

Report No. 20398-SU

# Sudan

## Options for the Sustainable Development of the Gezira Scheme

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Prepared Jointly by:

Government of Sudan  
and

Macroeconomics 2

Country Department 6 — Eritrea, Ethiopia, Somalia, Sudan  
Africa Region



## CURRENCY EQUIVALENTS

US\$ 1.00 = SD 233 (1998)

US\$ 1.00 = SD 256 (1999)

SD 1.00 = LS 10.00

## AREAS, WEIGHTS AND MEASURES

One feddan = 0.42 hectare = 1.038 acres

One kantar of seed cotton = 315 lbs

One kantar of cotton lint = 100 lbs

One metric ton = 1000 kilograms

## FISCAL YEAR

July 1 to June 30

## ABBREVIATIONS AND ACRONYMS

ARC	- Agricultural Research Organization
BOS	- Bank of Sudan
CMC	- Cotton Marketing Corporation
DRC	- Domestic Resource Cost
EC	- European Community
ELS	- Extra Long Staple
FAO	- Food and Agriculture Organization
FAOTCP	- Food and Agriculture Organization Technical Cooperation Program
FFS	- Farmers' Field Schools
FOB	- Free on Board
FU	- Farmers' Union
GDP	- Gross Domestic Product
GFM	- Gezira Flour Mill
GOM	- Gezira Oil Mill
HPS	- Hand Picked Selected
IMF	- International Monetary Fund
IPM	- Integrated Pest Management
IWC	- Irrigation Water Corporation
GLR	- Gezira Light Railway
GS	- Gezira Scheme
GRS	- Gezira Research Station
LS	- Sudanese Pounds
MCM	- Million Cubic Meter
MOFNE	- Ministry of Finance and National Economy
MOIWR	- Ministry of Irrigation and Water Resources
MS	- Medium Staple
NGO	- Non Government Organization
NPC	- Nominal Protection Coefficient
O&M	- Operation and Maintenance
SCC	- Sudan Cotton Company
SD	- Sudanese Dinar
SGB	- Sudan Gezira Board
SL	- Short Staple
UN	- United Nations
WUA	- Water Users' Association
WUG	- Water Users' Group

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Map (IBRD No.30670)



## Preface and Acknowledgements

This report on the Gezira Scheme has been prepared jointly by the Government of Sudan and the World Bank. The decision to prepare this report arose out of a request from the Minister of Finance and National Economy for non-lending assistance in the context of a review of its future relations with the Bank. A preliminary draft was discussed in Sudan in February this year and as a result a substantial number of changes were made to the report. The report was reviewed again in May 2000.

The Government members of the joint team established to prepare this report were: Omer Ali Mohamed El Amin (General Manager, Sudan Gezira Board) \* and El Toyib Elalam (Sudan Gezira Board), El Fatih Ali Siddig (Director General, International Economic Relations Department, Ministry of Finance and National Economy), Abdelrazig el Bashir, (Under Secretary, Ministry of Agriculture and Forests), Siddig Abbo and Omer M. A. Elawad (Ministry of Irrigation and Water Resources), Gafaar Ibrahim (Agricultural Research Corporation), Abdin M. Ali (Director General, The Sudan Cotton Company Ltd.) and Fatma Abdalla Shoke (The Sudan Cotton Company, Ltd). The World Bank team was led by Jack van Holst Pellekaan and team members were Inger Andersen, Mohamed Abdelgadir Adam, Albert Agbonyitor, Richard Carroll, Paul Wani Gore, Parvis Heckmat, and El Sayed Zaki. Word processing was done by Messrs. Patrick Mamboleo and Felix Ogbebor managed by Ms. Roboid Covington. The work of the Bank was under the supervision of Albert Agbonyitor (Task Manager) and Frederick Kilby (Sector Manager) and under the overall direction of the Country Director for Sudan, Ms. Oey Meesook.

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*\* Professor El Amin Dafalla, who preceded Omer Ali Mohamed El Amin as General Manager of the Gezira Scheme, was a leading member of the joint team during the early work on this report.*



## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

1. This report has been prepared at the request of the Government of Sudan by a joint team from the Government and the World Bank. The team's objectives were to assess the main factors which constrain the sustainable development of the Gezira Scheme (GS) and to develop medium to long term plans, as well as short term actions, to address those constraints.

### SUMMARY

#### **A Large and Complex Enterprise**

2. Started in 1925, the Gezira Scheme has an area of about 2.1 million feddan or about 880,000 hectares. This makes it about one-third the size of Belgium reflecting the enormous management challenges that the Scheme presents. It is one of the biggest irrigation systems in the world, but has over time turned into one of the least efficient with an irrigation intensity typically less than 50 percent. Nevertheless it uses about 35 percent of Sudan's current allocation of Nile water. The Gezira Scheme also produces two-thirds of Sudan's cotton exports although cotton production has declined to such an extent that the value of cotton exports, which used to provide about half of total export proceeds, are now second to livestock.

3. The Government is aware that the GS is inefficient and a net drain on the national economy. Following many years of unprofitable performance and increasing indebtedness, a high level Presidential Committee examined the operation of the Scheme and in November 1998 recommended, inter alia, that it be converted into a joint stock company in which the Government and the private sector would have shares. There has since been an intense nationwide debate on this recommendation. In 1999 the Government requested the World Bank to also review the GS and assess the options for addressing its problems. It was subsequently agreed that Government and Bank staff would jointly prepare a report.

4. **Current Management:** The GS is governed by a Board of Directors appointed by the Government and chaired by the Minister of Agriculture and Forests while its day to day management is the responsibility of the General Manager of the Sudan Gezira Board (SGB) supported by a staff of about 7,000. Apart from its regular contact with the Ministry of Agriculture and Forests, the SGB works closely with the Ministry of Irrigation and Water Resources (MOIWR) which provides water "in bulk" at the junction of the main and minor canals and is also responsible for the operation and management of the Sennar Dam and the main canals. Recently the SGB was given responsibility for the operation and maintenance of the minor and smaller canals. The SGB also collaborates closely with the Agricultural Research Corporation (ARC), the Sudan Cotton Company (SCC), and the Gezira State Government.

5. **Tenants in Financial Difficulties:** Most of the approximately 120,000 tenant farmers cannot earn an adequate income for their families from crops on a typical 20 feddan irrigated farm. Consequently the majority of tenants, given that they do not consider higher yields and more intensive cropping systems are feasible under current circumstances, depend on off-farm income

to stay above the poverty line. This is why sharecropping and livestock production (which involves considerable grazing outside the Scheme) have become popular solutions to the financial difficulties facing tenants. The proportion of tenants who enter into sharecropping arrangements with the landless is about 30 percent. About 40 percent of tenants earn additional income from livestock production while most households have some livestock in the Gezira community.

### **Major Problems Facing the Gezira**

6. This report finds that there are currently five main problem areas facing the Gezira Scheme:

**(a) Large Debt Burden:** Following many years of unprofitable performance the total debt of the Scheme reached SD8.6 billion (equivalent to US\$34 million at the end of 1998/99 at the prevailing exchange rate). The Scheme's main creditors are private companies (for example contractors) and various organizations that have provided services. This debt compares with the estimated current annual net revenue from Gezira's agricultural activities (excluding livestock and agro-processing) equivalent to about US\$46 million.

#### **(b) Institutional Weaknesses**

- Centralized administration and over-staffing of the SGB reduce the managerial and economic efficiency of the Scheme. For example:
  - current land tenure arrangements do not allow the formal sale of tenancies eliminating the option for existing tenants to retire from irrigation farming and for new entrants to invest;
  - uniform five-course cropping rotation for tenants with a mandatory requirement to grow one-fifth of their land to cotton each year unnecessarily constrains tenants' management choices;
  - centralized decision-making on cotton production management, such as use of herbicides and aerial spraying, affect tenants' costs substantially;
  - uniform administrative charge, equivalent to a land rent, based on a tenant's land use regardless of the quality and location of land, provides no incentive for tenants to improve efficiency; and
  - centralized irrigation water management and distribution through the MOIWR and SGB with minimal involvement from water users result in inefficient water use.
- Monopoly service enterprises such as the ginneries, the Agricultural Engineering Department, the Gezira Light Railways and the Telecommunications Unit are not financially sustainable since, even though some earn revenues that exceed costs, margins are slim and would be negative if they made provision for depreciation of capital stock.

#### **(c) Infrastructure and Technical Deficiencies**

- Irrigation infrastructure is in serious disrepair and the distribution of water is inefficient and wasteful, with low cost recovery.
- Irrigation intensity is at or below 0.5 compared with a possible level of at least 0.75.
- Average crop yields are well below potential based on field trials.

#### **(d) Uneconomic Production**

- Because of low average yields, the Gezira Scheme is uneconomic from the national and tenant point of view.
  - Research has shown that irrigated agriculture in Sudan, measured through the impact on irrigated wheat and cotton production, generated the smallest income multiplier for rural

households compared with two other main sub-sectors in Sudanese agriculture (i.e. semi-mechanized and traditional farming).

- A typical tenancy of 20 feddans of irrigated land with a five course crop rotation (including one course used for cotton) and current average yields does not provide an income above the poverty line for an average family in the Gezira.
- There are no formal credit institutions available to Gezira tenants other than the SGB which provides short term credit for cotton production. This is unlikely to change until tenants have the right to transfer tenancy rights to creditors in the event of default on their loans. Informal "sheil" credit provided by private lenders is available but at interest rates that are multiples of the rates charged by formal lending institutions.

**(e) Social Inequities**

- Differences in welfare between social groups (basically the tenant employers and the migrant employees) have been a feature of the GS since its inception. These groups are dependent on each other through labor and sharecropping contracts. The extent of this dependence varies according to the fortunes of tenants and their agricultural production. Some Sudanese analysts argue that the income-based differences in welfare between the groups are accentuated by different access to public social services and that this creates tension between them. Others claim that there is little or no tension between the two groups.

**Sound Prospects for Sustainable Development**

7. The Gezira is potentially an economically viable irrigation scheme if the issues mentioned above can be addressed. Critical factors that currently enhance future prospects for the Scheme include positive attitudes towards institutional and management change, growing confidence in the stability and growth of the national economy, encouraging market opportunities for the products from Gezira, good prospects for economic production, and a more flexible approach to addressing social problems. The basis for optimism about these factors is briefly discussed below.

**(a) Positive Attitudes to Institutional and Managerial Change**

- There is a growing consensus among stakeholders on the need for an enlarged private sector involvement in the delivery of a range of services to tenants with a corresponding reduction in the role of the public sector. There is also growing support for more flexibility in the choice of crop rotations, and for providing mechanisms for the formal and sale of tenancies.
- Most of the institutional and managerial changes suggested for the GS in the past, including those in the context of the Government's macroeconomic policy changes in 1992/93, were rejected because there was a reluctance to move away from the status quo. While there continues to be resistance to change from those who would lose as a result of any institutional and managerial changes, there is a strong commitment by the Government, the SGB and the Farmers' Union to the reform of the Gezira Scheme.
- The SGB staff are dedicated to the task of improving the performance and reputation of the GS. There are outstanding examples of SGB staff working under extremely difficult conditions such as in the machinery workshop and the ginneries, but the current staff numbers will need to be reduced because there is considerable redundancy. Adjustment of staff numbers should be aimed at achieving a core of well trained staff to provide a sound base for improved management.

- While the original design of the Gezira Scheme envisaged centralized management, it is possible to move to a decentralized management system in which production decisions and the provision of services are left to farmers and the private sector. This shift would not require special modifications to the existing physical infrastructure.

**(b) Improved Macroeconomic Situation**

- The macroeconomic situation in Sudan is improving steadily. For example inflation has declined from a peak of 150 percent per annum in 1992 to about 10 percent in the 12 months to May 2000. Also, the exchange rate regime is open and stable; tariffs on imports have been steadily reduced; and export income has become more diversified with increased exports of livestock and recently substantial oil exports adding to the traditional cotton and gum arabic exports.
- The Government is cognizant of the importance of maintaining the quality of infrastructure and improving the performance of the Scheme. Consequently there is a focus on generating adequate funds for the rehabilitation of the GS in the context of a long term vision for the future of the Scheme.

**(c) Encouraging Market Prospects for Agricultural and Livestock Output**

- Although world cotton markets are extremely competitive, Gezira can still find substantial markets for its main line Acala (medium staple) cotton production. Export and domestic market prospects are also sound for the other main products from the Gezira, except perhaps for wheat because of its weak competitive position against imported wheat.
- The markets for Sudanese livestock in the region are strong.

**(d) Good Prospects for Economic Production**

- Given the generally sound market prospects and with improved technology, better irrigation management and appropriate inputs, the yields for the main crops can be increased to levels that would generate remunerative incomes for tenant families. This would enable both tenant families and the GS to meet debt obligations.
- The returns to institutional change and rehabilitation have already been shown to be high from the economic analysis of the previous Gezira rehabilitation project financed by a number of donors including the Bank.

**(e) Skilled ARC Staff**

- There are highly skilled staff in the Agricultural Research Corporation who can continue the development of agricultural technology that is the fundamental basis for the sustainable growth of the Scheme.

**(f) Addressing the Social Problems**

- A more inclusive approach to the rights of migrant labor leading to an improvement to their access to social services can be achieved.

## **CONCLUSIONS**

### **Medium to Long Term Plans for Institutional Change**

8. **A Vision of the Future:** The joint team concluded that any consideration of future change needs to start with consensus on a vision about the future structure and operation of the GS. The following is the joint team's vision.

*The vision for the Gezira Scheme in this report is that it becomes a center of increased economic and social activity where the private sector has invested and established enterprises to meet the demands for agricultural production services from tenants. The vision includes ultimately the establishment of an independent, privately managed Gezira Authority operating the scheme at a profit. The Authority would decentralize responsibility for certain managerial activities in the Scheme to competent farmer groups. Its own responsibility would be (in collaboration with other agencies such as the Ministry of Irrigation and Water Resources, Ministry of Agriculture and Forests and the Agricultural Research Corporation) to arrange for the efficient delivery of core institutional functions such as irrigation, agricultural extension and the dissemination of market information to tenants on an environmentally sustainable basis. Finally the Authority, in collaboration with the State Government, would ensure the provision of improved social services to all members of the Gezira community.*

9. The main conclusion from this report is that the Scheme's problems can be successfully addressed and hence the vision described above can be achieved through a public/private sector partnership. The following paragraphs summarize a strategy that was chosen from four medium to long term options considered by the joint team. The advantages and disadvantages of each of the options considered are analyzed in Chapter 6 of this report.

10. **Public/Private Sector Partnership:** The SGB, as a public institution, could increase its effectiveness substantially if it were to focus on the construction and maintenance of major infrastructure, the broad allocation (in consultation with groups of tenants) of the irrigation area to various crop rotations, the distribution of irrigation water through main canals to meet water demand, and the provision of core support services to tenants such as agricultural extension, and market intelligence for the commodities produced in the Gezira Scheme.

11. The private sector (namely groups of tenants and other entrepreneurs) could contribute to the overall efficiency and equity of the Scheme by taking primary responsibility, (through Water Users Groups) for decisions by tenant groups on preferred crop rotations, the distribution of irrigation water through minor canals to satisfy the demands of tenant groups, for efficient water use, for improved cost recovery for irrigation water costs, as well as the provision of services such as plowing and fertilizer sales. This transfer of responsibilities from the public to the private sector would continue a trend which started a number of years ago.

12. The joint team concluded that a number of steps need to be taken to implement this strategy. They are outlined in chapter 6 (mainly paragraph 6.32) and summarized below:

- **Leadership:** The Gezira Board of Directors should be directed to provide strong leadership to facilitate the implementation of the strategy. The Directors should be augmented in number by the addition of a senior representative from the Ministry of Finance and National Economy and a non-Government lawyer appointed by the Government.
- **Management Assistance:** The Gezira Board of Directors should be supported by a Management Assistance Team (MAT) which would provide expert support to the Directors on their deliberations and provide assistance in respect of the implementation of their decisions.
- **Bulk Water Delivery:** The Ministry of Irrigation and Water Resources should be responsible for delivering irrigation water to the main canals in the Scheme. In the first phase of this strategy the management and distribution of irrigation water in the minor canals and below, would be the responsibility of the SGB. It is anticipated that, following a transition to a second phase of change in Scheme management, and after the piloting of Water Users

Groups, such groups would take over the responsibility for water distribution and management through the minor and tertiary canals to meet tenants' water demands.

- **Stimulus to the Private Sector:** The SGB should provide the enabling environment for the private sector (such as traders and agricultural services companies) to be the primary vehicle for the sale of agricultural inputs and services. Obviously, in the short run the SGB is likely to remain the main supplier of services, inputs and credit, but under the changed policy the SGB would provide such services without Government subsidy. In other words the SGB could continue its current role of providing services such as plowing, weed and insect control to tenants who expressed their demand to the SGB but these services should be provided under terms and conditions similar to those facing the private sector. During the proposed institutional transition the private sector would increasingly take over the role of the SGB in the provision of agricultural inputs and services.
- **Cotton Accounts:** The individual account system for cotton with the SGB should be abolished but tenants could still avail themselves voluntarily of credit facilities through the SGB at market interest rates, if the SGB is prepared to provide such a service.
- **Farmer Crop Choice:** Freedom of choice should be introduced for farmers (as a group) to grow any crop within the constraints of technology and reasonable agricultural practice.
- **Ginneries:** The ginneries should be offered for sale through international competitive bidding, but not until after a few years into the implementation of the above-mentioned institutional changes so that potential buyers can better assess the long term demand for ginning services in the Gezira.
- **Cotton Marketing:** The Sudan Cotton Company could continue to be the preferred marketing institution for cotton, although private trading in cotton by tenants and the SGB would be allowed and encouraged.
- **Sale of Tenancies:** Tenants should be provided with the opportunity (following appropriate changes in the law) to buy and sell their tenant rights within the Gezira Scheme.

### Short Term Actions

13. The changes described above are medium to long run institutional changes, even though their implementation could start relatively quickly. Nevertheless, it is essential to improve the efficiency of Scheme operations as soon as possible. The joint team concluded that this can be done by implementing a number of short term actions to improve the incentive for tenants and the SGB leading to almost immediate improvements in technical performance and income flows. There is strong support for these actions among the Gezira and Managil Farmers' Union, the SGB and Government administrators. While relevant to all options for change considered by the joint team, they would become part of (and in some cases overlap) the set of actions proposed above. The proposed short term actions are as follows:

- **Annual Administrative Charge:** Establish a fixed annual administrative charge per feddan of irrigable land to be paid by Gezira tenants. The actual charge would depend on the quality of the land and would be due regardless of the crops grown or the level of production. Planning for this action should be started immediately with the introduction of a fixed annual administrative charge at the start of the 2001/2002 fiscal year (paragraphs 6.23 and 6.35).
- **Irrigation Water Charge:** Establish irrigation water charges based preferably on the amount of water used annually per feddan or, if metering is not possible, as a fixed rate for each crop type on the basis of the anticipated water use irrespective of the crop results. The charge should be discounted for shortfalls in water delivery as verified jointly by the Water User

Groups and the SGB. Planning for this action should be started immediately with implementation of a fixed irrigation charge at the start of the 2001/2002 fiscal year (paragraphs 6.23 and 6.35).

- **Sale of Tenancies:** Prepare immediately the legal instruments that would allow tenants in the Gezira or any other Sudanese national to buy and sell tenancy rights in the GS subject to some simple conditions on maximum / minimum tenancy size and land management practices. The target date for change in the legal instruments and implementation of this strategy should be no later than January 1, 2002 (paragraphs 5.16, 5.23, 6.23 and 6.35).
- **Water User Groups:** Take steps to establish immediately two pilot Water User Groups in different blocks of the GS in areas where the delivery and distribution of irrigation water is technically efficient, where the water volumes can be reasonably well measured, and where tenant groups are strongly interested in participating in the pilot<sup>1</sup> (paragraphs 2.15, 6.33 and Annex 3).
- **Tenant Crop Choice:** Offer groups of farmers in a specified pilot area which has reliable irrigation water supply and tenancies in a contiguous “hydraulic unit” the opportunity to exercise their choice of crop rotation for a period of a year starting with the cotton season.<sup>2</sup> Implementation for the whole Scheme should start as soon as positive conclusions from the pilot are available (paragraphs 3.9, 6.32, 6.35 and Annex 5).
- **Cash on Delivery for Cotton at Ginneries:** Establish a cash payment of a fixed proportion (no less than 50 percent) of the expected “farmgate” price for cotton (according to grade) when cotton is delivered to ginneries. Of course those tenants who have received crop financing from the SGB would have this payment immediately credited against their SGB debts. Subsequent payments for cotton should be determined according to a contract between the tenant and the SCC. This system of payment should start with the 2002 seed cotton deliveries. There should immediately be introduced a more transparent determination of final payments for cotton which should be subject to monitoring by a committee appointed by the Minister of Finance and National Economy (paragraphs 4.25, 4.27 and 6.35).
- **Study of Formal Credit:** A study should be mounted immediately to assess the possible forms of credit institutions that could be formed to offer a safe location for savings and provide seasonal and long term credit to (a) tenants as an alternative to the cotton accounts provided by the SGB, and (b) the Gezira community as a whole for agricultural and livestock production as well as for other purposes such as consumer durables and housing (paragraphs 4.40, 5.23, 6.20 and 6.35).
- **Agricultural Research:** Ensure the adequate and sustained funding of the Agricultural Research Corporation to ensure the continuation of a strong program of research leading to improvements in the productivity of irrigated crops (paragraphs 3.13 and 6.35).
- **Benefits and Costs of Infrastructure Rehabilitation:** Given the undoubted need to rehabilitate the irrigation system and some other public infrastructure in the Gezira Scheme, plans and funding should be established as soon as possible for a detailed assessment of the

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<sup>1</sup> This work should be coordinated with an ongoing Technical Cooperation Program (TCP) in the Gezira financed by FAO called “Raising Productivity through Broadening Farmer’s Choice on Farm Systems and Water Management” which will involve pilots with Water Users Groups as well as pilots on providing tenants with the choice of farming systems.

<sup>2</sup> This work should also be coordinated with the ongoing TCP project financed by FAO (see footnote 1). The Minister of Agriculture and Forests had announced in April, 2000 that tenants in the Gezira would no longer be required to grow cotton. No further details have become available about this announcement.

rehabilitation needs for the Scheme, in the light of the evolving institutional changes and cropping systems, and the net benefits from such rehabilitation (paragraphs 2.22 2.44).

## RECOMMENDATIONS

### Establishing Government Policy

**14. Process of Decision and Consultation:** Given the considerable participation of civil society in the preparation of this report, it is recommended that the Government make a decision on the principles of policy and institutional reforms for the Gezira Scheme and set in motion a process of further consultation and planning for implementing the reforms. The joint team recommends a process of policy reform and institutional change for the Gezira Scheme that involves the intensive participation of all stakeholders, including the State Government.

**15. Core Recommendation:** This report recommends that in the short to medium term the SGB should continue the trend in recent years of transferring many of its functions to the private sector. There should be a partnership in which the SGB management remains responsible for construction and maintenance of major infrastructure, and the private sector should be allowed to become responsible for water management in minor canals and the provision of production and processing services. In the longer term the Gezira Scheme should become an autonomous authority with no formal ties to the Government.

### Major Immediate Steps

16. Six steps are envisaged for the immediate future.

- First, a decision by the Government on the medium to longer term vision for the Scheme which would then become Government policy.
- Second, a decision by Government on the joint team's conclusions on the preferred institutional change to achieve that vision, and on any guidelines it may wish to establish with regard to matters such as overall policy and the timing or sequence of institutional change.
- Third, appointment by Government of a competent body to be responsible for implementing its policy. The joint team has concluded that the Gezira Board of Directors is the appropriate body and should be assisted by a Management Assistance Team (MAT).
- Fourth, confirmation by the Government that the existing Ministerial Committee for the Implementation of Irrigation Schemes be charged with the responsibility of reviewing progress in the implementation of the Government's policy decisions on the Gezira Scheme as part of its standing obligations.
- Fifth, the Government should allocate funds to finance the work of the body charged with implementing the Government's decision, and also explore sources of funds for the detailed benefit-cost analysis of the rehabilitation of the Gezira infrastructure.
- Finally, there should be widespread dissemination of the Government's policy decisions among tenants as well as the broad Gezira community, and the establishment of a framework for continuous consultation on future plans for institutional and managerial changes in the Gezira Scheme with all stakeholders including the Government of Gezira State.

17. A Number of recommendations on various aspects of the GS infrastructure have been made. They are as follows:

- **Irrigation:** It is clear that the irrigation system in the Gezira is technically inefficient and needs considerable rehabilitation. Chapter 2 discusses the shortcomings and indicates action that should be taken. It recommends that plans for de-silting and the repair of regulators be formulated and costed pending decisions on the future institutional arrangements for the Gezira Scheme (paragraph 2.22).
- **Roads:** The capacity of any central Gezira Scheme administration to maintain the road network should be strengthened either through force account or contracting (paragraph 2.31).
- **Gezira Light Railways:** The GLR should remain under the authority of the Scheme, but there should be an intensive review of its efficiency and long term justification at the earliest opportunity (paragraph 2.34).
- **Department of Agricultural Engineering:** Tenants should be given the choice as to whether the Department or private contractors plow their land (paragraph 2.37).
- **Ginneries:** Ginneries should be moved out of the public sector and offered for sale. That sale should be at a time (probably in a year or two) when the longer term demand for ginneries in the Gezira has been clarified (paragraph 2.39).
- **Workshops:** Future status of the SGB workshops should be examined in an independent study (paragraph 2.41).
- **Telecommunications:** The Gezira Telecommunications Center should become integrated into the national telecommunications grid (paragraph 2.43).



# 1. TIME TO TAKE ACTION

## Background

1.1 The Gezira Scheme (GS), located between the Blue and White Nile towards their confluence, was established in 1925 when the Sennar Dam across the Blue Nile was completed. In 1959-63 the original Gezira Scheme was extended to include the Managil area. The combined Gezira/Managil Scheme now covers a command area about 2.1 million feddan (about 882,000 hectares) under gravity irrigation.<sup>3</sup> Estimates of the total potential cultivable area under irrigation in Sudan within the Nile Basin vary, but it is probably between four and five million feddan depending, of course, on the availability of water.<sup>4</sup> Hence the GS represents about a quarter of all irrigation area in Sudan and half the area of irrigation schemes drawing water from the Nile system. It uses about 35 percent of Sudan's current allocation of Nile water. About 55 percent of the GS, is the property of the central Government. The remainder of about 45 percent of the land is still owned by previous landholders and with whom the central government has a long term rental agreement. The current rental rates are ridiculously low by today's standards but are under review.<sup>5</sup>

1.2 The GS is one of the largest irrigation schemes in the world. This report will show, however, that it operates at a low level of technical and economic efficiency. Designed for a cropping intensity of 0.75 the achieved cropping intensity is usually no more than 0.50 which is very low by any international standard.<sup>6</sup> The Scheme has been plagued over many years by serious water management and distribution problems, as well as low yields, costly pest control for cotton, inadequate financing and marketing arrangements for most crops, inefficient agricultural processing, disillusioned farmers, and low cost recovery for irrigation water deliveries. As a result the GS regularly incurs an operating loss and tenants often find it impossible to make ends meet from farm income alone despite the fact that on average farm size is 20 feddan.<sup>7</sup>

1.3 The Government has been concerned for many years about the Scheme's technical and economic inefficiency as well as its heavy demands on public resources. As pressures on the Government's budget mounted, together with the realization that Sudan's future agricultural

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<sup>3</sup> In this paper any future reference to the Gezira Scheme will include the Managil extension. One feddan = 1.038 acres = 0.42 hectares.

<sup>4</sup> An objective of the report will be to place the Gezira Scheme into context of the total irrigation in Sudan.

<sup>5</sup> A Presidential committee has been examining the level of rents paid to the original owners of the Gezira land and is understood to have submitted its report in November, 1998. It is understood that a draft report has been prepared and submitted to the Government.

<sup>6</sup> This is the ratio of total annual average area under crop to total command area.

<sup>7</sup> Earlier research has shown that irrigated agriculture, measured through the impact on irrigated wheat and cotton production and based on 1978/79 data, had the smallest income multiplier for rural households compared with the other main sub-sectors in Sudanese agriculture (i.e. traditional and semi-mechanized farming) Evans David, and Mohamed Diab, *Food Security Income Distribution and Growth in the Sudan: Some Preliminary Findings*, mimeo, World Bank, Washington D.C., 1989.

trading opportunities would be tied closely to highly competitive global markets, the search for strategies and policies to improve the efficiency of the Gezira have become more urgent. The Gezira is estimated to contribute directly about three percent of national GDP. It produces about two-thirds of Sudan's cotton exports (historically Sudan's major export but one that has slumped considerably in absolute and relative terms in recent years) and produces significant volumes of food crops and livestock for export and domestic consumption. If the GS is to play an important future role in the country's economy it needs to become more efficient and more productive. Therefore resolution of the problems of the Gezira Scheme is obviously highly relevant to Sudan's national development program and to the improved efficiency of Nile water usage. The Bank has in the past contributed to the rehabilitation of the GS; the sustained development of the Gezira is also highly relevant to any future Bank assistance strategy for Sudan.

### **Previous Studies/Investments**

1.4 The GS has been studied numerous times over the last 30 years. Many of these studies were financed by bilateral and multilateral donors including the World Bank.<sup>8</sup> They made recommendations for change in the institutional arrangements and management of the GS. In many cases recommendations made 10 to 20 years ago were similar to recommendations in more recent studies. The failure to take action in the past to remedy obvious institutional problems has resulted in the current serious deterioration in all aspects of the Scheme. It is certainly time to take action.

1.5 Over the last two years the Government has again taken a number of steps aimed at addressing the problems of the Gezira. These steps, described briefly later in Chapter 6, included a high level committee appointed by the President<sup>9</sup> to review the problems of the Gezira as well as other central government owned irrigation schemes.<sup>10</sup> This Presidential Committee submitted its report in November, 1998 and made numerous recommendations. In summary the report concluded that the GS should in future become a private company capitalized by publicly traded shares. Shareholders could come from a variety of investors, including the Government whose share of the equity would be based on the market value of its equity in the Scheme. It was envisaged that farmers would sign production agreements in return for the provision of farm inputs and services from the company. The Presidential Committee also made proposals for the future of institutions such as the Gezira Ginneries and the Agricultural Engineering Department which are part of the GS, as well as for cotton marketing arrangements. Some of the report's recommendations were followed up such as the review of rental rates paid to the original owners of land that is part of the GS. Others, such as the central recommendation on the future ownership and management of the GS are still under discussion. A summary of the Presidential

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<sup>8</sup> See, for example, *The Gezira Study mission* (Rist Report), 1966; and the World Bank Report No. 1836-SU, *Sudan: Agricultural Sector Survey*, May 18, 1979 which includes detailed annexes on the Irrigation Sub-Sector in Sudan. See also World Bank Credit No. 1388-SU, *Sudan: Gezira Rehabilitation Project*, which became effective in May, 1985 and was closed in December 1993 at a final cost of US\$191.4 million. Final disbursements include \$71 million from IDA, \$47.8 million from the Arab Fund, \$29 million from a Japanese grant, \$2.4 million from the Saudi Fund, \$8.4 million from an Italian grant, \$8.2 million from a British grant, and a Government of Sudan contribution of \$24.6 million. The Implementation Completion Report prepared by the FAO Investment Centre re-evaluated the rate of return for the project as it had been implemented at 19 percent and showed that 12 studies were financed and completed on various issues. There has been no further World Bank project assistance to Sudan since this project closed.

<sup>9</sup> Established by Decree 365 of 1998.

<sup>10</sup> There are five other schemes also owned by the central government. They are Rahad, Suki, New Halfa, White and Blue Nile Schemes.

Committee's recommendations, justifications, actions taken and mission comments can be found in Annex 1 to this report.

### **Request from the Government**

1.6 Following the start of a process aimed at normalizing relations between the Sudanese Government and the World Bank, the Government of Sudan requested non lending assistance from the Bank including an assessment of actions that could be taken to improve the efficiency of the Gezira Scheme.<sup>11</sup> The Bank agreed to provide this assistance and use the recommendations of the November 1998 Presidential Committee's report as its point of departure. In effect the Bank was being asked for a "second opinion" on the most effective future development strategy for the Gezira Scheme.

1.7 The Government's request to the Bank was made in March, 1999. Following further negotiations on the normalization of relations the Bank launched a reconnaissance mission in August to follow up on the Government's request. That mission reached agreement on objectives for the review and the basis for a collaborative approach between the Government and the Bank to the preparation of a final report. A joint Government/Bank team was established to undertake this task.<sup>12</sup> The main Bank mission visited Sudan in November, 1999. A further Bank mission visited Sudan in February, 2000 to discuss a preliminary draft of this report primarily with members of the joint team. A second draft was discussed in Sudan with the Government on May 27, 2000.<sup>13</sup>

### **Improving Economic Performance**

1.8 The fortunes of the GS are influenced by the national economic environment. Strong growth in the domestic economy will stimulate demand for its output, inflation will place cost pressures on producers and raise interest rates for credit, weakness in the balance of payments will make it more difficult to obtain imported inputs, and domestic budget deficits will reduce the chances of public financing for important infrastructure development. Fortunately the economy is gradually improving which makes this an excellent time for taking action on the institutional and economic problems of the GS. The following paragraphs will sketch out the major features of the improving macroeconomic picture. A more comprehensive statement can be found in Annex 2.

1.9 **Economic Growth.** Achieving sustained growth in Sudan has been hampered by civil war, social dislocation and the brain drain, as well as the deterioration of basic infrastructure and the lack of access to aid and foreign investments. In addition, Sudan has often suffered from severe external shocks, including floods and drought. Nevertheless, there are broad indications that the economy improved in the 1990s after years of decline. Officially, the GDP growth rate averaged five percent from 1992-93 to 1998, based mainly on agriculture.

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<sup>11</sup> Following the accumulation of arrears in payment obligations, the World Bank closed its Resident Mission in Khartoum in 1993. Since then there has been no lending, economic and sector work or supervision of projects since all projects were cancelled soon after the departure of the Resident Mission.

<sup>12</sup> Members of the joint team are Omer Ali Mohamed El Amin (General Manager, Sudan Gezira Board) and El Toyib Elalam (Sudan Gezira Board), El Fatih Ali Siddig (Director General, International Economic Relations Department, Ministry of Finance and National Economy), Abdelrazig el Bashir, (Under Secretary, Ministry of Agriculture and Forests), Siddig Abbo and Omer M. A. Elawad (Ministry of Irrigation), Gafaar Ibrahim (Agricultural Research Corporation), Abdin M. Ali (Director General, The Sudan Cotton Company Ltd.) and Fatma Abdalla Shoke (The Sudan Cotton Company, Ltd).

<sup>13</sup> This final report has taken into account the comments and reactions received on two previous drafts.

1.10 **Inflation.** Based on Khartoum figures, inflation was high in the earlier parts of the 1990s, reflecting high fiscal deficits and domestic credit expansion. Crop failure and shortage of basic food items, and increases in the domestic price of key imports, especially petroleum, also fuelled inflation. Of course the abolition of most administered prices since 1992 allowed high prices to be reflected in the open market. Recently, however, as the exchange rate stabilized and supplies improved inflation declined substantially from a peak of 150 percent in 1992 to 12 percent during the 12 months to May, 2000.

1.11 **Savings/Investments:** Domestic savings are low at about five percent of GDP. There are no Government revenue surpluses over recurrent expenditures. The Government is placing increased emphasis on deregulating and promoting private investments, which are also very low, excepting the recent spurt of foreign direct investments focused on creating the oil pipeline and related activities. The Investment Promotion Act of 1990 (amended in 1996) was amended again in 1999 to rationalize the investment sanctioning procedures and stimulate greater private investments and growth.

### **Public Resource Management**

1.12 Development financing and effective public resource management are extremely difficult. During 1994-96, for example, revenue fell from 9.4 to 6.2 percent of GDP, while expenditures rose from 22 to 26.6 percent of GDP. The revenue ratio at the federal level is about eight percent of GDP. Even if state level revenues are taken into account, the total revenue ratio would only be about 12 percent of GDP, compared to the average in less developed countries of 18-20 percent.

