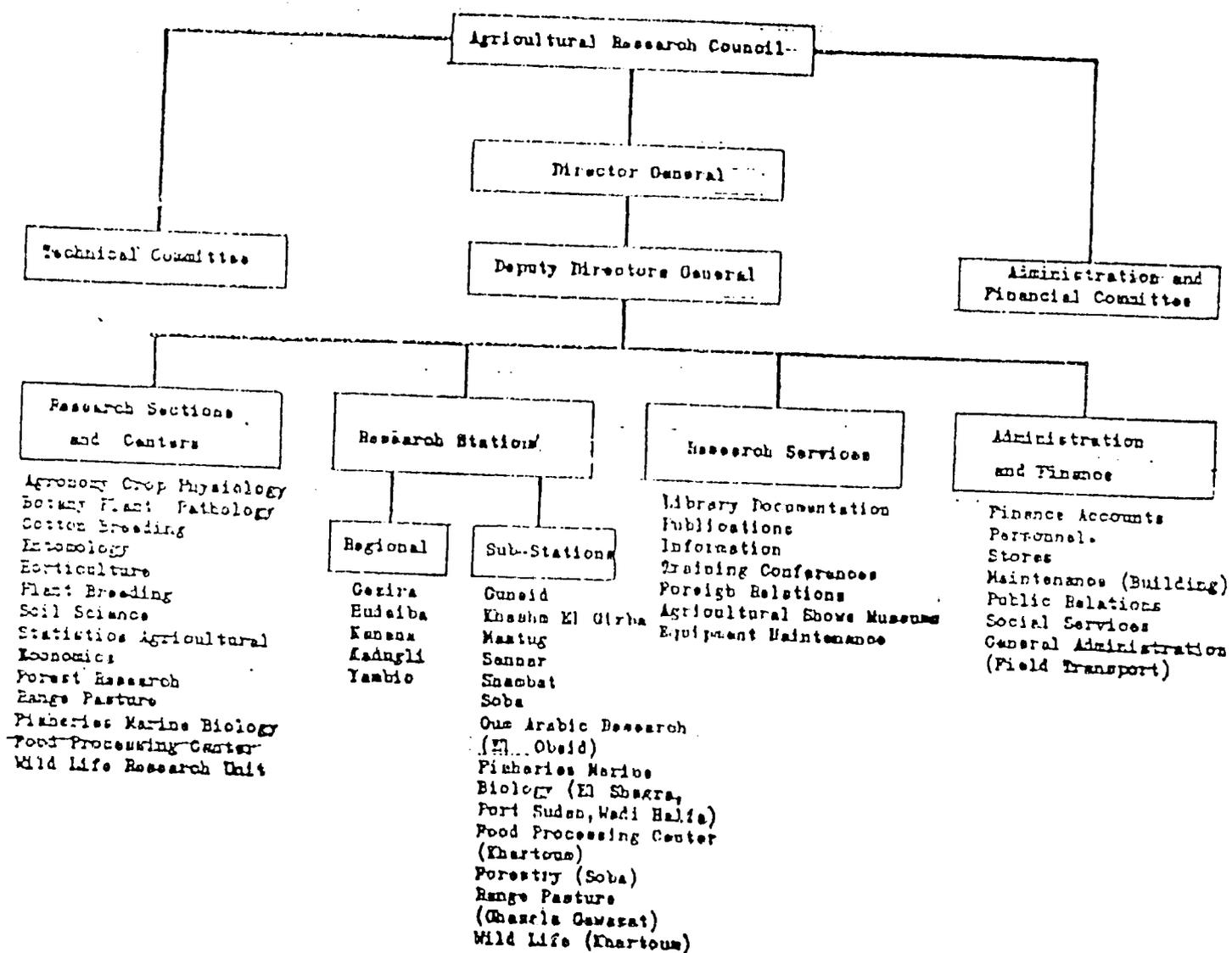
Organization of the Seed Administration



Source: FAO

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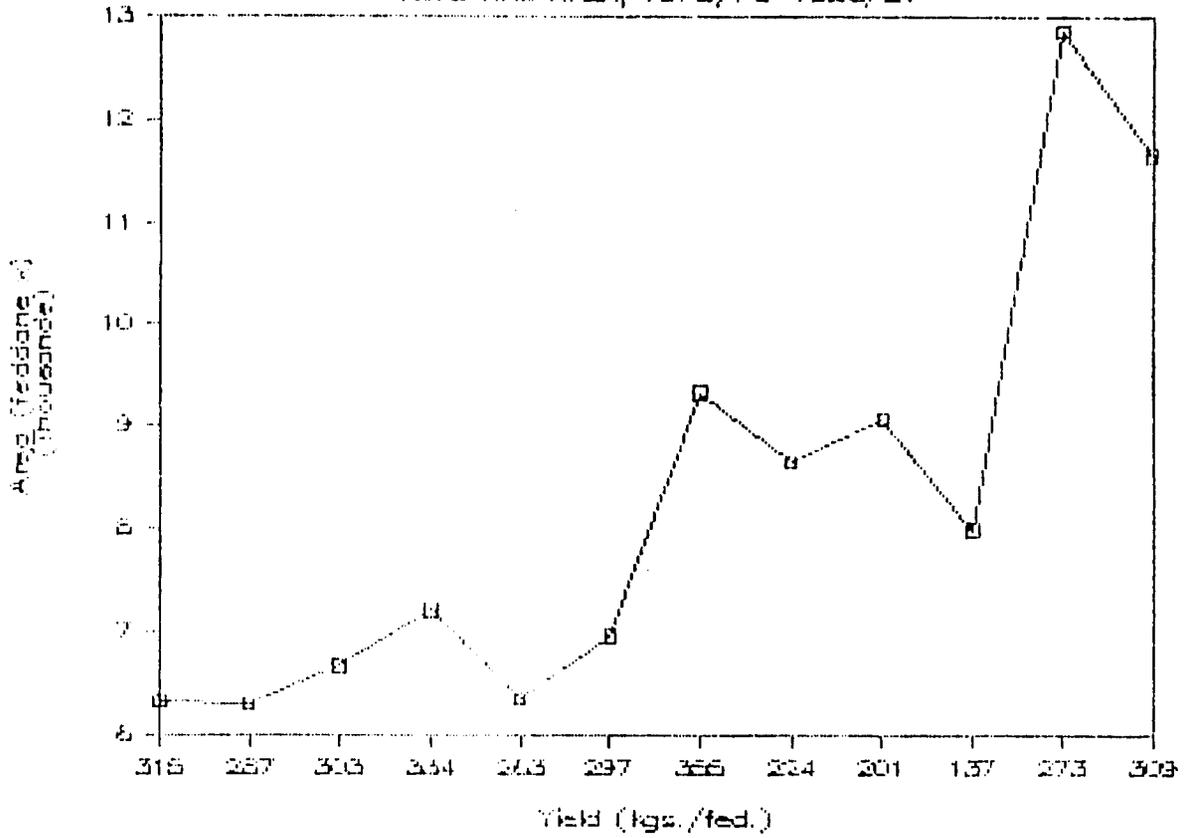
Organization of the Agricultural Research Corporation

