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THE STRUCTURE OF INCENTIVES IN SUDAN'S
RAINFED AGRICULTURAL SECTOR

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EXECUTIVE SUMMARY

The purpose of this report is to examine the structure of incentives facing Sudanese agriculture, in particular the rainfed sector in the North. The analysis estimates how recent and possible future policy changes may affect agricultural productivity and their potential for improving the performance of the economy. The report also considers specific activities which may be supported by the U.S. Agency for International Development in assisting the government of Sudan in its efforts to increase the rainfed sector's contribution to economic growth, export earnings, and improved producer incomes.

Since the rainfed sector is primarily in private hands, these activities can best be implemented through policy initiatives that enhance the structure of incentives to the private sector and through selected public sector initiatives such as accelerated investments in agricultural research and extension and enhancements to the agricultural marketing system (including road and rail transport). Recent experience in sorghum production and marketing indicates that private rainfed agriculture has the potential and ability to respond to improved incentives.

Working with secondary data sources, the report presents an overview of the agricultural sector in the last ten years and analyses of the tax system, exchange rate policies, agricultural pricing and marketing, and government intervention and their implications for relative efficiency. These analyses are presented in the context of the macro economic situation, specifically, trade, money supply, and fiscal deficits.

The output of the rainfed sector increased throughout the 1970's through an expansion in cropped areas. By contrast, output from the irrigated sector declined because there was no growth in cropped areas and yields were declining or stagnant. Even though most public sector investment was directed towards the irrigated sector, the structure of incentives was such that these resources were effectively taxed away. On the other hand, the disincentives facing the rainfed sector were not as severe and producers were more responsive to private market mechanisms.

Recent policy initiatives have eliminated some of the distortions in the structure of incentives. Export duties on several agricultural commodities have been removed. The exchange rate system was recently unified and devalued, thereby bringing the price of foreign exchange closer to its true value. This removed an implicit subsidy on imports of wheat, flour, sugar, petroleum, agrochemicals, and spare parts. It raised the prices received by domestic producers for exports of their output; this may not elicit a large increase in the output from the rainfed sector, since its commodities have been traded at the true price of foreign exchange since September 1980. Explicit subsidies on petroleum, wheat, and sugar are being phased out with consequent Treasury savings of \$50 to \$60 million per year. The recent bumper crop of sorghum, depressed world prices for wheat and sugar, and United States wheat imports under the PL 480 Title III program should dampen the cost of living and nutritional impacts caused by the removal of the implicit and explicit subsidies.

Much remains to be done. Low land rents and subsidized credit have resulted in undercapitalization of the rainfed sector. The tax system lacks buoyancy and progressivity. Increased agricultural research and, more importantly, an effective extension service are needed to increase productivity. Technical and economic inefficiencies in the marketing system must be eliminated. Policy initiatives in these areas will significantly improve the structure of incentives facing rainfed agriculture, thereby realizing some of the potential of this sector and ameliorating the problems in Sudan's domestic economy and its foreign trade position.

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SECTION 1: INTRODUCTION

1.1 Purpose

The problems that have plagued Sudan's economy over the past 10 years are inextricably linked to the performance of the agricultural sector. Any solution to those problems must therefore be based on revitalizing that sector. The potential is there. The productivity of the sector in the past demonstrates what could be achieved again. How can the performance of the sector be improved so that this potential is realized? The most efficient and effective way is to improve the structure of incentives within agriculture, that is, the signals to which producers respond that are generated by the tax system, exchange rate policies, prices of agricultural commodities, government subsidies, and activities of parastatal organizations.

The exact characteristics of the structure of incentives depend on the nature of agricultural production, which in the Sudan encompasses both irrigated and rainfed agriculture. The irrigated sector includes the government-controlled and private schemes along the banks of the Blue Nile, White Nile, and Nile River. Initially, these projects were devoted solely to the production of cotton, Sudan's major export. During the 1970's, the government changed the cropping pattern and introduced wheat, sorghum (dura), and groundnuts. The rainfed sector is the rest of the country. This report, however, focuses on rainfed agriculture in the North because this region has the highest potential for improving the country's economic situation in the near term. Major products of this sector include gum arabic, livestock, groundnuts, dura, millet (dukhn), and sesame. For the most part, these are produced by traditional farming methods which are labor intensive and use few

imported inputs, such as fertilizers and pesticides. In recent years, some mechanized farming schemes have been developed in the rainfed sector in the North. These schemes now account for one-half of total dura production and about 25 percent of the total output of this sector [12]. Mechanized farms use more imported inputs, mainly tractors, fuel, and spare parts, for land preparation and planting. Weeding and harvesting of most crops are still done by hand.

The purpose of this report is to examine the structure of incentives facing producers in the agricultural sector, in particular rainfed agriculture. The irrigated sector has been extensively analyzed and has always received the lion's share of funds invested in agricultural development. The rainfed sector has been neglected relative to the irrigated sector. Yet rainfed agriculture provides the Sudan with a diversified export mix, supplies it with several important food grains and oilseeds, has the potential of making Sudan self-sufficient in food production, and is the major source of employment. By contributing to growth in the rainfed sector, it is possible to improve the incomes of the majority of the population which constitutes the bulk of the private sector in the Sudan.

In addition to examining the structure of incentives, we will analyze its impacts on rainfed agricultural productivity and the domestic economy over the past decade and attempt to estimate how recent policy changes will enhance productivity, improve the performance of the domestic economy, and ameliorate the balance of payments problems by increasing foreign exchange earnings. Finally, we suggest USAID activities that will aid and support the government of Sudan in its efforts to increase the rainfed sector's contribution to economic growth, export earnings, and improved producer incomes.

1.2 Setting

Agriculture is the major productive activity in the Sudan. It generates 35-40 percent of the gross domestic product. The crop-producing subsector contributes about 40 percent of this amount; the livestock and forestry subsectors account for most of the remainder. Agriculture employs over two-thirds of the labor force. It supplies over 95 percent of total exports by value. The industrial sector primarily comprises industries that process agricultural products, e.g., textiles, sugar, vegetable oils. Other large sectors of the economy, notably wholesale and retail trade and transport and communications, either service the agricultural sector or are major users of its outputs. Thus, the performance of this sector determines the performance of the domestic economy as well as Sudan's foreign trade position. Consequently, government policies and international and domestic events that affect agriculture will be quickly transmitted throughout the economy and will have direct impacts on Sudan's foreign exchange reserves.

In some respects, Sudan's economy performed well during the 1970's relative to other sub-Saharan African countries [19]. Sudan's gross domestic product (GDP) grew at an annual rate of 4.3 percent during the 1970-1979 period compared with 2.9 percent for sub-Saharan Africa (1.6 percent if Nigeria is excluded). Sudan's current account deficit declined from 8.6 percent of GDP in fiscal year (FY) 1976 to 6.1 percent in FY 1980; by contrast, the ratio for oil-importing African countries was higher and only decreased slightly from 9.5 percent in 1975 to 9.2 percent in 1980. Per capita GNP in 1979 was \$370 compared with \$411 for sub-Saharan Africa.

In other important respects, however, Sudan's economy lagged far behind the average performance of the sub-Saharan African countries [19]. Export volumes from Sudan declined at an annual rate of 4.4 percent over the

1970-1979 period compared with an overall decline of 0.8 percent per year for the other countries. The growth of import volumes during this period, 4.5 percent per year, exceeded the 3.3 percent annual growth rate for sub-Saharan Africa. As a result, Sudan's trade balance deteriorated rapidly from a \$50 million surplus in FY 1973 to a \$1 billion deficit in FY 1981. The current account balance, which includes trade in invisibles, moved from a surplus of \$1.4 million in FY 1973 to a deficit of \$543 million in FY 1980. As scarce foreign exchange reserves dwindled and budget deficits increased, the government increased its borrowing from outside sources; the external debt increased from \$1.2 billion in 1975 to over \$3 billion in 1980 [9] or approximately 30 percent of GDP over this period. Interest and principal payments on external debt as a percent of total export earnings (the debt service ratio) declined from 20 percent in 1975 to 11 percent in 1977, then increased to 21 percent by 1980; it reportedly rose to about 50 percent by the end of 1980 [9]. By contrast, the debt service ratio for all oil-importing African countries rose from 8 percent in 1977 to 16 percent in 1980. Finally, real GDP, which increased by almost 6 percent in FY 1978, declined by 1.2 and 0.6 percent in FY 1979 and FY 1980, respectively, primarily a result of decreases in the output of the agricultural sector [11].

In spite of this mixed picture, the prospects for improvement are good. The country has extensive unrealized natural and human potential and its leadership has manifested a commitment towards efficiency by encouraging market mechanisms as the principal means for resource allocation [20]. The costs of this transition will be high and may have extensive redistributive effects. Well-targeted and -executed external assistance can assist the Sudan in achieving the transition to growth and efficiency in an equitable manner.

SECTION 2: RECENT PERFORMANCE OF THE AGRICULTURAL SECTOR

The output of Sudan's major crops (except cotton) increased during the 1976-1981 period through an expansion of cropped areas in the rainfed sector; in the irrigated sector there was no growth in areas planted. Yields were either declining or stagnant in both sectors. Both the yield and the area cropped in cotton fell over this period resulting in a decrease in total output. Among the tradeable commodities, the major export crops (exportables) discussed in this section are cotton, dura, groundnuts, and sesame; two crops grown entirely in the irrigated sector, wheat and sugar, are termed import substitutes because all domestic production offsets imports of these commodities. Millet, a major food grain, is generally a nontraded good.

The total area planted in the export crops increased from 8 million feddans in 1969/70 to 12 million feddans in 1980/81 at an annual average growth rate of 4 percent. The increase of 4 million feddans occurred entirely in the rainfed sector; the area cropped in the irrigated schemes was about 2 million feddans in 1969/70 and 1980/81, although it did peak at approximately 2.6 million feddans in 1975/76. Irrigated areas planted in wheat and sugar rose from 300 thousand feddans to 500 thousand feddans during the same period, representing an average growth rate of just under 5 percent per year. However, this increase was not large enough to offset the decrease in irrigated areas devoted to cotton. While there is little, if any, physical competition for resources between these crops and cotton, the structure of incentives (including the joint account system) was such that cotton declined by 42 per cent in the period. The contribution of areas cropped and yields to total output of the export crops, the import substitutes, and the nontraded commodity is examined in more detail in the following sections.

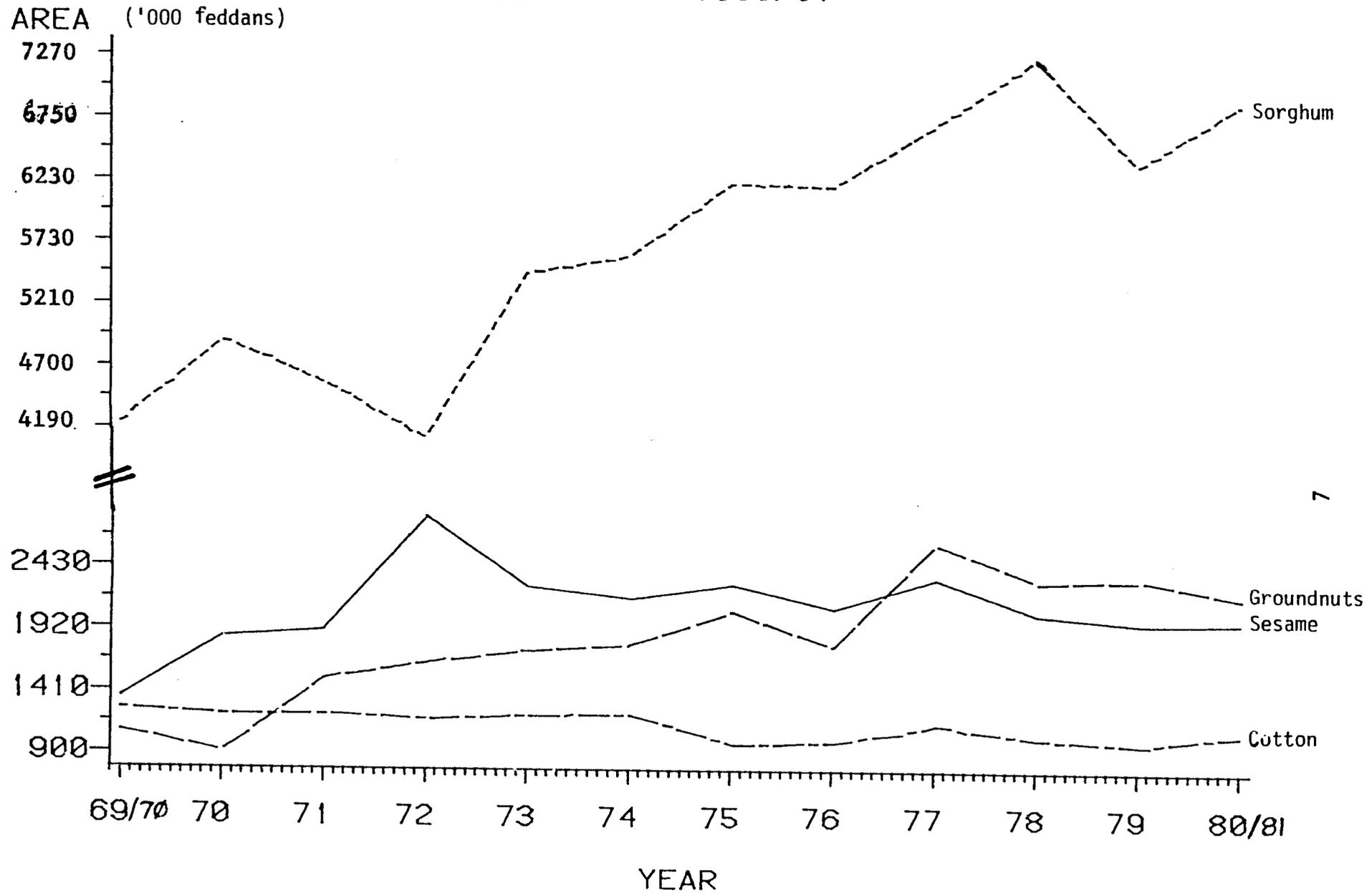
2.1 Export Crops

Figures 1 and 2 show the areas cropped and average yields for the major export crops from 1969/70 to 1980/81. During the period, the area planted in seed cotton declined at an annual rate of 1.3 percent from 1.3 million feddans in 1969/70 to 1.1 million feddans in 1980/81. Average yields also declined at a rate of 3.6 percent per year from 540 kg/feddan to 360 kg/feddan. As a result, production of seed cotton fell 4.8 percent annually from 675 thousand tons in 1968/70 to 390 thousand tons in 1980/81. Since the area planted in rainfed cotton is approximately 10 percent of the total, or 100 thousand feddans, the poor performance of cotton production is concentrated in the irrigated sector.