1.13 Development expenditures funded by the central government are minimal, rising from 0.5 to 0.8 percent of GDP between 1996 and 1998. An estimated 0.2 percent of GDP of development spending was self-financed by public corporations owned by the Government. Gezira's contribution to this will need to improve. As a result of the financing difficulties less than half of the development expenditure budget has been funded since the mid-1990s. The share of foreign financing of development projects was an estimated 10 percent in 1998.

### **External Performance**

1.14 **External Debts and Trade:** The main challenge to external financial management is a heavy external debt burden, which amounted to some US\$23.7 billion at the end of 1999. Multilateral institutions account for 19.4 percent of the debt. The major multilateral creditors include IBRD, IDA, the IMF, the Arab Development Fund, and the Arab Bank for Economic and Social Development. Estimated exports totaled US\$780 million, compared to imports of US\$1412 million in 1999. Export volume grew at 14 percent during 1995-99, due to trade and exchange rate reforms and liberalization of procurement prices. Exports are becoming more diversified largely due to the start of petroleum exports in mid-1999. The share of cotton and gum arabic exports fell from 33 to 14 percent between 1994/95 and 1999, while groundnuts dropped from 5.5 to 0.7 percent. Livestock's share remained the same (about 14.7 percent) while gold's and sesame's share showed some increase. Petroleum exports are expected to account for an increasingly large share of total exports, rising from one-third of total exports in 1999 to more than half in 2000. Most of Sudan's petroleum product needs are now met by local production rather than through imports.

1.15 **Exchange Rate Reforms:** Sudan made unsuccessful attempts at exchange rate reform in the early 1990s. A unified exchange rate system adopted in February 1992 collapsed in October 1993, as inadequate reserves, ineffective instruments of monetary control and weak financial policies undermined stable market-oriented exchange rate policies. Starting in 1997, a phased introduction of a wide range of trade and other reforms moved the exchange regime towards a unified system. The spreads between official and unofficial exchange rates were gradually

reduced and the exchange rate was effectively unified by the end of October 1998. The rate is now determined on the basis of a 5-day moving average.

## **Poverty and Social Development**

1.16 **Poverty:** Sudan's per capita income was about US\$290 in 1998.<sup>14</sup> Poverty is increasing, though no reliable estimates of its incidence, depth and intensity are available.<sup>15</sup> Recent growth of agriculture has not ensured nation-wide food security, because of disparities in income, regional differences in the pattern of agricultural growth and disruption caused by the civil war. The vulnerability of Sudan to drought causes substantial reductions in food production and enormous losses in income from other agricultural and pastoral activities, and hence serious increases in poverty. So long as the drought has not also affected the Nile water supplies, irrigation schemes such as Gezira can play an important role in sustaining growth in agricultural production which provides employment and, if not additional food production, additional income to import food.

1.17 **Social indicators:** The social indicators for the 16 northern states are lagging behind countries at the same level of per capita income. In the North, the adult illiteracy rate is 47 percent (59 percent for women).<sup>16</sup> Life expectancy at birth is 53 years; infant mortality is 71 of 1,000 births. Basic social services, namely, education, health and water and sanitation, have been seriously eroded as a result of the combined impact of civil conflict and natural disasters. Only some 30 percent of rural residents and 40 percent urban dwellers have access to safe drinking water. Primary school enrollments have declined to about 56 percent. Access to health services is also limited.

## **Time for a Change in the Gezira**

1.18 The improving economic conditions summarized above can be traced to the change in macroeconomic policies in 1992 when most markets in the economy were to a large extent released from the burden of Government controls. The Government also encouraged the private sector to increase its investment in the economy and put in motion a program of this-investment in productive enterprises. As discussed in Chapter 6, this was also the time when the Gezira Scheme was no longer able to automatically obtain finance for its activities from the Central Bank (Bank of Sudan.) Since then the Scheme has used a consortium of commercial banks for financing and when this was terminated the Sudan Cotton Company became the main financier. Nevertheless, eight years after the major turn around in Government economic policy the Gezira has still not changed from a government irrigation system with minimal adjustments in the situation facing tenants on matters such as credit, input supplies, water management, tenancy transfer, cotton ginning and marketing. It is time to follow through on the Government's 1992 objectives of encouraging the private sector to take on a greater role in economic development.

## **Overview of the Report**

1.19 **Objectives:** This report is an evaluation of the basic infrastructure of the GS, its efficiency as an irrigation system and producer of irrigated products, the effectiveness and sustainability of changes in management policies, operational strategies, and institutional arrangements introduced into the Gezira Irrigation Scheme since the above-mentioned Presidential Committee report of 1998. It was also agreed that the report should include an analysis of possible future changes in

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<sup>14</sup> Total population was estimated at 28.3 million in 1998, with average annual growth rate of two percent.

<sup>15</sup> Estimates of the level of the incidence of poverty covering the 16 Northern states alone vary widely up but go as high as 90 percent.

<sup>16</sup> Based on 1997 data.

policies, strategies and institutions that are currently being considered by the Government. In effect the main objective of the report is to assess the most effective future development strategy for the Gezira Scheme.

1.20 **Audience:** The primary audience for this report is the Government of Sudan and the Sudan Gezira Board, but its likely audience is much larger. Among the groups with an interest are the Gezira-Managil Farmers' Union and tenant farmers, the Sudanese legislature, the commercial agro-industry sector including traders in agricultural inputs, the financial sector, the world cotton marketing and processing industry, bilateral and multilateral donors, and non-government organizations (NGOs). The report is therefore written so that those not closely associated with the Gezira Scheme in the past will be able to grasp its long history and the main issues facing the Scheme now.

1.21 **Structure of the Report:** Apart from the Summary, Conclusion and Recommendations, the report will be organized around five main issues. They will be as follows:

- **Infrastructure:** An evaluation of the current and future development of the Gezira Scheme's infrastructure such as irrigation operations and management, as well as the current supporting infrastructure for land preparation, communications, ginning and transport.
- **Technology:** An evaluation of the availability and future development of appropriate technology for the various crops and livestock, the use made of the available technology, and the role of the Agricultural Research Corporation.
- **Economic Incentives for Farmers:** An analysis of the profitability and competitiveness of various irrigated crops and livestock production options under irrigated conditions from the national and farmer's point of view. The chapter will analyze the impact of different levels of yield on the profitability of tenant farmers in the scheme.
- **Social Issues:** A brief perspective on life in the Gezira which reveals significant poverty. This chapter will focus on how the fortunes and welfare of people with and without land are affected by the productivity of the Gezira Scheme and the way its resources are managed and administered.
- **Institutional Issues:** An evaluation of the effectiveness and efficiency of the institutional arrangements that have been or are being implemented at the time of the mission in the Gezira, compared with other options. This part of the report will include an evaluation of the overall institutional arrangements of the Gezira Scheme, including the appropriate roles of the public and private sector, and options for a changed institutional management structure.

## 2. INFRASTRUCTURE

2.1 The purpose of this chapter is to briefly discuss the issues facing the vast infrastructure investment in the Gezira Scheme (GS). It is estimated that the value of infrastructure within the GS is between \$4 and \$6 billion.<sup>17</sup> Most of this is, however, accounted for by the irrigation infrastructure and therefore this chapter will focus quite heavily on irrigation and discuss the problems facing the irrigation works and indicate strategies for addressing those problems.

### IRRIGATION

2.2 The Sennar Dam was completed in 1925 and most of the other infrastructure in the GS dates back to about that time. In the Managil area infrastructure dates back to the early 1960s when that extension to the scheme was brought on stream. Given its age it is remarkable that most infrastructure is still in working condition. This is to the credit of the original designers and those who for many years devoted considerable energy and resources to maintaining structures and machinery under very severe financial constraints. Nevertheless, some infrastructure is not functioning efficiently and is in need of substantial and urgent rehabilitation. The World Bank's Gezira Rehabilitation project (approved in 1983)<sup>18</sup> was intended to provide support for the rehabilitation of the GS. This project was closed in December, 1993 when the Bank withdrew its financial support from Sudan. This chapter will start with irrigation infrastructure because it faces major problems and is in urgent need of rehabilitation.

2.3 The Gezira is the only gravity-fed large irrigation scheme in Sudan. Only about 70,000 feddans of the total command area of 2.1 million feddans<sup>19</sup> are not under gravity irrigation. The main features of the GS are flat topography and unlined earth canals with low percolation due to high clay content of the soil. It is regarded as an outstanding feat of engineering and has been a model for other large irrigation projects in Sudan. To discuss the problems it is necessary to describe some of the crucial features of the scheme.

#### The Irrigation System

2.4 **Water Storages:** Irrigation water is supplied from the Blue Nile reservoirs at Roseires and Sennar. The Blue Nile has an average annual flow of 50-billion cubic meters at Roseires, with large seasonal and annual variations. The flow of the Blue Nile rises steeply from the end of June to an end-of-August peak, followed by a sharp decline, to a minimum flow of about two percent of the peak, at the end of April. The Blue Nile carries large quantities of silt as a result of its steep gradient and heavy seasonal rainfall in its upper catchment area. The silt load in the Nile is heaviest during July and August and as a result of an increase in irrigation during these months,

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<sup>17</sup> This is not a formal valuation. The estimate includes (a) irrigation land - \$3.15 billion; (b) GS buildings including ginneries - \$0.1 billion; (c) machinery, equipment and vehicles - \$0.09 billion; (d) roads - \$0.1 billion. There is no explicit valuation for the Sennar Dam or the main canals from the dam to the scheme.

<sup>18</sup> Bank Report No.120, *The Gezira Irrigation Scheme in Sudan*, Agriculture and Rural Development Department, 1990.

<sup>19</sup> Sudan Gezira Board manages some additional 60,000 feddan in pump schemes located on the east bank of the Blue Nile (Hurga, Nur ed Din and Guneid extension) which is not served by the Sennar Dam.

significant volumes of the reservoirs are lost to siltation, annually. The storage capacities of Roseires (3,024 million cubic meters) and Sennar (930 million cubic meters) are relatively small and represent only about five percent of the average annual flow of the river (and 15 percent of the Nile water allocation to Sudan). Siltation studies suggest that by the end of 1985, the volume of the Sennar reservoir had been reduced by 34 percent (compared with the designed volume) to about 600 million cubic meters and that of Roseires by 25 percent to about 2,250 million cubic meters. The Sennar Dam itself, however, has recently been renovated and is in excellent condition.

**2.5 Water Distribution:** Water is diverted from the Sennar reservoir by means of twin main canals with a combined maximum daily discharge capacity of 31.5 million cubic meters (354 cubic meters per second), running north to the first group of canal regulators 57 kilometers from the dam, (See *Map No. IBRD 30670* at the end of the report). From there four branch canals convey water to the Managil extension, while the Gezira main canal runs north for another 137 kilometers. Major canals take off from main and branch canals and supply water to minor canals. These canals flow continuously throughout the growing season. The network consists of 2,300 kilometers of branch and major canals, and over 8,000 kilometers of minor canals. Minor canals supply water via gated outlet pipes to field channels (Abu Ishrin)<sup>20</sup> each irrigating 90 feddans, (38 hectare), called "Numbers". Each number is divided into 18 tenant fields of 5 feddans (called hawasha). A network of cross-bunds for irrigation by basins in turn divides the tenants' fields. See Annex 3 for a diagram of a typical layout of the irrigation system.

**2.6** Water flows in the primary canal network (main, branch and majors) continuously during the irrigation season - July through April. Minor canals were designed to store water at night as irrigation was to be carried out only during the hours of daylight but this is no longer practiced. The water is released based on an indenting procedure whereby at the beginning of each cropping season the demand at each minor canal and the delivery losses are calculated for various reaches of the canals up to the Sennar Dam. The volume of water released is regulated by various control structures throughout the system.

**2.7** The major canals have peak design capacity of 20 cubic meters/feddan/day (equivalent to 0.55 liter/second/feddan) in Managil and between 13.5 and 15 cubic meters/feddan/day in Gezira (equivalent to between 0.37 and 0.41 liter/second/feddan). These capacities were based on the peak water requirement of the cropping pattern and intensity envisioned at the design stage. They determine the optimum capability of the irrigation system for water delivery and distribution and crop diversification and intensification, which indicates that there is greater flexibility at Managil extension.

**2.8** The minor canals are grossly over designed for the flows (0.5 to 1.5 cubic meters/second) that they are intended to carry. Minor canals are set at very slight slopes, 0 to 5 cms per kilometer, and flow with very low water velocities, and thus have a very limited sediment transporting capacity. They act as sediment traps particularly at the head reaches of the canals. Weed growth reduces velocities further, enhancing rates of sediment deposition. The result is a massive de-silting requirement as part of annual maintenance.

**2.9 Water Losses:** In the Gezira scheme seepage losses are virtually nil due to the extremely impermeable nature of the soil and subsoil. Irrigation water does not contribute to the deep groundwater table underlying the scheme. Evaporation and breakage from the canals to the roads and fallow areas are the major sources of water losses from the system. Therefore, the water use efficiency of the irrigation network is potentially very high.

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<sup>20</sup> Designated as "Abu Ishrin" or "Abu xx" which literally means "father of 20" meaning that the canal governs 20 field channels. The Abu xx conveys water to the "numbers".

2.10 **Drainage:** The present drainage system consists of 1,500 km of major drains and about 6,000 km of minor drains. There are no on-farm drainage facilities due to the nature of the soil and absence of high groundwater table. The main purpose of the drainage is to remove the surface runoff due to rain or excess irrigation.

### **Operation of the Irrigation System**

2.11 **Crop Rotations:** The Gezira scheme was built with the primary objective of producing cotton. The land is divided into 114,000 tenancies<sup>21</sup> with an average size of 20 feddan (about 8 ha). Each tenant has plots in four numbers (tertiary units) and has to plant according to the approved rotation so that all the cotton fields are together, all the fallow together in another "Number" and so on. In the very early days a six-course rotation was practiced, but following some failures, this was changed in the early 1930's to an eight-course rotation (cotton, fallow, fallow, cotton, fallow, sorghum, lubia, and fallow) with nominal cropping intensity of 50 percent. This kept the demand for water within the capacity of the irrigation system to deliver. Since that time there has been further diversification and intensification. Until recently, the main Gezira scheme had a nominal intensity of 75 percent in a five-course rotation of cotton, sorghum, groundnuts, wheat with one fallow, while the Managil extension had 100 percent with no fallow. At the present, however, fallow has also been introduced in Managil where the target cropping intensity is 75 percent throughout, although various problems have kept the actual intensity well below that figure in recent years.

2.12 **Water Management:** Current water management in the Gezira Scheme is substantially different from the original design, which was used satisfactorily prior to the 1960's. The two-fold expansion of the irrigation area and successive crop intensification in mid-1960's following completion of Managil extension required additional quantities of water to be diverted and distributed. Accordingly, the volume of water released to the system at Sennar increased by more than three-fold from 2,000 million cubic meters in 1957-58 to 7,100 million cubic meters in 1997-98 – equivalent to about 35 percent of the Sudan's share of the 1959 Nile Water Agreement, measured at Sennar. The additional amount of water carries a greater volume of silt, particularly because diversion of irrigation water from the Sennar Dam begins a month earlier than before, at a time when silt concentration in the Nile is at its peak. Therefore, considerably more extensive annual silt and weed removal activities are necessary to keep the system in good working condition.

2.13 In order to distribute the increased quantity of water required for intensification, most of the branch and major canals are being operated with higher than the original design water levels, and the minor canals that operated as night storage canals are now flowing continuously. The present practice of canal operation does not pose a major problem when the canal networks are adequately maintained. However, it becomes problematic and causes breaches of the canal banks and excessive loss of water when the canals are silted up, because the water levels need to be raised even higher to deliver the same quantity of water. At higher water levels the control structures in the canals cannot function efficiently.

2.14 The management of the GS in respect to irrigation water has always been divided between the Ministry of Irrigation and Water Resources (MOIWR) and Sudan Gezira Board (SGB). MOIWR is responsible for supply and delivery of water to the minor canals. In 1995, MOIWR established the Irrigation Water Corporation (IWC), a financially independent parastatal, to operate and maintain the irrigation system in the GS and other large central Government-owned

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<sup>21</sup> This is the official number of tenancies, but informal information from the SGB indicates that the number of tenancies has increased to about 128,000. The mission could not obtain an up to date statement of the number of tenancies and their size distribution from the SGB.

irrigation schemes. Therefore, until recently, IWC/MOIWR was also responsible for maintenance of the minor canals, but this arrangement failed because water rate collections declined and the IWC filed for bankruptcy. The responsibility for the distribution of irrigation water in the minor canals and below was then transferred to the SGB in March 1999. SGB is now also responsible for operation and maintenance of minor canals down to the field level as well as the collection of water charges.

2.15 In practice the tenants are already involved in operation and maintenance of the smallest field canals (Abu Sittas)<sup>22</sup> and *de facto* control of the operation of the larger tertiary canals (Abu xx). On the other hand maintenance of Abu xx canals is carried out by SGB at the tenant's expense. The tenants have no formal groups for the coordination and management of operation and maintenance activities. In Chapter 6 it will be *recommended* that such groups be established to improve the efficiency of water management and maintenance and to collect water charges.

### **Serious Deterioration in the Status of the Irrigation System**

2.16 The Gezira Scheme has a long history of satisfactory performance to the extent that it has been used as model for design and development of all other major irrigation systems in Sudan. In recent years, however, the Scheme has been run down because of increased silt deposits and insufficient funding for repair and maintenance. The operation of the scheme is inefficient and there is a lack of equity and reliability of water supply to tenants.

2.17 **Siltation of Canals and Drains:** The amount of silt entering the Gezira Scheme has increased significantly over the years. The main sources of siltation are the Blue Nile waters, wind-blown material and canal banks eroded by rain, and animal crossings. Historical data available for 1933-38 and 1988 suggest that average sediment concentrations in the water flowing through the Gezira main canal in August have increased four fold. This increase is attributed to: (a) the diversion of much higher quantity of water due to the successive extensions of the scheme to its present size, and increased crop intensity; (b) the use of water in late July and early August, when sediment concentrations are at their highest; (c) the reduced trapping efficiency of the Roseires and Sennar reservoirs as their dead storages are silted up; and (d) the increased erosion in the Blue Nile catchment area in Ethiopia.

2.18 The amount of silt deposition varies from year to year and is usually higher in the dry years when more water is diverted from the Blue Nile. Physical conditions of the canals and the amount of silt removal backlog also play an important role in the annual silt deposition in the canals. Studies conducted by Ministry of Irrigation's Hydraulic Research Station in collaboration with Hydraulic Research Ltd., U.K. in the late 1980's suggest that average annual silt deposition in the Gezira canals is from 5 to 10 million m<sup>3</sup>. MOI's experience, however, indicates that in recent years the average amount has been even higher than 10-million cubic meters (about 6.8 cubic meters/feddān, or 16.0 cubic meters/ha). Of the sediment entering Gezira irrigation canals (at km 57), approximately 5 percent settles in the main canals; 23 percent in the majors and branches; 33 percent in the minor canals and the remaining 39 percent pass on to the field. Therefore, of the total quantity of silt deposited in the canals, 54 percent ends up in the minor canals.

2.19 The minor canals are generally silted up and infested by luxuriant weed growth to a degree that little water reaches the tail end of the numbers and some areas are now out of production. Minor canals are in worst condition as the proportion of the annual silt deposition in these canals (54 percent) is more than the total amount deposited in all the remaining Gezira irrigation canals

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<sup>22</sup> Designated as "Abu Sittas" or "Abu vi"; literally "father of six" meaning that the canal governs six field channels. The Abu vi conveys water to the farmers field called a "hawasha" in a number .

combined and the amount removed has been far from sufficient. The main, branch and major canals are generally in better condition, although severe weed infestation and pockets of shallow silt deposits near the banks are common. In the last five years canal regulators and structures have not received any repair and /or maintenance and most do not function correctly. Water escapes at the main and major canals are not in good working condition. The result of all these shortcomings has been rising canal beds and water levels, "drowned" control structures, excessive loss of water, difficulties in supplying parts of the scheme with water, and reductions in cropped area.

**2.20 Silt Removal:** There has been a major effort to clear silt from the canals, but this has not kept pace with the rates at which silt is settling. The annual quantity of silt removed from the canals declined by 48 percent, from a peak of 14.2 million m<sup>3</sup> in 1995/96 season to 6.9 million m<sup>3</sup> in 1998-99. As a result, there is a large backlog of silt, the amount of which is increasing rapidly as more silty water is forced (with slow velocities) through a network of highly deteriorated and partially obstructed canals. In the 1980's when the irrigation canals were in better conditions removal of five to seven million cubic meter of silt was considered to be satisfactory. Nowadays, with the irrigation canals in poor condition, removal of 10 to 14 million cubic meter of silt from the canal, or a two fold increase is not nearly satisfactory.

2.21 Until recently, de-silting and de-weeding operations were carried out solely by the Earthmoving Corporation (EMC), a parastatal that was formerly a division of MOIWR. At present, however, a number of qualified private contractors with adequate capability and equipment have emerged. These private contractors are actively competing with EMC, which is currently facing financial difficulties. Indeed, it is understood that private contractors have taken over more than 85 percent of the excavation and earthmoving work in Sudan. A number of these private contractors are active in the Gezira Scheme.

2.22 A significant canal de-silting program started in March 1999. Some 13 private and public contractors were mobilized to carry out the works. The program is planned to remove the silt backlog entirely, particularly in the minor canals, and set the stage for a regular annual de-silting program in the coming years. By the end of October 1999, nearly seven months after the start of the program, a massive quantity (32.5 million m<sup>3</sup>) of silt had been removed (4.6 million m<sup>3</sup>/month) which is greater than the total quantity of silt removed in the last three years. Much more de-silting remains to be done, as many canals visited by the mission are still heavily silted and infested by weeds. No particular program for repair and maintenance of the water regulators and gates has been planned for the near future. It is *recommended* that plans for de-silting and the repair of regulators be formulated and costed pending decisions on the future institutional arrangements for the Gezira Scheme.

2.23 Traditionally, manual labor was used for removal of weeds, but this practice has been abandoned due to health hazards such as bilharzia. Chemicals also are not being used against weeds because of environmental reasons and budgetary constraints which preclude hiring specialized foreign contractors. The IWC used excavators with specialized weed-cutting buckets for removing weeds with very limited success. The main problem with this approach has been lack of funds, particularly foreign exchange, for maintenance of the equipment. At present, only four out of twenty excavators are operational and de-weeding activities are limited. In practice, removal of weed is incidental to the on-going de-silting operations that are carried out by contractors.

**2.24 Maintenance Costs:** The deposition of silt and weeds in the canals has become the most serious technical problem of the Gezira Scheme. The operation and maintenance expenditures by IWC have averaged US\$14.3 per irrigable hectare (SDinar 6.1/feddan) per year over the last four years. More than 60 percent of which was spent on de-silting of canals, alone. The amount spent

on de-weeding and maintenance of regulators was very low and accounted for only one percent and four percent, respectively. These O&M expenditures are clearly below what is considered adequate for an unlined irrigation system which under harsh climatic conditions suffers from severe chronic siltation and weed infestation problems. Continuous decline and deterioration of the irrigation infrastructure over the last four years reflects the inadequacy of maintenance. Experience suggests that adequate operation and maintenance would cost anywhere between two to three times the amount currently being spent annually (about SD2.1 billion, or US\$8.2 million).

**2.25 Cost Recovery:** Until March, 1999 IWC established water charges per crop on the basis of its annual budget for operation and maintenance of the irrigation infrastructure, approved cropping pattern and water requirement of individual crops. The proposed budget was negotiated with SGB prior to presentation to the IWC board of directors, which included farmers representatives and members of the SGB and sister bodies managing other irrigation schemes. In the budget negotiation process the proposed budgets were reduced considerably, before approval. The capital recovery costs that were always included in the proposals, although modest, were never approved. In the four-year life of the IWC, the average reduction of the proposed (and realistic) annual budgets was 38 percent. Under the new arrangements, SGB will set annual water rates to be charged per crop, based on the annual O&M budget negotiated with Gezira Irrigation Administration and the agreements reached with the Farmers' Union representatives.

2.26 Irrespective of the agreed water charges, they are not levied if crops fail which establishes a disincentive for farmers to ensure a successful crop. Although, the irrigation network is equipped to measure water discharges in the primary system down to the minor canals as mentioned already, accurate measurement is not currently possible due to the deterioration of regulators and the higher than designed water levels in most canals. Water charges in the GS are therefore flat annual rates per crop regardless of the number of irrigations and/or the amount of water used by the tenants. This does not offer any incentive for the tenants to conserve water. Charges are also levied if irrigation water is not delivered.

2.27 Water charges are low in terms of total costs of production (only five to seven percent of direct farm input cost), but the annual revenues generated are not sufficient to cover the costs of an adequate level of operation, maintenance and the timely replacement of the irrigation and drainage facilities.

2.28 Under the current arrangement SGB collects water charges for cotton through the tenant individual account system set up in 1981. Water charges for other crops are collected by SGB, directly from the tenants at harvest time. The amount to be paid is based on the harvested rather than cropped area as determined by the SGB Inspector. If there is a dispute as to whether a water charge should be paid, a committee is established which then meets to resolve the dispute.<sup>23</sup> Figure 7 in Annex 3 shows the fluctuations in water charge collection rates over the last ten years. The average total water collection rate for the last ten years was very low at 41 percent of the amount budgeted. SGB's payments to IWC were similarly low with a sharp decline from a high of 82.9 percent in 1996-97 season to a low of 5.7 percent in IWC's final full year of operation, namely 1998-99.

2.29 The low level of water charge collection has resulted in low funding of operation and maintenance activities which in turn led to the deterioration of irrigation infrastructure and low level of services to tenant farmers. Consequently, large areas went out of production (either due to water shortages or flooding) and cropping intensity fell to a mere 37 percent in 1998/99 season

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<sup>23</sup> The committee is made up of the field inspector, a village council representative, a Farmers Union representative, the accountant for the block, a member of the security corps, and the sammad.

with significant losses to tenants. This in turn led to the inability of the tenants to pay water charges. This vicious cycle, which is discussed in more detail in Annex 3, continues today. In Chapter 6 it will be *recommended* that charges for water be levied according to the amount used.

## OTHER INFRASTRUCTURE<sup>24</sup>

### Roads

**2.30 Features:** There are about 18,000 kilometers of roads along the canal system and 30,000 kilometers of farm access tracks. All these roads are unsurfaced dirt roads and are almost impassable after the rain and part of the rainy season. The roads are important for general communications and the transport of goods and services, and yet in most parts they are deteriorated and in need of considerable rehabilitation.

**2.31 Constraints and Actions:** The increasing population and motor vehicle use have resulted in heavier traffic than the original design of these roads. Lack of adequate maintenance and poor drainage together with heavy traffic are the contributing causes of deterioration of the roads. While there is no specialized technical section within the Engineering Department of the SGB, road maintenance is carried out by administrative blocks - usually ad-hoc and is limited to light surface grading. It is *recommended* that the capacity of any central Gezira Scheme administration to maintain the road network should be strengthened either through force account or contracting.

### Gezira Light Railway

**2.32 Features:** The Gezira Light Railway (GLR) network was built in 1919 for the purpose of transporting seed cotton from the collecting centers to the ginneries and delivering agricultural inputs such as fertilizers, seeds, herbicides and sacks to the field. The railway covers about 75 percent of the scheme and includes some 900 km of narrow gauge track connecting 119 cotton-collecting centers. In addition to main lines there are some 437-km of station loops, branches and tracks in yards and around ginning factories.

**2.33** In 1998/99 season, GLR transported some 11 million-ton km of agricultural products, or about 30 percent of the Gezira transport demand. Privately owned and operated trucks transported the remaining 70 percent at very competitive rates. GLR has been particularly effective in the wet season when many of the Gezira roads are impassable. GLR has been able to compete with trucks on the short-hauls by introducing a low rate of SD 30 per ton km, which is based on its annual expenses and projected demand, but includes neither amortization nor major maintenance. The rates charged by private trucks are SD 30-35 per ton km for the short hauls, and less than SD 30 per ton km for the long hauls.

**2.34 Constraints and Actions:** GRL is equipped with 62 locomotives and 1,800 wagons. The number of operational locomotives and rolling stock is seriously depleted because of inadequate maintenance. In addition many of the tracks which are often damaged at road crossings by vehicles and by floods are in need of substantial repair. It is not likely that the private sector would find the railway system an attractive investment. It is therefore *recommended* that the GLR remain under the authority of the Scheme, but it is also *recommended* that an intensive review of its efficiency and long term justification be made at the earliest opportunity.

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<sup>24</sup> The information in this section is drawn from various sources such as direct interviews with SGB officials in the infrastructure units, data provided in writing by the officials, and various documentation on the assets of the GS such as in Bank Report 4218-SU, *Sudan: Gezira Rehabilitation Project*, Staff Appraisal Report, World Bank, May 15, 1983.

## **Department of Agricultural Engineering**

**2.35 Features:** In principle all land allocated to cotton production in any year is prepared for planting by the SGB's Department of Agricultural Engineering using its fleet of tractors and cultivating equipment. This Department is in theory also responsible for the cleaning of Abu xx canals, land preparation for cotton including ridging before planting, application of pre-emergence herbicides, the broadcasting of fertilizers, and sometimes wheat and sorghum harvesting, and the threshing of groundnuts. Currently the Department has a staff of 44 engineers/ technicians and 368 mechanics, drivers and laborers, all of whom are permanent. It undertakes only about 30 percent of the work for which it was established and the remainder is contracted out to the private sector at the same approved rates the tenants are charged for the Department's services through their individual accounts. It is understood, however, that the Department still does all the cleaning of Abu xx canals.

**2.36 Constraints and Actions:** The main constraints faced by this Department are the same as similar field units in a centrally managed organization elsewhere in Africa. It has a large area to cover, a large and complex inventory of equipment, a huge staff management challenge with public sector overheads, and financial conditions such as its fees and a budget which are set by a central bureaucracy – namely the SGB. Under such conditions it is difficult to be flexible and competitive with the private sector. Indeed, in the past this Department has not been able to cover its costs, although it appears that the reverse was true for 1998/99. Nevertheless it is not clear that adequate provision has been made for depreciation of vehicles, machinery and equipment.

**2.37** While no judgement can be made about the quality of the Department's work compared with the quality of work done by the private sector, there have been complaints about the quality of land preparation for cotton in the GS. Delegating its work to the private sector is logical because of the inability of the Department to handle all the land preparation commitments, but supervision of the work of the private sector may not have been adequate. There is no reason in principle why the private sector should not undertake all land preparation and related crop preparation activities. This would place the responsibility on tenants for deciding on who should and at what cost. The Department may wish to remain as a competitor with the private sector rather than have the responsibility to arrange for all the work. It is *recommended* that tenants be given the choice as to whether the Department or private contractors plow their land .

## **Ginneries**

**2.38 Features:** All cotton produced in the GS is sent to one of the Scheme's 12 ginneries according to the location of the tenant and the variety of cotton. Many of these ginneries date back as far as 1927 but have been renovated to varying extents and also some have been converted from "roller gins" to "saw gins" which are more suitable for the ginning of Acala cotton. Some ginneries are still not mechanized. The ginneries currently have a permanent employment of 194 administrative and professional staff and 1,208 permanent machine operators. During the 1999/2000 ginning season an additional 530 temporary administrative/professional and 4,493 temporary machine operators and field laborers were employed.

**2.39 Constraints and Actions:** Operating these ginneries has become a major challenge because of their age and the shortage of spare parts. Many of the spare parts are now manufactured by the Gezira workshops because these parts are either no longer available or because of the shortage of foreign exchange.<sup>25</sup> It was not possible for the mission to obtain a

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<sup>25</sup> Despite an expenditure of \$21.86 million on the rehabilitation of ginneries under the Gezira Rehabilitation Project (1983) the overriding need remains the further rehabilitation of the ginneries in order to make them more efficient. The basis for moving forward is available in a report prepared under the

complete profit and loss statement for the ginneries, but it is known that in 1998/99 annual operating costs were 80 percent of annual revenue that year. But costs did not include depreciation and taxes. The exact profit is therefore difficult to assess but it is not likely to have been large. Data received on costs and revenues for the previous year, when throughput of seed cotton was much larger, show a similar situation. Nevertheless, earlier (audited) partial accounts suggest that significant profits can be made from the ginneries. While there are some who maintain that the close institutional connection between the production and processing of cotton needs to be kept intact through the continued public sector ownership of the ginneries, there is a stronger view that ginneries should be moved out of the public sector and offered for sale<sup>26</sup>. The joint team *recommends* that the ginneries be offered for sale at a time (probably in a year or two) when the longer term demand for ginneries in the Gezira has been clarified.

## Workshops

2.40 **Features:** The SGB workshops have become vital units for the continued operation of the GS. There are four workshops in the GS. Three provide general support and the fourth specializes in vehicle repairs. The general workshops undertake a range of activities including the rehabilitation of locomotives for the Gezira Light Railway, the manufacture of spare parts for the ginneries (about 40 percent of the spare parts required by the ginneries are produced in the Gezira workshops), the rehabilitation of many types of engines, the repair of farm equipment including the rebuilding of crawler tractors, and various types of sheet metal work. In addition the workshops do contract work for the private sector in the region. It was not possible to obtain any financial information on the workshops but it is likely that, given the difficult financial position of many of its clients within the GS, the workshop would be fortunate to break even.

2.41 **Constraints:** Unfortunately the workshop buildings and machinery are old. Much of the machinery is at least 40 years old and working conditions are difficult to say the least. Despite their age these workshops operate quite effectively and are staffed by dedicated staff although many who become qualified leave for better paying jobs.<sup>27</sup> The extent to which these workshops are required in future will depend on the type of institutional change that takes place in the Gezira. Nevertheless, regardless of the institutional change, they are a substantial capital and human asset, despite the age of the machinery and buildings. This is an attractive operating unit, although it needs rehabilitation. It would be a strong candidate for sale to the private sector but, depending on the future role of the SGB, it may be a valuable asset for sustaining its services on a charge-back system. It is *recommended* that the future status of the SGB workshops be examined in an independent study.

## Telecommunications

2.42 **Features:** The telephone system in the Gezira is vital for the exchange of many types of information within the Scheme on matters such as water levels in canals to accounting and financial information. There are some 2,100 telephones on the system of which 1,184 are radio telephones. The current network was financed under the Gezira Rehabilitation Project at a cost then of \$29 million. The system is operated by a total staff of 52 of whom 13 are engineers.

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Gezira Rehabilitation Project (1983); see *Improvement of the Efficiency at Ginneries and Handling of Seed Cotton and Lint: preparation of Guidelines and Specifications for the Establishment of an Industry Management Information, Accounting, Inventory and Materials Handling System*, 1990. Prepared by Agriculture Australia Ltd.

<sup>26</sup> Note, for example, the recommendations of the Presidential Committee on irrigation schemes in 1998.

<sup>27</sup> The Gezira Rehabilitation Project had allocated \$21.6 million to the rehabilitation of workshops and their machinery but virtually nothing was disbursed before the project was closed.

2.43 **Constraints and Actions:** The telecommunications equipment installed in 1984 came with a commitment from the Japanese supplier that spare parts would be available for a period of 15 years. During this period some spare parts were purchased but the shortage of foreign currency was a major impediment. With the passing of the time limit of the availability of spare parts the unit is even more vulnerable to spare parts not being available. In general this unit has made a profit from its activities since it has also sold its services for private communications in the area. For example it obtains LS7 million per month from the national carrier SUDATEL by renting equipment. It is *recommended* that in the near future the Gezira Telecommunications Center becomes integrated into the national telecommunications grid.

## CONCLUSIONS

2.44 This chapter has covered many issues, but a recurring theme has been that while the basic infrastructure of the Gezira is sound in terms of its design, it has become inefficient because of serious deterioration resulting from poor management and inadequate financing. Subject to decisions on institutional change as the basis for improved management, additional finance will be needed to bring the "public" infrastructure to a minimum acceptable standard. The justification for expenditures should emerge from a careful analysis of the benefits and costs of rehabilitation. At the same time some of the infrastructure would be more appropriately managed by the private sector. In this respect many of the recommendations made in this chapter are the same as those made earlier by the Presidential Committee on irrigation schemes.

### 3. AGRICULTURAL TECHNOLOGY <sup>28</sup>

3.1 Technology development is fundamental to growth and efficiency in agriculture. The main purpose of this chapter is to briefly assess the available technology for crop management and production in the Gezira. It examines differences between yields achieved under research conditions and in farmers' fields compared with the genetic potential yield levels for each of the main crops. The chapter also includes an assessment of the status of institutions responsible for research and the extension of technology, and integrated pest management.