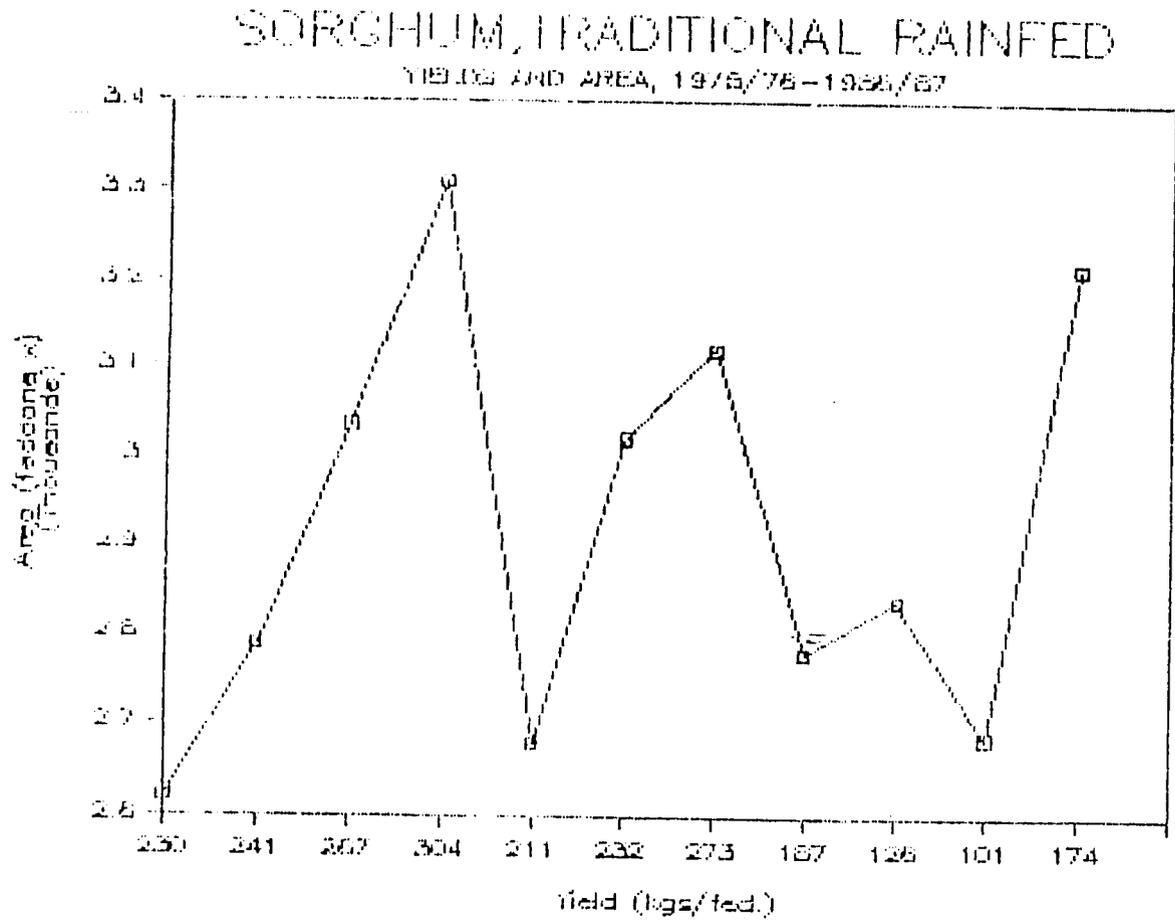


Source: FAO

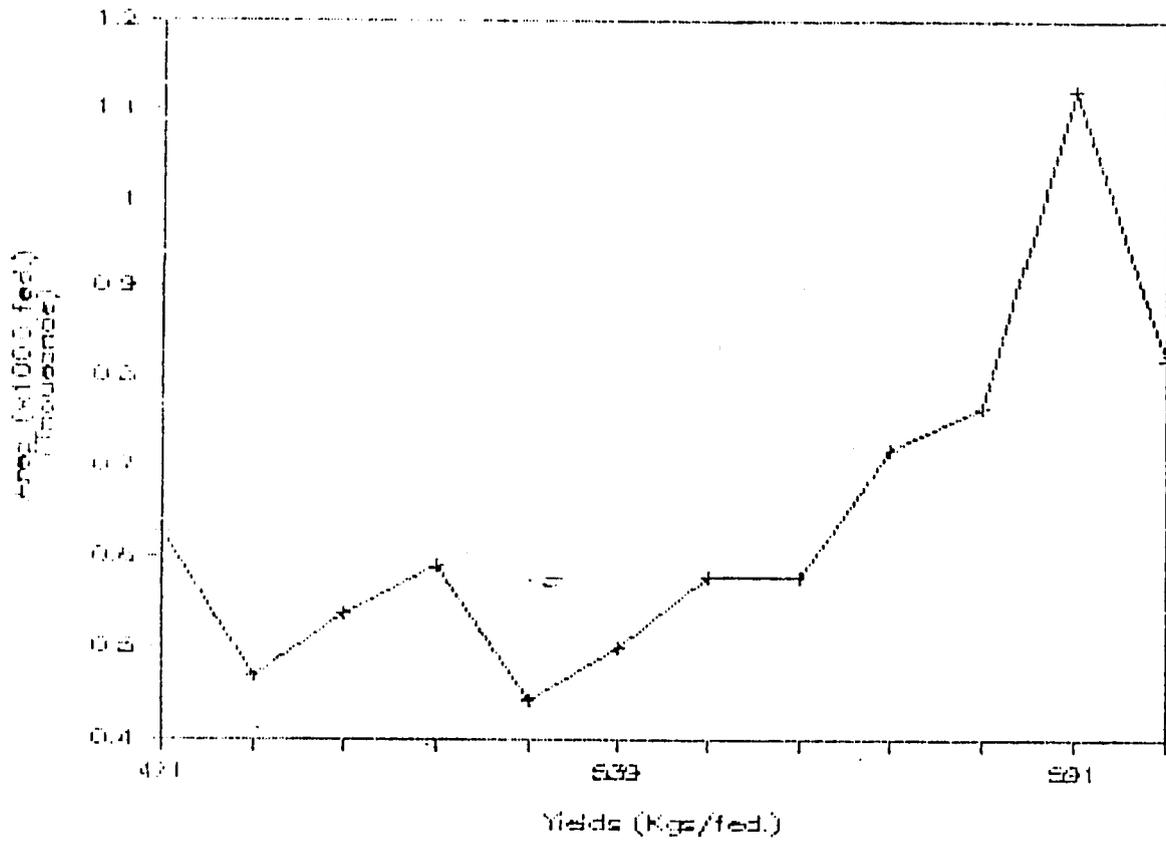
### SORGHUM, TOTAL SUDAN

YIELD AND AREA, 1975/76-1986/87

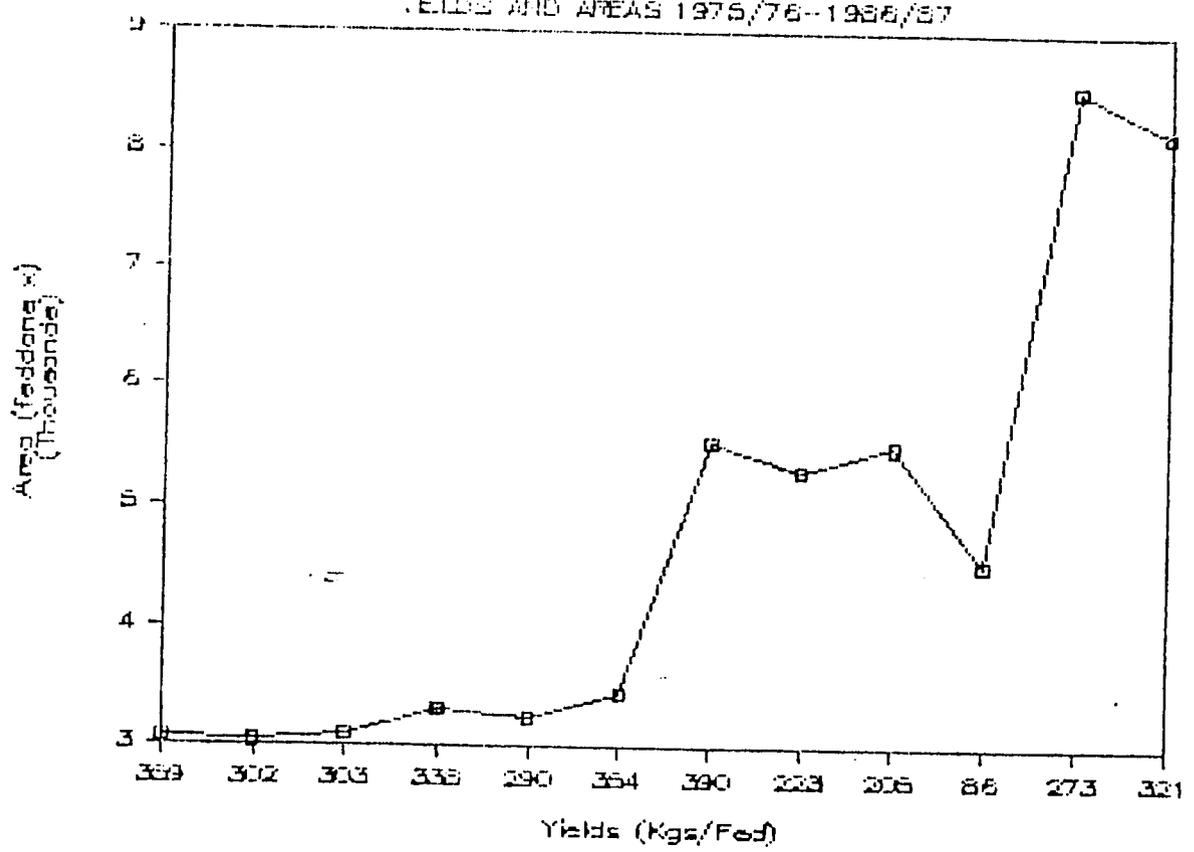




### SORGHUM, IRRIGATED 1975/76-1986/87



### SORGHUM, MECHANIZED RAINFED YIELDS AND AREAS 1975/76-1986/87



ANNEX I.  
LIST OF PERSONS INTERVIEWED  
SUDAN SEEDS INDUSTRY PROJECT  
SEPTEMBER 1987

1. Dr. Osman Ibrahim Gameel                      Director General
2. Dr. Musa Mohamed Musa                      Deputy      Director      General,  
Agricultural                      Research  
Corporation      (ARC),      PO      Box  
126, Wad Medani, Sudan
3. Abdel Moneeim Basir El Ahmed              Breeder Peanuts
4. Abdel Latif El Mubarak Nier                Breeder Sorghum
5. Osman El Obeid Ibrahim                    Breeder      Sorghum,      ARC,      Wad  
Medani
6. Omar A. F. Yousif                            Director      Plant      Propagation  
Administration,                      National  
Seed      Administration      (NSA),  
Sennar
7. Mohamed El Hassan Osman                 Director,      Seed      Certification  
Administration,                      National  
Seed      Administration      (NSA),  
Sennar
8. Omer Mohamed El Faki Marzoug            Seed      Specialist,      CIEA-GEIGY  
Services      Ltd.,      PO      Box  
2643/2807, Khartoum
9. Omer Ali El Daw                              Kosti      Enterprise      for      Crop  
and      Agricultural      services  
(Seed      Dealer),      Sennar,      El  
Medina, PO Box 180
10. Y. Ahmed Dash                              Permanent      Undersecretary      of  
Agriculture,                      Ministry      of  
Agriculture, Khartoum
11. Geoff Crooks                                 Consultant      USAID,      Coopers &  
Lybrand      Associates,      Plumtree  
Court, London FC4A 4HT
12. Mr. Peter Garvie                              Chemicals & Seed Manager  
Mr. Abbas El Sharif                              Technical      Seeds  
The      Shell      Company      of      the  
Sudan,      Ltd.,      PO      Box      1050,  
Telex 22474, Khartoum

13. Dr. Hari Shukla Pioneer Overseas, Inc.  
Cairo, Egypt
14. Dr. Ignacio Narvaez Director, Global 2000, Inc.,  
Khartoum
15. Dr. Mohammed O.H. El Karouri Technical Director, Blue  
Nile Agricultural Project,  
AAAID, Khartoum
16. Dr. Mohamed A. Ibnouf Director for Planning and  
Development, Mechanized  
Farming Corporation, PO Box  
2482, Khartoum
17. Dr. Leila Monawar Cereal Technology Dept.  
Dr. Paul Burena Cereal Technology Dept.  
Dr. Sitt El Nafar Badi Director  
Food Research Center,  
Shambat, PO Box 312,  
Khartoum North
18. Kamal Abdul Partner  
Mohamed Ibrahim Partner  
Mirghani El Haag Technician  
Mohamed Ibrahim Mohamed Technician  
Pioneer Seed Company, Tel  
81505, Khartoum
19. Dr. M. Abdel Raziq Bashir Deputy Director,  
Agricultural Planning and  
Statistics Administration  
Ministry of Agriculture
20. Mohammed J. Qassim Vice-President, Citibank,  
NA, PO Box 2743, Khartoum
21. Dr. E. A. A. Zaki Permanent Undersecretary,  
Economic Planning, Ministry  
of Finance and Economic  
Planning
22. Abdel Rahman M. Tohami Agricultural Planning  
Administration, Ministry of  
Agriculture

23. William Bateson                      Agricultural                      Planning  
Advisor,                      Agricultural  
Planning and                      Statistics  
Administration,                      Ministry of  
Agriculture
24. Brian Da Silva                      PO Economist, USAID/SUDAN
25. Dr. M. S. Joshi                      Project Coordinator, Sudan  