Total cropped areas in the irrigated schemes rose during the first half of the decade from 2.0 to 2.6 million feddans, then gradually fell to its original level of 2.0 million feddans by 1980/81. The expansion of irrigated land from 1969/70 to 1975/76 occurred because new schemes were brought into production. The decrease in total cotton output was a result of a change in government policy which also affected the production of other irrigated crops. To promote export crop diversification and food self-sufficiency, the government in 1974 began diverting land away from cotton and into other crops, notably groundnuts, wheat, and dura. At the same time it did not change the financial relationship between the tenant farmers and the management boards of the irrigated schemes, nor did it alter its cotton trade policies. Hence, all operating costs of the schemes, regardless of what crops were grown, were charged to the cotton account; tenants continued to receive 49 percent of the net proceeds from the sale of cotton while collecting all receipts from the sale of other crops; an explicit export tax on cotton applied; and cotton was traded at overvalued official exchange rates.

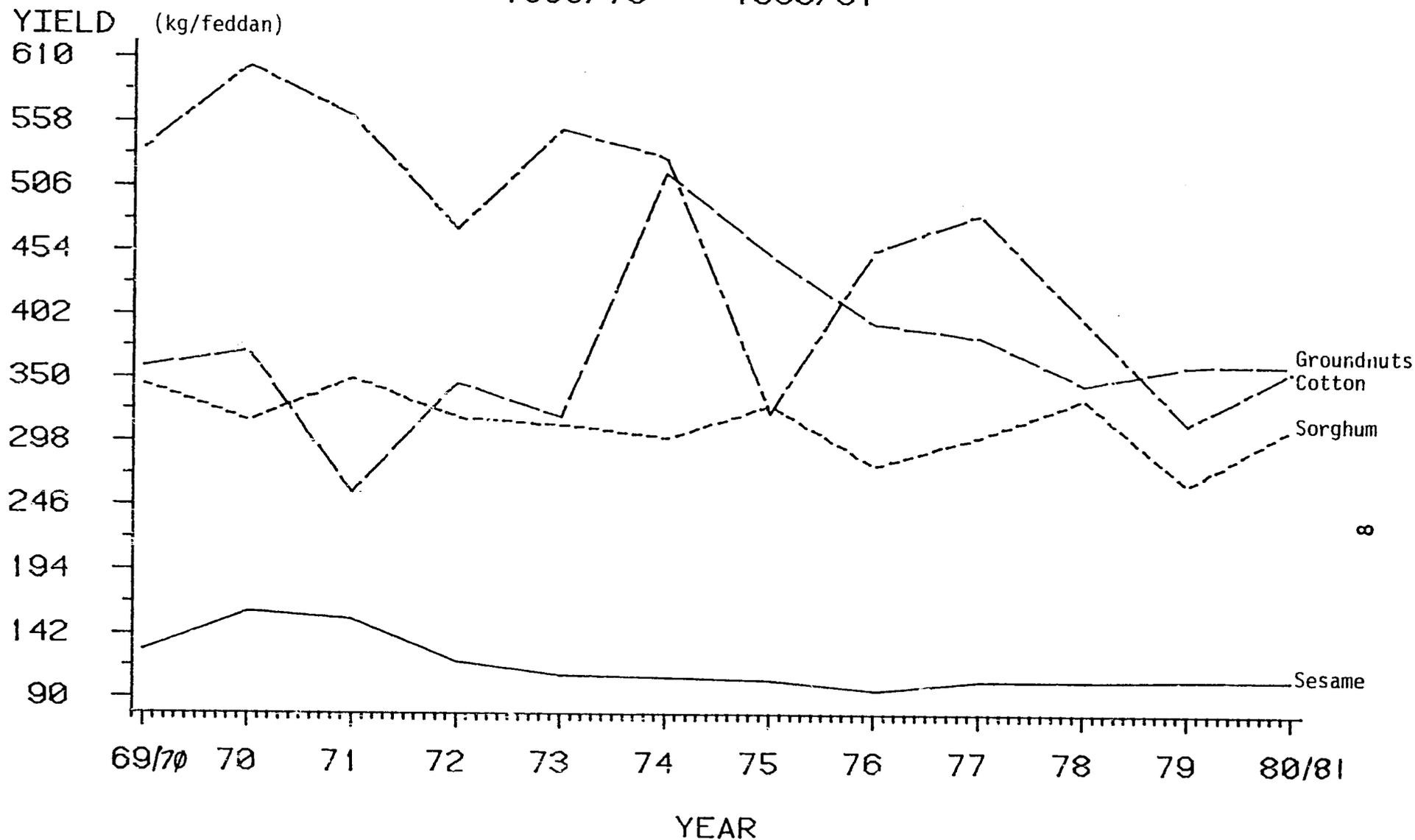
Figure 1. AREA PLANTED IN EXPORT CROPS

1969/70 -- 1980/81



Source: Food and Agriculture Organization of the United Nations, Sudan: Report of FAO Programming Mission, October 1980.

1969/70 -- 1980/81



Source: Food and Agriculture Organization of the United Nations, Sudan: Report of FAO Programming Mission, October 1980.

This policy implicitly taxed export crop production by the amount of the over-valuation (see Section 3.2). Diversification into groundnuts and wheat meant these crops were competing with cotton for the available irrigation water between November and January. Cotton production fell, thus reducing the revenues that normally accrued to the management boards and the government. As operating expenses were also rising, the resulting operating deficits had to be financed by borrowing from the banking system, a process which fueled inflation (see Section 4.2). As a result of the fall in cotton exports, foreign exchange reserves declined. This meant that the necessary maintenance of the schemes could not be performed. Machinery and spare parts could not be obtained; the irrigation canals began to fill with weeds, further restricting water availability. Thus, areas cropped in groundnuts and dura also declined by nearly 300 thousand feddans between 1975/76 and 1978/79 while yields for these commodities did not significantly improve. This exacerbated the decline in performance of the irrigated sector. Thus, there was a shift away from cotton production resulting in a decrease in total output of that crop; at the same time, total irrigated area fell during the latter half of the decade resulting in absolute decreases in the areas planted in the crops which were being grown in place of cotton.

The output of groundnuts doubled in the decade of the 1970's with most of the increase coming from area increases in the rainfed sector. In the Gezira scheme of the irrigated sector, the area planted in groundnuts increased from 151 thousand feddans in 1969/70 to 424 thousand feddans in 1975/76, then fell sharply to 229 thousand feddans by 1979/80; this represents an average annual growth rate of 4.3 percent over the decade. In the Gezira, average yields increased from 350 kg/feddan in 1969/70 to 1500 kg/feddan in 1975/76, then

declined to 1200 kg/feddan in 1979/80 [17]. These yields are two to four times the yields in the traditional rainfed sector and the annual growth rate of 13 percent in irrigated yields far outstrips the very slight improvement in rainfed groundnut yields. However, during this period, the traditional rainfed sector produced between 50-70 percent of total output [12]. Available data for 1975/76-1978/79 indicate that the area cropped in groundnuts in the rainfed sector accounted for 75-85 percent of the total area [14]. The total area planted in groundnuts doubled during 1969/70-1980/81 from 1.1 million feddans to 2.2 million feddans, growing at an annual rate of 6.8 percent. Of the 1.1 million feddans brought under groundnuts cultivation during the 1970's, the irrigated sector accounted for 100 thousand feddans, or 9 percent of the total increase. Although yields fluctuated widely over this period, there was no sustained growth so that 1980/81 saw little improvement on the average yield of 360 kg/feddan in 1969/70. Thus, the increase in output from 390 thousand tons in 1969/70 to 800 thousand tons in 1980/81 came entirely from the expansion in areas cropped, primarily in the rainfed sector.

The mechanized rainfed sector produces about 50 percent of total dura output. Traditional rainfed agriculture accounts for another 40 percent and the remaining 10 percent is produced in the irrigated sector. The total area cropped grew at an annual rate of 4.5 percent, from 4.2 million feddans in 1969/70 to 6.8 million feddans in 1980/81. The average yield declined over the period by 1 percent annually from 340 kg/feddan to 310 kg/feddan. As a result, sorghum production increased from 1.5 million tons in 1969/70 to 2.1 million tons in 1980/81 at a rate of 3.5 percent per year. The increases in area cropped and output occurred almost entirely in the rainfed sector, particularly the mechanized farms. In the Gezira scheme, the area cropped in dura

increased on average at 1.2 percent annually, from 290 thousand feddans in 1969/70 to 327 thousand feddans in 1979/80, while there was only nominal growth in yields of 0.6 percent per year from 470 kg/feddan to 500 kg/feddan. The expansion of areas cropped in the irrigated sector accounted for only 1 percent of the additional 2.6 million feddans brought under cultivation, although it represented over 10 percent of the additional 216 thousand tons produced.

Sesame is grown in both the mechanized and the traditional rainfed sectors. The area cropped increased at an average annual rate of 3.6 percent from 1.4 million feddans in 1969/70 to 2.0 million feddans in 1980/81. Average yields, however, declined by almost 2 percent per year from 130 kg/feddan to 100 kg/feddan, so that output only increased from 180 thousand tons to 210 thousand tons, or at an annual rate of 1.7 percent.

With the exception of groundnuts, the performance of the irrigated sector was generally weaker than that of the rainfed sector. Although yields are significantly higher in the irrigated sector, they did not as a rule improve much over time; combined with the lack of growth in cropped areas, production from this sector was lackluster. These results, especially the increases in areas cropped, could be explained as the combined effect of two phenomena: (1) government policies that discriminated against the irrigated sector relative to the rainfed sector, even though the bulk of public sector investment in agriculture has been directed towards the irrigated sector, and (2) the attempts of rainfed agricultural producers to maintain their incomes and to insure food security in the presence of declining yields.

