

PN-ABC-658 J. Turk
61269

DEVELOPMENT OF SUDANESE AGRICULTURE

for
USAID
Development Studies Program

by
Ken Lyvers
Wendell Morse
C.C. Lu

JANUARY, 1966

CONTENT

	PAGE
PREFACE AND ACKNOWLEDGEMENTS	iii
EXECUTIVE SUMMARY	iv
I. BACKGROUND	1
II. DONOR ASSISTANCE TO SUDAN	2
A. Total Assistance	2
B. USAID/DA & ESF Funding for Sudan	2
C. The Role of PL-480	2
D. USAID Strategy -- Western Sudan Initiative	6
III. IMPORTANCE OF AGRICULTURE TO THE SUDAN ECONOMY	7
A. Economic Importance of Agriculture	7
B. Land use, Soil and Rainfall	7
C. Major Production Systems and Regions	13
D. Agricultural Production	14
IV. DEVELOPMENT CONSTRAINTS AND APPROACHES TO OVERCOMING THEM	18
A. Constraints to Agriculture Development	18
B. Approaches to Overcome Constraints	19
V. ASPECTS OF A NEW AGRICULTURAL STRATEGY	19
A. Agriculture Production with Export Focused Strategy	19
B. Increase Fertilizer Use	20
C. Better Regulated Mechanization and Land Use Planning	20
D. Irrigation and Agriculture Production	21
E. Hybrid Seed Production	21
F. Credit and the Commodity Import Program (CIP)	22
G. Agricultural Research	23
H. Data Gathering and Analysis	23
I. Afforestation	24
J. Other Aspects of the Strategy	24
VI. CONCLUSIONS	25
REFERENCES	26
ANNEXES	
1. USAID -- WESTERN SUDAN INITIATIVE	
2. CONSTRAINTS TO AGRICULTURAL DEVELOPMENT IN SUDAN	

TABLES AND FIGURES

<u>TABLES</u>	<u>PAGE</u>
1. Foreign Assistance to Sudan	3
2. Program Summary (USAID)	4
3. Sudan--PI-480 Assistance, 1979-88	5
4. Climatological Zones of Sudan and Rainfall	8
5. Land Classification	9
6. Land Use on Potential Arable Land	9
7. Estimated Cultivated Area by Farming and Operating Systems, 1979	10
8. Crop Summary, Area, Production, and Yield by GOS	15
9. Sorghum and Millet, Area and Production Estimates by GOS	16
10. Sorghum and Millet, Area and Production Estimates by ERIM/USDA and GOS	17

FIGURES

1. Natural Resource Regions of Sudan	11
2. Sudan: Location of Sub-Sectors and Length of Growing Season in Days	12

PREFACE & ACKNOWLEDGEMENTS

This paper was initially prepared to meet partial requirements of the Development Studies Program conducted in January of 1986 at the Public Affairs Center in Washington by the University of Southern California.

All three of the authors have knowledge of Sudan having worked there previously. Ken Lyvers is assigned to Sudan as the head of the Agriculture Office, although he was on evacuation orders (for security reasons) to AID/W when this report was prepared. Wendell Morse is an Agricultural Economist with the Food For Peace office in AID/Washington and C.C. Lu is an Agricultural Economist with the Dacca mission in Bangladesh.

The initial idea for the paper was conceived by the Director of USAID in Khartoum when he indicated interest in mid 1985 to focus the agricultural port-folio and suggested that an agricultural strategy statement be prepared. In the initial week of the DSP course the three authors decided to draft this paper with the view that it might be helpful both for the new USAID management as well as others interested in the development of Sudan. Views were solicited from several people. Special thanks are extended to the following who took the time to review an earlier draft and provide comments: USAID--Keith Sherper, Cal Martin, Kenneth Prussner, Larry Abel, Tim Harris and Ray Meyers; USDA, ERS--Brian de Silva; Checci--Will Bateson; and USC--Paula Diebold de Cruz. A special thanks is also extended to Bonita Benison for her secretarial assistance.

The views expressed in this paper are those of the authors and do not represent the official position of the U.S. Agency for International Development.

EXECUTIVE SUMMARY

Agriculture dominates the economy of Sudan. It accounts for about 40% of the total GDP and 75% of the GDP in the production sector while employing 72% of the labor force. The role of agriculture in generating exports is particularly crucial with nearly 95% (1981-82) of the total value of all commodity exports coming from agriculture. These included the export of cotton (37%), groundnuts (12%), gum arabic (11%), livestock (14%), sorghum (16%) and oilseed (10%). In spite of Sudan's strong agricultural base, imported agricultural products (food and beverage) account for about 25% of the value of the country's imports.

Donor assistance to Sudan from 1943-84 has been extensive with nearly \$4.4 billion being provided from various multilateral (\$1.35 billion), bilateral (\$1.82 billion), OPEC (.88) and communist (\$.34) sources. Through 1984 the U.S. Government provided \$1.01 billion of economic (\$791.8) and military (\$218.6) assistance. U.S. total economic assistance to Sudan has continued at a high level with \$146.3 million being provided in 1984, \$142 million in 1985 and another \$87.8 planned for this year. With all of this assistance the economic situation in Sudan continues to deteriorate with an accumulated debt of over \$9 billion. The country is unable to reach a viable standby agreement with the IMF and cannot pay off its debts.

Although data sources conflict, it appears that about 90 million acres of land in Sudan are potentially arable. Of this total, approximately 30 million are cultivated, although the area actually cropped each year is considerably less, varying from a five year average (79 to 84) of 15.09 million to an estimated total of 20.4 million in 1985. Much of the remaining potentially arable land is being utilized for livestock grazing or is in a fallow system of cultivation which is the common way of land usage in the country.

The three major systems for farming in Sudan, in addition to the limited areas of pure nomadic and semi-nomadic livestock herding in the extreme north and northwest are: 1) irrigated agriculture, concentrated mostly along the Blue and White Nile valleys between the 11th and 15th parallels; 2) mechanized, rainfed agriculture typical of the east-central Sudan where rainfall normally exceeds 600 mm; and 3) traditional rainfed agriculture, typical of the west and south, and includes most of the country's livestock.

Production of sorghum and millet, which are the major food grain staples of the country, has varied widely in recent years and plummeted to an all time low in 1984 to 1.255 million metric tons. Production in 1985 appears to be an all time high, however, with recent projections by the government of 4.83 million tons. Total production is even higher at 4.918 million tons when acreage estimates obtained through remote sensing and yields estimates of the Government are used. Assuming these figures are reasonably accurate, Sudan has excess production of over 1 million tons. Furthermore, the cropped acreage under production in the East (14.86 million acres) is nearly 5 times that of the West (3.122 million acres) and production in the East (3.834 million tons) is 7.5 times that of the West (509,000 MT).

Constraints to increasing production are numerous and more adverse in the western part of the country than in the East. These constraints include land, soil, desertification, climatic, ecological, physical infrastructure, farm level, along with institutional, economic, and financial policy. In general, the soil in the West is potentially much less productive than in the East. Also, there is evidence of a long-term climatic change in the northern parts of the West, where the length of the growing season has decreased from 78 to 63 days and the traditional farmer's chances of successful cropping declined from a 1 in 2 years to 1 in 3 years, in this marginal semi-arid environment.

The focus of USAID in the rainfed or dryland areas of Sudan is appropriate although the "Western Sudan Initiative" is questionable. Under this initiative USAID is focusing development efforts in Western Sudan (Kordofan and Darfour Regions) and has either approved or plans five major projects with a total estimated funding of \$128.6 million in foreign exchange and local currency of 377.8 million Sudanese pounds (equivalent to \$151 million at the official exchange rate). This "initiative" is effectively utilizing the total USAID DA account funding for four years and over three years of PL-480 local currency generations. Much of this funding and all of these projects, except the El Obeid-Kosti road could focus in the more productive areas in the higher rainfall areas of the West (below 13 degree N latitude). AID may want to critically review the Western Sudan Initiative, however, to see if some of these resources should be directed or at least more closely linked to other agriculturally more productive areas of the country, especially the East.

In addition to the above, other aspects of the future agriculture strategy in Sudan should focus on diversifying and increasing the production of export crops. This strategy should include the following:

1. As a way to augment both labor and machinery productivity, begin the use of fertilizer in farmers fields and then dramatically increase the use of fertilizer and possibly other inputs in the rainfed sector, assuming this proves economically feasible;
2. Through land use and soil survey mapping and through land tenure studies and land related policy reform, provide support to and better regulate mechanized farming under the private sector;

3. Reduce the production of medium staple cotton in the irrigated schemes and increase the production of hybrid sorghum and groundnuts and other crops such as corn and possibly rice, which show a potential for high production and might be exported to the Middle East countries;
4. Place highest emphasis in the agriculture sector to the development of a viable hybrid seed industry based in the private sector;
5. Focus the USAID CIP funding on importation of agriculture inputs and commodities for the private sector (i.e. fertilizer, appropriate farm machinery, and agro-industry processing and equipment manufacturing) and consider tying much of the local currency proceeds to a credit program for the agriculture sector;
6. Provide a commodity focus to the agriculture research program and expand it to the entire rainfed area of Sudan and not just to the West as is currently the situation;
7. Carry out better data gathering and analysis including consideration of area estimates through remote sensing technology, use of area frame sampling techniques, and conduct additional economic and other analysis including work on irrigation;
8. Emphasize afforestation, livestock improvements activities including animal traction, the establishment of farmer organizations, and stress technologies for increasing land productivity such as seed dressing along with zero and other reduced tillage techniques.

It should be possible for the West to reach earlier levels of groundnut production for export, as well as produce enough food for internal regional consumption. Additional infrastructural improvements (drinking water and roads) are urgently needed, however, in the potentially more productive southern areas of Kordofan which are currently uninhabited. In fact, large segments of the population in the Northern part of Kordofan and Darfour, (above 13 degrees N latitude) should be encouraged to migrate to the southern areas of Kordofan, and probably would do so if these infrastructural improvements are made. If the people are not moved, however, donors should be prepared to continue feeding programs since good sustained agriculture production is not feasible.

In the authors view, Sudan and other developing countries must make systematic investments in agricultural production in the potentially more productive areas of their country. If this focus is shifted in Sudan from the West to the East by the Government and Donors, there is little question that "Sudan can become the bread basket of the Arab World."

DEVELOPMENT OF SUDANESE AGRICULTURE

I. BACKGROUND

Sudan is the largest country in Africa, with an area of 2.4 million square kilometers. Total population is about 22.4 million people, 72% of whom are directly employed in agriculture. Much of the country is desert or semi-desert with relatively low population pressure on the land.