Seed Project, UNDP/FAO, NSA,  
Khartoum
26. Dr. Dafalla Ahmed Dafalla                      Project Director                      Western  
Sudan Agricultural                      Research  
Project, Khartoum
27. S. Tahir Qadri                      Agro-Forestry  
Desertification, USAID/SUDAN
28. Chris Carney                      GDO                      Grain                      Storage  
Facilities, USAID/SUDAN
29. Arthur Thivierge                      KORAG,                      Project                      Manager,  
USAID/SUDAN

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ANNEX II.  
DEFINITIONS AND EXPLANATION OF TERMS  
SUDAN SEEDS INDUSTRY PROJECT  
SEPTEMBER 1987

Categories of Seeds

- o Breeder seed: a class of original seed in a seed certification program that is produced under the supervision of plant breeder(s).
- o Basic seed: a class of seed in a seed certification program produced by multiplication of breeder seed and intended for production of certified seed or commercial seed, as in the case of non-certified private hybrids.
- o Certified seed: a class of seed that has been certified to conform to standards of genetic purity established and enforced by a seed certification authority. It may be the direct descendant of Breeder, Basic or Certified seed, and is intended either for production of another class of certified seed or for purpose of commercial crop production.

Thus, there can be the following types of certified seed: (a) "Certified basic seed," the certified seed derived from breeder seed; (b) "Certified commercial seed," which is certified seed directly descended from basic seed; and (c) "Second generation certified commercial seed" or "Certified commercial seed II" for seed that - for emergency purposes - must be produced from first generation certified commercial seed.

Categories (b) and (c) are normally abbreviated for the sake of simplicity and called Certified seed.

Registered Seed

In some seed production programs where there is a stable and regular production of two generations of certified-type seed, the first generation, equivalent to (b) above, is called "Registered seed," while the second generation (c), a true commercial seed, is the only one for which the name "Certified seed" is reserved.

- o Commercial seed: seed, intended for crop production, that has not been produced under a seed certification program. Commercial seed and Certified seed must both conform to the same minimum official seed quality standards, and are equal in physiological and physical quality. The difference is that Commercial seed may be from a hybrid or variety produced by a proprietary seed company, which guarantees

with its firm's name and prestige the genetic identity of its seeds in their original unopened packages, while Certified seed carries an implicit genetic guarantee from a certification agency which is generally in the public domain, and is entitled to be certified. Commercial seed may become Certified seed if certification is voluntarily requested, and the certification process is duly conducted.

- o Grain for seed: ordinary market class grain used for seeding purposes.
- o Common seed: a class of seed produced from unknown parentage and placed in the market without guarantee as to origin or quality.
- o Cultivar: a distinct true breeding strain (variety) or an agricultural, horticultural, or plantation crop.
- o Hybrid: the first-generation cross produced by controlling pollination of two varieties, lines or species.
- o Vegetative propagation: reproduction (multiplication) of an individual plant or of a cultivar by means of cuttings (i.e., without use of seeds).

