

PN-HAZ-482

MM-55415

AGRICULTURE AND NATURAL RESOURCES STRATEGY ASSESSMENT

**IQC Contract No. 650-0071-C-00-8005
Project No. 650-0071-3-30123**

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USAID/SUDAN**

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December 1987

PREFACE

This report is the output of a three-week field effort in the Sudan which consisted largely of a desk study of selected documents describing the general status of the Sudanese economy as well as its agricultural and natural resource base. The documentary information and discussions with USAID staff members and Sudanese professionals provided the basis for a brief description of the macroeconomic setting in the Sudan, an overview of the agricultural sector, an enumeration of opportunities for agricultural growth, and a description of current USAID activities in support of Sudanese agricultural development. All of this information is contained in the Appendices. The main body of the document presents the suggested strategy and rationale.

The study benefitted greatly from discussions, interactions and logistical support from the Agricultural Development Office staff. Members of the Economic Policy and Planning Office staff provided constructive comments and criticism as well as office space. Brian D'Silva of USDA and Sudanese development economists Ibrahim Elbadawi and Sadiq Umbadda directly supported the development of this study by providing the team with an initial introduction to policy issues, feedback to our strategy ideas and suggestions, and a thorough review and critique of the final product. Their input was much appreciated by the team as it helped inject political realism into the final suggested strategy.

The limited amount of time and level of effort allocated to this study meant that it is perhaps "quicker and dirtier" than one would like. We do hope, however, that it serves the basic purpose for which it was intended, to assist USAID/Sudan in developing a medium-term plan for support to Sudan's agricultural sector. As always, the responsibility for the content and accuracy of this report lies strictly with the authors.

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AGRICULTURE AND NATURAL RESOURCES STRATEGY ASSESSMENT

SUDAN

A. Major Development Problems

The Sudan is faced with a plethora of development problems which both affect the development of the agricultural sector and are affected by it. As the most important sector of the Sudanese economy (one third of GDP, 95 percent of export earnings, employer of four-fifths of labor force), this sector must make a major contribution to the solution of the following problems, which are pervasive and interrelated:

1. Static Economic Growth

Although there has been considerable fluctuation in the Sudanese economy over the past decade, primarily due to drought and recovery, there has been less than two percent average annual economic growth in this period. Since the population has continued to grow at an average annual rate of 3.1 percent, per capita economic growth has been negative.

2. Foreign Trade Imbalance

The Sudan produces very few non-agricultural commodities, and few consumer goods except food. It relies heavily on the foreign exchange earned on agricultural exports to permit the importation of fuel and most producer and consumer goods. The general decline in agricultural commodity markets, while petroleum and most manufactures increased in cost, led to a chronic merchandise trade imbalance. This was offset by borrowing, thereby creating an international debt in excess of \$10 billion and raising corresponding problems in debt servicing. Correcting this trade imbalance by increasing agricultural exports is complicated by an overvalued exchange rate and lack of aggressive marketing of Sudanese products.

3. Public Sector Deficit

A large, inefficient and growing public sector absorbs a disproportionate share of savings. Public sector revenues have declined owing to slow growth and a new tax system providing lower returns. The deficit has been financed by borrowing. In 1986 the debt reached 11 percent of GDP, contributing to an annual inflation rate close to 50 percent. Major sources of support for national and provincial governments derive from export trading income of agricultural products by parastatals and taxes on agricultural production and trade.

4. Food Security

The Sudan has enormous food production potential, yet currently lacks the capacity to routinely satisfy its internal consumption needs. This reflects not only low agricultural productivity, but also the uncertainty of Sahelian weather, dedication of irrigated land to produce export commodities, and weak infrastructure whose limited storage and inadequate transport work against geographic redistribution of food supplies.

B. Government of Sudan agricultural sector goals

As part of its new Four-Year Salvation, Recovery and Development Program, the Government of Sudan has identified the following goals and objectives to be of primary importance for the general economy, and for the agricultural sector in particular, given its pervasiveness in the country.

- o Maximize foreign exchange earning from the agricultural sector
- o Maintain adequate food supplies for the domestic population (food security)
- o Enhance and preserve the natural resource base
- o Correct the imbalance of agricultural and regional development, placing more relative interest (investment) in the traditional rainfed sector
- o Stem the tide of rural-urban migration
- o Promote changes in institutions leading to greater efficiency and productivity.

C. USG Interests and Objectives

The U.S. interest as advanced by AID is not at variance with these GOS objectives. In particular, "the focus of the Agency's Agriculture, Rural Development and Nutrition Program is to increase the income of the poor majority and expand the availability of food, while maintaining and enhancing the natural resource base."

U.S. interests in Sudan derive from its strategic location, its historically constructive approach to Middle East politics, its political and diplomatic influence in the Arab and African worlds, its recent entry into the small club of African democracies, and its potential as a food exporter to the Middle East. The protection of U.S. interests in the Horn of Africa and

the Nile Valley depend upon a friendly government. AID's contribution to the U.S. interest is to mitigate the economic hardships that persist from historical mismanagement and drought, laying the basis for long-term economic growth.

D. Constraints and Limitations

1. Historical/Political Heritage

The Sudan achieved its independence in 1956 after more than two centuries of colonial domination. Agricultural development concentrated on irrigated cropping and placed special emphasis on the production of cotton for export. The British-Egyptian authority established a system of government based on the English parliamentary system and developed road, rail and river transport systems and a communications system. The institutions and infrastructure established were systematic and functioned relatively well, although heavily dominated by bureaucratic control.

Following independence, the inherited political structure and physical infrastructure began to break down as competing national interest groups pressed their individual desires on the central government. Civil strife between the North and the South impeded development of the southern region while attempts to assuage other needs of the country led to decentralization, heavy international borrowing, expansion of public sector employment and experimentation with new economic policies. As the economy deteriorated so did opportunities for gainful employment, resulting in the out-migration of many well-qualified Sudanese professionals. These weaknesses limit the political, economic, and managerial capacity of the GOS administration to take desirable corrective measures to restructure institutions or rehabilitate infrastructure.

2. Unstable Macroeconomic Situation

Sudan has had virtually no economic growth in the last decade and real per capita income has declined. Inflation is growing, triggered by excessive demand growth and a public sector deficit created by excess employment and declining revenues. The public sector debt is now 11 percent of GDP. The international debt now exceeds US \$10.2 billion. The impact of an overvalued exchange rate has led to a scarcity of agricultural production inputs and consumer goods and has fostered the creation of a black market in currency and consumer goods. This has encouraged imports of competing agricultural products while discouraging Sudanese exports. It has also reduced the financial capacity of the GOS administration to provide essential services.

3. Agro-Ecological Constraints

Sudan's natural resources are neither limitless nor uniformly productive. Overexploitation of relatively fragile resources may cut short achievement of their full potential. The northern third of the country is desert, while the Sahelian center suffers from uncertain rainfall, prolonged drought, and the lack of sub-surface water. The vast irrigation schemes already developed along the Nile now utilize 80 percent of the irrigation water available to the Sudan through treaty with Egypt concerning utilization of Nile waters.

4. Size, Population Density, and Transportation Constraints

Sudan, the largest African nation, has a population of only \$21 million with a density of about 8 per square kilometer (30 per square kilometer of agricultural land). This compares with weighted average population densities of 36 and 460 in North Africa and the Middle East, or 56 and 112 in Sub-Saharan Africa. The lack of permanent water sources limits human settlements and grazing to the rainy season, or to natural oases and water points that have been developed along transportation corridors.

Sudan also has one of the lowest densities of all weather roads in the world. Few intercity roads are paved, while most are unimproved tracks that become impassable in the rainy season. The small trucks and high operating costs per ton mile which this engenders contribute to the high margins between farmgate and consumer. The national railroad operates at 20 to 40 percent of capacity. The inability to distribute relief food supplies during the recent drought or to redistribute locally produced food from surplus to famine areas dramatizes in humanitarian terms the heavy economic costs of a weak transportation system.

5. Farming System Constraints

Sudan's low population density, vast land base, and production potential, coupled with soil types requiring mechanical power for effective exploitation in certain areas, have promoted the development of four distinct farming systems or sub-sectors in the Sudan: the traditional rainfed; the nomadic pastoral; the mechanized rainfed; and the irrigated schemes. These systems are subject to common constraints of low productivity due to inadequate technology, lack of adequate access to productive inputs and credit, and deteriorating soil fertility.

Each sub-sector or system suffers from unique constraints. The nomadic pastoral system regards livestock as a store of value and markets them only when money is required for family expenses

or when drought conditions force a drastic reduction in herds. Traditional rainfed agriculture, limited to lighter soils that can be farmed with hand tools and limited animal traction, is characterized by small producers with limited access to inputs, credit, and markets. Mechanized rainfed farmers use heavy tractors to clear and till the soil on extensive acreages, tending to "mine" the soils through their practice of continuous cropping. When the soils become non-productive, these operators often move to other areas, subjecting previous acreage to wind and water erosion with potential for desertification.

Although somewhat complementary in the use of different soil types and the utilization of smallholder labor surplus, the mechanized rainfed system often competes with other systems. In the case of traditional rainfed smallholders, it destroys trees that provide a source of income from gum arabic and the production of charcoal. In the case of nomadic pastoralists, grazing land is destroyed. The irrigation schemes are weatherproof and not directly incompatible with mechanized rainfed farming. However, the former realize a low return on investment due to poor management and emphasis on cotton production, a high-value but extremely high-cost commodity, and cultivation of low-value field crops with low productivity.

6. Inequitable Incentive Structure

Farm income and freedom of choice are primary incentives for agricultural development. The large farmers in the mechanized rainfed schemes are for the most part relatively sophisticated merchants who have the experience, capacity and connections to achieve these. Small producers in the irrigated schemes have little choice of crops or technology, both dictated by the public-sector scheme managers.

Incomes from traditional rainfed farming are constrained by low productivity, unavailability of credit and inputs, and the need for cash motivating farmers to sell crops at harvest. For some grain crops, a differential of 100 percent distinguishes price at harvest time from the price five to six months after harvest. This difference is due partly to high storage losses and interest. Local village councils impose high taxes on the sale of cash crops in the formal markets, while the central government captures revenues by using the parastatal marketing boards to set low producer prices on export commodities. The combined effect is to reduce the farmer's proportion of final sales value. This not only limits his net income, but lowers his ability, and incentive, to achieve greater productivity.

E. Proposed Strategy

1. Major Conclusions on Sector Status

a. The Sudanese agricultural sector provides a living for 80 percent of the population and sustenance for the remainder, employs 80 percent of the economically active labor force, furnishes 95 percent of the country's foreign exchange earnings and most of the GOS revenue at national and local levels. Despite its relative importance, the Sudanese agricultural sector performs less than adequately relative to its potential in terms of output and derived employment, rural income, GOS revenue, and foreign exchange. A number of reasons account for this situation; many have their origins in, or are exacerbated by, inappropriate policies and practices of the public sector.

b. The macroeconomic situation is weak and prospects for its reform are uncertain. Donors are generally supportive, but the GOS has not yet developed an economic program to garner that support. Certain positive policy reforms have been undertaken recently (e.g. October, 1987), but it is too soon yet to judge their effectiveness on the agricultural economy.

c. Public sector institutions are generally overstaffed and inefficient. Their strong involvement in production and marketing of irrigated commodities, and in the marketing of all agricultural exports, frequently has perverse effects on the agricultural incentive structure.

d. Domestic marketing (which involves the collection, transport, classification, storage, and distribution of many export crops as well as food) is largely in private hands. Although market competition in some commodities is encouraged through government-run auctions, participation is restricted by licensing, whereas most trading transactions are still privately negotiated. The effect is to reduce the farmers share of the market price, thus limiting his income while enhancing that of the trader. This tendency is exacerbated by scarcity of credit and private lending contracts that require the farmer to sell at harvest, when prices are normally half those obtainable four to six months later.

Markets for export products such as cotton and gum arabic are controlled by parastatals. These tend to maximize their own revenues rather than encourage producers by means of remunerative prices and other market incentives.

e. The quality and use of economic and social data on the agricultural sector leave much to be desired. Economic data

is accumulating, but serious gaps in information remain which inhibit meaningful analysis.

Little is known about how different incentives affect adoption of various agricultural management practices. Since complex cultural variables come into play, it is unwise to estimate results based simply on traditional western economic incentives.

f. Currently, the better-watered South is excluded because of civil war from development intervention. The traditional farmers (both rainfed and pastoral) in the central and northern regions are subject to major uncertainties by Sahelian rainfall variability. They supplement their income in good years and bad by seasonal employment on irrigated and mechanized rainfed farms.

g. Each of the four major farming systems contributes to the Sudan's food security needs and export trade. Traditional rainfed farms in normal years satisfy their subsistence needs, contribute surplus food for the towns, and produce gum arabic, groundnuts, and sesame for export. Some 6000 mechanized rainfed farms are the principal source of sorghum grain, the basic energy food supply, while the large irrigated schemes are the major source of cotton, groundnuts, and sesame for export. Nomadic pastoralists satisfy most of their subsistence needs and sell livestock for domestic consumption and export to meet other requirements.

h. In varying degree, the three rainfed systems also contribute to environmental degradation and, ultimately, desertification. Natural cover is eliminated by agriculture, overgrazing, or collection for fuelwood. Of the three, the mechanized rainfed system is the most destructive because of its extent, the thoroughness of cover destruction, and the lack of any incentive for sustainable use.

i. Despite its vast size and low population density, the Sudan is approaching the limits of economical agricultural expansion. About 80 percent of available irrigation water is already in use. Traditional rainfed agriculture already occupies sites with permanent water, light soils, and adequate rainfall. Although mechanized rainfed agriculture can expand into heavier soils, it too is limited by the availability of permanent water and adequate rainfall. Future expansion will increasingly depend on the application of science-based technology. The productivity of most crops produced in the Sudan is below regional averages, and well below potential. Higher unit costs, however, will reduce Sudan's comparative advantage. Lack of an aggressive marketing strategy effectively reduces Sudan's potential market share.

j. Sudan has an international transportation advantage to the Middle East, if it can overcome high internal transport costs. Traditionally, Sudan has been oriented to export marketing of agricultural commodities, possessing public/private organizations experienced in these markets. It has a near monopoly on gum arabic, although this is being eroded by synthetics and alternative producers. The outlook for its other traditional exports (cotton, edible oils, feed grains) is not very good, because of world overproduction and/or high local production costs. It is well situated for production of off-season fruits and vegetables for the European and Middle Eastern markets, particularly under irrigation, and for tropical products and exotics such as karkadeh. However, these markets are highly competitive and demanding, requiring a long-term focus with gradual expansion as experience is acquired. Wheat is about the only significant potential opportunity for import substitution. Yet, given domestic production costs above the marginal price for imported wheat, substitution is unadvisable.

In summary, the major constraints to growth in the sector are: uncertainty of rainfed agriculture; fragility of the Sahelian environment; weak transportation; an unstable economic and political environment; inefficient public sector institutions; and an agricultural marketing system that provides little return to farmers.

Major strengths of the sector are: three distinct productive farming systems; massive investment in irrigation, permitting year-round production of almost any crop in Sudan's climate; a smallholder production system with surplus labor that generally yields surplus food and export products despite uncertainties; a mechanized rainfed system operated by a small number of entrepreneurial farmers, combining tractor power to exploit heavy soils with the smallholder surplus labor to produce massive food supplies.

Improvement in the sustainable productivity of these systems and in production incentives are the basis for the recommended agricultural sector strategy. Low population density and weak infrastructure require that project activities be concentrated in limited geographic areas.

2. Sector Goal

The goal is to improve productive efficiency and effectiveness of the sector in order to:

- a. raise incomes of the rural poor;
- b. improve food security;

- c. maintain and enhance the natural resource base; and
- d. increase foreign exchange earnings from agriculture.

3. Strategic Objectives for Agricultural Sector Activities by Sub Goals

- a. Raise incomes of the rural poor by:

- (1) improving the share of commodity prices received by the farmer;

- (2) improving access to credit, inputs and storage through better farmer organization; and

- (3) increasing off-farm employment on mechanized rainfed and irrigated schemes, due to expanded sustainability.

- b. Improve food security by:

- (1) Upgrading the productivity of rainfed traditional and rainfed mechanized systems by means of improved technology;

- (2) improving selected parts of the road network; and

- (3) encouraging better postharvest storage in villages.

- c. Conserve natural resources by:

- (1) developing improved technology and management for mechanized rainfed farms to make sustained agriculture more profitable; and

- (2) Establishing an incentive/disincentive system geared to rational behavior to encourage rainfed mechanized farms to maintain a sustained agricultural system.

- d. Increase foreign exchange earnings from agriculture by:

- (1) encouraging GOS to develop a positive macroeconomic environment;

- (2) stimulating greater attention to non-traditional agricultural exports; and

(3) promoting a more aggressive approach to marketing of traditional exports to maintain/expand market share.

4. Policy Agenda

The GOS' capacity and willingness to achieve effective change are constrained by historical and temporal political factors. An awareness of these must temper expectations of AID's ability to influence the GOS administration to make desirable changes. However, AID policy and program strategy, above all, must avoid worsening the national policy and institutional environment. Given limitations on AID's resources and influence, it is desirable to work in concert with other donors. Donors must refrain from providing conflicting advice.

The proposed policy agenda is predicated on the promotion of certain strategic precepts. These give direction to the design of individual projects and the policy dialogue needed for its implementation. The following are the most important:

a. Limiting Public Agricultural Sector Growth

An appropriate public sector role is to stimulate the agricultural sector to modernize itself, enabling it to fulfill its role as provider of food, employment, and income. It does so by providing a policy environment that encourages the private sector to make economically rational investment and other decisions in response to market forces. Government investments and services to agriculture are financed by taxing the sector, hence are at the expense of private investment. Direct government investment is appropriate to provide public goods when the private sector lacks economic incentive or capacity to do so. Areas of investment that provide the possibility for adequate economic return should be the domain of the private sector. The government should play only a regulatory role to ensure free entry and compliance with health and safety requirements.

b. Encouraging Economic Stabilization

Economic stabilization is generally good for agriculture. The advantages are: control of inflation and encompassment of a competitive market determined exchange rate; a monetary policy that provides an adequate supply of credit at market interest rates; and fiscal and budget policy that balances public sector income with expenditure and provides funds for operational and personnel costs.

c. Increasing the Farmers' Share of Agricultural Income

Increasing the farmers' share of agricultural income is the fundamental means for increasing output and rural

welfare. This improvement is best brought about by boosting productivity increases with improved technology that lowers unit costs of production, and/or by collective farmer action that improves economies of scale and influence in product and factor markets. Government action is not the best means. However, the GOS' dependence on profits from parastatal trading is in direct conflict with the objective of decreased government involvement. Only government decision can reduce this involvement.

5. Program Priorities and Rationale

USAID's current strategy for the agricultural sector, as outlined in the 1984 Country Development Strategy Statement Concepts Paper, focuses on enhancing the productive performance in the rainfed dryland areas of Sudan, with special emphasis on Western Sudan (Kordofan and Darfur regions) and traditional rather than mechanized systems.

The rationale for this approach centered on the rainfed sector's contribution to both domestic and export products, especially sorghum, groundnuts, millet, and gum arabic, as well as its perceived potential for future growth. The Government-operated irrigated subsector did not receive emphasis because of high capital requirements of the schemes, inefficiencies introduced by government control, and high investments already allocated by the World Bank and others for system rehabilitation.

This concentration on the traditional rainfed agricultural subsector is directed at each of the sector subgoals outlined above, and warrants continued priority attention. However, while concentration can address some aspect of each of these subgoals, it does not necessarily deal with the most important aspects nor in the most effective manner. For example, a major source of traditional rainfed farm family income is derived from seasonal employment on rainfed mechanized and irrigated farms. The major source of food energy in Sudan and the greatest surplus for urban consumption is sorghum grain produced on the mechanized rainfed farms.

The primary environmental problem is degradation caused by these same mechanized rainfed farms under present operating systems. This "mining" of the land presents a serious long-term problem for the Sudan if actions are not now taken to arrest the process. Appropriate actions in this subsector would also likely provide positive benefits to the traditional rainfed subsector through conservation of pasturelands, increased opportunities for gum arabic exploitation, and more stable patterns of off-farm employment.