The predominant role played by the agricultural sector in the Sudanese economy is a reflection of Sudan's natural resources and long recognized comparative advantage in agriculture. However, in recent years, the productive potential of these resources has not been realized. In the latter half of the 1970's, the total cropped area stagnated and, since 1977/78, has actually declined in response to the shortages of inputs that occurred because of the extreme foreign exchange shortages, transport problems, and low prices. The latter were largely a result of the cost recovery mechanism on the irrigated schemes, an overvalued exchange rate, artificially set prices, and government marketing monopolies. Yields of the major export crops grown under irrigation fell. The cost of producing these crops rose. The resultant cost-price squeeze precipitated serious balance of payments problems, and seriously depleted the availability of domestic resources, both for recurrent expenses and for investment. Many aspects of production have changed, and a reversal of the existing trend will require a rigorous redetermination of how currently available resources should be deployed to restore, then exceed previous levels of output.

Virtually all of Sudan's productive land is used in some form, even if only for transhumant livestock production with a very low human population density. But throughout Sudan there is considerable potential for increasing the productivity of the land. Although the changes necessary to unleash this potential are relatively easy to identify, the complex and inter-related social and technical factors involved make it difficult to forecast the time it will take to bring them about. A key factor will be the rate at which the investment and human resources required can be mobilized. With the current economic situation, such resources are very scarce and likely to remain so for the remainder of the decade. Resources for public sector investment will be at a premium; consequently, Government will need to both carefully assess its priorities in allocating public funds, and seek ways to maximize the contribution that private investment can offer.

For Sudan as a whole, improving productivity of the agricultural sector will depend heavily on introduction of new technologies and development of physical and institutional infrastructure. While this applies to both the irrigated and rainfed areas, it has particular relevance for the rainfed. Changes in production mix can be expected. Some are already occurring. Within the rainfed subsector, for example, there is a move out of transhumant livestock towards mixed cropping and livestock activities. The social costs of such changes are already evidenced by the land pressures appearing in the

more favored crop areas within the traditional systems. In the irrigated subsector the move is away from cotton towards groundnut, sorghum and livestock. However, unless these changes in both subsectors are directed towards the evolution of integrated farming systems that are consistent with relative prices, including the real value of the pound, and that are capable of sustaining and/or increasing current crop yields and carrying capacities, increments in rainfed output will be difficult to sustain, and the declining outputs of the irrigated subsector will be difficult to reverse.

II. DONOR ASSISTANCE TO SUDAN

A. Total Assistance

Total donor assistance to Sudan both historically and through the present time has been extensive. Table 1 indicates that from 1946 to 84 the multilateral assistance was \$1.35 billion and that bilateral aid DAC countries disbursements from 1978-83 was \$1.82 billion. The OPEC countries disbursed \$877.5 million from 1978-83.

B. USAID, DA and ESF Funding

The U.S. Government contributions to Sudan increased substantially to \$146.3 million in 1984 another \$142 million in 1985 and was reduced to \$87.8 million for 1986. These latter figures do not include military assistance (\$218.6 million from '46 to '84), nor PL-480 which has been averaging about \$50 million a year (See Table 2 and 3).

C. The Role of PL-480

The PL-480 program has been a very important part of overall assistance to Sudan since 1980. (See Table 3). Its importance will continue in the near future. The PL-480 program in Sudan has been used during this time:

- 1) as a balance of payment support for needed foodstuffs;
- 2) to encourage policy analysis and reform in the agricultural sector; and
- 3) as a source of local currency to finance important USAID/GOS agricultural and rural development projects.

PL-480 policy changes were successfully used to:

- 1) greatly reduce or remove export taxes on groundnuts, edible oil and sesame;
- 2) keep trade and exchange policies under surveillance so that domestic food is favored over imported food;
- 3) reduce consumer price subsidies for wheat and wheat flour products;
- 4) determine the economic feasibility or private sector investment in sorghum milling capacity and the blending of composite wheat sorghum flour; and
- 5) reorient domestic wheat price policy from an artificially low ceiling price to an import parity based floor price.

PROGRAM SUMMARY (In thousands of dollars)								
Fiscal Year	Total	Agriculture, Rural Development and Nutrition	Population Planning	Health	Education and Human Resources Development	Selected Development Activities	Other Programs	
							ESF	Other
1985								
Loans	-	-	-	-	-	-	-	-
Grants	142,000	23,313	540	1,140	-	3,007	114,000	-
Total	142,000	23,313	540	1,140	-	3,007	114,000	-
1986								
Loans	-	-	-	-	-	-	-	-
Grants	87,812	25,200	1,050	350	-	1,400	59,812	-
Total	87,812	25,200	1,050	350	-	1,400	59,812	-
1987								
Loans	-	-	-	-	-	-	-	-
Grants	118,000	23,005	2,250	50	-	2,695	90,000	-
Total	118,000	23,005	2,250	50	-	2,695	90,000	-

**FY 1987
PROGRAM HIGHLIGHTS**

- Balance of payments assistance and support of economic policy reforms (\$90.0 million).
- P.L. 480 commodities to help meet food requirements, provide balance of payments support and support policy reform (\$53.7 million).
- Agriculture infrastructure, research and technology development and dissemination (\$23.0 million).

Support to development assistance projects through 1985 included:

- 1) improved operation of Sudan railway;
- 2) opening river transportation to private sector;
- 3) support to AID projects (Agricultural Planning and Statistics, Western Sudan Agricultural Research, general agriculture production and marketing in the South, and primary health care in the West and South).

Sudan will be unable in the near future to either grow or commercially import sufficient amounts of wheat to meet domestic demand. Annual import requirements will be around 400,000 MT for the next 3-5 years. This is a net requirement which considers an annual consumption increase of 12% and substitution of sorghum for wheat at 10% per year.

The Sudan PL-480 program in FYs 86-88 (approximately \$150 million) will continue:

- 1) to support balance of payment needs;
- 2) to encourage policy analysis and reform in agriculture; and
- 3) to provide local currency financing for agriculture and rural development projects focusing in the West.

Table 3

SUDAN PL-480 ASSISTANCE, 1979-88

<u>YEAR</u>	<u>TITLE I</u>	<u>TITLE III</u>	<u>TOTAL ASSISTANCE</u>
1979	21	—	21
1980	6	20	26
1981	15	20	35
1982	7	20	27
1983	31	20	51
1984	30	20	50
1985	25	25	50
1986	25	25	50
1987	25	25	50
1988	25	25	50

Source: 1) State Cable, Khartoum 7746, May 20, 1985
 2) Congressional Presentation, FY 87.

D. USAID Strategy -- Western Sudan Initiative

On April 19, 1984 AID/W held its executive level meeting to review Sudan's Submission for the FY 1986 CDSS cycle (1). Mission had submitted a Country Development Strategy Statement Concepts Paper (a full fledged CDSS has never been submitted for Sudan) which included a fairly detailed "Rainfed Agriculture Strategy". While some issues were raised at the review the concept paper was accepted and became the first CDSS for Sudan. The USAID Mission's first agriculture strategy, which articulated the reasons why USAID should focus on "rainfed" rather than "irrigated" agriculture, were sound. As quoted from the concept paper,

With the financial and technical limits on what we can do in agriculture as a whole, focussing on private rainfed agriculture is a sound way of narrowing the scope of our efforts. In contrast to irrigated production, the labor-intensive nature of rainfed farming and the minimum foreign exchange requirement for capital inputs can assure high returns from marginal investments in technology and supporting infrastructure. Rainfed agriculture is also critical to Sudan's food security. Mechanized dry land farmers produce, on average, 55 percent of Sudan's sorghum. Other farmers in rainfed areas produce another 35 percent of the nation's sorghum, as well as 100 percent of the millet, 75 percent of the peanuts, 70 percent of the sesame and virtually all of the livestock. Overall, rainfed agriculture is the key producer in Sudan's economy, in 1982 accounting for 65 percent of the entire country's gross foreign exchange earnings.

While the above analysis does include the entire rainfed sector, no one during the reviews nor apparently during the following years, raised any serious questions about a West vs a country-wide "rainfed strategy". Also, during the recent Sudan Program Review (Jan 13-15, 1986) the "Western Sudan Initiative" (2) was reviewed and re-substantiated, as submitted by the Mission and is provided in Annex 1.

The Western Sudan Initiative includes five major projects with estimated funding and status of implementation provided as follows:

<u>Projects</u>	<u>\$Million</u>	<u>LSMillion</u>	<u>Status</u>
1. Western Agr Marketing Road	60	137	Road being designed.
2. Kordofan Rainfed Agriculture	18.1	98.5	Partially obligated in '85 under implementation.
3. Western Sudan Agr. Research	26.0	25.3	Under implementation for six years with four stations nearly constructed.
4. Regional Fin. and Planning	8.3	77	Being redesigned as PVO project.

5. Rural Health Support	<u>16.2</u>	<u>40</u>	Under implementation since 1978.
TOTAL	128.6	377.8	

III. IMPORTANCE OF AGRICULTURE IN THE SUDAN ECONOMY

A. Economic Importance of Agriculture

Agriculture dominates the economy of Sudan. It accounts for about 40% of the total GDP, and 75% of the GDP in the production sector and employs 72% of the labor force. The role of agriculture in generating exports is particularly crucial. In 1981/82 nearly 95% of the total value of all commodity exports came from agriculture. These included the export of cotton (37%), groundnuts (12%), gum arabic (11%), livestock (14%), sorghum (16%), and oilseeds (10%). However, in spite of Sudan's strong agricultural base, imported agricultural products (food and beverage) account for more than 25% of the value of the country's imports. With increases and diversification of agricultural production, and more emphasis on agro-industry many of these imports could readily and efficiently be produced in Sudan, and thus save scarce foreign exchange.

B. Land use, Soils and Rainfall

For anyone who has looked at Sudan carefully, it is evident that the availability of reasonably good land in areas where rainfall is generally adequate for one crop a year constitutes the major natural resources of the country. It is also evident that there are wide variations in estimates of the amount of cultivable land actually available in the country. Table 4 provides the Climatological Zones of Sudan and Rainfall in each zone as provided by the FAO (3). According to this same source Sudan is also divided into the following land use categories:

1. Land, 237 600 000 ha, and surface water, 12 881 000 ha (total 250 581 000 ha).

2. Distribution of lands according to use:

Cultivable	84 000 000 ha
Pasture	24 000 000
Forests	91 500 000
Uncultivable	38 100 000

Total	237 600 000
-------	-------------

3. Distribution of agricultural lands:

Uncultivated	76 866 000 ha
Actually cropped	7 134 000

Rainfed	5 727 000
Irrigated	1 407 000
Fallow	840 000
Total cultivable	<u>84,000,000</u>

Table 4. Climatological Zones Of Sudan And Rainfall In Each Zone

<u>Zone</u>	<u>Area (ha)</u>	<u>% of total area</u>	<u>Rainfall mm</u>
Arid zone	75 520 000	29.0	0-75
Semi-arid	49 310 000	19.6	75-300
Low rainfall savannah	68 894 000	27.5	300-1000
High rainfall savannah	34 706 000	13.6	900-1800
Flood region	24 605 000	9.8	700-1600
Subtropical rain forest mountains	647 000	0.3	high
<u>Total</u>	<u>253 682 000</u>	<u>99.8</u>	

World Bank data (5) and FAO generally agree on the total land in Sudan. Table 5 indicates that 597.12 million feddans * (250.89 million hectares) are in various land classes in the country. The potential arable land (see Table 6), however, is only 85.46 million feddans (35.91 million hectares), which is less than half of the FAO estimates. The World Bank data is probably more accurate since it is based on an aerial survey carried out by Resource Management and Research, the consultants who conducted the 1975/76 livestock census. Also, the potential arable land does include recent fallow and abandoned land.