Meanings of the Following Terms As Used in This Report:

- o "Roguing" is the removal of off-type plants from a seed production crop to purify the stand based on phenotypic selection.
- o "Improved crop varieties" and "HYV"s include both crop varieties (cultivars) and hybrids. HYV means "high yielding variety."
- o "Food grains" refers to cereal and legume grains. In the Sudanese context the specific crops are primarily beans, cowpeas, maize, pulses, millet, rice, sorghum, groundnuts and wheat.
- o "Seed system" refers to every aspect of all activities carried out by both public and private sectors entailed in the multiplication, drying, conditioning (processing), storage, distribution, inspection, testing, regulation, and certification of crop varieties received from plant breeders in order to make available to farmers for planting seeds that are of consistent high quality and purity.

- o "National Seed System" refers to the institutional organization of agencies dealing with seeds, the legal framework, and its functional coordination.
- o "Varieties" is used to include hybrids when that term is applicable. Thus, if referring to maize, "varieties" should be interpreted as "varieties and/or hybrids, etc."
- o "Cultivar" is synonymous with "variety."

ANNEX III.  
LIST OF ABBREVIATIONS USED  
SUDAN SEEDS INDUSTRY PROJECT  
SEPTEMBER 1987

1. ABS - Agricultural Bank of Sudan
2. ADO - Agricultural Development Officer
3. ARC - Agricultural Research Corporation
4. CGIAR - Consultative Group for International Agricultural Research
5. CIAT - International Center for Tropical Agriculture
6. CIMMYT - International Maize and Wheat Improvement Center
7. CIP - Commodity Import Program
8. CPA - Crop Protection Administration
9. FAO - Food and Agriculture Organization
10. FOB - First on Board
11. GDP - Gross Domestic Product
12. GOS - Government of Sudan
13. HYV - High Yielding Varieties
14. ICD - Industry Council for Development
15. ICRISAT - International Center for Research On Semi-Arid Tropics
16. IDA - Irrigation Development Authority
17. IITA - International Institute for Tropical Agriculture
18. INTSORMIL - Institute for Sorghum and Millet
19. IRRI - International Rice Research Institute
20. LS - Sudanese Pounds
21. MANR - Ministry of Agriculture and Natural Resources
22. MFC - Mechanized Farming Corporation

23. MT - Metric ton
24. NSA - National Seed Administration
25. NUP - National Union Party
26. PID - Project Identification Document
27. PP - Project Paper
28. PPA - Plant Propagation Administration
29. SCA - Seed Certification Administration
30. SPSPA - Sudan Private Seed Producers Association
31. UNDP - United Nations Development Program
32. USAID - United States Agency for International Development
33. USDA - United States Department of Agriculture
34. VRSC - Varietal Release Sub-Committee
35. WSARP - Western Sudan Agricultural Research Project

ANNEX IV.  
COMMENTS ON ISSUES RAISED DURING  
USAID/AFR/DP WASHINGTON REVIEW OF SUDAN  
PRIVATE SEED SECTOR INITIATIVE PID (650-0081)

SUDAN SEEDS INDUSTRY PROJECT  
SEPTEMBER 1987

The USAID/Mission to Sudan requested that the ICD team respond directly to a memorandum dated March 10, 1987, addressing five sets of issues that were raised during the AFR/DP review of the Sudan Private Seed Sector Initiative PID (650-0081) in Washington.

During the final debriefing of the team by USAID in Khartoum, it was recognized that while the issues had been addressed they were scattered throughout the various sections of the report. It was agreed that a summary of the issues would be prepared and annexed to the final report.

SUMMARY

DP Issues: Sudan Private Sector Seed Initiative (650-0081)

1. Who is suffering from declining yields?

According to data investigated from various sources, especially the report prepared by the Ministry of Agriculture and Natural Resources, PAEA, DAES on Provincial Shares and Instability of Food Crop Production in the Sudan, dated May 1987, indications are that on a national basis there has been a decline in yields from 1973/74 to 1986/87 in all crops except wheat. Scrutiny of the data indicates the most rapid decline in yields occurred during the drought years, and a modest recovery nearly equal to the average was experienced. Although the issue of whether yields are declining in all three subsectors may be debated, it may not be as significant as the fact that yields achieved are far below international averages for all major crops grown, even though basic agricultural, national resources are good. Comparative yields of the five major food and oilseed crops, as shown in various tables included in the report, show yields in Sudan far below international average levels. Agronomic trials conducted on both traditional and mechanized rainfed agriculture in the Blue Nile Province have shown excellent yield responses to applications of improved seed, tillage, planting, fertilization, weed control, crop rotations and intercropping. In most areas of Sudan, low agricultural yields can be attributed to, firstly: a shortage of inputs including improved seed, fertilizer, pesticides and fuel; secondly: inappropriate and poor cultural practices including tillage, precise planting, weed control, pest (locust and bird) control and irrigation water management; and, thirdly: government policies not conducive to long-term agricultural development, and deficient production by the private sector.

While all of the above are interrelated in improving crop production and maximizing crop yields, historically, high quality seed of improved varieties has been the cheapest means available with which to introduce the benefits of improved agricultural technology.

Whose seed quality is declining and why?

The quality of seed referred to by the original PID must be taken in the context of the time period in which it was prepared: during and immediately following a severe and devastating drought and famine.

Historically, the quality of all seed on a worldwide basis has gradually and continually improved. However, during periods of prolonged drought and famine, seed supplies in stricken areas do decline and deteriorate. This is due to farmers' need to replant fields several times, using the best seed available first and gradually using poorer seed as successive plantings fail and are lost. Eventually, if famine persists, any remaining seed stocks will be eaten for food, leaving no locally adapted seeds for future planting.

A second short-term reason that seed quality declined in Sudan is the declining ability of the Agricultural Research Corporation to maintain adequate supplies of improved breeder seed from which foundation and certified seed are produced. The need to replenish improved varieties of sorghum and millet in Sudan is crucial because of rapid deterioration of genetic purity, due to high levels of outcrossing with abundant indigenous wild sorghum and millets.

Quality of seed can also temporarily decline whenever there are severe shortages of seed production and subsequent seed supplies. Under those conditions, seed producers will remove lesser quantities of the undesirable materials during processing. Seed certification agencies also tend to accept substandard seed during what they refer to as "emergency seed shortage situations."

#### Mechanized Rainfed Environmental Concerns:

The concern over what effect the project might have on the mechanized rainfed subsector is valid. It appears, however, that this concern is based on fragmentary and incomplete information. As the text of the report explains, the mechanized rainfed subsector consists of three major sub-divisions; demarkated, undemarkated, and agricultural companies.

The author(s) of the issues memorandum seem to view all mechanized rainfed farms as dangerous entities determined to practice unbridled soil exploitation. While there is an element of truth to this generalization among certain absentee owners found in the undemarkated sub-division, it is not true of the subsector as a whole.

If one can expect farmers in Sudan to respond to high quality seed and greater availability of other inputs, as do farmers elsewhere, they will move from a system of extensive farming practices to more intensive farming systems. An intensive system does not necessarily imply the removal of more tonnage of crops, but does imply the application of management techniques and inputs needed to optimize production on a sustained basis.

In the context of mechanized rainfed farming in Sudan, seed in and of itself is expected to have little or no impact on the expansion of new farm land. Other factors, such as the cost of land and the cost of new machinery to farm the land, have a far greater effect on expansion.

2. What will be the impact of the project on the structure of production in Sudan?

The project as envisioned will be directed at all three of the agricultural subsectors, but from different perspectives. The mechanized rainfed subsector will benefit most from the establishment of international seed companies. For the establishment of these companies on a private basis, however, they will need and will receive the least amount of help. In the presence of a receptive climate for private investment and operations, they will establish themselves. The traditional rainfed subsector, on the other hand, will be least affected by the establishment of international seed companies. They will be most affected by the development of local seed producers or "seedsmen," which will require the greatest amount of assistance and the longest period of time. The irrigated subsector, being predominantly public sector-controlled, has historically received the greatest amount of assistance. It will receive only whatever assistance is needed to facilitate greater private sector participation.