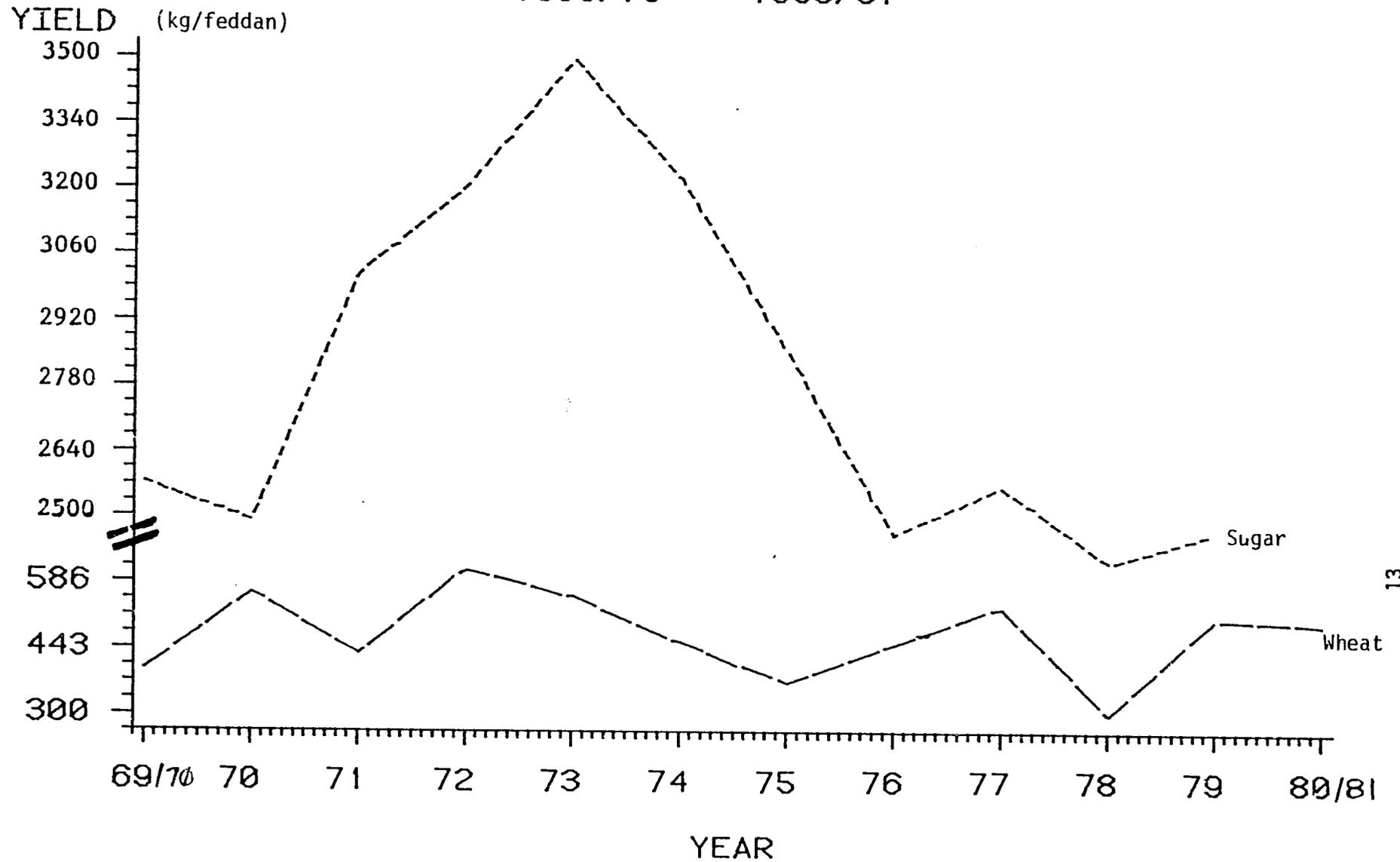
2.2 Import-substitute Crops

The major import substitutes, wheat and sugar, are grown only in the irrigated sector. Figures 3 and 4 depict cropped areas and yields, respectively,



Source: Food and Agriculture Organization of the United Nations, Sudan: Report of FAO Programming Mission, October 1980.

Figure 4. AVERAGE YIELDS OF IMPORT CROPS
1969/70 -- 1980/81



Source: Food and Agriculture Organization of the United Nations, Sudan: Report of FAO Programming Mission, October 1980.

for wheat and sugar. Because of the government-directed cropping pattern described above, the area planted in wheat increased from about 300 thousand feddans in 1969/70 to a peak of 700 thousand feddans in 1975/76; it then fell to about 450 thousand feddans by 1980/81 as maintenance problems increased in the irrigated schemes. Over the decade wheat yields improved only slightly from 400 kg/feddan in 1969/70 to 500 kg/feddan in 1980/81, an annual growth rate of 2.1 percent. As a result of increases in cropped areas and yields, wheat production grew at a rate of 6.1 percent from 115 thousand metric tons to 220 thousand metric tons. Areas planted in sugar rose from 30 thousand feddans in 1969/70 to over 50 thousand feddans in 1979/80, an annual increase of 6.2 percent. Yields rose from 2.5 tons/feddan in 1969/70 to around 3.5 tons/feddan in the early 1970's, then fell off and stabilized at 2.5 tons/feddan during the latter part of the 1970's. As a result, production of sugar increased over the decade from 75 thousand to 130 thousand metric tons at an average annual growth rate of 5.8 percent.

Although the production of wheat and sugar rose over the decade primarily because of an increase in cropped areas, it was not nearly enough to satisfy domestic demand. The government policy of import substitution fell far short of its objective and this level of output was achieved at a cost higher than would have been incurred had an amount equal to domestic production been imported. Sudan's general comparative disadvantage in wheat production has been central to the recent debates on agricultural policy. This will be discussed in more detail in Section 4.

2.3 Millet: The Nontraded Good

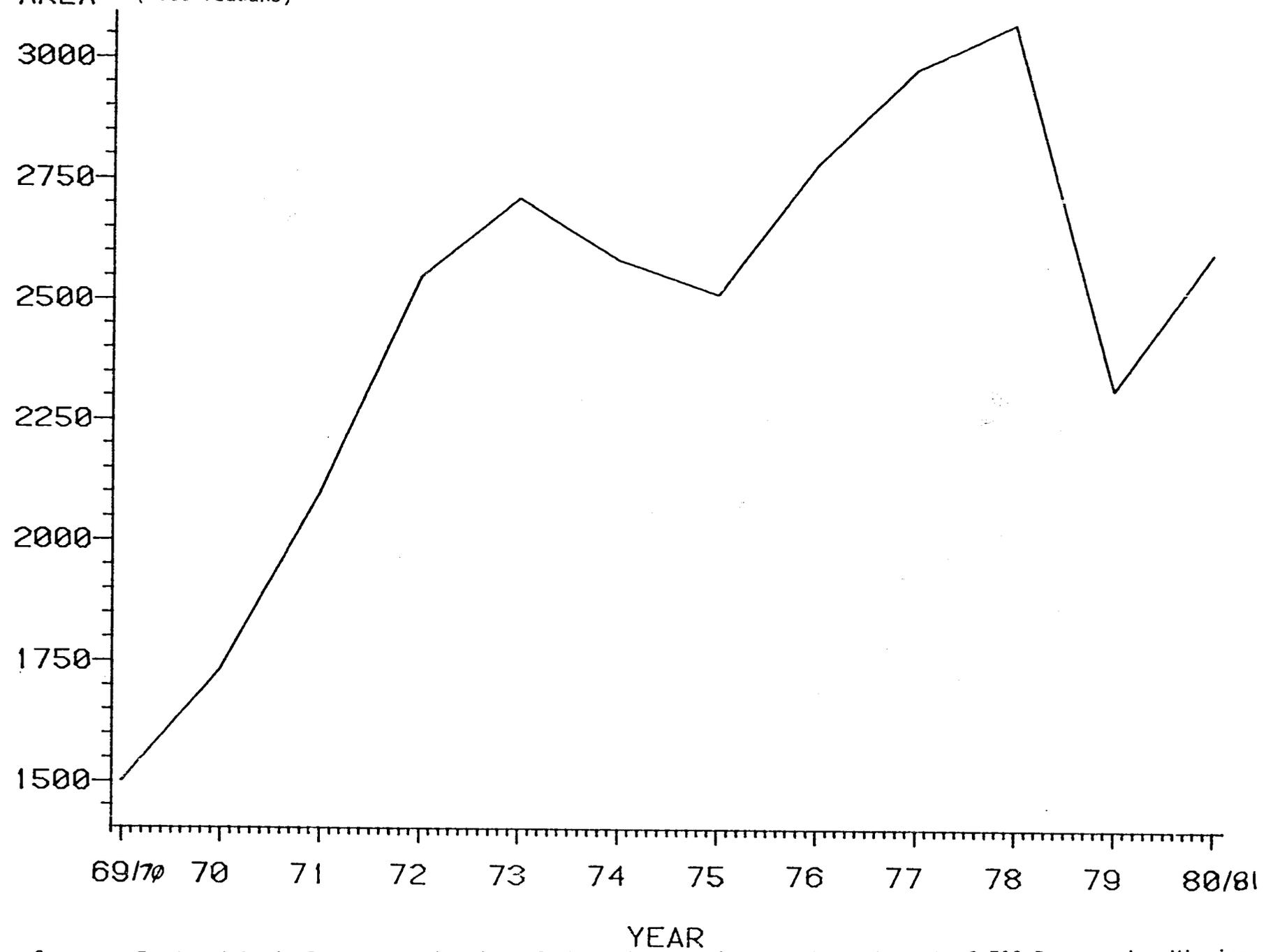
Millet is an important food staple in Western Sudan. All of it is produced in the rainfed sector. Very little is exported and none is imported. It is considered a nontraded commodity since the market for it clears domesti-

cally. The area cropped in millet rose steadily during the early 1970's from 1.5 million feddans to about 2.5 million feddans; it peaked in 1978/79 at 3 million feddans but in the last two crop years declined to around 2.6 million feddans (Figure 5). Millet yields declined fairly steadily throughout the first half of the decade from 260 kg/feddan to about 160 kg/feddan; since then they increased erratically to their current level of 190 kg/feddan in 1980/81 (Figure 6). As a result of these two effects the total output of millet increased from just under 300 thousand metric tons in 1969/70 to just under 500 thousand metric tons in 1980/81. Among the major grains and oilseeds grown in the Sudan (groundnuts, sesame, dura, wheat) output of millet has generally ranked third, behind dura and groundnuts. In terms of areas cropped only dura exceeded that for millet. Thus, while it has little value as an export, millet is an important foodgrain and should figure significantly into any policies designed to achieve food self-sufficiency and improve rural incomes.

Millet, sorghum, groundnuts and sesame all typify the performance of the rainfed sector. Output increases have been achieved through increases in areas cropped in the presence of declining or stagnant yields.

1969/70 -- 1980/81

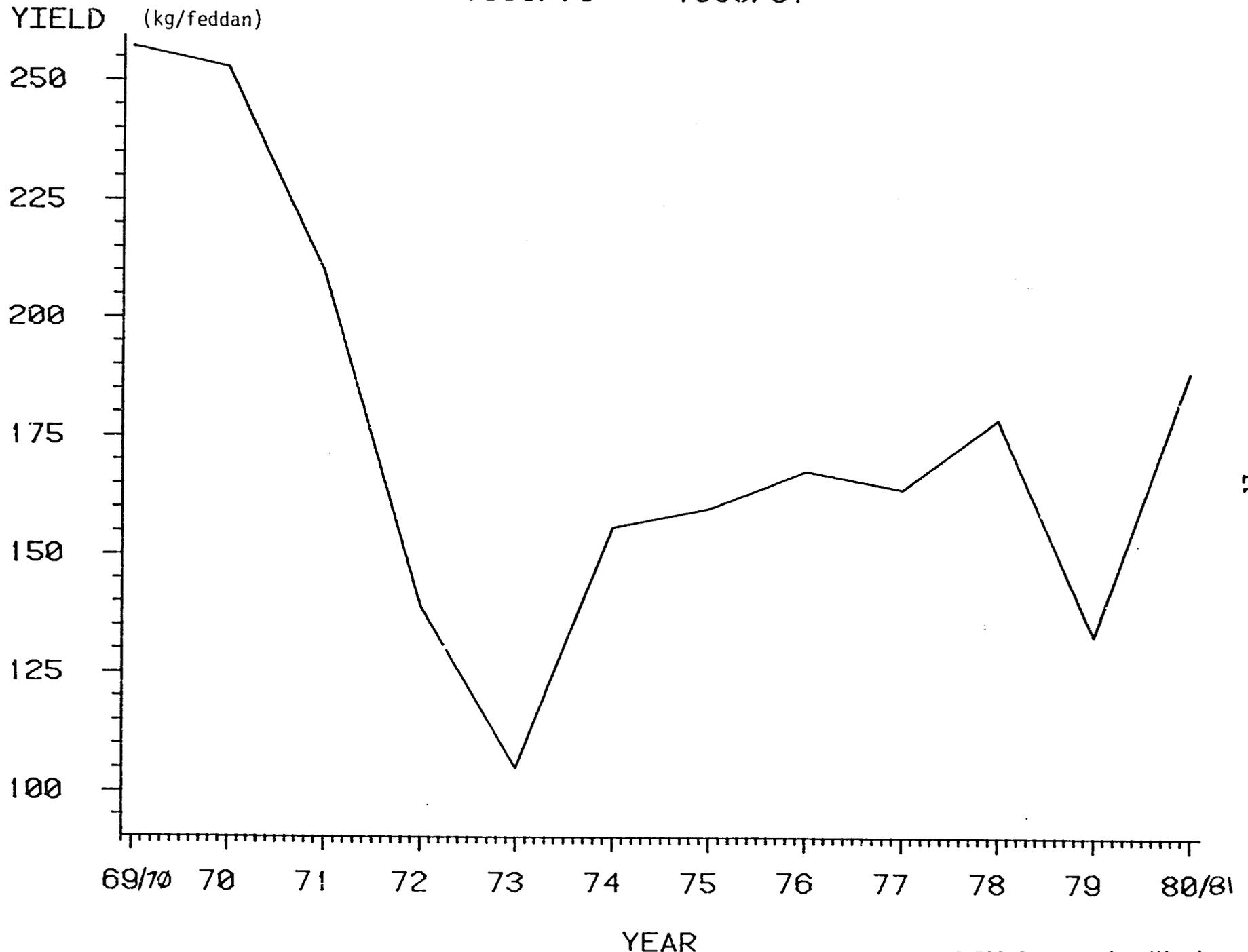
AREA ('000 feddans)



Source: Food and Agriculture Organization of the United Nations, Sudan: Report of FAO Programming Mission, October 1980.

Figure 6. AVERAGE YIELDS OF MILLET

1969/70 -- 1980/81



Source: Food and Agriculture Organization of the United Nations, Sudan: Report of FAO Programming Mission, October 1980.