Another World Bank source (Table 7 Estimated Cultivated Area by Farming and Operating Systems, 1979) indicates that only 26.68 million feddans, exclusive of unlicensed or undemarkated land, are being cultivated within the farming systems in Sudan. The total area cropped each year is considerably less however, varying from a five year average (79 to 84) of 15,092 million to an estimated total of 20, 413 this past year, as taken from the Government of Sudan data (4).

* One feddan is equal to 1.04 acres or .42 hectares.

Table 5: Land Classification

<u>Land Class</u>	<u>m feddans</u>	<u>000 km²</u>	<u>% of total</u>
Potential arable	85.46	358.9	14
Grazing land	241.83	1,013.6	40
Heavy forest	57.93	243.3	10
Desert	205.36	862.5	34
Swamps and Water surfaces	6.97	29.3	1
Urban areas	0.07	2.8	-
	597.12	2,510.4	100

Table 6: Land Use on Potential Arable Land

	<u>m feddans</u>	<u>000 km²</u>	<u>% of total</u>	<u>% of cultivated</u>
Irrigated land	4.17	17.5	5	16
Mechanized farming land	5.76	24.2	7	22
Traditional cultivation land	16.75	70.4	20	63
Forest plantation	0.04	0.2	-	-
Other (grazed or unutilized)	58.74	246.7	69	-
	85.46	359.0	100	100

Figures 1 & 2 provide additional information on Sudan (16). Figure 1 divides the country into major areas based on soils and Figure 2 provides the "Location of Subsectors and Length of Growing Season in Days". As can be seen from these figures, the major producing periods in the country are between 120 to 180 day length of growing season within the Central Clay Plains and Qoz and Nuba Mts resource areas. The FAO states that nearly 19 percent of the potential agricultural land lies in an area where the growing period is less than 90 days, while 40 percent has a growing period varying from 90-300 days and the rest zero-day growing period. These growing periods do relate only to the availability of rainfall and do not consider the effects of irrigation water on the growing periods.

A significant factor for growing crops in the West is the decrease in average rainfall over the past decade (beginning in 1966) in El Obeid. This phenomenon needs to be studied in more detail to clearly decide how extensive this shift has become. If it is permanent, more emphasis needs to be given to migration of the people in this zone to higher rainfall areas in the Southern portions of Kordofan and possibly Darfour. Fairly extensive good cultivable areas are available in Southern Kordofan, which is uninhabited because there is no infrastructure (roads and potable water).

Sudan: Estimated Cultivated Area by Farming
and Operating Systems, 1979

<u>Cultivated Areas</u>		
<u>-OVERALL-</u>		
<u>Farming System</u>	<u>Million Feddans</u>	<u>Percent</u>
Irrigated	4.17	16
Mechanized Rainfed	5.76 ^{1/}	22
Traditional Rainfed	<u>16.75</u>	<u>62</u>
Total	<u>26.68</u>	<u>100</u>
<u>-In Irrigated Systems-</u>		
<u>Operating System</u>		
Corporation Tenants	3.8	91
Government Estates	.24	6
Private Independent Operators	<u>.13</u>	<u>3</u>
Total	<u>4.17</u>	<u>100</u>
<u>-In Mechanized Rainfed System-</u>		
<u>Operating System</u>		
Licensed Private Farmers	3.5 ^{1/}	61
State Farms	.36	6
Estates	<u>1.9</u>	<u>33</u>
Total	<u>5.76</u>	<u>100</u>

^{1/} Unlicensed acreage is estimated variously from about 3 million feddan to "more than the licensed area", i.e., over 3.5 million feddan. If this is added, total cultivated areas rise to about 30 million feddan, and rainfed mechanized area to about nine million, i.e., about 30 per cent of the new total.

SOURCE: Agricultural Bank of the Sudan, Agricultural Services Project. Preparation Report, Vol. I. Main Report, August, 1979 (except for unlicensed estimates).

Physical Resource Regions of Sudan



C. Major Production Systems and Regions *

1. Major Systems

The three major systems of farming in Sudan, in addition to the limited areas of pure nomadic and semi-nomadic livestock herding in the extreme north and northwest are:

- irrigated agriculture, concentrated mostly along the Blue and White Nile Valleys between the 11th and 15th parallels;
- mechanized, rainfed agriculture, typical of the east-central Sudan where rainfall exceeds 600 mm, and
- traditional rainfed agriculture, typical of the west and south, and including most of the country's livestock.

Climate and soils, together with the native flora and fauna, create the potential and restrictions for use of the landscape for agricultural purposes. The vastness of Sudan translates into great ecological, human and institutional diversity and corresponding complexity in rainfed and irrigated agriculture. It should be noted that these are broad geographic or production systems groupings, not to be confused with the administrative regions established in early 1981.

a. The East

The East is dominated by the Blue and White Niles and the riverine ecology and economies developed under their influence. It is an area of massive irrigation schemes and larger scale mechanized production. Among and around these schemes are zones of traditional crop and livestock producers who are gradually, but inexorably, being squeezed by the continuing expansion of the modern mechanized schemes. While the rivers provide water security for the irrigated sector, both mechanized and traditional production units depend on a semi-arid rainfed environment similar to that of the West. The major ecological distinction between the East and the West -- which are both climatically semi-arid -- apart from the rivers, is the greater proportion of heavy cracking and non-cracking clays in the former. A much more important difference is the relatively well-developed physical, financial and administrative infrastructure of the East in comparison with the West and South although the level of development in all rural areas is similar i.e. no roads and other infrastructure. Population densities of both people and livestock are high and the level of social services and employment opportunities is much greater than in other areas. Agriculture is integrated with the export and processing sectors of the national economy.

b. The West

In the West, agriculture is almost completely rainfed. It succeeds or fails according to annual management of the available soil and vegetation resources. Large differences in soils and their drainage and water holding characteristics impose restrictions on the types of crop grown and the

* This section was taken primarily from "Sudan--Agricultural Strategy Assessment--Summary Report" by DIA-RTI of January 1982 and is reference (7).

patterns of rangeland use. The more coarsely textured qoz sand belts with lower water holding capacity support millet production and wet season grazing for the transhumant pastoralists. The intermediate clays and cracking clays support dura (sorghum) and sesame production by sedentary small-scale cultivators, large-scale mechanized sorghum (and some cotton) production, and dry season grazing for the pastoralists. Besides crops and livestock, the West supports a very important gum arabic gathering economy now threatened by environmental degradation in the major habitats for Acacia Senegal. Population concentrations have developed in the principal areas of rainfed cultivation, and urbanization has accelerated as more and more of the transhumant population has become sedentary.

c. The South

The South's main distinguishing ecological feature is the vast White Nile drainage system which creates the barrier marsh or Sudd, long the effective demarcation between northern, Arab cultures and southern Black African ones. In general, the South's higher rainfall gives it a greater natural production potential than the East or West. However, twenty years of civil disturbances have damaged the limited physical and social infrastructure that were put in place before independence. The Nilotic tribes form the major ethnic groups. Most are agropastoralists whose existence is finely tuned to subsistence needs and to the potential of the various environments in which they live. Their subsistence systems enable the South's people to support themselves with minimal material inputs.

D. Agricultural Production in Sudan

Production of various crops has varied widely in recent years based primarily on rainfall. This production (See Tables 8 & 9) plummeted to an all time low in 1984. Only 1.255 million metric tons of sorghum and millet were produced on 11,113 million feddans (11.558 million acres). This year a record high is projected of 4.830 million tons on 16,080 million feddans (16.722 million acres).

An important data source was utilized in 1985 to determine acreage estimates for Sudan. USAID contracted with the U.S. Department of Agriculture (USDA) and the Environmental Research Institute of Michigan (ERIM) to use Remote Sensing technology to determine the area under sorghum and millet production. Table 10 provides a brief summary of the area and production estimates from this work. The ERIM/USDA estimates are reasonably close in total terms to those of the Government of Sudan with a production of 4.92 million tons (vs 4.839 by GOS figures) under a cropped acreage of 19,499 million (vs 16.7 by GOS). When the West and the East are closely compared (Table 10) the statistics are more divergent. The cropped acreage in the East is nearly 5 times the West (14.856 million vs 3.122 million acres) with production in the East nearly 7.5 times the West (3.83 million vs 509 thousand tons).