One of the most promising potential sources of foreign exchange and farm income is the production and marketing of non-

traditional agricultural products, especially fruits and vegetables, to European and Middle Eastern markets. Such an initiative could lead to greater farm incomes, especially in the irrigated areas, as well as provide added pressure for more flexible decision-making in the irrigated schemes.

Further rationale for a modified strategy, especially with respect to activities in the irrigated areas, is found in two significant conditions. First, the drought from 1984-86 confirms some inherent uncertainties with rainfed agriculture and the attendant need to diversify in order to ensure a more stable food production and income base. Secondly, mobilizing the traditional sector will require huge investments in infrastructure just when the U.S. foreign economic assistance budget is declining significantly.

In view of the above, the suggested strategy for agriculture proposes project efforts in three operational program areas:

- o Traditional Rainfed Agriculture
- o Mechanized Rainfed Agriculture
- o Non-Traditional Agricultural Exports

Concentration within these program areas is to be achieved by: (1) activity selection; (2) geographic area; and (3) timing of activities, rather than by restriction to a specific subsector.

Activity Selection. The proposed activities in each program area include a very few highest priority operations, carefully selected to achieve maximum impact within each major agricultural subsector. It should be noted that these activities were selected before the team examined the currently authorized and planned USAID/Sudan agricultural program. Consistencies between the two should therefore be interpreted as mutually confirming, rather than as an endorsement of the USAID/Sudan agricultural program.

Geographic Area. These program areas are equivalent to major agricultural subsectors, each of which covers an enormous acreage in a vast country. Projects within these programs will not cover the entire subsector, but must be designed to take advantage of favorable environmental and infrastructural characteristics and to provide experience to build on. The cost of a particular activity can thus be adjusted (within limits) by restricting the area of operation.

Intervention Phasing. Entry into new subsector programs must be gradual in order to assure successful operations. A significant lead time is needed before major investment in order

to identify and debate options, carry on a dialogue with the GOS, perform studies, conduct pilot operations, and evaluate outcomes. Many of the alternative program activities suggested herein are relatively low cost studies and pilot operations which can be phased into a program still focused mainly on the traditional rainfed subsector. Should policy and other conditions warrant, major subsequent investments would come three to five years from the present, after investment requirements from the traditional subsector have peaked. Note also that AID investment in both the traditional subsector and new program activities will be complemented by that of other donors if AID performs the pathfinder role.

It is only after sites have been selected and projects have been designed that reliable estimates of internal rates of return can be calculated. Prior to this, the selection among subsectors must be based on their presumed contribution to broader objectives. Final prioritization of areas of concentration and individual projects should be accomplished through discussions and debate within the Mission and with Sudanese development professionals and the GOS. The following is an illustrative evaluation of program contribution to development goals:

OBJECTIVE	TRADITIONAL RAINFED	MECHANIZED RAINFED	NON-TRADITIONAL EXPORTS
Primary Goals:			
Farm Income	High	Fair	Fair
Food Security	High	High	Low
Nat Resource Cons.	Fair	High	Low
Foreign Exchange	Fair	Low	High
Other Objectives:			
Devel. Imbalances	High	Low	Low
Rural-Urban Migr.	High	Fair	Low

While these are operational programs, strong emphasis is placed on collaborative experimentation, rather than on prescriptive methodology. Stress is placed on establishing a sustainable framework of technology and incentives that motivate the private sector to invest and perform as desired, rather than attempting to provide management controls through public-sector institutions. Public sector investment, whether in infra-

structure, research, technical assistance, or training should focus on supporting this framework.

GOS macroeconomic and investment policies are an important influence on the success of any of these programs. It is important that these policy decisions be informed by an adequate data base, appropriately analyzed, and used by decision makers at the highest levels of government. This is the reason for emphasizing these functions in a separate, non-operational program.

F. Program Initiatives

Following are initiatives for USAID consideration in each of the operational program areas, along with suggested strategies for policy dialogue and improvement of information flows.

1. Development of the Traditional Agricultural Subsector

Traditional agriculture is the major source of the basic food commodities, including livestock, as well as the source of two of the major export commodities, gum arabic and sesame. Given the historically low levels of investment in the subsector, it is apparent that there is potential for substantial improvement in individual productivity and total production of domestic crops and export commodities. This can be achieved through improvements in the availability of credit, inputs, transportation, and storage infrastructure; the provision of orderly marketing; adoption of new technology; and price policy adjustments. Enhanced production and productivity will lead to increased food supplies, rural incomes and employment, and a general increase in the welfare of the rural population. Providing better employment and income opportunities in rural areas will also alleviate the economic pressure to migrate toward the urban centers.

The key limits and constraints to be addressed by the suggested strategy are: low productivity, and hence low incomes, stemming from current production systems; the existence of policy and marketing structures which appropriate the majority of the gross income from agricultural production; and inadequate infrastructure in support of agricultural production and marketing. The proposed strategy consists of four distinct sub-elements, each designed to accomplish a specific goal or objective contributing to the alleviation of the major constraints enumerated above.

a. Technology development and transfer

Productivity levels of food grains in the traditional subsector are low, yet the potential exists for significant yield increases from commodity-specific research

which takes into account the limitations and constraints faced by farmers. USAID has already made a considerable investment toward this end by funding the WSARP Project and will continue to contribute through the new Agricultural Research and Production Project. Varietal improvement is required for food and export crops, complemented by two technology transfer activities as follows:

- o the development of an efficient private sector certified seed multiplication industry and distribution channel. This is especially important, since traditional farmers have little or no access to production inputs due to inadequate distribution systems and resource constraints.
- o the development of an effective means of transferring new technology to farmers as it is developed, which may involve the organization and staffing of a public or private extension system.

In the near term, ARC should receive support to integrate and take full advantage of the WSARP experience, continue research programs at Kadugli and El Obeid, and provide opportunities to upgrade and maintain ARC staff. The research agenda should include study of current farming systems, including socioeconomic aspects such as employment and migration patterns, gender roles, non-farm and off-farm activities, and influence of all these on agricultural production.

b. Infrastructure development

(1) Socioeconomic

There are many inefficiencies and inequities in rural production and marketing systems that could be corrected by collective social action. For example, at present there are numerous cooperatives and a national farmers organization that could be utilized to influence the performance of product and factor markets. The use of existing cooperatives or the establishment of new marketing cooperatives will provide an entity through which to channel and distribute credit, inputs, and general production and marketing information. They can also be utilized to provide storage and to undertake the physical marketing of commodities, providing an assembly function and enhancing orderly marketing. An activity along this line is currently being implemented as part of the Kordofan Rainfed Agriculture Project. In order for activities of this type to be effective, projects should be based on a thorough analysis of the production and marketing system to identify the current structure of the system and its overall efficiencies or inefficiencies and inequities.

Another alternative would be to try to improve current systems that perform a useful economic role rather than to establish new institutions. For example, agricultural credit is being provided through an informal system which is costly yet responds to needs. It may be feasible to make this system perform better through increased supply of capital and increased competition.

(2) Physical

Not all factors that promote agricultural development are directly "agricultural". Transportation systems (roads, rivers and railways) are crucial to agricultural development, especially in large countries like the Sudan. Communications systems are also vitally important for transferring market and other information. The adequacy of these systems, and the cost and feasibility for support in these areas should be given serious consideration if budget constraints allow. USAID has and should continue its past support toward construction of critical infrastructure on a regional, targeted basis, complementing investments in socioeconomic development.

In the near term, USAID should support the means to better utilize available water in unirrigated areas. Although underutilized for productive purposes, there currently exists a technique for capturing and spreading water that runs through seasonal water courses. Simple, inexpensive structures (small dams) should be designed and built using local labor and expertise.

c. Development of the Gum Arabic Industry

The tree, Acacia senegal, is native to Sudan. It is economically important as a source of gum arabic and fuelwood, and ecologically important for its role in natural resource conservation. Gum arabic should be viewed as an important industrial crop. Full advantage should be taken of Sudan's near monopoly position in the international market. A thorough knowledge of the international gum markets is essential to the development and expansion of the export market and to the maximization of export earnings. A thorough analysis should be undertaken to determine the most feasible manner of incorporating gum arabic into a stable, sustainable farming system. Current USAID interventions in this regard include the establishment of 25,000 feddans of Acacia senegal in Southern Kordofan as part of the Sudan Reforestation and Anti-Desertification Project. An important policy consideration is to shift the objective of the Gum Arabic Corporation from maximizing current government revenues to maximizing returns to producers, thereby enhancing production incentives.

d. Livestock Marketing Extension Training

The strategy for livestock implies education, teaching, and demonstrating the relative merits of marketing livestock at optimum weights. There is now an effort underway by the World Bank which provides transport, feeding, and a market in Khartoum for livestock coming in from the West. The adoption of weight and grade standards in the markets as a basis for price is also an educational endeavor. These concepts can be promoted through technical assistance in marketing and by working with the marketing cooperatives and the Farmers Union.

It is recommended that USAID's provide technical assistance in marketing extension, utilizing producers organizations as the facilitating group. However, one must take into account a major constraint specific to livestock: the traditional view that livestock is a store of value rather than a cash commodity.

Basic to achieving the goals and objectives of the strategy for the traditional sector is a change in government policy that currently maximizes revenues at the expense of producers and the commodity industry. AID should seek to influence the central government to shift its policy by illustrating the positive effects that such a shift will have on overall production, total industry returns, and, consequently, on government revenues.

2. Improvement of the Performance of the Mechanized Rainfed Subsector

A thrust into the mechanized rainfed subsector is justified on grounds of food security, employment generation, environment, and technology.

Food Security: The subsector occupies 9.2 million feddans and produces over a million tons of sorghum, the primary food energy source of Sudan. Generally located in areas with less variable rainfall, mechanized rainfed farms produce a more reliable food source than traditional rainfed systems. During favorable periods, the surplus produced can be stored or exported. Thus, strengthening the sector can reduce the risk of future food shortages, particularly in the western traditional farming areas.

Employment and Equity: Much of the mechanized rainfed area is unpopulated owing to isolation, the lack of permanent water, absence of schools, clinics, and communications, and soils not suited farming with hand or animal traction implements. Mechanized land-breaking and planting operations are required to farm the heavy cracking clays in the rainfed areas, and large blocks (1000-3000 feddans) are needed to warrant the investment in tractors and implements. However, weeding and harvesting are hand operations. Consequently, the subsector is a major income

source for the underemployed traditional farmers of Western Sudan. This system also complements the labor requirements of the irrigation schemes along the Nile. Labor moves back and forth between the irrigation schemes and the mechanized farms, particularly during the dry season harvest.

Environment: As currently practiced, mechanized rainfed agriculture presents an environmental hazard. Land is cleared of natural vegetation (trees, shrubs and grasses) in very large blocks, and generally farmed to continuous sorghum with minimal adherence to recommended rotation and fallow. As fertility declines, the land is abandoned to wind and water erosion (and hopefully, recovery) and farmers move to clear another area. In essence, this is bush fallow on a grand scale. Under Sahelian conditions, desertification is as probable an outcome as recovery. The system also disrupts traditional nomadic pastoralism, and eliminates the trees and shrubs that produce gum arabic and charcoal. Nevertheless, the economic importance of rainfed mechanized agriculture assures its continuance. The solution must be to alter the technology and management to assure sustainability and that of traditional pastoral and gathering systems.

Technology: The mechanized rainfed subsector, despite its great size, is managed by about 6,000 primary owners and 12,000 farm managers. The owners are relatively sophisticated merchants with access to investment resources, preferences, and markets. Thus, the subsector can respond very quickly to price incentives, as demonstrated in 1985. It should also be more cost effective and easier to encourage this relatively small number of decision-makers to adopt more productive technology and better environmental management systems.

a. Adaptive Research

The strategy for reforming the mechanized rainfed subsector is primarily dependent on more productive technology and acceptable environmental management techniques, developed and proved through adaptive research. This research must be carried out as a collaborative effort with leading mechanized rainfed farmers to assure its practicality and to identify any factors which might limit the widespread adoption of results. Through this process, the Mission will also seek to define mechanisms for transferring the developed technology, for providing inputs in a timely and economical manner, and for encouraging regulation of the subsector to avoid its worst effects.

The research should lead to both improved productivity and sustainability, and should examine the socio-economic factors that will permit accomodation with traditional systems and encourage rehabilitation rather than abandonment. The following are examples of the kinds of orientation believed practicable:

(1) Soil fertility programs including the use of fertilizers, biological nitrogen fixation, and rotations designed to sustain crop production, thereby avoiding abandonment.

(2) Land preparation and weed control practices to permit earlier seeding, thus taking advantage of early season rains and avoiding production variability due to late season rainfall variability.

(3) Introduction and varietal screening of improved cultivars (e.g., non-shattering sesame, drought-resistant dwarf sorghums) to increase economic yields and improve rotations.

(4) Incorporation of seasonal grazing in mechanized dryland farming, through utilization of crop residues and fallowed land, including accelerated recovery programs by re-seeding with forage species.

(5) Recovery of severely deteriorated abandoned land by replanting with fuelwood or gum arabic species.

At the present time, research programs neglect this subsector. It is suggested that the research and extension program be included in the upcoming project design for Agricultural Research and Production, as a collaborative effort with leading mechanized rainfed farmers. Research into plant breeding and screening can be centered on the ARC station at Wad Medina, while soil fertility trials, varietal trials, machine testing, and weed control practices can center on the Kadugli and Abu Namma substations.

b. Necessary Policy Changes

Farming systems research must be complemented by socio-economic investigation of feasible incentives for encouraging realistic adherence to sound land use policies. Current restrictions limiting mechanized rainfed operations to demarcated lands are largely ignored, as are the prescribed rotations. Although these violations are not fully explained they almost certainly reflect rational decisions by the beneficiaries.

The mechanized subsector has found it profitable under existing technology levels and GOS policies to move onto undemarcated lands and engage in agricultural production. In so doing, they have often: (1) infringed upon traditional rights of transhumants to certain livestock routes, grazing areas, and watering sites; (2) opened marginal lands to cultivation, soil degradation and desertification; and (3) destroyed fuelwood needed by traditional agriculturists and pastoralists as a

consequence of land clearing operations. Correction of these deficiencies requires something more than policy dialogue. It requires a search for acceptable and enforceable changes in the system. Such changes could include: an increase in land rent to cover cost of replanting/reforestation; limitations of the length of time land may be rented; restrictions on the total amount of land that can be rented; and tighter enforcement of existing regulations of the Mechanized Farming Corporation or other government agencies.

There is an acute need for feasible methods for classifying and evaluating land areas as to suitability either for mechanized farming, for planning and implementing reforestation and village fuelwood projects, or for the re-establishment of rangeland grasses. However, knowledge of this sort may be necessary yet insufficient to alter farming system methods currently employed. Change is more likely to come about because of behavioral knowledge of the participants.

The USAID sponsored projects, planned or in place, concerning planning for land use and reforestation are useful, but probably insufficient for dealing with this problem. These include the Eastern Refugee Reforestation Project, the Sudan Reforestation and Anti-Desertification Project, and Sudan Resource Data-Base Monitoring. The first, limited to 8,000 feddans in Kassala Province, may provide useful experience, but can have a minor impact on the immensity of the problem. The second project appears more inclusive because of its emphasis on development of an information base and self-help activities in sustaining forest management in traditional agricultural systems. Whether the third project can effectively determine soil types suitable for mechanization by remote sensing is unknown. If achieved, it would offer an effective tool for future GOS selection of demarcation lands for mechanization.

3. Development of Non-Traditional Agricultural Exports

Sudan's export trade in agricultural products has been concentrated on a few traditional commodities traded in broad international markets, e.g., cotton, sesame, groundnuts, gum arabic, livestock, sorghum. Such markets will always absorb the Sudanese product, albeit at reduced prices in periods of general oversupply. The prevailing outlook is poor. Sudan can continue to produce for these markets by improving its comparative advantage, lowering unit costs through increased productivity. It can also regain market share by more aggressive marketing. However, neither approach will offset the poor product outlook caused by worldwide overproduction or competing products.

At the same time, there is an unfilled market demand in Europe and the Middle East for out-of-season fresh fruits and

vegetables, as well as exotic tropical and subtropical products, either fresh or processed. Sudan's latitudinal range and its irrigation schemes within a desert climate are ideal for producing a wide variety of such products at times when their markets are undersupplied. At such times, prices are high enough to provide exceptional margins--indeed, high enough to yield extraordinary profits even after meeting transportation costs and factoring in risks due to perishability. The promise of such profits warrants careful analysis of the possibilities of increasing non-traditional agricultural production, both as a way to expand the returns on irrigated schemes and as a means to provide additional income from rainfed farms and by the marketing and processing of new products.

The basic objective would be to develop and facilitate the production and export of high-value non-traditional crops and processed products. While there are a great many steps to be undertaken to effectively accomplish this objective, we suggest that in the near-term USAID begin by implementing the following first stage program.

a. Foreign Market Opportunity Analysis

For the fresh market, such an analysis requires the identification of target markets, market requirements, tariff and non-tariff barriers, market "windows" (periods of consistent low supply), seasonal price movements and any preferential status of the Sudan. This information would be compared with Sudan's capacity to produce adaptable crops of required quality at the appropriate season. The cost of production and marketing, and transport availability and cost, would all be taken into account.

For the processed products, the opportunity analysis identifies those crops adaptable to the Sudan, the potential yield and quality of those crops, and the various products that could be processed from such crops. These factors are then related to current foreign market demand, trends, and anticipated changes, including the latent demand for high-value specialty foods and new products, such as a beverage developed from the local karkadeh.

These initial analyses will yield a list of target commodities which can be produced in Sudan with the characteristics required for the fresh and processed markets. Ideally, these commodities will exhibit the following characteristics:

- o Be subject to low tariff or other barriers;
- o Require a minimum investment in grading, packing, storage and processing equipment and facilities;

- o Fit identifiable market windows in targeted countries with a high margin between f.o.b. export prices and cost of production;
- o Have high demand or identifiable latent demand for high-quality or specialty processed products.

With these criteria in mind, and with the aim of concentrating promotion and investment efforts, one can group commodities in terms of their potential for high returns to investment to assure that they are at least competitive with current products.

b. Non-Traditional Crop Research and Identification

Production field trials are needed to identify those crops and cultivars which are best suited to the Sudan and to the targeted markets for fresh or processed products. The research program would also project yields, production costs, quality expectations and profit potential. A decision can then be made about the feasibility of production and marketing specific crops and products. If deemed feasible, the following activity could be supported.

c. Postharvest Technology Introduction and Implementation

The production and export of non-traditional products requires proper postharvest technology. This includes proper harvesting methods, pre-cooling, grading, packing and shipping of perishable commodities. Processing of these products requires proper facility design, as well as proper handling of raw products and their correct processing, holding, and shipping. Appropriate equipment must be imported or fabricated in country.

The export of perishable non traditional exports is particularly sensitive to the policy and management environment. Farmers need freedom to establish cropping patterns as well as production and postharvest handling methods satisfactory to the market. Exporters must be able to get the product from the farm to the import market without bureaucratic delay. Both farmers and processors need access to foreign exchange to buy needed inputs and equipment in a timely manner. Above all, a rational tariff structure and an exchange rate which is not overvalued are needed if producers and processors are to achieve reasonable economic returns from their investment.

USAID/S has only one activity which relates to non-traditional ag exports. A project was initiated to provide information to production managers of the Gezira and Rahad irrigation schemes. The development of quantitative programming models will permit them to examine the economic consequences of production choices. It will also provide information on

alternative optimal cropping patterns, both existing and potential, based on physical input-output relationships, and relative prices. This analysis will in turn allow ex ante determination of the economic performance of non-traditionals, as well as indicate their proper place in alternative cropping patterns. This activity should be supported basically as it is designed without modification.

d. Necessary Policy Reform

In the irrigated areas, rather strict requirements govern the types and quantities of various crops that farmer/tenants must plant. Production of non-traditional export crops require a change in managerial processes in the direction of incentives and flexibility in establishing cropping patterns more reflective of private and social profitability. USAID should act as a facilitator of this process by making managers of the scheme and tenants aware of the export possibilities and advantages; at the same time, USAID should withhold further support until the necessary changes have been made.

4. Policy dialogue and information

USAID and other donors engage in policy dialogue with governments to encourage modification in macroeconomic and other policies. Certain policies, inferred through economic logic, are necessary to promote productive investment, economic growth, and the ability to viably participate in international financial and trade markets. Macroeconomic policies have a marked effect on the success of agricultural development efforts. However, the effects of policies are not limited to agriculture. Thus, the dialogue should be conducted in a forum in which other legitimate development interests are included. Collectively, the donor community has a vested interest in the economic prosperity of Sudan and has some degree of control over resources needed to encourage policy changes. These resources should be utilized to bring about required changes.