#### MAJOR ISSUES

##### **Agricultural Research** <sup>29</sup>

3.2 The Gezira Scheme is fortunate to have one of Sudan oldest and largest agricultural research stations located near its headquarters. The Gezira Research Station (GRS) at Wad Medani was established in 1918 to serve the Scheme and subsequently became part of the Agricultural Research Corporation (ARC). It has a well-trained, experienced and competent staff of some 246 research scientists of whom 99 have PhDs. There are some 70 researchers in the GRS, most of whom work on issues related to the Gezira Scheme. The GRS staff have developed production technologies suitable for environmental conditions in the Scheme. The greatest impact of the GRS has been in areas such as germplasm improvement (i.e. the development of new cultivars for the major crops), breeder and foundation seed (see Box 3.1), crop protection, and the introduction of groundnuts, wheat, citrus

##### **Box 3.1: Seed Maintenance, Propagation and Certification**

**Cotton:** The high quality of Sudanese cotton in earlier years was to a large extent the result of high quality seed. Maintenance, propagation and certification remained the joint responsibility of the SGB and the ARC since the inception of the scheme. Variety maintenance was the responsibility of ARC; seed certification was the responsibility of SGB. Propagation was divided among the two institutions. ARC provided the breeder and foundation seed, but the cost of producing it was the responsibility of the SGB. The production of registered seed and certification were the responsibility of SGB.

For the last three seasons (1997/98 to 99/00) the SGB has failed to provide the ARC with funds to meet the cost of the technical staff supervision and field transportation for the identification of foundation seed. Field visits were consequently reduced and roguing (cleaning and removing off types) was reduced. This resulted in serious variety mixing in the cotton fields, which progressively lowered the grades, the prices and market reputation.

Organizational changes in the Agricultural Administration in the SGB have resulted in the Seed Propagation Department working on a commercial basis. The SGB can obviously not certify its own production. A separate certification authority is under consideration by the National Production Committee (formerly the Cotton Varieties Committee).

**Other Crops:** For sorghum, wheat and groundnuts the ARC periodically provides the SGB (and other irrigation schemes) with breeder seed. No further technical support is provided.

*Source:* Ahmed Salih Fadlalla, Agricultural Research Corporation

<sup>28</sup> Some of the material in this chapter is based on information provided directly to the mission. The report of an FAO Reconnaissance Mission (17 November, 1999) which preceded the Bank mission and focused, inter alia, on technical issues in agriculture was also a very useful source of information for the mission.

<sup>29</sup> This section is based on a paper prepared for a workshop held during the mission in Sudan in November 1999 by Dr. Osman A. A. Ageeb, former Director General of the Agricultural Research Corporation.

trees and some vegetables. For each of the main crop varieties grown in the GS appropriate input packages have been developed that could bring the yields for these varieties in line with yields in well-managed comparable irrigation systems in other parts of the world.

3.3 Technological options are at present not a constraint to the efficient production of crops in the GS because of the substantial investment into research at ARC in the past. Nevertheless, the continued sustainable development of irrigated agriculture is only possible if based on continued strong research programs that develop higher levels of productivity and efficient diversified production technologies. Such work will, however, need assured long term funding to be successful. It is *recommended* that the funding of ARC be increased to ensure that its research team has the resources to maintain its vital work ensuring that technical progress in Sudanese agriculture continues. The joint team considers that sustained and substantial support for ARC is a high national priority. Economic factors which influence yield levels will be discussed in Chapter 4.

### **Extension of Research Results**

3.4 With support from externally funded projects, research results were quickly tested in demonstration plots and they showed that yields in the Gezira could be raised considerably. With the help of partners such as Global 2000 and FAO information was disseminated relatively quickly through field days, radio and television, and field visits. In the process close relationships were established between the extension service and farmers of the Gezira. In 1996 the S.G.B changed the extension structure as part of a Scheme-wide effort to reduce costs and increase efficiency. The position of agricultural extension officer in each of the 18 group offices was abolished and the responsibility for extension was transferred to about 300 field inspectors with the objective of increasing the ratio of extension officers from 1:7,000 to 1:400. But while the ratio of extension officers improved it may have weakened the support received by farmers since the field inspectors also had administrative and management responsibilities. These duties not only take up their time but because of their regulatory content can result in conflict with farmers and prevent establishing a constructive advisory relationship with them. It appears that the extension system was weakened, although the introduction of farmers' field schools has introduced more vigor into the system (see Box 3.2). To date there has been no assessment of the effectiveness of farmers' field schools.

3.5 The central units of the Extension Department at GS headquarters at Barakat were maintained albeit at a reduced staff level. They attended to functions such as training of field inspectors, supervision, preparing guidelines, monitoring and evaluation, and providing technical back stopping. These units, however, worked under considerable difficulties since funds were severely limited for travelling, printing of training and information materials, and for the maintenance and replacement of printing machines, photocopiers and audiovisual equipment. It is widely acknowledged that the quality and coverage of the extension service has recently deteriorated to an unsatisfactory level and is in urgent need of improvement. It is *recommended* that fixing this shortcoming be given a high priority by the SGB.

### Box 3.2: Farmers Field Schools (FFS)

In 1996, the FFS were adopted as the main strategy for training of farmers in all aspects of crop protection and production for all crops with the objective of affecting a qualitative change in behavior, skills and attitudes of farmers.

A plan of work was issued with the following directive:

- The Extension Department will perform its central role of supervision, guidance, monitoring, technical back stopping, training and evaluation of FFS.
- All activities of FFS at group level will be handled by field inspectors.
- More attention should be given to practical training and participatory approach.
- Field inspectors should be trained in the methodology of FFS and technical aspects necessary for running FFS.
- Establish one FFS immediately in 113 blocks and to increase the coverage year after year and eventually cover all Gezira farmers in four years.
- Formulation of steering committee at Barakat headquarters composed of members from ARC, Ministries of Irrigation, Health, University of Gezira, representative from tenant and trade union, and concerned departments in the Agricultural Administration of the SGB to plan and evaluate the FFS program.
- Formulation of local committees at group level from top administrators and specialist at the group level.
- The responsibility for administration and supervision of the FFS at group level was given to the deputy group inspector who should report to the Director of Extension.

In the first year 1996/1997 113 FFS were established and in the second year 1997/1998 the FFS were increased to 249 FFS, and in the third year 1998/1999 the number amounted to about 450 FFS.

All field inspectors have been trained on relevant subject matters, and a range of booklets have been made available to them which cover the whole of FFS curriculum. Both training and booklets, were a joint effort between IPM program, ARC and extension department.

*Source:* Mohamed Sid Ahmed (Manager, Agricultural Extension Department, SGB)

### Crop Protection and Integrated Pest Management <sup>30</sup>

3.6 Cotton is attacked by four main insect pests. Their incidence and the severity of the damage they cause vary by years with environmental conditions. In earlier years repeated (typically eleven) spraying of insecticides by air was the predominant approach to insect control but this led to considerable pollution and diminished the role of natural enemies. Integrated Pest Management (IPM) reduced the required average number of sprayings from six per season to four. This has had considerable implications for the cost of cotton production since the cost of insecticides is the largest component of cotton production costs. IPM was later extended to vegetable production. Box 3.3 contains a brief review of the genesis and achievements of the IPM program.

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<sup>30</sup> This section draws from contributions made to the mission by Elamin M. Elamin (Director, Crop Protection Research Centre (ARC), Ahmed Hassan Mohamed (Director, IPM Research and Training Center, ARC), Asim Ali Abdelrahman (ARC), and Abbas Hago Elnazar (Crop Protection Manager, SGB)

### Box 3.3: Achievements of Integrated Pest Management (IPM)

In 1979 an integrated pest management (IPM) project was initiated with the support of the Government of the Netherlands (as well as other donors such as the World Bank) and executed by the ARC and FAO. The project included four phases; the first three (1979-93) were devoted to cotton and the fourth phase (1993-96) was focused mainly on vegetables.

The main achievements of the first three phases of the IPM research program were the release of the recommendations in 1993 which led to the reduction of pesticide usage. Cotton spraying was reduced from six to four per season. The reduction in the number of sprays saved cotton farmers about \$10 million per season for the chemicals and application costs. The reduction in the pesticide application also had a positive impact on the environment, and particularly on the possibilities of promoting the role of natural predators for the insects which attacked cotton.

A notable achievement in phase four was the introduction of the IPM Farmers' Field Schools and the establishment of the IPM Research and Training Center in the Gezira Research Station. The Center, with the assistance of ARC scientists, designed curricula for the FFS, trained the FFS trainers, prepared training materials and monitored the progress of the IPM training at the FFS. As mentioned in Box 4.1, FFS now also cover production, human health, and the environment.

After the termination of the Netherlands-supported IPM program, a FAO Technical Cooperation Programme (TCP) supported a continuation of work but it was concluded in August 1998. This has resulted in a substantial reduction in the output of the IPM Research and Training Center.

*Source:* Ahmed Hassan Mohamed and Asim Ali Abdelrahman (ARC)

3.7 The assessment of pest infestation in the field is conducted by well-trained SGB technical staff. They are supervised by assistant entomologists under the supervision of an entomologist who evaluates the pest situation and is the only person making decisions on spraying and the selection of the pesticide to be used. Spraying is supervised by crop protection staff assisted by the field inspectors and their staff. It is selective according to insect infestation. Loading of insecticides on aircraft is carefully monitored, spray delivery systems on aircraft are calibrated to ensure that they deliver the right quantities, and chemicals are carefully stored to eliminate pollution.

#### **Actual Yields Fall Far Short of Technical Possibilities**

3.8 Table 3.1 shows that, in spite of the availability of technically proven and economically viable improved production and pest control packages, as well as the good linkages that exist between the GRS/ARC, the SGB and tenants, average farm yields for all crops other than groundnuts and onions are 30 to 40 percent of achievable levels based on field research. The federal Ministry of Agriculture and Forests has acted to improve average productivity by involving senior ARC leaders in the Ministry and senior ARC research staff in joint committees along with Gezira field staff and farmers to regularly evaluate the constraints to increased productivity. The committees pay frequent visits to farmers' fields during the growing season to identify production problems and give on the spot advice to farmers. They also report to the Ministry on progress. These committees and the farmers' field schools have created an awareness of production problems in the GS and have highlighted the demand for improved technology. But, regrettably, these joint efforts have become less frequent because of a shortage of funds to finance their activities.

**Table 3.1: Comparison of Potential, Research and Farmer Yields for Major Crops**

Type of Crop	Yields				
	Potential Yields	Research Yields	Farmer Yields		
<b>Cotton</b>	(kantar seed cotton per feddan)				
Extra Long (Barakat)	16	12	4.5		
Long (Shambat)	18	14	5.0		
Medium (Acala)	22	18	5.5		
	(tons per feddan)				
Wheat	2.5	2.0	0.6		
Sorghum	2.5 (open)	3.0 (hybrid)	2.3 (open)	2.7 (hybrid)	0.8
Groundnuts	2.8	2.0	1.2		
Onions	16	12	8		

Source: Agricultural Research Corporation

Note: 1 Kantar = 315 lbs seed cotton; 1 feddan = 1.038 acres = 0.42 hectares

Potential yield = The genetic yield potential under optimal growing conditions

Research yield = Yield under a standard set of practices and research management

Farmer yield = The average yield on farmers'/tenants' fields

### **Evidence that Higher Yields can be Achieved**

3.9 Frequent visits by research staff to farmers' fields have also assisted them to obtain feedback about the performance and suitability of their recommendations in the field. Research staff therefore have a basis for focusing on specific problems and the GRS research program has become more "demand-driven". GRS staff have gained considerable experience in carrying out participatory research in farmers' fields. An example of this work is described in Box 3.4. The results show that farmers who adopted recommended technology and crop management practices can regularly achieve wheat yields approaching research levels, that were double the average yield for the block, and were 35 and 70 percent higher than farmers in the same "number."<sup>31</sup> Unfortunately this research work has also ceased due to lack of financial support. Nevertheless, with adequate advice, tenants could take advantage of improved technologies that are already available for many crops suitable to the Gezira environment. While constraints on rotations have been considerably relaxed, the compulsion to grow cotton, at times under sub optimum conditions, means that tenants remain imprisoned in a cycle of weak incentives and low productivity. The efficient solution is for tenants (in groups) to take responsibility for their own choice of crop rotations in accordance with their own evaluation of the soils and micro climate on their land.<sup>32</sup> The only limitation to such choices should be water management and technical constraints.

<sup>31</sup> The GS is divided into 18 large units called "groups" which range in size from 60,000 to 190,000 feddans. Each group is divided into smaller units called "blocks" that range from 4 to 10 per group. Blocks are divided into "numbers" which are 90 feddans each. The numbers are divided into "hawashas" which are usually parts of farms. A tenant may have two or more hawashas in different numbers making up the total area of his/her farm.

<sup>32</sup> Note that FAO funding for the completion of a GIS-based agro-ecological zonation study for the Gezira has been approved for implementation. This work, when completed, will be of considerable value to researchers and to tenant groups as the basis for choosing crop rotations.

### Box 3.4: Some results from Pilot Production Plots in the Gezira Scheme

Research staff from the Gezira Research Station (GRS) have worked with nine cooperating farmers in the Wad Hemaïdan village in one "number" (an area of 90 hectares) located in Dirweesh block providing advice on the production of irrigated wheat. All farmers within the number and the block received the standard inputs provided by the Gezira Board such as cultivation of the land, seed, fertilizer and water supplies. The cooperating farmers used the management practices recommended by the ARC. Over the years 1986/87 to 1988/89 the wheat yields achieved by farmers were measured and compared with the yields achieved by other farmers who were producing wheat in the number and the block of which the number is a part. The results were as follows:

Item	86/87	87/88	88/89	Average
Sowing date	9-11 Nov, 86.	31 Oct, 87	14 Nov, 88	
Number of irrigations	6	7	7	
<u>Yields</u>		tons grain/ha (tons grain/feddan)		
Average yield for cooperating farmers	3.9 (1.6)	3.7 (1.6)	4.6 (1.9)	4.1
(1.7)				
Average yield for non-cooperating farmers	2.3 (1.0)	na	3.4 (1.4)	na
Average yield for block	1.8 (0.8)	1.7 (0.7)	2.0 (0.8)	1.8
(0.8)				

These results provide evidence that under the recommended management practices much higher yields can be obtained than under the current practices adopted by farmers. Indeed, the yields of cooperating farmers approached research yields (see Table 3.1).

Source: Gezira Research Station, ARC (Osman A. A. Ageeb)

### Livestock

3.10 In 1986 a detailed review of livestock activities in Gezira found that some 90 percent of households (tenants and non tenants) in the Gezira Scheme owned some livestock, including camels, horses, donkeys and poultry. In general rich tenants have large numbers with a substantial proportion of cattle, while those without land have small numbers of predominantly small ruminants.<sup>33</sup> In 1999 the SGB staff estimated that about 40 percent of tenants owned cattle and small ruminants. Table 3.2 summarizes the estimated distribution of these livestock numbers in 1998.

**Table 3.2: Estimated Number of Cattle and Small Ruminants in the Gezira Scheme 1998**

Type of Livestock	Numbers
Cattle	247,490
Sheep	590,000
Goats	1,126,380

Source: Sudan Gezira Board

Note: Livestock numbers in the Gezira vary considerably throughout the year according to the availability of feed which is in turn a function of the cropping cycles. The numbers in the table above are average numbers through the year.

3.11 In the early days of Gezira there was little assistance from the SGB with the introduction of livestock into farming systems. In the early eighties, however, an Animal Production Unit in the Agricultural Administration was established with quite broad functions ranging from advice on fodder crop production to artificial insemination. Research Support is also provided by the

<sup>33</sup> See Government of Sudan, *Gezira Rehabilitation Project: Livestock Integration Study*, July 1987.

Agricultural Research Corporation which has developed viable production packages for livestock enterprises in the Gezira. On the other hand, funds for further research are severely limited. Livestock fit easily into the current five course rotation (or any other rotation) since there is a substantial amount of biomass (mainly crop residues) produced on all farms that can be put to greater use in animal feeding. The major problem facing livestock producers, however, is the absence of a reliable winter forage crop and animal parasites.<sup>34</sup>

3.12 Earnings from livestock are an important supplement to incomes received from irrigated crops and is indeed a vital supplement to the household income for the average tenant in the Gezira. While milk production from cows (and to some extent goats) is popular, researchers have drawn attention to the scope for a greater diversification in the range of livestock production activities, and greater integration of livestock production into farming rotations. Such integration would be promoted by giving farmers greater flexibility of crop choice allowing them to move away from the compulsion to follow a five course rotation and using a larger proportion of their farm for livestock production. The importance of livestock in the farming system is reflected by the evidence that tenants who own livestock generate more income and are better able to finance their crop production than tenants without livestock.

### CONCLUSIONS

3.13 This has been a very brief overview of technology issues. It was not intended to be a detailed treatment of all the issues and obviously important matters such as weed control technology, future mechanization and alternative crops have not been discussed. Nevertheless the core conclusions are clear. First, a considerable stock of technology is available for implementation. Second, agricultural research must be continued intensively and funded on a sustained basis so as to ensure continued availability of improved technologies.

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<sup>34</sup> The availability of considerable crop residues does not, however, ensure adequate feed availability throughout the year. For example, it has been estimated in ARC that the total annual demand for energy by animals under a five course rotation is about 17 million mega joules, compared with an annual availability of 15 million mega joules (Osman Ageeb, personal communication).

## 4. THE ECONOMICS OF CROP PRODUCTION

4.1 This chapter will show that crops grown in the Gezira Scheme can be profitable for the typical tenant but because yields of all crops are lower than achievable levels farmers struggle to make ends meet. As a result casual labor and nearby towns struggle and the SGB loses money every year. This poor performance has been a chronic problem in the Gezira despite the Government's decontrol of prices and most markets since 1992 which was intended to stimulate the agricultural sector.

### MAJOR ISSUES

4.2 The analysis below will first outline the farming situation for tenants in the GS. Since yield is crucial to crop profitability, the chapter will then discuss the reasons for the generally low crop yields. The profitability of crop production is then assessed for a base case scenario that assumes average current yield performance by farmers, and two other scenarios using two higher yield levels. This is followed by an evaluation of the profitability of specific crops in the standard rotation in the GS from the national point of view.

#### Structure of Farming in the Gezira Scheme

4.3 **Farm Size.** Surprisingly it was not possible for the mission to obtain a detailed size distribution of tenancies in the GS. It is known, however, that although there is some variation, farms are typically 20 feddans with four feddans for each of the four crops in the standard five-course rotation with four feddans remaining for fallow.

4.4 **Crop Rotation.** Although a variety of crops is grown in the GS, cropping patterns must be consistent with the design of the irrigation system, specifically, with efficient water use. The present cropping pattern is the result of a rigidly set crop rotation or sequence over a five-year period. The current "five course" crop rotation sequence in the Gezira has been used since the 1991/92 crop year and is as follows.<sup>35</sup>

Cotton – Sorghum – Groundnuts - Wheat (or other winter crop) - Fallow

4.5 This sequence is used Gezira-wide and, while farmers can make a choice of which summer and winter crops they grow, they must grow cotton in designated areas in the summer as decided by the SGB. In technical terms the current rotation is regarded as a major advance on previous rotations. First, following cotton with sorghum forces farmers to clean their fields quickly of disease-harboring cotton plants in order to make timely preparations for the planting date for sorghum. Second, following wheat with cotton (with a fallow year in between) allows cotton to benefit from the residual phosphorous and nitrogen fertilizers used for the wheat crop.

4.6 **Cropping Calendar.** Only one crop is grown per year on a given area and the typical timing of harvesting and planting of each crop is shown in Table 4.1

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<sup>35</sup> It is understood from discussions in Sudan in May, 2000 that the standard rotations is to be changed to cotton – wheat – sorghum – groundnut – vegetable/fallow.

**Table 4.1: Cropping Calendar for Major Crops in the Gezira Scheme**

Crop	Planting	Harvesting
Acala	July	December/January
Barakat	August	January-March
Sorghum	June/July	October/November
Groundnuts	May/June	October/November
Wheat	November	March

4.7 In recent years, sorghum has been the main crop in terms of area in the Gezira Scheme with an average of 35 percent of total area planted, followed by wheat (25-30 percent) but trending sharply downward, cotton (under 25 percent) and groundnuts (about 20 percent). Sorghum has occupied the largest area because of its role as both a fodder and a subsistence grain crop. However, cotton is the dominant crop in economic terms because of high costs and, sometimes, high benefits for the SGB from its production as well as its importance to farmers for cash income, and to the economy for the foreign exchange it generates (see Annex 4, Table 16).

4.8 **Gezira Board Support for Crop Production.** While the SGB requires farmers to grow cotton because of its importance to the national economy and of course to the SGB itself, SGB provides considerable financial support to tenants for the production of cotton.<sup>36</sup> This support has been provided because the Scheme is centrally managed and farmers have had few choices in respect to plowing, aerial spraying and other major production decisions in respect to cotton production. The dependence of tenants on the SGB is reinforced by the fact that there are no formal credit institutions that tenants can use to finance their irrigation farm operations independently. In summary, the SGB provides the following services at present:

- Plows and furrows land designated for cotton production;
- Applies pre-emergence herbicides when necessary;
- Provides seed and fertilizer for planting;
- Advice on cultural practices and crop management;
- Arranges with the Ministry of Irrigation and Water Resources for irrigation water supplies and for its distribution throughout the scheme;
- Operation and maintenance of irrigation canals (minors and below);
- Assesses the need for aerial spraying against insects and then arranges for and supervises; the aerial spraying at the appropriate time;
- Provides cash advances to tenants for harvesting costs;
- Undertakes the ginning of cotton in the Gezira Board ginneries;
- Arranges with the Sudan Cotton Company for the transport of lint cotton from the ginneries to Port Sudan or local textile mills and for the marketing of cotton.

4.9 The costs associated with all these services (plus the SGB administrative charge) are deducted from the tenant's individual account after the cotton is sold and the proceeds net of marketing costs and export tax are received from the Sudan Cotton Company. Table 21 in Annex 4 provides an example of a typical tenant account.

4.10 In the past similar support was provided by the SGB for the production of other crops, but this has been discontinued. Tenants producing other crops may, however, contract independently with the SGB for plowing, fertilizer supplies and other services but this is now of minor

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<sup>36</sup> Support to tenants in financing inputs was provided by irrigation authorities as far back as the first large pump irrigation scheme on the Nile at Zeidab established in 1908. See Galal Mohamed Yousif, *The Gezira Scheme: The Greatest on Earth*, 1997.

importance. Of course tenants producing these other crops get irrigation water deliveries and pay for the maintenance executed by the MOIWR and the SGB. As discussed in Chapter 3, tenants benefit from the work of the ARC and to some extent, from the SGB extension service.

### Factors that Depress Yields of All Crops in the Gezira Scheme

4.11 **Lack of funding for labor for crop management and harvesting.** Farmers rely on hired labor to various degrees for their crops. Because of financing problems, farmers must also economize on this out-of-pocket expense. Hired labor used for supplementary land preparation, thinning, weeding and even harvesting must be curtailed, which depresses yields even more. In the case of cotton, farmers are supposed to receive cash advances from the SGB to cover the costs of labor hired for cotton planting, weeding and harvesting. The financial problems of the SGB have limited these cash advances.

4.12 **No Formal Financial Intermediation.** It is well known in Gezira that tenants with their own adequate financial resources for farming have better results than those who do not.<sup>37</sup> The shortage of funds for farm operations on the tenant's side can be attributed in large part to the near total lack of formal financial intermediation in the GS which is a problem affecting Sudan nationally. When farmers do have years of surplus, there is no financial institution which farmers trust in which to deposit cash surplus. Therefore, the irrigation farmer, like the less privileged rainfed farmer, continues to live from year to year without the possibility of building savings to provide a cushion when a bad year strikes. Consequently there has been almost no wealth accumulation in the Gezira, despite its longevity and government support to tenants.<sup>38</sup> The SGB-administered "individual account" system has to a large extent substituted for a formal credit system. The availability of the individual account system, together with no interest payments on outstanding debt past one year and debt forgiveness for tenants twice in the last 20 years, has no doubt also dampened the emergence of private credit institutions. It is possible that the recent reduced SGB involvement in the financing of non-cotton crops will stimulate the emergence of other sources of credit.

4.13 Lack of access to adequate finance on the SGB side is because of previous poor management performance that has led to a large debt burden and year to year cash flow difficulties. The current situation is that the SGB cannot finance inputs and labor cash advances for tenants in a sufficient or timely manner. It should be acknowledged that the current SGB management has gone to extraordinary lengths to obtain funds to finance its obligations. This will be discussed in more detail in Chapter 6.

4.14 **Shortage of Irrigation Water.** For all crops, the number of actual irrigations used by farmers is less than recommended (see Table 4.2). The lower number of irrigations is the result of the declining efficiency in water delivery infrastructure discussed already in Chapter 2. Less frequent irrigation reduces yields.

**Table 4.2 Actual and Recommended Number of Irrigations by Crop**

Crop	Actual	Recommended
Cotton	10-12	16
Wheat	6	8
Groundnuts	5	8
Sorghum	5	8

Source: Socio-Economic Unit- Sudan Gezira Board, 1999

<sup>37</sup> Osman Ageeb (former Director General, ARC), personal communication

<sup>38</sup> See Tony Barnett and Abbas Abdelkarim, *Sudan: The Gezira Scheme and Agricultural Transition*, Frank Cass, 1991 for a discussion of the absence of capitalism in the Gezira Scheme.

4.15 Another important effect on yields relating to water supply is the “head to tail effect.” The head to tail effect refers to the gradually diminishing supply of water as it travels to plots that are further and further away from the source. These plots are said to be at the tail of the irrigation flow. Farmers at tail ends have lower yields and, therefore, lower incomes. As Table 4.3 below shows, the head to tail problem is acute in the GS resulting in about 50 percent reduction in yield for cotton and typically about 30 percent loss for other crops. Another feature of this table is the substantial difference between the yields in the two systems. The differences may have been a function of the year in which the study was made, but it does suggest the possibility of lower incomes in Managil although the areas of tenancies there are smaller.

**Table 4.3: Yield Effects on Crops Because of Distance from Water Source**

Crop	Gezira Main		Managil	
	Head	Tail	Head	Tail
Cotton ( kantars seed cotton/feddan )	5.14	2.99	4.48	2.20
Wheat (tons/feddan)	0.57	0.39	0.41	0.30
Groundnut (tons/feddan)	0.40	0.31	0.45	0.27
Sorghum (tons/feddan)	0.51	0.35	0.47	0.39

Source: “Socio-Economic Impacts of Irrigation Water Shortages at the Tail ends of the Gezira Scheme Canalization System,” The Sudan Gezira Board, Planning and Socio-Economic Research, (supported by a Ford Foundation technical assistance grant), November 1995.

4.16 Despite the assistance that tenants receive the typical Gezira farmer operates within a vicious circle in his production and marketing processes. Farmers’ lack of financial resources to finance even one season’s production has made every facet of the production process from land preparation to final sale of the crop less efficient. Box 4.1 shows the priority problems cited by farmers in the field interviews during the main mission for this work in November 1999.

**Box 4.1: Farmers' Problems - Type and Frequency**

During the preparation of this report members of the joint team visited farmers in the Gezira who listed the following problems facing them. The results follow.		
	<u>Total</u>	<u>Percent</u>
Insufficient labor cash advance from SGB	11	20.0
Shortage/timing of irrigation water	9	16.4
Inadequate/late land preparation	9	16.4
Delayed payments for cotton crops	4	7.3
Inadequate pest control	4	7.3
Cleaning of Abu Ishreen	4	7.3
Inadequate health problems - malaria, bilharzia	3	5.5
Water charges too high	2	3.6
Cost of spraying too high	2	3.6
Low returns	2	3.6
SGB should market production and protect prices	2	3.6
Improved varieties not available	1	1.8
Silting problems in canals	1	1.8
High taxes	1	1.8
<b>Total</b>	<b>55</b>	<b>100.0</b>

4.17 **Land preparation.** As the SGB withdraws increasingly from land preparation farmers must pay cash for the service provided by the private sector, but often arranged by the SGB. Because of inadequate financial resources farmers understandably try to save on such costs (or contractors cut corners). Land preparation is often not carried out with sufficient care to provide a good seed bed and, therefore, a good yield. For example, unless the seed bed for wheat is very fine, yields will be low and production unprofitable.

4.18 **Inadequate application of fertilizers and pesticides.** Inputs procured by the SGB often arrive too late for planting, or not at all. In addition, farmers who are supplied fertilizers for cotton production have pressing household needs and they sometimes decide to sell fertilizers supplied by the SGB to obtain cash, rather than apply the recommended quantities to their fields. The inadequate application of fertilizers further depresses yields. To their credit SGB staff and management have gone to extraordinary lengths to obtain funds to finance SGB obligations to tenants.

### **Crop-Specific Factors that Reduce Yields**

4.19 **Cotton (Extra Long Staple-Barakat and Medium Staple-Acala).** All of the above issues have negatively affected cotton yields. Because cotton is labor intensive requiring 65-70 man days per feddan to produce, the lack of financing to hire labor is especially damaging to yields. Since many farmers have very low liquidity, they once again are forced to scrimp, because labor for crop establishment and maintenance is an out of pocket expense (unlike other cotton input costs that are provided on credit by the SGB). The harvesting or picking stage is the most labor-intensive phase of cotton production. In recent years, farmers report that the SGB advance pays only a small portion of the labor costs for harvesting, with farmers financing the rest. As a result subsequent cotton planting is often late which reduces yields. This occurred in the 1999/2000 season with devastating effects on yield and incomes.

4.20 A distinguishing feature of cotton production, which has demoralized farmers recently, is the delay of many months in payments for their cotton (see Box 4.1 above). This is basically an issue of slow disbursement of the proceeds from Gezira cotton sales by the SGB. On the production side, the delayed payment makes farmers less willing to use the full complement of inputs, particularly those that require out of pocket labor expenses. As a result, yields are depressed as farmers economize at the expense of important cultural practices.

4.21 **Sorghum (grain).** Sorghum also suffers from the problems faced by other crops described above resulting in yields that are only half of the potential. Fitting sorghum into the rotation has also been problematic because of the termite problem (see groundnuts below).

4.22 **Wheat.** Wheat was not a traditional crop in the GS but the rapid rise in the demand for wheat (stimulated to a large extent by subsidized bread prices in the past) led to an expansion of production promoted by Government “crash programs” in irrigation systems such as the Gezira in the mid-1980s as a food security crop. In the early 1990s, wheat became a mandatory part of the four crop-one fallow rotation. Wheat production in the Gezira, however, has had many difficulties. Yields declined in the late 1990s, because of inferior land preparation, and a loss of farmer confidence in being able to grow wheat profitably. Even in its best year, average yields were only a little above half of their reasonable potential. On the other hand Chapter 3 shows that under the right conditions and with recommended crop management wheat yields in tenant’s fields can approach research yields. With liberalization of the market for all grains, imported wheat out-competed domestic wheat, and wheat farmers incurred losses. In crop year 1998/99, wheat cultivation was no longer mandatory. Farmers are now free to grow other winter crops such as sunflower and sesame, or vegetables in place of wheat. The Government’s wheat policy in the early nineties has, however, left a serious legacy of heavy debts on tenants and the Scheme.

It was yet another example of the failure of Government control over farmers' production decisions.

**4.23 Groundnuts (hand selected, oil, and cake).** Farmers in the Gezira reported widespread problems with termites because of the current standard rotation. Termites develop in the sorghum stalks left from the previous year and seriously affect the groundnut crop which follows. Sorghum stalks are left in the field longer because of their role as fodder. This problem remains unsolved.

**4.24 Vegetables.** Vegetables may be grown in the crop rotation, either in conjunction with groundnuts or in place of wheat or other winter crop. Vegetables are for domestic consumption. The main vegetables cultivated are onions and tomatoes. Although statistics are not as detailed as for the major crops, it is estimated that onions and tomatoes account for about 60 percent of the total area under vegetable cultivation.

### **Marketing, Production, Processing and Payment Issues**

**4.25 Cotton:** The Gezira tenant farmer does not receive payment for seed cotton delivered to the Gezira ginneries until:

- (a) the seed cotton has been ginned, baled, transported, stored, and shipped.
- (b) the proceeds have been transferred from the SCC to the SGB after port charges, commissions, export taxes (no longer levied) and other trading cost charges ; and SCC Commission and
- (c) the SGB deducts the costs of inputs (for all crops) and services it has provided to tenants during the production process, pays state and local taxes and zakat, and also paid other operational expenses such as SGB salaries and utility bills. Even after this process tenants are usually not paid in full; final payments often follow months later.

**4.26** Farmers who make a profit after deductions for inputs and services, often do not receive their payment until 4-12 months after delivery of their crop for ginning. For example, at the time of the field interviews for this report (November 1999), many farmers still had not received payment for cotton that was delivered to ginneries in November and December of 1998. Apart from the delayed payments, the actual prices received by tenants are also difficult to explain. For example, it has been possible to reconstruct the average price received by tenants for average quality Acala cotton in the 1998/99 season using information from the SGB. The typical price received by tenants from the SGB for average quality Acala seed cotton in 1998/99 was \$33.9 per kantar of lint (see Table 21, Annex 4 which reproduces a typical account for a tenant who delivered cotton for processing cotton in 1998/99). On the basis of information on export receipts for cotton and marketing costs incurred by the Sudan Cotton Company (Table 20 in Annex 4) the price received by tenants is 77 percent of the fob price of lint at Port Sudan.

**4.27** On the other hand Table 4.4 shows that, on the basis of the world price for Acala cotton (fob Port Sudan), and deductions for marketing costs and export taxes paid by the SCC together with the value of cotton seed, the SGB should be in a position to pay \$40.43 per kantar of lint to producers. This estimate compares with the actual payments to producers of \$33.90 per kantar of lint mentioned in the previous paragraph. Both these prices are "pre State tax returns". This difference indicates a considerable "implicit tax" on producers that is not explained by the information on the costs of marketing and ginning of cotton and the value of seed cotton. Discussions with SGB staff failed to uncover an official explanation for this difference.

**4.28** The preceding analysis raises many questions related to the efficiency of the institutional arrangements for cotton marketing and the payments to producers. These matters will be discussed in Chapter 6 where all the institutional issues will be brought together.

**Table 4.4: Summary of Price Formation for Acala Cotton for the Gezira Tenant (1998/99)**

Item	Amount (\$/kantar lint)
World market price for Acala (fob Port Sudan) \a	44.0
Less: Marketing costs incurred by Sudan Cotton Company \b	4.84
Net price from Sudan Cotton Company to the Sudan Gezira Board \c	39.16
Less: Cost of ginning undertaken by the Sudan Gezira Board ginneries \d	6.60
Less: Cost of transport of lint from Gezira to Port Sudan \e	1.13
Plus: Value of seed sold by the Sudan Gezira Board \f	9.11
Net possible price to tenant (before deduction of SGB costs and state taxes)	40.43
Price received from SGB (before deduction of SGB costs and state taxes) \g	33.90

\a Based on the mission's analysis of international prices for cotton (see Annex 4, Table 22 )

\b Based on 11 percent of the fob price. The basis of this assumption is the cost of marketing Barakat cotton obtained from the Sudan Cotton Company (See Annex 4, Table 20)

\c Price received by Sudan Gezira Board for distribution to tenants.

\d See Annex 4, Table 12. This cost represents the cost of ginning a kantar of seed cotton (315 lbs) which then yields a kantar of lint (100 lbs). This cost was charged to tenants at a rate LS per kantar of seed cotton.

\e See Annex 4, Table 22

\f Equivalent to the yield of seed from a kantar of cotton

\g This is the average implicit price received by tenants for Acala from the SGB used to calculate their revenue from cotton production. (See Annex 4, Table 21).

4.29 **Non-cotton crops.** All sales of crops such as groundnuts, wheat and sorghum are sold on the private market. By all accounts this is quite a competitive market. Medium sized traders sell to the retail traders in the market and usually transport the produce from the farm. Mission field interviews revealed that these traders' have fairly narrow margins but this is compensated for by the volume of their business. Margins for retail traders are usually about ten percent of the sales price and sometimes even less. Retail traders improve quality by sorting and cleaning the grain which is understood to result in a three percent loss. In relatively rare cases does the SGB choose to purchase crops on its own account. It then often uses these crops for further trading in exchange for goods and services it requires.