To understand the interrelationship of the various crops produced by the subsectors, and how they impinge on each other in the market, one must examine where each crop is produced, and where and how it is marketed. This issue has been addressed in the report and thus will not be treated here in depth.

SORGHUM is produced by all three subsectors but is marketed differently by each. In the traditional rainfed subsector, sorghum is mainly a subsistence crop and therefore only marketed at the village level when surpluses exist. Sorghum is marketed on a variety basis. It is therefore difficult to place new and unknown varieties in the market. The large mechanized rainfed farmers sell their crops to large urban centers and companies for export. Lesser amounts go to villages if the variety in question is known and acceptable. The irrigated subsector produces sorghum for both subsistence and market centers, therefore competing with the mechanized rainfed farmers. When

the hybrid sorghum HD-1 was developed, it was promoted on the basis of improved yields alone. When it came to market, it was an unknown variety and could not compete with the commonly known and, therefore, preferred varieties. It also lost market interest when it gained the reputation for producing an inferior Kiseru (sorghum flat bread) because of poor baking characteristics.

MILLET is produced almost entirely by the traditional rainfed farmers as a subsistence crop.

SESAME is produced by both the traditional rainfed and the mechanized rainfed farmers, however new hybrid SUNFLOWER seed production will be greatly expanded in the mechanized rainfed subsector. It is, therefore, supposed that a larger market share for sesame will be left to the traditional rainfed subsector.

PEANUTS are produced only by the traditional rainfed and the irrigated subsectors. Varieties compete in what appears to be a relatively large market.

Because the various subsectors produce crops which do not seem to actively compete in the same markets, the domination by one subsector of another's market seems remote at this time.

3. What is the GOS commitment to liberalizing seed production?

This issue is quite difficult to evaluate at this time. Since the government was dissolved, senior officials in the relevant ministries have been unable to make meaningful commitments. There seemed to be agreement from the Ministers of State and MANR that they were in favor of privatizing the seed industry and were, in fact, already engaged in the process. The ICD recommendation that a seed conference be held in Sudan (prior to submission of the PID), where all interested participants in the seed industry could discuss the pros and cons, and openly voice their opinions, seemed to be widely accepted. Such a conference would offer an excellent opportunity for the GOS to express a commitment to reform of the seed industry.

4. How many elements of a national seed multiplication program are presently operating?

In the report, we have identified in detail the roles and functions of the Agricultural Research Corporation and the National Seed Administration. The ARC is charged with developing and releasing new seed varieties, and planting materials for use by agriculture in the Sudan. It is a public agency and has, consequently, focused entirely on developing seed for the public agricultural corporations. More recently, the ARC has added research in traditional agriculture in the Western Sudan Agricultural Research Project at El Obeid and Kadugli.

Assistance has been provided by USAID, World Bank, INSORMIL and now Global 2000, Inc.

The National Seed Administration (NSA) provides for multiplication of breeder seed into foundation seed by and through the Plant Propagation Administration (PPA). Certified seed is being produced by the PPA, and by the various agricultural corporations. To date, however, they have succeeded in meeting less than 10% of the total demand.

The Seed Certification Administration (SCA) inspects and certifies seed produced under the auspices of PPA. The PPA's seed distribution network is very limited. It sells seed only from its own seed production stations, and from NSA Headquarters in Khartoum.

Imported vegetable seed is marketed and distributed privately through merchants.

The Draft Seed Law was prepared from the viewpoint of a totally publicly owned seed industry. It is currently under revision and, at the moment, no seed legislation is in force.

5. Are the proposed PP design schedule and resources sufficient?

A major portion of the data and documentation needed for preparation of the PP were researched, accumulated and provided by the ICD mission. It is likely that a modest effort will be required to finalize the PPP and to supplement data already gathered.

ANNEX V.  
COMMENTS ON THE STATUS OF  
SEED LEGISLATION IN SUDAN  
SUDAN SEEDS INDUSTRY PROJECT  
SEPTEMBER 1987

1. Summary and Introduction

There is no approved Seed Law in the Democratic Republic of Sudan. If any regulations on seeds exist anywhere in the body of legislation of the country, they are not being enforced at present.

A Draft of Seed Act of 1982 was revised by the African Development Bank, but not further approved. A series of proposals for "Seeds Regulations, 1980" exists with testing, inspection, variety release procedures, and seed certification standards for a number of crops. None of these is presently officially approved. Seed Certification is, therefore, conducted in the Sudan with no formal legal basis. The present structure of the National Seed Administration comes from an Office Order (No SCR/A/5/9/3/A) of February 8, 1982, of the Minister of Agriculture.

At present there is a "Draft Seed Law, 1985" that appears to have been approved at the initial level, and could be submitted for discussion and approval at the Legislation Assembly some time this year.

An English translation of the "Draft Seed Law, 1985" was reviewed, and comments on it are included in this report.

The mission believes this draft to be fragmented and incomplete. It does not include the administrative bodies of the National Seed System, created by "Office Order of February 8, 1982." An Office Order is a legal instrument of a level inferior to that of a Law. For a Law to be complete it must include, satisfy, or amend the provisions included in the instruments of an inferior legal category which exist at present. If this exercise were completed, there would be an excellent opportunity to propose the elements that might be of interest to the GOS before committing itself to a final decision on a Seed Law.

ICD has collaborated with the Government of Turkey in providing elements of legal advice, which helped that country decide on a new legal framework for the seeds industry. A similar exercise is currently under way with the Government of Pakistan.

A set of specific recommendations is included on components of the Seed Law for discussion and analysis. Essentially,

the Seed Law should be organized around the following fundamental concepts:

- I. Policy Objectives and Considerations
- II. National Seed System
  - A. Public Sector Administration
    - 1. National Seeds Authority
      - 1.1 Organization and functions of NSA
    - 2. Basic Seed Production Corporation
    - 3. National Seed Council
  - B. Private Sector Representation
    - 1. National Seed Industry Association
- III. Private Seed Industry Investment and Promotion
- IV. Regulatory Components of the Law
  - A. System and Functions Concerning Research Testing
  - B. Variety Evaluation and Registration
  - C. System and Functions Concerning Seed Certification and Quality Control
  - D. Seed Import and Export
  - E. Seed Quarantine
  - F. Varietal Protection
- V. Authority to Transfer Regulations into Law

In the opinion of the mission, as matters now stand it would be advisable to convene a high level workshop and discuss the technical structure and components of a law intended to "open the doors" to the private sector, and establish a public/private sector partnership in developing a modern national seed system. This is an area in which, in general, there seems to be very little experience in Sudan. ICD has helped design and organize similar workshops in the past.

The exercise might prove of interest in terms of enhancing the government's perception of the legal framework required for private sector participation in the seed industry, and thus be useful information for policy design.

## 2. General Comments

The translation of the Draft Seed Law, 1985, consists of five Chapters:

- Chapter 1. These are basically "definitions" of terms.
- Chapter 2. Deals with the establishment, structure and functions of a variety release committee.
- Chapter 3. Deals with production and marketing, and with import and export of seeds.
- Chapter 4. Refers to inspection of seeds.
- Chapter 5. Refers to Regulations (by-laws) and to sanctions and penalties.

In general terms the Draft Seed Law is too fragmentary and incomplete to be considered a Seed Law, which is an instrument for the organization, administration, promotion, and control and regulation of the seed subsector in Sudan. It does not include any preamble nor policy considerations (political philosophy) as to the legislators' aims and objectives in developing the legislation (i.e., why is seed legislation being developed). There is nothing in the law on promotion of private seed production. It is not known whether such activity is to be encouraged or even tolerated. Much less, of course, is expected on research in the private sector, but even Seed Certification and Seed Quality Control are not dealt with. A few aspects of the National Seeds Administration's duties (such as inspection) are pointed out, but on the whole there seems to be a lack of integration and coherence. Some items better left for by-laws, such as the fine for certain infractions of the Law, are included in the Draft Law. It should be recalled that laws are not supposed to be amended every year; regulations are.