As difficult and as frustrating as it may seem, the pre-conditions for suggested productive investment in the various agricultural subsectors will come about as the result of policy dialogue and reform. If necessary policy conditions are not forthcoming, and reasonable benefit-cost ratios cannot be expected from project outputs, then donors should refrain from financing projects. Projects that are not economically and socially viable and do not increase net returns to the private sector do not merit donor support. Thus, policy reform is a sine qua non as a pre-condition for implementing each of the recommended program activities.

The policy dialogue process is less influenced by donor leverage than by national appreciation of the importance of

policy decisions and understanding of the mechanisms and relationships of policy instruments. The benefits of policy analysis come primarily from advice on current problems requiring cabinet level decisions, performed directly in support of those decisions. This implies one or several small advisory units of first-rate economists who understand policy analysis to work directly with the primary decision makers, i.e., the members of the economic cabinet. These units make the most effective use of medium-term policy analysis studies, supported in turn by the data and information-gathering process. AID and other donors will be well served by facilitating establishment of such small economic advisory units.

To facilitate the policy formulation process, USAID is currently funding, through the Agriculture Office, the Agricultural Planning and Statistics Project which provides basic information on sector performance and relevant policy analyses. This activity should be continued and expanded to address critical policy questions. It should also provide a forum through which various decision-makers in various ministries can have input into the policy analysis process and can benefit, as well, from the results. However, the impact of this project will remain limited until economic advisors can work directly with these decision-makers.

This process must be continuously supported by effective information collection, analysis, and dissemination. High-quality quantitative and qualitative information regarding the nature and performance of the agricultural sector is fundamental in order to carry out sound analyses and develop prescriptions for agricultural development. The lack of good information implies that decisions are made based on impressions and generally held beliefs which may or may not be accurate. In gathering and putting together the available information for this strategy assessment, a good deal of information and analysis was available, but there were some gaps and inconsistencies. For example, there appears to be little current information regarding household incomes, employment allocation between farm and off-farm activities, gender roles and the importance of women in agricultural production. More serious, perhaps, is the absence of good qualitative description and analysis regarding how production and marketing systems work, taking into account the goals, values, and incentives of all the actors involved. An important activity in this regard would be to undertake an analysis of current data sources and availabilities to uncover gaps and duplications and aid in the design of a better system. Again, the nature and scope of information to be collected needs to be very closely correlated to policy analysis needs.

USAID/Sudan has, at the present time, several projects involved in various aspects of information generation and analysis, but with a substantially greater emphasis on

quantitative information than on analysis. Most relevant in this regard is the Agricultural Planning and Statistics Project which has helped the Ministry of Agriculture and Natural Resources establish a statistics collection and reporting function. Additional policy analysis is currently being done. Under consideration for funding is the Sudan Resource Data-Base Monitoring Project which, among other things, will provide critical information for monitoring current status and trends in deforestation and land degradation. Such projects are useful for establishing a data base for policy and program development and should be continued.

Also under study for funding is a proposal from the Ministry of Finance to fund an agricultural census. With a few exceptions, the statistical information currently available and USAID's current work are sufficient to provide a good quantitative base for agricultural decision-making. As implied above, greater emphasis is needed on the analysis and interpretation of available data as well as the development of better understanding of how systems function. An important precept on the economics of information may provide guidance. Information should be collected only to the point where its marginal value is greater than or equal to its marginal cost. Collecting information without a clear idea of the demand for information for policy analysis is not a particularly fruitful exercise.

Information is useful to private-sector decision makers as well as to government. The private sector can and should contribute to the policy dialogue through its own analysis of conditions and incentives. Such participation tends to assure greater realism in government decisions and helps to avoid the uncertainties inherent in ad hoc policies. It follows that the collection and analysis of information must include a system and entity to disseminate and promote its use. At the present time there is no adequate system to disseminate basic agricultural information to producers or market participants. One positive step in this direction is the publication under the APS Project of the monthly Agricultural Situation and Outlook. Because circulation of this publication is limited, a means for broader dissemination needs to be developed. Radio may serve this purpose.

APPENDICES

CHEMONICS

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APPENDIX I

MACROECONOMIC SETTING

Considerable structural problems in the economy of Sudan have been responsible for little or no growth in GDP during the past decade. The structural problems trace back to the early 1970s when the Government of Sudan nationalized several private enterprises, undertook significant public investment in projects that have yielded low returns, engaged in heavy foreign borrowing, and generally maintained over-valued exchange rates which have favored increased consumption and discouraged production of exports supposed to generate foreign exchange to service the foreign debt.

Rising inflation caused scarce private financial resources to move toward investment in non-productive assets such as real estate, imported durable consumer goods, and more stable foreign currencies. Attempts by the Government to reduce inflation by price regulation and controls further increased uncertainty regarding the profitability of commodity production. The resurgence of a vigorous underground economy (black market) meant that incoming remittances from Sudanese working outside the country escaped taxation, causing the Government to forego a potentially important revenue source.

Since the late '70s, the Government has been attempting to stabilize the economy and return it to a growth path. Rather than continuing expansionary investment policies, it has taken steps to rehabilitate existing capital assets. It has also undertaken successive devaluations of the currency to provide incentives to production for export and import substitutions, while making some modest attempts to re-establish the domestic private sector. By and large, such efforts have met with little success. This was due in part to uncontrollable factors such as the 1982-84 drought as well as the continuing conflict in the South. More importantly, the efforts that were made to reform policy were of insufficient scope and duration to obtain a real impact.

In February of 1985, the Nimeiri Government took stronger measures, among them increasing urban bread and petrol prices. This led to riots and exacerbated an already critical situation, culminating in the fall of the Government in April of that year. A transitional military government assumed power, and turned its attention to famine conditions caused by the drought, the conflict in the South, and the peaceful transition to democratic rule. The transition government was in power only one year, and was unable to take any substantive action to check the deteriorating economy. In May of 1986, a democratically elected coalition Government took office, and has been working since then

toward the development of a comprehensive long-term economic program as well as short-term stabilization policies implemented on October 3, 1987.

A. Current Situation and Recent Trends

1. GDP and Agricultural GDP

As indicated in Table 1, Sudan's economic growth has stagnated over the last decade, increasing at an average annual rate of one-half percent per year. More recently, Sudan has experienced a modestly negative growth rate of 1.8 percent since 1981/82. The principal conditions causing this poor record are enumerated above. With population increasing at approximately 2.8 percent per year, real per capita income has consistently declined. This trend was exacerbated during the drought years of 1983-85, while in recent years a significant rise in GDP has signified a quick recovery from the drought.

The contribution of the agricultural sector to overall economic performance has been strong and fairly consistent over the past decade relative to other sectors (Table 2). During that time, it has provided no less than 31 percent of GDP, with an average contribution around 36 percent. The reduction in percent share of GDP occurred in 1984/85, mainly as a result of the effects of a three-year drought. The agricultural sector ranks second in importance to the service sector in terms of GDP.

Within the agricultural sector, the irrigated and livestock subsectors have made the largest and most consistent contributions to GDP, though the livestock subsector has declined significantly in recent years due to herd reductions resulting from the drought (Table 3). The rainfed mechanized and traditional subsectors have contributed to GDP in similar patterns, both experiencing significant declines during drought years. Forestry, fisheries, and agricultural services have increased steadily in importance, but still contribute less than 10 percent of total agricultural GDP.

2. Exchange rate policies

Since the mid-1970s, Sudan experienced high rates of domestic inflation. The primary cause was excess demand generated by deficits in the public and parapublic sectors financed through credit creation; a significant jolt was dealt by the oil crisis of the late 1970s. Sudan introduced a complicated multiple exchange rate system in response, which has only recently been unified in October of 1987 (a black market parallel rate still exists). The exchange rate system resulted in price distortions, misallocation of scarce resources, administrative and punitive controls, and foreign exchange scarcity. Although the structure of exchange rates and the gaps

Table 1. Real and Per Capita Gross Domestic Product, 1975/76 - 1986/87
(Constant 1981/82 Prices) (a)

	{Drought}							AVERAGE % GROWTH RATE	
	75/76	81/82	82/83	83/84	84/85	85/86	86/87	75-86	81-86
Real GDP (LS Millions)	5956	6236	6264	6084	5387	5937	6244	0.5	-1.8
Annual Change in GDP (% p.a.) (b)	-	3.0	-0.4	-2.9	-11.5	10.2	4.1	1.2	-1.4
Population (Millions)	16.6	21.0	21.6	22.2	22.8	23.5	24.1	2.8	2.7
Real GDP/Capita (LS)	359	297	290	274	236	253	259	-2.3	-4.4

(a) Sources: 1975/76 figures and annual growth rates from World Bank (1987).

1981/82 - 1986/87 figures taken from Macroeconomic Task Force (1987)

(b) 81/82 figure is average over previous six years.

Table 2. Sectoral Contribution to GDP and Growth Rates, 1975/76-1986/87
(As % of Real GDP) (a)

	{Drought}							ANNUAL % GROWTH RATE	
	75/76	81/82	82/83	83/84	84/85	85/86	86/87	75-86	81-86
Agriculture	38	38	35	35	31	35	34	0.5	-3.0
Manufacturing	7	6	6	7	7	7	7	1.6	2.9
Construction	5	6	7	6	7	6	5	1.4	-4.0
Energy and Water	2	1	2	2	2	2	-	3.4	13.3
Services	48	49	50	50	53	50	52	1.6	-0.9

(a) Sources: 1975/76 figures and annual growth rates from World Bank (1987).
1981/82 - 1986/87 figures taken from Macroeconomic Task Force (1987).

Table 3. Agricultural GDP by Subsector (Constant 1981/82 Prices) (a)

	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87
Crops - Irrigated	583	738	761	715	686	713
Crops - Rainfed Mechanized	354	175	175	64	285	317
Crops - Rainfed Traditional	494	328	271	174	305	226
Livestock	810	808	738	530	632	698
Forestry, Fisheries and Agricultural Services	155	157	168	172	181	188
Total - Agriculture	2396	2214	2159	1654	2090	2143

(a) Source: Macroeconomic Task Force (1987)

between controlled and "market" rates have varied over time, one aspect has remained consistent throughout: controlled exchange rates have overvalued the Sudanese pound.

The overall effect of an overvalued exchange rate is to encourage consumption by making imports cheap and discourage investment by making exports costly. The GOS' exchange rate policy, combined with other price and subsidy policies, has had a generally negative effect on agricultural investment. In general, it has penalized production of agricultural exports, with export prices tied to overvalued official rates. At the same time, the potentially beneficial effect of the policy on the input side was offset by requiring many imported inputs to be purchased at the more devalued commercial rate or on the open market. (A more detailed and quantitative discussion of this subject is contained in ElBadawi, 1987.)

Special input subsidies and concessions regarding importation of durable capital inputs (tractors and other agricultural machinery) particularly helped the irrigated and mechanized rainfed subsectors overcome the negative effects mentioned above. The more traditional rainfed crop and livestock subsectors, which do not use great amounts of imported inputs, were penalized mainly by a reduction in profitability of the export market. If the production of export crops were not so heavily discouraged by exchange rate and other policies, shifts in production patterns would likely have occurred toward products like gum arabic exhibiting high export potential, higher rural incomes, and positive effects on the natural environment.

3. Monetary policy

Annual monetary expansion in the Sudan averaged nearly 40 percent between 1981/82 and 1986/87, rising from LS 1,825 million at the beginning of the period to LS 9,011 million by the end of fiscal year 1986/87. The money supply was primarily expanded through the extension of credit, 60 percent captured by the public sector, and 40 percent by the private sector. Over time, Government expenditures increased as a result of increases in nominal wages of public employees, rising numbers of employees on Government payrolls, and the high cost of the conflict in the South.

Given the lack of economic growth during the past decade, as noted previously, it is fairly safe to conclude that the demonstrated monetary expansion fueled inflation rather than financing economic expansion. Other things being equal, inflation causes agricultural productivity (yields) to decline as prices of capital inputs rise comparatively faster than wages, causing a reduction in the capital/labor ratio. Controls on product prices and exchange rates contribute to a deterioration in the terms of trade for agriculture.

4. Fiscal policies

During the past seven years, the fiscal performance of the Sudanese Government has been weak. While the levels of real expenditures have fluctuated, tax revenues have declined steadily. In 1984, the tax structure was abolished and replaced with the Islamic Zakat system, which taxes income, wealth and agricultural production of Moslems, with an equivalent Social Equity tax on non-Moslems. Total revenue declined as Zakat rates on income and profits are just 2.5% (5-10% on agricultural crops), with much of the proceeds being allocated to local social welfare programs with little returned to the central government. In the same year, when the implication of the new system were realized by the Government, a Social Justice tax was imposed on the incomes of companies, partnerships, and individuals. In 1985, the individual exemption was lowered and top marginal rates of the Social Justice tax were increased. Public sector companies, that had previously accounted for about half the revenue from companies, remained entirely exempted from taxes.

The revenue situation was further exacerbated by the tight foreign exchange situation. With the persistence of price and exchange rate controls, investment has been curtailed, and real wage rates have declined, causing erosion of the tax base. Moreover, a significant proportion of economic transactions (as yet unmeasured) has shifted to the unofficial (black market) economy out of reach of taxation.

On the expenditure side, real current expenditures (salaries and wages) declined between 1981 and 1984, taking a sharp upward swing in fiscal year 1984-85. Expenditures on defense increased due to the conflict in the South. Development and equity expenditures declined sharply, partly offset by foreign aid. Debt rescheduling and accumulation of arrears helped alleviate the situation somewhat.

On balance, the public deficit has increased from 6 percent of GDP in 1981/82 to a high of 12.3 percent of GDP in 1984/85 (Macroeconomic Task Force, 1987). External financing covered an average of 60 percent of the deficit, the remainder financed internally through the Central Bank, thus further expanding the money supply. Such deficits have had a significant impact on the high levels of inflation experienced in recent years.

5. International Trade

a. Total Imports and Exports

Total imports have declined steadily since 1981/82 (Table 4) due, principally, to severe import restrictions. These include import bans and tariffs and taxes on more than a hundred

Table 4. Major Commodity Imports (US\$ Millions)

	1981/82	1982/83	1983/84	1984/85	1985/86
Food and Beverages	395	277	219	192	195
Other Consumer Goods	126	112	96	59	85
Petroleum	339	333	351	286	266
Intermediate Goods	462	415	404	355	322
[Fertilizer])	[20]	[31]	[29]	[33]	[48]
[Insecticide]	[34]	[52]	[53]	[97]	[74]
Capital Goods	432	398	300	222	188
Total Goods Imports	1754	1534	1370	1114	1055

(a) Source: World Bank (1987)

commodities. As a result, economic development has been hampered due to shortages or high prices of certain essential inputs. Import restrictions were the result of scarcity of foreign exchange aggravated by poor export performance and unattractive exchange rates. These adversely affected remittances of Sudanese nationals working abroad who accounted for a significant inflow of foreign exchange. With the implementation in 1987 of a policy permitting importation regardless of the source of the foreign exchange, the situation with respect to production capital inputs has been alleviated somewhat.

Total export performance in 1985/86 was well below potential and is on a decline from 1983/84 (Table 5). Although projected exports for 1985/86 are not available, projections for 1986/87 (MFEP, 1983) were 1.184 million. As an indicator, therefore, exports were only one-half of projected potential exports, assuming that export levels for 1985/86 would be near 1986/87 levels.

Table 5. Major Commodity Exports (US\$ Millions)

	1981/82	1982/83	1983/84	1984/85	1985/86
Cotton	69.4	174.6	333.2	245.1	136.0
Groundnuts	71.5	37.7	44.6	15.0	6.7
Sesame	48.2	54.1	67.5	45.0	35.1
Sorghum	65.0	91.0	31.1	-	0.5
Gum Arabic	43.9	47.4	61.9	41.6	27.3
Livestock	108.6	141.1	145.5	211.5	249.8
Others	25.4	35.2	38.5	37.2	41.8
Total	432.0	581.1	722.3	595.4	497.2

(Source: World Bank (1987))

b. Agricultural Imports and Exports

Imports of food and beverages have trended downward since 1981/82. Most significant was the elimination in 1985/86 of sugar imports, since sugar production in the Sudan has grown to near self-sufficient levels. Declining imports of petroleum and farm implements, and the small increase in fertilizer and insecticides had a detrimental impact on the level of production of exportable commodities.

Exports of agricultural commodities and products constitute over 90 percent of total exports. Poor performance by the

agriculture sector and agricultural exports in 1985/86 and previously has had a serious impact on the availability of foreign exchange and balance of payments. This poor performance was largely due to consecutive droughts, pest infestation in the irrigated schemes that affected cotton yields, and adverse government policies. The government exchange rate system and tax structure contributed heavily to poor performance, resulting in a disincentive to producers of export commodities (ElBadawi, 1987). Surprisingly, export levels were probably higher than could have been expected due to drought conditions that forced livestock producers to cut their herds. These reductions will adversely affect exports of livestock and total agricultural exports for several years as producers rebuild their herds.

B. Evaluation of macroeconomic policies as they affect agriculture

The combined impact of macroeconomic policies and certain uncontrollable factors like drought has been to promote the shift of capital away from productive investments in agriculture in favor of investments in relatively inflation-proof assets such as real estate, foreign currencies, and luxury durable goods.

Sudan's economy depends heavily on a relatively few agricultural export products to provide the foreign exchange needed to import critical raw materials, capital inputs, and consumer goods, and to repay foreign debt. It has had to confront drought, higher energy prices, declines in world prices of cotton (its principal export), and relative stagnation and declines in the productivity of the rainfed crop and livestock subsectors. In response to these situations, the government has stepped up intervention in production through the creation of parastatals, administratively determined prices and exchange rates, and substantial foreign borrowing.

The debt service problem and the tendency of Government to try to control the economy administratively rather than relying on markets constrain Sudan's agricultural growth. Agriculture's contribution to the balance of payments by expanding exports and reducing imports through substitution will depend on exchange rate policies and the incentives that affect investment in economically productive technology and capital inputs. To be effective, these must reduce unit costs by increasing yields. Thus, the feasibility of the suggested strategy for agricultural development presented in this report hinges on a set of appropriate macroeconomic policies that provide incentives to stimulate, rather than retard, growth in production.

APPENDIX 2

AGRICULTURAL SECTOR OVERVIEW

Agriculture dominates Sudan's economy: it accounts for 30-40 percent of total GDP, contributes approximately 95 percent of the value of total exports, and provides employment and livelihood to 80 percent of the population.

Historically, the major feature of agricultural development in the Sudan has been an extremely skewed distribution of investment resources. Investment has been heavily concentrated in irrigated and mechanized rainfed farming areas in the eastern and central parts of the country, with resulting increases in production of domestic food stuffs and export crops. However, production increases have been largely attributable to expansion of planted areas. Yield levels have remained static or declined, so too the subsectors' net contributions to foreign exchange earnings and Government revenues.

The traditional rainfed subsector, on the other hand, has received few Government investment resources. It produces food crops such as sorghum, millet, groundnuts, and sesame, as well as livestock. These products are marketed through a developed market structure in the north. Further development of the traditional subsector is hampered by insufficient infrastructural and institutional services like transportation, credit, and input procurement. In western Sudan there are indications of environmental degradation to mechanization and overgrazing.

A. Historical Context of Sudanese Agriculture

There are, broadly, three periods identifiable in the development of Sudanese agriculture; 1) the pre-British period, 2) the British and British-Egyptian period, and 3) the post-British period.

1. The Pre-British Period

The pre-British period dates back to antiquity and is characterized by traditional agriculture and fishing along and near the Blue Nile and White Nile rivers. Agriculture during this period was almost entirely subsistence oriented. In the south, agriculture developed as a supplement to hunting and collection of "wild" food items. In the north, migratory pastoral agriculture developed as populations from the north moved or were displaced into the regions to the south. Migration also occurred from the south to the central and northern areas.