TABLE 8 : CROP SUMMARY : AREA, PRODUCTION, AND YIELD, 1985/85 CROP SEASON WITH COMPARISONS:

CROP	5-Year Average 1/			Crop Season -1984/85			Crop Season- 1985/86			Area % Change		Prod. % Change	
	Area 000 Fed	Prod 000 MT	Yield Kg/Fed	Area 000 Fed	Prod 000 MT	Yield Kg/Fed	Area 000 Fed	Prod 000 MT	Yield Kg/Fed	From Average	From 1984/85	From Average	From 1984/85
SORGHUM													
Irrigated	582	250	430	766	436	569	1168	664	568	101	52	166	52
Rainfed Mech.	4398	1267	288	4534	389	86	7335	2783	379	67	62	120	615
Rainfed Trad.	2883	601	208	2687	272	101	3703	825	223	28	38	37	233
Total, Sorghum	<u>7863</u>	<u>2118</u>	<u>269</u>	<u>7987</u>	<u>1097</u>	<u>137</u>	<u>12206</u>	<u>4271</u>	<u>350</u>	<u>55</u>	<u>53</u>	<u>102</u>	<u>287</u>
SESAME													
Rainfed Mech.	571	72	126	603	70	116	1248	113	91	119	107	57	61
Rainfed Trad.	1469	139	95	1250	63	50	1377	114	83	-6	10	-18	61
Total, Sesame	<u>2040</u>	<u>211</u>	<u>103</u>	<u>1853</u>	<u>133</u>	<u>72</u>	<u>2625</u>	<u>228</u>	<u>87</u>	<u>29</u>	<u>42</u>	<u>8</u>	<u>71</u>
MILLET													
Irrigated	14	5	357	20	10	500	15	6	400	7	-25	20	-40
Rainfed Mech.	5	1	200	11	1	91	31	10	328	520	182	900	940
Rainfed Trad.	2711	386	142	3095	147	47	3828	542	142	41	24	40	269
Total, Millet	<u>2730</u>	<u>392</u>	<u>144</u>	<u>3126</u>	<u>158</u>	<u>51</u>	<u>3874</u>	<u>558</u>	<u>144</u>	<u>42</u>	<u>24</u>	<u>42</u>	<u>253</u>
GROUNDNUTS													
Irrigated	299	241	809	326	257	788	146	111	761	-51	-55	-54	-57
Rainfed Trad.	1812	422	233	1432	129	90	1137	291	256	-37	-21	-31	126
Total, Groundnuts	<u>2111</u>	<u>663</u>	<u>314</u>	<u>1758</u>	<u>386</u>	<u>220</u>	<u>1283</u>	<u>402</u>	<u>314</u>	<u>-39</u>	<u>-27</u>	<u>-39</u>	<u>4</u>
WHEAT													
Irrigated	360	180	500	115	79	687	425			18	270		
Total, Wheat	<u>360</u>	<u>180</u>	<u>500</u>	<u>115</u>	<u>79</u>	<u>687</u>	<u>425</u>			<u>18</u>	<u>270</u>		
COTTON													
Egyptian	524	224	3.02 ^{2/}	419	273	4.62 ^{2/}	498			-5	19		
Acala	333	218	4.63	448	352	5.55	281			-16	-37		
American	130	16	.87	129	24	1.80	70			-46	-46		
Total, Cotton	<u>985</u>	<u>458</u>	<u>3.29</u>	<u>996</u>	<u>649</u>	<u>4.60</u>	<u>849</u>			<u>-14</u>	<u>-15</u>		

1/ 5-Year average includes 1979/80 to 1983/84. 2/ Cotton yield reported in Big Kantars per Fedd
TOTAL MAY NOT ADD DUE TO ROUNDING.

* Planning and Agricultural Economics Administration, Ministry of Agricultural and Natural Resources,
Agricultural Situation & Outlook, Monthly Report No 1, November 23, 1985

Table 9

Sorghum and Millet Area and Production Estimates -1985 (000 tons)/

(GOS Data in 000's)

LOCATION	SORGHUM		MILLET		TOTAL	
	<u>Feddans</u>	<u>Tons</u>	<u>Feddans</u>	<u>Tons</u>	<u>Feddans</u>	<u>Tons</u>
<u>West Sudan</u>						
North Darfour	114	21	700	105	814	126
South Darfour	7	2	--	--	7	2
Mechanized						
Traditional	420	113	850	187	1270	300
North Kordofan	173	19	2030	2203	2203	220
South Kordofan						
Mechanized	346	104	--	--	346	104
Traditional	<u>796</u>	<u>159</u>	<u>105</u>	<u>21</u>	<u>901</u>	<u>180</u>
SUB TOTAL	1856	418	3685	514	5541	932
<u>East/North Sudan</u>						
Mechanized	6982	2677	31	10	7013	2687
Irrigated	1168	664	15	6	1183	670
Traditional	<u>1300</u>	<u>351</u>	<u>14</u>	<u>14</u>	<u>1375</u>	<u>365</u>
SUB TOTAL	9450	3692	121	30	9571	3722
Southern	900	162	85	14	985	176
GRAND TOTAL	<u>12,206</u>	<u>4272</u>	<u>3891</u>	<u>558</u>	<u>16097</u>	<u>4830</u>

* Data was taken from the November, 1985 Agriculture Situation and Outlook Report by the Agriculture Planning and Agriculture Economic Administration, Government of Sudan.

With a feddan equal to 1.04 acres the total acres in sorghum and millet is 16,741 million acres.

Table 10

Sorghum and Millet Area and Production Estimates 1985

(ERIM/USDA/GOS)

<u>LOCATION</u>	<u>AREA</u> <u>(0000 Feddan)</u>	<u>AREA</u> <u>(000 Acres)</u>	<u>PRODUCTION</u> <u>(0000 Metric Tons)</u>
<u>West Sudan</u>			
North Darfour	356	370	45
South Darfour	923.6	961	160
North Kordofan	920.8	958	69
South Kordofan	800.7	833	235
Mechanized	(626)	651	
Traditional	<u>(175)</u>	182	
SUB TOTAL	3,001	3,122	509
<u>East Sudan</u>			
Mechanized and Irrigated	6,388	6,592	1919
Traditional and Undemarkated Mech.	<u>7,946</u>	<u>8,264</u>	<u>1915</u>
SUB TOTAL	14,234	14,856	3834
Other (Southern etc)	<u>1463</u>	1521	575
GRAND TOTAL	<u>18,748</u>	<u>19,497</u>	<u>1,918</u>

* Data was taken primarily from FEWS REPORT (8) #4 (Table I and II) as estimated using USDA, ERIM and GOS data. One feddan is equal to 1.04 acres.

As this study was being completed additional information was made available which should be noted (see Ref. 9 & 10). USDA figures in FEW draft report number 5 increased the total acreage planted to sorghum/millet in the East to 14.8 million (vs. 14.23 million in Table 10). The total production also increased to 4.57 million tons vs. 3.83 in Table 10. The traditional figures also included the undemarketed mechanized and was estimated at about 70% of the total. Wigton (10) seriously questioned the ERIM and USDA methodology that was used and the resulting statistics. According to this draft report, "the ERIM procedures underestimated the true totals" and since USDA classified all vegetation in the East as sorghum/millet and subtracted the GOS estimates for sesame, the total estimates were probably too high.

As in part stated earlier, when one compares the above production and acreage figures for the West vs the East it is evident that more emphasis must be given to the East, if the Government and donors are serious about increasing production. Also, considering the very low level of agriculture productivity throughout Sudan, the relatively poorer soils in the West vs. the East, as well as the lower rainfall and decreasing length of growing season in the northern parts of the West, provides further evidence that much more emphasis must be given to mechanized and irrigated agriculture production in the East. This is particularly important if sustained and significant increases in agriculture production are desired over both the short and long term. More is written on this subject in the last section of this paper where aspects of a new agriculture strategy are discussed.

IV DEVELOPMENT CONSTRAINTS AND APPROACHES TO OVERCOME THEM

A. Constraints to Agricultural Development

The constraints to the development of Sudanese agricultural are numerous and are discussed in detail in Annex 2. These constraints are also more adverse in the western part of the country where two major constraints can be identified: 1) ecological limitations imposed by a low and extremely variable rainfall, high evaporation, recurring drought, soils of low fertility, and limited accessibility of ground water; and 2) increases in the human and livestock populations which change social traditions, create pressures and encourage ecological degradation.

Several other constraints which are applicable throughout much of Sudan, are related to the basic issues stated above and can be classified as ecological and socio-economic. Some ecological issue and constraints are: deterioration of rangelands; grass fires; parasites and pests; low protein and mineral intakes by grazing stock; reciprocal pressures of livestock and crops in competing production systems; lack of effective technologies of crop husbandry; crop diseases, weeds and pests; inadequate tillage methods; unimproved crop varieties; low soil fertility; and poor water management. The socio-economic constraints include: the conflict between individual ownership of livestock and communal land use; socio-economic insecurities in a fragile ecosystem; attempts to buffer social groups against environmental vicissitudes by overstocking, shifting cultivation and increased sedentarization; lack of market opportunities, and insufficient demand for consumer goods and few

opportunities for investment of capital other than in livestock. Other major constraints are the lack of physical infrastructure, especially roads and drinking water facilities throughout the rural areas of Sudan along with institutional, economic and policy issues. Farm level constraints to increasing production are particularly adverse, although much less so in the higher rainfall areas (above 400 mm) of Sudan.

B. Approaches to Overcoming Constraints

The Sudan-Agricultural Strategy Assessment (5) provides some detailed approaches to overcoming key constraints to Sudan's agriculture development. Many of these constraints will take years of development and may never be fully overcome. Others are receiving extensive support and attention, particularly within USAID's "Western Initiative" which is focusing on Kordofan and is "opening up the West" with the Kosti El Obeid road. All of the projects both planned and under implementation in the West should greatly facilitate long-term economic development and begin alleviating agricultural constraints. Implementation of the Agricultural Strategy noted below should facilitate both economic and agriculture development and should accelerate the means to overcoming constraints noted above.

V. ASPECTS OF A NEW AGRICULTURAL STRATEGY

Several questions have been asked in earlier sections in this paper about USAID's Western Sudan Initiative. If the production statistics of Section III-D are reasonably accurate whereby the cropped acreage in the East is 7.5 times the West (3.834 million metric tons vs 509 thousand) it becomes increasingly evident that more emphasis should be given to the production of export crops which can be grown in the East and then easily exported through Port Sudan. Also, since the soils of the West are generally less productive than the East and a long-term climatic change appears to be taking place which reduces the traditional farmer's chances to produce a crop in the Northern areas of the West, much of the USAID Western Sudan Initiative should be implemented in the generally more productive areas of the Southern West. In fact, studies need to be completed to consider movement of large numbers of people to the potentially more productive areas of Southern Kordofan. Access roads and drinking water will be essential for these areas. Specific aspects of the new agricultural strategy are provided as follows:

A. Increase Agriculture Production with Export Focused Strategy

In September of 1984, Dr. Hadley E. Smith, USAID Senior Economic Advisor stated, "The urgency of increased emphasis in the AID program on production of exports is becoming more acute as the capacity of the GOS to service external debt deteriorates" (11). This statement is still valid today and the cornerstone of USAID's future strategy should be export oriented and focussed on the more productive areas of the country to include Southern areas of the West with irrigated, mechanized and traditional areas of the East which are in fairly close proximity to Port Sudan. In IFPRI Research Report 47 (12), Nabil

Khalidi indicates that if past trends continue, demand for food commodities in the region (Middle East/North Africa) will surpass projected output, resulting in a gap of about 52 million tons in basic staples by the end of the century. This article goes on to project that if yield could go from .47 tons/hectares to 1.22, and if a acreage could go from 6.95 to 10.4 million hectares from 1990 to the year 2000, the increment of output would increase from 4.9 million tons to 8.24 million tons. As stated in Section III-D of this paper, production this past year should be approximately 4.92 million tons which is about 1.5 million tons in excess of Sudan's needs. This level of production can be sustained and probably increased by 5% a year, if farmers are given adequate incentives and support. Exports would need to be allowed at the commercial or possibly open market exchange rates and inputs such as hybrid sorghum seed, fertilizer and improved equipment are essential.