The draft does not recognize nor mentions the right of any natural or judicial person residing in the Republic of Sudan to "produce, buy and sell seeds." Unless this right is clearly stated at the outset, and subject only to the provisions of the Law, a healthy seed industry is unlikely to develop.

If the primary objective of the law is to insure a sufficient and opportune supply of high quality seed of improved varieties, at just prices, and as soon as possible, then the Law must be clearly "promotional" in nature. By "promotional," it is meant that the GOS considers the development of a vigorous private seed industry to be in the interest of the nation. If the objective of the GOS is different, it should be reflected in the content of the Seed Law.

Unfortunately, in the recent past excessive regulation and control on the seed industry have been popular in developing countries. Seed industries in many countries have been over regulated and farmers over protected. Seeds should come first and protection later, although not far behind. Seed quality will be protected first and foremost by legitimate producers who will want to stay in business to develop repeat sales to their clients.

If government wishes to assume primary responsibility for protecting farmers from mischief, thievery, and other characteristics often attributed to established seed merchants, producers and distributors, then government must fully assume its responsibilities, including potential legal action against government agencies and individuals liable for damages under judicial courts. Government should understand that morality cannot be certified. A "certification" guaranteeing a certain uniform genetic identity level in a bag of seed, is no better than what the producer put in the bag of seed in the first place. It is the trust and satisfaction of the consumer that will ultimately prevail.

Consumer protection can and should be better defined and controlled through truth-in-labelling provisions in the law. As these are not spelled out, the inspection provisions of the law are incomplete and insufficient.

Seed legislation should be well structured and comprehensive, but should be kept as simple as possible. A complex law, not amenable to change and evolution, may actually become a greater impediment to its objectives. A simple law whose non-structural provisions can be modified from year to year by decree of the Ministry of Agriculture, without requiring additional level legislative action, is a better solution.

### 3. Missing Elements of the Law

The following important elements are missing from the structural components of the Administration of a National Seed System:

- a. Complete seed law and provisions for the development of regulations, including promotional, administrative, and regulatory components.
- b. Seed administration authority to carry out the above-mentioned activities. Its composition and functions include seeds promotion and administration, seed quality control, and seed certification directorate or sub-authorities.
- c. National Seed Council as policy advisory body with representation of seed industry and government, responding directly to the Ministry of Agriculture.
- d. Basic seed production authority.
- e. Varietal testing authority, independent of tests and evaluations from the ARC.
- f. Varietal registration department for registration of released varieties originating in the public sector, and for varieties and hybrids marketed by the private sector.
- g. Varietal evaluation committee for evaluation of released varieties originating in the public sector.
- h. Seed quality control and consumer protection articles incorporated in the law.
- i. Seed certification articles incorporated in the Law.

- j. Representation of the private seed industry through an official National Seed Industry Association.
- k. Complete set of rights and responsibilities spelled out for private sector on seed import and export.
- l. Seed quarantine regulations as they apply to the seed industry and to research institutions and activities.
- m. Research on varietal development, testing, and variety introduction by the private sector.

4. Promotional Elements of the Law

If the Seed Law is to be an instrument to encourage private sector participation in the development of a vigorous seed industry in Sudan, it should include the following components:

- a. Investment incentives and recognition of the seed industry as an agro-industrial subsector.
- b. Credit incentives.
- c. Foreign exchange incentives
- d. Seed prices de-controlled. Reduction of government-based price competition in seeds.
- e. Agricultural producer status for seed companies.
- f. Use of government infrastructure for seed production, processing and storage by the private sector.
- g. Establishment of an important new balance between promotional, administrative and regulatory components to give the general feeling of a "promotional" Law.
- h. Appropriate modifications in the Investment Act of 1980.

The overall structure of the Law should depart from the stereotypes of obsolete and over regulatory seed laws - often copied from country to country - which have been a tremendous disservice to many developing countries. Model seed laws, such as in Peru (1978), Chile, Brazil, Turkey (1983 - 1984), which depart from obsolete legislation, can be obtained for comparison.

5. Definitions

Chapter 1 of the Draft Seed Law, Act 2, interpretations, is incomplete and some of the definitions need amendment and clarification.

#### 6. Administrative Structure

Chapter 2, dealing with Administrative Structure of the Seed System of Sudan, mentions one minor component: a technical committee for varietal release. Committees as collegiate bodies have no authority. They can only be consultative bodies to government. As such, under the proposed law there should be a variety registration authority or department to act upon resolutions of the committee. This variety registration authority would also eventually recognize varieties registered for protection of breeder creations.

Other administrative structures are missing from the draft proposal, as indicated under (3.) above.

#### 7. Production and Marketing

Chapter 3 requires that seeds meet official specifications. These are not defined, and elaboration of this point is needed. In general, all restrictive clauses are better omitted, as each of them can be shown to be either incomplete in description, causing serious consequences to the health of the industry, or leading to distortions of a normal government-industry relationship.

#### 8. Inspection and Quality Control

(x from p.2)

Presently, the NSA leans heavily on the authoritative "government control seed system" model common in the legislation of some European countries, rather than the "truth-in-labelling" approach of the U.S.A. NSA believes in excessive regulation and control, which in turn requires high energy expenditures (personnel, equipment, and above all operating funds). Private sector also believes in regulation to the extent that it limits fraudulent practices, but does not become a hindrance to its own activities. Unfortunately, in some countries, certification practices have not protected farmers but, rather, together with other restrictive practices have impeded the ability of the private sector to perform efficiently.

The case of private hybrids - which are essentially non-certifiable, as their pedigrees are unknown - poses a problem. Government agencies often confuse "certification" with something which it is not - namely, the assurance of genetic identity in the case of private hybrids - by confounding a guarantee of genetic identity with "seed quality control," which is not and should not be part of the certification process. It would be correct to certify only public varieties or public

hybrids of known pedigree and origin, and leave it to the quality control system to apply "truth-in-labelling" requirements to all seeds, whether certified or not.

It must be clearly stated and understood that "certified" seeds are not necessarily of better quality than "non-certified" seeds. The percentage of seed certified in the U.S. has been going down, while percentages of seed subjected to the quality control has risen. The percentage of certified seed in Iowa today (about 5%) is lower than it was in 1926.

Seed companies working with hybrids (sorghum, maize, sunflower, pearl millet, some vegetables, cotton, etc.) originating elsewhere in private research, would clearly be at a disadvantage if the GOS applied "certification" procedures legitimately only to materials developed through public research in the Sudan, and did not apply parallel truth-in-labelling controls to all seeds, including non-certifiable private hybrids. If GOS wishes to grant certification to private hybrids grown in Sudan, what would be done in bad years when seed of the same hybrids comes from the U.S., where those hybrids are not certified since certification is not required in the U.S. for hybrids? Even if private companies in Sudan acquiesced to eventual GOS pressure to certify their hybrids, they would not turn their lines over to GOS; so the only certification possible would be on seed quality and number of off-type plants, which the companies, in fact, can and do accomplish themselves in their own labs and fields, anyway. This would essentially amount to nothing but seed quality control.

What the GOS should do through NSA is:

- a. Certify the genetic identity (basic seed to certified seed control) of public self- or open-pollinated varieties.
- b. Certify the genetic identity (basic seed to certified seed control) of public hybrids.
- c. Certify the genetic identity of private registered varieties or private registered hybrids, which are voluntarily submitted for certification.
- d. Inspect and control, for germination, vigor, mixtures, weeds, and foreign material, and in some cases for seed borne diseases, the seed lots of all seed that go into commercial channels in order to check that they are within standard tolerances established in the seed by-laws or regulations. Both certified and non-certified seeds should conform to the same minimum quality standards.