2. The British and British-Egyptian Period

British occupation and management of the region systematized the traditional structure and infrastructure of government and agriculture and marshalled much of the resource base. Productivity was emphasized and exportable surpluses of cotton, grain and livestock were achieved. Government and private institutions were developed according to the "British" system, including ministries and parastatals and their systems of management. Railroads and roads were built and communication systems were established. The production base was dramatically expanded in the 1914-1925 period with the conception, construction, and operation of the massive Gezira Irrigation Project--over one million feddans of irrigated land in one project. By the mid-60's more than two-million feddans had been added. Traditional agriculture was basically ignored as the major emphasis was placed on commercial crops.

3. The Post-Independence Period

At the time of independence in 1956, the established and efficiently managed structures and infrastructures of government and of the agriculture sector were transferred from the colonial government to the new independent state of the Sudan. For a time the established mechanisms operated efficiently. Gradually, differing opinions, changing governmental policies and objectives, and rifts among the influential resulted in a general deterioration and collapse of maintenance and management systems. Government debt increased and the only viable foreign exchange earning sector, namely agriculture, stagnated.

There was evidence of deterioration in services by the public sector, worsening balance of payments and an increasing out-migration of the skilled and well-educated: managers, scientists, teachers and technicians. Major emphasis was placed on extensive production systems in an attempt to increase production for domestic needs and for exports to pay the foreign debt. A prolonged drought in the mid-80's added to the worsening performance of the agriculture sector. The banning of interest rates, regarded as usury under Islamic law, created problems of allocation of capital to various sub-sectors and credit to producers and market intermediaries. The civil war raging intermittently in the south since independence has contributed to the poor financial position of the Country and has disrupted natural product flows of commodities between the north and the south.

B. Resources in Agriculture

1. Natural Resource Base

a. Climate

Sudan is divided into six broad climatic zones largely defined by the amount of rainfall received. In the north is the arid zone where annual rainfall is less than 75 millimeters per annum. The zones then progress southward with each successive zone receiving more rainfall than the previous one. Finally, in the extreme south, is a sub-tropical zone where rainfall can be in excess of 1600 millimeters per annum. The following is a description of each zone and rainfall received.

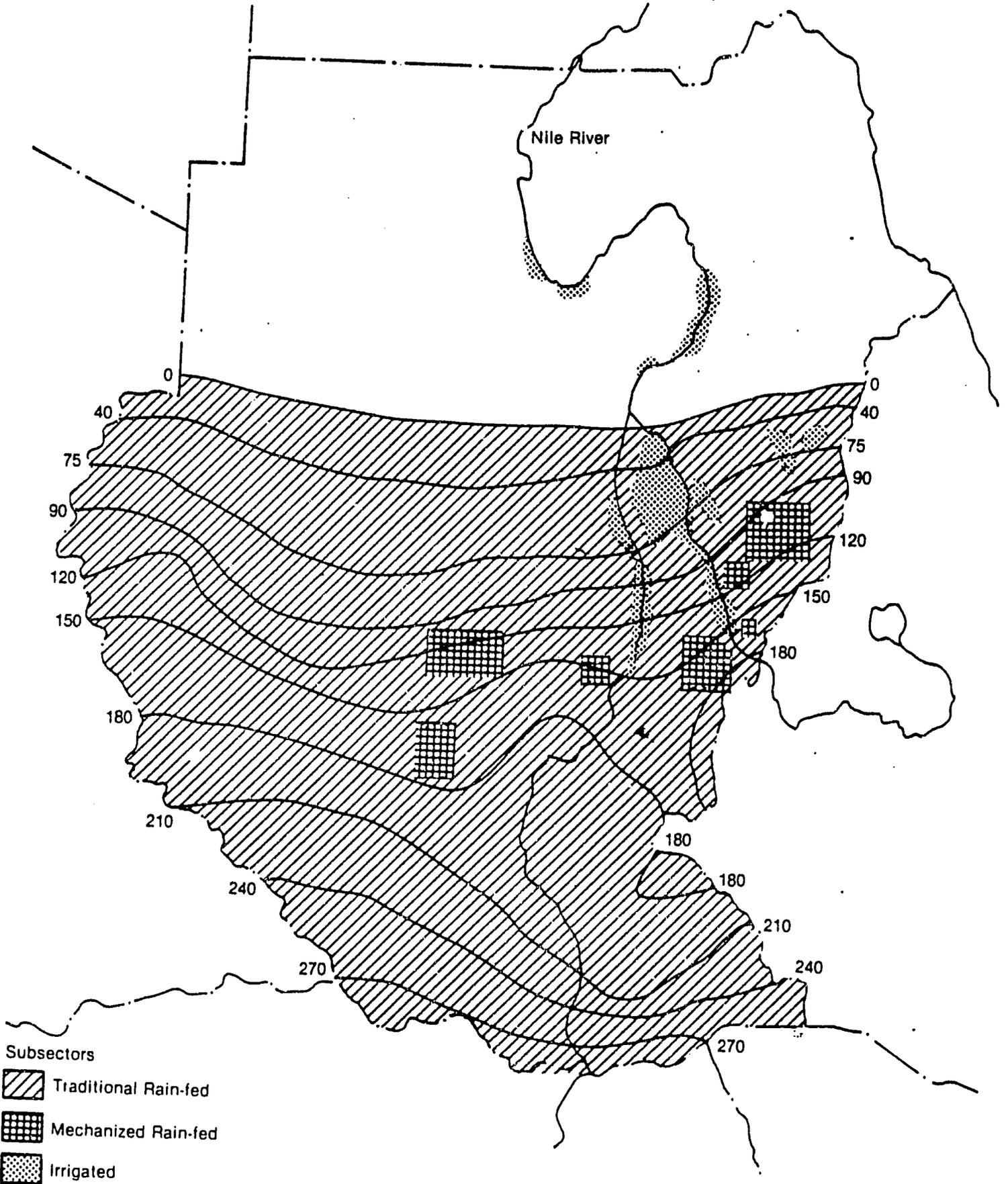
<u>Type of Zone</u>	<u>Characteristics</u>	<u>Annual Rainfall</u>
Arid	Complete desert	below 50 mm
Semi arid	Acacia desert shrub	50 - 300 mm
Savanna	Acacia tall grass forest savanna, comprising the eastern clay plains, and the western goz sands	500 - 800 mm
Savanna (high rain)	Broad leaved forest or swamp grassland, including southern clay plains, and western leached latosols.	800 - 1000 mm
Sub-tropics	Sometimes called montane rainforst along the southern border.	1000 - 1500 mm

The northern one-third of Sudan is desert and inhabited by nomads. Of the remaining two-thirds, approximately one-half is suitable only for grazing, less than a quarter is potentially arable, and the balance is in thick forests, swamps, and water surface.

USAID development assistance has tended to concentrate in the seasonal rainfall area ranging from 400 mm (0 day growing season) in the north to 800 mm (180 day growing season) in the south (Figure 1). The 400 mm isohyet falls just north of Khartoum while the 800 mm isohyet falls south of Gedaref near the Ethiopian border and passes southwestward to Kadugli in Southern Kordofan, then goes generally westward to Chad. It is in this area that one finds the large scale irrigation projects, the mechanized farming, the semi-nomadic and sedentary livestock

Figure 1

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



owners (also further south), and the traditional agriculture practiced under semi-arid conditions.

b. Land and Soils

Figure 2 shows the natural soil resource regions of the Sudan:

Eastern Sudan: This consists of the Red Sea Coastal Plain, the Central Clay Plains, and the Piedmont Zones. While there are site-specific differences, all these areas show similar patterns of limited rainfall and soil erodibility. It is in the Central Clay Plains that mechanized farming, primarily with sorghum, is concentrated.

Central and Western Sudan: The Nuba mountains are characterized by soil shallowness and infertility. The Qoz sands have severe wind erosion problems, low nutrient status, and poor water holding capacity. The Central Clay Plains suffer water logging, the potential for erosion, and slow infiltration rate. Traditional farming and livestock herding takes place on the Qoz sands as well as in the Nuba Mountains area.

Southern Sudan is characterized by the Southern Clay Plains which suffer from water logging, infertility, and creeping floods. The Ironstone Plateau on the southwestern border suffers from soil shallowness, erosion problems and seasonal drought.

The following table breaks down distribution of total cultivated land area in the Sudan by type of farming system.

Farming system	Area Under Cultivation	Distribution %
Irrigated	4.17 million feddans	16
Mech. rainfed	5.76 million feddans	22
Traditional rainfed	16.75 million feddans	62
Cultivated Land:	26.68 million feddans	100

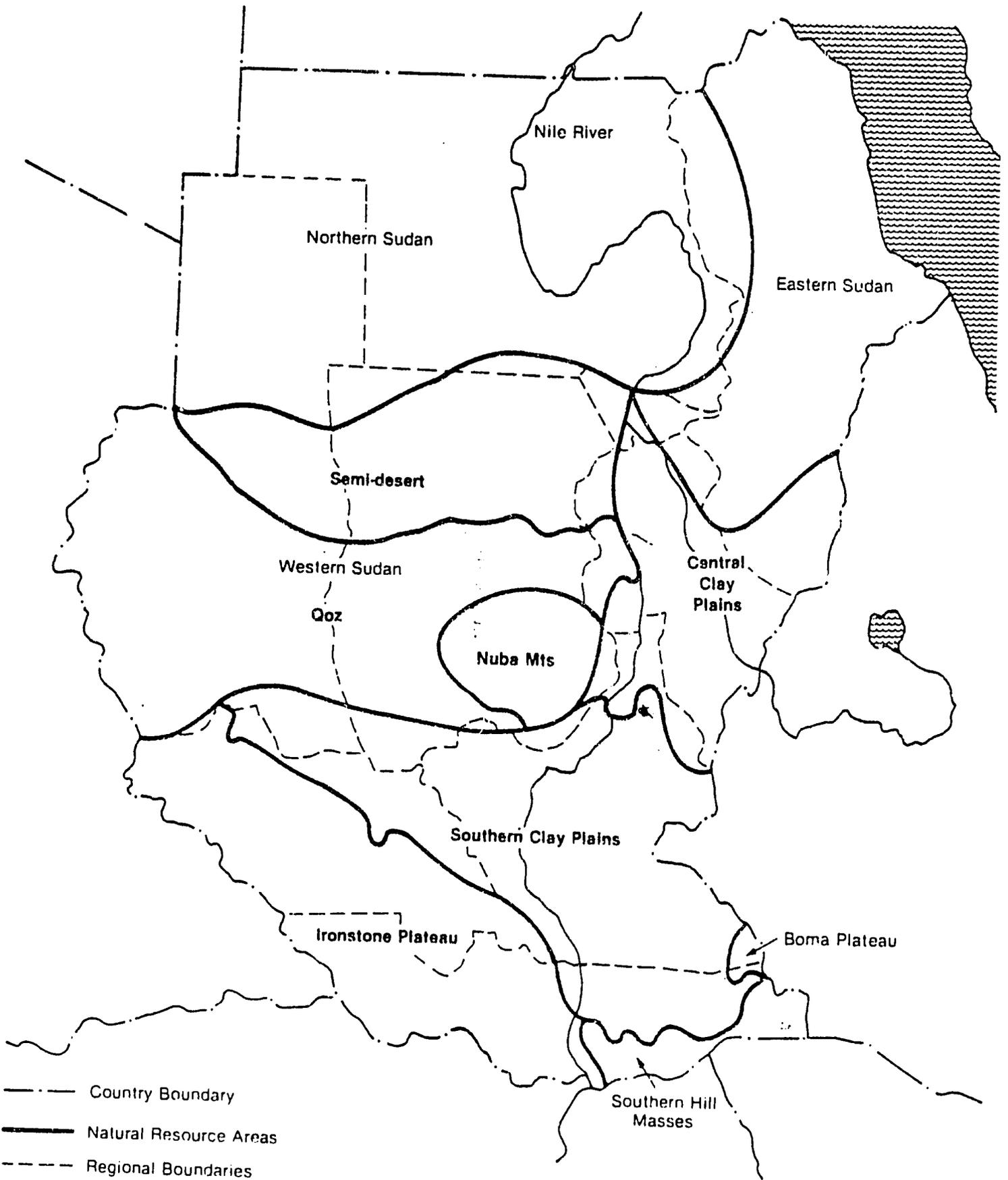
c. Forests and Rangelands

Forty percent of the land area of the Sudan (241 million feddans) is classified as grazing land. It supports the estimated 53 million head of livestock found in the country. The bulk of livestock is found in the north with South Darfur Province the major producer.

Trees and forests on these rangelands provide direct and indirect benefits. Animal browse from shrubs and trees is estimated to provide about 30 percent of feed requirements. Forests also provide direct employment in two ways: production

Figure 2

Natural Resource Regions of Sudan



of gum arabic, and production of charcoal from the wood of Acacia senegal.

d. Water

Water resources in the Sudan are substantial and inefficiently utilized. Of 34 million cubic meters of water per year believed to be available from rainfall, surface and underground sources, less than half is effectively utilized. The remainder evaporates or runs off into river beds. Seasonal irrigation would be achievable if some of the lost water could be captured and redirected to areas of greatest need through the use of water spreading technology.

By far, irrigation schemes use the lion's share of water. As these schemes rely for the most part on the Nile River, the amount of water available to them is regulated by bilateral agreements between Egypt and the Sudan covering allocation of water flows. Two agreements have been signed: the first in 1929 that restricted use of the river flow during the dry season; and the second in 1959 that allocated the Sudan an additional portion of the Nile waters as measured at Aswan. However, because of insufficient seasonal availability of Nile waters during the base flow period, utilizing this allocation effectively has required the construction of adequate storage capacity to accumulate flood water. Thus a construction program for dam reservoirs was carried out at Senar and Roseires on the Blue Nile, at Jebel Aulia on the White Nile, and at Khashm el Girba on the Atbara River.

2. Income and Employment

Agriculture provides employment for nearly 80 percent of the population. While there is little open unemployment in rural areas, there is considerable underemployment, as employment depends on rainfall patterns that do not allow year-around production. This situation necessitates periodic migration of the rural population from traditional areas toward seasonal employment opportunities in the irrigated and mechanized rainfed areas. This labor force, estimated at approximately 1 million persons, helps satisfy the labor demand for picking cotton or harvesting sorghum, wheat, and groundnuts. These fall outside the peak period for employment on the traditional farms. Even with the existence of this force, high seasonal labor requirements, especially in the irrigated areas, encourage more permanent forms of migration as poor rural workers move to better perceived opportunities in or near urban population centers.

The team was unable to encounter reliable up-to-date data regarding the level and distribution of income of the economically-active Sudanese population.

3. Institutional Resources

Institutions are the facilitating structures through which an economy functions. In agriculture, the adequacy and capability of the institutions servicing the industry, either in the public sector or the private sector, determine the degree of development and level of output. In turn, the institutions established are only as effective as the capability of the personnel managing the institutions and the overall purposes and objectives of the institutions.

a. Public Sector

Agriculture in the Sudan is dominated by public institutions. These include the Ministry of Finance and Economic Planning, the Ministry of Industry, the Ministry of Agriculture, the Ministry of Transport, the Ministry of Commerce, Cooperatives and Supply, and others. These Ministries either own, control, direct, operate or influence nearly every aspect of agriculture. Policies of the central government form the framework in which each operates and the hierarchy of power and interdependence among and between the ministries.

The Ministries, in turn, have their individual corporations, companies or agencies (parastatal institutions) that are directly involved in the daily business of agriculture and that interface daily with the farmer and intermediaries in the agricultural and food marketing system.

Historically, Sudan was part of the British Empire from which it inherited a system of governmental organization. Under such a system, parastatal organizations are established to perform functions which would otherwise be carried out by the private sector or to carry out regulatory functions. In the Sudan, parastatals were set up that have had virtual monopolies or monopsonies over various commodities. Among these are the Gum Arabic Company Ltd., and the Sudan Cotton Company Ltd., all under the Ministry of Finance and Economic Planning. Others of importance are: in the Ministry of Animal Resources, the Live-stock and Meat Marketing Corporation and the Animal Production Public Corporation; in the Ministry of Industry, the Spinning and Weaving Company Ltd. and the Abu Naama Kenal and Bag Company Ltd.; and in the Ministry of Transport, the Sudanese Rail Corporation, the River Transport Corporation and the Roads and Bridges Public Corporation. In addition to these, there are some eight joint public-private agricultural corporations, four developmental corporations and the Agricultural Research Corporation.

There are 14 or more Agricultural Production Corporations (APC's) directly involved in agricultural production. These autonomous corporations are accountable to the Ministry of

Agriculture. Each corporation has a Director General who is counseled and assisted by a board.

The majority of the APC's are irrigated schemes managed by the corporations with the farmer/producer considered essentially a tenant. These APC's account for over 90 percent of the irrigated area and significant amounts of land and resources in other agricultural systems (Table 6). The GOS has decided to move to privatization and has begun to place some of the schemes back into private hands.

The general performance of all APC's has been highly unsatisfactory. An administrative budget is provided for the APC's within the National Budget and operational capital is obtained through lines of credit with the Bank of Sudan and/or through direct allocations by the Ministry of Finance through the Ministry of Agriculture. In 1981 the public corporations accounted for 30 percent of the total government deficit of which the agricultural corporations accounted for 75 percent.

The Mechanized Farming Corporation is responsible for administering the lease-holding of land in the designated rainfed agricultural zones. Parcels of land of 1,500 to 2,000 feddans are leased to private companies or individuals for up to 25 years at very nominal rates. Leases call for up to 500 feddans of each lease-hold to be held in fallow, however, the lease agreements are not enforced.

Table 6. Production by APC's as a Percentage of Total Production. 1978

Category	% of Total Production/Area
Irrigated Crops Area	92
Rainfed Crops Area	34
Sugar Production	100
Cotton Production	98
Wheat Production	93
Sorghum Production	68
Sesame Production	46

b. Private Sector

The private agricultural sector has few formal institutions. These consist mainly of the Sudanese General Farmers Union, cooperative, private production corporations, and market intermediaries. Public sector institutions dominate and advertently or inadvertently, stifle the formation and operation of private sector institutions.

o Cooperatives

The Sudanese have a history or tradition of cooperative action in their daily village life and in farming. At various times of the year, relatives and neighbors join together in planting, weeding or harvesting operations on an informal basis. In 1976 there were some 2,700 formal cooperatives registered with 360 involved in the agriculture sector.

Cooperatives fall under the auspices of the Cooperative Division of the Ministry of Commerce, Cooperatives and Supply. The Division, headed by a Director General, is responsible for promoting cooperatives as a tool in development and with planning, training of personnel, defining and identifying the roles of cooperatives in development programs and auditing cooperative activities. Cooperatives also receive considerable assistance and support from the Sudanese General Farmers Union.

There are several types of cooperatives including production cooperatives, processing cooperatives, service cooperatives, marketing cooperatives and farm machinery cooperatives. The majority of the cooperatives are located in the irrigated schemes and the traditional rainfed areas.

o Sudanese General Farmers Union

The Sudanese Farmers Union was established under the Farmers Organization Act of 1976. It has many objectives including enhancing the well being of farmers, increasing productivity, improving credit availability, supporting the formation of cooperatives and, in general, supporting farmers and the agricultural community. The Union represents farmers, mainly the private and traditional farmers, in all areas of the Sudan. It is organized at the village and National levels and is sustained by membership fees. It is a member of the Arab Farmers Union and of the General Union of African Farmers. The Union works closely with regional and local agricultural staff and with relevant ministries at the National level with whom regular meetings are held. It also works closely with the various APC's and the farmer/tenants. The Farmers Union has staff that work much like extension agents and their work is held in high regard.

o Private Agricultural Corporations

There are a large number of private corporations actively engaged in agriculture. They are mainly involved in farming operations in the rainfed mechanized farming areas, both in the demarcated areas and the non-demarcated areas. These corporations reportedly have the capability to amass large sums of capital and to effectively manage large, extensive farming operations. Although increases in total production of sorghum have achieved short-term gains, the longer-term effects of

sorghum--soil depletion, desertification and poor land resource management--may have deleterious effects on the long-term viability of agriculture in these areas.

Private-sector institutions also include the myriad intermediaries, individuals or companies providing service functions within the marketing system. From a functional viewpoint, these intermediaries and service groups or individuals are similar to, and undertake the same functions as, those found in every other marketing system. The major differences are related only to size and the degree of technology (postharvest technology) applied or utilized.