B. Increase Fertilizer Use

Fertilizer has never been used in the rainfed areas of Sudan, and horizontal (more land use) rather than vertical (increased production per area) expansion has taken place. Wide-spread land degradation has occurred, especially in the large mechanized areas. For a viable self-sustaining agricultural system to be established in Sudan more wide-spread use of fertilizer is essential. In a report (13) Dr. Riley suggests that just the addition of 20 kgs of super-phosphate per hectare might double the production of sorghum/millet on the Western soils, with a benefit to cost ration of 10-1. Demonstrations and additional research trials should be conducted throughout the West to substantiate this earlier research work. Also, USAID/S&T/Agr has suggested that addition of phosphates to soils should be considered capital cost, the same way that construction of irrigation schemes are in irrigated areas.

Additional fertilizer demonstration and trial work are needed to build a demand for fertilizer in the rainfed areas of the country and to substantiate the economics and improved technology inherent in the use of improved inputs. Recently, the USAID office of Agriculture Development in Sudan prepared a proposal for expanding the FAO fertilizer trials program to the rainfed areas of the country. This program must be implemented to both test the technology and to build demand for fertilizer use and to check the feasibility of input use under rainfed conditions. No country in the world has been able to build a viable self-sustaining agriculture system without fertilizer, and Sudan is no exception. Also, USAID is planning to contract for the International Fertilizer Development Center (IFDC) to do a complete review of the fertilizer situation in Sudan and this study must be completed and relevant aspects implemented to carry out the export focused strategy recommended above.

C. Better Regulated Mechanization and Land Use Planning

While support must be provided to the mechanized sector of the country to increase production, this sector must also be better regulated or "indiscriminate mining" of the soil will continue. Table 5 indicates that

only 3.5 million raddans have been legally licensed to private traders but other Government sources indicate that the unlicensed land exceeds the licensed. Therefore, top priority must be given to the development of both soil and land use maps through aerial and remote sensing photography, for better land use planning. Mechanized farmer's fields should be physically marked on the maps and use of the land regularized and taxed.

Of equal and possibly more importance to control indiscriminate mechanization are land tenure studies to provide policy recommendation to the Government on mechanized farming. Several related studies have recently been approved to be jointly conducted by the Land Tenure Centre of the University of Wisconsin and the Institute of Environmental Studies, University of Khartoum. The initial mechanization study must be completed soon and other studies conducted as needed to provide the basis for the GOS to establish policies to conserve its greatest natural resource, land, and to make it more productive for the economic benefit of the country.

D. Irrigation and Agricultural Production

USAID took the decision in the late 70's and reaffirmed it in the CDSS written in 1984 that its focus would be on the dryland or rainfed areas of the country, since the World Bank was facilitating irrigation system rehabilitation and related assistance to the irrigated areas of the country. While this position is sound, complete exclusion of the irrigated sector in the past from USAID funded analysis has been short-sighted. Decisions were taken recently, however, that further analytical work would be done in the irrigated sector. While USAID has excluded the irrigated area, USDA has done some excellent work (see reference 6 and other USDA reports).

From these reports it is clear that the growing of medium staple cotton should be limited in Sudan and that other less input intensive crops (specifically hybrid sorghums and groundnuts) could help replace the cotton. More diversification should be urgently put into the cropping system of the large irrigation schemes with emphasis being given to other exportable crops such as corn and possibly rice*. USDA has also developed a linear programming model which should be applied to Gezira and Rehad on a continuing basis to allow scheme management to review trade-offs before the cropping season. The move away from cotton to other more exportable crops is an urgent requirement and should be supported, and in fact, encouraged by USAID.

*It should be noted that fairly extensive work was done on rice breeding and production in Gezira in the late 60's and 70's. As expected, considering the type of soils and other climatic data on the area, very high levels of rice production (equivalent to those in Egypt and Asia) are possible. Since rice, unlike wheat, can easily be grown in Sudan, much more emphasis should be given to it both for internal consumption and export.

Since Sudan has the largest area under irrigation in Africa (1.7 million hectares) and since irrigation development is a high priority within AID and increasingly so within the Africa Bureau, more careful analysis and study should be conducted on irrigation in Sudan. In addition to the modeling work mentioned above, studies should be conducted on irrigation systems rehabilitation, private sector pumped systems, and ways to obtain more farmer involvement in system management of the large public sector schemes.

E. Hybrid Seed Production

Hybrid sorghum seed production by the private sector in Sudan is one of the most encouraging aspects of agricultural development in the country and should be supported by USAID in all ways possible. This past year 11 private/semi-private growers were producing HD-1 hybrid sorghum seed. USAID provided technical assistance, and some local currency and is now considering expansion of these efforts with more local currency and with the Commodity Import Program to allow these private growers to import seed production and processing equipment as needed.

In the authors' view, there is no single activity in the country which should receive higher priority for funding and other support than the hybrid seed industry of Sudan since the improved seed being produced hold tremendous potential for increasing grain production in the country. The International Sorghum and Millet CRISP (INTSORMIL), recently projected that hybrid sorghum seed production has increased from three tons in 1983 to 1500 tons in 1985 with one half of this production from the private seed companies. Since USAID is also importing another 1000 tons (a total of 2500 tons of seed) INTSORMIL estimates the hybrid area to be planted in 1986 should be 625,000 acres and should result in approximately 937,500 tons of grain.

F. Credit and the Commodity Import Program (CIP)

While the USAID CIP for Sudan has been running aground \$120 million per year (See Table 3) this amount is being reduced to \$59.8 million this year. Another \$50 million was earmarked from 1985 funding, however, as a loan guarantee for the IMF. If an IMF stand-by agreement is not reached this money will be available for the normal CIP effort in 1986. In the recent Program Review of Sudan it was again stated that priority emphasis will be given to private sector imports for the dryland or rainfed areas of the country. Looking at other aspects of this strategy, this is the most important and appropriate use of the CIP funds for such imports as: agricultural inputs (fertilizer), selected equipment included seed production and processing as well as appropriate tillage equipment, bulk storage of grain and seed drills. Agro-industries, such as agro-processing and farm equipment manufacturing to produce small to medium size grain threshers, should also be included under the CIP.

Use of PL-480 and possible CIP generated local currency for an expanded credit program is essential for increased agriculture production in Sudan. A credit program is planned under the new Kordofan Dryland Agriculture Project and should be modeled after the credit efforts established under the Blue Nile Integrated Agriculture Development Project. A credit program is planned in

the South and other credit efforts should be expanded. Since a successful credit program should be tied to new and appropriate technology, which should follow with the new hybrid sorghum seed (HD-1) and the use of other inputs, the potential exist for credit to play an important role in the development of agriculture in Sudan. Other innovative credit efforts could be attempted by linking the CIP equipment/inputs to credit for loans under the Agriculture Bank of Sudan, and possibly under Commercial Banks, in a manner similar to the "revolving seed fund" established in the Ministry of Agriculture to facilitate seed development activities. This seed fund was established last year with the proceeds from importation of 7,500 tons of wheat seed from Egypt.

G. Agriculture Research

USAID and the World Bank have been supporting agriculture research in Sudan since the late 70's, when a combined project (AID for \$26 million plus local currency and the World Bank for \$12 million) constructed four major research stations, two each in Kordofan and Darfour Regions. At the time this paper was being written the Western Sudan Agriculture Research Project (WSARP) was being evaluated and the initial design of a new project was being studied. In line with USAID's plan to strengthen agriculture research in Africa, Sudan was selected as one of the eight priority "technology producing" countries in Africa and a long term 15-20 year effort is envisioned. Along with expansion of USAID's rainfed strategy throughout the country our research efforts should also focus on rainfed agriculture throughout Sudan and not just the West as is the case under WSARP. Expansion and coverage of the entire rainfed area of the country are essential for several reasons including the fact that the largest and most productive rainfed area of the country in the East is now being ignored and second, a commodity focus is essential, which means inclusion of sorghum, most of which is being grown in the East.

H. Data Gathering and Analysis

The USAID mission in Sudan has been assisting the Government with agricultural statistics, data gathering, and analysis since 1981 through the Agricultural Planning and Statistics Project. This project's purpose is to strengthen the Ministry of Agriculture's Planning and Agricultural Economics Administration's capacity for policy analysis and formulation, project planning and statistical data collection, management and reporting. The project was evaluated this past year and the project amendment is under preparation to extend and slightly expand current project activities to the University of Khartoum. Continuation of the the project is an urgent requirement to improve the data base in Sudan and to facilitate agricultural related policy analysis by the Ministry of Agriculture. Also, the amendment and future work should include an integrated information system which utilizes the latest technology and integrates satellite data, landsat MSS and TM data and incorporates ground data in a way that takes advantage of the strengthes of each of these tools. An "Area Sampling Frame", or at least a modified version of the frame, should be utilized in Sudan and might take several years to be established to adequately cover the country. Once established this methodology is dependable and can be used to estimate crop acreage, livestock and other socio-economic parameters associated with rural populations.

I. Afforestation:

Reforestation is somewhat like the weather in Sudan. While everyone talks about it, very little is actually being accomplished in the field. Much more emphasis must be given to this important area similar to the USAID/Dutch/ CARE Refugee reforestation Project in Gadarif. This project establishes nurseries to provide trees to villagers for fuel-wood lots and some preliminary work has been done to establish wind or shelter belts, which in some parts of the world have increased production by 10-15%. All of these aspects should be dramatically expanded throughout Sudan. In higher rainfall areas, or possibly those which use excess irrigation water, high yielding trees such as lucena (ipil ipil) should be planted extensively including "alley cropping" whereby other crops are grown in the alley between the trees. Farmers throughout Sudan in both the traditional and mechanized areas, and to a limited extent in the irrigated areas of the country should all be encouraged and assisted in growing trees both for commercial and their own consumption. If this cannot be done desertification will continue and probably intensify.

J. Other Aspects of the Strategy:

Other aspects of the proposed agriculture strategy include:

1. The establishment of farmer organizations such as corporatives are essential if production of the small traditional farmer is to be facilitated. It is almost impossible for the small farmer to obtain credit, get inputs and to market his produce effectively unless he joins forces with other farmers. A special look was planned of the cooperatives which were established under the Blue Nile Integrated Agriculture Development Project to see what can be learned both to establish viable organizations in that area and to expand them to other parts of Sudan. An impact Assessment to determine the impact of the project on both the farmer and the area in general, followed by a final Project Evaluation, while delayed, should still be conducted later this year.
2. Seed dressing is a proven and simple way to increase crop establishment and reduce seedling disease to increase yields. Seedling disease was a particular problem in Damazine this past year where it was estimated that 50,000 acres had to be reseeded after a seedling disease hit the crop.
3. Zero and other reduced tillage techniques including mulching where possible, must be tested and should have some relevancy, especially to the mechanized areas.
4. While most livestock improvement projects have not proven very effective in Sudan, much more emphasis and adaptive research must be given to management of herds, growing better forage and use of phosphate in the diet of the cattle. USAID has recently approved \$.5 million of OFDA funding for the importation of veterinary medicines and drugs with the proceeds going into a revolving fund for additional procurement. Other programs like this are needed to improve livestock production.
5. Animal Traction is another improved technology which has not proven very successful in Sudan although using cattle with carts for haulage appears to be

going well in certain parts of Southern Kordofan. The hard cracking clays of Southern Kordofan do not lend themselves well to animal tillage although similar type soils in India are being tilled by animals. This is an area, however, that does need additional work.