### **Processing of Cotton and Grain Crops**

4.30 Large mills in the immediate vicinity of the GS, whether for cotton lint, cotton seed, groundnuts or wheat, operate well below capacity or are entirely idle. Gezira simply does not generate enough production now to keep the factories operating at anywhere near their break even points. The Wad Medani Textile (WMT) mill has been using rainfed cotton for several years because it was more economical than Gezira cotton, even though the plant is located in the Gezira region. It is understood that the same plant plans to shift to polyester fibre exclusively within the next few years.

4.31 Wheat marketing has had a bleaker experience. The Gezira Flour Mill (GFM) had been idle for 5 months at the time of the mission. It was reported that the GFM does not mill wheat from the Gezira Scheme; rather it mills imported wheat. Gezira wheat is not favorable for bread baking. Because there is no demand for Gezira wheat from bakeries, the GFM does not mill it. Imported wheat is also less expensive, at LS480,000 per ton, compared with LS620,000 ton for Gezira wheat in 1999. Much of the Gezira wheat obtained by the GFM is re-sold as grain to farmers in the north for seed, and even to the seed propagation department at the SGB. Even wheat-based animal feed is imported. Staff at the mill felt that reinstating trade protection from imported wheat would lead to increased demand for Gezira wheat. This reports argues against such a policy

4.32 Processing of sorghum and groundnuts is done by small and large mills. Farmers provide the raw product with mills having to improve on the decortication for groundnuts by the farmers. Small mills are located near the market where consumers to have their sorghum / or wheat milled at LS4,500 per sack.

4.33 The Gezira Oil Mill (GOM) is designed to produce both cotton seed oil, for the domestic market, and groundnut oil, for the export market. The production manager, an ex-staff member of the SGB, said that the mill had not produced groundnut oil for several years. The mill remains open by producing soap. The manager complained also of high taxes on production which add substantially to the final cost of output. Groundnut cake costs LS17,000 per sack before taxes and LS23,000 after (35 percent increase), while groundnut oil costs LS23,000 per 8.1 kilo tin before taxes, and LS29,000 after (26 percent increase).

### **Crop Production Costs**

4.34 Table 4.5 lists all major production costs per feddan for the major crops in the Gezira rotation. Cotton is by far the most expensive crop to grow, owing mainly to the much higher pesticide and herbicide inputs, and somewhat higher labor cost. Water charges and administrative charges are also higher for cotton, but the difference represents only about 1 percent of total costs. Because crop year 1998/99 was an unusually poor year for production, costs from the previous crop year, 1997/98, are used for the analysis.

4.35 These costs assume a constant yield level. At higher yields, costs would be slightly higher for sacks, harvest labor, and transport, but not enough to materially affect net revenue results.

### **Net Revenue for Different Crops**

4.36 Table 4.6 shows the three yield assumptions converted to standard measures (tons per feddan) and the net returns by crop per feddan in both Sudanese pounds and dollars. The "Base Case" is based on the most recent seven years yield data (with high and low yield years taken out). The "highest achieved" is based on the best production years reported by farmers during field interviews. The "research yield" is based on ARC farm trial data. Cost figures are from Table 4.4 and are based on the 1997/98 crop year. Hence, the exchange rate applicable to this analysis for conversion to US dollars is SL2,000 per US\$1.0.

4.37 Although cotton is the most expensive crop to grow, it is also the most profitable on a unit area basis. Barakat is more profitable than Acala, which confirmed the perception of farmers interviewed in the field. Under typical yields, sorghum is the next most profitable after Barakat, followed by groundnuts and wheat. If the better case yields are achieved, then wheat is the next most profitable after cotton, with sorghum and groundnuts following at about the same profit level.

**Table 4.5: Production Costs by Major Crop for Crop Year, 1997/98**  
(LS/feddan)

Item	Cotton		Other Crops		
	Acala	Barakat	Wheat	Groundnut	Sorghum
Land Preparation	30,250	30,250	24,715	10,600	14,815
Labor					
- Cultural Operations	43,078	43,249	16,800	28,916	21,537
- Harvesting/Picking	58,821	52,221	14,867	63,500	34,385
Material Inputs					
Seeds	11,965	12,814	45,093	7,000	5,687
Fertilizers	51,684	51,684	65,801	0	26,099
Herbicides	30,041	30,041	0	0	0
Pesticides	100,438	100,436	9,928	0	0
Sacks	12,270	10,677	13,342	43,500	21,600
<b>Subtotal</b>	<b>206,398</b>	<b>205,652</b>	<b>134,164</b>	<b>50,500</b>	<b>53,386</b>
Services	12,380	12,380	0	0	0
Land/Water charges	21,600	21,600	16,201	16,850	13,000
Admin. Charge	16,380	16,380	13,520	13,000	11,700
Transport	29,074	25,643	4,561	11,500	0
<b>Subtotal</b>	<b>79,434</b>	<b>76,003</b>	<b>34,282</b>	<b>41,350</b>	<b>24,700</b>
<b>Total Production Cost</b>	<b>417,981</b>	<b>407,375</b>	<b>224,828</b>	<b>194,866</b>	<b>148,823</b>

Source: Gezira Board Socio-Economic Unit

### The Role of Livestock

4.38 Livestock also play an important role in the Gezira Scheme. The estimated number of livestock in Gezira is 458,000 animal units. An animal unit is equal to 500 kg. of animal weight. About 40 percent of tenant farmers own livestock. Paragraph 5.18 provides more details.

4.39 On the basis of calculations made by the mission, net economic benefits from cows are substantial with annual rates of return of up to 60 percent, based on milk production. Goats and sheep have lower returns, also based on milk production, but are still profitable. Although livestock are beneficial to household incomes, the benefits are dependent on Gezira crops for fodder. As discussed in Chapter 3, the limited supply of fodder is a substantial constraint to livestock expansion in the Gezira. Typically, tenants graze livestock on land outside the Gezira for part of the year. Nevertheless, within limits, livestock do offer potential for increasing income and improving nutrition in the Gezira. The current five-course rotation expressly includes crops that can be used for fodder, specifically, sorghum stalks and groundnut residues.

**Table 4.6: Net Returns to Tenant Management for Major Crops, 1997/98**

Item	Cotton		Other Crops		
	Acala	Barakat	Wheat	Groundnuts	Sorghum
<b>Yields</b>	(tons per feddan)				
Base Case Yield	0.58	0.55	0.59	0.79	0.84
Highest Achieved Yield	1.40	1.33	1.01	1.12	1.07
Trial/Research Yields	1.85	1.76	1.81	1.18	1.26
<b>Farmgate Price(LS/ton)</b>	807,663	1,081,439	380,000	273,000	220,000
<b>Prodn. Costs (LS/feddan)</b>	417,981	407,375	224,828	194,866	148,823
<b>Net Return (LS/feddan)</b>					
Base Case Yield	51,232	182,721	27,772	73,634	101,377
Highest Achieved Yield	711,413	1,029,242	211,046	182,578	171,675
Trial/Research Yields	1,075,177	1,491,958	551,325	202,971	227,523
<b>Exchange Rate</b>	2,000	2,000	2,000	2,000	2,000
<b>Net Return (US\$/feddan)</b>					
Base Case Yield	25.62	91.36	13.89	36.82	50.69
Highest Achieved Yield	355.71	514.62	105.52	91.29	85.84
Trial/Research Yields	537.59	745.98	275.66	101.49	113.76

Source: Sudan Gezira Board Socio-Economic Unit and mission estimates. Based on crop year 1997/98

## Credit

4.40 Given the scarcity of financing for crop production, alternative formal credit institutions could play an important role, if balanced with effective savings mobilization to sustain the source of credit. The seasonal demand for credit may be estimated as the total of out of pocket production costs for tenants in the Gezira. On this basis the total maximum annual financing requirement would be SL287 billion, equivalent to \$144 million. If only the top third of credit-worthy farmers were financed, then the credit amount would be SL92 billion (\$48 million). If a successful reform of the Gezira financing arrangements were instituted, and barring disastrous weather conditions, the percentage of external financing of expenses would decline as farmers generate income and save.

## National Perspective on Economics of Crop Production

4.41 In addition to farmer net returns, it is important to analyze profitability and protection/taxation of the major crops from the national point of view. The national perspective on the economics of crop production of crops in the GS is based on whether there is net benefit or net cost for the economy. There are a number of standard measures for assessing these benefit and cost effects. They are the domestic resource coefficient (DRCs) and net protection coefficients (NPCs), which have been calculated for major crops for 1997/98 and 1998/99.

4.42 The DRCs measure the net foreign exchange that domestic resources can generate in the production of a particular crop. A DRC above the number one means that the opportunity cost of domestic factors of production used in producing a crop exceeds the additional value added at world prices from producing that crop for export, and hence the net benefit of producing it

domestically is negative. In other words, it is costing the nation more to produce than is gained from the sale on the export market.

4.43 NPCs are the value added (usually the price) in the production of a commodity at domestic prices divided by the value added (again usually the price) in the sale of the same commodity in the world market. An NPC above one means that the production of the commodity is protected by current policies (i.e. producers are receiving a price in domestic markets that is higher than they would on world markets). On the other hand if the NPC is below one it means that the production is being taxed by current policies (i.e. producers are receiving a price on the domestic market that is less than they would if they were to sell the commodity on world markets). An NPC close to one means that there is competition between the domestic and export markets which indicates free movement of commodities and no net interference in trade. Table 4.7 shows the prices used in the DRC and NPC calculations, while Table 4.8 shows the yields used for the calculations.

**Table 4.7: World Prices of Crops**

Commodity <sup>a</sup>	1997/98	1998/99
Cotton Lint		
Barakat (U.S. \$/lb.)	0.80	0.70
Acala (U.S. \$/lb.)	0.54	0.44
Wheat (American II-\$/mt)	142	110
Sorghum (\$/mt)	120	90
Groundnuts (HPS-\$/mt)	500	550
Oil (\$/mt)	850	700
Cake(\$/mt)	120	130

<sup>a</sup> All prices are fob Port Sudan., except for wheat which are c.i.f.

Sources: Sudan Cotton Company, Sudan Oil Seed Company, Ministry of Agriculture and Forests

**Table 4.8: Yields of Major Crops Used for DRC Analysis**

Commodity	1997/98	1998/99
Cotton Lint		
Barakat (kantars/feddan)	4.07	4.07
Acala (kantars/feddan)	4.61	4.61
Wheat (mt/fd)	0.70	0.27
Sorghum (kg/fd)	941.9	728.0
Groundnuts (HPS-kg/fd)	1040	464.3

4.44 The DRC calculations show that in most cases crops produced in the Gezira are very profitable from the national point of view (Table 4.9). The exceptions are sorghum and wheat but only for crop year 1998/99, which was an exceptionally poor year for yields, as Table 4.8 shows. The DRC for cotton includes the values of lint, seed and escarto products. Cotton seed exports are still prohibited by law. The DRC for sorghum includes its fodder value. Shells, oil and cake are incorporated into the DRC for groundnuts. The assumption is that in one sack of groundnuts, 55 percent account for the shell, 17 percent for oil, 25 percent for cake and 3 percent for losses. The DRC calculations for 1991/92-92/93 from the 1995 report were very consistent with the calculations for the later years, although indicating slightly higher profitability than in 1997/98. The exception was wheat, which was estimated to be much more profitable by the earlier DRC. The main reasons were the higher yields achieved during the 1991/92-92/93 crop years.

4.45 The NPCs from 1991/92-92/93 show that all crops were heavily taxed by the economic policies at the time. The liberalization that took place in 1993 is reflected in the higher NPCs,

**Table 4.9: Domestic Resource Costs and Net Protection Coefficients for Major Crops and Livestock, 1991/92-1992/93, 1997/98 and 1998/99**

Crops	DRC			NPC		
	1991/92-92/93	97/98	98/99	1991/92-92/93	97/98	98/99
Long Staple cotton	0.19	0.29	0.26	0.57	0.82	0.77
Medium staple cotton	N/A	0.50	0.65	N/A	0.90	0.78
Groundnuts	0.26	0.28	0.96	0.52	1.03	1.01
Sorghum	0.77	0.73	1.23	0.52	1.78	2.05
Wheat	0.24	0.68	-0.78	0.58	1.34	1.08

Sources: Mission calculations and World Bank report *Supply Prospects for Agriculture*, World Bank, 1995 unpublished. For technical notes and assumptions, see Annex 4, Part B.

approaching unity during 1997/98-98/99. Cotton, probably because of its cash generating nature, is still taxed and the tax increased significantly in 1998/99. The bulk of the cotton taxes are in the form of export tax (5 percent) and state and local taxes (12 percent). As expected, the level of taxation for long and medium staple cotton are about the same. Groundnuts are neither taxed nor protected. Sorghum, as the main food crop, is fairly highly protected. Wheat was once protected, as the NPC of 1.34 for 1997/98 shows, was fully liberalized by the following crop year, reflected in the NPC of 1.08 for crop year 1998/99.

### Incomes and Profitability from the Gezira Scheme

4.46 **Estimating Revenue:** Variations in the shares of different crops planted and cultivated in the GS are clear from Table 4.11. It also shows the large slump in area in 1998/99. Sorghum has been the most widely cultivated crop. During 1990/91-94/95, food crops/grains dominated the area under cultivation. For the purpose of estimating total revenue from the GS in an average year, a five-year average of areas has been used. For all three cases an average of the last five years has been taken, yielding the averages in Table 4.10.

**Table 4.10: Average Area used for Major Crops (1990/91 to 1994/95)**

Period	Barakat	Acala	Wheat/Other Winter Crop	Groundnuts	Sorghum	Total
	(feddans)					
5-year average area	82,337	145,425	397,845	199,139	431,116	1,255,863

Source: Sudan Gezira Board, Socio-Economic Unit.

**Table 4.11: Areas Designated by the Gezira Board for Production by Crop 1990/91-98/99**

Season	Cotton	Wheat	Groundnut	Sorghum	Total
(% of area planted)					('000 feddan)
90/91	18	43	3	36	1,411
91/92	14	35	2	48	1,509
92/93	12	35	11	42	1,474
93/94	11	37	13	39	1,407
94/95	19	30	15	36	1,304
95/96	23	30	18	30	1,317
96/97	24	28	18	30	1,374
97/98	22	27	20	31	1,111
98/99	22	18	21	39	693

Source: Calculated from area data obtained from the Socio-economic Research Unit, Gezira Board

4.47 Combining the estimated net return per feddan by crop for the three yield scenarios and multiplying by average areas of each crop in the scheme yields an aggregate net revenue for the scheme for the three scenarios. The results are shown in Table 4.12.

**Table 4.12: Estimated Total Annual Net Revenue for the Gezira Scheme by Crop**

Scenario	Barakat	Acala	Winter Crop	Groundnuts	Sorghum	Total
	(US\$'000)					
Base Case Yield	3,725	7,522	5,524	7,332	21,853	45,956
Highest Achieved Yield	51,729	42,372	41,982	18,179	37,006	191,268
Research Yield	78,179	61,422	109,671	20,210	49,045	318,526

Source: Calculated using net return from table 4.6 and average areas from Table 4.10

4.48 In the base case scenario, that is for current yields, area cultivated and prices, the GS tenants should realize an aggregate annual net revenue of about \$46 million in 1997/98. Distributed across roughly 114,000 tenants, the average net revenue per tenant household would be \$403 per annum. With the higher yield scenarios, average annual net revenue per tenant household would be \$1,677 (highest achieved), and \$2,793 (research yield). Wheat would appear to be the most profitable crop at the higher yield scenarios. However, the higher yield scenarios for wheat require a much larger improvement in yields relative to the other crops. In addition, Gezira wheat has encountered serious marketing obstacles, namely, that imported wheat out-competes Gezira wheat on price and quality. So, there is a strong likelihood that increases in wheat production would not find a market. This is not the case for the other crops. Cotton would generate the greatest net revenue with Barakat leading Acala, and sorghum next, with groundnuts last. It is also worth noting that for base case yields the rate of return from crops produced in the Gezira would be about one percent per annum if the Scheme is valued at \$4 billion.<sup>39</sup> For the "highest achieved yields" it would be about 4.5 percent

4.49 **Indicative Rate of Return:** In addition to the estimated earned incomes indicated above, some 40 percent of tenants would earn an additional income from livestock.<sup>40</sup> Nevertheless by far the most important addition to income is derived from off farm income. While precise data are not available reliable estimates show that on average tenants in the Gezira earn 60 to 70 percent of their annual earnings from off farm employment. If it is assumed that 60 percent of earnings are derived from off farm income then with an average household income for the base case of \$403 per year, total household income (with no additional income from livestock) would climb to \$1,008 per annum or \$168 per caput. This is still less than the average GDP per caput for the whole of Sudan namely \$290 in 1998. Although there is no formal poverty line in Sudan at present, it is not likely to be below \$168 per capita and hence families who earn 60 percent of their income off farm and achieve the average crop yields are unlikely to be above the poverty line unless they earn a substantial income from livestock. For yields typically achieved by farmers during their best production years ("highest achieved yields"), household income (including off farm income but not including livestock) would rise to \$4,193 or \$699 per caput which is well above average Sudanese income levels. This at last would be an attractive income.

## CONCLUSIONS

4.50 The main conclusion from the economic analysis is that all major crops typically grown in the Gezira can be profitable at both the farm and national level. This profitability holds even for conservative yield assumptions, which are of course much higher than yields achieved at present, and without the inclusion of indirect benefits such as the stimulus to economic activity in the

<sup>39</sup> See paragraph 2.1 for estimates of the estimated value of the Gezira Scheme.

<sup>40</sup> See paragraph 4.38.

immediate vicinity. Cotton, especially Barakat, is the most profitable, although that would probably change if supplies were increased above current levels since the World market for Barakat is constrained. Groundnuts and sorghum are the least profitable although the calculations do not take into account the impact on soil fertility of groundnuts nor the value of sorghum stalks. Cotton carries higher risk than other crops because insects are a hazard and inputs are far more costly (roughly twice as costly) than for the other crops and therefore reasonable yields must be achieved to avoid substantial losses. Satisfactory incomes can be earned from Gezira farms but, even with income from livestock, extraordinarily high incomes are not likely without further technological change (e.g. the introduction of new rotations leading to a higher cropping intensity) or productivity change (with current rotations). Therefore tenants will probably always want to supplement their farm incomes with work off the farm at certain times of the year when agricultural activities are reduced. Barnett and Abdelkarim have said, "... in Gezira, and similar areas, we can hardly talk about an agrarian capitalist class"<sup>41</sup>, but that was a judgement in the light of existing technology. It could change if new technologies and higher value crop emerge.

4.51 The second major conclusion is that the poor performance of Gezira agriculture is largely determined by the poor performance of the SGB and the total lack of financial intermediation other than for cotton (through the SGB). Input and water delivery for cotton, as currently provided by the SGB, are inefficient, resulting in low yields and farmer dissatisfaction. Farmers' chronic lack of financing needed for greater self-reliance is largely a consequence of the lack of a financial intermediary that would allow farmers to borrow as well as accumulate wealth during surplus years through savings. It is also affected by the absence of any security such as tenancy rights. This lack of financial intermediation has arrested the development of all aspects of Gezira agriculture. The recommendations in the summary address these problems and are consistent with the options for reform.

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<sup>41</sup> Tony Barnett and Abbas Abdelkarim, op cit, page 97.

## 5. SOCIAL ISSUES

5.1 The purpose of this chapter is to explore the major social issues that face farmers and administrators in the Gezira Scheme, and to suggest strategies for addressing these issues in order to achieve socially balanced and sustainable development.<sup>42</sup>

5.2 In summary this chapter shows that life in the Gezira Scheme is characterized by a pervasive social inequality which can be traced back to the original design of the Scheme. It is argued in this report that large inequalities are not sustainable in today's social environment. If they are removed friction between the major groups in Gezira's population is likely to be markedly reduced thus limiting any impact which these differences would have had on production relations and thus enhancing the economic viability of the Scheme as a whole. The current social situation is also derived from the conclusions of the previous chapter, namely that family incomes earned from farming in the Gezira are at present typically very low. Many tenants must be at or below the poverty line. For them tenancy has become a liability since they live in a constant state of indebtedness. Migrant workers who are dependent on tenants for work are therefore also affected. The inadequate basic social services described in this chapter inevitably makes the plight of these people even worse.

### MAJOR ISSUES

#### People of the Gezira

5.3 **The Gezira Scheme Draws Many People:** It is estimated that about 2.7 million people either live in the GS and depend on it in the region for their livelihood as tenants, sharecroppers, agricultural laborers, traders or providers of various services. The core of this population is made up of about 114,000 tenants in the GS with an associated population of about 798,000, (assuming average family size of 7 persons) who by law, must all be Sudanese. The other main group is migrant labor; some of whom are not Sudanese. They live in about 1,000 camps with a population thought to be about 600,000.<sup>43</sup>

5.4 The number of camps and their population increased dramatically following the long droughts in the 1970s and early 1980s, which were followed by the 1984-1985 famine. For example, in 1981, the number of camps was estimated to be 710 with a total population of 170,000. In 1986, there were reported to be 883 camps with a total population of about 460,452. About 32 percent of all the camps in the GS were established between 1976 and 1985 as people sought labor and residence in a more stable environment less prone to drought.

5.5 **Social Diversity:** In 1929, the majority of migrant laborers in the Gezira were from West and Central Africa, (25.8 percent from Nigeria, 35.7 percent from Central Africa and 38.5 percent from Western Sudan). By 1954, it was estimated that 16 percent of the Gezira population was made up of labor migrants from Nigeria and Chad.<sup>44</sup> While this proportion from West and Central Africa is currently probably about the same, the mission found that the overwhelming proportion (70 percent) of people in camps at present originate in Darfur with a significant number from Kordofan.

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<sup>42</sup> Annex VI contains a more detailed review of the social issues facing people in the scheme.

<sup>43</sup> From personal communication, Ms. Iqbal Ahmed Hagar, Manager, Planning, Social and Economic Research, Gezira Board. If "half tenancies" are included, this number is estimated to be as high as 120,000.

<sup>44</sup> See also: The Republic of the Sudan, Planning and Socio-Economic Research Unit, Sudan Gezira Board, *Gezira Rehabilitation Project, Migratory Labor Settlements in the Gezira Scheme*, Final Report, Jan. 1994.

5.6 Camps in the GS for seasonal labor were planned in designated areas but housing was supposed to be built of non-permanent materials, such as straw or wood, with more permanent structures of bricks and clay buildings banned. As generations of seasonal laborers established themselves within the Scheme, living conditions tended to erode. Basic education, health, water supply and sanitation services are usually of low standard.

5.7 The living conditions in the camps contrast with those of the tenants. Indeed, life in the Gezira is characterized by social stratification which can create social tension in some of the village-camp relationships. The general view of tenants and the SGB, is that the migrant population constitutes a substantial problem for the management of the GS. The following reasons were mentioned:

- (a) migrants settle on tenancies and reduce the area cultivated (about 30 percent of settlements);
- (b) the migrant camps obstruct canal clearing work because of their proximity to the canals (33 percent of settlements);
- (c) animals from the camps devour crops; and
- (d) migrants produce alcohol which leads to unruly behavior and reduced productivity of workers.

5.8 Ways need to be found to achieve a greater integration of the two broad social groups since they are basically inter-dependent, the migrant labor is of crucial importance to tenant production and income.

5.9 **Increasing Reliance on Hired Labor:** Studies by the Socio-Economic Unit of the SGB have found that with increasing farmer wealth, educational achievements and social aspirations, less than 20 percent of tenants rely on family labor in agriculture and that hired labor is a dominant factor of production.<sup>45</sup> Most of the family labor is in watering of cotton and wheat. However, laborers, who are often sharecroppers in sorghum, groundnuts and vegetable production, are responsible for almost all the field operations for cotton and wheat. Indeed, studies have shown that over 30 percent of the tenants lease or rent their land to others who are mostly laborers. In addition the system of delegating a person (*wakeel*) to be responsible for cultivating one's tenancy is common; about 15 percent of the tenancies are estimated to be farmed under the *wakeel* system. The general consensus is, however, that productivity under these arrangements is generally lower than if managed by tenants themselves since there is less care for the land under the delegated management system.<sup>46</sup>

5.10 **Aging Tenants:** About 43 percent of the population is under the age of 15 years, but the general age of the tenant population is relatively high. While the majority of tenants (66 percent) were 20-59 years old in 1984, some 30 percent were aged 60 and above, and only 3.6 percent were under 20 years of age.<sup>47</sup> In the random sample of 50 farmers who attended the group discussion sessions with the World Bank mission in November 1999 the average age was found

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<sup>45</sup> *Gezira Rehabilitation Project; Migratory Labor Settlements in the Gezira Scheme*, Final Report. Jan. 1994,

<sup>46</sup> Mohammed M. Abdel Salam; *Institutional Impediment to Development in Sudan Gezira Scheme*, in, Elfatih Shaaeldin (ed.), *The Evolution of Agrarian Relations in the Sudan: A Reader*, The Hague, 1987.

<sup>47</sup> Kamil Ibrahim Hassan, *Production Relations in the Sudanese Agriculture: The Case of the Gezira Scheme*, DSRC Seminar No. 54, November 1984. Similar data were reported in the Republic of the Sudan, *Gezira Rehabilitation Project; Gezira Scheme Tenants Household Survey, 1987/88, Final Report*. June 1991: and in Mohamed Abdel Gadir Adam; (1196); *The Policy Impacts on Farmers Production Resource Use Efficiency in the Gezira Irrigated Scheme of Sudan*, Van Kiel Verlag, Germany.

to be 56 years. The aging tenants are, of course, more likely to use casual labor to assist on their farms and work as sharecroppers. A high interdependence between tenants and migrants is the inevitable outcome. This interdependence is mixed, however, with some strain as different status, cultures and aspirations clash.

## Land Tenure

5.11 The growing population in the camps and in villages has added to the pressure on land in the GS. At present land cannot, however, be legally exchanged within the GS and therefore restructuring of land ownership in response to these pressures is not possible.

5.12 **A Brief History:** Prior to the establishment of the GS, land in the Gezira plain was used for rainfed crops and grazing under a land tenure pattern that included private ownership. In establishing the scheme, under the 1921 Gezira Land Ordinance, the Government either leased or bought land from its land owners. As a result, about 60 percent of the land is today Government land. The remaining 40 percent is still freehold, which is rented by compulsion from its owners for a fixed annual rate of LS0.10 per feddan for 40 years.<sup>48</sup> Landowners were prevented from renting this land to others, and speculation was avoided by placing restrictions on the sale of land. The Sudan Gezira Board manages all the land in the Scheme.<sup>49</sup> This has had the effect, it is said, of alienating the tenant from the land he cultivates and thus adversely affect his attitude toward working and investing in land.<sup>50</sup>

5.13 **The Land Tenure System is Simple:** The Gezira Land Ordinance of 1921 specifies that “the tenant may not transfer, assign, sublet or part with the possession of the land comprised in the tenancy or any interest there in or in the crop grown there on, except with the consent of the government or such person or persons as the government may appoint as aforesaid”. A farmer is also not allowed to own more than one tenancy, but his wife and sons can own tenancies in their own right. A tenancy can be inherited, but officially it can only be fragmented to half the size of a full tenancy.

5.14 **Fragmentation of Farms:** As mentioned earlier (para.4.3), no official distribution of farm size was available to the mission. It is known, however, that there is an increasing incidence of half tenancies but, as was seen in the previous chapter, half tenancies are uneconomic at current low yields. At the same time there is evidence that absenteeism by tenants and the use of the

**Table 5.1: Estimated Distribution of Tenancy Size in the Gezira**

Area of Tenancies (feddans)	Proportion of Tenancies (%)
8	15
10	30
20	50
40	5

Source: Block Inspectors of the areas visited during the World Bank mission in November, 1999.

<sup>48</sup> This is clearly an insignificant rent these days. The report of the Presidential Committee on irrigation schemes the Gezira drew attention to this. A ministerial committee has examined the rental issue and has, it is understood, completed its report.

<sup>49</sup> See also: Sharif el Dishouni, (1989), *Traditional and Modernization in Sudanese Irrigated Agriculture: Lesson from Experience*, DSRC Monograph Series, No.36; and Mohamed Hashim Awad, (1987); *The evolution of Land ownership in the Sudan*; in Elfatih Shaaeldin (ed), *The evolution of Agrarian Relations in the Sudan*, The Hague, 1989.

<sup>50</sup> See Mohamed Abdel Salam, *Institutional Impediments to Development in the Sudan Gezira Scheme*, in Elfatif Shaaeldin (ed), *The Evolution of Agrarian Relations in the Sudan*

*wakeel* system of delegated management have been increasing. This has therefore caused an increased fragmentation in the units cultivated, while the registered tenancy size has not changed. Discussions with Block Inspectors during the Bank's mission indicated that the distribution of tenancy size in the Gezira is about as shown in Table 5.1.

5.15 A study by Farah<sup>51</sup> observed that the correlation between tenancy size and additional income is positive and significant at the five percent level. Hence, the tenants operating the small-size tenancies are not only incapable of financing most of the agricultural operations, but also will often fail to cover their family expenses. As a consequence, a large proportion of these tenants resort to borrowing from rich tenants and local money-lenders, who employ the *sheil* credit system. Farah's study further showed that there is an inverse relation between tenancy size and those who were involved in the *sheil* credit system.

5.16 **Tenancies Need to be Flexible:** The current land tenure arrangements are inflexible and constrain changes in farm size that are clearly needed for sustainable development in the GS. This inflexibility could be removed by allowing the sale of tenancies to permit the aggregation of land within specified area limits. Such sales would allow farmers and the GS to recoup the value of their shares in investments made in the irrigation areas. Funds accruing to the SGB could be re-invested in improvements for the Scheme. Allowing structural adjustment through sales of tenancies would also allow some farmers to liquidate their debts. For others it could lead to more sustainable farming as those with larger farms would probably operate more profitably.

### Assets, Credit and Debt

5.17 **Tenants Hold Few Assets:** Following a 75-year history of almost complete provision of production services (as well as many social services), most tenants in the GS have very few farm assets. For example, the Bank mission was informed that only about five percent of tenants have tractors or harvesters. It is estimated that about eight percent of tenants own pick-up vehicles. Those who own lorries are mostly traders and they make up less than two percent of the tenants in the Gezira. The distribution of vehicle and large machine ownership is skewed in favor of the rich tenants who combine farming with trade. A survey of machinery on farms in 1979 indicated that about 80 percent of tractors and 68 percent of the combine harvesters in the Scheme were owned by trader-tenants.

5.18 It was mentioned earlier (paragraph 4.38) that 40 percent of tenants in the Scheme have animals. Studies by the Social and Economic Development Unit found that tenants have an average of 12.4 animals per household, of which 2.7 were cattle and 8.6 were small ruminants and the rest were donkeys. Large tenancies generally have more animals than the small tenancies, but livestock are becoming an increasingly important source of income for all tenants. The most important animals are shown in Table 5.2.

**Table 5.2: Average Number of Animals owned per Tenant Household**

Size of Tenancy	Sheep	Cattle	Goats
All Sizes	4.4	2.7	4.2
Large	7.5	5.5	5.0
Small	3.7	2.1	4.0

Source: Sudan Gezira Board; Gezira Rehabilitation Project, Gezira Scheme Tenants Household Survey, 1987/88, Final Report, 1991.

5.19 **Migrants Increase Asset Holdings:** Migrant laborers have acquired assets over time and some now own sheep, goats, poultry and cows. A study conducted by the Socio-Economic Department in 1993 found that goats were the animals most frequently owned by the camp

<sup>51</sup> Mohamed Abdel Salam, *ibid.*

population. It was estimated that 75 percent of the camp households had goats and 56 percent had sheep.

5.20 **Credit Allocation Causes Concern:** The distribution of assets in the GS is largely due to credit policy in the Agricultural Bank of Sudan, supported by the Gezira and Managil Farmers Union Executive Board. The Agricultural Bank offers credit only to those who satisfy the principle of credit-worthiness. This principle benefited traders and rich tenants. A study by Farah Hasan Adam has argued that the Farmers' Union often uses its political power to influence the Agricultural Bank to offer credits to the wealthy tenants. This is significant since privately owned machinery performs a large part of the operations for sorghum, groundnut and vegetable production.<sup>52</sup> The mission was informed that the current situation is very similar to that observed by the 1979 survey by Farah.

5.21 While credit for regular production activities is provided through the individual account system operated by the SGB, assets are the basis for additional credit for crop production, maintenance and harvesting. It is well-known by researchers in Gezira that tenants with their own resources to purchase fertilizer or make other improvements to the production environment achieve the highest crop yields and therefore have higher incomes. Obviously those with assets have a huge comparative advantage in gaining access to credit. Those without assets are forced into using the informal "sheil" credit system which is associated with high real interest rates and usually leaves borrowers worse off and financially tied to the lender.

5.22 As emphasized already in paragraph 4.50, production in the Gezira will never be sustained unless there is a well established formal credit system which tenants and others can use to obtain credit at reasonable rates of interest. The overriding problem in the past has been the absence of any collateral loans because tenants have released their main crop (cotton) to the SGB which effectively has a lien on the cotton from which it then deducts the various production costs and other charges. The future value of non cotton crops is uncertain and certainly not a preferred collateral for formal credit institutions such as the Agricultural Bank.

5.23 **A Suggestion:** If the land tenure arrangements in the Gezira could be changed such that tenancies could be bought and sold, then there is no reason why the assessed value of tenancies could not provide a firm collateral for loans from formal credit institutions. On this basis there may also be prospects for tenants to establish their own cooperative credit institution ("credit union") that could provide financial services to the whole population of the Gezira and serve to mobilize safe savings as well as provide term loans for many purposes.

### **Social Services**

5.24 When farmers operated under the joint account system in the Gezira a proportion of the crop proceeds were subtracted to provide for social services. Under this arrangement the SGB provided most of the villages of tenant farmers with social services. The SGB did not have a presence in the camps and, while the residents of the labor camps were never excluded from the services provided to the villages, the World Bank mission was informed that labor camps were rarely beneficiaries of these services.

5.25 The laborers, with whom the mission discussed this matter expressed the view that they should be provided with social services and they are willing to contribute to the cost of such services. In the villages where they live along side the tenants, they claim to pay the monthly contribution for water and schools through the village committees, although their children do not

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<sup>52</sup> Farah Hasan Adam; *Evolution of the Gezira Patterns of Development within the Context of the History of Sudanese Agrarian Relations*; in Elfatih Shaaeldin (ed) op.cit.

go to school and they do not have piped water in their houses. These discrepancies are a potential source for social unease.

**5.26 Education:** Today Gezira state has more schools than most states in the Sudan. Adult literacy rate for the State 10 years and over is above the national average at 64 percent, (73 percent for males and 55 percent for females), compared to 53 percent (64 percent for males and 42 percent for females), for the whole country.

5.27 Over 90 percent of the tenants in the villages in the GS are currently served by primary schools, while less than 10 of the villages (one percent) have secondary schools. In the past, it was customary for most secondary schools to be located in large urban centers, and most of these were boarding schools but they have now been abolished. Secondary schools in villages are generally rare in Sudan, and this is true for the Gezira, too.

5.28 On the other hand the majority of the migrant camp population is illiterate. Khalwa (Koranic schools) education is the most commonly available in the camps. Studies by the Socio-Economic Department of the Gezira Board indicate that less than 2 percent of children in camps are enrolled in primary school and less than 0.5 percent in senior schools. Dropout rates among these children are very high; in particular among girls who tend to leave school/khalwa once they reach the age of 13-14 years of age.

**5.29 Health:** Access to health services is also much higher in Gezira state than for the whole country. In 1993, there were a total of 36 hospitals in the Gezira state, while the total of health centers and primary health care units were estimated to be 133 and 215 respectively. The number of hospital beds in Gezira state was 2,640; there were 59 medical specialists, 246 medical doctors and 561 medical assistants.

5.30 At the Gezira Scheme level, 52 percent of the tenants have access to health centers within their village; 47.9 percent seek such services from adjacent villages and the average distance from a village to a clinic was 3.7 kilometers. Some 36 percent of the tenants sought hospitals services, but only 2.9 percent had such services in the village. The remaining 97.1 percent sought such services in large villages and towns, with an average distance of 12 kilometers.