4. Agricultural credit

There are two credit systems in the Sudan: the Informal or Sheil System, and the Formal System.

a. The Sheil System:

The Sheil System is the dominant form of credit in the traditional sector. Credit, in the form of money, consumables, seeds, etc, is extended by merchants and private individuals. Repayment is in the form of crops harvested. This forms over 90 percent of all credit in the traditional sector in terms of numbers of loans. The system avoids an explicit charge of interest but an implicit charge in crops is negotiated via the establishment, prior to the loan, of a price that accounts for the lenders costs, risk and profit.

The informal system is not unlike systems found in many countries where a merchant extends credit for production expenses and receives part or all of the crop, subtracting the original loan from the proceeds paid for the whole crop. This is often a form of pre-harvest contracting. In this system credit and marketing services are tied together. The value received by the lender at the time of sale of the crops or portion thereof representing payment is part interest and part commission for services provided for selling the commodity.

Informal credit sources are: professional money lenders, traders and shopkeepers; landlords; relatives and friends.

b. The Formal System

The formal agricultural credit system is comprised of three public banks: The Bank of Sudan (BOS), The Agricultural Bank of Sudan (ABS); and The Sudan Savings Bank (SSB). At times, several commercial banks also make loans to agricultural enterprises but this amounts to only about one percent of the total farmers.

The Sudanese Savings Bank was created in 1974 to mobilize savings. Agriculture receives only about four percent of the value of loans granted.

The ABS is the principal formal agricultural lending institution. Formed in 1957, it began operations in 1960 to serve the small- to-medium size farms, to foster applications of improved technology and to provide support for marketing and storage. However, larger-scale commercial agriculture is the principal beneficiary. Short-term seasonal production loans account for 75 to 80 percent of its portfolio with a smaller amount (20 to 30 percent) of medium-term credit extended for machinery acquisition (Tables 7 and 8). The bank operates through 24 branches and sub-branches.

In addition to providing loans at favorable rates of interest (7 to 9 percent) the ABS also provides foreign exchange at official rates for imports, and authorization for fuel purchases at subsidized rates. Other services of the ABS include importation of machinery and equipment, fertilizer and farm chemicals. These are distributed mainly to the irrigated sector or the rainfed commercial sector. The ABS provides few services at present to the traditional sector except for small seed treatment packages that are distributed directly to small farmers through its branches.

The ABS has not fulfilled its stated role of providing loans to farmers with small holdings. Presumably, this is a two-fold problem: logistics and accountability are made difficult by poor communications and transport in the traditional farming areas; and the sheer number of small landholder farmers complicates the loan process.

One possible solution to the credit problem and other related problems of storage, orderly marketing and production input distribution at the small traditional farmer level is the provision of production and marketing credit through producer marketing cooperatives. A program of ABS (Department of Rural Economy, 1983) during the period 1977/78 through 1982/83 illustrated the great potential of such a system. The program began in 1977 with two cooperatives with a total of 5,000 Mukhumas and grew to 27 cooperatives with a total of 30,000 Mukhumas. The volume of loans increased from Ls 15,000 to Ls 680,000. The repayment percentage was more than 90 percent over the six year period. The 1980/81 season was a drought year and brought the six year average down. The loans granted were initially for production but continued as marketing loans. Participation in the loan program obligated the farmer to participate in the storage and marketing program.

Credit and marketing services are inextricably related and through a vibrant program of marketing cooperatives, these

services could be provided to the farmer. A program of this nature, coupled with programs targeted at upgrading marketing system performance, could be the basis of a renewed vigor in the traditional sector.

Table 7. Loans Granted by the Agricultural Bank of Sudan, by Type. 1982 - 1986

Total	Short-Term Loans	Medium Term Loans	Long-term Loans	Total
	- - - - -	LS. 000 - - - - -	- - - - -	- - - - -
1982	13,562	10,712	-	24,274
1983	19,039	6,967	-	26,006
1984	18,945	7,886	-	26,831
1985	51,869	16,008	-	67,877
1986	37,849	10,093	-	47,942

Source: Bank of Sudan, 27th Annual Report, 1986

Table 8. Loans Extended by the Agricultural Bank, 1984 - 1986. Percent.

Type of Loan	1984	1985	1986
Short Term	70.6	76.4	78.9
Medium Term	29.4	23.6	21.1
Long Term	-	-	-
TOTAL	100.0	100.0	100.0

Source: Bank of Sudan, 27th Annual Report, 1986

C. Agricultural production and marketing

1. Major farming systems

a. Irrigated agriculture:

The irrigated subsector occupies over four million feddans and is concentrated largely along the Blue and White Nile Valleys, consisting of government-owned and tenant-operated schemes for the most part. Some private pumping units remain along the main channels and rivercourses.

(1) Production Patterns

The major contribution of the subsector has been in the production of sorghum, millet, wheat, groundnuts, and cotton. For the years 1980-84 the following were the approximate acreages, yields, and production.

Crop -----	Yield/Feddan ----- (Kg) -----	Total Feddans ----- (000) -----	Total Tons -- (000) -----
Sorghum	285	628	285
Millet	432	16	7
Wheat	512	293	150
Groundnuts	677	282	190
Cotton	340	476	237

Groundnuts and cotton are grown primarily for export, while sorghum, millet, and wheat have been destined for national consumption.

(2) Description of a Typical Irrigated Farm

On the Gezira project, taken here as an example, tenants have long-term rights to the land and can pass on tenancy to their descendants.

Decision-making on the rotation to follow, water use and timing, cultural practices, and marketing lies in the hands of the Sudan Gezira Board, the principal management unit of the scheme. It, in turn, follows the technical recommendations of the ARC located at Wad Medina.

Farmers will have either 20 or 40 feddan units on which they follow a four course rotation consisting of fallow, cotton, groundnut/sorghum, and wheat. On the 20 feddan units there are four parallel land courses, each course consisting of a long and narrow land strip of 90 feddans. Each farmer receives five feddans from each course. All farmers must plant the same crop on each land course in order to facilitate the irrigation, mechanization, and aerial spraying services provided by the SGB.

The SGB provides the farmers with irrigation water, tractor hire services for land preparation, fertilizer, insecticides, threshing hire services in the case of sorghum and wheat, and tractor hire for mechanized lifting of the groundnut crop. At time of delivery of the crop, the farmer is paid for his production, less the in-kind advance for inputs.

The following is an average farm budget for a tenant farm on the Gezira scheme for 1985/86. Data was taken from continuing farm management studies that are underway:

Table 9. Average Farm Budget, 20 Feddan Farm, Gezira Irrigation Scheme, Sudan, 1985/86

Gross Return	Area (Fd)	Yield (Kg)	Prod (Kg)	Value (Ls)	Gross Ret. (Ls)
Crops:					
Cotton	5	501	2505	1.63	4083.15
Wheat	5	402	2010	.70	1407.00
Sorghum	2.5	700	1750	.42	735.00
Groundnuts	2.5	700	1750	1.12	1960.00
Fallow	5				
Totals:	20.0				8185
Estimate on amount of gross used for home consumption					1500
Gross income					6685
Cost of production -----Ls per Feddan-----					
Item	Cotton	Wheat	Sorgo	G.Nut	
Land prep.	48.88	19.12	11.33	10.36	394.23
Agric. Opertns.					
Hired lbr.	35.46	1.40	.22	0	184.85
Family lbr	7.69	11.15	24.71	33.57	239.90
Hrvst/post hrvst:					
Hired lbr.	86.89	28.43	28.40	39.04	745.20
Family lbr.	0	0	28.40	26.02	136.05
Materials	436.22	146.55	28.69	51.79	3115.06
Services	74.27	16.99	0	0	456.30
Transport	23.18	9.57	5.45	7.60	196.37
Water charge	65.00	40.00	32.50	32.50	687.50
Grand total:	777.59	273.21	159.70	200.88	6155.46
Cost per crop:	3887.95	1366.05	399.30	502.20	
Net return to family labor and management					906.00

When analyzing the above data breakdown, one is immediately impressed by the labor intensity, especially of hired labor. It is understood that rural labor markets function fairly effectively in redistributing labor geographically depending on need.

Also notable is the amount of capital tied up in production of cotton as compared to the other crops. While yields and prices are only for one year, the cost side of the following comparisons gives an idea of the capital requirements:

Per Feddan Costs and Returns

Crop	Gross Income	Cost	Net Income
----	-----	----	---
Cotton	816.63	777.59	39.04
Wheat	281.40	273.21	8.19
Sorghum	294.00	159	135.00
Groundnut	784.00	200.88	584.00

The costs of growing cotton are at least twice and sometimes three times that of other crops, while the net return is extremely low. Materials alone (chemicals) account for Ls436.00 of the cost, and items like hired labor are very high.

(3) Productivity of the Subsector

Cotton: U.S. yields per unit area are at least twice those in the Gezira example and from the average of other production schemes. The low yields reflect shortfalls in use of recommended practices such as: quantity of fertilizer used; early planting to promote ripening before the onset of cool weather; efficiency of water use; and timeliness and frequency in the use of chemicals for insect control. Resistance to insecticides by whiteflies has become a very serious problem. Cotton is generally the only crop officially receiving fertilizer on the irrigation projects.

The production parastatals should pay closer attention to market forces when deciding on the order of rotations on the irrigation projects. Infrastructure in Sudan is set up for cotton all the way from the custom spray operations, to ginning, and to the final step of bailing for export. The sector supports a lot of people, but the generation of net foreign exchange is not high due to the high use of imported inputs.

Groundnuts: Groundnut yields are low, less than half those being economically obtained at the ARC Research Station at Gezira. Nonetheless, they were the highest income earner and per acre cash cost is quite low in comparison to cotton. Groundnuts respond easily to the use of phosphoric pentoxide, but the amount actually used is reported to be negligible. They also do a certain amount of nitrogen fixing in the soil which has a beneficial effect on succeeding crops.

Wheat: Attention has been paid to this crop because it is an import substitute for wheat flour to make bread. Historically, yields have been low in the range of 400-600 kilograms per feddan. This translates to approximately 14-22 bushels per acre, considered very low even under dryland conditions in the U.S. where yields are seldom under 40 bushels. (Wheat is not normally grown under irrigation in the U.S. due to

its low return on investment). The northern Sudanese irrigation areas do best with wheat because of the length of the cool period during the critical period of flowering. This permits greater flexibility in planting dates.

ARC at Wad Medani has obtained wheat yields of up to 1500 kilograms per feddan (55 bushels per acre). Global 2000, a private voluntary organization operating in the Sudan, obtained an average of 37 bushels per acre on its demonstration plots with private farmers in the last growing season. This compared to eight bushels per acre on the farmer check. They applied urea and phosphate only, and changed the recommended application time of urea.

Sorghum: Only a small amount of sorghum is grown under irrigation. Yields are minimal and only slightly in excess of 400 kilograms per feddan. This is equivalent to about 15 bushels per acre, comparable to yields obtained by Nebraska farmers of 80 bushels per acre under dryland conditions, and at least 120 bushels under irrigation.

Rice: Rice is not currently grown on the Gezira scheme example shown above, although it was grown on about 27,000 feddans in 1986. USDA figures indicate that average paddy yields were less than a half ton per feddan. Yields at Gezira are slightly over a half ton per feddan, however a Chinese advisory team recently produced over two tons. This is a good yield even under US conditions.

Whether rice should occupy a place in the irrigated sector rotation system is debatable. It is a high water user; however, the paddies could be flooded early in the rainy season when there is a surplus of water. Later in the growing season it could be treated like an upland rice crop, thus conserving water use.

Sugar cane: Sudan is expanding its sugar production in order to meet local demand and provide a surplus for export. However, it is understood that at present the country is exporting sugar to repay a loan for establishment of the sugar plant at Kenana, while at the same time importing sugar to meet domestic demand.

Horse beans: This is a major legume but is being replaced by groundnuts. Researchers cite low yields which are probably caused by high temperatures and incidence of powdery mildew. Yield increases largely depend on the improvement of agronomic practices including earlier planting, regular irrigation, and spraying for aphid and disease control.

(4) Effect on Natural Resource Base

The Nile waters are the main source of supply for irrigation in the Sudan. However, the country is coming close to utilizing its entire supply. While the supply could be increased by constructing water conservation projects in Southern Sudan (Jonglei Canal Project), this project was halted due to civil strife.

(5) Problems and Constraints

Seasonal availability of Nile waters restricted to the December-May period is one of the major shortfalls of the irrigation system. It has been tentatively proposed to heighten the Roseires dam and build two more dams on the upper Atbara to provide sufficient storage capacity. The silting up of reservoirs is most serious on the Atbara River, still severe on the Blue Nile, but less of a problem on the slow-flowing White Nile.

Water hyacinth is a very serious impediment to water flow, especially on the White Nile projects. The plant uses up water and plugs the channels. In Thailand it has become necessary to use draglines to periodically clear the channels of this weed. Considerable research work has been done in Asia to control the weed, but nothing feasible has been developed to date.

Continual satisfaction of the farmer's water demand at his field outlet ditch remains the most serious problem in water management. Too often, water delivery is delayed until the last farmer on the course has completed his work, be it planting, weeding, and remaking of bunds and ridges. At Gezira, changes have been brought about by initiating a continuous flow system to the farmers.

At present, most tenant farmers on Sudan irrigation schemes are paying an indirect charge on land and water in the form of a crop sharing arrangement based on the cotton crop. Gezira, as can be seen from the example, has introduced a system of water charges for each crop. In its first phase of 300,000 feddans, the Rahad project has introduced a water charge at a flat rate per holding. This rate factors in adequate funds to meet asset depreciation, annual expenses of the Corporation, and returns to the GOS for its investment. If capital and recurrent costs are to be recovered, more schemes should raise their system to adequately recover these costs.

Past growth in the irrigated sector has largely hinged on expansion of areas under crop with little attention to increasing or even maintaining yields. Natural soil fertility, measured by declining organic matter and levels of phosphate and potash, has indicated that additional fertilizers need to be added. In the

case of nitrogen, the use of more legumes in the rotation is indicated. Without these measures, the residual fertility level will continue to decline.

The rigidity of the rotational system for crop mix and quantity has acted as a major constraint. World demand for food and fiber are in continual change; if profits are to be maximized, there must be flexibility.

While 20 percent of available water can still be exploited (and this is of concern to some), it is not the main problem for the short or even the long term. The availability and cost of capital dictate that, in the future, the main challenge will be to obtain better economic efficiencies from the water resources already developed and available.

b. Mechanized Rainfed Agriculture

(1) Nature of the subsector

The mechanized rainfed subsector covers about 5.24 million feddans and comprises about 6,000 farmers. It is concentrated in the central rainlands of the country, largely within the 450-800 mm rainfall belt. Suitable land for cultivation in this area ranges as high as 65 million hectares. The availability of permanent water supplies determined the patterns of traditional settlement; thus the area was largely uninhabited until it was opened up for mechanization after World War II.

The MFC is charged with the responsibility to develop and administer mechanized rainfed farming in The Sudan. It demarcates or gazettes land for allocation to farmers, builds roads, manages state farms, does some adaptive research, collects rents, and does other services for farmers on the schemes. 4.5 million feddans are farmed in the demarcated areas with an additional one million feddans earmarked for later development. However, another 4.5 million feddans is farmed outside the demarcated areas, but not all on a continuous basis.

Over 90 percent of the planted area is devoted to sorghum and the remainder to sesame. A minute amount is planted to millet. The average production levels during the period 1980-84 were as follows for the sub-sector:

Crop	Total Feddans (Kg)	Yield (000 tons)	Total Production (000)
-----	-----	-----	-----
Sorghum	4643	256	1187
Sesame	588	121	72
Millet	6	161	1
Total:	5237		

(2) Description of a Typical Farm in the Mechanized Sector

The owner of a typical mechanized farm is 45 years of age and has at least eight years of school. He may or may not be a merchant, but he most likely possesses good management knowledge and has some investment capital. Often owners are of Northern Sudan and Khartoum origin where arable land is scarce and livelihood needs to be pursued in other areas of the country.

Actual day-to-day management of the farm is in the hands of a foreman who supervises the tractor operator and greaser. The owner generally resides in one of the larger cities and makes occasional visits to supervise the operation.

Originally, the size of farm allocated on the demarcated areas was 1,000 feddans but this was raised to 1,500 feddans in order to make an economically efficient unit for a 60-70 horsepower tractor and associated machinery. The average farmer has this size unit as well as either more land for farming outside of the demarcated area or more land on the demarcated lands which is leased to close relatives.

Buildings consist of some shelters for storing sacked grain and farm supplies, and some housing for the permanent and temporary staff. The investment in land clearing varies depending on the amount of brush and trees. Cleared trees are used to produce charcoal, which, when sold, provides a partial return on the investment in land clearing.

Machinery used for farming is not sophisticated and relatively inexpensive when computed on a per feddan basis. There is the 3 plow (60-70 horsepower) tractor, a Canadian wide-level disk planter, and a trailer.

The first operation disks the field, while in the second operation the field is disked again, but this time sorghum or sesame is planted. The next operation is to negotiate with a labor contractor for weeding crews, with laborers coming from the traditional rainfed areas or from neighboring countries. The

sorghum crop is hand harvested and threshed by stationary threshers. Sesame is all hand harvested and threshed.

Some studies have been undertaken in recent years to show profitability of the mechanized farm operations and their mode of operation. The following table has been prepared which shows an average farm budget for the 1985/86 cropping year:

Table 10. Annual Budget for an Average Farm, Mechanized Rainfed Operations, Sudan, 1985/86.

Crops	Area (fd)	Yield (kg)	Prod. (kg)	Value(*) (Ls)	Gross Return (ls)
Sorghum	2057	231	475,167	.51	242335
Sesame**	446	40	17,840	2.00	35680
Millet	683	40	27,320	.85	23222
Subtotal:	3186				301.237

Cost of Production -----Cost per Feddan-----

Item	Sorghum	Sesame	Millet	
Rental value(***)	6.49	6.62	6.10	20,469
Land tax	1.00	1.00	1.00	3,186
Seed	4.33	4.60	2.86	12,912
Labor	44.21	59.56	25.06	134,621
Machines/fuel	9.58	9.96	9.04	30,322
Threshing	2.27	-	0.38	4,929
Transport/fuel	19.64	11.65	10.42	52,712
Sacks	8.79	1.89	1.49	19,942
Totals	84.46	78.42	46.93	279,093

Net cash income for farm owner: 22146

* - Prices show extreme variability for sorghum depending on season and year. Storage for later sale appears very profitable.

** - Millet acreage high due to high returns during drought.

*** - Represents an opportunity cost or a return on investment in land clearing.

Source of data: MOA/PAEA, Khartoum

The average size of mechanized farms was over 3,000 feddans in 1985. Yields were low as compared to the four years average

from 1981/84. During that period the sorghum yield was 256 kg/feddan, sesame 121 kg/feddan, and millet 161 kg/feddan.

The land tax imposed by the MFC is only a small proportion of the total costs. There have been attempts to raise this tax by the MFC but it has not been successful due to political pressure. Mechanized farmers receive an indirect subsidy on fuel as they generally obtain most of their fuel at official exchange rates. In a sample study of 261 farmers by MOA/PAEA it was found that they paid an average of Ls 6.27 per feddan for fuel. When it was purchased from the MFC at the subsidized rate for use on demarcated lands, the charge was Ls 3.74 per gallon. Seventy-six of the 261 farmers purchased fuel in the open market at over Ls 5.00 per gallon.

Hired labor is twice the cost of the next most expensive item, that of transport. Mechanization has served to increase rather than displace labor use as it has opened up new lands not heretofore farmed. Its weeding and harvest operations are still done by hand, using labor secured largely from the traditional farming sector. During 1985/86 it is estimated that over 29 million persondays of such labor was utilized for sorghum alone. For this the laborers earned about Ls 183 million as a means of supplementing earnings from their traditional farms. They earned an additional Ls 59 million weeding and harvesting sesame for a grand total of Ls 242 million from the two crops.

(3) Trends in Productivity

Overall production from the subsector has been gradually increasing ever since World War II. However, after the drought in 1985, in response to higher price expectations and available fuel supplies, there was a dramatic increase in production. In that year alone, the increase in acreage and tonnage was 84 and 100 percent respectively over the average of the previous four years. This demonstrates the potential vigor of the subsector in providing a large and rapid supply response in the absence of drought, if adequate incentives are provided.