VI. CONCLUSION

In the authors' view, Sudan and other developing countries, must focus agricultural production in the potentially more productive areas of their country. If this focus is shifted in Sudan to the higher rainfall areas of the West and to the East by the Government and Donors, and other aspects of this proposed agricultural strategy are implemented, there is little question that "Sudan can become the bread basket of the Arab World."

REFERENCES

1. USAID, Sudan. Concepts Paper---Country Development Strategy Statement FY 1986. March 1984.
2. USAID, Sudan. Sudan Program Review Papers. January 13-15, 1986.
3. Food and Agriculture Organization of the United Nations (FAO). Regional Study on Rainfed Agriculture and Agro-Climatic Inventory of 11 Countries in the Near East Region. Rome, 1982.
4. Planning and Agricultural Economics Administration Ministry of Agriculture and Natural Resources. Agricultural Situation and Outlook Monthly Report, Number 1. November 23, 1985.
5. The World Bank, Eastern Africa Region, Northern Agriculture Division. Sudan Agricultural Sector Review. Volume II. March 17, 1978.
6. Brian C. D'Silva. Sudan : Policy Reforms and Prospects for Agricultural Recovery after the Drought. September 1985. U.S. Department of Agriculture, ERS.
7. Donald Humpal, et. al. Sudan-- Agricultural Strategy Assessment--Summary Report. By Development Alternatives, Inc. & Research Triangle Institute, January 1982.
8. Price, Williams and Associates. Sorghum/Millet Crop Production and Surplus/Deficit Estimates For The Sudan. FEWS Report #4 January 24, 1986.
9. Price, Williams and Associates. USDA-FAS 1985 Sudan Sorghum. FEWS Draft Report #5.
10. William H. Wigton. Draft Evaluation Report--Sudan Crop Production Estimates Based on Landsat MSS and TM Data. February, 1986.
11. Hadley E. Smith. Rainfed Sector Strategy and Agriculture Inputs for Export Crops. USAID Senior Economic Advisor, Draft Report. September 10, 1984.
12. Nabil Khaldi. Envolving Food Gaps in the Middle East/North Africa: Prospects & Policy Implications. International Food Policy research Center, Research Report 47.
13. Jim Riley. Increasing Crop Productivity in Western Sudan--Results of Selected Agronomic Trials. CID/Washington State University. Western Sudan Agricultural Research Project Publication No. 37. June, 1985.

USAID--WESTERN SUDAN INITIATIVE *

The deteriorating economic and political conditions in Sudan suggests greater clarity in the project portfolio that goes beyond that which we might have achieved in the past. USAID's response to the constant array of crises has been to tighten the project portfolio into a mutually reinforcing and self-sustaining set of activities which are grounded in sound, practical economic thinking. Building on the already extant projects in Western Sudan, USAID has proposed rainfed agriculture in Western Sudan as the focus of our core project portfolio. This focus derives from three factors which we have come to know as characteristic of Sudan: 1) Even accounting for drought cycles, investments in rainfed agriculture generate higher net foreign exchange earnings than equal investments in irrigated agriculture; 2) Despite GOS assumptions to the contrary, public generated savings and investment will not induce sufficient economic development in Sudan to support continuous growth; and 3) Centralized approaches to managing Sudan break down in the face of Sudan's sheer size.

Studies done by USAID and other donors have shown that, given the economic distortions in the irrigated sector, which are not likely to disappear in the foreseeable future, selected investments in rainfed agriculture will generate higher net foreign exchange earnings than equal investments in the irrigated schemes. The World Bank concluded in November 1983 that Sudan has a clear comparative advantage in producing nearly all crops for export and that most crops grown under rainfed conditions particularly sorghum, show a higher comparative advantage than their counterparts grown on irrigated land. A USAID analysis of Sudan's exchange rate conversion formula for exports, completed in October, 1984, reconfirmed the Bank's conclusions on both the general competitiveness of Sudan's export crops and mechanized rainfed sorghum's edge over its irrigated counterpart. It also showed that irrigated cotton -- the work-horse of previous IBRD and IMF inspired Recovery programs -- generates the least foreign exchange, per unit of foreign exchange invested in traded inputs, of all of Sudan's major agriculture exports.

The Government's lack of resources to finance the irrigated schemes' heavy foreign exchange component lends additional support to a private sector, rainfed focus. By early 1984 the GOS had accumulated a debt estimated at over \$9 billion with annual debt service obligations in excess of export earnings -- even with rescheduling. Increased assistance to the irrigated agriculture implies further dependence on a steady flow of foreign exchange for fertilizer, pesticides, fuel and spare parts to keep the irrigated schemes functioning. This level of capital investment per feddan (acre) does not reflect the scarcity of capital versus labor in the Sudanese economy. Nor does it mesh with the estimated amount of foreign exchange available for such investment. Moreover, moving from the economic to the practical, the schemes' heavy dependence on imported inputs, diverts scarce foreign exchange to the highly administratively and economically inefficient public sector, causing an inefficient market allocation of hard currency that squeezes the dollar supply available to the private sector.

* Copied with minor changes from document titled, "Sudan Program Review," Jan 13-15, 1986.

In spite of population shifts brought on by the drought, mechanized and traditional farmers in the rainfed subsector will continue to account for virtually all private sector agriculture in Sudan. Both traditional and mechanized cultivation methods have their limitations, but private farmers have shown a responsiveness to changing incentives that the public irrigated schemes have not permitted. Water rehabilitation is a case in point. When the Public Water Corporation was unable to repair or maintain water yards and small pumps, local farmers banded together, investing both personal time and collected taxes, to assure private maintenance and rehabilitation of the water equipment.

With an area equal to the United States east of the Mississippi, Sudan's sheer size and diversity preclude central government solution and management of development issues. Dissatisfaction with the relationship between regional and central administration has prompted numerous revisions of the basic statutes which govern it, but without the results that were intended. While the previous government attempted decentralization, the present regime has tended -- albeit in an unannounced manner -- toward a more centralized approach. However, in view of policies that continue to support urban consumption at the expense of rural production, many doubt even this democratic government's commitment to the outlying areas.

Regardless of the Government's intent, Sudan -- today more than before -- does not have the administrative talent or the institutional base to administer in a centralized fashion a broad area with diverse cultural, religious and socio-economic values.

USAID's rainfed approach has focused on increasing agricultural profits by improving market links and production technologies. The majority of the rainfed sector consists of private farmers -- both mechanized and traditional -- who account for the bulk of Sudan's net foreign exchange earnings. The objective is to give farmers the incentive and financial leverage to match donor assistance with private capital and labor that can make economic growth self-sustaining. A long-standing tradition for self-help in the West, as well as a demonstrated responsiveness to price incentives, indicate that the strategy should be effective. Indeed, the very nature of the people is such that they have become self-reliant and unaccustomed to government assistance. Any influx of resources at the local level will support a well-established determination to improve living conditions and increase incomes. Current and proposed investments in Western Sudan illustrate the core of the Western rainfed strategy.

Western Agricultural Marketing Road. Fundamental to improved production in Western Sudan is the ability to move surplus production from production areas to national and world markets. Various sector analyses and independent studies have identified unreliable and expensive transport as one of the principle constraints to farmer income and agricultural incentives in both the West and South of Sudan. The AID project consists of constructing and providing maintenance for an all-weather road from Tendelti to El Obeid, a total of 185 miles. The African Development Bank will provide parallel

- 28 -

financing for the 116 mile continuation to Kosti, terminus of the already existing paved roads to Port Sudan and Khartoum. This road extends the basic trunk of Western Sudan toward the road completed between Nyala and Zalingi. One level down from the international and national thrust of the Western Road, the Kordofan Rainfed Agriculture Project (KORAG) provides the next link in the effective marketing network in Kordofan. The project's three components will facilitate increased production by assuring higher farmer net income: (1) Farm-to-market roads will link production areas to the transport arteries; (2) Grain storage warehouses will provide a holding point between producer and consumer, allowing higher marketing profits from seasonal price increases; and (3) Production and marketing credit will give farmers the financial flexibility to store their crops.

With marketing bottlenecks reduced by projects such as the Western Road and KORAG, increased yields will have the single most important effect on increased farmer incomes and production incentives. The Western Sudan Agricultural Research Project (WSARP), authorized in 1978, has continued to work towards increased production and yields through improved farm technologies and the transfer of improved technologies to the farms. A combination of the farming systems approach and the lack of a baseline caused the project to examine a wide range of crops, farming techniques, livestock management alternatives and social issues. As a result, there is now a great deal of baseline data on a wide variety of subjects, but few conclusive results on technologies that can be commercialized. Continuing research will focus on some of the promising outputs thus far: high yielding sorghum varieties, short-maturing millet, potential intercropping with legumes, water conservation techniques and supplementary nutrition for livestock. It will incorporate within its scope, work on mechanized farming and avoidance of the degradation that mechanized practices have brought to the land. Techniques for disseminating research results through commercial channels will be explored.

As these investments were being made, the Regional Finance and Planning Project was to have supported complementary local development activities. Both technical assistance and investment capital, however, became mired in a web of regional bureaucracy. Local initiative and external resources were never united to promote effective planning and project implementation. Regional planning became an expensive paper exchange between regional and central governments.

The Regional Finance and Planning Project is currently being amended to tap the Sudanese tradition for communal self-help. Like market oriented initiatives, by and large, it circumvents moribund government bureaucracy. Donors and governments alike have not adequately nurtured this dynamic system. After the disappointments of regionalization, our objectives are to 1) have potential beneficiaries participate in project selection; 2) capitalize on local self-interest to keep these projects running; 3) channel sufficient funds directly to local development activities in order to encourage planners to abandon sterile offices and work with the people in the countryside; and 4) emphasize the development of local features of infrastructure that contribute to production.