5.31 Urban hospital services are only enjoyed by a small number of tenants (one percent) due to transportation difficulties. Private clinics are far from the villages and only 0.7 percent have access to such services. The average distance to these facilities is 28 kilometers.

5.32 The health condition in most of the migrant camps is extremely poor, and camp residents walk long distances to receive basic health services. This coupled with high costs means that the majority of camp populations uses traditional healing for ailments and disease. Health hazards to the camp population are increased by their proximity to the canals and the lack of clean drinking water, which result in a high incidence of Schistosomiasis (Bilharzia) and malaria among the camp residents. The Bank-assisted Blue Nile Health Project introduced some hand-powered pumps and sand filters in some of the camps, but it was reported to the World Bank mission by the camp residents that many of these are now in disrepair.

**5.33 Water, Electricity and Sanitation:** The population in the Scheme depends on two main sources for domestic water consumption, surface (canal) and ground water. Underground water is available in major formations and utilised through boreholes, hand pump wells and shallow wells. Some treatment is usually done through slow sand filters in some areas of the Scheme. However, in many areas, such water is not treated. Many communities, in particular the camp population, depend on canals as sources of drinking water.

5.34 A study conducted by the Social Development Unit in 1988 found that most of the tenants (75 percent) had piped water for their domestic use either within or outside their houses. The role

of the former Social Development Fund was clearly noticeable here, as the fund had played a major role in providing most of the tenancy villages with drinking water through the program of deep bore wells. Thus relatively few tenants (25 percent) still rely on surface wells or canals for their domestic use. These figures show that Gezira tenants are slightly better off than the average for Gezira State (see Annex VI).

5.35 Electrification of villages started as part of the Social Development Unit. Thirty percent of the tenants in the Gezira area have access to electricity compared to 2.7 percent in Managil. Even with electricity available, 80 percent of the tenants still depend on kerosene for (part of) their lighting needs. The majority of households depend on wood and charcoal for cooking. Gas cooking is still very insignificant (one percent). The majority of the tenants (52 percent) use open space as toilets while 46 percent use pit latrines.

## CONCLUSIONS

5.36 There is a sense of serious social inequality in the Gezira. Tenants are anxious about the future because their incomes are declining in real terms and no doubt the earnings from farming for some puts them below the poverty line. Their only strategy is to augment their incomes through off-farm work. Since most economic activity in the immediate vicinity is highly dependent on the Gezira Scheme itself, the prospects for additional work are limited. The difficulties facing the tenants are compounded by the fact that they cannot sell their land and leave for another job and another life. They, or one of their relatives, are forced to stay on in the Gezira hoping that the next season will bring better incomes. Unfortunately many are likely to remain in a constant state of indebtedness which makes many of them feel more like low level managers of someone else's land than managers of their own land. Adjustments to the tenure arrangements must be part of the solution to the farmers' dilemma.

5.37 Migrant workers who depend on the tenants for most of their work are vulnerable to the low income earning capacity of tenant farms. Their situation is made worse because they are forced to live in dwellings which are temporary at best, and are faced with a low level of social services for themselves and their children. Their housing and social services contrast with the higher quality housing and social services in tenant villages. Greater integration of this part of the Gezira society must be part of the development strategy.

5.38 Tenants and migrant labor quite naturally do not feel in control of most factors that affect their welfare. In such an environment all blame is placed on the Sudan Gezira Board and on the Government whose institution it is. The SGB certainly faces constraints and is not in a position to address all the problems of the Gezira, but it is in a position to address some of the irrigation management, crop production and financial problems. Institutional change for the Gezira must be part of the future development strategy. The next chapter discusses the options the Government could consider to achieve institutional change to address the very serious social and economic problems facing the Gezira.

## 6. INSTITUTIONAL ISSUES

6.1 Previous chapters have referred frequently to management and institutional weaknesses as reasons for the problems faced by the Gezira Scheme. In many cases institutional issues have indeed proven to be major bottlenecks to efficiency and production growth. Examples from previous chapters that stand out are sub-standard and delayed operation and maintenance of the irrigation system, major shortfalls in the collection of charges for irrigation water and other services (i.e. the “administration” charge), the role of the SGB in requiring tenants to produce cotton on part of their land while promising to provide land preparation services and inputs (financed by individual tenant accounts) that are either of inadequate quality or are not made available on time, low yields for all crops in relation to field trials, payment to tenants for cotton which are delayed up to 12 months and are a relatively low proportion of the f.o.b. price, poor quality of extension service, the lack of formal credit facilities for financing the production of other crops, and the constrained land tenure system that does not allow open trading in tenancies. The purpose of this chapter is to review the institutional structures that create such problems and explore options for solving them.

### MAJOR ISSUES

#### **Brief Historical Perspective on the Gezira Scheme<sup>53</sup>**

6.2 Understanding the characteristics and history of the Gezira Scheme makes it easier to understand the current institutional problems facing the SGB, the tenants and the Government. Institutions are defined as “rules of the game” that emerge from formal laws, informal norms and practices, and organizational structures in a given setting. The incentives that current institutional arrangements create shape the actions of public officials. Institutions overlap with, but are not synonymous with, organizations. They are affected by policy design but are broader in scope and less subject to frequent change than most policy frameworks.<sup>54</sup>

6.3 The rules of the game when the Gezira Scheme was constructed by the British and subsequently under the management of Sudan’s central Government, were that the Scheme existed to produce cotton for export at the lowest possible cost. This institution still exists. Quite often during the preparation of this report the suggestion that cotton should not be the core focus for the Scheme was rejected by the Gezira management. The rules of the game from the tenants’ point of view were that if the Government wanted them to produce cotton the Government should provide all the support needed to do this at the lowest possible cost to the tenant. With management and tenants each aiming to minimize costs there has always been tension and disappointment resulting in a distortion of incentives toward “satisfying” rather than “maximizing” production opportunities. This has been the situation for most of Gezira’s existence and the root cause for its mediocre performance and institutional inefficiency, except for a short period after independence noted below.

6.4 **Early Origins based on Private Sector Investment:** While the possibilities for large-scale cotton production had been realized as early as 1839, it was not until 1904 that an American investor (Leigh Hunt) was granted a concession at Zeidab. Subsequently the Sudan Plantation Syndicate, a private company, was authorized to begin experimenting with cotton production in

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<sup>53</sup> This section has used material from books by Galal Mahmoud Yousif, *The Gezira Scheme: The Greatest on Earth*, 1997 and Tony Barnett, *The Gezira Scheme: An Illusion of Development*, Frank Cass and Company Ltd, New Jersey and London, 1977.

<sup>54</sup> Taken from *Reforming Public Institutions and Strengthening Governance: A World Bank Strategy*, internal draft, November 1999.

1911 in Tayba which was to become a nucleus for the prospective Gezira Scheme. In 1913 the British Parliament approved a loan of three million Egyptian pounds to the Sudan Government to start building the Gezira Scheme to produce cotton. This decision was the culmination of many years of detailed investigations through pilot pump irrigation schemes in a number of locations along the Blue Nile, as well as pressure from the British Cotton Growing Association, the British textile industry, and members of Parliament from Lancashire. Following the British government's decision to support the scheme the Sudan Plantation Syndicate, the Kassala Cotton Company and the Sudan Government signed an agreement in 1919 that established a partnership for the development of the Gezira Scheme which continued until the end of 1949. After a delay due to the First World War the Sennar Dam was completed in 1925 and in the first season 80,000 feddans were irrigated.

**6.5 Government Appointed Board takes Control:** On January 1, 1950, following many years of considerable agitation against the continued presence of non-Sudanese management for the GS, the government terminated its agreement with private companies and the GS came under the management of a corporation called the Sudan Gezira Board (SGB). This change was still six years before Sudan became independent from British rule. Since 1950 the GS has operated under a government act and managed by a Board of Directors generally under the strong influence of the Ministry of Finance and the Ministry of Agriculture whose minister chairs the Board of Directors.

6.6 It is interesting to note, however, that the first chairman after Independence was a well-known businessman of strong independent character with good relations with all the main political parties. This choice of chairman was apparently motivated by the Government's desire that the Scheme be (a) independent of political interference; (b) managed along the lines of a private enterprise even though it was a government corporation; and (c) have independence in terms of the pricing, financing and marketing of cotton. There are many in Sudan who feel that this management arrangement stood out as very successful during which yields were high, marketing was efficient, relations between tenants and the Scheme management were cordial, and the Scheme's major expansion took place smoothly.

6.7 In subsequent years Government influence increased. In 1964, following the popular revolution, political parties scrambled to capture the support of farmers and consequently the Farmers' Union gained considerable strength and demanded a share in decision making in the Scheme. In 1969, following the *coup d'etat* the Scheme came even more under the control of the public sector and its efficiency declined further as managers became political appointees with inadequate experience. The Scheme also became a source of extraordinary rents to the Government and substantial implicit taxes on tenants.

6.8 Farmer representation and Board composition has varied over the years in line with changes in the Act. Currently there are four farmers' representatives on the Board. There is at present considerable doubt about the benefits for tenants in general from their representatives on this core institution. At the same time there is considerable doubt about the capacity of the Board as a whole to take charge of the challenge to rejuvenate what is essentially a dysfunctional organization. See Box 6.1 for a brief review of the issues related to tenant representation on the Board and its decisions.

### Box 6.1: Tenants Representation and Decisions in the Gezira Board

Farmers' representation in the Gezira Board of Directors increased progressively since the idea was introduced in the 1963/64 season when there was only one representative. It was increased to three members in 1965, but was reduced back to one representative in 1969. Then increased to four members as stipulated in 1984 Act. In 1993, in the aftermath of the proclamation of the liberalization policies, the number of the farmers' representatives in the Board of Directors was raised to 50%, out of a total of 20 members. Notwithstanding the strong objections from the Farmers' Union, the Government decided in 1998 to reduce their representation to four members as per the 1984 Act.

Representation and participation of producers is an essential element for effective management and high performance. Unfortunately the presence of farmers in the Board of Directors has not produced the desired results so far as the tenant farmers are concerned. The main reasons for this include: (a) emphasis was on representation and not participation of "real" producers; (b) representatives manipulate decisions to their political ambitions rather than for the interest of the small producers; and (c) some representatives remained on the Board for decades, which is not conducive for injection of new ideas and blood.

Despite the generally substantial representation of tenants on the Board, decisions by the Board do not reflect strong leadership on fundamental issues. The Bank mission examined decisions made by the Board of Directors over the last 12 months and found them to be administrative in nature with no hint that the Scheme faced fundamental technical and financial problems. Nor were there any decisions that suggested a debate on strategic or policy issues.

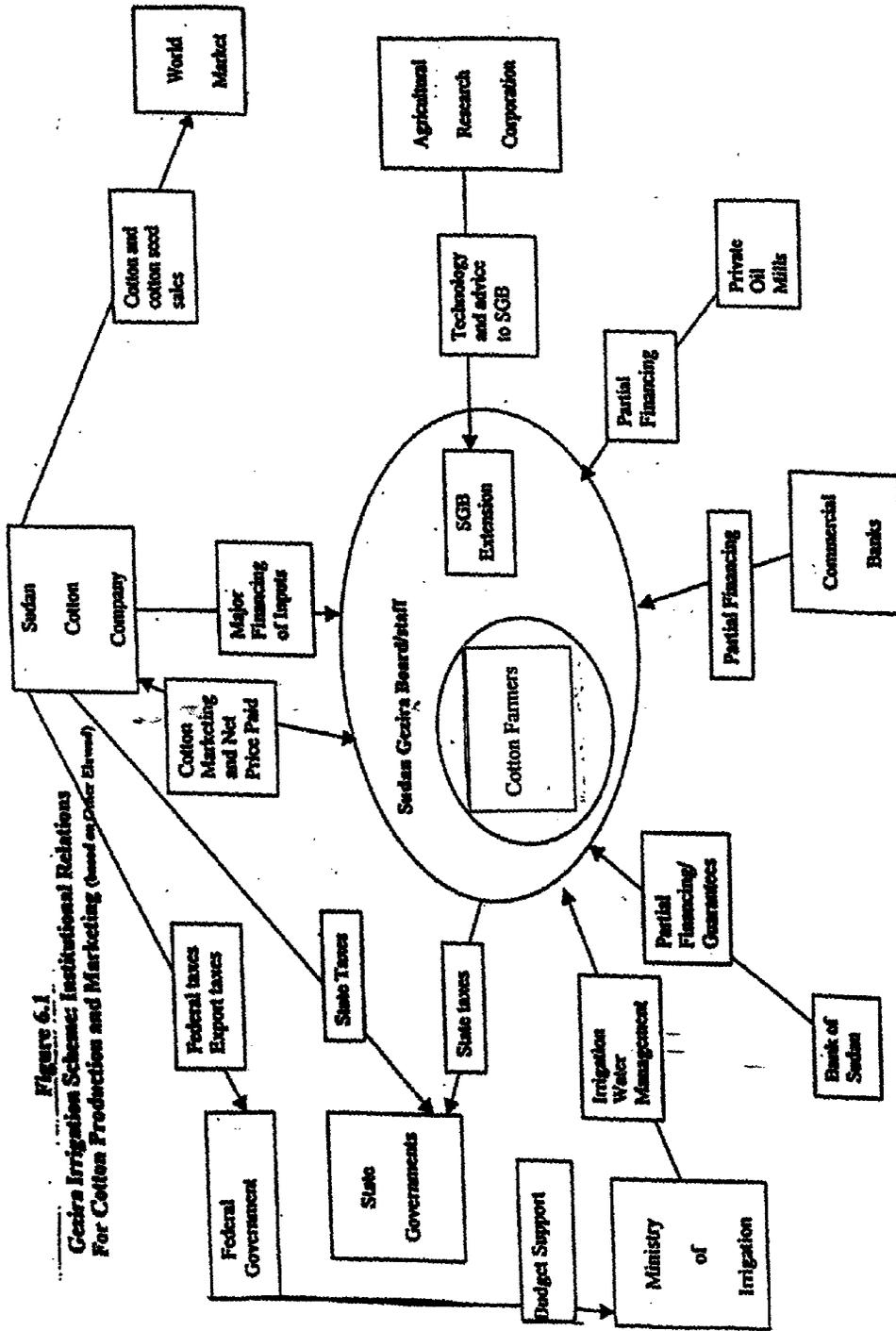
*Source:* Mission information

### The SGB and its Relationship to Other Institutions and Organizations

6.9 Figure 6.1 displays the complexity of the institutions organizations around the SGB in relation to cotton production and marketing and financing. The relationships for other crops, though less complex, are nevertheless also important. The SGB is the hub for a set of highly complex and often non transparent relationships.

6.10 The complexity of the institutional relations stems from the historical role of public sector management of the Scheme and the many ways it has sought to establish alliances in order to remain financially viable. The following paragraphs review briefly the roles played by and the issues facing the main institutions associated with the Gezira Scheme.

**Figure 6.1**  
**Gedra Irrigation Scheme: Institutional Relations**  
**For Cotton Production and Marketing (based on Deir Elweh)**

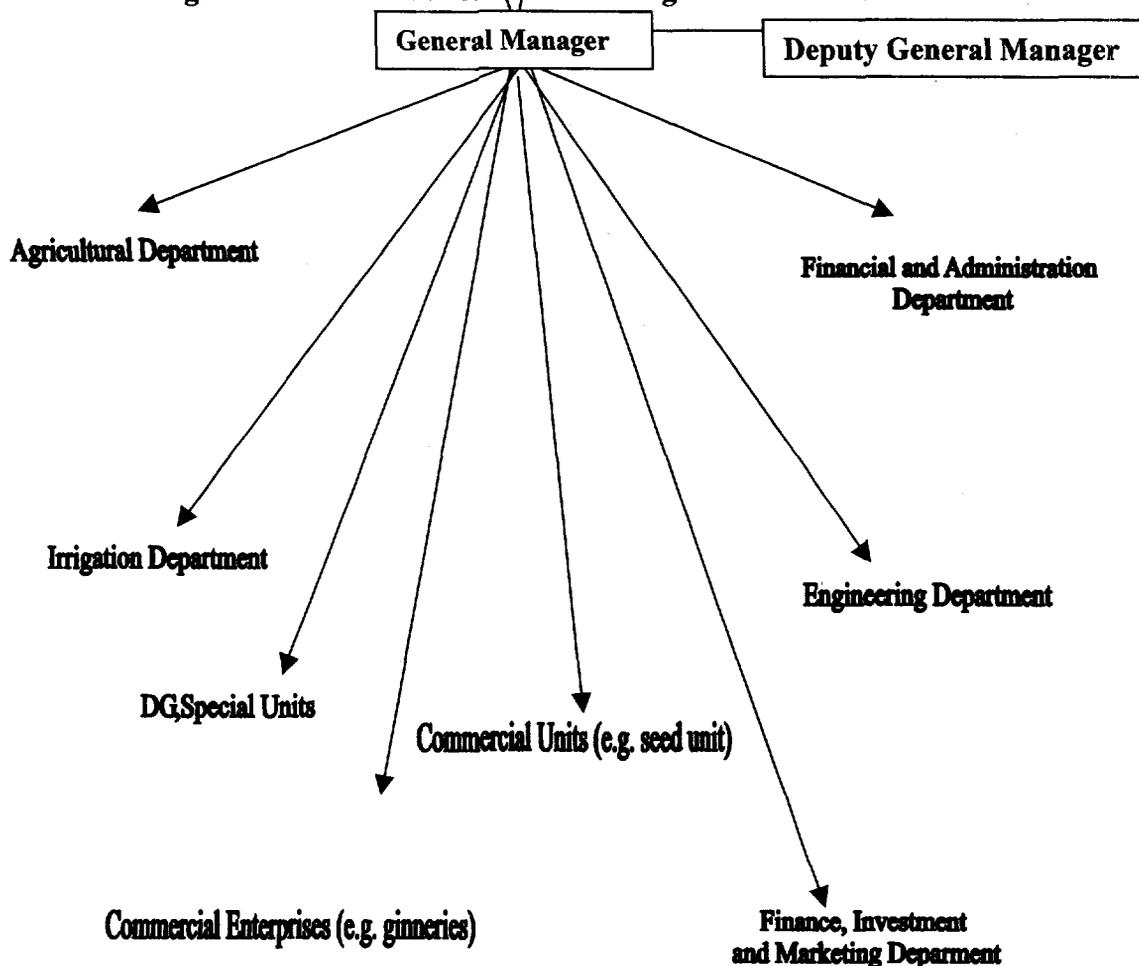


## The Sudan Gezira Board

6.11 The SGB led by a General Manager is responsible for the day to day management of the Gezira Scheme. It has a staff of 7,056 (1999)<sup>55</sup> of whom about 25 percent are “classified” staff. The remainder are defined as laboring level staff. The following institutional arrangements are key to the operation of the Gezira Scheme.

6.12 **SGB is Highly Centralized:** The SGB has a centralized organization which reflect the role it plays in the Scheme. Figure 6.2 which is the organization chart provided to the joint team by the SGB management reflects the centralization of authority showing eight major departments and units reporting directly to the General Manager without any intermediate authority. While there is a Deputy General Manager position it has not been filled for a number of years and would appear to be unimportant in the management structure. Irrespective of the future role and size of the SGB, there can be little question about the need for a restructuring of the SGB to distribute authority more evenly if it is to become more efficient. The majority of the professional staff works in the Barakat headquarters of the GS which undoubtedly reduces their interaction with tenants in the field.

Figure 6.2: Sudan Gezira Board Managerial Structure



<sup>55</sup> The authorized number of positions is 8,077, but the SGB policy has been to reduce the staff through not replacing retirees. See Table 1, Annex 1 for more details on current SGB staffing.

**6.13 Tenants' Choice of Crops Still Constrained:** In the past the SGB was an authoritarian institution instructing tenants what they should grow, where they should grow it, the inputs they should use, the management practices they should follow, and where they should sell their crop. This approach has been considerably relaxed but SGB still requires tenants to produce cotton as part of the five-course rotation (see Chapter 4) in accordance with a standard cropping sequence with some options for individual crops within that sequence. Such requirements have placed impossible pressures on many tenants since cotton is not suited to all soils and environments in the Scheme, and cotton production involves paying SGB for the costs for land preparation and other services. Many SGB staff have concluded that a more participative approach to the management of the GS, including removal of the cotton production requirement, would pay high dividends for tenants. On the other hand the SGB management has so far resisted change, presumably because the employment of its staff and access to resources depend directly on its intermediary role in cotton production.

**6.14 Joint Accounts Changed to Individual Accounts:** Production costs incurred by the SGB on behalf of tenants were financed from the start of the Scheme in the 1920s through a system of joint accounts. In return for their work the tenants shared 40 percent of the profits. This was not a satisfactory system. It provided tenants with no incentive to produce a high yield and quality output since any effort to achieve a high return would be automatically shared with the management of the Scheme. Not surprisingly the GS performed poorly and yields stagnated. In 1980, following World Bank encouragement, the individual account system was introduced which in theory would provide incentives to tenants because they would receive all the profits from their own farming efforts. While the theory was correct, the profits were slim because the tenants had no control over the costs charged by the SGB and, as was shown in Chapter 4, prices paid to tenants for cotton are not only delayed by up to a year but are also discounted significantly by the SGB. The individual account system is therefore not regarded as completely satisfactory by tenants.

### **Serious Financial Challenges and Problems**

**6.15 GS Independence is a Challenging Responsibility:** While there was no discussion of privatizing the GS in 1992 when the Government launched its liberalization policy, (see Annex 2) the most immediate implication for Gezira was that it would need to become more independent financially. Under the government's policy the GS could no longer rely on the support of the Bank of Sudan (the central bank) for financing its foreign exchange requirements as it had done for many years. In future the GS would need to obtain credit from commercial banks for the purchase of agricultural inputs. But financial needs of the Gezira were enormous and no one commercial bank could provide the funds needed. In 1993 the Government successfully prevailed on a number of Sudanese private banks to form a Consortium to provide loans to the SGB. This worked until 1998 when the debts incurred by the SGB had become too large for the Consortium to handle and financial support for SGB slipped back on to the desks of the Ministry of Finance and National Economy: In 1998 the Ministry provided SD502 million (\$1.9 million) to the Gezira to support its operating expenses, including fuel. In 1999 about SD 840 million (\$3.3 million) was provided for the rehabilitation of infrastructure and the Ministry of Irrigation received SD100 million (\$0.4 million).

**6.16 Substantial Debt Load:** The deterioration in income earning capacity of the Gezira Scheme and the resultant accumulation of debts by both the scheme and by tenants (Tables 6.1 and 6.2) resulted in a series of measures by the Government and the Gezira management to secure improved financial security for the scheme. In 1982 and again in 1992 the central Government forgave the accumulated debts of farmers in the scheme. Table 6.2 shows that for Gezira total liabilities have accumulated to SD8.6 billion (LS 86 billion) which is equivalent to about \$34

million.<sup>56</sup> The Gezira continues to be in financial difficulties since it is understood that it typically has an annual operating deficit of about \$1.2 million and liabilities have apparently increased further. As a result debts remain unpaid and salary payments for GSB staff are often deferred.

**Table 6.1: Cumulative Arrears to the Sudan Gezira Board and Collection Ratios 1998/99**

Crop	Cumulative arrears plus 1998/1999 season costs (SD billion)	Collections (SD billion)	Ratio of collections <i>a/</i> (percent)
Cotton	8.46	5.19	61.4
Wheat	8.46	4.19	49.6
Sorghum	2.17	1.02	47.0
Groundnuts	1.19	0.24	20.0

*a/* Ratio of collections to arrears as of September 1999

Source: Financial Administration, Sudan Gezira Board

Note: Debts were forgiven on two occasions. First in 1981/82 after the abolition of the joint account and the adoption of the individual account system and second in 1992/93 to mark the start of the liberalization policies.

**Table 6.2: Gezira Scheme Liabilities, 1998/99 (SD billion)**

Creditors	Amount
Companies & Organizations	5.593
Contractors	1.222
Tenants	0.846
Workers (SGB employees)	0.926
Total	8.587

Source: Finance Administration, Sudan Gezira Board.

**6.17 Coping with Debts and Keeping the Scheme Running:** The failure of tenants to pay their water rates because of widespread dissatisfaction with the irrigation service led to the non payment by the SGB to the MOIWR for irrigation water and the operation and maintenance. This led in turn to defaults by the SGB to contractors and a reduced rate of silt removal by the MOIWR (see Chapter 2). Following the report of a Ministerial Committee (December 1997) which considered urgent funding of irrigated agricultural projects the MOF provided funds directly to a new institution called the Irrigation Water Corporation within the MOI which was charged with operation and maintenance in return for irrigation water charges from tenants. Chapter 2 records that this crash program worked for a few years and large quantities of silt were removed from the canals in the Gezira as well as in other irrigation schemes for which the federal government had a responsibility, but it could not be sustained. At the same time the SGB attempted to settle state taxes and some of the debts to private contractors, the MOIWR and the insurance companies through "in kind" payments of cotton, wheat, fertilizers and scrap equipment and machinery. This was not acceptable to some creditors and also clearly an unsustainable solution.<sup>57</sup>

<sup>56</sup> Using an exchange rate of SD256=US\$ 1.0

<sup>57</sup> The SGB made many efforts over the years to obtain financial support. The main sources have been: (a) partial financing and guarantees from Sudan Cotton Company; (b) partial financing from consortium of Commercial Banks, particularly for wheat production and input supply at a high service charge (48-60 %) or predetermined Salam prices until 1998; (c) partial financing from advance sale of cotton seeds to local oil mills as well as escarto; (d) suppliers' credit especially for imported inputs guaranteed with cotton

6.18 **Demise of the Commercial Bank Consortium:** While the Consortium of Commercial Banks was able to recover its short term credit to the GS up to 1997, it ceased to provide credit in 1999 because of (a) failure of the Gezira management to repay; and (b) increased delinquency among wheat farmers especially with the decrease in productivity during 1998/1999. The total arrears to the Consortium is estimated at about SD 1.8 billion. It is understood that the Consortium is taking action to recover its debts and that the Bank of Sudan has again stepped in to provide the necessary seasonal finance.

6.19 A fundamental reason for the demise of the Consortium as a creditor was that the total financing requirements were much more than prudent lending capacity. The Government's decision to liberalize wheat production and marketing in 1998 requiring farmers interested in wheat production to finance this from their own resources or credit, relieved the Consortium of a responsibility that had created many problems. On the other hand it created pressure to establish formal financial intermediation institutions so that tenants might save safely and obtain short term credit to (a) finance land preparation; (b) buy improved seeds and other inputs; and (c) pay for casual labor.

6.20 The mission found that the lack of such financial institutions, along with chronic irrigation problems, were an important reason for the significant drop in wheat plantings during the 1999/2000 season. It is *recommended* that a formal study of options for credit institution be started urgently.

6.21 Tenants still experience serious problems with their accumulated debts. The Presidential Committee report (November 1998) stated that the "accumulated debts of farmers to all creditors was is about SD21 billion, of which SD13.9 billion have been settled, and the remaining is about SD7.1 billion, a debt collection rate of 66 percent."<sup>58</sup> Some tenants are reported to have suffered legal prosecution as a result of their indebtedness.

6.22 **Tenants are Trapped:** Tenants are caught in an impossible trap. They are on the one hand required to produce at least one crop of cotton in the standard rotation; on the other hand if they wish to move out of farming they are by law not allowed to sell their tenancy rights. The only possibility for them is to transfer the tenancy to a family member. It is clear that many informal transfers (with the tacit approval of the SGB) have already taken place but numerous current tenants have no one else to transfer tenancies to. An obvious solution is to change the law and make the sale of tenancies (within specified size limits and under certain land use conditions) legal. This would allow those who do not wish to farm in the Gezira to leave and also perhaps resolve their debts. It would also allow (again within limits) for some amalgamation of tenancies to make irrigated farming more economic because of economies of size.

6.23 **A Need for Sustainable Solutions.** The way out of debt is for the Gezira Board to lead a change aimed at implementing further relaxation of control within the Scheme consistent with the policy changes introduced by the Government in 1992. The many institutional and policy constraints facing the Gezira should be removed and thereby stimulate the private sector to invest. Actions that are likely to provide such a stimulus include:

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warehouse receipts and/or guaranteed from Bank of Sudan; (e) central government budget support, either in terms of direct transfers especially as a rescue operation or some specific development financing; (f) deferred payments to Irrigation Water Corporation of the MOIWR, private contractors and Gezira farmers with surplus earnings and other creditors.

<sup>58</sup> Note that the Sudanese pounds used in the Presidential Committee's report have been converted to Dinners. It is not clear that the arrears of the Consortium of Commercial Banks (SD1.8 billion) is consistent with the Committee numbers on accumulated debts. These data could not be verified.

- (a) remove the requirement that the SGB undertakes all land preparation and the provision of inputs for cotton with financing from the individual account;
- (b) farmers should (in self contained hydraulic units and subject to a technical review) be allowed to choose their rotations including the choice not to grow cotton; ..
- (c) an annual land rental (the “administration charge”) should be levied according to the value of land and should not vary according to the success of crops’, it should be a flat annual charge;
- (d) irrigation water should be charged according to the volume used or on the basis of the number of irrigations if adequate volumetric measurements are not available;
- (e) tenancy rights in the GS should be tradable among Sudanese nationals;
- (f) the SGB (in collaboration with the ARC) should build on its potential strengths to provide sound technical advice and support to all farmers (tenants or sharecroppers), assist in building institutions such as water users associations, and collect, analyze and disseminate information (extension) on improved technologies and local commodity markets with the objective of raising productivity.

**6.24 Payment of Annual SGB Commitments:** The current outflows for the SGB are represented mainly by payment of federal and state taxes, water rates to the MOIWR, costs of agricultural inputs, and various administrative costs including insurance, transport etc as well as the repayment of principal and service charges to the Consortium of Commercial Banks. The Consortium had for years paid most of the debts of the Gezira Scheme; including the bill for agricultural inputs, cost of financing from commercial banks, suppliers’ credit, inland transport of cotton and financial settlements to the Bank of Sudan and MOF. The (SCC) continues this role, but it is an unsustainable situation unless the profitability of the Scheme can be improved. Of course the SCC could not play this role were it not for its unchallenged position in the export marketing of cotton, but even its near monopoly position is no guarantee of its continued ability to finance the deficits of the Gezira Scheme.

### **Cotton Marketing**

**6.25 Establishment of the Sudan Cotton Company:** From 1970 to 1996 the Government exerted full control over cotton marketing through the Cotton Marketing Corporation (see Box 6.2). In 1993 the Government transformed the Cotton Marketing Corporation (CMC) into a private company (Sudan Cotton Company - SCC) registered under the 1925 Companies Act. Within the context of the liberalization policy, the Government decided in 1993/94 to sell the company to the Farmers’ Union (71.8% of shares), the Pension Fund (14.6%) and the Farmers Commercial Bank (13.6%). The company is now managed by a Board of Directors composed of 11 members, 10 members representing shareholders in ratio of their holdings plus the Director General of the SCC who is appointed by the shareholders of the company.

## Box 6.2: Selected Issues Concerning the Cotton Marketing Corporation

**Establishment of Government Controlled Cotton Marketing Corporation:** In 1970 the Government nationalized the cotton export trade and the Cotton Marketing Corporation (CMC) took over the responsibility for all cotton exports. From then on interventions and financial support from the Ministry of Finance and the Bank of Sudan (the central bank) to the federally-owned irrigation schemes such as Gezira became standard practice. The CMC, however, engaged in a number of practices, such as in pricing policy, that were detrimental to the short and long term profitability of the tenants. This continued until 1993.

**Marketing of Cotton:** During 1970-1993, the Government had complete control over the cotton lint exports for which it determined the exchange rate. It also decided on the sale of lint to the domestic textile mills based on the international price in US dollars, but valued lint at an overvalued exchange rate. For example, while the unified exchange rate was typically about LS90 per \$1.0, the exchange rate used for cotton exports was LS25 per \$1.0. This margin was maintained for many years until it was relaxed to a margin of 20 percent and then eliminated in 1998/99. Hence cotton producers received less in local currency than they would have at a market-based exchange rate and they therefore heavily subsidized both the general budget and the national textile industry.

**Marketing of Cotton Seed:** The distribution of cotton seed was the responsibility of the Ministry of Industry and it was standard practice to allocate seed to oil mills established prior to 1972 at a ratio equivalent to their design capacity. It was only in the early 1980's that competition was introduced to determine the clearing price of cotton seed. However, this system was abandoned and the cotton seed sale was left to the management of various irrigation schemes to decide cotton seed marketing strategy in subsequent years. Given their financial difficulties most schemes resorted to advance sales to private dealers.

6.26 It was originally intended that one seat on the Board of the SCC be rotated among the management of the federally owned schemes that produced cotton. This idea was abandoned after the General Manager of the Gezira Scheme completed the first term and a dispute ensued over the sequence and period of subsequent representation from the schemes. There are, however, some other more important questions regarding the operation of the SCC. They are:

- (a) Do the Farmers' Union members on the Board of the Sudan Cotton Company represent the interests of tenants in the Gezira; this is not an easy matter to judge, but Farmers Union leaders assured the joint team that they do represent Gezira tenants;
- (b) Is it appropriate for the SCC to place a heavy emphasis on the financing and the provision of guarantees for input supply for the Gezira, and has this activity reduced the efficiency of cotton marketing; and
- (c) Given the weak financial position of the Gezira Scheme and its dependence again on the Ministry of Finance and National Economy for funding, to what extent does the Government influence cotton marketing strategy at the SCC.

### Options for Change in the Gezira Scheme – Medium to Long Term

6.27 **Gezira's Problems can be Successfully Addressed:** While this report has drawn attention to many positive aspects of the Gezira Scheme, it has also highlighted a number of problems. On the negative side, it is at present obviously not a profitable investment from either the national or the tenants point of view, and it is not providing the growth in employment that is so necessary for poverty reduction. On the positive side, this report concludes that Gezira's problems can be

successfully addressed. There are substantial opportunities to make the Gezira Scheme a source of considerable revenue for Sudan if efficiency and productivity can be raised and if the combined energies of the public and private sector can be harnessed.

**6.28 A Vision of the Future:** Any consideration of future options needs to start with consensus on a vision about the future structure and operation of the GS. What will the Scheme look like and how will it work?

*The vision for the Gezira Scheme in this report is that it becomes a vibrant center of increased economic and social activity where the private sector has invested and established enterprises to meet the demands for services from tenants. It is also envisaged that tenants have negotiable titles to their land and a strong incentive to produce efficiently and profitably working together in groups to maximize the use of the available land and water resources. Finally the vision is of an independent, privately managed Gezira Authority operating at a profit that, because of its policy of decentralizing authority to competent farmer groups, becomes responsible (in collaboration with other agencies such as the Ministry of Irrigation and Water Resources and the Agricultural Research Corporation) for the efficient delivery of irrigation, extension and market information services to tenants on an environmentally sustainable basis, and also providing leadership in ensuring the provision of social services to all members of the Gezira community.*

6.29 The following paragraphs outline briefly some options for moving forward to establishing a sustainable development path for the Gezira. These options are based on a number of principles that have been analyzed in recent work in the World Bank on the reform of public institutions.<sup>59</sup> The essential principles used here were : (a) a reduction in the role of government and hence an alteration in the balance of power and responsibility between the government and the private sector; (b) decentralization of authority within the SGB; (c) divestment of some of the functions of the SGB; and (d) a progressive sequencing of institutional changes within SGB over time.

6.30 The options for change, some of which make up parts of a sequence of change, are described in more detail in Table 6.3. They were studied and debated by the joint team; while they are not the only options, they were judged to be the most relevant. The final solution may be a combination of one or more of the options outlined. They should be and implemented in a deliberate participatory process with the close involvement of all substantial stakeholders.

## CONCLUSIONS

**6.31 Option A: Presidential Committee Proposals:** The Committee recommended the conversion of the GS into a joint stock company. The SGB would be replaced by a company management. Many organizational structures within the company would be possible including:

- The sub-division of the whole scheme into smaller companies, but the proposed joint stock company would retain the responsibility for overall water management.
- Assets currently owned by the central Government would become its share in the proposed company. Other parties (including farmers, commercial banks, project employees, citizens and private investors) would be invited to participate in the company.