SECTION 3: THE STRUCTURE OF INCENTIVES

The structure of incentives comprises the tax system, exchange rate policies, prices of agricultural commodities, and government intervention in the markets for agricultural inputs and outputs, such as subsidy programs and parastatal involvement in the production and distribution system. This structure affects resource allocation decisions in agriculture because it generates a real price or cost for every input and output to which producers respond. It determines the performance of the sector; any problems can best be solved by changing the structure. Although some elements of the incentive structure are common to all subsectors within agriculture, the precise characteristics vary with the type of production system. For example, the joint account system used in the irrigated schemes governed tenants' decisions regarding which crops would receive their time and resources, but it did not directly affect producers in the rainfed sector. The purpose of this section is to examine the structure of incentives in the traditional and mechanized rainfed sectors.

Rainfed agriculture has historically been a part of the private sector, unlike the irrigated schemes. While private agriculture can benefit from increased government support (for example, improvements in the infrastructure and agricultural research), it has been responsive to price incentives. Rainfed producers are more responsive to market forces than producers in irrigated schemes. Public sector investment designed to improve the functioning of provincial markets, including the development and dissemination of agricultural research results and marketing information, would capitalize on the intrinsic strength of the rainfed sector and yield high returns to relatively small outlays.

3.1 The Tax System

Tax revenues have consistently provided at least 80 percent of total central government revenue since the mid-1970's [8]. Of this amount, indirect taxes have accounted for about 80 percent, direct taxes on income and profits for 10-15 percent, and export duties for 5-10 percent. The heavy reliance on indirect taxes is unusual for an African country [8]. To better understand how the tax system affects the agricultural sector, the discussion in this section focuses on the incidence of direct and indirect taxes on exports, imports, and domestic production. (The implicit taxation from exchange rate overvaluation is discussed in Section 3.2.) It should also be noted that this discussion is primarily descriptive; others have studied the tax system extensively and made recommendations for its reform and improvement [1, 8]. A principal recommendation includes eliminating specific taxes in favor of ad valorem taxes to increase both the buoyancy of the tax system and its progressivity. Although some reform would be desirable, the present tax system is not a significant explicit disincentive to producers in the rainfed sector, especially traditional producers.

3.1.1 Exports

Exports are taxed directly through export duties and indirectly through the development tax. Export duties are ad valorem taxes. There are several rates, most between 5 and 15 percent; in the past, the rate for a specific commodity has varied widely from year to year. The duty on cotton was eliminated in 1980, as was the duty on sesame. Exports of dura are currently taxed at 25 percent; millet, groundnut, cottonseed, cottenseed and sesame cake, and vegetable oils are taxed at 15 percent. Livestock and livestock products are taxed at rates of 5, 10, 14, 15, 20, and 25 percent. A development tax of 5 percent (essentially a manufacturers sales tax) currently

applies to exports of all commodities. Thus, for any export there will be a wedge of at least 5 percent up to a maximum of 30 percent between world and domestic producer prices.

3.1.2 Imports

Imports are subject to customs duties, consumption duties, and the defense tax. The combined levies on imports account for about 50 percent of total tax revenues [8]. Customs duties alone generated around 40 percent of all tax revenues; they comprise 25 ad valorem rates (the basic rate is 40 percent) and 16 specific rates. Development items are generally taxed at the lower rates, while the highest rates (100 to 900 percent) are applied to luxury items. Consumption duties applied to beer, cigarettes, matches, motor fuel, and lubricating oil are equivalent to the excise taxes levied on domestic production. Prior to 1979, the 5 percent development tax applied to all imports except wheat and flour, medicines, and milk for babies. This was lifted in 1979, and a 5 percent defense tax took its place. In March 1981, the defense tax was increased to 10 percent.

The rainfed sector, unlike the irrigated sector, uses few imported inputs and is thus relatively immune from the impacts of these taxes. Seeds, insecticides, and agricultural machinery were exempted from customs duties in 1976. Imports of urea and other fertilizers were taxed at 5 percent and sacks and bags at 12 percent. However, many of the inputs to the transportation sector are subject to import duties: railway rails (10 percent), diesel fuel (15 percent), railway equipment parts (20 percent), freight cars (25 percent), tires and trucks (30 percent), petroleum and all other railway equipment (40 percent).

Except for millet and sorghum, many agricultural commodities are taxed at rates designed to protect domestic production. Wheat and wheat flour are

taxed at 25 percent; refined sugar at 30 percent; rice, cottonseed, and oil cake at 40 percent; bread at 50 percent; groundnuts, raw sugar, and all other grains at 70 percent. Inexplicably, several commodities subject to customs duties are either directly subsidized (wheat, flour, sugar, bread) or used in heavily subsidized industries (rail transport). The subsidies on wheat and sugar are currently being phased out [20].

3.1.3 Taxes on Domestic Production

Taxes levied on domestic production include the 5 percent development tax, a complicated system of 33 categories of excise taxes employing both ad valorem and specific rates, and local taxes. Specific excise taxes are applied to the production of wheat flour, vegetable oils, and sugar; the development tax would only apply to an agricultural commodity if it were processed--vegetable oils, for example. Local taxes (ushur) are levied on the output of mechanized farms in the west and southwest; they are an important source of revenue for the regional governments. The amount of the tax varies from region to region, but is usually between 10 and 15 percent. Detailed information on these taxes is not available; local taxes are a disincentive because they drive a wedge between the demand and the supply price and farmers' revenues are generally decreased.

3.2 The Exchange Rate System

Exchange rate policies are a critical factor in the structure of incentives facing agriculture. An overvalued exchange rate has two important effects. First, it discourages the production of exportables and import substitutes because the prices (in domestic currency) received by producers are below those they would receive if the exchange rate were at its market equilibrium. Second, it stimulates the demand for imports by effectively lowering the prices domestic consumers have to pay.

3.2.1 Exchange Rate History

Prior to March 1972, the official exchange rate at which all commodities were traded was fixed at $\$2.87 = \text{LS}.1$ ($\text{LS}.0.348 = \$1$). In March 1972, a de facto devaluation of 15 percent was accomplished through an exchange subsidy for receipts and an exchange tax on payments; this established an effective exchange rate of $\$2.50 = \text{LS}.1$ ($\text{LS}.0.4 = \$1$) that applied to all transactions except exports of cotton and gum arabic. In May 1975, gum arabic exports were moved to the effective rate. A second devaluation took place in June 1978. The official rate was fixed at $\$2.50 = \text{LS}.1$ and the effective rate was devalued to $\$2.00 = \text{LS}.1$ ($\text{LS}.0.50 = \$1$) by increasing the exchange tax/subsidy rate. Cotton remained the only commodity traded at the official rate; all other exports and all imports were converted at the effective rate.

In September 1979 a third devaluation occurred. The official rate was fixed at $\$2.00 = \text{LS}.1$ (the old effective rate). The exchange tax/subsidy program was eliminated and a parallel rate was established in its place at $\$1.25 = \text{LS}.1$ ($\text{LS}.0.8 = \$1$). At the same time, however, the list of commodities and transactions converted at the official rate was expanded to include government transfers, essential imports, invisibles, and traditional exports such as cotton, groundnuts, dura, and sesame. Only nontraditional exports (about 8 percent of the total) and imports previously brought in under the nil value license system (approximately 30 percent of the total) were traded at the new parallel rate. Thus, this devaluation did little to stimulate traditional exports or curb imports.

One year later, in September 1980, many of the commodities traded at the official rate were shifted to the parallel rate. The official rate still applied to cotton, wheat, flour, sugar, petroleum, pharmaceuticals, and powdered milk. During the third quarter of 1981, cotton was finally transferred to the list of commodities traded at the parallel rate.

On November 9, 1981, the two-tiered system of exchange rates was replaced by a unified system and devalued to \$1.11 = LS.1 (LS.0.9 = \$1) [20]. This policy change corrected one of the greatest distortions in the structure of incentives in the agricultural sector by eliminating much of the overvaluation that characterized the exchange rate system in the past. This point is discussed further in the following section.

3.2.2. Overvaluation of the Exchange Rate

An overvalued exchange rate implicitly taxes exports and subsidizes imports by an amount equal to the overvaluation. This section presents estimates of the overvaluation of the official and effective (or parallel) exchange rates. The results are used in estimating the net protection of three important rainfed crops (Section 3.3).

A purchasing-power-parity approach was used to convert nominal exchange rates to real rates. This involved selecting an appropriate base year, obtaining an estimate of the real rate in the base year, and calculating a set of deflators. The year 1972 was selected as the base because in FY 1973 (1 July 1972 - 30 June 1973) the current account was almost in balance with a small surplus of LS.500 thousand. An estimate of the real exchange rate in 1972 was obtained from Pick's Currency Index [14] by averaging the black market rates for that year. The deflator for each year is the ratio of two ratios: the numerator is the ratio of Sudan's CPI for the year of interest to the CPI in 1972; the denominator is the ratio of the IBRD world inflation index in the year of interest to the index in 1972. The real exchange rate for a given year is the product of the deflator for that year and the real exchange rate in 1972. The amount of overvaluation in each year was calculated as the percentage difference between the real and nominal exchange rates. The results, which are presented in Table 1, should not be interpreted as

Table 1. Overvaluation of the Exchange Rates

	Official			Effective (parallel)		
	Nominal (LS/\$)	Real ^a (LS/\$)	Over- valuation ^b (%)	Nominal (LS/\$)	Real ^a (LS/\$)	Over- valuation ^b (%)
1970	0.348	0.522	50.0	-	-	-
1971	0.348	0.496	42.5	-	-	-
1972	0.348	0.516	48.3	0.400	0.516	29.0
1973	0.348	0.496	42.5	0.400	0.496	24.0
1974	0.348	0.506	45.4	0.400	0.506	26.5
1975	0.348	0.558	60.3	0.400	0.558	39.5
1976	0.348	0.562	61.5	0.400	0.562	40.5
1977	0.348	0.607	74.4	0.400	0.607	51.8
1978						
Pre June	0.348	0.640	83.9	0.400	0.640	60.0
Post June	0.400	0.640	60.0	0.500	0.640	28.0
1979						
Pre September	0.400	0.731	82.8	0.500	0.731	46.2
Post September	0.500	0.731	46.2	0.800	0.731	-8.6
1980	0.500	0.819	63.8	0.800	0.819	2.4
1981						
Pre November	0.500	-	-	0.800	-	-
Post November	0.900	-	-	0.900	-	-

^aThe 1972 black market rate from Pick's Currency Index (LS.0.516=\$1) was assumed to be the real exchange rate in that year. Real rates for the remaining years were calculated using the consumer price index for Sudan (1975 = 100), CPI^S, the IBRD world inflation index (1975 = 100), CPI^W, and the following formula:

$$E_i^* = E_{72}^* \frac{CPI_i^S}{CPI_{72}^S} \frac{CPI_{72}^W}{CPI_i^W} \quad \text{where } E_i^* \text{ is the real exchange rate in year } i.$$

^bOvervaluation = $\frac{E_i^* - E_i}{E_i} \times 100$ where E_i is the nominal exchange rate in year i .

estimates of the shadow exchange rate because the prices of traded commodities are included in the Sudanese and world CPI's in the deflator. A shadow exchange rate would reflect price changes in Sudan's home (nontraded) goods relative to price changes in the home goods of its major trading partner, for example, the EEC. However, such indexes were not available, so the estimates of real exchange rates were used as proxies for shadow exchange rates.

The results show that exports traded at the official rate were implicitly taxed at rates between 40 and 80 percent; imports brought in at this rate were subsidized by equivalent amounts. Until September 1979 when the parallel rate was established, the amount of overvaluation ranged from 25 to 60 percent. The parallel rate was slightly undervalued (9 percent) but because most commodities were shifted to the official rate at that time, the implicit tax (subsidy) on exports (imports) was over 40 percent. During 1980 the parallel rate was only slightly overvalued. Thus, trading many commodities at the parallel rate removed much of the implicit taxation or subsidization. However, the tax rate on cotton and the subsidy rate for wheat, flour, sugar, petroleum, and pharmaceuticals climbed to over 60 percent, since these commodities were traded at the official exchange rate. Although price indexes for 1981 are not available, the unification and devaluation of the exchange rates in November 1981 probably brought the nominal exchange rate closer to the real price of foreign exchange, since inflation in Sudan has reportedly been higher than the world inflation rate. Since all of Sudan's exports from the rainfed sector have been traded at close to the real price of foreign exchange since September 1980, the November 1981 exchange rate regime will not significantly boost exports from this sector. The major impact will be to increase the price of petroleum, thereby inflating transportation costs.

3.3 Pricing and Marketing of Selected Rainfed Crops

In a perfectly competitive economy, agricultural producers would receive 100 percent of the world market price, net of an efficient marketing margin, for their output. Divergences from this ideal are introduced by exchange rate overvaluations or undervaluations, government taxes and subsidies, and inflated marketing margins. If the net effect of these factors raises producer prices above world prices, positive protection exists and producers are effectively subsidized by the amount of the difference between world and domestic prices. If the net effect is to depress producer prices relative to world prices, the protection is negative and producers are effectively taxed by the amount of the price difference. The purpose of this section is to estimate the net protection of dura, sesame, and groundnuts in three provincial markets over time and examine the policy implications of the results.