Crop	Total Feddans (000)	Yield (Kg)	Total Production (000 tons)
Sorghum	8537	273	2328
Sesame	1178	58	58
Millet	126	174	22
Totals:	9841		2408

The subsector has been a decided asset to the country and the economy. It is a major supplier of high caloric food for the

urban sector. Export markets in the Near East and Saudi Arabia have been quite elastic and able to absorb surplus sorghum from Sudan. Historically, the subsector has been a net generator of foreign exchange.

(4) Effects on Natural Resource Base

Mechanized farming leads to degradation of the soil, especially in some undemarcated areas due to the farming of more fragile soil and lands susceptible to wind erosion.

Land under continuous cultivation in the demarcated areas has lost some of its fertility. Farmers have ignored the 3-course rotation system ordered by the MFC and have planted "wall-to wall" sorghum to maximize profits. Sorghum yields tend to decrease by almost 20 percent in many areas after only 5 years. This situation would correct itself if fertilizer or green manure were applied as a regular soil improvement practice. Instead, the MFC allows the farmers to move to another piece of land after their original lands have become depleted. They then retain the right to return to the original lands after a period of fallow. However, by this method soil rejuvenation will take years, and the recovery period is significantly lengthened since the leguminous trees and shrubs have been removed.

(5) Problems and Constraints

Machinery and spare parts: The mechanized farms are large consumers of fuels, machinery, tractors, and spare parts all of which must be purchased abroad using scarce foreign exchange. Also, self-propelled combines are imported when stationary threshers at a fifth of the cost would work just as effectively. The commonly used flat-level disk planter unit is also not the best implement to use in the Sudan as it leaves a rough and compacted seedbed which results in poor germination and low soil water absorption. Availability of spare parts is a continuing problem for the machinery now in use.

Delayed Planting: Farmers delay their planting after the onset of the rainy season in order to allow weeds to grow. The weeds are then disked under during the land preparation operation. In so doing, there is a delay beyond the most opportune planting time in order to make maximum use of available rainfall. Most of the heavy rains fall early in the rainy season. If planting is delayed, there is greater danger of plant stress due to drought. It has been estimated by the MFC agronomist that sorghum yields alone are depressed by up to 40 percent due to late planting.

Varieties: Mechanized rainfed farmers continue to plant the standard tall varieties. They make more

money even with lower yields due to a price differential advantage dictated by consumer preference. Yet, no benefit is added by having long stalks, as there is little need for additional fuel or building material. There has been substantial over-investment in harvesting equipment, since purchased combines cannot harvest the tall varieties and end up being used as stationary threshers.

Up to 40 percent of the sesame crop is lost through shelling. The varieties used are antiquated and have been replaced in other parts of the world by those having a closed seed cup. Sorghum yields are extremely low and reflect very low levels of technology use.

c. Traditional Rainfed Agriculture

(1) Nature of the Subsector

The traditional rainfed subsector covers over six million feddans (excluding rangeland) of the cultivated area of Sudan. Besides the southern region it mainly encompasses four provinces of North and South Darfur and North and South Kordofan, parts of Blue and White Nile, and Gezira. The average of crops and production levels during the period 1981-84 is as follows:

Province	Sorghum (000mt)	Millet (000mt)	G.Nuts (000mt)	Sesame (000mt)	Total (000mt)
Blue Nile	602	64	20	246	932
Gezira	154	6	0	0	160
White Nile	149	77	49	24	299
North Kordofan	436	1045	673	723	2877
South Kordofan	370	41	34	114	559
North Kordofan	48	410	90	11	559
South Darfur	362	984	704	178	2228
Total:	2121	2627	1570	1296	7614

Sorghum is the most important food crop for the Sudan. The traditional farms produce 28 percent of the Sudan's sorghum, with total planted area increasing from 2.25 feddans in 1972 to 2.66 million feddans in 1983, an increase of about 18 percent. Sorghum acreage increased by 64 percent (3.7 million feddans) in 1985 after the drought but the increase came mainly from not planting groundnuts. Thus, it can only respond as a subsector to increased price by substituting acreage devoted to other crops. Average surplus for market after home consumption averages 35 percent of farm production.

Millet is the primary traditional subsistence crop with traditional farmers producing most all of the tonnage. Yields

are low, averaging only 142 kilograms per feddan. Three of the four provinces in western Sudan are historically deficit in millet and are not producing enough to satisfy their requirements. Low productivity of the soils coupled with subsistence farming practices using rudimentary technology explain the deficit. Millet is grown where there is a very short growing season and only marginal rainfall. Surplus for market after consumption is about 21 percent in average years.

Groundnuts are produced mainly on traditional farms where lighter soils permit easy harvesting. Seventy percent of the total groundnut production tonnage comes from this traditional sub-sector. Average market surplus after home consumption is reported to be about 74 percent, which demonstrates that groundnuts are grown principally as a cash crop.

Between 50 to 70 percent of Sudan's annual sesame crop is produced in the subsector; the amount varies due to drought and if there are higher price expectations for sorghum and millet.

(2) Description of a Typical Rainfed Farm

The following farm budget example is presented in order to show some characteristics of farms in the traditional rainfed sedentary farming sector. It represents an average of over 250 farms in North and South Kordofan, and Southern Darfur Provinces, an area which plants 67 percent of the groundnuts, 51 percent of sesame, 77 percent of millet, and 14 percent of sorghum in Sudan.

Table 11. Farm Budget, Traditional Rainfed Area of Kordofan and Southern Darfur, 1985/86.

Crops(*)	Area (Fd)	Yield (Kg)	Prod (Kg)	Value (Ls)	Gross Return (Ls)
Millet	9.8	62	607.6	0.47	285.56
Sorghum	5.8	142	823.6	0.33	271.79
G.Nuts	1.4	157	219.8	1.17	257.17
Sesame	4.5	32	144.0	1.41	203.04
Misc.	0.2				150.0
Subtotal:	21.7				1167.57
Livestock: (Cattle, goats, and sheep, animal culls)					700.00
Grand Total:					1867.60
Home consumption (**)					1031.00
Gross cash income:					836.60
Cost of Prod.	-----Ls per Feddan-----				
Item	Millet	Sorgo.	G.Nut	Sesame	
Seed	.89	.71	10.69	2.74	40.14
Tools	.34	.34	.34	.34	7.31
Sacks	1.31	3.04	8.00	.65	44.60
Pesticide	.03	.03	.03	.03	.12
Transport	.33	1.33	4.29	.80	20.55
Hired Lbr.	6.39	3.84	16.04	3.99	125.31
Total	9.29	9.29	39.39	8.55	238.03
Net cash income for family labor:					Ls 598.57
Total family person days:					182
Return per family person day:					Ls 3.29

(**) - 1985/86 survey results by MOA/PAEA; yield of sesame considered low.

(*) - Assuming a family of six and consuming 1000 kg of cereals, part of livestock, and 300 kilogram of groundnuts.

The size of farms and amount for fallow will vary depending on the amount of family and hired labor available, the type of soil to be worked, and in some areas, the availability of vacant land within a reasonable walking distance from the village. Land is usually given to a village group by the sheik and village elders determine who gets the use of the land. Women can also have rights to land. Land can lay in fallow for up to 12 years

in areas where there is low population density, while in other areas it can be farmed very frequently. In the latter case, a higher value is placed on manure from livestock either from pastoralists or from animals owned by farmers from the village.

If family and hired labor use was totaled on a feddan basis, it would amount to about 34 days on sorghum, 28 days for sesame, 38 days for groundnuts and 28 days on millet. Hired labor is often done by hired working groups. A farmer wanting work done will contact the leader of a work group, a price (including food and drink) is agreed to, and the job is completed. Women organize their own work groups to do specific tasks especially with regard to the household/market garden.

It has been estimated that women handle about 80 percent of the agricultural work in traditional farming and pastoral systems in Sudan. In recent years this has increased, due to the fact that men members of the household are doing more work on mechanized farms. The absence of men has also involved the women more in the day-to-day management of many traditional farms. These facts have significant implication for technology development and transfer processes and should be taken into account in hiring and training agricultural professionals as well as shaping the nature of the research itself.

Almost all of the households in the four western provinces would have some type of livestock, either poultry, cattle, sheep, or goats or some combination thereof. Two to three animals per household would be the upper limit and given over to village herdsman for tending.

All of the families will have a household/market garden which is the responsibility of the women. The women grow the day-to-day food requirements for the family, and a little extra to assemble and sell at periodic market days in the community. Women also make and sell handicrafts which bring in additional income.

(3) Trends in productivity

The following is a tabulation of productivity of four major crops in the traditional rainfed sectors since 1965. Data was taken from both World Bank and MOA/PAEA summaries:

Table 12. Trends in Productivity, Four Major Food Crops, Traditional Rainfed Sector, Sudan, 1965/1986

Crop	-----Yield, Kilograms per Feddan-----				
	1965/73	1974/81	1982/84	1985	1986
Sorghum	100.7	185.7	188	167	155
Millet	222.9	153.8	124	97	75
Sesame	144.0	100.0	121	49	127
Groundnut	273.7	266.0	222	235	123

Yields of the above crops have generally decreased over the period. Therefore any total production increases have come from an extension of the land area and the use of additional labor to till the extension. Decreasing yields over time indicate that there are decreasing periods of fallow.

(4) Problems and Constraints

Such inputs as fertilizer, insecticides and herbicides are generally unavailable and little used due to the dispersion of small farms and the lack of adequate transportation and marketing facilities. Even if production inputs were available, current costs and farm incomes are such that farmers would have few resources with which to buy them. Production credit comes almost entirely from private money lenders who charge exorbitant interest rates. As a result, yields suffer due to soil infertility and excessive damage from weeds and pests.

The requirement for family and occasionally hired labor becomes critical during the periods of land preparation and weeding. Many families are forced to make a tradeoff between work on their own farms or wage labor in the mechanized or irrigated areas. Male heads of household often migrate to these areas during periods that compete for on-farm labor. These absences tend to restrict the size of farms as excessive weeds greatly affect yield. Also timeliness of planting ensures that the crops will be matured before onset of the rainy season.

Traditional farmers generally have less access to educational extension services provided by government. They are generally unaware of extension or research station recommendations. This is not as critical as it may seem, since, in general, there is a dearth of technology available to directly address the needs and constraints of traditional rainfed agriculture.

d. Nomadic Pastoral Systems

The majority of Sudan's livestock production is carried out by transhumants who move the herds to the south in the dry season to take advantage of more productive grazing lands

when testse fly populations are low. At the beginning of the rains they gradually move north leaving some of their group at various locations to plant and care for food crops. The food produced is picked up on the return trip at the close of the northern rainy season. A second livestock system involves sedentary farmers who most often turn animals over to a villager herder who cares for all the animals of the village.

The total livestock herd currently numbers about 55 million head (19 million sheep, 20 million cattle, 14 million goats, and three million camels). The north of The Sudan holds the bulk of the livestock (75 percent) in ecological zones ranging from desert in the extreme north to semi-arid brushlands and wooded savannahs further south. South Darfur Province is the most important cattle-grazing area.

Very little research on the livestock sector exists to support a technology transfer program. USAID was instrumental in placing a greater emphasis on livestock with the WSARP project in 1982. There have been some trials and studies since then in areas such as range classification and evaluation, rangeland carrying capacities, and tribal livestock systems. While a good start has been made, it is not enough on which to base any conclusions regarding recommendations for range and livestock improvement.

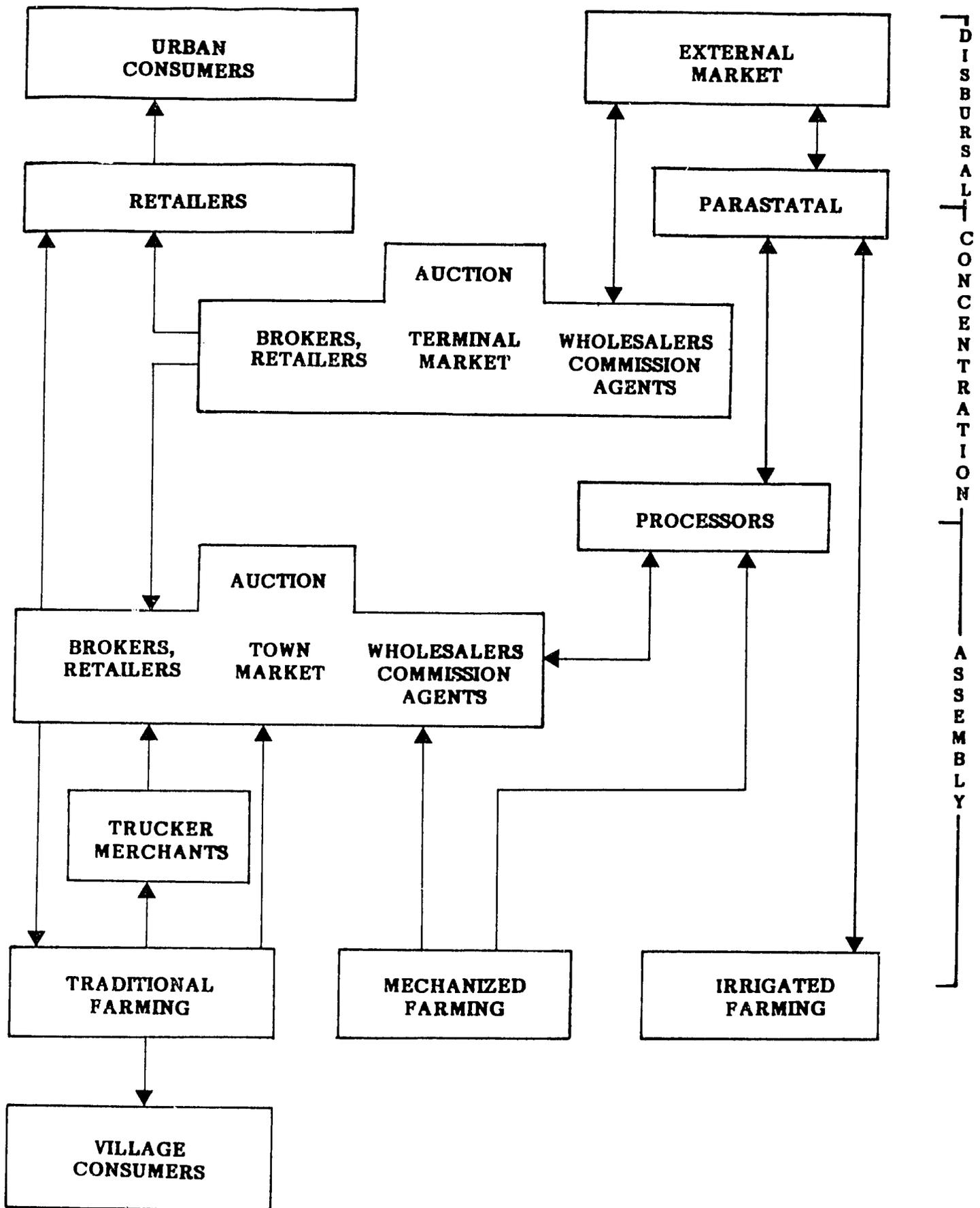
3. Agricultural Marketing

a. The Agricultural Marketing System

The agricultural and food marketing system in the Sudan is similar to other marketing systems in the developing world. It consists of various structures, both public and private, that facilitate the realization of certain higher order functions--assembly, concentration, and disbursement of agricultural commodities and products (Figure 3). It is composed of numerous intermediaries involved in various second order functions, such as wholesaling, retailing and exporting, and a multitude of individuals, firms, organizations and government agencies or departments facilitating the performance of lower order functions of buying, selling, transport, credit, processing, storage, grading, packing, grades and standards, information, regulations, risk bearing and others.

To properly analyze and comprehend the marketing system through the functional approach utilizing the terminology, it is necessary to recognize that there exists a hierarchical order of marketing functions. In the creation of time and place utility of agricultural commodities and products the higher order functions of assembly, concentration and disbursement are undertaken through the second order functions of wholesaling, retailing and exporting. These, in turn, are facilitated through

Figure 3 . A CONCEPTUAL MODEL OF THE AGRICULTURE MARKETING SYSTEM IN THE SUDAN



a myriad of lower order functions that are, or may be, performed many times throughout the marketing system as the commodities move through the various market channels from the producer to the ultimate consumer.

(1) Market Structure

The marketing system in the Sudan is composed of many markets of varying order, many competing intermediaries, many types of intermediaries, and a decadent infrastructure. There are also alternative market channels for each of the major commodities, except cotton.

There is an identifiable hierarchy of markets (Figure 4). In ascending order beginning with those nearest to the producer are: (1) the village or small town market; (2) the market town; (3) the regional market centers or sub-terminal markets (eg. Kadugli and Feshad); and (4) the dominant or terminal markets (eg. El Obeid and Khartoum). The assembly, concentration and disbursement functions are realized as the commodities move up and through these market levels.

For some markets, especially the market towns and regional markets, the government has established auction-type markets for certain commodities (eg. gum arabic, groundnuts, and sesame). These were established with the objective of enabling producers to bypass middlemen. However, this does not appear to have been the case. The commodities are sold and bought by middlemen (wholesalers, commission agents, brokers, etc.) but, town councils limit the number of buyers through licensing.

(2) Infrastructure

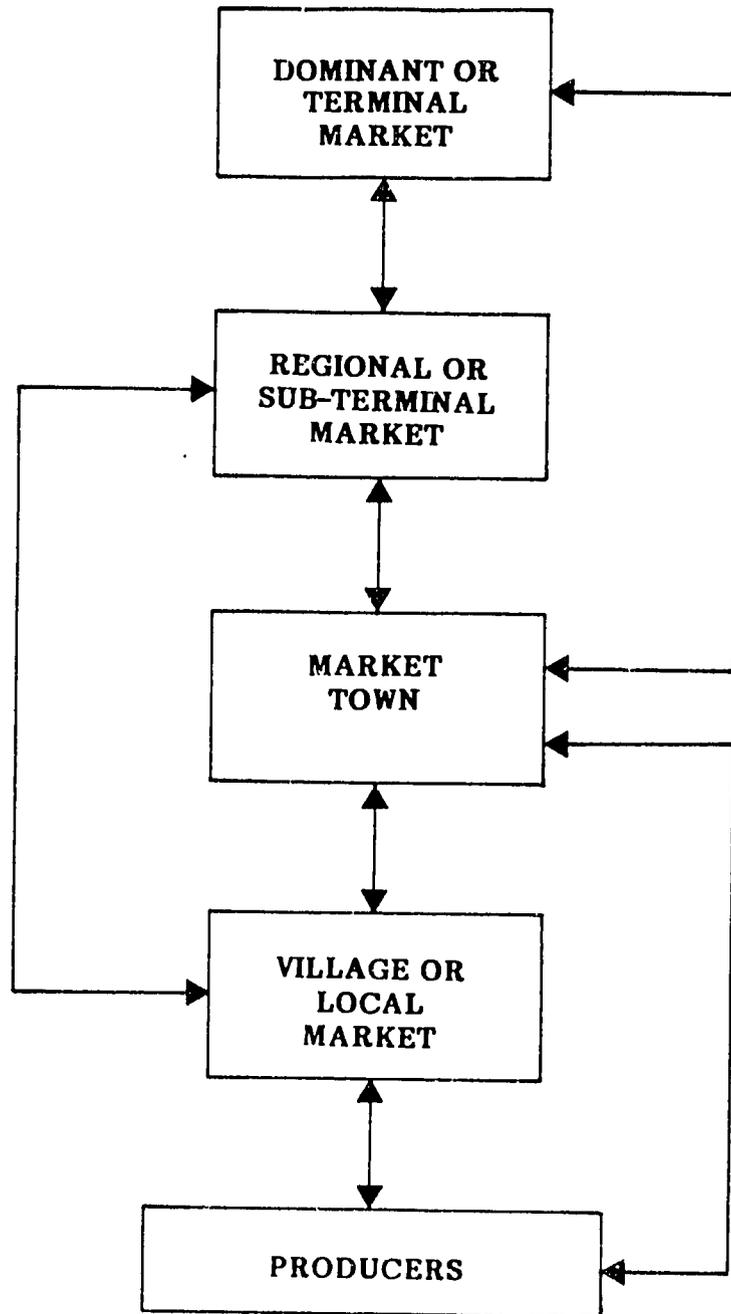
The basic infrastructure of the marketing system consists of transport, storage, communications, processing, and credit. The general state of the infrastructure is decadent and stagnant. Credit, highly inadequate and underdeveloped, has been discussed in a previous section.