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<sup>59</sup> The principles used here have in part been drawn from *Addressing the Challenge of Reforming Public Institutions and Strengthening Governance*, prepared by the Public Sector Group of the PREM Network, internal draft, July 1999. For a comprehensive analysis of processes for institutional for change see *Toolkits for Private Participation in Water and Sanitation*, World Bank, August 1997.

- The central Government, and the original land owners, who collectively hold title to about 40 percent of the whole area, would retain ownership of that land.
- The report envisaged that a private Agricultural Mechanization Company and an Engineering Services Company would be formed. It was also suggested that the Sudan Cotton Company (SCC) while continuing to be responsible for cotton marketing should take over responsibility for operating the Gezira ginneries.
- The Committee also recommended that tenants should be allowed to buy and sell tenancy rights within certain constraints related to size of farm and environmental concerns.
- Tenants would also be given increased flexibility in their choice of crops grown.
- The Farmers' Union opposed this option because it may jeopardize the security of their members. The proposal has also been subject to political attack because of the possibility that about half of the irrigated area in Sudan could come under foreign management.
- The government has so far not acted on most of the recommendations in this report except the transfer of water management from minor irrigation canals from the MOI to the SGB and the establishment of a ministerial committee to the land rental paid to original land holders in the Gezira Scheme area. That committee has completed its report.
- The joint team's *conclusion* was that:
  - ➔ While Option A would be beneficial because it would result in a clean break from the immediate past and remove the Government as the primary institution responsible for the Scheme, there were at least three drawbacks which led the team to conclude that this option was not likely to be practical. First, assuming an accurate reserve price for the Scheme can be established, it is unlikely that adequate capital would be available from within Sudan to finance the purchase. Therefore, finding a buyer (or group of buyers) may require considerable foreign financing, involve drawn-out negotiations probably over a number of years during which the Scheme would continue to deteriorate. Second, negotiations would undoubtedly create considerable uncertainty among tenants and the rest of the Gezira community regarding their future rights which could disrupt those negotiations. Third, failure so far with the privatization of the White and Blue Nile Pump Scheme does not provide confidence that a similar strategy would be successful in the Gezira. Finally, while negotiations would need to include the question of water rights from the Nile, it was not clear what environmental safeguards (if any) for water and land use within the Scheme could be negotiated as part of the sale.

**6.32 Option B: Transfer Major Functions of the SGB to the Private Sector:** This option suggests that with a reduced staffing, targeted training and forceful leadership, the SGB could become a more effective institution by withdrawing some of its controls and handing responsibility to the private sector for many of its functions. The principal changes would be:

- The opportunity (by law) for tenants to buy and sell tenancies, and abolition of a mandatory individual account for cotton with the SGB.
- Freedom of choice for farmers (as a group) to grow any crop within the constraints of technology and reasonable agricultural practice as agreed by a proposed Crop Choice Committee.
- MOIWR would continue to be responsible for delivering irrigation water to the Gezira Scheme where the SGB would be responsible for irrigation water distribution, operation and management of canals, and cost recovery.

- It is assumed that private traders would start to take over the sale of agricultural inputs and services. The SGB could have a transitional role in selling services such as plowing and inputs in competition with the private sector to tenants who expressed their demand to the SGB. Obviously in the short run the SGB is likely to remain the main supplier of services, inputs and credit, but it would need to do so without government subsidy in competition with private commercial providers. In time it is anticipated that the private sector would increasingly take over the role of the SGB in the provision of services, inputs and credit.
- The main role for the SGB would be the management and distribution of irrigation water below the minors, various support services such as extension and market intelligence for tenants, and the individual account system for tenants who have a need for it and may use it basically as a credit system.
- It is anticipated that under this option the ginneries would be offered for sale by public tender –not immediately but a few years into the implementation of this option so that buyers can better as to gauge the long term demand for ginning services.
- SCC would continue to be the preferred marketing institution for cotton, although private trading in cotton by tenants and the SGB would be allowed.
- The Gezira Board of Directors would be expected to provide strong leadership to facilitate the implementation of this option. The Board should be augmented by the addition of a senior representative from the Ministry of Finance and National Economy and a lawyer. It was suggested that the Gezira Board of Directors be supported by a Management Assistance Team (MAT) which would provide expert support to the deliberations of the directors and provide assistance in respect of the implementation of the decisions of directors by the SGB.
- There was broad support among all stakeholders for this option.
- The joint team's *conclusion* was that:
  - ➔ This option represents an appropriate first step towards a process of institutional change in the Gezira Scheme.

**6.33 Option C: Transfer of Major Functions of the SGB to the Private Sector and Decentralize Water Management:** This option would be the same as above but with the establishment of Water User Groups (WUG) for a block or groups of blocks whichever is most efficient.

- WUGs (managed by farmers or a contract management team) would be independent hydraulic units that would pay for irrigation water in bulk at their boundaries such as the boundary of a block which is typically 25,000 hectares. There would be a logical incentive for farmers within a WUG to manage and maintain the tertiary irrigation systems efficiently in order to get most benefit from the purchased water. Their organizational survival will depend on their financial viability, which would only be achieved by recovering operation and maintenance costs from water users. The long-term productivity of irrigated agriculture within a WUG can be assured through high quality operation and maintenance and sound water management performance by the members of the WUG.
- The Gezira Board of Directors, augmented as suggested in option B, would again be expected to provide strong leadership to facilitate the implementation of this option. As with Option B, it is suggested that the Gezira Board of Directors be supported by a Management Assistance Team (MAT) which would provide expert support to the deliberations of the directors and provide assistance in respect of the implementation of the decisions of directors by the SGB.

- The joint team's *conclusion* was that:
  - ➔ This option is an appropriate second step towards a process of institutional change in the Gezira Scheme.

#### 6.34 **Option D: Replace the Gezira Board Directors with a Contract Management Team:**

Under this option the Gezira Board of Directors would be disbanded. It would be replaced by a management team chosen through international competitive bidding.

- The team or company would operate the Gezira under contract to the Government of Sudan which would supervise its activities with the aid of various performance indicators.
- Some of the SGB staff may remain as employees but this would be a decision by the contract management team.
- The contract management team would be paid a fee for work and possibly a share of any profits, but these aspects would be subject to negotiation with the Government.
- The joint team's *conclusion* was that:
  - ➔ This option would remove the Scheme almost completely from the public sector. On the other hand it will be very difficult in the short run for the contract management team to receive the firm assurances it needs from Government on first, its powers to make institutional changes, and second, the allocation of funds from the central government for and capital improvements within the Scheme.

#### **Short Term Actions**

6.35 The options described above provide possible medium to long run solutions, even though their implementation could start relatively quickly. Nevertheless, it is essential to improve the efficiency of operation of the GS as soon as possible. Efficiency in the GS can certainly be improved quickly by taking a number of short term actions which would change the incentive for tenants and the SGB and lead to almost immediate improvements in performance and income flows. There also appears to be widespread support for these actions among the Farmers' Union, the Government and administrators. While relevant to all options, they would become part of Options B and C presented above. They are as follows:

- **Fixed Annual Administrative Charge per Feddan:** Establish a fixed annual administrative charge for the privilege of using irrigated land in the Gezira according to its assessed quality but regardless of the crops grown or the outcome of these crops. Such a charge (equivalent to an annual land rental) means that producers would have an incentive to use the land to its maximum productivity and the SGB would receive a fixed and certain revenue for its services which establishes its annual budget limit. All current arrangements for the arbitration of the administrative fee that should be paid by tenants should be disbanded. The determination of the total revenue from the administrative charge should be made by an independent body (for example a Gezira Land, Water and Cotton Rate Committee) constituted by the Ministry of Finance and National Economy but chaired by an independent person from outside the Government. The Ministry should require the Committee to report to it by a fixed date each year. Planning for this action should be started immediately with implementation of a fixed annual administrative charge at the start of the 2001/2002 fiscal year.
- **Fixed Irrigation Water Charge per Feddan:** Establish irrigation charges (which would vary according to the known quality of water deliveries and soil type) based preferably on the amount of water used annually per feddan, or if metering is not possible a fixed rate for each crop on the basis of the anticipated water delivery schedule irrespective of the crop results,

but discounted for shortfalls in water delivery as verified by the SGB. Such a charging arrangement would mean that tenants pay for water used and they are responsible for the outcome of the crop. It also means that shortfalls in the delivery of water will result in less revenue for the Ministry of Irrigation and Water Resources or the SGB depending on who is responsible. The determination of the water charge should also be made by the Gezira Land, Water and Cotton Rate Committee mentioned above. Planning for this action should be started immediately with implementation of a fixed irrigation charge at the start of the 2001/2002 fiscal year.

- **Formalize the Sale of Tenancies:** Prepare immediately the legal instruments that would allow tenants in the Gezira or any other Sudanese national to buy and sell tenancy rights in the GS subject to some simple conditions on maximum and minimum tenancy size. The target date for change in the legal instruments and implementation of this strategy should be no later than January 1, 2002.
- **Establish Pilots to Explore the Effectiveness of Water User Groups:** Take steps to establish immediately two Water User Groups in different blocks of the GS in areas where the delivery and distribution of irrigation water is efficient, where the water volumes can be reasonably well measured, and where tenant groups are strongly interested in participating in the pilot.
- **Freedom of Crop Choice:**<sup>60</sup> Offer groups of farmers in a specified pilot area which has reliable irrigation water supply and tenancies in a contiguous “hydraulic unit” to exercise their choice of crop rotation for a period of a year starting with the 2000/2001 cotton season. The group’s choice should be transmitted by a specified date in writing to a body called the Gezira Crop Choice Committee. The Ministry of Agriculture and Forests will establish this Commission which should be chaired by a person outside the Government and have representatives from the SGB, the Ministry of Irrigation and Water Resources, Ministry of Agriculture and Forests, Agricultural Research Corporation, and the Farmers’ Union. The SGB would provide the secretariat for this Committee. The Committee (which would replace the current Cotton Production Committee) will have the responsibility of assessing whether the preferences of farmer groups can be met and if not what changes in crop rotations for various groups would need to be made. An announcement by the Committee on approved crop choices for the groups would need to be made by a date in the year which would allow land preparation, planting and irrigation to proceed at peak efficiency. The pilot should start immediately, but the start to the Gezira-wide application of this action should start before the beginning of the 2001/2002 cotton season. It is anticipated that after a year or two this process will become routine as farmer groups settle into their preferred rotations.
- **Payment of Cash on Delivery for Cotton at Ginneries:** Initiate for the next cotton harvest a cash payment of fixed proportion (no less than 50 percent) of the expected “farmgate” price for cotton (according to grade) when cotton is delivered to ginneries. Of course those tenants who have received crop financing would have this credit immediately debited against their SGB debts. Subsequent payments should be determined according to a contract between the tenant and the SCC. The ginneries could act on behalf of the SCC in respect of the payments and will be responsible for grading and weighing of the seed cotton. The proposed Gezira

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<sup>60</sup> During the week that this report was being completed it was heard that the Minister of Agriculture and Forests had announced that tenants in the Gezira would no longer be required to grow cotton. No further details were available. It should also be noted that FAO has recently approved Technical Cooperation Program (TCP) support to Sudan covering the piloting of raising productivity through broadening farmer’s choice on farm system and water management which includes support for an agro-ecological zonation study which would provide information on the suitability of the land for various crops.

Land, Water and Cotton Rate Committee would announce the percent advance payment at the same time as the Gezira Crop Choice Committee makes its decisions before the start of the season. This action implies also that farmers need not agree that the SGB provides the land preparation and other services for cotton production. The cash advance payment should start with the 2001 seed cotton deliveries.

- **Study of Institutional Development for Formal Credit:** A study should be mounted as soon as possible to assess the possible forms of credit institutions that could be formed to collect savings and to provide seasonal credit to tenants as an alternative to the SGB
- **Funding of Agricultural Research:** Ensure the adequate and sustained funding of the Agricultural Research Corporation by the central government to ensure the continuation of a strong program of research leading to improvements in the productivity of irrigated crops.

**Table 6.3: Evaluation of Four Institutional Options for the Future Management of the Gezira Scheme**

Options	Advantages	Disadvantages
<p><b>A. Ministerial Committee Proposal</b></p> <ul style="list-style-type: none"> <li>• Convert SGB into a common stock company with government as major but less than 50 % shareholder</li> <li>• MOIWR still responsible for irrigation water delivery to the minor canals</li> <li>• Legal position of farmers would need to be determined by company, but could assume that tenancy arrangements would remain the same in the short term</li> <li>• Sudan Cotton Company would take over the ginneries</li> </ul>	<p>Managerial and financial responsibility for the Gezira Scheme would be removed from the slow and constrained decision making Government corporation and result in a more efficient scheme resulting in higher incomes for all those involved.</p> <p>Pressure would be placed on farmers (be they tenants or freeholders) to become more efficient in order to meet market rates for their leases and services which they are either sold by the new "Gezira Company" or buy from the open market.</p> <p>Pressure would also be placed on the MOIWR and the new "Gezira Company" to be efficient in water delivery at the minor canals.</p> <p>The new "Gezira Company" would need to find a way to efficiently handle water distribution and the operation and maintenance of the minor/tertiary canals so as to retain the support of the land tenants.</p> <p>The new "Gezira Company" would also need to find ways of improving extension of research but could re-invigorate the research/extension linkages.</p>	<p>Political concern about "selling the farm" to foreigners may ultimately block any sale.</p> <p>Availability of enough capital to make the purchase with funds from within Sudan is doubtful. Hence part foreign ownership is inevitable and may be seen by some as counter to national interest.</p> <p>Establishing a reserve price for the Gezira Scheme will be difficult. Without a reserve (with weak demand) it may be sold at substantially less than fair market value.</p> <p>Private sector management may not be adequately focused on social issues facing people in the Scheme creating resentment and reduced efficiency.</p> <p>Tenant resistance to a sale would be high because of the uncertainties it would bring to their life and their political capacity to block sale.</p> <p>Opposition by tenants may delay and disrupt the bidding process and create many uncertainties and loss of production</p> <p>The disappointing experience of privatization of the White and Blue Nile Irrigation Schemes does not bode well for privatization of the Gezira although the circumstances are different.</p>

Options	Advantages	Disadvantages
<p><b>B. SGB Continues but Land Tenure Policy Changed, Abolition of Account System, Full Flexibility for Farmers' Choice of Production Rotations, Annual Land Rental, Payment for Irrigation Water According to Use</b></p> <ul style="list-style-type: none"> <li>• Land tenure policy is changed so as to allow buying and selling of tenancies within specific tenancy size limits supervised by the SGB. Administrative charge replace by annual land rental rates established by independent rental board appointed by the Ministry of Finance and National Economy</li> <li>• SGB remains responsible for irrigation water distribution, operation and maintenance in minor and tertiary canals, cotton processing and marketing, but discontinues automatic land preparation and financing of inputs through individual accounts (unless contracted to do so by the tenant).</li> <li>• Annual determination of cotton production allocations discontinued and replaced by group choices by farmers subject to technical and environmental constraints.</li> <li>• Aerial spraying of cotton to be discontinued</li> <li>• MOIWR still responsible for irrigation water delivery to the minor canals</li> <li>• SGB may continue to provide credit arrangements for tenants to purchase inputs and other services using liens on tenancies or output as collateral. Other credit institutions will be encouraged to become involved. In the short term the</li> <li>• Ministry of Finance may need to provide guarantees in order for the SGB to gain access to sufficient finance for it to carry out its responsibilities.</li> <li>• Private traders take over agricultural input marketing, and are encouraged to enter marketing for non cotton crops.</li> </ul>	<p>Increases market-based competition for the use of irrigated land compared with historical rights and will increase pressures on raising the efficiency of land use</p> <p>SGB staffing would need to be reduced , but it would still maintain control over the broad land use in the Scheme so as to safeguard long term land productivity and environmental stability.</p> <p>The cost of most services will be market determined rather than determined by the top heavy cost structure of the SGB.</p> <p>Farmers are likely to have a choice of creditor rather than be forced to use the services of the SGB. This competition, in which the SGB could play a part, would make credit markets more efficient.</p> <p>Processing facilities such as ginneries may increase their output and profitability if cotton and other crops become more popular and production increases.</p>	<p>SGB management and staff may not be able to efficiently manage their new role. For example the important agricultural extension role may not reach a high enough standard to advise tenants of new production techniques and market information. The SGB may also not be up to the task of irrigation water operation and management as well as cost recovery.</p> <p>Some farmers may not gain access to credit to purchase services and inputs and consequently cotton and other production will decline.</p> <p>Inadequate competition in the market for goods and services (e.g. agricultural inputs) may result in higher costs for tenants than necessary.</p> <p>The efficiency of cotton processing and marketing (still under SGB control) may not improve and wipe out efficiency gains in production.</p> <p>Rotations adopted by farmers may be environmentally too exploitive and lower the long term productivity of land.</p> <p>Control of cotton insects without SGB/ARC centralized management and aerial spraying may not be environmentally sound and also variable among farms with cross contamination leading to disputes which may spill over into non repayment of credit because of production losses.</p> <p>If cotton production is substantially reduced as a result of farmers' free choice some ginneries may become uneconomic and close down.</p>

Options	Advantages	Disadvantages
<ul style="list-style-type: none"> <li>Sudan Cotton Company remains as cotton marketing body, but on condition that advance payment paid for seed cotton on delivery and testing at ginneries. SCC (in collaboration with the SGB) will no longer hold cotton as collateral to finance the import of production inputs for cotton.</li> <li>Gezira Board of Directors expected to provide strong leadership to implement this option. It should also introduce rigorous training program for SGB staff</li> </ul>		<p>The SGB may not gain access to sufficient financial resources to meet its commitments under this option.</p>
<p><b>C. Same as Option B but with Decentralized Water Management using Water Users Groups or Similar Groups</b></p> <ul style="list-style-type: none"> <li>Establish Water Users Associations (WUGs) at the block level</li> <li>SGB would undertake responsibility for the development of WUG as sustainable institutions.</li> <li>The MOIWR would undertake to provide a planned quantity of irrigation water on a bulk basis to the WUGs at a fixed charge to be paid according to an agreed schedule during the year. Payment would also be agreed in advance in a contract. The WUGs then re-sell the water to their members and also take responsibility for the distribution of the water to the various farms, and maintain the canals.</li> </ul>	<p>WUGs (perhaps based on existing village councils) provide a cohesive institution for irrigation water management the discussion of community needs and contributions, and thereby also lead to strengthening of community interest in the overall sustained development of the GS .</p> <p>Transferring irrigation management to WUGs would reduce SGB/MOIWR costs of irrigation services substantially</p> <p>WUGs are likely to operate and maintain the irrigation systems under their control at a more cost-effective manner and hence they increase the chances of irrigation cost recovery.</p> <p>WUGs would ensure water distribution is efficient and that water is effectively used.</p> <p>Other advantages as for Option B</p>	<p>It may be impossible to develop the financial organization for strong WUGs and this may lead to weak management and inadequate technical capacity to handle water management as well as canal and control structure operation and maintenance.</p> <p>Water charges may not be rigorously collected from farmers or corruption may arise leading to the inability of WUGs to pay for irrigation water supply by the MOI leading to the complete breakdown of the WUG concept.</p> <p>Other disadvantages as for Option B</p>
<p><b>D. Gezira Board of Directors Disbanded and Replaced by Contract Management Team Responsible to Minister of Finance and National Economy</b></p> <ul style="list-style-type: none"> <li>Appoint contract management team chosen by international competitive bidding.</li> <li>Details of tenant responsibilities and</li> </ul>	<p>This option would remove the public sector from the management of the Scheme and could make its operation more efficient assuming there are incentive provisions in the management contract.</p>	<p>Tenant contracts would probably receive a major overhaul and as a result tenants may not be able or prepared to comply with a new management approach.</p>

Options	Advantages	Disadvantages
<p>options to be determined by management team</p> <ul style="list-style-type: none"> <li>• Role and retention of SGB staff to be determined by management team</li> <li>• Government to make a commitment to capital budgets for improvements to Gezira infrastructure for rolling five year periods, on condition of satisfactory performance by management team.</li> </ul>	<p>The GS may generate more revenue than any of the other options Improved technologies, and modern management systems and approaches are likely to be introduced</p> <p>A sound Government/private sector partnership could be a strong force for the stability and sustained operation of the GS because of the mutual interest in achieving stability over the long term</p>	<p>The management team may not turn out to be competent or able to integrate its style with Sudanese rural culture to be successful.</p> <p>Access to capital from the government for improvements to the GS may be blocked or delayed despite previous agreements with the Ministry of Finance resulting in serious implementation problems in the GS and loss of efficiency.</p> <p>The cost of the management contract itself in the end may be too heavy for the GS to carry unless there is a resurgence of yields and production</p> <p>Problems could arise between the management team and the MOIWR on costs for bulk water and its delivery leading to water shortages or delays in water supplies.</p>

## ANNEXES

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**ANNEX 1: SUMMARY OF THE REPORT BY THE PRESIDENTIAL COMMITTEE FOR IRRIGATED SCHEMES:  
RECOMMENDATIONS, JUSTIFICATIONS, ACTIONS TAKEN AND REMARKS BY MISSION**

Recommendations	Justifications	Actions Taken	Mission's Remarks
<p><b>A Institutional Reform</b></p> <p>1. The establishment of a joint stock company (based on sale of shares to the public). The State share in the proposed company would be the asset currently owned by the state. Other parties including farmers, scheme employees provide sector entrepreneurs and commercial banks would be invited to purchase shares and participate in the company.</p>	<ul style="list-style-type: none"> <li>• Gezira was developed as a profit-making business and not a subsistence scheme.</li> <li>• The existing management approach gives the impression to farmers that the Gezira scheme is indeed a project aimed at providing farmers with a subsistence income</li> <li>• For prolonged period, the Gezira Scheme was managed by a public corporation under the control of the civil service bureaucracy, which is not suitable for a profit-making enterprise.</li> <li>• The financing requirements for structural reforms, rehabilitation and investments are vast and beyond the reach of Government, it can only be obtained by attracting private investments. The existing institutional set up is not conducive for donor support or private finance.</li> <li>• To cope with the liberalization and privatization policy of the Government and enhance competition and competitiveness.</li> </ul>	<ul style="list-style-type: none"> <li>• The Council of Ministers discussed and adopted in principle the recommendation for privatization; but serious steps for implementation are yet to be taken. Any implementation is not likely in the immediate future.</li> </ul>	<ul style="list-style-type: none"> <li>• There are numerous obstacles and practical limitation to the proposal.</li> <li>• Serious resistance from farmers, who are keen to continue having access to public funds for periodic rehabilitation.</li> <li>• The public and particularly the elites and employees, is not fully convinced of the feasibility of the proposal, and some of the public is suspicious of the motives behind the privatization proposed.</li> <li>• The estimated marked value of The Gezira Scheme is high (\$ 4 to \$ 8 billion) and would severely limit effective private participation i.e.</li> </ul>
<p>2. The MOIWR or its agencies shall manage the major irrigation structure down to the inlets of the minor canal.</p>	<ul style="list-style-type: none"> <li>• The structures are national property.</li> <li>• Their operation is linked to the Nile water resources.</li> <li>• Concentration of</li> </ul>	<ul style="list-style-type: none"> <li>• The Irrigation Water Corporation responsible for collection of water rates and financing of O&amp;M, including desilting responsibility was transferred to the MOIWR.</li> </ul>	<ul style="list-style-type: none"> <li>• MOF remained skeptical about re-engagement in financing O&amp;M of the irrigation system</li> <li>• The consortium of Commercial Banks, which contributed to financing the cost of production,</li> </ul>

Recommendations	Justifications	Actions Taken	Mission's Remarks
	<p>technical expertise is necessary to efficiently operate and manage a complex system.</p> <ul style="list-style-type: none"> <li>• Only the Government can provide the necessary financial resources to run a major irrigation system.</li> </ul>	<p>The IWC has since become bankrupt and has dissolved. Its functions have been taken over by the Sudan Gezira Board.</p> <ul style="list-style-type: none"> <li>• Ministry of Finance reluctantly assumed the financing role and provided funds to the MOIWR for desilting.</li> <li>• Private and State owned companies moved in under ontract to participate in desilting and O&amp;M of the irrigation system.</li> </ul>	<p>including water costs (rates) during the period 1992-1998, for all practical purposes stopped outstanding debt when reached of about LS 18 billion.</p>
<p>3. The proposed company shall manage the irrigation system (including operation and maintenance) from the inlets of the minor canals to the field, in cooperation with the MOIWR.</p>	<ul style="list-style-type: none"> <li>• The ultimate objective is to increase the participation of the farmer in the management of water at field level.</li> <li>• Application of water at field level directly affects crop productivity and total production.</li> <li>• Within the proposed company, the future development of the extension service on water use would be the responsibility of the agricultural staff.</li> </ul>	<ul style="list-style-type: none"> <li>• The Gezira Scheme management assumed the responsibility of irrigation water O&amp;M from the inlet of the minor canals to the field.</li> <li>• A new department of irrigation (DOI) created within the SGB.</li> </ul>	<ul style="list-style-type: none"> <li>• MOF provided significant financing for minor canals, which hold 65% of the accumulated silt.</li> <li>• The Gezira management has no intention of involving the farmers in the operation of irrigation systems.</li> <li>• However, the mission witnessed during field visits considerable joint action by tenants farmers to manage and improve the flow of water in the canals.</li> </ul>
<p>4. Involving farmers in decisions related to annual agricultural production (i.e. crop production choices) and irrigation management.</p>	<ul style="list-style-type: none"> <li>• Only through increased participation of farmers in agricultural production decisions and effective field application of water can</li> </ul>	<ul style="list-style-type: none"> <li>• Stiff resistance to this proposal from the SGB to farmers' participation in water management. No action taken to date.</li> </ul>	<ul style="list-style-type: none"> <li>• Evidence from worldwide experience suggests that participation of farmers in water management is critical for efficient use of the resource,</li> </ul>

Recommendations	Justifications	Actions Taken	Mission's Remarks
	productivity be increased.		reduces the cost of O&M, and enhances farmers' satisfaction.
5. Establishment of various enterprises as joint stock companies.	<ul style="list-style-type: none"> <li>• Enterprises can be operated on commercial basis</li> <li>• Enterprises can be made attractive to private investors</li> <li>• Private entrepreneurs have experience with these kinds of operations in other agricultural areas.</li> </ul>	<ul style="list-style-type: none"> <li>• The Gezira Scheme attempted to operate these enterprises on commercial basis.</li> <li>• No serious steps, legal, administrative or financial, have been taken for the establishment of the proposed companies.</li> </ul>	<ul style="list-style-type: none"> <li>• The enterprises are yet to be established as autonomous managerial and financial units.</li> <li>• These enterprises are still under the direct control of the General Manager of the SGB; their operations are neither independent nor strictly based on commercial business principles. Their financing is entirely controlled by the Gezira Board of Directors.</li> <li>• The supervision of private contractors is entrusted to these enterprises leading to confusion in functions and to conflict of interest. In fact much supervision is not performed in a professional manner. While major civil works such as buildings should be done through private contractors, non-commercial enterprises could undertake maintenance as well as supervision of private civil contractors.</li> </ul>
6. Creation of special department to operate the Gezira Light Railway (GLR). this company could form a partnership with the Sudan Railway Authority, if possible.	<ul style="list-style-type: none"> <li>• The demand for the GLR service is limited to the transportation of cotton produce and of inputs, especially during the rainy season. Consequently it is difficult to establish a market oriented, private company.</li> </ul>	<ul style="list-style-type: none"> <li>• A special administration for GLR already exists. The SGB claims that it functions on business principles, but its finances are under the control of the Board. No further action has been taken.</li> </ul>	<ul style="list-style-type: none"> <li>• The GLR is characterized by high levels of fixed assets.</li> <li>• Capital stock such as railway tracks, locomotives, spare parts, workshops are depreciating rapidly.</li> <li>• The quality of the SGB work force has been seriously and</li> </ul>

Recommendations	Justifications	Actions Taken	Mission's Remarks
	<ul style="list-style-type: none"> <li>• Technical support from the Sudan Railway Authority may be necessary.</li> <li>• The parent company may use its resources to rehabilitate the GLR, track, and locomotives.</li> </ul>		<p>negatively affected by the staff reduction policy since 1990.</p> <ul style="list-style-type: none"> <li>• GLR is facing serious competition from the owner operated trucks/ lorries.</li> <li>• GLR track services are negatively affected by the frequent breach of canals due to siltation and malpractice by farmers and lack of adequate drainage.</li> </ul>
<p>7. Gezira communication system to be coordinated and managed by a specialized communication company (e.g. SUDATEL).</p>	<ul style="list-style-type: none"> <li>• To operate the communication system on commercial basis.</li> <li>• SUDATEL has demonstrated a capacity to cover most of the territory of Sudan.</li> </ul>	<ul style="list-style-type: none"> <li>• Gezira Board transformed the system from "free" service administered by a unit to a partially commercial system generating revenue; but still SGB receives free services.</li> <li>• Gezira Scheme is involved in discussions to integrate its operations with SUDATEL.</li> </ul>	<ul style="list-style-type: none"> <li>• The system is likely to become technically obsolete and therefore, it is necessary to integrate it with a private company that has the capacity to invest in its renewal.</li> <li>• The Gezira Board does not have the resources to provide spare parts, especially since the supplier company has a commitment only until year 2003 for the provision of spare parts at cost.</li> </ul>
<p><b>B. Economic &amp; Financial Policies</b>  1. Production Relations: The committee emphasized the suitability of the individual account-system provided the negative effects are reduced or neutralized.</p>	<ul style="list-style-type: none"> <li>• It is theoretically an equitable system in which each farmer should receive the return from his or her investments.</li> <li>• Leads to more efficient resource use.</li> <li>• Results in higher productivity per unit of input.</li> </ul>	<ul style="list-style-type: none"> <li>• The system is in place, but nothing done so far to reduce or eliminate the negative aspects of the individual account system because of the ability of the SGB to deduct all its costs from farmers cotton returns without any audit of the justification of those costs.</li> <li>• The Government appointed a committee to reexamine the production relations and</li> </ul>	<ul style="list-style-type: none"> <li>• The negative aspects of the individual account system are a product of poor implementation of the system, and could be summarized as follow:- <ul style="list-style-type: none"> <li>- Farmers' accounts are kept on individual basis, and separate for each crop, but all costs (regardless of crop) are still deducted from the cotton crop, returns creating a major disincentive.</li> <li>- Farmers are supposed to be paid</li> </ul> </li> </ul>

Recommendations	Justifications	Actions Taken	Mission's Remarks
		<p>financial relations between the tenants and the SGB. The committee is actively reviewing the relations with particular focus on the high indebtedness among farmers.</p>	<p>on the receipt of cotton at the ginning gates, but payments are usually delayed for about 18 months.</p> <ul style="list-style-type: none"> <li>- Given the precarious financial position of the Gezira Scheme it frequently fails to pay farmers who have surpluses. The SGB also fails frequently to pay the water rates collected from proceeds of cotton to MOIWR..</li> <li>- Farmers are supposed to receive remunerative prices for their produce, but taxes remained high, and until recently cotton export proceeds were valued at a very high official exchange rate of Sudanese currency to the US dollar.</li> <li>- Irrigation water availability is jeopardized by a dilapidated irrigation network, affecting all crops, particularly cotton.</li> <li>- Individual account should have encouraged private initiative, but farmers are marginalized in decision-making in respect of crop choice, varieties, water application and other inputs and cost of production.</li> <li>- All kinds of extension services on crops, water application, competitive enterprises (e.g. livestock) are lacking.</li> <li>- For the system to be more effective, the current practice of deducting all costs (particularly water rates) from the cotton crop should be immediately</li> </ul>

Recommendations	Justifications	Actions Taken	Mission's Remarks
			<p>stopped.</p> <ul style="list-style-type: none"> <li>- Farmers should have greater choice, whenever technically possible, in crop selection and in water application.</li> </ul> <p>An effective credit system should be devised to (a) increase farmers contribution in farming decisions and (b) create a direct link between farmers and financing institution i.e., the present approach of project level financing should ultimately be dismantled, except for reasons of bulk purchase.</p>
<p>2. Water Charge Levels and Collection: Water charges for each crop should be determined on the basis of efficient water use and collected from the proceeds of each crop, not only from cotton. To ensure the collection from all crops, farmers should pay the water charges for other crops in advance.</p>	<ul style="list-style-type: none"> <li>• Farmers should not pay for inefficient water delivery.</li> <li>• If water charges for all crops are deducted from the cotton proceeds, then incentives for cotton production are effectively reduced.</li> </ul>	<ul style="list-style-type: none"> <li>• To increase physical efficiency of water delivery, a 3-year rehabilitation (desilting) program is currently under implementation financed by Federal Government (MOF).</li> <li>• The responsibility of water management in the upper reaches of the system (Sennar dam, structure, main and major canals to the inlets of the minor canals) remains with MOIWR, while from the inlet of the minor canals to the farmers fields managed by the SGB.</li> <li>• The MOIWR is financed directly from the Federal Government Budget.</li> </ul>	<ul style="list-style-type: none"> <li>• The physical delivery of water is not sufficient for efficient water use, and there is no substitute for active participation of farmers in water management at field level.</li> <li>• Farmers should receive adequate water at field level, and in case the Gezira Board failed to supply the necessary water in time, farmers should receive adequate compensation.</li> <li>• Farmers should pay water rates in full and on time. A system of water rates collection per crop could be developed in connection with farmers' field level organization for water management. Alternatively a private system for collection of water rates could be adopted.</li> </ul>

Recommendations	Justifications	Actions Taken	Mission's Remarks
<p>3. Cotton Marketing and Sale: Committee emphasizes the need for consolidating the body that markets cotton abroad, and the participation of Gezira (company) in the process of cotton marketing. The SCC should be responsible for the ginning factories as well as sorting, grading and transportation of cotton. The SCC Should become responsible for sale of all cotton derivatives: lint, seed and escarto. The SCC should concentrate on cotton sales and be detached from the financing of production inputs. The SCC should not resort to premature sale of cotton to meet the foreign currency requirements of the Government (and / or the Gezira Scheme) at the expense of remunerative cotton prices to the producers.</p>	<ul style="list-style-type: none"> <li>• Participation of the proposed Gezira company and grassroots "real" farmers' organizations considered essential for transparency and confidence in cotton marketing.</li> <li>• These functions are seen as important marketing services to ensure quality of cotton and enhance confidence of foreign buyers.</li> <li>• The ginning facilities could be capitalized as shares held by the Gezira Company in the SCC, and therefore Gezira becomes qualified to participate in cotton marketing.</li> </ul>	<ul style="list-style-type: none"> <li>• The SCC is under the control of the Farmers Union.</li> <li>• No actions taken on most of these recommendations.</li> <li>• The Committee subsequently warned the Government of the risk that cotton marketing could become highly monopolistic non-transparent and tax farmers heavily. Consequently, the Committee proposed the introduction of private competition and more active participation of farmers in cotton marketing.</li> </ul>	<p>The producers should be represented by their field level production committees (not by a highly politicized Union) and the SGB should assume the responsibility (or at least a major role) in cotton sales.</p> <ul style="list-style-type: none"> <li>• The SCC in many respects resembles a marketing board, which were historically used by governments to tax farmers heavily, to control the foreign exchange earnings and deplete the capital stock of producing units.</li> <li>• Producing units marketing their cotton on a competitive basis should allocate adequate foreign exchange from the proceeds of cotton to meet the importation of inputs (fertilizers, insecticides, pesticides, jute sack; etc).</li> <li>• No deductions from cotton proceeds for financing other crops.</li> <li>• No sale of cotton derivatives without transparent and competitive bidding. There are experiences of selling cotton seed (sometimes forward sales at quantities beyond expected output) directly for settling debts or for meeting local tax obligations, or meeting immediate financing needs.</li> </ul>
<p>4. Land Tenure Issues A decree should be issued to renew</p>	<ul style="list-style-type: none"> <li>• Without immediate action to legalize the Government right to</li> </ul>	<ul style="list-style-type: none"> <li>• A Committee was formed under the chairmanship of the State</li> </ul>	<ul style="list-style-type: none"> <li>• In addition, it is necessary to create a competitive market for</li> </ul>

Recommendations	Justifications	Actions Taken	Mission's Remarks
<p>the duration of the expropriation of the private land in Gezira Scheme. To amend the rental rates for land leased as well as the law, a technical committee should determine the new land rates for that purpose.</p> <p>Owners of land used by the Gezira Scheme should be given the right to sell their land and tenancy owners the right to lease their tenancy with the approval of Gezira management.</p>	<p>access the private land, there will be a legal flaw.</p> <ul style="list-style-type: none"> <li>• For investors to come forward and participate in the capitalization of the Scheme there should be no land dispute with the landowners.</li> <li>• The rates paid by the Government to private landowners is negligible at present (the rate which was decided at the start of the Scheme was 10 Egyptian piastres). As such, land has very low value and neither Government nor farmers have an incentive to invest in land improvements.</li> </ul>	<p>Minister for Agriculture. Its main task was to determine a just land rental rate, and grant the private land owners their rights on land without jeopardizing the efficient operation of the scheme and the realization of scale economies.</p>	<p>land; such exchange of land among private owners is likely to consolidate land, inject new capital, and improve economies of scale.</p> <ul style="list-style-type: none"> <li>• Land market and the sale of usufruct rights on plots will also increase the security for sharecroppers and therefore encourage them to invest in land.</li> <li>• A transparent relationship between the Sudan Gezira Board, the farmers and the sharecroppers would assist the establishment of water users associations, the formation of which is a prerequisite for breaking the vicious circle of poverty prevailing in the Gezira.</li> </ul>
<p>5. Fiscal and Financial Reforms</p> <p>In accordance with the Council of Ministers Decree (284 / 1996) the rate of all taxes and Zakat should not exceed 15% of net value of produce in the irrigated sector.</p> <ul style="list-style-type: none"> <li>- Cost of inputs can be reduced significantly if adequate resources are allocated for its procurement and importation.</li> <li>-The unification and simplification of financing sources and procedures and the encouragement of self financing from farmers' resources and the encouragement of income earning activities.</li> <li>- Cotton sales; the cotton marketing company should limit its role to</li> </ul>	<ul style="list-style-type: none"> <li>• Over taxation of the farming sector is a major disincentive and as a result farmers are forced to neglect farming and divest.</li> <li>• There is evidence that farmers pay higher margins for their inputs due to high cost of financing under <i>sheil</i> credit.</li> <li>• Farmers should be encouraged to save and invest in farming. To achieve this, household earnings increased through additional income generating activities.</li> <li>• SCC should become a</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers still not sure about the Government intentions in this regard</li> <li>• There is some information that the Zakat Administration accepted the principle of using the net value as a basis for calculation of Zakat.</li> <li>• The Government established a high level committee for procurement of inputs and provided adequate guarantees for financing; a move which produced positive results.</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of foreign exchange, advance sale of cotton at discount prices and discrimination in exchange rate result in high cost of production, low revenues and disincentives and dissatisfaction of farmers.</li> <li>• Diversification of household earnings sources should improve farmers' capacity to save and invest provided that there are incentives in farming particularly cotton.</li> <li>• A credit system should be devised to provide individual farmers with their financing needs. It is unfortunate that</li> </ul>

Recommendations	Justifications	Actions Taken	Mission's Remarks
<p>marketing of cotton and its derivatives.</p> <ul style="list-style-type: none"> <li>- Cotton producing schemes should become associated with of the CMC through subscription in the company's capital stock to the value of their ginning factories.</li> </ul>	<p>specialized cotton marketing institution.</p>		<p>Gezira does not have a history of financial intermediation at the household level. Cotton financing is provided through the SGB, while other household consumption and production credit is provided through moneylenders (<i>Sheil</i>), remittances and sharecroppers.</p> <ul style="list-style-type: none"> <li>• Marketing of cotton should be based on three principles: <ul style="list-style-type: none"> <li>- Cotton producers should have an active role in sales of cotton.</li> <li>- Monopolistic access to cotton should be avoided because at the end farmers will suffer.</li> <li>- The marketing company decisions should be transparent and the company should not be used for unduly taxing of producers.</li> </ul> </li> </ul>
<p>6. Financial and Accounting System Reform</p> <p>The financial and accounting system and expenditure should be based on production budget prepared and approved before the agricultural season.</p> <ul style="list-style-type: none"> <li>- Attract competent accounting officers.</li> <li>- Improve store keeping.</li> </ul>	<ul style="list-style-type: none"> <li>• The administrative budget based on a calendar year is not suitable to agricultural production.</li> <li>• Accounting and financial procedures are important for diligent financial management, transparency, and farmers' confidence in the system.</li> </ul>	<ul style="list-style-type: none"> <li>• The budgetary year for agricultural schemes including Gezira has been changed to July – June.</li> <li>• Reforms are difficult to start because the financial position of the Scheme situation is very precarious.</li> </ul>	<ul style="list-style-type: none"> <li>• A budget based on production activities, transparent procedures for accounting and determining farmers' revenue, procurement, water rates and administrative expenses.</li> <li>• Improving the quality of accountants through intensive training and adopting measures and incentive to retain their services essential for the proper financial management of the scheme.</li> </ul>

**Table 1: Summary of Total Employees, in Sudan Gezira Board 1999**

Administration	Classified Staff			Labor			Total Approved
	Approved	Occupied	Vacant	Approved	Occupied	Vacant	
Agricultural Management	1074	1002	72	2929	2077	852	4003
Investment	99	92	7	215	184	31	314
Engineering	147	139	8	528	527	1	675
Special Units	153	131	22	223	222	1	376
Finance Department	108	107	1	53	52	1	161
Administration	58	58	0	247	247	0	305
Commercial Units	272	271	1	1971	1947	24	2243
<b>Total</b>	<b>1911</b>	<b>1800</b>	<b>111</b>	<b>6166</b>	<b>5256</b>	<b>910</b>	<b>8077</b>

Source: Sudan Gezira Board, Personnel Department.