29

PVO's will function as organizers and administrators as they use GOS/AID jointly programmed local currencies. They will help villages organize themselves, identify projects, analyze implementation alternatives and establish accounts in local banks to deposit user fees to pay for spare parts and maintenance. To the extent that villages can generate their own revenues to contract for maintenance, the upkeep for development expenditures will draw increasingly less on the central budget. This activity will depend heavily at first on U.S. generated local currency with emphasis being given to various aspects of local infrastructure. Water development will provide a major focus for this self-help activity. It will include all types of water--village portable watering combined forestry/agricultural purposes. To the extent possible, this activity will be initiated through private contractors. As the CIP is channelled more into rural undertakings, there will be foreign exchange financing for more agriculture inputs by the private sector, particularly for agro-industry and agro-forestry.

In support of improving rural life in Western Sudan and improving productivity, the Sudan Rural Health Support Project addresses health needs of its rural populations. The original project design (1978) was undertaken within the context of the then recently completed National Health Programme which established the Primary Health Care Program. Within this national health plan and the PHCP, the project selected activities to address what were perceived to be the most pressing constraints to delivery of health services in rural Sudan. Technical assistance includes the provision of technical specialists in administration, material and child health, medical logistics, and health education. A substantial local retraining component will be linked with services to enable the project to bring improved primary health care to the project area. Another component provides for the construction of four medical supply warehouses, one training center and the renovation of selected dispensaries and training centers.

The Western Initiative and the Proposed Title III Program

Each of the projects in the Mission's core portfolio described above contains a considerable local currency component in addition to dollar requirements:

	LS million	\$million
W Ag Marketing Road	137.0	60
KORAG	98.5	18.1
W. Ag Research	25.3	26.0
Regional Fin and Planning	77.0	8.3
Rural Health Support	<u>40.0</u>	<u>16.2</u>
Total	377.8	128.6

In addition to the projects, the core Western portfolio needs a continuing longer term improvement in the policy environment that only a Title III program can provide. Linking the macro-economy to the agricultural producer is an important but missing element to development in Western Sudan. Policy

dialogue will be initiated in this area. It will be concerned with the complicated marketing and tax regimes that have a direct impact on producer profits (the motivating factor for production) and the government revenues (critical to finance essential services and project activities). One example is the taxing and pricing of gum arabic. Reforms in these areas often require long-term analysis and are best suited to incremental changes that allow more efficient mechanisms or market forces to dominate. One-time actions through CIP's or Title I may not be appropriate since some changes, if left on their own could simply transfer government corporations of allocation systems into private monopolies. Addressing the links between the individual producer and the macro-economy requires focus on local institutions, organizations and villages. Because of the heretofore ignored importance of the local level, local currencies and projects which use them creatively are essential. The drought has only demonstrated the local needs which have always been there: village nurseries, water and range management and energy plantations. And these must tap the indigenous self-help associated with the policy reforms that will improve local conditions. Thus, Title III becomes an appropriate vehicle for achieving program objectives.

Thus, with the realistic assumption that there will be some level of pL-480 wheat and wheat flour as part of a core program for Sudan -- at least for the next three ears -- it is imperative that this program be integrally linked -- in terms of local currencies and policy issues -- with the essential long term production-stimulation program which the Western Rainfed Agricultural project portfolio represents.

CONSTRAINTS TO AGRICULTURAL DEVELOPMENT IN SUDAN1. Ecological Constraints.

The country is subdivided into three main geographic areas and its component agricultural systems of irrigated, traditional and mechanized. Each area contains great ecological diversity and hence, variations in agricultural production potential. An agricultural strategy for Sudan must be based on an understanding of the nature and extent of these variations and of how they limit development plans and project.

a. Land.

These limits are often underestimated or ignored when Sudan's land resources are characterized as having a vast untapped potential. The truth is that recent trends in the costs of bringing new lands into production may not enable the biological potential of many areas to be economically exploited in the foreseeable future.

The first ecological constraint, then, is a land-based one. Virtually all economically utilizable land, while perhaps underutilized, is "occupied". Thus, displacement of occupants or major modification of the existing uses would have to take place in most areas before further development can occur. The agricultural potential regions of Sudan, as defined by the Sudan Soil Survey, the major natural constraints of each ecological region are summarized in the following table.

The most important point to be gathered from the table is that soil related ecological constraints are site-specific rather than country or even region-wide. Moisture stress in crops and forage plants may be due to insufficient rainfall in one area, poorly distributed rainfall in another, and poor infiltration or water-holding capacity in yet a third. In other areas, the problem is excess water rather than insufficient water. Soil constraints need to be defined locally before solutions are sought.

b. Desertification.

A large area of the western Sudan is subject to desert encroachment. Desertification is the deterioration of ecosystems to the point where sand dunes are destabilized, resulting in larger scale loss of arable crop, grazing, and shrub land and consequent socioeconomic dislocation. It is the major immediate peril to the existing arid and semi-arid land-use systems and to the future development of sustainable agricultural systems with higher productivity levels. Most observers agree that human population growth and the accompanying increase in exposure of bare soil surfaces and nutrient export through agricultural activities are the prime initiators of this environmental deterioration.

* This Annex is taken largely from reference, Sudan Agricultural Strategy Assessment--Summary report by DIA and RTI, Jan. 1982.

The most visible and alarming signs of these processes are in the arid and drier semi-arid parts of Sudan. In extensive areas of Northern Korodfan and Northern Darfur, long-term trends in land productivity and visible movements of sand, as well as short-term changes in the condition and composition of natural vegetation, indicate that the carrying capacity of the land is being exceeded.

The impact of this process is also being felt in the slightly more humid areas of Southern Darfur and Southern Kordofan. Transhumate pastoralists have shortened their migratory routes and thereby increased the overall level of pressure on land. At the same time acceleration of mechanized scheme development on the Qoz sand and intermediate soil types has created new points of sand destabilization and wind erosion. The socioeconomic effect of this environmental deterioration is increased conflict among herding populations and between herding populations and sedentary cultivators.

c. Long-Term Climatic Change.

There appear to be a long-term changes in total rainfall and annual variations in the rainfall in Sudan in parts of western Sudan. At El Obeid, comparisons of rainfall records showed long-term climatic deteriorate between the decades 1943-52 and 1970-79. The earliest safe sowing date had shifted forward by 12 days and had become more unreliable; the mean length of the growing season decreased from 78 to 63 days. Most important of all, the number of growing seasons during the decade (43-52) that were too short for a 60-day dukhn millet crop to mature fully increased from 3 to 5. In other words, the traditional farmer's chances of successful cropping declined from a 1 in 2 years to a 1 in 3 years in this marginal semi-arid environment.

A similar long-term decline in the rainfall in the wetter areas of the Sudan is unlikely to have had the same dramatic effect on traditional crop production. Traditional farmers in the dry monsoon climates grow several sorghum varieties with different maturation periods, and the moisture stress during grain swelling.

Analysis of data for the most recent decade (70-79) from 11 stations in three climate zones of Sudan show that the trend to drier conditions in the rainfed areas has not continued. Thus, while firm conclusions should not be drawn without more sophisticated and comprehensive analysis, the long-term drying trend may be leveling off.

d. Other Man-made Environmental Problems.

Beyond the land, soil, desertification and climatic constraints to improvement of Sudanese agriculture, a number of other environmental problem areas of great significance, brought about or originated by human changes to the natural environment, can only be mentioned briefly here.

In the irrigated subsector a massive problem has been created by dam siltation proceeding at about twice the expected rate. The problem is due to

33

the enormous increase in the sediment load of the Blue Nile owing to removal of the plant cover of the Ethiopian highlands, aggravated because the original designs excluded siltation structures as being too costly at the time of construction.

Another ecological problem in the irrigated subsector is the increasing difficulty with water hyacinth both in reservoirs behind dams and in the major irrigation canals on the large schemes. There is also a health problem. The canals have served as breeding sites for parasitic pathogens and vectors such as malaria mosquitos, schistosomiasis snails, hookworms and Guinea worms, among others.

In some areas poor drainage has led to increasing salinity of farm lands and a decrease in productivity.

Animal pests are a serious problem in both irrigated and rainfed agriculture in Sudan. In common with many of the Sahelian countries, desert locusts and granivorous birds cause extensive damage to sorghum and millet crops. In some years losses as high as eighty percent have been estimated by provincial authorities. Once the crops are harvested, storage pests become a major problem. Rats and insect pests cause great losses each year. Control measures have, for the most part, not dealt with the underlying ecological dynamics of these problems.

2. Physical Infrastructure Constraints.

a. East.

The eastern portion of the country is relatively well supplied with roads, railroads, airports, river transport, and telecommunication services. However, while the large irrigation schemes are served well, albeit expensively, the rainfed subsector experiences many of the difficulties and uncertainties in input supply and output movement that more remote regions of the country do. While there are important gaps in the transport and communications network and severe seasonal disruptions in traffic, the basic infrastructure problems in the East relate much more to maintenance, organization and management than they do in the West and South.

The glaring exception to this general statement is the link between Port Sudan and the rest of the country. As the nation's sole seaport it is vital that this facility have the capacity to handle essentially all imports and exports in a safe and cost-effective manner. Although they have improved, Port Sudan's operations are still inefficient, causing long delays and adding excessive, needless charges to imports and exports.

b. West.

Transport is probably the biggest infrastructural constraint to increasing agricultural production in western Sudan. One of the weakest link is the railroad. Its level of service has been declining at a time when it should be

providing low cost transport to and from the West. Since 1976, roads have become the major transport mode during the dry season, but road transport can only operate at very high cost and risk during the rainy season. At the farm level delay in the transport process means that mechanized operations lag behind the optimum dates, which, in turn, tends to lower crop yield. Beyond these direct effects, investors have to question the risks and greater costs which the weak road system imposes on large scale operations. At the other end of the cropping calendar, producers must deal with the difficulties of getting their crops to market, or even to their home storage sites, over badly degraded roads. And, if the harvest is delayed until the roads become more passable, losses to granivorous birds and storage pests increase. The low capacity of the railroad to handle the increasing demand for transport of agricultural inputs and commodities to and from the West means long delays and high costs. Producers have to turn to alternative modes of transport. For livestock this means continued dependence on the traditional stock trails which imposes extra marketing costs because of huge weight losses. Also, these trails cannot be used for three months each year because of the lack of forage along the way.

Lack of water infrastructure also acts as a brake on agricultural production in several ways: i. the lack of water points restricts the amount of clearing and pre-planting operations that can be undertaken during the dry season; ii. on rangelands, the lack of water in some good grazing areas prevents their full utilization while it increases the pressure on already overgrazed lands; iii. the inappropriate placement and spacing of water points leads to inappropriate crop cultivation in areas which are marginal for arable agriculture, and iv. Strands of gum arabic which are beyond the normal reach of cultivators and herders due to the lack of drinking water, remain unexploited.

c. South.