The net protection rate is the difference between the nominal protection rate (NRP) and the amount of exchange rate overvaluation. The NRP for a commodity captures the effects of government taxes and subsidies on the output of that commodity; it is the percentage difference between the domestic producer price and the world (border) price adjusted to reflect transport and marketing costs. Estimates of the NRP's are presented in Section 3.3.1. In Section 3.3.2 these are combined with the effect of the overvalued exchange rate (Section 3.2.2.) to arrive at an estimate of the net protection for the major rainfed crops.

3.3.1 Nominal Protection Rates

Four markets in three provinces were selected for analysis. The Gedaref market in Kassala (Eastern Sudan) is one of the largest markets for dura and sesame. El Obeid, in Northern Kordofan, is a major trading center for Western

Sudan; dura, sesame, and groundnuts are among the commodities marketed. In the White Nile Province (Central Sudan), Kosti represents a major market for dura, while large quantities of sesame and groundnuts are traded in Tendelti. All four markets are linked by rail to Khartoum and Port Sudan.

Producer prices in these markets for the crop years 1975/76-1978/79 are presented in Table 2. There is considerable variation both across markets in a given year and across time in a given market. In general, prices are higher in the western markets than in the central and eastern markets. These variations reflect differences in transportation costs, production costs, demand conditions, and levels of marketed surpluses. The producer prices of dura in El Fasher (Northern Darfur), which are significantly higher than the prices in other markets, are also presented to support a conclusion that will be drawn from the analysis of the NRP's below.

The cost of transportation from the market to Port Sudan must be netted out of the border price of each commodity to determine the border price facing the producer, or the export parity price. Ideally, other marketing costs, such as storage, handling, and commissions, should also be netted out; this information was not available, so the marketing margin is not treated in this analysis. Two sets of transportation costs were estimated, one for road transport by lorries and one for rail transport (see Table 3A). Rail transport costs were assumed to be 50 percent of road transport costs; no attempt was made to calculate transportation costs by commodity. These costs, which are given in piasters per ton kilometer, were multiplied by the distance of each market from Port Sudan (Table 3B) and the result was subtracted from the border prices of the commodities to determine the export parity prices. The percentage difference between the producer and export parity prices of a commodity is the nominal protection rate for that commodity; these are pre-

Table 2. Producer Prices of Selected Rainfed Crops, by Provincial Market (LS/ton)

	1975/1976	1976/1977	1977/1978	1978/1979
Dura				
Port Sudan (F.O.B.) ^a	43.4	45.3	54.0	88.5
Gedaref	17.8	27.7	35.6	41.1
El Obeid	46.1	52.7	45.1	118.1
Kosti	22.4	21.0	47.7	41.2
El Fasher	73.3	136.5	109.7	125.5
Sesame				
Port Sudan (F.O.B.) ^a	184.1	203.7	260.1	404.0
Gedaref	111.2	69.1	114.7	156.6
El Obeid	125.0	133.2	81.6	140.9
Tendelti	120.5	85.7	129.2	207.9
Groundnuts				
Port Sudan (F.O.B.) ^a	137.1	217.6	209.1	282.7
El Obeid	62.4	97.3	80.5	107.9
Tendelti	70.0	54.6	76.5	97.4

Sources: Internal Trade Statistics and Price Indices, 1978,
 Department of Statistics, Ministry of Planning, April 1981.

Sudan Foreign Trade Analysis: 1970-1979, Department of Statistics,
 Ministry of Planning, May 1981.

^aExport (border) prices F.O.B. Port Sudan in LS/ton converted at official exchange rate.

Table 3A. Transportation Costs (pt./ton km)^a

	Road	Rail ^b
1976	1.4	0.7
1977	2.0	1.0
1978	3.0	1.5
1979	3.5	1.8

Sources: John F. Due, "Rail and Road Transport in the Sudan," Faculty Working Paper No. 423, University of Illinois at Urbana-Champaign, July 1977; Thurvald Moe, World Bank.

^aRates assumed to be the same for all commodities.

^bAssumed to be one-half the road transport costs.

Table 3B. Distances of Markets to Port Sudan (km)

	Road	Rail
Gedaref (Kassala)	852	800
El Obeid (N. Kordofan)	1613	1537
Kosti (White Nile)	1512	1217
Tendelti (White Nile)	1624	1313

sented in Table 4. Because not all marketing costs could be identified, these estimates understate positive protection and overstate negative protection.

Most of the NRP's for dura marketed in Gedaref are negative. Nominal protection tended to increase (the NRP's became less negative) from 1975/76 through 1977/78, but decreased sharply in 1978/79. However, NRP's for dura marketed in El Obeid and Kosti paint a different picture. Both NRP estimates for the El Obeid market show high levels of positive protection; those based on road transport costs range between 120 and 700 percent, while those based on rail transport costs are between 40 and 90 percent. The results for dura traded in Kosti are mixed; the NRP's based on road transport costs are consistently positive (between 1 and 450 percent), while those based on rail transport costs are negative for all years (around -37 percent) except 1977/78. Since a positive NRP implies that the producer is receiving more than the world market price, dura from El Obeid and Kosti could not be competitive on the export market. Saudi Arabia has recently been importing Sudanese dura at a premium above the world price, but this does not account for the positive NRP's in the earlier years. Since there were no explicit subsidies in these two markets, the high positive protection rates could reflect high marketing costs, disarticulated regional markets, export markets other than Port Sudan, or all three of these.

For example, El Obeid dura is competitive in the west. Prices in the El Fasher and Nyala markets in the Darfurs (see Table 2) were significantly above those in other provincial markets, reflecting a high demand for Sudanese dura in Chad and the Central African Republic to alleviate the food shortages in these countries. Political unrest in the Kordofans and Darfurs kept prices high as people stockpiled food against possible interruptions in supply. The El Obeid market, and possibly the Kosti and Tendelti markets as well,

Table 4. Nominal Protection Rates for Selected Rainfed Commodities (%)^a

	1975/1976		1976/1977		1977/1978		1978/1979	
	NRP ^b _{rd}	NRP ^c _{rr}						
Dura								
Gedaref	-43	-53	-2	-26	25	-15	-30	-45
El Obeid	122	41	305	76	705	46	269	94
Kosti	1	-36	39	-37	455	34	16	-38
Sesame								
Gedaref	-35	-38	-63	-65	-51	-54	-58	-60
El Obeid	-23	-28	-22	-29	-62	-66	-59	-63
Tendelti	-25	-31	-50	-55	-39	-46	-40	-45
Groundnuts								
El Obeid	-46	-51	-47	-52	-50	-57	-52	-58
Tendelti	-39	-45	-71	-73	-52	-60	-57	-62

^aNominal protection rate (NRP) = $(p^{\text{producer}} \div p^{\text{border}}) - 1$. Producer prices are from Table 2. Border prices taken from Table 2 and adjusted for transport costs from market to Port Sudan from Table 3.

^bNRP's calculated by netting road transport costs out of the border price.

^cNRP's calculated by netting rail transport costs out of the border price.

supplied these needs. El Obeid served the same function for Western Sudan and its neighbors as Port Sudan did for the world market. Thus, while El Obeid is not export competitive because of cost barriers between it and Port Sudan, it is competitive in its own region even given the high costs incurred in shipping dura to markets further west. Even if links between El Obeid and Khartoum and Port Sudan are improved, the El Obeid market will probably continue to supply the western regions, rather than becoming a major supplier of the eastern provinces and the export market.

Sesame is heavily taxed in the Gedaref, El Obeid, and Tendelti markets. Nominal protection in Gedaref decreased from about -35 percent in 1975/76 to between -50 to -65 percent from 1976/77-1978/79. In El Obeid, the NRP's were between -20 and -30 percent in 1975/76 and 1976/77, then sharply decreased to -60 percent in 1977/78 and 1978/79. Nominal protection for sesame marketed in Tendelti decreased from -30 percent in 1975/76 to between 40 to 50 percent from 1976/77-1978/79. Thus, producers were confronted with greater disincentives in the last two years of the period, since the effective taxation of their output increased. That the nominal protection for sesame is significantly less than that for dura in these markets probably had a debilitating influence on the production of sesame relative to dura. The negative protection of sesame relative to dura across widely dispersed markets may also help to account in part for the trend towards the monoculture of dura in rainfed agriculture and may also indicate a bias in government policies in favor of food production and against cash crop production. Given the relative riskiness of sesame production and its potential for export earnings, a lower level of taxation would appear warranted.

Producers of rainfed groundnuts also faced severe disincentives in the markets examined. The gap between road and rail transport costs made little

difference in the El Obeid market; NRP's consistently remained around -50 percent from 1975/76-1978/79. In Tendelti, which is closer to Port Sudan, nominal protection decreased sharply from -40 percent in 1975/76 to -70 percent in 1976/77, then increased to about -60 percent in the last two years of the period. These NRP's, which are about par with those for sesame and significantly lower than those for dura, lend credence to a pro-food crop/anti-cash crop bias in the structure of incentives in the rainfed sector.

3.3.2. Net Protection Rates for Selected Rainfed Crops

The analysis of nominal protection rates did not account for the impact on the producer of overvalued exchange rates. Since an overvalued exchange rate implicitly taxes agricultural production, it decreases the nominal protection. If there is negative nominal protection, the overvaluation would make the protection rate even more negative, thereby adding to the overall taxation of output. This section presents estimates of the net protection for rainfed commodities, which is defined as the difference between the NRP's (Section 3.3.1) and the overvaluation of the official exchange rate (Section 3.2.2.).* The results are shown in Table 5.

Since the nominal protection for sesame and groundnuts was negative in all markets during the period, the overvaluation of the exchange rate further reduced the protection of these crops. The net protection rates for sesame and groundnuts were usually between -100 and -130 percent over the period. A brief example will illustrate the effect of protection rates of this magnitude

*It is appropriate to use the overvaluation of the official exchange rate even though most rainfed products are traded at the effective or parallel rate, because all trade statistics from which the border prices were taken are converted at the official rate.

Table 5. Net Protection of Selected Rainfed Commodities (%)^a

	1975/1976			1976/1977			1977/1978			1978/1979		
	Over-valuation	NP ^b _{rd}	NP ^c _{rr}	Over-valuation	NP ^b _{rd}	NP ^c _{rr}	Over-valuation ^d	NP ^b _{rd}	NP ^c _{rr}	Over-valuation ^e	NP ^b _{rd}	NP ^c _{rr}
Dura:												
Gedaref	61	-104	-114	74	-76	-100	72	-47	-87	74	-104	-119
El Obeid	61	61	-20	74	231	2	72	633	-26	74	195	20
Kosti	61	-60	-97	74	-35	-111	72	383	-38	74	-58	-112
Sesame												
Gedaref	61	-96	-99	74	-137	-139	72	-123	-126	74	-132	-134
El Obeid	61	-84	-89	74	-96	-103	72	-134	-138	74	-133	-137
Tendelti	61	-86	-92	74	-124	-129	72	-111	-118	74	-114	-119
Groundnuts												
El Obeid	61	-107	-112	74	-121	-126	72	-122	-129	74	-126	-132
Tendelti	61	-100	-106	74	-145	-147	72	-124	-132	74	-131	-136

^aNet protection = NRP minus the percent overvaluation of the exchange rate. Overvaluation of the official exchange rate was used in these calculations because all trade statistics (from which the border prices were taken) are converted at this rate.

^bCalculated using the NRP_{rd} entries from Table 4.

^cCalculated using the NRP_{rr} entries from Table 4.

^dWeighted average of overvaluations in 1978 to account for the June devaluation.

^eWeighted average of overvaluations in 1979 to account for the September devaluation.

on producer incomes. If the net protection of a crop was -100 percent and the producer received LS.500 for his output, increasing the protection to zero percent would add LS.1000 to his revenue; increasing net protection to -50 percent would double his revenue. Thus, negative net protection rates of this size not only are a severe disincentive to production, but also have significant income effects.

The net protection of dura marketed in Gedaref and Kosti is generally negative regardless of which set of transportation costs are used. Although net protection increases (becomes less negative) in these markets from 1975/76-1977/78, it decreased sharply in 1978/79 (see Table 5). The net protection rates based on road transport costs for dura marketed in El Obeid are still positive and range between 60 and 600 percent over the period. Those based on rail transport costs oscillate closely about a zero percent rate over time; hence, transport costs, and the availability of transportation, are a critical determinant in the export competitiveness of dura.

3.4 Subsidies in the Rainfed Sector

The mechanized farming schemes are the principal recipients of subsidies to rainfed agriculture. Because of the nature of traditional farming, such as the way land is allocated (there is no private ownership of farm land) and cultivation methods, the traditional rainfed sector is not subsidized to any extent. The three types of subsidies considered in this section are exchange rate overvaluation, low land rents, and credit extension by the Agricultural Bank of Sudan (ABS).

The overvalued exchange rate implicitly subsidizes imported inputs, such as petroleum, agrochemicals, tractors, and spare parts. There is an additional subsidy if the input is traded at the official rather than the parallel rate, as petroleum was. Since traditional rainfed agriculture uses

very few imported inputs, jute sacks being the primary one, the mechanized schemes were the primary beneficiaries of the implicit factor subsidies. However, the recent exchange rate unification and devaluation of November 1981 eliminated this subsidy. As a result, the cost of production on these schemes will rise significantly. Unless there is a corresponding increase in the prices of agricultural commodities, the more inefficient private mechanized farms will fail. Thus, at least in the short run, the growth of this sector could stagnate.