## ANNEX 2: MACROECONOMIC DEVELOPMENTS

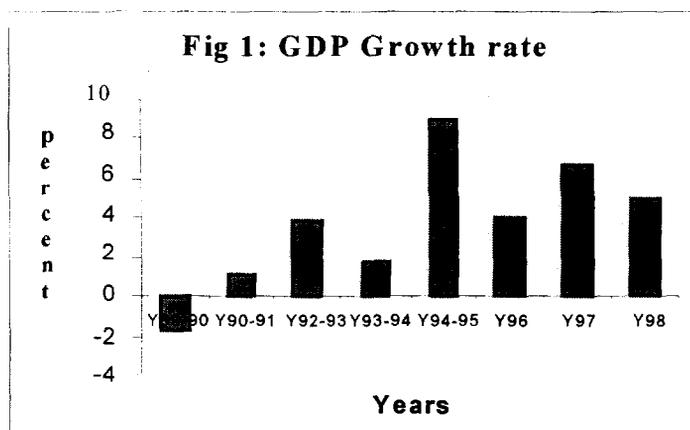
### The Structure of the Economy

1. Sudan's economic growth is dominated by agriculture, which accounted for an estimated 45 percent of GDP, 55 percent of employment, and 85 percent of export earnings in 1998. Among the three main agricultural systems, irrigation contributes 27 percent of agricultural GDP, and it produces most of the cotton, sugar cane, legumes, orchard crops, peanuts and wheat.<sup>61</sup>

2. A notable development in agricultural production in the 1990s is the emergence of livestock as a major export product in place of cotton, which is in a decline. Livestock exports rose from US\$22.6 million in 1990/91 to US\$120 million in 1998, while earnings from cotton fell from US\$162.8 million to US\$95.6 million during the same period, due mainly to inefficiency and decline of the irrigation sub-sector. Another recent development is the start of oil production in August 1999.

### Recent Economic Performance

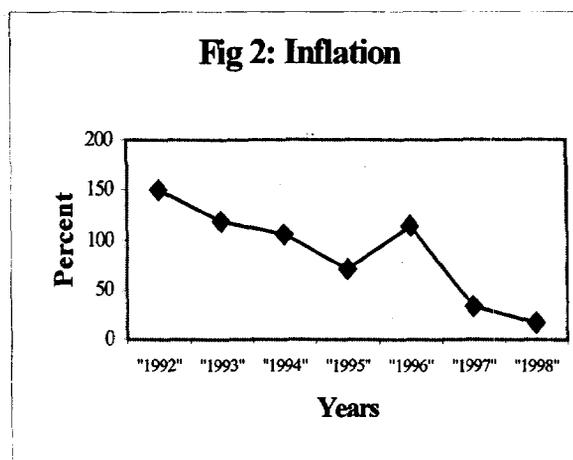
3. **Economic Growth:** Achieving sustained growth in Sudan has been hampered by civil war, social dislocation and the brain drain, as well as the deterioration of basic infrastructure and the lack of access to aid and foreign investments. Infrastructure bottlenecks, including erosion of transport and irrigation, and shortage of electricity, have been severe. In addition, Sudan has been vulnerable to severe external shocks, including floods and drought, which often result in recurrent famine. The prospects for a lasting peace, which would help release resources to channel to development, remain uncertain.



4. Specific growth numbers need to be viewed with caution, mainly because of the dearth of reliable data, especially on crop yields, acreage and subsector weights. Nevertheless, there are broad indications that the economy improved in the 1990s after years of decline (Figure 1). Officially, the GDP growth rate averaged five percent during 1992-93 to 1998, were led mainly by agriculture. Construction activities linked to investments in oil in the last three years contributed to the growth process. The general economic improvement has been helped by the government's containment of fiscal deficits, limits on monetary growth and a reduced rate of inflation which was running at over 100 percent in the early 1990s. The key structural reforms aim at enhancing efficiency by liberalizing the trade and exchange rate regimes, phasing out price controls and privatizing public enterprises.

<sup>61</sup> Assuming that the GS produces a little more than one-quarter of the GDP from all irrigation schemes, it is estimated that the GS accounts for about seven percent of agricultural GDP, or about three percent of national GDP.

5. **Inflation:** Based on Khartoum figures, inflation was high in the earlier parts of the 1990s, reflecting widened fiscal deficits and domestic credit expansion. Crop failure and shortage of basic food items, and increases in the domestic price of key imports, especially petroleum, also fuelled the inflation. The abolition of most administered prices since 1992 allowed high prices to be reflected in the open market. Recently, inflation declined from a peak of 150 percent in 1992 to 17 percent in 1998 as Government adopted tighter policies, especially tight monetary measures (Figure 2). Broad money growth fell from an average of 85 percent during 1992-96 to 34 percent in 1997-98.



6. **Savings and Investments:** Domestic savings are low at about 5 percent of GDP. There are no Government revenue surpluses over recurrent expenditures. The Government is putting emphasis on deregulating and promoting private investments, which are also very low, excepting the recent spurt of foreign direct investments directed only at creating the oil pipeline and related activities. The Investment Promotion Act of 1990 (amended in 1996) was amended again in 1999 to rationalize the investment sanctioning procedures and stimulate greater private investments and growth. The Act provides guarantees against nationalization and for transfer of profits. The Act also provided fiscal exemptions for investors, including tax holidays and exemptions on import duties, fees and consumption and production taxes. However, the discretionary tax exemptions created many problems. Authority for implementing the exemptions has been spread out among various federal and state level departments, often leading to overlapping processes. The Government's amendment to the Investment Encouragement Act in 1999 was intended mainly to (i) establish a "one window" system of uniform facilities for all investors, (ii) allow exemptions and tax holidays already granted to expire as originally sanctioned, (iii) eliminate open-ended exemptions and limit new exemptions. However, political support was not adequate to pass these amendments to the Act in 1999. The Government is currently reviewing the Act with a view to rationalizing the exemptions process.

### Public Resource Management

8. Low tax revenues, large expenditures and lack access to external financing have made sound macro-fiscal performance difficult. Similarly, development financing and effective public resource management are extremely difficult. During 1994-96, for example, revenue fell from 9.4 to 6.2 percent of GDP, while expenditures rose from 22 to 26.6 of GDP. The revenue ratio at the federal level is about 8 percent of GDP. Even if state level revenues are taken into account, the total revenue ratio would be about 12 percent of GDP, compared to the LDC average of 18-20 percent. A program of tax reform to enhance the efficiency of the tax system through the introduction of a VAT is being prepared for implementation.

9. Development expenditures funded by the central government are minimal, rising from 0.5 to 0.8 percent of GDP between 1996 and 1998. An estimated 0.2 percent of GDP of development spending was self-financed by public corporations owned by the Government. Less than half of the development expenditure budget has actually been funded since the mid-1990s. The share of foreign financing of development projects was an estimated 10 percent in 1998.

10. Under the decentralized federal structure, the central government is focused on agriculture, energy and mining, which accounted for over 60 percent of its development expenditures during 1996-98. Agriculture accounted for 41 percent of the central Government's development expenditures; energy and mining absorbed about 25 percent of development expenditures during the same period. The central Government has responsibility for formulating social policy and for funding a few social services, such as

higher education and selected community services. The public corporations focus on transportation and communication, giving these sectors over 70 percent of their development expenditures in 1996-98. The corporations are commercially oriented in such areas as telecommunication, railways, ports, electricity, shipping and aviation. Reforms, including privatization, of these corporations are currently under way.

### External Performance

11. **External Debt:** The main challenge to external financial management is a heavy external debt burden, which amounted to some US\$22 billion at the end of 1998. Multilateral institutions account for 19.4 percent of the debt. The major multilateral creditors include IBRD and IDA the IMF, the Arab Development Fund, and the Arab Bank for Economic and Social Development. Bilateral creditors account for 57 percent; of this Paris Club creditors are owed 27 percent. Non-Paris bilateral creditors, mainly Gulf countries, account for 30 percent. The rest of the debt is owed to foreign commercial banks and foreign suppliers.

12. External debt service is unmanageable under existing circumstances. Arrears on external debt are estimated at US\$ 19 billion. In net present value terms, the debt stock was estimated at 3310 percent of export of goods and non-factor services (XGNS). Scheduled debt service payments were estimated at 224 percent of XGNS, well exceeding the manageable cut-off range of 20-25 percent. Nevertheless, Sudan has started to rebuild its relations with the Bank, the IMF and other multilateral creditors. It has maintained an IMF staff-monitored program with the IMF since April 1997 and has begun making monthly debt service payments to the Bank, the IMF and some other multilateral creditors, such as the African Development Bank. While the arrears continue to grow, these payments constitute an initial step towards normalizing relations.

13. **Exports and Imports:** Estimated exports totaled US\$1329 million, compared to imports of US\$ 1925 million in 1998. Exports volume grew at 12.9 percent during 1995-98, due to trade and exchange rate reforms and liberalization of procurement prices. Exports are becoming more diversified. The share of cotton and gum arabic exports fell from 37 to 20 percent during 1994/95 to 1998, while gold, groundnuts, livestock and sesame rose sharply. The recent discovery of petroleum stands to diversify exports further.

14. Since the mid-1990s merchandise imports have risen faster than exports. The composition of imports changed as agriculture production has improved. Food imports fell from 18 percent of total imports to 14 percent during 1994-98, while the import of manufactured goods rose from 29 to 41 percent. The main sources of exports are Saudi Arabia and China, which together accounted for 30 percent of imports in 1998. In addition, domestic substitution for oil imports will affect the current account balance positively.

15. The fast import growth widened the trade deficit by 6 percentage points to 15 percent of GDP during 1995-98. Private remittances of Sudanese working abroad are a major source of inflows helping to finance the external gap. Nevertheless, the current account balance is weak. The current account deficit was equivalent to 6.7 percent of GDP in 1997, rising to 9.8 percent of GDP in 1998. The deterioration in the current accounts balance reflects in part the inflow of capital goods to finance oil sector investments.

16. **Exchange Rate Reforms:** Sudan made unsuccessful attempts at exchange rate reform in the early 1990s. A unified exchange rate system adopted in February 1992 collapsed in October 1993, as inadequate reserves, ineffective instruments of monetary control and weak financial policies undermined stable market-oriented exchange rate policies. Starting in 1997, a phased introduction of a wide range of trade and other reforms moved the exchange regime towards a unified system. The spreads between official and unofficial exchange rates were gradually reduced. Import and export restrictions, including surrender requirements were relaxed except for a few items kept for reasons of religion, national security, public health and domestic food sufficiency. The pricing and import of oil products was liberalized and financing of public sector imports through the Bank of Sudan was eliminated. The exchange rate was

effectively unified by the end of October 1998, following review of the regulatory framework and a period of reserve build-up. The rate is now determined on the basis of a 5-day moving average.

### Poverty and Social Development

17. **Poverty and Social services:** Sudan's per capita income is US\$290.<sup>62</sup> Poverty is increasing, though no reliable estimates of its depth and intensity are available.<sup>63</sup> Recent growth of agriculture has not ensured nation-wide food security, because of disparities in income, regional differences in the pattern of agricultural growth and disruption caused by the civil war. The Food and Agriculture Organization and the World Food Program estimated 45 percent reduction in cereal production in parts of the Western Region, North Darfur and North Kordofan in 1998.

18. Social indicators for the 16 northern states are lagging behind countries at the same level of per capita income. In the North, the adult illiteracy rate is 47 percent (59 percent for women).<sup>64</sup> Life expectancy at birth is 53 years; infant mortality is 71 of 1000 births. Basic social services, namely, education, health and water and sanitation, have been seriously eroded as a result of the combined impact of civil conflict and natural disasters. Only some 30 percent of rural residents and 40 percent urban dwellers have access to safe drinking water. Primary school enrollments have declined to about 56 percent. Access to health services is also limited.

19. Although there are no reliable quantitative information on living conditions in the South, poverty is reported to encompass virtually the entire population in the South. Aside from some fairly limited border trading with Kenya and Uganda, the cash economy has broken down completely. Employment (either formal or informal) is virtually non-existent. Access to social services is minimal. The bulk of the population in the South is dependent on food aid from NGOs, UN agencies and bilateral donors.

20. **Safety Nets:** Extended family and community networks are the main sources of social safety nets for most households. Estimates of remittances to Sudan from families abroad are in excess of US\$ 1 billion a year. However, the extended family and community safety nets have come under strain as whole communities are ravaged by drought, flood, civil war and other disasters. These ravaged areas depend mostly on the NGOs and UN agencies.

21. Safety net programs organized under the policy guidance of the ministry of social planning assist children, women, and the destitute. Services provided include free medical treatment of endemic diseases and emergency treatment, grants for university students from poor homes, and cash grants to poor families. These services have limited coverage.

22. **Zakat.** One of the better known safety net programs is financed through the Zakat, which is contribution from income rooted in Islamic religious traditions for assistance to the poor. The largest of the Zakats funds is a major source of financing for a nationwide poverty alleviation program, supporting an estimated 100,000 beneficiaries each year. Contributions from the fund are said to be based on 2.5 percent of income of wealthy households engaged in commerce; 5 percent of income of wealthy households engaged in traditional agriculture and 10 percent of income of wealthy households engaged in irrigation agriculture. The Zakat funds are managed by religious bodies outside the budget. The largest

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<sup>62</sup> Total population was estimated at 28.3 million in 1998, with average annual growth rate of 2 percent. The figure for per capita income is for 1998.

<sup>63</sup> Estimates of the level of poverty covering the 16 Northern states alone vary widely up to 90 percent.

<sup>64</sup> Based on 1997 data

Zakat mobilized over an estimated US\$ 4 million in 1997. The total amount mobilized by all Zakats was estimated at US \$14 million minimum. Fifty percent of the Zakat funds is given to the needy in cash as well as to finance group investments in irrigation, canals, fishing and other enterprises; thirty percent is donated to hospitals to rehabilitate facilities and finance medicine and pharmacies.

## ANNEX 3: INFRASTRUCTURE AND MANAGEMENT OF THE GEZIRA IRRIGATION

### A. DESCRIPTION OF THE IRRIGATION SYSTEM<sup>65</sup>

#### Storage Dams

1. **Sennar Dam.** The Sennar dam is situated on the Blue Nile some 260 km southwest of Khartoum. The dam, completed in 1925, was built to supply the Gezira irrigation scheme by gravity from head works on the left bank of the river. The total storage capacity of the reservoir created by the Sennar dam was 930 million m<sup>3</sup>. The total length of the dam including embankments is just over 3 km, of which the central section, built of masonry, is 600 m long with a maximum height of 26 m. This latter section contains 80 low level sluices and a 300 m spillway, which can be closed off by steel panels when the flood has passed. The maximum water level elevation at the reservoir is 421.7 m and the minimum is 417.2 m to maintain maximum flows in the Gezira canal.

2. **Roseires Dam.** The Roseires dam is situated on the Blue Nile approximately 250 km upstream of Sennar dam. The dam, with a designed reservoir retention level of 480 m, completed in 1966, was constructed to provide storage for irrigation in the low water season and for hydropower generation. The total storage capacity of Roseires reservoir was 3 000 million m<sup>3</sup> and the live storage was 2,400 million m<sup>3</sup>.

3. The dam is a concrete buttress type about 1 km long, flanked on either side by earth embankments 8.5 km long to the west and 4 km long to the east. For sedimentation control in the reservoir the dam has five deep sluices set at the lowest possible level in the main river channel. The discharge through the dam is normally passed through these deep sluices, which are equipped with radial gates for control purposes. A gated spillway, with a crest level set at the minimum draw-down level of 467 m, augments the deep sluices when the peak flood is passed. Silt has influenced the design and operation of the two dams. In spite of the fact that filling of the reservoir takes place after the elapse of the flood, siltation has resulted in reducing the live storage at Sennar from 600 to 480 million m<sup>3</sup> and silted up the dead storage of Roseires reservoir. The present live storage capacity is just sufficient to meet the present irrigation demand in a year with an 80 percent reliable flow. In 1984/85, for example, the low river yield resulted in cutting out wheat from the rotation for insufficiency of water supply. Raising of Roseires retention level by 10 meters to elevation 490 meters is under consideration. The heightening of the dam would increase the live storage almost three times to about 7,000 m<sup>3</sup>. This additional storage will offer large possibilities to modify the calendar and cropping pattern in the Gezira scheme.

#### Conveyance and Distribution System

4. The irrigation system comprises twin main canals running from the head-works at Sennar to a common pool at the cross-regulator at km 57. The Managil main canal of 186 m<sup>3</sup>/sec design capacity was constructed in parallel to the old Gezira main canal of 168 m<sup>3</sup>/sec capacity, to serve the Managil extension. The water distribution system includes:

- 2 main canals of total length of 261 km with conveyance capacity ranging from 168 and 186 m<sup>3</sup>/sec at head-works to 10 m<sup>3</sup>/sec at the tail end;

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<sup>65</sup> Parts of this Annex have been based on the World Bank Publication No. 120 "The Gezira Irrigation Scheme in Sudan", Agriculture and Rural Development Department, 1990

- 11 branch canals of total length of 651 km with conveyance capacity ranging from 25 to 120 m<sup>3</sup>/sec;
- 107 major canals of total length 1,652 km with a carrying capacity ranging from 1.5 to 15 m<sup>3</sup>/sec;
- 1,498 minor canals of total length of 8,119 km with a delivery capacity ranging from 0.5 to 1.5 m<sup>3</sup>/sec;
- 29,000 water courses called "Abu Ishreen" (Abu xx~ of total length of 40,000 km with 116 l/sec capacity;
- 350,000 field channels called "Abu Sitta" (Abu VI) of total length of 100,000 km with 50-l/sec capacity.

5. Downstream of the first common cross-regulator at km 57 the main canals are divided into reaches, which vary in length from 5 km to 22 km, by further cross-regulators. These regulators are the control points for the branch and major distribution canal off-takes. The branch canals are similarly divided into reaches by cross-regulators and major distributor canals are grouped at these regulators. The major canals are divided into reaches of around 3 km and the carrying capacity of the conveyance system (0.39 liter/sec/ha) can meet the maximum demand on the system at full rotational cropping of 75%.

6. The main, branch and major canals are designed as regime conveyance channels, with water flowing continuously day and night. The minor canals are designed for night storage delivering water directly to the watercourses.

### **Canal Regulators**

7. The control structures are designed to maintain a constant upstream level and the discharge is controlled by manually operated means.

8. The two main classes of regulator gate in use are the vertical lifting sluice gate and the movable weir. There are a number of different types of sluice gate (gantry operated sluice gates, rack and worm gates, roller sluice gates). The system of water control throughout the distribution system relies on knowledge of the discharge characteristics of the regulator gates. The flow through the sluice gates is estimated from calibration charts requiring readings of gate opening and upstream and downstream levels.

### **Moveable Weirs**

9. Moveable weirs are installed as head and cross-regulators on major canals and at most head regulators on minor canals for discharge up to 5 m<sup>3</sup>/s. They comprise a moveable weir plate and frame with a downstream plate sloping at 1.5 set in a masonry or concrete structure.

10. Minor canal off takes are generally grouped at the cross-regulators. There is normally no irrigation off take direct from the main canals, branch canals or major canals.

11. The characteristics of these weirs are.

- (i) provided the upstream level is kept constant, they give a very accurate discharge from a formula requiring the value of the head of water over the weir only;
- (ii) the discharge is independent of the downstream water level;
- (iii) being overshot, they are very sensitive to fluctuation in upstream level.

### Field Outlet Valves

12. The original field outlet valves, in abbreviation FOP gates, discharging into the Abu xx through field outlet pipes (FOP) consisted of a chopper-type valve. The flow was controlled by rotating the chopper gate about hinge pin. This valve is very vulnerable to stealing. Virtually all valves have been replaced by oil drum bottoms, bags or other local materials - or not replaced at all.

### Escapes

13. The Gezira scheme is characterized by a very limited capacity for escape of surplus water. Very large areas on the periphery of the scheme have no escape possibility at all.

14. The total escape capacity is 67 m<sup>3</sup>/sec, which is less than 20 % of the capacity of the main canals, and is intended primarily to allow for emergency spillage due to sudden decreases in irrigation demand following rainfall.

15. As a result of the low escape capacity combined with the long length of supply canals, farmers are often required to continue to take water into their fields for some time, even when they are already flooded by heavy rain.

### Minor Canals

16. The minor canals are a key feature of the Gezira canal irrigation system. They are over designed in relation to the flow they have to convey, especially in the downstream reaches, since they have been designed to act as night storage reservoirs. In two experiment units in the early 1920's the minor canals were designed as regime channels with continuous flow. The night storage reservoir concept was introduced in the design of the first 300,000 fd in the mid 1920's when it was realized that tenants were opposed to irrigation at night. It was decided that the field outlet pipes would be closed at night and the continuous discharges into the heads would be stored within the minor canals until the morning. The dimensions of the cross section vary from a bed width of about 3 to 4 meters and a depth of 1.30 to 0.80 meters going downstream. The standard distance between two successive minors is 1.42 km.

17. The total length of a minor canal can be as much as 20 km. Each minor is divided into reaches with a length varying from 1 to 4 km depending on the slope of the land. The reaches are separated by night-storage regulators consisting of brickwork well and sluice gate or, in the lower reaches, by a gated pipe.

18. The minor canals are primarily designed to command land for direct application of irrigation water to the field. The design criteria are a command of 20 cm above the highest parts of the field. The water level corresponding to these criteria is known in Sudan as full supply level (FSL), which differs from the definition used in most countries, i.e., the water level in the canals when running at maximum flow capacity.

19. Since the banks are set further apart than what would be required for carrying the required flows, there is sufficient material for their construction. At intervals of 292 m along the minor canal, field outlet concrete pipes take off at right angles, each feeding a 90 feddan field called a "number". These pipes - 12 meters long and 0.35 m diameter - are buried at least 60 cm below the service road of the minor canals.

### Field Irrigation System

20. The uniform slope of the land in the Gezira Scheme has permitted a very regular layout of fields. The typical layout is shown in Figure 1.

21. The field irrigation system is designed to serve standard units of 90 feddan (Numbers) measuring 1,350 x 280 m and irrigated by watercourses known as Abu Ishreen (Abu xx). This unit is divided into eighteen 5-feddan plots (called hawshas) watered by secondary watercourses called Abu Sitta (Abu vi) taking off from watercourses.

22. A "number" is normally planted with one crop (cotton, wheat) or divided between simultaneous crops (groundnut, sorghum).

23. The Abu xx had originally a design bed width of 1.00 m and a depth of 0.40 m and a design command of about 0.20 m. A special ditcher pulled by a crawler tractor nowadays rebuilds the Abu xx, and the plant used for construction dictates its new section. Its theoretical capacity is 116 l/s (5,000 min 12 hours).

24. In the standard field layout, the hawsha is further divided into fourteen angayas by small ditches and the angayas, in turn, were divided into 10 smaller basins called hods. This subdivision has been abandoned because too demanding from the tenants in time and energy. Irrigation water distributed from the Abu VI is now distributed to the angayas until there is free standing water throughout the field.

### **Drainage System**

25. The original design of the Gezira irrigation scheme recognized that because of the nature of the soil and absence of a high water table, there was no need for, and indeed no means of providing subsurface drainage of the fields. The only need for drainage, therefore, was for dealing with surface runoff from rainfall or excess irrigation.

26. The present surface runoff drainage system consists of minor surface drains of total length of about 6,000 km and major drains totaling about 1,500 km in length. Minor drains run parallel to minor canals. These discharges into the major or collector drains, which generally follow the lines of natural drainage and lead the runoff water to outfalls. Although there are no field drains parallel to the Abu xx to take runoff from the fields runoff disposal is seldom a serious problem. At the time of the heavy showers a large part of the total area is fallow or has not yet been planted. The rains fall on dry cracked fields, which can absorb a large part of it. With the angaya system of irrigation, each small plot retains some of the non-absorbed rainfall. In this system, retention facilities are automatically built-in, the disadvantage is frequent water logging. (see Figure 1)

27. The major drains ideally outfall beyond the cultivation boundaries to natural drainage lines and thence to the Blue or the White Nile. However, in much of the Gezira this does not happen. Several drains terminate in large local depressions and so runoff water either has to be pumped into nearby canals, or is allowed to pond up and then evaporate, usually on land which is unsuitable for agriculture. The lands so flooded are left uncultivated deliberately but often are used unofficially for labor settlements.

## **B. ISSUES IN IMPROVED WATER MANAGEMENT**

### **Vicious Circle**

28. The Gezira irrigation network is in state of disrepair. Maintenance is often deferred due to inadequate funding. Water is not delivered to the farms in timely manner, or not delivered to the farms at the tail end of the Abu xx, causing low yields and low farm incomes. A large proportion of farmers are unwilling to pay water charges, although the charges are only a small fraction of the crop production costs. The situation, which has progressively worsened in recent years, is the outcome of a "vicious circle" shown in Figure .

### **Changing the Paradigm**

29. In order to break the vicious circle, the tenants/farmers have to be assisted and trained to assume a greater responsibility for the operation and maintenance of the minor irrigation system. Experience in other countries suggests that empowering farmers with a role in irrigation management; in the context of an improved institutional framework for the irrigation system, is the key to a more productive, and sustainable irrigated agriculture and increased farmer income.

### **Establishing Water User Groups**

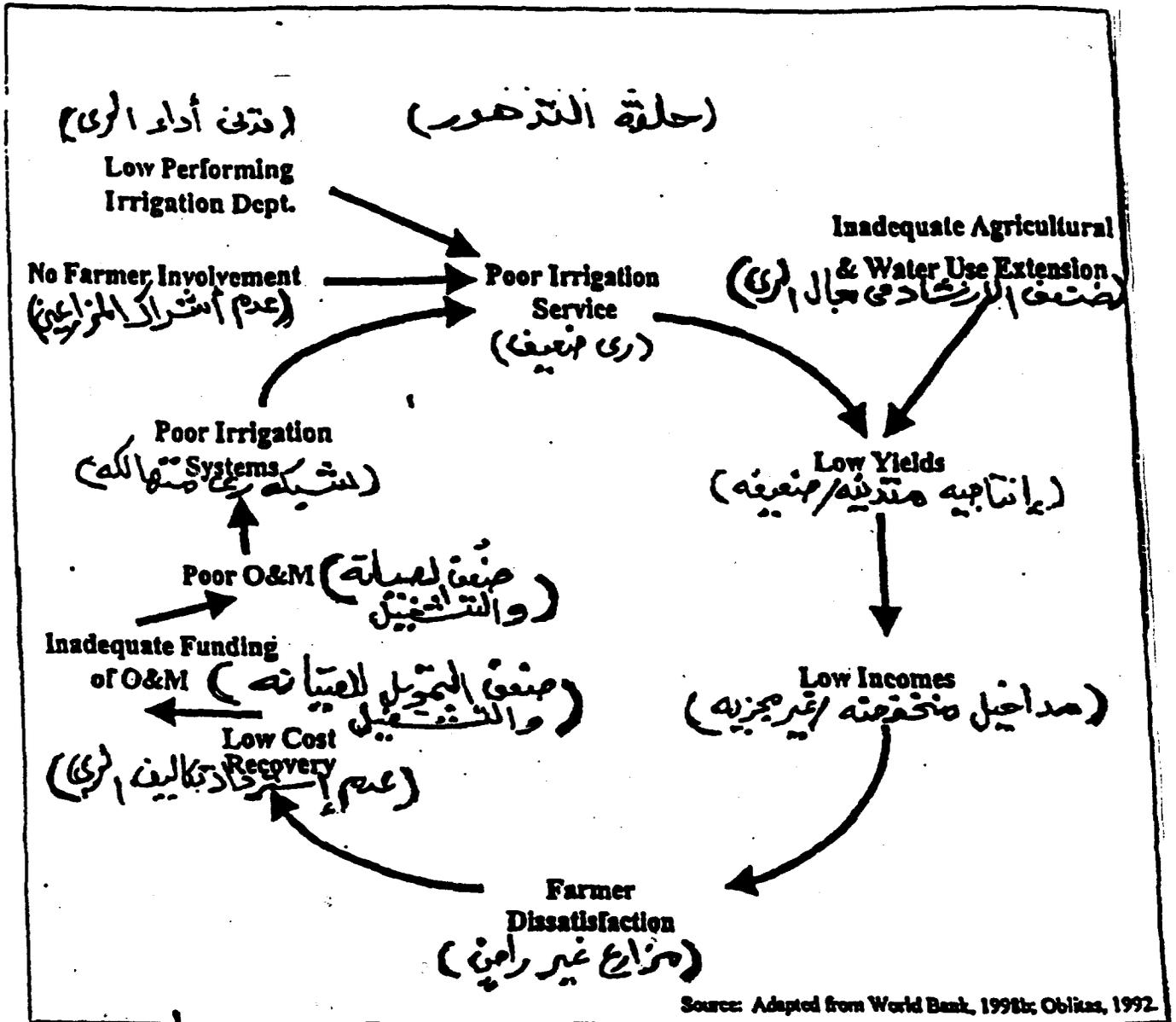
30. The Presidential Committee also recommended involvement of tenant farmers in annual decision making on irrigation and water management policies. In line with this recommendation, an option for improved water management would be to decentralize the control of irrigation water management and give a greater role and responsibility to farmers through the formation of Water Users' Groups (WUGs). Providing the managers of WUGs are trained and supported by a central irrigation authority such as the SGB to operate and maintain the lower/minor distribution systems, a decentralized water management system has proven to be effective in improving water management efficiency.<sup>66</sup> The introduction of WUGs could be gradual starting with a few blocks. Should WUGs be introduced, the MOI would continue to operate and maintain the main system.

31. The principle is that WUGs would be independent hydraulic units and would pay for irrigation water in bulk at their boundary. There would consequently be a logical incentive for farmers within a WUG to manage tertiary systems efficiently. Their organizational survival depends on financial viability, which can only be achieved by recovering operation and maintenance costs from the users. The users will have a personal interest in ensuring the long-term productivity of their irrigated agriculture. This is ensured through good operation and maintenance management performance.

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<sup>66</sup> See, for example, *Transferring Irrigation Management to Farmers in Andhra Pradesh, India*, World Bank Technical Paper No. 449, The World Bank, Washington DC, October 1999; and *Toward a Financially Sustainable Irrigation System: Lessons from the State of Victoria, Australia, 1984-1994*, World Bank Technical Paper No. 413, The World Bank, Washington DC, 1998.

FIGURE 3: THE VICIOUS CIRCLE



### Virtuous Circle

32. At present, water users are unofficially involved in operation and maintenance of field canals (quaternary) and operation of Abu xx canals (tertiary), without having much influence on water distribution and management. In interviews with the mission members, current irrigators indicated their willingness to actively participate in irrigation management and formation of WUGs.<sup>67</sup> It is possible for WUGs to become part of a strategy to convert the vicious circle (see the internal circle in Figure 4) to a sustainable irrigation system with adequate operation and maintenance in a virtuous circle as shown in Figure 4

33. The main action required to start this new arrangement would be for the Gezira Board to promote and encourage participation of water users in decision making and water management, and to assist them to form WUGs on minor canals and federate themselves into larger units. The size of WUGs would depend on a number of factors such as social cohesiveness, layout of the irrigation network and the economy of scale for cost-effective operation and maintenance services. The present "blocks" in the GS, which are typically 25,000 feddan, could with minor modifications in their boundaries to match a hydraulic unit be a viable size for a WUG. They could be non-profit organizations, solely for irrigation management and should have a legal base and status. The WUGs would receive and pay for water in bulk, distribute it among their members, maintain the system, collect payments for water and operation and maintenance.