(a) The Transport System

Transport is an indispensable function of marketing, creating time and place utility of commodities. The system of transport in the Sudan is highly inadequate. The lack of transport is a great disincentive to increasing agricultural production and a high cost element in the price structure of commodities.

Rail transport: The rail system in the Sudan is inadequate. The Sudanese Rail Corporation (SRC) is a parastatal organization under the Ministry of Transport responsible for the operation and maintenance of rail systems. The Ministry of Finance, however,

Figure 4. HIERARCHIAL MARKETS IN THE AGRICULTURAL MARKETING SYSTEM



exerts control over the budget. Although extensive, the system serves only a limited area. Priority of services is given to export crops. Currently the system is undependable due to old, inadequate equipment, lack of maintenance, and inefficient operations of the SRC. It operates at 20 percent or less of its capacity except for the Khartoum-Port Sudan section which is operating at about 50 percent of its capacity. SRC has been handicapped by a lack of funds, over-employment, and inability to set its own freight charges. Some aid has been provided by the World Bank to upgrade its services and action has been taken to eliminate a large proportion of excess labor. However, massive investment is required to repair and upgrade the rail system and to expand the system to other areas. USAID initiated a "Financial Railway Rehabilitation Project" in 1981. The five year, Ls 12.9 million project was financed through Pl 480 Title III funds.

Many of the problems of the rail system stem from over employment and a strong union, a large operating deficit, lack of maintenance, and inappropriate rate structures imposed by the Ministries. The poor service provided by the railroad has resulted in greater use of trucks and a low demand for services from the railroad.

River Transport: River transport, like the rail system, is in a state of rapid decline due to antiquated equipment and poor management by the River Transport Corporation. The river transport system has much potential, especially for those areas where road construction is impossible because of flooding. There is, evidently, no immediate plan to upgrade the system. However, utilization of the system would benefit the country greatly by affording cheap transport to many areas that have few alternatives.

Air Transport: Air transport is limited and not considered feasible for agricultural commodities at this time. However, development of a non-traditional export industry producing fresh commodities for export and high-value processed products could utilize air transport. Sudan Airways and one private charter company provide passenger and delivery services within the country.

Road Transport: There is a major road network consisting of primary roads and feeder roads in the more developed areas of the country. However, there are few major roads or feeder roads in the areas now being developed extensively for agriculture or in the traditional agricultural areas. Much of the transport of commodities is over unimproved tracks which are virtually impossible to traverse in the wet season. This limits transport of inputs to the areas of production and commodities from the areas of production to local market towns and terminal markets.

Transport vehicles consist mainly of privately owned six to eight ton trucks. Because the roads are poor and the tracks extremely rugged, trucks are subject to severe stress, resulting in costly repair and upkeep, and travel is extremely time consuming.

Primary transport from fields to villages or town markets is usually less than 50 miles. Rates are about Ls 0.75 per ton kilometer or three to four times higher than long distance hauls on improved roads. Secondary transport, between market villages or towns and terminal market towns, is generally over 50 miles. Roads are generally better and charges lower.

The trucking industry is dominated by small operators, many of them merchants owning from one to four trucks. There is a fair amount of competition tending to maintain competitive transport rates. However, the condition of the roads limits the life of the trucks, and spare parts are not readily available.

The planning, design, construction and maintenance of national highways and primary roads is the responsibility of the Roads and Bridges Public Corporation, created in 1973. It is funded through the government budget. The secondary and feeder roads are, theoretically, the responsibility of the regional governments.

There is a great need for additional primary, secondary, and feeder roads in all areas of the country. In addition, the maintenance of existing roads is highly inadequate. The timely maintenance of the existing road system in the country and a planned and aggressive program of road expansion should be a national priority in The Sudan. All donor agencies should participate in such a priority program, as an adequate road network is paramount to a strong, healthy, and growing agriculture and nation.

(b) Storage

Storage of all types in the country is inadequate. There is very little freezer storage, almost no cold storage except in the Khartoum Central Market with 220 tons capacity. Storage for grains is highly inadequate both in terms of capacity and quality. The ABS has the only adequate commercial storage, with silos at Gedaref and other facilities located at strategic sites throughout the Country, including the south. Storage in the north is mainly for sorghum while in the south the majority of the storage is for rice. Merchants often store grains throughout the Country in rudimentary facilities resulting in losses of from 10 to 40 percent, depending upon the length of the storage period.

In the north and west, a traditional storage method known as matamura permits farmers with sufficient volume and capital to store their grain for periods of up to four years. In the south, a traditional system of storage called Azande makes use of large, thatch-roofed, mud-walled "baskets" on stilts. utilized.

(c) The Communications System

The communications system is highly inadequate: communications between regions is limited. The basic infra-structure is in place in the capital region with links to the major cities and towns. However, links with areas outside of the major population centers are limited.

(d) Processing

Processing in the Sudan is undertaken primarily by the private sector with the exception of sugar refining. The cotton ginneries are located within, and controlled by, the irrigated agricultural schemes. Processing of oil seeds into oil and cake, flour milling, manufacture of dairy products, hulling of rice and other forms of processing, however, are all under-taken by private sector entities of varying sizes. Vegetable oil processing suffers from over capacity, with only an estimated 20 percent of capacity utilized. The largest processing venture in the Sudan is the government sugar refining mill located in Kenana

(3) Market Conduct and Performance

There appears to be a relatively high level of competition among and between intermediaries in the market with little empirical evidence of collusion, restriction of producers to markets, or excess profits. Intermediaries are basically identified as trucker merchants, wholesalers, brokers, commission agents, and retailers. Some intermediaries assume multiple roles in providing transport or credit and operate as wholesalers and retailers. The producers have some choice in market channels and types of sales. In many cases, farmers have received cash advances for their crop or loans (the sheil system) and are obligated to give part or all of their crop to the merchant providing the cash advance or the individual providing the loan. The government parastatals, on the other hand, capture a large excess profit through their operations and their monopolistic or monopsonistic positions.

The marketing system, although appearing to be competitive and fairly orderly, is in fact not competitive, orderly or efficient. A large multitude of small merchants handling small quantities of commodities, multiple handling and selling of commodities as they move from the producer to the consumer, multiple transport charges, multiple market taxes and multiple

margins, result in lower returns to farmers and higher prices to consumers.

Profit margins by private traders are not well documented or defined and are confusing. One study (WSARP, 1981) indicates the following markups on sorghum in the domestic market:

Producer to Merchant	- 40.0%
Local Merchant to Regional Merchant	- 34.8%
Regional Merchant to Terminal Market	- 23.3%

The markups or margins include transport, storage, grading and other costs and physical or conditional loss. Calculated profit margins at each stage or transaction are five to ten percent. The producer share of the final sale is also not well documented nor defined. The following, gleaned from various studies, is given as an indicator:

<u>Commodity</u>	<u>Producer Share</u>
Domestic Sales (%of regional merchants sale price)	
Sorghum	39.1%
Export Sales (% of export price)	
Sorghum	33.5%
Gum Arabic	33.0%
Sesame	56.0%
Groundnuts	35.0%
Cotton	18.0%

When considering the sale price of export items by the parastatals in US dollars, the producer share, in real terms, is significantly lower.

Price volatility is a norm in the market for most commodities. Prices drop drastically at harvest time and rise gradually once harvesting of the crop has ended and marketing of the crop by those unable to store their crop has ceased. Prices of some commodities (eg. sorghum) can escalate 100% in less than six months. Some of this is attributable to high storage loss as well as to speculation.

The practice by processors and exporters, especially the parastatals, of buying commodities at the end of the marketing channel rather than directly from the producer or in the production area adds unnecessary costs to processed products,

reduces returns to the producer, and probably reduces the quality of the end product due to multiple handling.

The federal government and its parastatals have a general monopsonistic and monopolistic control of export commodities while the local government councils directly influence, generally negatively, the performance of the markets under their jurisdiction.

b. Commodity Marketing

(1) Grain Marketing - - Sorghum, Millet, Wheat and Rice

(a) Millet

Millet is utilized locally with only about 10 to 15 percent entering the market. Basically, millet is a preferred grain and the urban poor do not purchase it because of its high cost--usually double the price of sorghum.

(b) Sorghum

The bulk of sorghum is produced by the mechanized rainfed farming schemes. Their large volume and well financed operations permit them to ship their grain directly to major markets. They also have the option of storing their grain until prices are optimal. The traditional small-scale farmer producing sorghum, however, has only a small volume and must sell his crop immediately at harvest to cover his needs. Sales are usually to trucker merchants visiting the area or to the village market. Often, the crop is turned over to a merchant or moneylender to repay a sheil loan.

The bulk of the sorghum crop is utilized domestically. However, in recent years, a significant portion has been exported. The government, during periods of drought, imposes a ban on the export of sorghum. Sorghum exports are undertaken by private traders who must secure licenses or permits to export from the government.

(c) Wheat

Wheat production is located exclusively in the major irrigated schemes, with the Gezira project producing over 90 percent. Wheat forms part of the standard rotation with cotton. The tenant farmers deliver their wheat directly to the collection centers of the APC schemes. It is then forwarded to flour mills based on a quota determined by the Ministry of Commerce.

(d) Rice

Rice production is located in the south of the Sudan and is produced almost exclusively by traditional farmers. Although utilized chiefly in the area of production in the south, rice has a potential as a cash crop and a valuable export commodity. Marketing the crop produced in the south is limited, however, by the lack of roads and transport and the war raging in the south.

(2) Cotton Marketing

Cotton is the most important export crop in the Sudan. Only a small portion is utilized domestically. It is a politically sensitive commodity, with central government policy targeting it as their major earner of foreign exchange. The Sudan Cotton Board is responsible for cotton policy, research, and establishment of prices. The Cotton Public Corporation controls and handles the export of cotton through four separate subsidiary companies.

Cotton is produced almost exclusively on the irrigated schemes and PAPC's. The PAPC's provide the infrastructure and general overall management. The farmers, now tenants on the schemes with their own plots of land, produce, harvest the crop and deliver it to ginneries located on, and operated by, each PAPC scheme. On delivery, farmers are now paid for their seed cotton a producer price established by the government and based on the grade of cotton delivered. The PAPC's deduct loans granted, fertilizer and tractor work provided from the proceeds. The cotton seed is sent by the PAPC's to private processors for processing into oil and cake.

Cotton is a government monopoly/monopsony. Producer prices have been established, generally at very low levels, with producers receiving a very small percentage of the export price (eg. 18%) and considerably below parity with other crops such as sorghum. This has resulted in declining cotton production and yields, with farmers, reportedly, more interested in producing other cash crops. The net and gross returns presented previously for the irrigated areas demonstrate the relative unattractiveness for producers of cotton.

(3) Oil Seeds--Sesame and Groundnuts

Oil seeds form a major export category. Exports are in the form of oil, cake and, in the case of groundnuts, nuts. At this time the Sudan Oilseeds Corporation (SOC) has a virtual monopoly in exports. The processing of oilseeds, however, is within the private sector.

Crops grown on PAPC's are delivered by the tenant farmer to collection stations of the PAPC and are passed on to private oil processors or to the SOC. In the traditional rainfed areas, farmers sell to trucker merchants (Dubbai) who in turn sell to larger merchants or on auction markets. (Only about 20 percent is sold through auction markets). Merchants buying at auction markets or directly from other merchants, sell to oilseed processors or directly to the SOC.

Sesame is considered to be a very efficient foreign exchange earner and, with new varieties to reduce shattering, could become a more significant export crop. Groundnuts, on the other hand, are extremely poor in quality and yield. Again, introduction of new varieties and certified seed, together with improved cultural practices, could make groundnuts a more important cash crop and export commodity.

(4) Gum Arabic

Gum arabic is a significant export commodity, producing about 10 percent of total national foreign exchange earnings. Sudan has a near monopoly in its production, with 85 percent of the world's output. The industry is dominated by a government monopsony/monopoly in terms of export marketing, with the Gum Arabic Company setting minimum producer prices, Company buying prices, and f.o.b. selling prices. Although the Sudan is the major producer of gum arabic, there are competing substitutes in the world market, including synthetics. In addition, other nearby countries are beginning to plant the Acacia senegal tree from which the product is derived.

Gum arabic is of two types, both obtained from two different species of the acacia tree. The trees grow in the arid regions of the west. Villagers tap the trees and collect the solidified gum. It is collected and sold in very small lots to local merchants or to trucker merchants. They in turn sell it to other merchants and on the auction markets in market towns.

The gum, after purchase by merchants, is cleaned and graded and after the final sale, is transported by rail to Port Sudan. Multiple sales and handling, multiple taxing and transport charges and multiple margins tend to keep the prices to the producer/collector very low and at or near the minimum producer price.

The GAC has a scheme of price differentials based on grade and cleanliness of the gum. The merchants, who buy from the producer based on no grade, take advantage of the price differential by grading and cleaning the commodity before resale. The GAC's policy is not oriented to maximizing producer returns but rather to maximizing government revenues. There is, evidently, no attempt to establish collection or buying centers

in the areas of production to eliminate multiple sales and multiple margins and costs. The Government does not view the gum arabic as an industry nor does it have a policy of development of the commodity to take full advantage of its near monopoly position in the world market. Gum arabic is a preferred gum but little has been done to gain a real knowledge of the world market, preferences by users, price elasticities, and other pertinent information paramount to structuring an international marketing strategy for the development of the commodity.

(5) Livestock Marketing

Livestock is both an important domestic commodity and an important export commodity, ranking second in exports in the past three or four years. Livestock includes, principally, cattle, sheep, goats and camels. Live cattle and sheep are largely exported to the Middle East while camels are exported to Egypt. Goats are generally consumed locally.

Nomadic herders or transhumants produce 80 to 90 percent of the cattle and almost all of the other classes of livestock. Livestock has, traditionally, been considered a store of value rather than a source of income. Consequently, income considerations are of secondary importance in determining livestock sales.

Kordofan and Darfur supply 70 to 80 percent of livestock for domestic markets and export markets. The main sales activity is in July through December. Livestock markets are located in most of the major towns with the largest operated by the Livestock and Meat Marketing Commission (LMMC), a government parastatal. Cattle are generally sold at auction while other classes of livestock are sold by negotiation. A type of broker, called a Damin, acts as an agent of the producer and provides guarantees to buyers for the producer, at a fee. Taxes are levied at the markets on each transaction. To avoid the taxes, many transactions occur outside of the formal market. In addition to levying taxes, the town councils also impose retail price controls, although they are not always enforced.

Transport of livestock has been facilitated by rail through the provision of holding yards and cattle cars. The principal method, however, is the traditional trekking, often requiring two or three months over a route of some 1200 km.

(6) Fruits and Vegetables

A wide range of fruits and vegetables is now produced in the Sudan in the various regions and many new types could be introduced and produced successfully. Because of the lack of adequate infrastructure (transport, storage and packing),

almost all produce is consumed domestically and the bulk is consumed near the area of production.

All villages and towns have specific market locations where producers or trucker merchants are required to deliver their produce and where the Gebina tax is collected on each transaction. Many producers sell their crop before harvest (contract selling), receiving an advance. The trader/buyer then harvests, transports and markets the crop(s). This is a common practice in many developing countries. There are no grades and standards, no quality control, no adequate packing or containers and rough, multiple handling is the norm.

The domestic marketing of fruits and vegetables is underdeveloped and lacking in every aspect. The Khartoum Central Market has a small refrigerated capacity of 220 tons and there are few, if any, other refrigerated facilities.

Fresh fruits and vegetables and processed products are generally classified as non-traditional agricultural products. A great potential exists, especially in the irrigated schemes, for production and processing of a wide range of fruits and vegetables and their products. Target markets would be the Middle East, Europe, and other African countries. For some processed specialty and fancy foods and gourmet foods, the United States, Canadian and Japanese markets could also be tapped.

c. Input Marketing

The basic production inputs utilized are seeds, chemicals, fertilizer, machinery, fuel, and labor. Acquisition of imported inputs is dominated by the Agricultural Production Corporations (APC's), the ABS and the Crop Protection Department, Ministry of Agriculture (MOA). A small number of merchants procure supplies for distribution to the private sector.

(1) Seeds

Almost all seeds utilized in Sudan's agricultural production are open pollinated varieties saved by producers from previous harvests or acquired from neighbors or the market. There is a formal seed multiplication and certification scheme in the Sudan, albeit on a limited scale. The National Seed Administration (NSA) obtains foundation seed from the ARCs and multiplies the seed, distributing it only to producers in the irrigated schemes and the demarcated rainfed mechanized sector. Seed is marketed at 15 percent above the market price for the commercial commodity. Seed multiplication, however, is limited and provides for only about 15 percent of the demand. Improved seed quality and the increased adoption of hybrids offer opportunities to upgrade yields and profitability, especially in groundnuts, sesame and sorghum. In order to

achieve this, the seed industry must be expanded and improved so that greater volumes of certified improved seed can be made available to traditional farmers.

(2) Agricultural Chemicals

Imported agricultural chemicals consist of: (a) herbicides-used mostly by rainfed mechanized sorghum producers; and (b) insecticides-used by cotton producers to control pests on cotton, the MOA for use in national campaigns against locusts, grasshoppers, and pests, as well as for pest control in the ABS storage facilities. Agricultural chemicals are imported and distributed mainly by the APC's for their schemes and by the ABS. The traditional subsector utilizes virtually no chemicals except for seed treatment, and this is distributed to traditional farmers through the branches of the ABS.

(3) Fertilizer

About 90 percent of all fertilizer is used by the large scale irrigated schemes and is imported and distributed by the APC's. The ABS imports about nine percent of the fertilizer and distributes it to the small scale irrigated subsector. The rainfed mechanized and traditional subsectors use virtually no fertilizer.

(4) Farm Machinery and Equipment

Farm machinery and equipment is imported by the APC's for their schemes by the ABS and by private importers for the mechanized rainfed subsector and the irrigated sector. About 60 to 65 percent of equipment purchases are financed by the ABS. Spare parts for equipment is a major problem although there are stipulations requiring purchase of spare parts when import permits are granted by the Ministry of Commerce. Regulations concerning spare parts are not enforced and, consequently, equipment has little utility over the long run.

(5) Fuel

Fuel is imported and controlled by the government. The ABS provides authorizations to parastatals and schemes in demarcated rainfed mechanized areas and irrigated areas enabling them to obtain fuel from the government at subsidized rates.

(6) Labor

Labor is a major requirement in each of the three types of farming. However, labor requirements in the mechanized rainfed schemes and irrigated schemes is highly seasonal, requiring vast numbers of workers. Because of the

seasonal labor demand in the commercial farming areas, there exists, at times, a shortage of labor in the traditional farming areas. The hybrid sorghums permitting the full use of combines and the use of herbicides would serve to reduce the labor requirement in the mechanized rainfed areas.

c. Major Market Constraints

Although the marketing system in general appears to be relatively efficient, in reality, it is regressive and restrictive. Government policy, market taxes, licensing practices, price setting and controls, and government monopolies and monopsonies have a negative impact on producer profit which is the motivating factor for production. Government policy, at the national, regional and local levels, is oriented to maximizing revenues from agriculture.

(1) Taxation

Town councils are empowered to levy taxes on cash crops. Taxes imposed include the Ushur tax, a 15 percent ad valorem tax, and the Gibena tax, a tax of 50 piasters per kantar. In many cases, the establishment of formal markets and "walling-in" of a market was undertaken to assure the collection of the taxes. Local regulations require that commodities be traded in the formal market and a clearance certificate must be obtained to prove payment of the taxes before commodities can be moved by rail or road. Many transactions are made, however, outside the market to avoid the taxation.

As commodities move from the producing area and are assembled through various levels of the market channel, and disbursed, they ultimately pass through more than one or two markets before reaching the end user. The same commodities could, therefore, have taxes levied on them several times.

(2) Licensing

Through licensing, the town councils allow merchants to operate in the markets and restrict the number of buyers on the auction markets. This tends to limit competition, especially for the export crops. The central government also restricts and controls exports of those commodities exported by the private sector through issuance or non-issuance of export licenses or permits.

(3) Pricing

Town councils have the authority to establish retail prices on a wide range of commodities in their markets. The central government and its parastatals establish minimum producer prices and buying prices of selected commodities and in

some cases, such as gum arabic, establish the f.o.b. export price.