What the private sector should do in the area of seed quality control for private hybrids which are not submitted for certification, is:

- a. Develop internal quality control systems, including grow-outs, seed quality tests, and inspections.
- b. Label seed lots with the results of analyses, or with an indication that the quality exceeds the minimum tolerances expressed in the country regulations.
- c. Inspect the seed lots and re-label them, or remove them from the market if their quality falls below the legal minimum.

9. Seed Imports and Exports

As seeds are an input required on a timely basis, licensing of seed imports should be treated differently from other imports. A phytosanitary import permit should be the only restrictive mechanism which applies to seed imports.

Registered companies conducting research and seed production in Sudan may be given an import permit on a permanent or semi-permanent basis to introduce seed samples for research purposes.

Seeds used for sowing should not be subject to import duties.

Seed exports, once proof exists that the local market is satisfied, should benefit from incentives such as quick licensing and favorable exchange rates.

10. Quarantine on Seeds

The law requires a section specifying and describing quarantine procedures, and the requirements regulating certificates and procedures for import and export of seeds.

11. Research and Extension

The law should be specific about the right of seed companies to conduct private research on variety/hybrid development, and to test by themselves or in partnership, or cooperation, with GOS institutions. The right to register and protect creations, and to market the research conducted by GOS institutions, would also result in development of varieties which could be protected and marketed by the private sector.

GOS research and extension institutions should be explicitly directed to develop production (husbandry) methodologies suitable to new varieties (regardless of whether public or private) and to make their findings known to farmers.

Advance testing of varieties and hybrids should be a service offered by the GOS. This service should be conducted by an agency, independent of the ARC, which originates the hybrids. The results of the tests would be diffused by the extension service. As conditions differ from location to location, and even from farm to farm, the public service should abstain from recommending varieties with performances which fall within certain tolerances. Yield, earliness, disease/pest tolerance, quality, adaptability to mechanized harvesting, drought resistance, ease of seed production, and many other factors contribute to the market value of a given variety. Farmers should be given a wide selection of varieties to choose from, and the farmers themselves should be the ultimate judges of variety merit for their own land. The same applies to seed companies, which should be permitted, ultimately, to judge their own selections and to decide which varieties/hybrids to market.

## 12. Varietal Registration

A varietal evaluation committee should recommend the registration of new cultivators with superior proven performance in at least one area, not necessarily yield.

A varietal registration department would undertake the registration of varieties/hybrids, whether of public or private origin, as well as varietal descriptions (botanical characteristics). This would apply both to protected and unprotected varieties.

Registration should proceed after two test seasons where satisfactory tests were obtained. Private seed companies should be allowed to market test varieties and hybrids while under generalized test (in limited quantities), as well as to test seed production factors and methodologies in new varieties.

## 13. Government Support of Private Sector

The law should include provisions to support private sector activities as follows:

- a. Permission to borrow from public or private banks under the best market conditions, and on a priority basis, both for working capital and to purchase fixed assets.
- b. Provisions for the authorization of land, equipment and plant leases of GOS property by seed firms.
- c. Authorization of GOS institutions to provide services to private seed firms in seed harvesting, processing, storage, and other activities such as might be required to promote the production of high quality seed in Sudan.

- d. Investment guarantees and benefits of the 1980 Investment Act revised and improved in the areas of investment authorizations, oprations, earnings and remittances.

14. Basic Seed

Because of the importance of a sufficient and guaranteed supply of basic seed, the PPA should by law become a basic seed producing organization, with all the characteristics of a parastatal seed organization within the agricultural sector. Present activities of the PPA in commercial seed production should be ended within no more than 5 years. The Law should explicitly state the disposition and transfer of assets to private and public corporations.

15. Private Sector Organization

The Law should recognize a private trade organization, representing the seed trade of Sudan, as an association of registered and organized seed industry members. It should also provide for its official representation in the National Seed Council.

16. National Seed Council (NSC)

This NSC is the key government organization in the National Seed System. It deals with policy making, representation and coordination on seed matters between the government and the private sector. This organization as an advisory body is authorized to formulate and propose policies and measures for approval by the Minister of Agriculture.

## ANNEX VI

### Seed Industry Development

#### Matrix of Recommended Policy Measures

<u>Policy Area</u>	<u>Recommended Action</u>	<u>Recommended Targets</u>
INVESTMENT AND TAXATION INCENTIVES	· Establish check list of promotional measures and define very clear investment incentives to both local and foreign firms.	
	- Positive attitude at all bureaucratic levels	- Trained GOS employees by mid 1988
	- Facilitate registration of seed companies	- Maximum 2 windows and 90 days for complete procedure by mid 1988
	- Definition of terms of reference on investment in the Seed Industry, in regard to applicable Laws, Regulations and Circulars, establishing the priority of most preferred stating on each law.	- Checklist of pertinent Articles in Investment, Industrial and Agricultural Laws, and Circulars, defining gaps and developing corrective legislation by late 1987/early 1988.
	- Percent ownership by foreign investors	- Seed Law and/or Ministry of Finance Circular or Decree by early 1988
	- Remittances of profits and capital at preferred exchange rate	- do -
	- Capital, capital gains and operational profits repatriation allowed	- do -
	- Law or no customs duties on farm and industrial machinery	- do -
	- Reinvestment of profits in fixed capital and working capital allowed tax free	- do -
MARKET POLICY	- Seed dealer registration	- Ministry of Agriculture - Mid 1988
	- Liberation of all restrictions on pricing seeds, and allowance of free market.	Ministry of Agriculture Early 1988 Directive

<u>Policy Area</u>	<u>Recommended Action</u>	<u>Recommended Targets</u>
CREDIT	- Development of line of credit in U.S. currency to be used by seed companies for purchase of farm machinery and seed plant processing equipment (in the U.S.) by registered seed companies and seedsmen.	USAID late 1988 administered by Agricultural Bank of Sudan
	- Seed dealer credit policy. Agricultural Development Bank preferential loans	Agricultural Bank of Sudan Mid 1988
	- Release of upper limits of commercial bank reserve ratios allocated by Bank of Sudan for expansion of medium and long term loans in US for the Seed Industry	Bank of Sudan Directives Early 1988
	- Seed inventory buildup financed with Agricultural Bank of Sudan loans at same equivalent interest rate as farmers loans.	Agricultural Bank of Sudan Early 1988 Circular
	- Seed inventory in bonded warehouses to serve as full collateral on Agricultural Bank of Sudan loans.	Agricultural Bank of Sudan early 1988 directives. ABS to facilitate and adapt parts of their warehouses to seeds.
	- Preferential credit authorization and hard currency funds allocated for basic seed and vegetable seed importation	Ministry of Commerce and Bank of Sudan Directives Early 1988
SEED IMPORTS	- Phytosanitary import permits to be issued on non-restricted species or geographical areas on short term basis (48 hours) automatically	Ministry of Agriculture Directive Early 1988
	- Plant quarantine restrictions to be made reasonable and objective	Ministry of Agriculture Directive Early 1988

<u>Policy Area</u>	<u>Recommended Action</u>	<u>Recommended Targets</u>
SEED IMPORTS	- Import of seed samples for testing to be facilitated to seed companies and ARC (1)	Ministry of Agriculture Circular Early 1988
	- Basic seed imports to be facilitated to seed companies and NSA (2)	- do -
SEED EXPORTS	- Basic and commercial seed surpluses, exports allowed and facilitated to seed companies, NSA and government managed scheme.	- do -
	- Export of seed samples of Sudan developed varieties for testing facilitated to seed companies and to ARC	- do -
VARIETY REG- ISTRATION	Registration of varieties submitted directly by owners of title to the variety, with description	Ministry of Agriculture Var. Registration Office - NSA
VARIETY RELEASE	Publicly tried varieties released after approval procedure of their Varietal Release Committee	Ministry of Agriculture Var. Release Committee NSA/ARC
TESTING OF VARIETIES	- Public and private advanced variety testing coordinated by Crop Research Program Coordinators at ARC. Independent testing and final date assembly and interpretation.	ARC Directive Late 1987
	- Accelerated testing for release or registration criteria	- do -
APPROVAL OF VARIETIES	- No "recommended" lists of varieties	- do -
	- Lists of registered or approved varieties	- do -