The low annual land rent (5 pt./feddan in 1977) has several undesirable effects. It is far below the opportunity cost of the land (LS.1.0/feddan) [16]. Thus, extensive use of the land is encouraged. Low land rents are a disincentive to capital investment in land, because there is not incentive to adopt modern technology that would exploit the land already under cultivation. The fact that horizontal expansion of the mechanized farming sector is encouraged might also contribute to soil conservation problems. With land essentially a free good and currently available at an almost infinitely elastic supply, there is no incentive to save that resource or augment its productivity. This problem is closely related to yet another form of subsidy, credit extended by the ABS.

Although not intended to be a subsidy, the poor repayment of loans extended by the ABS has transformed its loan program into a subsidy program. With land underpriced and readily available, there is a tendency to use credit to meet annual operating expenses rather than to invest in capital that would enhance the productivity of the land. A bad harvest will mean the farmer is unable to repay the loan. Since the farmer has not invested in capital assets, the bank cannot recover its money since the farmer has little incentive to repay.

Because a primary factor of production is greatly undervalued and the cost of entry into mechanized farming is relatively low, there is little or no penalty attached to the use of inferior complementary factors of production such as farm management skills. This increases the probability of poor performance and its consequences: abandonment of cleared land that will eventually be covered by scrub thorn bushes (thereby reducing the value of the land) and a default on payments with little or no possibility of loan recovery.

Thus, low land rents and subsidized credit have resulted in undercapitalization of the rainfed agricultural sector and a poor credit recovery experience. Raising land rents and tightening up the conditions under which loans are granted might lead to the adoption of new technology and consequently to more intensive use of the land. Productivity would increase, total output might increase even though fewer farms might be operating, and soil conservation problems would ease. Additionally, the increased revenues could be invested in developing the infrastructure which would make the marketing and distribution systems more efficient, as well as enhancing the value of the land.

3.5 Comparative Advantage in the Irrigated and Rainfed Sectors

In view of the current condition of the agricultural sector and Sudan's financial crisis, it is important that any investments designed to rehabilitate or to develop this sector be directed towards those areas and activities that will generate the largest returns. A first step in this process is to determine in which crops Sudan has a comparative advantage. The domestic resource cost (DRC) of producing a particular agricultural commodity is a good measure of comparative advantage. The DRC for an exportable good measures the amount of foreign exchange earned when a unit of domestic resources is

committed to its production; for an import substitute, it gives the amount of foreign exchange saved when a unit of domestic resources is used to produce that good. Since domestic resources are measured in units of local currency and foreign exchange earnings or savings in foreign currencies, the DRC for a good is an exchange rate that applies to the production of that good. When it is divided by the shadow price of foreign exchange, the DRC becomes a unitless number. If it is less than one, the country or region has a comparative advantage in its production because it can exchange domestic resources for foreign exchange at a rate below that at which the economy as a whole converts domestic resources into foreign exchange; a DRC greater than one means that a comparative disadvantage exists.

Table 6 presents the DRC's of the four major export crops and the two import substitutes in the irrigated and rainfed sectors. DRC's of irrigated crops are given for two crop years, 1972/73 and 1976/77. The results show that Sudan clearly has had a comparative advantage in the production of long- and medium-staple cotton and sugar. Production of wheat shows a comparative disadvantage; the Sudan would have saved foreign exchange if less wheat had been domestically produced. The Sudan moved from a comparative disadvantage in the production of irrigated dura to a competitively neutral position. The competitiveness of irrigated groundnuts also improved over the period. The DRC's of traditional and mechanized rainfed crops are also given for the 1980/81 crop year (with the exception of groundnuts). For each subsector, DRC's were calculated under two yield assumptions. The high yield assumption is more optimistic; the low yield was assumed to be 75 percent of the high yield in each case, and better reflects past experience.

The DRC's for the traditional subsector apply to crops grown in the Nuba Mountains of Southern Kordofan. This region has a strong comparative

Table 6. Domestic Resource Costs of Selected Crops^c

	Irrigated ^b		Rainfed (1980/81)								
	1972/73	1976/77	Traditional ^c (Nuba Mountains)		Traditional Modernized ^c (Nuba Mountains)		Mechanized private ^d (Eastern Sudan)		Mechanized State farms (Eastern Sudan)		
			Low Yield	High Yield	Low Yield	High Yield	Low Yield	High Yield	Low Yield	High Yield	
Cotton											
Long staple	0.6	0.6	--	--	--	--	--	--	--	--	--
Medium staple	0.7	0.7	--	--	--	--	--	--	--	--	--
Short staple	--	--	0.4	0.3	0.6	0.4	0.5	0.3	0.7	0.4	
Dura	1.4	1.0	0.5	0.3	1.5	0.7	1.0	0.6	2.3	1.3	
Groundnuts	1.0	0.7	0.8 ^a	0.5 ^a	--	--	--	--	--	--	
Sesame	--	--	0.6	0.4	--	--	0.8	0.5	0.6	0.4	
Wheat	1.9	1.5	--	--	--	--	--	--	--	--	
Sugar	0.5	0.6	--	--	--	--	--	--	--	--	

^a Domestic resource cost (DRC) is the value of domestic resources (in Sudanese pounds) committed to the production of output from one feddan divided by the value added in world prices (U.S. dollars). This result is then divided by the real exchange rate; the result is a unitless number. A value less than one indicates a comparative advantage; a value greater than one indicates a comparative disadvantage.

^b Data from K. Nashashibi, "A Supply Framework for Exchange Reform in Developing Countries: The Experience of Sudan," *IMF Staff Papers*, Vol. 27 No. 1, March 1980, Tables 3 and 4. Real exchange rates of LS.0.50 = \$1 for 1973 and LS.0.61 = \$1 for 1977 were used as proxies for the shadow exchange rate in those years.

^c Data from Sudanese Consulting Bureau adapted by Sigma One Corp., except for groundnuts.

^d Data from Sudanese Consulting Bureau adapted by Sigma One Corp. High yields taken from SCB data; low yields are 75 percent of high yields.

advantage in the production of short-staple cotton, dura, and sesame under both yield assumptions. The modernized traditional schemes (the DRC's are given in parentheses in Table 6), however, do not fare as well: low dura yields place these schemes at a comparative disadvantage. Groundnuts production also enjoys a comparative advantage, although not as great as that of sesame, dura, and cotton at lower yields.

The DRC's for the mechanized rainfed sector apply to production in the province of Kassala (Eastern Sudan). Results are shown for both private farms and state-run farms (numbers in parentheses). Both private and state-owned mechanized schemes are competitive in the production of cotton and sesame under both yield assumptions. The state-run farms are at a comparative disadvantage in dura production at both yield levels. Private tenancies are competitively neutral in dura production when yields are low, but have a comparative advantage at higher yields.

In summary, Sudan has a clear comparative advantage in cotton production in both the irrigated and rainfed sectors. The sharp decline in rainfed cotton output is attributable to the government's policy of fixing producer prices at a level far below the world price of short-staple cotton. In dura production, the traditional rainfed sector has a competitive edge over the irrigated sector, the modernized rainfed subsector, and the mechanized rainfed sector. The traditional sector also has a comparative advantage relative to the irrigated sector in the production of groundnuts. Both the traditional and mechanized rainfed subsectors show a comparative advantage in sesame production. The rainfed sector has benefited from recent policy changes. These are necessary conditions, but are not sufficient to elicit major output increases from this sector. Much remains to be done in the areas of tax reform, agricultural research, and improvements in the marketing system.

SECTION 4: IMPACTS OF THE STRUCTURE OF INCENTIVES ON FOREIGN TRADE AND THE DOMESTIC ECONOMY

The structure of incentives in the agricultural sector has directly contributed to problems in Sudan's domestic economy and in its foreign trade position. This section analyzes the recent performance of foreign trade (Section 4.1) and certain aspects of the domestic economy (Section 4.2). The deterioration of the economy has been caused by distortions in the structure of incentives; thus, solutions to these problems are best achieved by eliminating these distortions. Section 4.3 examines the likelihood of meeting the objectives set out for rainfed agriculture in the Export Action Program, given recent changes in the incentive structure.

4.1 Recent Foreign Trade Performance

Sudan's balance of payments position deteriorated drastically during the 1970's, mainly as a result of a steadily worsening balance of trade. In FY 1973, exports of goods and services exceeded imports by \$50 million. In FY 1974, there was a deficit of \$280 million because of the increase in world oil prices. The trade balance continued to decline until by FY 1981 imports were close to \$2 billion while exports were just over \$1 billion. Much of the deterioration in Sudan's trade balance occurred because the volume of exports declined erratically from 1974 on, while import volumes were generally higher than their 1970 level (see Table 7). Table 7 also shows that the terms of trade contributed to the declining trade balance, but were not the primary cause. The net effect of the volume and price changes was that the nominal value of exports more than doubled from 1970 through 1979, while the nominal value of imports more than tripled.

Table 7. Foreign Trade Indexes

	Export Indexes			Import Indexes			Terms of Trade
	Value	Volume	Price	Value	Volume	Price	
1970	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1971	181.7	141.7	128.2	117.9	105.7	111.5	115.0
1972	121.7	112.7	108.0	108.8	94.9	114.6	94.2
1973	142.5	111.8	127.5	154.4	109.8	140.6	90.7
1974	151.8	67.9	223.6	229.1	100.4	228.2	98.0
1975	154.2	78.1	197.4	325.3	115.8	280.9	70.3
1976	180.8	103.1	175.4	349.6	124.9	279.9	62.7
1977	172.2	77.8	221.4	325.3	117.1	277.8	79.7
1978	253.4	86.4	293.3	356.4	108.9	327.3	89.4
1979	237.2	75.8	312.9	355.1	96.8	366.8	85.3

Source: Sudan Foreign Trade Analysis, 1970-1979, Dept. of Statistics, Ministry of Planning, May 1981.

4.1.1 Exports

Table 8 shows the contribution of the major export crops to the total value of exports for selected years. Although the export mix has varied from year to year, cotton has always been the major export crop, accounting for 50 to 60 percent of the total value of exports. Groundnuts and sesame have generally been the second and third largest contributors, although in 1979 sorghum was the second largest export crop in terms of value. The irrigated sector produced almost all the cotton that was exported, while the rainfed sector accounted for all the sorghum and sesame; each sector generated roughly equal amounts of the export value of groundnuts.

As can be seen, the irrigated sector alone accounted for over half the total value of exports with the production of a single commodity, cotton. The rainfed sector generated about 40 percent of total export earnings; about 15 percent of this amount was in the four major crops. While its relative contribution in these crops may be small, exports from the rainfed sector provided diversification in the export mix, a policy objective that the government tried to achieve in the irrigated sector with little success.

The reason behind the decrease in total export volumes can be seen by examining the export volumes of selected commodities (Table 9). The decline over the 1970-1979 period of long-staple cotton exports from the irrigated sector to 50 percent of their 1970 volume is the chief reason. Groundnuts and sesame exports, which had been fairly strong through the late 1970's, suddenly fell off in 1979 because of production difficulties and government policies restricting the exports of oil seeds. As a result, their contribution to the total value of exports decreased from 23 percent in 1977 to 8 percent in 1979 (see Table 8). Dura exports grew at a phenomenal rate; in 1979, the volume was over 100 times that in 1970. This growth is attributable to a special

Table 8. Composition of Exports
(percent of total export value)

	1971	1973	1975	1977	1979		
					Irrigated	Rainfed	Total
Cotton	61	55	46	57	55	2	57
Sorghum	1	2	2	3	-	7	7
Groundnuts	8	9	23	13	2	3	5
Sesame	7	8	8	10	-	3	3
Cake and meal	4	5	3	3	2	3	5
Other ^a	19	21	18	14	-	23	23

^aIncludes gum arabic, livestock, and all other exports.

Source: Export Action Program: 1980-1990, Ministry of National Planning, September 1980.

Table 9. Volume Indexes for Selected Exports

	Long-staple Cotton	Dura	Groundnuts	Sesame	Total Exports
1970	100.0	100.0	100.0	100.0	100.0
1971	111.1	1904.0	206.0	117.6	141.7
1972	111.1	3038.0	194.9	105.7	112.7
1973	98.0	5216.4	235.7	127.9	111.8
1974	39.9	4994.5	220.8	131.7	67.9
1975	62.0	2443.4	349.6	69.2	78.1
1976	85.0	4774.4	520.1	126.4	103.1
1977	68.3	6786.4	272.5	133.5	77.8
1978	43.3	3233.7	166.5	82.6	86.4
1979	52.6	10014.3	78.0	21.5	75.8

Source: Sudan Foreign Trade Analysis, 1970-1979, Dept. of Statistics, Ministry of Planning, May 1981.

trade agreement with the Government of Saudi Arabia, which pays a premium over the world price for Sudanese dura. Recently sorghum output has continued to expand in response to the Saudi market and the fact that since September 1980 it has been traded at the parallel rate. The 1981 sorghum crop is reported to be a record 2.8 million tons, 55 percent more than 1980. Even so, the contribution of dura to the total value of exports only increased from 1 to 7 percent from 1971 to 1979, primarily because dura is a low value commodity compared with cotton, groundnuts, and sesame. Even if all the additional output for 1981 were exported, the increase in the volume of dura exports could not offset the poor export performance of other agricultural commodities. The experience with dura does, however, illustrate the potential of the rainfed sector to respond to price incentives.