(4) Government Monopoly/Monopsony

The central government controls to varying degrees the buying, selling, and pricing of commodities for export through its parastatals. The objective--and end result--is a maximization of government revenues at the expense of the producer. The failure of the parastatal to acquire the commodity in the producers' area permits multiple taxation and multiple margins before reaching the parastatal.

(5) Infrastructure

The inadequacy of transport, storage, and credit contribute directly to price volatility, low producer profits, low production, high postharvest losses, high consumer prices, spatial dislocation and other effects.

(6) Quality

The value and profitability of many of the commodities produced, both for domestic markets and export markets, are adversely affected by very low quality (eg. groundnuts and sesame). This is largely the result of poor seed quality, poor varieties and poor cultural practices.

(7) Knowledge of the Marketing System and its Functioning

Although many studies have been undertaken of "marketing," none has really delved deeply into the interworkings of the system. In fact, none has really described and identified the Sudanese agricultural and food marketing system from a structural and functional standpoint. Confusing terminology, unclear concepts, and unidentified and meaningless statistics have been utilized in describing, explaining, and delineating the system. Marketing is the motivating force for production. An in-depth understanding of the operation and functioning of the marketing system is paramount to the development of the agriculture sector. The structure, conduct, and performance of public and private institutions and individuals, the functional composition, dependence and interdependence of market intermediaries, producers and government (central, regional, town and local) agencies, and the relation and impact of international markets must be researched and understood before more precise recommendations for change can be made.

(8) Inputs

The unavailability of agricultural inputs places a limitation on the full use of scarce, valuable irrigated land, and a severe limitation on the extensive mechanized rainfed agricultural areas. Dependency on government imports of inputs and distribution by parastatals, or on obtaining permits to import has serious consequences for the production and marketing of agricultural commodities.

It is hypothesized that fertilizers, farm chemicals, tools and implements would be utilized more fully in all areas if they were more readily obtainable on a continuous basis. However, there is no basic distribution system of these items. Supplies are scarce and prices are high. Government distribution programs are disorganized and untimely. A formal distribution system utilizing marketing cooperatives at the farm level could enhance the use of improved seed, implements, and farm chemicals and could distribute required credit.

APPENDIX 3

OPPORTUNITIES FOR GROWTH IN AGRICULTURE

A. Agricultural growth models

There are five generalized agricultural growth models: two basic, and three that can overlay either of the basic models. Sudan, like most countries, has and needs a balance of all five strategies. The two basic models are resource-based and science-based. The overlays for both basic models are export-led, import substitution, and urban consumption.

The resource-based model relies on expanding land use, supplemented by irrigation, credit, and extension of traditional or borrowed elemental technology. The basic engine of growth is land and water development. Because both land and water are finite, growth will cease when these are fully developed. Yields from land and water are stable and will tend to decline without appropriate resource management and introduction of improved technology.

Unlike many developing countries, Sudan has a substantial land resource base for expansion of production. This has been accomplished mainly through mechanized schemes, with little attention to land use limits.

Sudan is approaching the end point for this growth model. Unfortunately, much of the remaining land is marginal for general agriculture without careful conservation methods, and lacking those, is deteriorating rapidly. Land which is suitable for mechanized sorghum production is being leased long-term in large blocks for private investment and development, with assistance from the MFC.

The science-based model relies on borrowed or indigenous technology generation, adaptation, and transfer. The basic engine of growth is productivity (higher yields) induced by the application of science and technology to agriculture. Improved yields are the only way by which unit costs are reduced consistently, permitting sustainable competitiveness. The science-based model requires viable factor and product markets, accompanied by a growing stream of personnel trained for adaptation of science to agriculture. Technology may be borrowed but must be tested and validated by local scientists who are linked with the international scientific community which generates most new technology.

Sudan has recently received considerable input from USAID along this line with the development of the Western Sudan Agricultural Research Project. The Project is currently dormant after investing significant effort in infrastructure development

and some on-farm research. Thus, it appears that the basic groundwork has been laid for some future productive efforts in technology generation and transfer using a farming systems approach.

The export-led agricultural growth model may overlay either of the above basic models. "Exports" can refer to either international or domestic inter-regional trade. The engine of growth is specialization and comparative advantage--a region or a country specializes in those commodities that it can produce better and more cheaply than others, and trades for other products.

Since colonial times, Sudan has been dependent on exports principally cotton, to obtain the imports of consumer and producer goods and raw materials vital to its economy. Both dependence on export of a limited number of products whose value is subject to variable international demand and lack of attention to maintaining a comparative advantage and expanding market share underlie the weakness of Sudan's agricultural export strategy. It has become increasingly apparent that Sudan must diversify its export base, improve its productivity, and market aggressively to achieve a sustainable international comparative advantage.

The import substitution agricultural growth model is focused on specialization to achieve real domestic unit costs equal to or less than prices of imported products. It too can be international or domestic interregional. The engine of growth is competitive productivity resulting from efficient specialization that substitutes for selected imports.

Sudan can and should substitute domestic production for imports when it can do so at competitive prices. However, such substitution must be based on efficient production rather than subsidies or tariff protection so that the economic gains achieved are real rather than illusory. The strategy can never be expected to completely substitute for imported products nor should it be pushed past the point where marginal cost is greater than marginal benefit.

The urban growth agricultural development model is based on expanding food and raw materials production to meet demand generated by urbanization and employment with rising real incomes. It usually includes some elements of efficient import substitution and regional specialization.

This self-sufficiency model is driven by industrial growth and may not be a promising stimulus for agricultural development until Sudan's economy has stabilized and investment capital becomes more readily available, especially from remittances generated by Sudanese working abroad. However, as employment and incomes increase, the usually high income elasticities of demand

for food will lead to an increasing need for food imports unless the agricultural sector is prepared to fulfill a larger share of consumption needs.

B. Priority Commodities

Commodities or products produced in the Sudan are limited to eight major categories, with a ninth category--fruits and vegetables-- composed of many smaller volume crops. The Sudan has the capability, however, of producing other commodities not now being produced.

Expansion in production, increase in profitability, and adoption of new commodities or products are dependent on a new outlook emphasizing a market approach and development of an overall national agricultural development policy accompanied by specific national production strategies and marketing strategies for each commodity.

1. Traditional Domestic Commodities

The basic commodities utilized as food staples and having potential for growth include: livestock; sorghum; millet; rice (in the south); and fruits and vegetables. The output, quality, and profitability to the producer can be greatly expanded by elimination of basic constraints. These include changes in local and central government policies, upgrading of infrastructure, establishment of private institutions such as marketing cooperatives, improvement in quality and availability of seeds, and many others.

2. Traditional Export Commodities

All of the traditional export commodities including sorghum, cotton, livestock, sesame, groundnuts, and gum arabic have great potential for growth and increased value. To achieve the optimum growth and returns, however, each commodity should be viewed as an industry. A national policy, objective, production strategy, and marketing strategy should be developed and implemented for each.

It is important to view each commodity on a national rather than regional basis, as a means of optimizing utilization of national resources and optimizing production and export volume of each commodity. A change in patterns of production is strongly advised, with conservation of soils and reforestation an integral consideration of each commodity policy and strategy.

The expansion in production and export volume of these commodities will require optimum utilization of production inputs, improvements in varieties and quality of seed, and improvements in crop protection programs in the case of sorghum, cotton,

sesame, and groundnuts. An expansion of gum arabic will entail changes in pricing, purchasing patterns, development of infrastructure (eg. water availability in areas of production), and planned plantings of trees. Livestock expansion will require: 1) a change in concepts by the producer whereby livestock will be marketed at optimum weight; 2) the use of feedlot finishing utilizing oil cake, now exported, as a protein source; and 3) establishment and operation of an animal health program to reduce parasites and diseases. The success of expansion programs all depend upon improved transport and credit.

3. Non-Traditional Export Commodities

No commodities that could be termed non-traditional are currently exported from the Sudan in any significant quantities. However, a large array of adaptable commodities and products could be produced in the Sudan. Research from the 1960's and 1970's as well as more recent research, supports the hypothesis that rice could be a major export commodity. Substituting rice in the rotation on the irrigated schemes could improve producer incomes and provide a highly profitable export crop.

Irrigated lands, as well as rainfed areas with adequate rainfall and appropriate temperatures, are capable of producing a wide range of high-quality horticultural products including fruits, vegetables, flowers, and ornamental plants. Irrigated land in the Sudan is a valuable, high-cost yet scarce resource. Horticultural crops are intensive and have a high value and may hold a great potential for fresh markets in the Middle East, Europe and other African nations.

A processing industry could also be developed, based on production of fruits and vegetables in irrigated areas, in the south and other regions. Such products should be higher value, high-quality, specialty and fancy food products rather than large-volume, bulk products with low per unit value.

Development and adoption of non-traditional commodities and products will require the establishment of infrastructure, introduction of new technology, and use of substantial production and marketing inputs. This, in turn, will entail substantial investments from domestic and international sources and acquisition of a considerable amount of production and post-harvest marketing technology. Much of the technology would have to be provided through technical assistance programs.

For fresh horticultural commodities, the primary requirement would be an opportunity analysis relating markets, market needs, periods of need, and prices in foreign markets to adaptable crops, seasonality of adapted crops, cost of production, and marketing and transport availability and cost. For processed products, the primary requirement would be an analysis of crops

adaptable to the Sudan and the corresponding products that can be processed from them. The latter must relate to international market needs or latent demand and must be competitive in terms of quality and cost.

C. Institutional Development Priorities

Institutions are the facilitating structures through which development is achieved and services are provided. In order to provide necessary services to the agricultural sector and make the necessary improvements, effective institutions must exist which have capable management and objectives properly oriented to production.

1. Public Sector

The dominance of public-sector institutions in the agricultural sector, the negative aspects of the parastatals, and the various activities undertaken to maximize revenues to the government have all been briefly treated in previous sections. To achieve the greatest return from the scarce resources of the Sudan requires a return of most of the production and marketing functions to the private sector. Such a change could result in greater returns to the sector in the form of increased production, improved returns to the producer, and expanded exports and revenue. The function of government and its institutions should be more oriented toward regulation and implementation of those necessary functions which the private sector is unwilling or unable to undertake.

There are exceptions and qualifications to this generalization, especially in relation to commodities such as gum arabic in which the Sudan has a near monopoly. In this case, the Gum Arabic Corporation should continue as a monopoly marketing agent, but with a change in orientation and policy. It should vertically integrate the industry, eliminating multiple handling and selling, and streamlining the acquisition of gum directly from the producer or producer-marketing cooperatives. Its role should be to improve producer profitability of gum arabic, thus eliciting a larger and more stable supply response. It should also adopt policies that promote expansion of the use and sales of the product and assure competitiveness in relation to substitutes.

In real terms, the Sudanese government parastatals and monopolies are not likely to evolve or be eliminated in the near future. However, a change in their orientation could be brought about. Government institutions should be oriented to the producer and the commodity industry of which they are a part or for which they have a responsibility. Their objectives should be to maximize returns to the producer and to optimize total production and export volume.

The irrigation schemes are immense, the logistics of providing irrigation water, maintaining roads, and other infrastructure is complicated. The PAPC's currently operating the schemes fall directly under the control of various ministries. Often, directives given are undoubtedly based on political rather than economic rationale. It would be advisable to place the PAPC's under an authority established by law but consisting of producers and intermediaries in the private sector as well as government representatives. This would remove them from direct control and manipulation by the ministries and help to focus the objectives of the scheme activities based on sounder economic principles.

2. Private Sector

The two major forms of private-sector institutions are the Sudanese General Farmers Union and cooperatives. It is believed that producer marketing cooperatives, properly organized with trained managers and properly serviced and assisted, could aid in enhancing orderly marketing, increasing production, distributing inputs, and alleviating price volatility. The Sudanese farmers have a tradition of cooperative action on which to base a dynamic cooperative movement.

Marketing cooperatives of producers in all regions of the Country could be utilized to channel credit from ABS and distribute it to their members with the cooperative responsible for guaranteeing the loan. In addition, cooperatives could establish and maintain:

- o storage facilities
- o distribution of inputs
- o market commodities, in volume, eliminating several buyers and handlers
- o protect against volatile price fluctuations
- o provide production and market information to members

In essence, the marketing cooperative could be the first stage of a general upgrading of the agricultural infrastructure. The demand created for managers and technicians could also help stem the so-called "brain drain".

The cooperatives could link with and receive services from the Farmers Union. The Union could provide assistance to the cooperatives and their members in organization, management training, and overall servicing of administrative needs. Currently such activities are taking place in various schemes including the Gezira Irrigation Project. In the Gezira Project, the Farmers Union has a well-organized and active staff that works closely with the farmers, Gezira management, and the cooperatives in the area.

Due to time constraints and information limitations, the team did not have time to delve into other types of private-sector institutions that surely exist and could be improved or better utilized for economic development. Many of these institutions are informal, organized loosely or not at all. They provide necessary services, perhaps at a very high cost to the consumer, in cases where neither the government nor anyone else is willing or able to intervene. Typical examples are the much maligned local market intermediaries who provide credit and services to small farmers. The assumption is commonly made that these institutions are "bad" and should be eliminated via direct government action or the formation of new alternative institutions such as cooperatives. History in much of the developing and developed world has shown that the organizational difficulties, funding requirements, and operational rigidities of such alternative organizations often lead to their demise once outside assistance ceases. Thus, it would be advisable to take a fresh look at some of these traditional institutions with a view toward discovering ways in which they could be made to function more effectively and equitably, rather than accepting at face value the argument to eliminate them.

D. Natural Resource Priorities

It is well established that the natural resource base is deteriorating in both western and eastern Sudan. Each has its own peculiar problems. In the west, ecological limitations exist imposed by low and extremely variable rainfall, high evaporation rates, recurrent drought, and low-fertility soils. There is also limited access to groundwater for both human and livestock consumption; where wells have been provided, overgrazing and concentration around water points have exacerbated land degradation. In the east and west, the most serious problem is the degradation of the environment due to mechanized shifting agriculture. This contributes to deforestation of economically beneficial trees, compaction and depletion of soils, and potential desertification. This last is a result of wind erosion when soil fertility declines and fields are left abandoned with no vegetative cover.

Opportunities for maintaining and enhancing the natural resource base mean modifying the structure of incentives in mechanized rainfed agriculture and gum arabic production so that short-run profit motives are more consistent with longer-run objectives in natural resource conservation and sustained yields.

Efforts should be made to "stabilize" mechanized rainfed agriculture by boosting the benefits of continuous long-term farming on allocated land rather than moving on to new lands. This can be accomplished through a program of research and extension designed to provide more productive sorghum varieties and maintain soil fertility by using fertilizers and rotating

crops with nitrogen-fixing legumes. The costs of moving from field to field should be increased by establishing rental fees that encourage greater stability or provide for replanting the land with vegetative cover. Preferably, cover should be pastures for the pastoralists and gum arabic for future harvest, when cultivation becomes no longer economically viable. This will require policy changes and changes in the Mechanized Farming Corporation.

Secondly, increasing the profitability of gum arabic production will have the effect of decreasing deforestation of Acacia senegal and encouraging replanting in deforested areas. Here, the most important changes required are a reorientation of the Gum Arabic Corporation toward greater producer profitability and initiatives to stimulate gum arabic demand and protect Sudan's gum markets.

APPENDIX 4

CURRENT USAID PROGRAMS IN SUDAN

A. Program Objectives

USAID's current strategy for the agricultural sector, as outlined in the 1984 Country Development Strategy Statement Concepts Paper, focuses on enhancing the productive performance in the rainfed dryland areas of Sudan, with special emphasis on Western Sudan (Kordofan and Darfur regions).

The rationale provided for this approach centered on the rainfed sector's current contribution to both domestic and export products, especially sorghum, groundnuts, millet, and gum arabic, as well as its perceived potential for future growth. The Government-operated irrigated subsector did not receive emphasis because of the high capital requirements of the schemes, the inefficiencies introduced by government control, and the high investments already allocated by the World Bank and others for system rehabilitation.

In contrast to irrigated production, traditional rainfed farming implies low domestic resource costs to produce net foreign exchange through exports due to its labor-intensiveness and minimal foreign exchange requirements. The subsector produces nearly 90 percent of Sudan's chief staple food crop, sorghum, a potential substitute for imported wheat and an important contributor to Sudan's overall food security.

B. Summary of Current and Planned Agriculture and Natural Resource Projects

o Western Sudan Agricultural Research Project (WSARP)

WSARP is a joint project of USAID, the World Bank, and the Government of Sudan designed to increase the capability of the Sudan Agricultural Research Corporation (ARC) to develop and test improved production systems in Western Sudan. Project elements included construction and equipping of research facilities in Darfur and Kordofan provinces; construction of a project administrative and support center in Khartoum; technical assistance in research administration, planning, execution, and training; and provision of all operating expenses. From September, 1978 thru May, 1987, USAID/Sudan provided \$19.2 million to support the above mentioned elements, as well as LS 17.5 million in counterpart funds for operating expenses.

o Agricultural Planning and Statistics Project

The APS Project was designed to assist the GOS to strengthen its capability for policy analysis and planning in the

agricultural sector. Since start-up in 1981, the project has provided technical assistance, training and commodities to the Planning and Agricultural Economics Administration of the Ministry of Agriculture and Natural Resources for policy analysis, project identification and evaluation, and agricultural data collection and statistics. The project has been amended to include a four-year extension to enable completion of original objectives while establishing closer linkages between the project's statistical and analytical outputs and the agricultural policy decision-making process. By EOP in April of 1991, USAID's contribution to the project will have been \$14.5 million.

o Kordofan Rainfed Agriculture (KORAG)

The KORAG Project was designed to aid in the completion of an agricultural marketing and transport network in Kordofan. The project consists of three components: (1) the development of a feeder road system which will link an agricultural production area encompassing 900 square kilometers to Kordofan's principal transportation arteries; (2) the design and construction of seven warehouses to be used for grain storage which, when linked with inventory loans, will permit farmers to profit from seasonal price fluctuations; and (3) the provision of agricultural credit in the form of production loans to create competition in informal credit markets to help reduce credit costs, and to provide inventory loans so that farmers may sell their crops when prices are highest. USAID's contribution to this project, in the form of a grant to the Government of Sudan, is \$18.1 million.

o Eastern Refugee Reforestation Project (ERRP)

Under this Project, CARE received a grant for \$5 million to accomplish these objectives: establish nurseries for tree seedling production; reforest 8000 feddans in Kassala Province in Eastern Sudan the area where refugees (mainly from Ethiopia) have settled in flight from drought conditions in their own countries; and train the population in harvest and management of established plantations. Intensive mechanized land clearing and cultivation of sorghum has led to an almost complete deforestation, with a consequent shortage of fuel and construction wood. The project provides employment for refugees and rural Sudanese, and introduce the practice of integrating agriculture, forestry, and animal husbandry so as to maximize overall land productivity on a sustainable basis while preserving environmental stability.

o Sudan Reforestation and Anti-Desertification Project

The SRAAD Project is designed to assist Sudan to rehabilitate drought-affected areas in order to halt desertification by (1) developing a sound information base from planning, managing, and monitoring forest resources in Western

Sudan; and (2) promoting reforestation in Southern Kordofan through participatory forest management and activities aimed at introducing and sustaining greater utilization of trees in traditional agricultural systems. The Project was signed in August, 1987, with AID contributing \$8 million over the six-year life of the project.

o Agricultural Research and Production

The new AR&P Project emphasizes the development and improvement of more productive varieties of staple food crops such as sorghum and millet in Kordofan. Improved seeds and cultural practices will be developed using a farming systems approach whereby conditions and constraints, socioeconomic as well as ecological, of the rural dwellers are factored in to the research design. The major components of the new project include full support for the Kadugli and El Obeid research stations developed under WSARP, and limited support to stations in Darfur. This new project should come on line sometime after October of 1989, and will be funded by AID for approximately \$10 million.

o Sudan Resource Data-Base Monitoring

This project is designed to accurately monitor natural resource and agricultural conditions in Sudan in order to provide up-to-date information to plan development and utilization of the country's natural resources. The project will be based on already existing SERISS remote-sensing activities, but will expand the GIS system to be able to include and analyze data such as soils, topography, water resources, population, and land use. An early-warning for decision-makers will include forecasting crop production and nutritional deficit. The Mission has requested funding of \$6 million for the life of the project.

o Privatization of Seed Production

This project is at the pre-PID stage, and will be designed to help establish and strengthen the ability of the Sudanese private sector to effectively produce and distribute high-quality seed of the basic staple food crops.

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