Virtually all analysts and policymakers agree that the most fundamental constraints impeding the Region's development are the utterly inadequate transportation and communications network and the civil war. True economic integration of the South with the rest of the country will remain a dream until an efficient, low-cost transport network is created. Until then, the south will remain much more dependent for its "external" trade on Uganda and Kenya (and to a lesser degree, Zaire) than on the northern Sudan, and it will not be able to exploit whatever latent comparative advantages it possesses in agriculture, mining and manufacturing.

For the traditional farmer, as well as any other economic operator, the primitive transport system means, above all, low prices for his output and higher prices for what he buys, both from inside and outside the Region. Indeed, in the southern Sudan, it means that during part of the year there is no market at all for surplus farm production.

The poor transport and telecommunications network in the south also represents a grave impediment to the political integration of the Region's

35

tribal groups, to the effectiveness of the Region's civil government and administration in general, and to agricultural administration in particular.

The problems and potential of Nile river freight and passenger traffic have been analyzed and documented sufficiently. It is generally agreed that the barge service between Juba and Kosti is completely unreliable and inadequate.

The railway system has also been studied expertly and recommendations for its improvement have been made, not only with regard to communication with the South. Renabilitation of the line between Khartoum and Wau, and establishment of faster and more frequent service, could materially improve the commercial links between the western portion of the South and the rest of the country.

Intra-regional telecommunications are virtually non-existent. Although a number of the larger district seats are equipped with microwave transceivers, the station functions only in Juba. This makes efficient public administration and modern business communication virtually impossible. Non-government institutions are obliged to install and operate their own communications equipment if they want to maintain contact with the outside world and with outlying facilities in the Region.

Lack of properly designed and operated storage facilities at the regional, local and on-farm levels reduces the likelihood that surplus production can be stored and that foodstuffs can be successfully distributed to deficit areas. It also leads to substantial post-harvest losses.

3. Farm Level Constraints in Rainfed Agriculture *

In general, the principal constraint on the farm household's total crop output without the introduction of new technologies is that of labor availability. (The major environmental constraint, of course, is the variability of rainfall which can mean the difference between an adequate diet the year round and serious food shortage as the new harvest approaches. Farmers in many areas attempt to insure themselves against unpredictable rainfall patterns by staggering their planting and/or sowing varieties with growing cycles of different lengths.)

In both semi-arid and sub-humid areas the key operation in which the labor constraint appears is weeding, and not planting or harvesting, except for sesame, which has special harvesting problems. This is perhaps the most important consideration to bear in mind in devising strategies and technologies for rainfed farm development.

Of course, to the extent that the weeding constraint can be successfully

* The team did not study the technological problems of the irrigated sub-sector sufficiently to include them in this discussion. Moreover, as indicated elsewhere, the problems tend to be even more basically institutional, rather than technological, than in the case of the rainfed sub-sector.

overcome, the labor constraint may arise in harvesting, and breaking through this barrier may require other technological improvements.

In most of the South, there is a complete lack of incentives for the traditional farmer to devise ways, and secure the means, for producing a marketable surplus because there is no market. This usually has to do with the absence or poor state of the road or other means of transportation as described earlier; ceteris paribus, the disincentive also tends to increase with the distance between primary and final markets.

Secondarily, market production is discouraged by the absence or shortage of adequate storage facilities at various levels. If bulk storage is lacking, a short-term increase in saleable surplus cannot be marketed in an orderly manner; at best the farmers take a price beating and will be discouraged from expanding output in the longer run. Inadequate or absent farm or community level storage facilities (as well as urgent cash needs) often lead subsistence farmers to sell part of their crop at harvest time when prices are low, only to buy back all or part of it later in the year at much higher prices. (Pest damage in storage also reduces their usable output by as much as 25 percent).

In both the East and the West livestock productivity is limited by management practices which emphasize herd size rather than per animal productivity. The pastoralists' strategy is to reduce the risk of herd loss under adverse environmental conditions. This is particularly the case for cattle, which have important roles to play in many societies' social and religious processes. Where there are strong links to livestock markets, there appear to be few incentives to maximize animal liveweight gain rather than number. Most producing areas are distant from the consumption centers. Weight loss is high during the trek to town markets. Hence, survivability rather than weight is a major buyer consideration. Besides the marketing problems, reduced dry season forage and water supplies limit weight gains in the more humid environments and cause weight loss in the drier ones. While herders could increase dry season standing forage by not burning rangelands, they continue to do so to stimulate succulent regrowth and to reduce ectoparasite populations. While forage conservation, fodder storage, and better animal health care could be applied by herders, these practices may well not be economic under current market conditions.

The main constraints to greater livestock productivity in the South (in addition to the market constraint), unfortunately, are beyond the cattle herding household's control: tsetse fly, seasonal droughts and seasonal flooding. The main problem caused by the dry season in many areas is not so much the lack of fodder as the lack of surface water for both men and animals. Among the constraints that seem to be within the herder's capacity to overcome--provided the necessary incentives and aids are forthcoming--are genetic, nutritional and veterinary measures for increasing cow fertility and decreasing calf mortality.

Soil conditions, input availability and cost and labor shortages in growing areas combine to make mechanized rainfed agriculture more land extensive than it is in most countries. Much mechanized sorghum and sesame production takes place on heavy cracking clays which become very slick when wet, preventing weeding by tractor. Soil active herbicides and application equipment require

scarce foreign exchange and may not be effective at normal doses on the heavy clays. High doses may well be uneconomic and environmentally unsafe. Foliar active herbicides have not yet been extensively tested in Sudan. Growers seem to avoid early competition from weeds and the high labor requirement of early hand weeding by delaying secondary land preparation and planting until after most weed species have sprouted. In addition to being reluctant to pay the labor costs, farm entrepreneurs have learned that they cannot obtain sufficient labor at low cost early in the growing season because small holders sow and weed their own crops at the same time. The staggered planting also helps avoid later competition for weeding and harvesting labor. However, it also reduces yield by decreasing the effective length of growing season, and probably by increasing exposure to insect and pathogen infestation. These cultural constraints have been made worse by poor site selection and layout during the early demarcation of mechanized blocks in the 1940's which have resulted in avoidable problems of field access and drainage. Another major problem is inadequate farm equipment especially the use of the wide-level disk, which creates a hard-plan and does not allow planting in rows nor application of fertilizer.

4. Institutional, Economic and Financial Policy Constraints.

Unlike some neighboring countries, the Sudan's basic present developmental constraints are not rooted primarily in an unfavorable environment and a lack of technical answers. Rather, they arise from the inadequacies of the national institutions to respond to the challenges, firstly, of the long-term developmental potential and, secondly, of the short-term economic and fiscal problems that the Sudan shares with most non-oil producers in the developing world.

The decline in export earnings have been due basically to a combination of inadvertent disincentives to maximizing cotton yields on irrigated farms with poor management of infrastructure and water allocation. Some of the disincentives have been removed, but export taxes on cotton are apparently due to continue.

Several other sources of distortions adversely affect the incentives for producers in the rainfed sector. The official exchange rate still overvalues the Sudanese pound. This effectively increases the demand for imports and taxed exports—a perverse result, given the current importance of agriculture in the Sudanese economy and its long-run potential for solving the balance of payments crisis and providing a foundation for stable growth and development.

The present critique, of course, is not meant to imply that all, and probably not even most, government policy decisions or their consequences are negative as far as agricultural development is concerned; for example, the GOS decision to refrain from imposing export and/or price controls on sorghum -- which probably called for some political courage -- helped materially to elicit a high satisfactory response of the private producing and trading sectors in terms of sharply higher output and exports in the early 80's.

On the other hand, public sector acts of commission are characterized by the assignment of entrepreneurial functions to public agencies that are not prepared to cope with the task. Almost inevitably, these agencies end up doing the job worse than even a moderately efficient private entity would have

8

done it, aggravating the public fiscal deficit. Two parastatals alone, the PAPC and the Kenana Sugar Corp., cost the GOS almost Ls 100 million per year in operating deficits. Admonishments to "improve management" of these agencies in the process tend (with exceptions) to be futile because the agencies have a built-in tendency to run aground. (The involvement of parastatal organizations in the production and marketing of certain agricultural products also constitutes another distortion in the structure of incentives.)

In the agricultural production sector proper, the government still does not seem to have quite convinced itself that it should not attempt to farm through public corporations, despite the dramatic examples of the huge irrigation schemes (especially Gezira) and of the limited and disastrous experiences with State farming of the Mechanized Farming Corporation compared with the rather successful schemes where land is leased and tractors are sold to small private entrepreneurs.

Outstanding among the acts of omission of the public sector is the neglect of the transport system. In this field, too, public entities attempt to monopolize services - and perform them badly - when private enterprise, suitably licensed and controlled, could provide them more efficiently (eg. river and air transport); at the same time, the public sector is emphatically not doing the job that it is expected to do in providing and adequately maintaining the transport infrastructure, such as roads, the railway track (if not the railway's operation) and safe Nile river navigation.

Much of the problem of institutional inefficiency is the result of the enormous brain drain towards the oil-rich countries of the Arabian peninsula. Public and private institutions in those countries are said to pay up to ten times the salaries that a well-trained Sudanese can expect to earn in his own country's public administration. And there are at present few if any incentives in Sudan for the internal and external private sectors to expand in such a way as to become an important employer of highly trained Sudanese personnel.

Sudan's tax structure is regressive, particularly as it affects low income producers, in that most taxes are explicit on a quantity basis rather than ad-valorem. At the farm level this increases taxes when farm incomes are low, and it contributes to a non-buoyant revenue structure for the central government revenues.

The current fiscal problems of the public sector are both cause and effect of this situation: on the one hand, inappropriate taxation policies and laws are failing to produce needed public revenue while some of them discourage production and trade: on the other hand, unnecessary and inefficient public agencies are squandering the scarce moneys that should be allocated to priority infrastructure investments. Insofar as the scarcity and misallocation of public money prevent the assured funding of development projects, especially those supported by external donors, the fiscal crisis will continue to have an increasingly negative impact on agricultural progress.

29

Another important financial institutional constraint is that institutional credit to date does not exceed one percent of rural lending in the Sudan at present. "Sheil" lending continues to be the prevalent form of credit despite government efforts to curb it. The system obviously keeps small farmers (and perhaps a few larger ones) in a permanent state of debt. Whether it truly reduces production incentives- as claimed by some- depends on whether one measures the sheil system against a hypothetical universal institutional credit (which often does not provide emergency consumption loans), or against no credit at all. Lending institutions and the public institutions dealing with technical and organizational support to small farmers have a lot to learn, but an ascending learning curve for them would seem to be the only hope for the establishment of the kind of strong and capillary credit system needed for helping market oriented small farmers get started. The Agricultural Bank's lending to date has been oriented primarily towards the entrepreneurial tenants in the mechanized farming schemes, where the Bank has been performing an indispensable financing, supply and purchasing/storage function.

40