4.1.2 Imports

Table 7 showed that the index of the value of imports increased steadily over the 1970's, rising to 3.5 times its 1970 level by 1979. This resulted from increases in both the volume and prices of imports, as the indexes show. Historically, Sudan has spent much of its available foreign exchange on intermediate goods and capital equipment which were used to develop the manufacturing sector of the economy. Another important use of foreign exchange has been to purchase food, primarily wheat, flour, and sugar.

One reason for the crop diversification program undertaken in the irrigated sector in the mid 1970's was to reduce the reliance of the economy on food imports; the ultimate objective was to become a net exporter of food. From 1972 to 1974, the proportion of total export earnings spent on food imports increased from 18 percent to 30 percent (Table 10); food imports as a percent of total import expenditures were fairly constant at 23 percent. From 1974 to 1979, foreign exchange earnings spent on food eased from 30 percent to

Table 10. Food Imports and Supply of Foreign Exchange

	Food imports (10 ⁶ \$) ^a	Total export earnings (10 ⁶ \$) ^b	Food imports as percent of export earnings	Food imports as percent of total imports ^c
1972	66.9	378.1	17.7	23.5
1973	99.6	485.1	20.5	22.3
1974	140.6	471.7	29.8	22.8
1975	152.4	559.7	27.2	16.8
1976	102.5	728.4	14.1	13.3
1977	87.2	843.7	10.3	9.5
1978	123.5	823.1	15.0	12.2
1979	114.8	848.8	13.5	12.5

^aIncludes imports of unmilled wheat, rice, wheat flour, sugar, coffee, and tea. Sudanese pounds converted to current US dollars at official exchange rate.

^bExport earnings are the sum of exports of goods and services and private and official unrequited transfers.

^cFrom Bank of Sudan, Annual Reports, 1973, 1977, 1979.

14 percent of the total; food declined from 23 percent to 13 percent of the total import bill over this period. This level of dependence on food imports is high in comparison to other sub-Saharan African countries, particularly since the official statistics may not include all food aid. The average ratio of food imports to foreign exchange earnings for six other sub-Saharan African countries over the 1965-1976 period ranged from 2 percent to 12 percent; 5 out of 6 were between 2 and 7 percent [18].

4.1.2.] Wheat and Sugar Imports. The quantity, price, and value indexes for wheat and sugar imports (the bulk of food imports) show why expenditures on food claimed a high proportion of the total supply of foreign exchange (Table 11). Although the volume of wheat and flour imports declined throughout most of the 1970's, then increased in 1978 and 1979 to close to their 1970 levels, the price rose to more than twice its 1970 level in 1974, remained there through 1978, and quadrupled in 1979. Since 1979, wheat imports have continued to grow to a level in excess of half a million metric tons per year. Of this, concessionary sales from the United States represent almost a third. The volume of sugar imports was almost 70 percent higher in 1979 than it was in 1970. Sugar prices peaked at 6 to 7 times their 1970 level in 1974 and 1975, then fell off to over three times the 1970 level by 1979. As a result, during the period 1973-1975 when food imports accounted for 20 to 30 percent of total export earnings, the value of wheat and flour imports was over 1.5 times the 1970 level, while that for sugar was 4 to 7 times its 1970 level. Including concessional imports (\$45 million) the 1980/1981 import bill for wheat and sugar was in excess of \$250 million U.S. Even at these high levels of wheat imports and increasing domestic output, the price subsidy scheme that maintains the price of bread artificially low has created excess demands. A

Table 11. Import Indexes for Wheat and Sugar

	Wheat and flour			Sugar		
	Value	Volume	Price	Value	Volume	Price
1970	100.0	100.0	100.0	100.0	100.0	100.0
1971	94.4	83.3	113.3	179.7	158.5	113.4
1972	96.1	96.1	100.0	182.7	106.2	172.0
1973	157.0	86.8	180.9	355.8	163.5	217.6
1974	150.6	50.4	298.8	579.8	96.2	602.7
1975	162.0	61.0	265.6	742.8	105.1	706.8
1976	142.0	55.1	257.7	413.3	114.2	361.9
1977	122.6	59.8	205.0	237.9	134.8	176.5
1978	164.4	75.3	218.3	442.4	182.2	242.8
1979	378.0	95.1	397.5	546.7	168.9	323.7

Source: Sudan Foreign Trade Analysis, 1970-1979, Dept. of Statistics, Ministry of Planning, May 1981.

factor that has contributed to this is that wheat and sugar were traded at the overvalued exchange rate, which helped maintain the prices of these commodities at the artificially low levels.

4.1.2.2 Bread Price Policy.^{*} Bread provides approximately one-third of the calorie requirements for the population of the greater Khartoum conurbation. Per capita consumption of wheat has been rising rapidly in the last few years, with about a third of the officially marketed wheat being consumed in the Khartoum conurbation. This increase cannot be explained by increased incomes and growing urbanization. It must in large part be attributable to an explicit cheap bread policy for the urban dwellers. Table 12 presents the budget shares for bread for different income groups in Khartoum. Even for the lowest income group, bread represents only 11.1 percent of food expenditures and less than 7 percent of total expenditures. Even if these figures exclude food away from home for workers, bread represents a high share of nutrients and, in relation to this, a rather low share of food costs.

Exchange rate unification, the PL480-III Agreement with the United States and negotiations with international lenders have placed pressure on the government to raise the price of bread. If import parity pricing were to be applied to wheat and flour, the price of bread would need to be increased by about 80 percent. Reportedly, the government intends to raise the price of bread by close to this amount (66 percent).

This has undoubtedly been a politically difficult decision, but its real impact should not be as great as the current political manifestations would suggest. If the demand for bread is totally inelastic in the short run, the

^{*}The material in this section touches on several issues that will be more thoroughly analyzed in the forthcoming wheat pricing study being conducted by Sigma One Corporation.

Table 12. Budget Shares of Bread

Income group	Share of Food expenditures (%)	Share of Total expenditures (%)
Urban Khartoum (3 towns)		
All Groups	10.61	6.20
< 500 L.S.	11.07	6.89
500-1000	10.72	6.72
1000-2000	11.06	6.78
2000-3000	10.45	5.71
3000+	8.54	4.00
Rural Khartoum		
All Groups	4.06	2.74
< 500 L.S.	4.10	3.13
500-1000	4.53	3.12
1000-2000	4.32	2.08
2000-3000	N/A	N/A
3000+	0.75	0.53

Source: Department of Statistics, Ministry of Planning, Household Budget Survey, 1979.

cost of living impact will be about 5 percent in real terms for the lowest income strata in Khartoum. If bread is somewhat price elastic, the cost of living impacts are even lower. In this case, the consumption impacts would reduce calorie intake by approximately 10 percent for consumers at the FAO requirements and less for those above it. Since there is little indication that urban Khartoum has serious nutritional problems (save for the refugee population), the deleterious impacts on human nutrition are likely to be small.*

The timing for these actions is fortuitous in that Sudan has experienced a bumper crop in dura and world wheat prices are depressed. With exchange rate unification and import parity pricing the domestic producer price of LS167.50 per ton will not change much. This should enable significant savings in treasury costs (\$50 to \$60 million) by eliminating the so-called producers' subsidy. It is also reasonable to expect substitution of wheat demand for dura consumption. With these policy changes, the growth in import demand for wheat should be slowed. The USAID PL480 Title III Program which was supporting the implicit subsidy can, under the new policy regime, facilitate the transition to lower reliance on food imports by continuing the supply without requiring an increase in the foreign exchange allocations to food imports.

4.2 Fiscal and Monetary Impacts

Much of the impact of the structure of incentives on fiscal problems and excessive growth of the money supply has occurred through the performance of parastatal, or public, entities. The poor performance of these state-run cor-

*Concern for consumption and nutritional impacts on low-income and otherwise at-risk populations could be more effectively addressed through alternatives such as the CRS Title II program.

porations over the past several years created a growing demand for public sector credit, thereby exacerbating the government's budgetary problems and forcing it to turn increasingly to external sources of credit to finance the resulting deficits.

Table 13 contains a breakdown of the money supply for FY 1975-FY 1980. The supply of money increased from LS.277 million in 1975 to over LS.1 billion in 1980 at a compounded growth rate of 29 percent per year. This is a primary factor underlying the high rate of inflation. Net claims on the public sector, which comprises the central government, local and provincial councils, and parastatal entities, was the primary reason; from LS.250 million in 1975, they grew at an annual rate of 31 percent to over LS.970 million in 1980. The parastatals, which include the agricultural and industrial entities and the public utilities, accounted for a substantial portion of the net claims on the public sector. The claims against these bodies increased from LS.105 million in 1975 to over LS.240 million in 1980, growing at over 20 percent per year. Since their growth rate was lower than that of the money supply, the proportion of net claims on the parastatals to the money supply declined from 38 percent to 24 percent over the period. Besides being inflationary, public sector borrowing of this magnitude crowds out private borrowing and thereby inhibits the capitalization of the private sector.

Of the parastatal entities, the agricultural corporations and boards receive the largest share of bank credit, with the public utilities and the industrial boards a distant second and third, respectively. The boards controlling the irrigation schemes accounted for most of the credit extended to agriculture by the banking sector. Of LS.140 million in 1977, these boards received about LS.120 million; in 1980, they received LS.205 million in credit against a total of LS.215 million [11]. On the other hand, credit extended to

Table 13. Components of the Money Supply (LS. millions)^a

	1975	1976	1977	1978	1979	1980
Net foreign assets	-107.16	-192.65	-191.76	-218.05	-201.26	-288.90
Net claims on private sector	175.69	239.00	264.47	318.37	407.24	525.90
Net claims on public sector	250.01	357.73	517.35	658.26	849.35	971.60
Central government and local and provincial councils	145.12	240.64	413.39	548.24	659.73	728.20
Parastatals	104.89	117.09	103.96	110.02	189.62	243.40
Other items	-41.97	-71.75	-124.27	-151.91	-234.35	-206.10
Total money supply ^b	276.56	332.33	465.79	606.67	820.98	1002.50
Net claims on parastatals as percent of money supply	37.9	35.2	22.3	18.1	23.1	24.3

^aAll figures apply to end of the fiscal year (June 30).

^bSum of net foreign assets, net claims on private sector, net claims on public sector, and other items..

Sources: Bank of Sudan, Annual Report, 1977, 1979.
IMF, Sudan-Recent Economic Developments, SM/81/70, March 1981.

the Mechanized Farming Corporation, the only parastatal body directly involved in rainfed crop agriculture, increased from LS.1.0 million in FY 1977 to LS.2.6 million in FY 1980.

Rainfed agriculture is relatively isolated from the public sector. Of course, it benefits (or suffers) from the performance of the largest public utility, Sudan Railways. And most of the loans granted by the Agricultural Bank of Sudan, a government-controlled financial entity, go to the rainfed sector. Thus, any policy changes affecting the organization or financial status of the parastatals would affect this sector primarily through its credit availability and its marketing and distribution system. Policy changes would not be likely to directly affect the viability or productivity of the sector as a whole, as would changes in the boards operating the irrigation schemes.

As discussed above, the subsidies on wheat and sugar are a drain on the Treasury. It is estimated that eliminating them would save between \$50 and \$60 million per year. This would reduce the budget deficit and consequently ease inflationary pressures. A smaller deficit would also mean less public sector borrowing, which would help the private sector by allowing more private borrowing.

4.3 The Export Action Program: Potential of the Rainfed Sector

The Export Action Program (EAP) of 1980 outlines an ambitious program to promote exports from the irrigated and rainfed sectors over the next 10 years, thereby increasing foreign exchange earnings and eventually solving Sudan's balance of payments problems. The proposed program for the rainfed sector is not as detailed or extensive as the one for the irrigated sector, which in the main calls for rehabilitating the existing schemes. It is forthrightly

admitted that the specific constraints to raising productivity in the rainfed sector have not yet been identified and that it is not known whether the constraints, once identified, can be overcome [12]. The plan recognizes that labor constraints in the rainfed sector mean that more capital investment is needed if the 1990 targets are to be met. However, the capital requirements are small compared with those for the irrigated sector. Public sector investment of LS.160 million is planned over the next 5 to 7 years; most of this outlay will be directed towards agricultural research and pilot projects. In addition, the EAP recognizes the rainfed sector's need for improved infrastructure, in particular adequate transport and marketing facilities, as well as adequate supplies of good seeds and credit.

The EAP lists projects and policies undertaken or planned for the benefit of rainfed agriculture and then gives the 1990 export target for each of the major rainfed products. These targets are actually estimates of export availabilities, which were derived by setting production targets and netting out estimates of increased consumption, seed, waste, etc. The production targets for the major rainfed crops, except gum arabic, are presented in Table 14 along with the targeted increases in cropped areas and yields that would enable the targets to be met. This section analyzes the feasibility of the targets in light of the past performance of the rainfed sector, the constraints on its potential performance, and how the recent policy changes might relax those constraints.