Notes: (1) ARC = Agricultural Research Council  
(2) NSA = National Seed Administration

<u>Policy Area</u>	<u>Recommended Action</u>	<u>Recommended Targets</u>
	- Criteria to be met for registration of varieties	Ministry of Agriculture NSA/ARC Agricultural Research and Seeds Seminar mid 1988
	- Consumer, farmer and industry acceptance criteria for new varieties	- do -
SEED QUALITY		
a) SEED CERTIFICATION	- Definition of seed certification standards for 1988-90 for Sudan and crops to be included	- do - and Regulations to Seed Law
	- Non compulsory certification	
	- Separation of Seed Certification from Quality Control functionally and administratively	Ministry of Agriculture Mid 1988 (Service)
b) SEED QUALITY CONTROL	- Definition of seed quality control standards for 1988-90 for Sudan and crop to be included	Ministry of Agriculture (NSA) Mid 1988
	- Organization of inspection and sampling	
	- Seed quality control labs.	
USE OF GOVERNMENT OWNED FACILITIES	- Facilitate the use of Government owned seed processing plants, storage facilities and equipment under commercial service or leasing contracts to the private sector	Ministry of Agriculture NSA directives Mid 1988
SEED LAW	- Preparation, discussion and approval of Seed Law and its initial regulations with full participation of Government and the private sector	- do -
BASIC AND BREEDERS SEED PRODUCTION	- Concentration of Basic Seed Production functions of Public Varieties in NSA. Also private companies may produce public basic seed under contract	NSA Private Sector Directives Early 1988

<u>Policy Area</u>	<u>Recommended Action</u>	<u>Recommended Targets</u>
	<ul style="list-style-type: none"> <li>- Private sector companies to produce or import their own basic seed</li> <li>- Pricing of basic seed established according to high value of such seed</li> <li>- Pre-basic or breeders seed to be produced by ARC or private companies</li> </ul>	
COMMERCIAL SEED OF PUBLIC VARIETIES (CERTIFIED OR UNCERTIFIED)	<ul style="list-style-type: none"> <li>- Production to be continued at NSA for non-hybrid seeds</li> <li>- Production to be continued at government schemes or corporations for non-hybrid seed.</li> <li>- Production of hybrid seeds to be transferred to the private sector</li> <li>- Production of non-hybrid seeds of public origin to be initiated by independent seedsmen and cooperatives in the regions, under a new Plan</li> <li>- Production of non-hybrid seeds of private origin to be allowed under Varietal Protection Registration and Certification regulations</li> </ul>	<p>NSA</p> <p>Government Schemes and Corporations</p> <p>Private Sector</p> <p>Independent Seedsmen Plan to be initiated in 1988 NSA/USAID/Extension Directorate/Global 2000</p> <p>Private Sector</p>
NATIONAL SEED INDUSTRY ASSOCIATION	<ul style="list-style-type: none"> <li>- Organization and official recognition as representative of seed industry</li> </ul>	<p>Ministry of Agriculture and Private Sector Late 1987</p>
NATIONAL SEED COUNCIL	<ul style="list-style-type: none"> <li>- Constitution, election of its members, development of by-laws</li> </ul>	<p>Ministry of Agriculture Early 1988</p>

<u>Policy Area</u>	<u>Recommended Action</u>	<u>Recommended Targets</u>
SMALL PORTABLE SEED PROCESSING EQUIPMENT	Make available to seedsmen in traditional agriculture areas small portable seed processing equipment on rental basis	NSA Early 1989
SEED WAREHOUSING	Develop warehousing facilities by means of credit to the private sector for improved seed storage and seed marketing	USAID Contract for design of efficient tropical seed storage facilities for Sudan mid-late 1988 Credit component for pilot storage
EXTENSION AND TRAINING	<ul style="list-style-type: none"> <li>- Training of seedsmen</li> <li>- Training of inproduction and processing seed manager, seed dealers in management marketing</li> <li>- Policy Seminars on Seeds for Government and Private Sector</li> <li>- Seed Certification and Quality Control</li> <li>- Research on breeding and variety testing</li> </ul>	NSA/USAID Contractors Late 1988
CROP MARKETING POLICY AND INFORMATION	<ul style="list-style-type: none"> <li>- Crop pricing and price support policy formulation, public announcement and implementation</li> <li>- Crop price reporting</li> </ul>	Ministry of Agriculture Directives, organization Early 1988  - do -
ANALYSIS OF OVERALL SEED INDUSTRY CONSTRAINTS, DEVELOPMENT AND POLICY	<ul style="list-style-type: none"> <li>- Holding of a National Seeds Industry Development Seminar</li> </ul>	National Seed Industry Association Ministry of Agriculture Ministry of Finance Bank of Sudan ARC Agricultural Bank of Sudan USAID as sponsors with ICD as resource support for private investors and international technical input.

ANNEX VII.  
EVOLUTION OF PUBLIC SEED SYSTEMS  
SUDAN SEEDS INDUSTRY PROJECT  
SEPTEMBER 1987

1. SERVICE DEPARTMENT FOR SEEDS

The first stage in the evolution of a publicly owned and managed seed production and distribution system is the development of a Service Department for Seeds in the Ministry of Agriculture. Its role is purely service-oriented. Seeds are usually distributed at or below cost, under the rationale that agriculture being a basic activity, and farmers being a large proportion of the population, they deserve technical and economic help from the state to bring about an increase in crop yields. The cost of seed, being low, could be assumed partially or in total by the state. No cost, or very little cost accounting, is maintained under this system. Capital costs associated with the public seed activity are assumed by the central government, including loans from international aid agencies. The National Seed Administration of Sudan is at this (primary) level.

2. NATIONAL SEED AUTHORITY

A system which would allow the governmental seed agency or authority to retain its earnings, and reapply them to its own ends, represents the second stage in evolution. This type of organization has limited financial autonomy, being under the direct control of a government agency or ministry.

3. NATIONAL SEED AUTHORITY

A third stage in development usually found in mixed economies or highly, centrally planned economies is the Parastatal Seed Corporation. It operates a private corporation, with a board of directors elected by a government agency, accounting procedures similar to those of a private corporation, and the possibility of retaining and reinvesting earnings in its own activities.

4. SEED GROWERS ASSOCIATION

In some limited cases (e.g., U.S.A., Peru), an early stage of the evolution of the national or commodity based seed system, was the establishment of private seed growers who used publicly bred materials, and who by virtue of adding a marketing and distribution system of their own, became seedsmen. Their association in many cases provided additional services to the seedsmen/members. State governments which aided this development found a way to channel the production of seeds of improved varieties through skilled farmers who became efficient seedsmen.

## 5. PRIVATE SEED CORPORATIONS

With the development of hybrid seed technology, and the biological protection it confers to the final seed product against duplication and unauthorized use, private seed corporations had possibilities of entering markets with products which could yield high performance to farmers, at higher prices per unit than non-hybrid seed. The return sales of hybrid seed allowed market forecasting, projections of revenues and profits and, therefore, of investment. Competition among private companies required that they move away from the initial sale of public hybrids to their own proprietary hybrids, and thus allow a price structure to be maintained. The development of variety protection legislation for non-hybrid based proprietary varieties, has allowed further expansion of private seed companies. A third stage of technological development: varieties developed by modern genetic engineering procedures will provide an enhanced base to private seed companies, provided that their products are patentable, as they already are in a number of countries.

Proceeding along the evolutionary lines indicated in the five types of seed producing/marketing entities, various mixes and proportions of these entities and their market participation may be encountered, as particular markets mature.

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ANNEX VIII.  
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