Examination of the production targets in Table 14 shows that more reliance is placed on horizontal expansion than on vertical expansion. The annual growth rates for areas cropped in groundnuts, sesame, dura, and cotton are roughly twice the growth rates of yields. A policy aimed at intensifying

Table 14. Rainfed Crop Production Targets

	1978-1979 average	1990	Required annual growth rate (%)
Groundnuts			
Area (000 fed.)	1976	2950	3.8
Yield (kg/fed.)	262	328	2.0
Production (000 tons)	517	967	5.8
Sesame			
Area (000 fed.)	2058	2860	3.0
Yield (kg/fed.)	104	122	1.5
Production (000 tons)	214	350	4.6
Dura			
Area (000 fed.)	6246	9540	3.9
Yield (kg/fed.)	300	353	1.5
Production (000 tons)	1846	3370	5.6
Cotton			
Area (000 fed.)	164	530	11.3
Yield (Kantar/fed.) ^a	0.9	2.0	7.5
Production (000 tons)	21	150	19.6

^aKantar = 143 kg.

Source: Export Action Programme: 1980-1990, Ministry of National planning, September 1980.

the use of areas presently under cultivation would result in growth rates of yields that significantly exceeded the growth rates of areas cropped. Given the vast areas of arable land not yet under cultivation and the relatively small amount of capital investment allocated to the rainfed sector over the next decade, a policy that implicitly relies on horizontal expansion to meet the targets might be reasonable.

However, infrastructure constraints are more likely to confound such a policy. In particular, expanding horizontally will increase the demand for transportation. If the planned extension of the road system is insufficient to meet future needs, it will be a major obstacle to the EAP, since most of the increased production of cotton, groundnuts, and sesame are intended for the export market. Without an adequate transport system, the western markets will remain isolated from the world market, and increased output will only tend to depress producer prices.

Although the EAP does not specify precisely how much expansion is targeted for each province, some of this information is given for sesame production, dura output from mechanized farms, and groundnuts production from traditional farms. The results show that cropped areas in Kassala, particularly the Gedaref area, are expected to increase by 600 thousand feddans, or 26 percent, over the decade. Cropped areas should expand by over 1.3 million feddans, or 130 percent, in the central provinces of the Blue Nile and White Nile. A substantial increase of 1.2 million feddans, almost 50 percent, is also anticipated for the western provinces, about equally divided between the Kordofans and the Darfurs.

Plans to extend the road system involve all these provinces. The highway from Port Sudan to Khartoum passes through the Gedaref region; in addition,

five feeder roads in the area are under consideration. In the Blue Nile, the Wad Medani-Sennar road has been completed, and roads from Sennar to Damazin (an important mechanized farming region) and from Sennar to Kosti are under construction. Of three planned roads in the Kordofans, the El Obeid-Dubeibat road is under construction and the En Nahud-Abu Zabad and Habila-Dubeibat roads are being negotiated. In the Darfurs, a road connecting Nyala and El Fasher has been budgeted. A road from Nyala through Kas and Zalingei and ending at the northwestern border town of Geneina is currently under construction. Whether these roads will adequately serve the future needs of these provinces is not known. At a minimum, however, all the roads that have been budgeted, negotiated for, or are under construction need to be completed, particularly if the targets in the central and western provinces are to be met.

Even if the targeted expansion in cropped areas occurs, greater productivity in the form of increased yields is needed if the output targets for the rainfed sector are to be achieved. Although the Sudan has had an agricultural research program for several years, it has had little impact on rainfed farmers because extension services are practically nonexistent. The current research program needs to be continued and expanded and much more effort needs to be made to get research results to the farmer. Since a major weakness of the extension service is a shortage of trained personnel, a policy initiative designed to attract (or train) qualified people would seem appropriate. An effective extension service providing the best available information on cultivation techniques and seed varieties is required for sustained improvements in rainfed sector yields.

Other policies have been implemented or are under consideration to improve the structure of incentives in the rainfed sector. These include the unification and devaluation of the exchange rates and the removal of the export duties on cotton and sesame. Abolishing the monopoly of the Sudan Oilseeds Company in exports of oilseeds resulted in substantial increases in groundnuts, seeds and oil shipments during the third quarter of 1981 [9].

In the public sector, the ABS is being "strengthened" through the IDA-financed Agricultural Services Project, which calls for an outlay \$300 million over the rest of the century. Under its auspices the ABS will be reorganized so that it can provide more credit to the rainfed sector, as well as more tractors and spare parts. Tax incentives under the Agricultural Investments Act of 1976 include concessions to private investors who operate huge mechanized farms (between 250 thousand and 500 thousand feddans). The size of these farms means that their location must be very carefully considered so that the already shaky relations between the nomads and the mechanized farmers are not exacerbated [16]. A policy of dubious merit is the government encouragement of producer cooperatives as the most efficient means of getting credit to smallholder farmers and to insure greater private control of resources. However, past experience with cooperatives does not support this optimistic conclusion; they usually break down after a few months [16].

The best way of realizing the potential of the rainfed sector still remains untapped, however, because of the government's policy of fixing the purchase prices for rainfed cotton, sesame, and groundnuts. The government recognizes what a severe disincentive this is: it recently doubled the purchase price of rainfed cotton from LS.2.60 per small kantar to LS.7.00 in belated recognition of the fact that for years the internal price of short-staple cotton has been far below the international price. As discussed in

Section 3.3, the production and marketing system operates very effectively, given the tremendous infrastructure constraints it is faced with. Commodities like dura and millet whose prices are relatively free from government interference move from surplus to deficit areas, as reflected in price differentials, both within the country and from the country to the world market. Oilseeds and oil exports increased once the Sudan Oilseeds Company was forced to compete with the private trading sector. Removal of government intervention in market prices would narrow the wedge between producer and world prices, improve producer incomes, and realize some of the potential--at little or no cost--of the rainfed sector.

SECTION 5: CONCLUSIONS AND RECOMMENDATIONS

In the past 10 years, the performance of the agricultural sector deteriorated, especially in the irrigated schemes, causing severe problems for Sudan's domestic economy and its foreign exchange reserves. Since land is not the limiting factor, it seems reasonable that the productivity levels of the early 1970's are realizable through an improved structure of incentives, with consequent improvements in the domestic economy and Sudan's foreign trade position. Recent experience indicates that the rainfed sector has the potential and ability to respond to improved incentives.

Throughout the 1970's, rainfed agriculture was expanding for all annual crops, except cotton, through increases in cropped areas. Recent rapid increases in sorghum production, which are believed to be a response to an improving structure of incentives, have principally been achieved through area expansion. Yields in sorghum have generally been stagnant at rather low levels. While further area expansion can undoubtedly be realized, there appears now an opportunity for increasing output through the intensification of production in existing areas. In this regard, agricultural research and enhanced availability of modern factors of production could play a key role in facilitating private farmers' abilities to respond to the improved incentives generated by recent policy initiatives. The realization of this potential would, however, require effective public sector delivery of research results and substantial improvements in factor markets.

In the latter half of the decade, irrigated areas sown to cotton and other crops decreased absolutely as a result of the disincentive effects of the joint account system and the reduced revenues of the management boards of

the irrigated schemes. The experience in the irrigated sector during the 1970's illustrates that it is not sufficient to direct resources towards a sector without, at the same time, providing the appropriate incentives for farmers to make effective use of the publicly-provided resources. That is, research, infrastructure, and agricultural services will not lead to productivity increases if the incentives facing farmers have the effect of taxing away the value of the publicly-provided resources.

The terms of trade were not the primary cause of the deteriorating balance of payments situation. Rather, the growth in value of imports far outstripped the growth in value of exports. The chief reason is the decline in cotton output. This is not surprising, since cotton production faced the most severe disincentives. The motivation for the direct and explicit taxation of cotton may have been to secure operating revenues for the government and the parastatals, but in so doing, the disincentives were so severe that the revenue base was eroded. This experience emphasizes the need for extensive tax reform in the Sudan.

Tax reform is under consideration and some changes have been made. For example, the export duties on cotton and sesame have been removed; the removal of the duties on groundnuts and livestock products is under consideration. Other reform measures should be directed towards increasing the buoyancy and progressivity of the tax system, for example, by eliminating specific taxes.

Since September 1979, the parallel exchange rate was minimally overvalued, if not, in fact, undervalued some of the time. By placing many of the tradeables on the parallel rate in September 1980, the Sudan has removed one of the most important sources of distortions to the structure of incentives. With the exchange rate unification and devaluation of November 9, 1981, the potential for aligning the valuation of domestic resources with

their international valuation has been created. Under this new regime, official price interventions will need to be stated explicitly and fiscal budget implications clearly identified. For example, the overvaluation of the official exchange rate has tended to mask the economic and budgetary cost of Sudan's cheap bread policy. Under the new regime, the Sudan may choose to continue to subsidize the price of bread, but the amount and source of the subsidy will need to be explicitly stated in the fiscal budget. In so doing, budget planners will be better able to gauge the opportunity cost of the resources allocated to the bread subsidy. In the past, a substantial portion of the implicit subsidy for bread was borne by domestic wheat producers, yet the accounting figures made it appear as if wheat producers were being directly subsidized. Furthermore, with multiple exchange rates for wheat and sorghum the relative prices for wheat versus sorghum were inverted from their usual international price relationship. In the absence of the special sorghum export arrangements to Saudi Arabia this condition would have been a serious distortion and disincentive to both domestic wheat and sorghum production.

The other side of exchange rate unification relates to higher factor costs (petroleum prices) in mechanized agriculture and in the transportation system. This will tend to shift back the supply of agricultural output from the more modern subsectors. Since sorghum has been traded at the parallel rate since September 1980, it is possible that much of the response to improved pricing has already been realized. Thus, major supply increases should not be expected to result from exchange rate unification per se. This policy reform, however, does create an environment which makes it more possible for resources to be utilized efficiently. This should, in turn, create incentives for investment and innovation.

Indirect estimates of marketing costs for dura in the West suggest that even if transport links between El Obeid and Khartoum and Port Sudan are improved, the El Obeid market will probably continue to supply the western regions rather than becoming a major supplier of the eastern provinces and the export market. This result is important because much has been made of the need to rehabilitate the rail system and to extend the road system in the West; such investments need to be carefully evaluated because the anticipated flow of produce (dura) may not be forthcoming. This is not to say that enhancement of the transport system may not be warranted, but that higher returns may possibly be obtained from intraregional connections in the West than from linking the West to the more developed East. An important caveat to be considered in this regard is the thinness and instability of the markets to the West.

The exchange rate unification and devaluation of November 9, 1981 has eliminated the implicit subsidies to petroleum, agrochemicals, and spare parts. The costs of production in the mechanized farming schemes and the irrigated sector are expected to rise in proportion to the product of the devaluation and the share of costs represented by these previously subsidized factors. The devaluation will have little impact in reducing the negative nominal protection facing the rainfed sector (with the exception of rainfed cotton).

In the absence of other changes in the structure of incentives, output from this sector is likely to decline, at least in the short run. To dampen this potentially deleterious impact, a combination of further tax reform (such as removing all remaining export duties) and public sector initiatives that enhance the productivity of the sector as a whole, e.g., accelerated agricultural research to increase the productivity of the scarce factors of

production (agrochemicals, labor and, for the irrigated sector, water) and reduction of any technical and economic inefficiencies in the marketing system. Our estimates of nominal protection reveal the likelihood that marketing margins are high.

Low land rents and subsidized credit have resulted in undercapitalization of the rainfed agricultural sector and a poor credit recovery experience. Raising land rents and tightening up the conditions under which loans are granted might lead to the adoption of new technology and consequently to more intensive use of the land. Productivity would increase, total output might increase even though fewer farms might be operating, and soil conservation problems would ease. Additionally, the increased revenues could be invested in developing the infrastructure which would make the marketing and distribution systems more efficient, as well as enhancing the value of the land.

The Sudan should not lose the current opportunity to remove an important distortion in the market for food and realize Treasury and foreign exchange savings by eliminating the implicit and explicit subsidies on wheat and sugar. Three favorable conditions exist--a bumper crop in domestic sorghum production, depressed international prices for wheat and sugar, and substantial concessionary assistance through the wheat imports from the U.S. under the PL 480 Title III Program--which minimize the deleterious cost of living and nutritional impacts on the urban minority which has become dependent on these subsidies. The long term impacts of removing the subsidies should be beneficial to the majority of Sudanese that are engaged in agricultural production.

Sudan has a clear comparative advantage in cotton production in both the irrigated and rainfed sectors. The sharp decline in rainfed cotton output is attributable to the government's policy of fixing producer prices at a level far below the world price of short-staple cotton. In dura production, the traditional rainfed sector has a competitive edge over the irrigated sector, the modernized rainfed subsector, and the mechanized rainfed sector. The traditional sector also has a comparative advantage relative to the irrigated sector in the production of groundnuts. Both the traditional and mechanized rainfed subsectors show a comparative advantage in sesame production. The rainfed sector has benefited from recent policy changes. These are necessary conditions, but are insufficient to cause major output increases from rainfed agriculture. Much remains to be done in the areas of tax reform, agricultural research, and improvements in the marketing system.

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