34. The irrigation and drainage systems to be turned over to WUGs should be in good working condition. To improve the systems, funds would be required to help WUGs and the MOIWR to invest in system rehabilitation, based on urgent needs. At least, a part of the investment could come from the farmer contribution, in kind or in cash. This has proved to develop a sense of ownership and enhance sustainability.

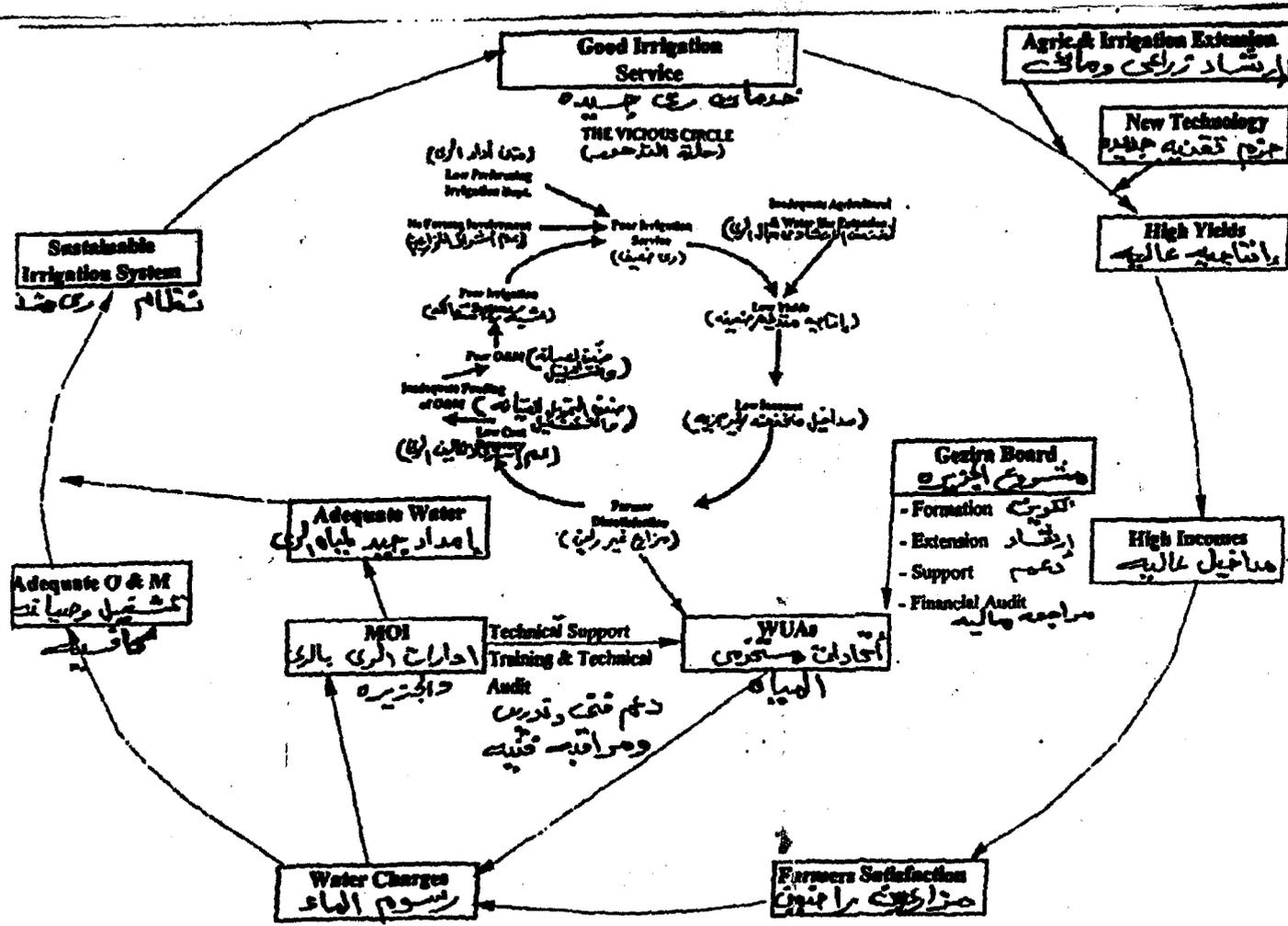
35. The management of irrigation facilities by private water users groups would require a sound legal base and regulations that the current laws of Sudan do not provide. An enabling law would be required to establish WUG as a legal entity capable of contracting, opening and operating bank accounts, and instituting and answering suits.<sup>68</sup> In addition, it should address the relationship between the WUGs and the MOIWR, SGB and the duties and obligations of the MOI/SGB and those of WUGs, and the structure of water rates and the operation and maintenance and other fees.

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<sup>67</sup> Farmers' Union representatives and irrigators interviewed in the field strongly supported the WUG concept and expressed a strong desire for its introduction.

<sup>68</sup> A study for Legal Framework for the Establishment of WUGs was conducted under IFAD-financed Northern Province Irrigation Rehabilitation Project in 1991. In addition, a very useful analysis of the legal issues is contained in Salman M. A. Salman, *The Legal Framework for Water Users Associations: A Comparative Study*, World Bank Technical Paper No. 360, The World Bank, Washington DC, 1997. This paper includes a model memorandum of understanding between a water users groups/association and a government institution providing the irrigation water.

FIGURE 4: THE VIRTUOUS CIRCLE



**TABLE 2: LONG-TERM AVERAGE FLOW OF THE NILE RIVER SYSTEM**  
(Billion m<sup>3</sup>)

River	Location	Annual Average	Average Monthly	
			Maximum	Minimum
White Nile	Khartoum	25.7	3.2 (Oct)	1.4 (Jul)
Blue Nile	Roseires	50.7	15.6 (Aug)	0.3 (Apr)
Atbara	at mouth	12.1	5.6 (Aug)	0.1 (Nov/Feb)
Main Nile	Egyptian Border	86.4	21.8 (Sep)	1.9 (May)

Source: Nile Waters Study, 1979

**TABLE 3: WATER RESOURCES OF THE SUDAN**

Source	Annual Yield (BILLION M <sup>3</sup> )	Constraints
Nile Water Agreement	20.50	Seasonal pattern coupled with limited storage facilities
Non-nilotic Rivers	5.50	Highly variable, short duration flows
Groundwater	4.00	Deep water entailing high cost of pumping
Present TOTAL	30.00	
Expected share from Swamps	6.00	Capital intensive with considerable social and environmental concerns
TOTAL	36.00	

Source: MOIWR, Khartoum

**TABLE 4: SEDIMENT DEPOSITION IN IRRIGATION CANALS**

Year	Sediment Input		Sediment Deposits in Canals						Total		Sediment Passing to the Fields	
	at Km 57		Main & Branch		Majors		Minors					
	mcm	%	mcm	%	mcm	%	mcm	%	mcm	%	mcm	%
1988	12.45	100.00	0.62	5.00	2.86	22.97	4.11	33.01	7.59	60.99	4.86	39.01
1989	5.83	100.00	0.29	5.00	1.34	23.00	1.92	32.96	3.55	60.96	2.27	39.04
1990	8.28	100.00	0.41	5.00	1.90	22.96	2.73	32.99	5.04	60.95	3.23	39.05
1991	9.78	100.00	0.49	5.00	2.25	23.02	3.23	33.04	5.97	61.06	3.81	38.94
1992	5.29											

Note: No data were collected after 1991; mcm=Million Cubic Meter

Source : Hydraulic Research Station, Ministry of Irrigation and Water Resources

**TABLE 5: AVERAGE MONTHLY FLOW OF BLUE NILE AT ED DEIM  
(Last ten years vs. Long - term average)**

Year	Month												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1989	29.2	18.2	14.4	16.9	17.2	36.0	191.0	386.8	345.0	221.0	83.7	44.8	1,404.1
1990	32.2	21.8	14.1	11.0	11.3	30.0	153.9	407.1	320.7	165.5	59.7	32.6	1,259.7
1991	20.6	12.1	9.4	13.0	24.0	54.3	253.9	461.6	529.0	154.8	74.0	43.5	1,650.2
1992	22.1	15.1	11.3	9.0	23.8	51.3	140.6	406.8	343.7	257.7	108.7	53.9	1,444.7
1993	29.8	18.3	11.6	23.4	36.5	37.7	274.0	493.0	426.0	252.0	112	51.0	
1994	29.0	17.4	11.4	9.2	24.0	65.8	271.0	585.0	450.0	145.0	93.0	36.1	1,736.9
1995	16.7	10.7	8.79	11.8	17.8	48.2	163.0	426.0	295.0	125.0	54.3	29.0	1,206.3
1996	18.2	11.2	11.5	16.5	44.2	134.0	338.0	553.0	381.0	192.0	76.8	44.1	1,820.5
1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1998	29.9	21.1	16.7	17.5	26.8	56.0	276.0	612.0	508.0	372.0	133.0	61.5	2,130.5
<b>Average</b>	25.3	16.3	12.1	14.2	25.1	57.0	229.0	481.2	399.8	209.4	88.3	44.1	1,581.6
<b>Long-term Average</b>	22.2	15.2	10.4	9.3	15.7	50.1	204.3	450.8	353.2	183.4	76.0	38.0	1,428.7

**Table 6: Gezira Scheme - Cropped Area, Water Consumption and Silt Removal**

Season	Cropped Area	Water Used	Silt Removed	Water Used	Silt Removed
	('000) fd	mcm	mcm	mcm/fd	mcm/fd
1987 - 88	1,272	2,880	5.75	2,264.2	4.5
1988 - 89	1,309	4,980	6.44	3,804.4	4.9
1989 - 90	1,384	5,260	6.51	3,800.6	4.7
1990 - 91	1,514	6,470	12.83	4,273.4	8.5
1991 - 92	1,643	6,650	13.49	4,047.5	8.2
1992 - 93	1,622	6,250	11.34	3,853.3	7.0
1993 - 94	1,581	6,560	12.00	4,149.3	7.6
1994 - 95	1,462	6,750	13.49	4,617.0	9.2
1995 - 96	1,393	6,190	14.20	4,443.6	10.2
1996 - 97	1,401	6,700	11.25	4,782.3	8.0
1997 - 98	1,165	6,920	10.03	5,939.9	8.6
1998 - 99	878	5,620	6.92	6,400.9	7.9

MCM = Million Cubic Meters

**Table 7: Irrigation Water Rates - 1998-99 Season**

Crop	Annual Crop Water Requirements (1)		Water Rates			
			Sudanese Pound			US Dollars
	m <sup>3</sup> /fd	m <sup>3</sup> /ha	(per fd)	per m <sup>3</sup>	per '000 m <sup>3</sup>	per '000 m <sup>3</sup>
Cotton ELS	4,887	12,678	21,600	4.42	4,420	1.72
Cotton MS	4,179	10,447	21,600	5.17	5,169	2.01
Wheat	2,473	6,388	21,000	8.49	8,492	3.30
Sorghum	3,685	8,759	15,740	4.27	4,271	1.66
Groundnut	4,103	9,722	15,740	3.84	3,836	1.49

Note: (1) Staff Appraisal Report, Gezira Rehabilitation Project

Source: IWC, SGB

**Table 8: Average Water Use per Harvested Irrigation Area  
All Crops**

Season	Area Irrigated (000) fd	Water Use mcm	Water Use Per fd (m <sup>3</sup> )
91 - 92	1,538	6,650	4,324
92 - 93	1,549	6,250	4,034
93 - 94	1,422	6,560	4,612
94 - 95	1,257	6,750	5,370
95 - 96	1,268	6,190	4,883
96 - 97	1,404	6,700	4,771
97 - 98	1,221	6,920	5,667
98 - 99	775	5,620	7,256

Source: Irrigation Water Corporation (IWC) &amp; SGB

**Table 9: Expenditures on Major O& M Activities by  
Irrigation Water Corporation (IWC)**  
(Million SD)

Actual Annual Expenses	95-96		96-97		97-98	
	Amount	%	Amount	%	Amount	%
Silt Removal	619.0	63.1	1,400.7	67.6	1,336.6	51.6
Weed Removal	41.5	4.2	12.5	0.6	30.2	1.2
Pump	118.5	12.1	174.3	8.4	188.4	7.3
Other	201.9	20.6	484.9	23.4	1,035.5	40.0
<b>Total</b>	<b>981.0</b>	<b>100.0</b>	<b>2,072.4</b>	<b>100.0</b>	<b>2,590.7</b>	<b>100.0</b>

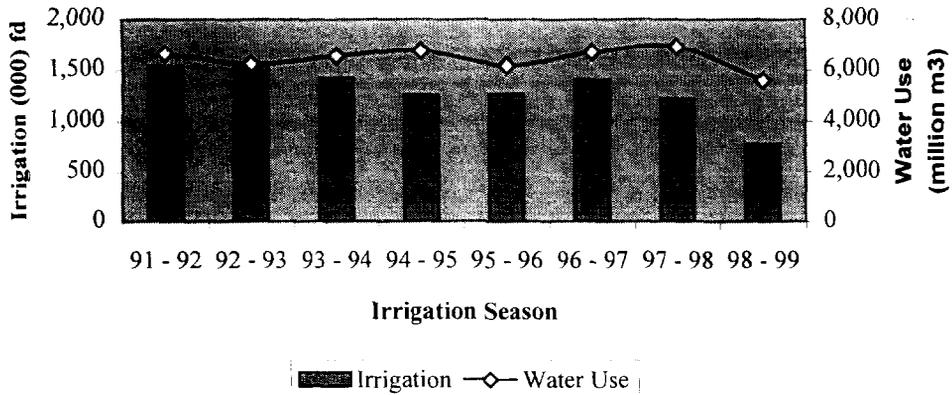
Source: Irrigation Water Corporation

**Table 10: Cropping Intensity in the Gezira Scheme**

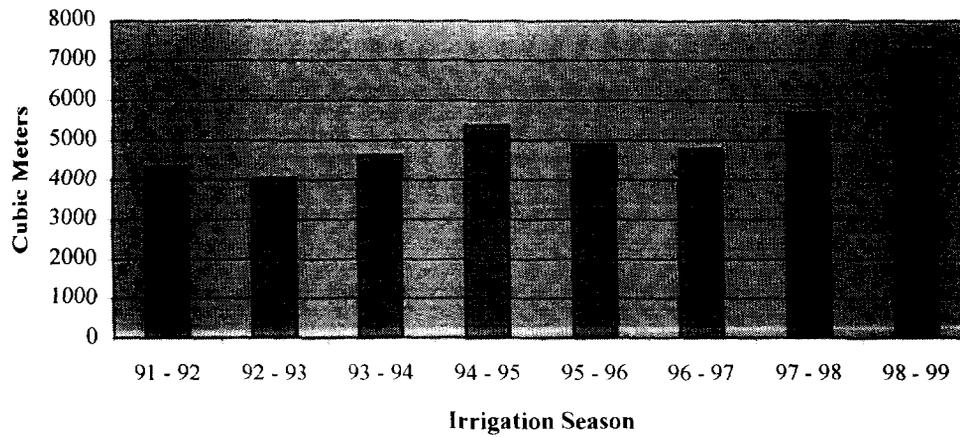
Season	Area		Cropping Intensity		
	Planned (fd)	Harvested (fd)	Planned (%)	Harvested (%)	Planned/harvested %
91 - 92		1,537,929.45		73.2	
92 - 93		1,549,248.75		73.8	
93 - 94		1,422,295.50		67.7	
94 - 95		1,256,983.50		59.9	
95 - 96	1,416,620.00	1,267,730.00	67.5	60.4	89
96 - 97	1,453,545.00	1,404,416.00	69.2	66.9	97
97 - 98	1,262,737.00	1,221,160.00	60.1	58.2	97
98 - 99	1,220,003.00	774,564.00	58.1	36.9	63

Source: Sudan Gezira Board and Irrigation Water Management Corp.

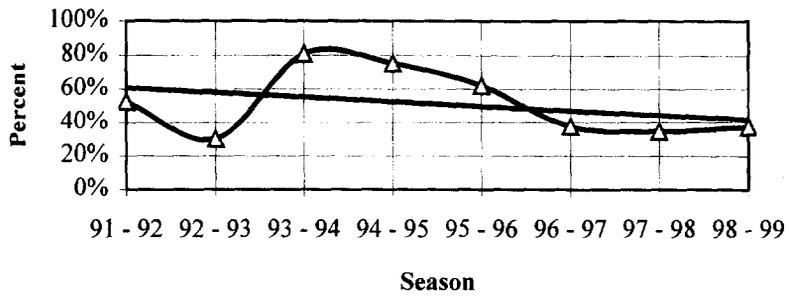
**Figure 5: Harvested Irrigation Area & Water Use**



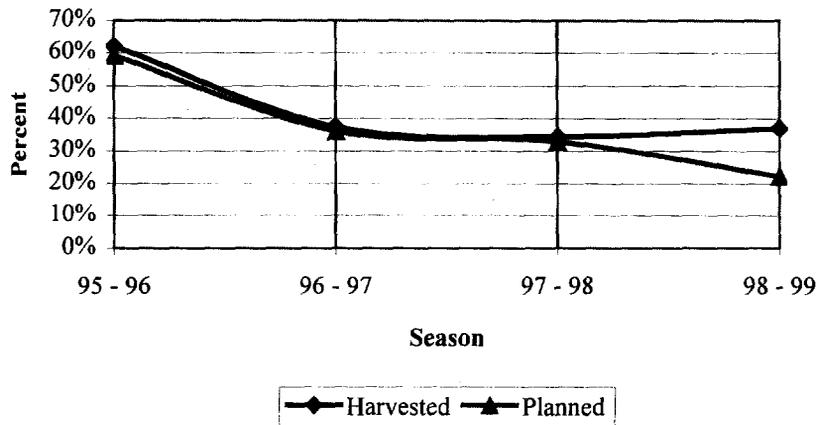
**Figure 6: Average Annual Use of Water (per feddan)  
Harvested Crop**



**Figure 7: Water Charges Collection Rate  
Harvested Crop Area**



**Figure 8: Water Charges Collection Rates  
Based on Harvested & Planned Crop Area**



## ANNEX 4: ASSUMPTIONS AND DATA FOR ECONOMIC ANALYSIS

### Assumptions in the Economic Analysis

1. Because the crop year 1998/99 was an unusually poor year for the Gezira, costs and yields in the economic analysis for the previous year are used to derive income per feddan. Yields are based on the past seven years with the highest and lowest taken out. All data were obtained from the Socio-Economic Research Unit in the Sudan Gezira Board unless otherwise noted.

**Table 11: Current Input Levels Used for Different Crops ( per feddan)**

Crop / Input	Seeds (kg)	Fertilizers (Kg)		Labour (person days)	Avg Number of Irrigations
		(Urea)	(Super- phosphate)		
ELS Cotton	17	80	0	68	13
MS Cotton	17	80	0	60	11
Wheat	60	80	40	11	6
Sorghum-Improved Cultivar	3	50	0	27	6
Sorghum-Traditional. Cultivar	6	0	0	24	6
Groundnuts	21	0	0	42	8

Source: Socio-Economic Research Unit, Sudan Gezira Board.  
ELS= Extra Long Staple, MS= Medium Staple

**Table 12: Cotton Picking Labor by Source  
(person /days)**

Season	Tenants' Families	Local Labor	Seasonal Migrants	Floating Labor	Total Available	Total Required
84/85	141,505	94,078	214,862	13,640	464,085	470,830
85/86	132,421	87,584	173,024	11,505	404,534	405,790
86/87	127,284	99,326	163,358	8,495	398,463	406,953
87/88	124,399	89,874	144,526	7,517	366,316	383,015
88/89	139,182	101,262	130,316	9,602	380,362	404,000
89/90	131,601	87,441	106,653	9,731	336,568	348,230
90/91	93,357	64,273	73,515	13,545	244,690	245,241
91/92	91,203	65,938	42,944	8,507	208,592	228,226
92/93	79,175	56,740	18,222	6,545	160,682	182,620
93/94	73,541	45,108	11,287	3,662	133,598	159,045
94/95	117,357	68,486	27,529	8,047	221,419	258,973
95/96	147,444	69,087	28,233	7,790	252,554	306,948
96/97	122,730	62,929	4,423	4,435	183,179	NA
97/98	164,827	80,798	6,577	3,997	292,109	335,842
98/99	62,755	44,101	2,999	14,581	124,436	NA

Source: Socio- Economic Research Unit, Sudan Gezira Board

Table 13: Gezira Scheme: Crops Yields (1984/85-1997/1998)

Season	MS* Cotton (Kantar/feddan)**	ELS* Cotton Kantar/fed**	Wheat Ton/feddan	Groundnut Ton/feddan	Sorghum Ton/feddan
84/85	7.62	4.39	NA	0.51	0.35
85/86	5.43	3.42	0.40	0.55	0.55
86/87	5.70	4.72	0.44	0.60	0.40
87/88	5.73	3.87	0.35	0.60	0.36
88/89	6.52	4.12	0.56	0.60	0.50
89/90	5.12	3.74	0.66	0.54	0.49
90/91	4.56	2.86	0.44	0.73	0.53
91/92	5.83	4.96	0.94	0.80	0.66
92/93	3.98	4.38	0.53	0.71	0.77
93/94	3.87	3.72	0.52	0.82	0.80
94/95	3.61	3.93	0.59	0.89	0.85
95/96	4.20	3.66	0.66	0.75	0.66
96/97	4.07	3.58	0.64	0.80	1.18
97/98	4.62	4.04	0.70	1.04	1.04
98/99	4.72	4.13	0.25	0.46	0.73

Source: Socio- Economic Research Unit, Sudan Gezira Board

\* ELS = Extra Long Staple, MS = Medium Staple

\*\* One kantar of seed cotton = 315 lb.

**Table 14: Prices of Different Grades of Barakat Cotton (Ls/Kantar of Seed Cotton)**

Season	Grades								
	1	2	3	4	5	6	7	8	9
84/85	155	150	145	140	135	130	125	120	115
85/86	235	230	225	220	215	210	205	200	195
86/87	273	268	263	258	248	238	229	218	208
87/88	338	328	318	308	293	278	263	248	233
88/89	722	702	682	662	642	622	602	582	562
89/90	873	817	787	747	727	707	687	667	647
90/91	1,167	1,107	1,047	987	967	947	927	907	887
91/92	2,485	2,385	2,285	2,185	2,085	1,985	1,885	1,785	1,685
92/93*	4,851	4,751	4,651	4,551	4,451	4,351	4,251	4,151	4,051
92/93**	6,090	5,990	5,890	5,790	5,690	5,590	5,490	5,390	5,290
93/94	15,260	15,160	15,060	14,960	14,860	14,760	14,660	14,560	14,460
94/95	37,957	37,857	37,757	37,657	37,557	37,457			
95/96	127,670	126,670	125,670	124,670	123,670	122,670	121,670		
96/97	104978	103978	102978	101978	100978	99978	98978	97978	
97/98	122,400	121,400	120,400	119,400	118,400	117,400			
98/99	144,527	143,527	142,527	141,527	140,527	139,527	138,527		

Source: Socio- Economic Research Unit, Sudan Gezira Board

\* "Salam" price

\*\* Ministry of Finance Price (for production over break-even)

**Table 15: Farmgate Prices of Groundnuts Sorghum, and Wheat (LS/ton)**

Season	Groundnuts	Sorghum	Wheat	
			Farmgate	Salam
84/85	531	1316	not grown	
85/86	1130	474	700	
86/87	983	410	770	
87/88	1,108	1,292	1,010	
88/89	1,021	1,033	2,400	
89/90	3,905	2,904	3,000	
90/91	8,192	12,724	6,000	
91/92	16,061	7,500	8,750	6,100
92/93	16,784	8,850	19,000	12,000
93/94	39,200	27,000	70,000	40,000
94/95	98,000	50,000	75,000	
95/96	112,000	110,000	220,000	
96/97	232,708	220,000	220,000	
97/98	273,000	220,000	380,000	
98/99	364,000	240,000	480,000	

Source: Socio-Economic Research Unit, Sudan Gezira

**Table 16: Area Allocation By Crop  
(000 feddans and % of total)**

Season	Cotton	%	Wheat	%	Groundnut	%	Sorghum	%	Total
84/85	765	55	NA	NA	213	15	420	30	1,398
85/86	401	30	242	18	103	8	579	44	1,324
86/87	415	35	177	15	151	13	448	38	1,191
87/88	383	32	252	21	160	13	394	33	1,189
88/89	405	33	274	23	111	9	427	35	1,216
89/90	358	28	392	31	80	6	441	35	1,271
90/91	251	18	613	43	40	3	507	36	1,411
91/92	216	14	533	35	35	2	725	48	1,509
92/93	175	12	514	35	163	11	622	42	1,474
93/94	150	11	523	37	187	13	547	39	1,407
94/95	253	19	393	30	191	15	468	36	1,304
95/96	301	23	391	30	231	18	394	30	1,317
96/97	331	24	390	28	246	18	407	30	1,374
97/98	246	22	302	27	223	20	339	31	1,111
98/99	154	22	123	18	146	21	270	39	693

Source: Socio-Economic Research Unit, Sudan Gezira Board

**Table 17: Net Returns to Farmers by Crop  
(LS/feddan)**

Season	Cotton				Wheat	G'nuts	Sorghum
	Barakat	Shambat	Acala	All			
84/85				258		138	358
85/86				-----	30	415	101
86/87				376	133.93	330	5
87/88	253	468		334.28	201.26	290	255
88/89	1,312	1,284		1,300	790	131	153
89/90	636	1,021		747	903	1,279	737
90/91	-383	100	-393	-286	862	5,642	4,081
91/92	2,947	2,012	3,879	3147	3,164	7,895	2,330
92/93	7,032	-3163	-5258	1,106	-1872	4,689	941
93/94	17,311	14,250	17,748	16,479	5,580	16,983	11,844
94/95	81,164	20,014	69,922	57,033	10,433	42,335	16,839
95/96	237,103		111,232	155,314	82,628	34,997	38,595
96/97	4735		34379	162815	66721	65304	141230
97/98	18111		74472	38502	27772	73634	101377
98/99					-97591	49526	45724

Source: Socio-Economic Research Unit, Sudan Gezira Board

**Table 18: Exchange Rates**  
(end of year, LS/US dollar)

<b>Year</b>	<b>Official rate</b>	<b>Parallel rate</b>
1980	0.4	0.5
1985	2.5	4.25
1990	4.5	11.3
1991	15	30
1992	100	143
1993	215	335
1994	315	525
1995	832	905
1996	1460	1795
1997	1712	1840
1998	2333	2333
1999 (latest)	2580	2580

Source: Bank of Sudan

### Notes on the DRC Calculations

2. The calculations cover two cropping season 1997/98 and 1998/99 for the major crops grown in the Gezira. These include long staple cotton, short staple cotton, wheat, groundnuts and sorghum. For vegetable crops the calculation is still under processing. Below are notes on these calculations.
3. **Crop yield:** The average of yield of the main crop for the last ten years were adequately documented in the Gezira. However, the yield levels used in the calculations were that corresponding to 1997/98 and 98/99 cropping season. But, it should be mentioned that last year was exceptionally a poor year crop. Cotton yield was expressed in sack/feddan. One ton equal to 28 sack of unshelled groundnut. Out of one it was assumed that 65% of it can be exported as "hand picked" HPS, 43% FAQ with 1% as physical losses. from the FAQ we can get 40% as oil , 58% as cake and 2% loss.
4. Yield of wheat and sorghum are expressed in sack/feddan. One ton equal 11 sack of 92.5 kg.
5. **Prices:** Two sets of prices are used in the analysis namely farm gate border equivalent prices. Farm gate prices are the prevailing prices in local markets. i.e. the average price the farmers get when they sell their crops. Similarly, the pricing of joint product such as cotton seeds were made according to the prevailing prices as they mostly consumed domestically. Border equivalent price is fob price of cotton, groundnuts and sorghum minus transport marketing and port charges. This includes for sorghum and groundnuts transport from Gezira to Port Sudan, unloading, custom duties, clearing expenditure, health, storage for one month, loading for export, unloading quay, transport to quay and fumigation. For cotton, it includes in addition to the above two percent SCC commission and some fees for promotion. Border equivalent price of wheat is the fob price of wheat at the point of export e.g. Australia to this freight and insurance and local charges i.e., port charges for harbor dues, fumigation, handling and local transport to Gezira were added.

### Notes on Cost of Production:

6. In Gezira detailed cost of production is available for the different agricultural operation or activities. Although it is easy to account for cost of material inputs, a substantial part of the cost of production of any crop stems from the operations, which involve different degrees of traded inputs such as land preparation, sowing, weeding, watering and harvesting. In Gezira the cost data collected in the field were recorded separately for mechanical and manual operations so that a basis could be established for splitting the total cost of each operation into traded input and domestic resource cost. The records are detailed enough to facilitate this desegregation. Based on the above criteria the traded inputs content of production costs were assumed to be as follows.
7. Allocation to traded input and domestic resource costs. The records are detailed enough to facilitate this desegregation. Based on the above criteria the traded input content of production costs were assumed to be as follows:

Fertilizer	90%
Pesticides	90%
Sacks	90%
Mechanical operation	70%
Seeds	60%
Water charge	40%
Transport	70%
Handling (Port. Sudan)	70%
Storage	20%

8. **Transportation** to Port Sudan is done either by rail or by truck. Many Gezira farmer transport its crop by rail. This is particularly true for cotton. However, recently big portion of crops was transported by truck. The following rates have been used in the calculations:

	1997/98	1998/99
Bale of cotton (LS)	12000	18000
Ton of other crops (LS)	50000	65000

9. **Shadow exchange rate:** The major difficulty to valuing inputs and outputs is the use of appropriate prices that reflect the opportunity cost. The prices of tradable inputs often don't correspond to their true economic value due to market imperfections and government intervention, resulting in distorted prices. An average rate between the official and parallel exchange rate used in the calculation of DRC for 1997/98 whereas 70% of the black market rate was used for 1998/99.

10. **Yields:** The base case yield used to calculate farm income is an average of the previous seven years with the high and low yield years discarded. In addition to the base case yield, two higher yield scenarios are calculated: (1) based on what farmers reported in field interviews were their highest yields achieved; and (2) potential yields recorded by the Agricultural Research Corporation with actual farm trials. In all cases, the farm trial yields were the highest, and farmer interview reported yields second highest. Table 19 shows these three yield scenarios, with the latest and highest achieved also expressed as a percentage of the farm trial (potential) yield.

**Table 19: Current, High, and Farm Trial (Potential) Yields for Main Gezira Crops**

	Units	Latest Yield Achieved		Highest Yield Achieved		Farm Trial Yields
		Yield	% of FT	Yield	% of FT	
Cotton-Acala	K of SC/F	2.7	20.4	10.0	75.6	13.2
Wheat	Sacks/F	2.5	12.7	11.0	56.2	19.6
Groundnuts	Sacks/F	14.6	44.4	31.3	94.9	32.9
Sorghum	Sacks/F	6.8	49.3	11.7	85.2	13.7

Note: FT-Farm Trials

Sources: Field interviews, Agricultural Research Corporation

11. **Cotton Marketing:** Historically, the SGB marketed cotton through its offices in Khartoum and Liverpool. In 1970 the Sudan Cotton Corporation (then, a public enterprise) was established by the Government to market all cotton in the Sudan. This corporation was sold to farmers in 1992, but continued as a de facto monopoly in cotton marketing as the Sudan Cotton Company (SCC). The SGB as a public institution is not represented on the Board of directors of SCC and hence it is not directly involved in cotton export decisions. The SGB delivers its cotton (all grades) to SCC stores at Port Sudan. The SCC floats international tenders and ships the cotton to buyers abroad. The SCC does not carry out any other marketing stages, i.e., transport, ginning, grading and reclassification. Calculation of cotton proceeds is based on prices of average grade, not the actual value of tenders, multiplied by the amount of lint delivered. The SCC then deducts the export tax, commission and arbitration fee as well as reclassification fees, which amount to somewhat less than five percent of the international price.

12. The Presidential Committee which reviewed the Gezira (see Chapter 6) proposed that all the cotton marketing functions should be the responsibility of SCC, including processing, transport, insurance and grading. To carry through this proposal or any privatization of marketing functions would require a valuation of all infrastructure involved in these activities. This value could be the share of SGB in the SCC. The Presidential Committee proposed this step to enable SGB to participate actively in the board of directors and export policy of cotton i.e. better area allocation according to price signal and, possibly,

relieve to some extent the financial stress of SGB as the working expenditure of ginneries as well as transportation cost would be the responsibility of SCC. Cotton marketing costs and taxes are found in Table 20.

**Table 20: Marketing Costs for Cotton (1998/99)**

Item	Amount / value	Percentage/ Cost per bale
Number of Bales	59166.0	
Total weight (kantars)	229530.0	
Avg.Int'l Price (\$)/Kantar		
Barakat	70.4	
Total Revenue (\$)	\$16,158,912	
Costs		
Export Tax	\$807,946	5.0%
SCC Commission	\$323,178	2.0%
Sudan Shipping Line	\$80,795	0.5%
Preparation of Bales	\$188,089	\$3.179/Bale
Reclassification	\$88,749	\$1.5/Bale
Arbitration	\$323,178	2.0%
Total Costs	\$1,811,934	
Net Revenue	\$14,346,978	
Net Rev./Tot. Rev.	88.8%	

Source: Financial Administration of the Gezira Board Crop year 1998/99

### Explanation of Payments between SGB and SCC

13. The flow of money between SGB and SCC begins with a predetermined calendar for harvesting and marketing. The official calendar of harvest, sale and payment for cotton is described below. The finances of the SCC and the SGB have become deeply intertwined. As a result, SCC's operations have a direct impact on input supply and even SGB's daily finances. In recent years the SGB has been receiving advances on the following year's cotton crop.

Timing	Activity
Dec-Feb	Farmers harvest cotton
Dec-May	Ginning and transport
Jan-June	Export of cotton
Jan-Mar, June	SCC makes tender (3 separate tenders), is paid shortly afterward
June 30	Farmers (should) receive their cotton payments

14. However, the current flow of money between the SCC and the SGB also involves input supply: (1) Inputs are received on the basis of a one-year (360 days) suppliers' credit; (2) SCC guarantees payment for the inputs by co-signing an undertaking with the Bank of Sudan and the Farmers' Bank, with future cotton crop proceeds as collateral--if SCC fails to pay on time, it incurs a financial penalty; (3) accounts between SCC and SGB are to be settled on June 30, 1999; (4) The SCC subtracts the export tax (recently removed) and marketing costs, and the remainder is transferred to SGB; (5) SGB should then make payments to cotton farmers based on the standing of their accounts.

15. Unfortunately, in 1998/99, with SGB's mounting financial difficulties, SGB's immediate financing needs exceeded the remaining balance. SGB had to pay for more pressing needs such as electricity bills

and staff salaries. As a result, farmers did not receive the entire payment due, nor were the payments on time. SCC, in order to promote cotton production, regularly finances SGB revenue shortfalls.

16. Because the SGB is under severe financial strain, for the time being, the SCC plays the additional role as a financially sound partner with whom input suppliers are willing to do business. Should the SGB take over cotton marketing without solving its indebtedness, input suppliers may be reluctant to extend suppliers' credits which would leave the farmers without inputs.

**Table 21: Sample Tenant Account for Four Feddan of Cotton.**

Debit Items	LS	Credit Item	LS
Picking	176,000.00	Crop value	1,612,622.00
Fertilizers, seeds and sacks	345,942.16		
Transport costs to station	64,662.00		
Land and water fees	107,250.00		
Other expenses	15,305.00		
Pesticides	610,951.07		
Land preparation	79,687.00		
Fertilizer dispersal and irrigation channel (Abu eshreen)	15,375.00		
Social services	3,948.99		
Zakat	15,234.99		
Previous debts	68,090.00		
Farmers' association	7,000.00		
Duty stamp	10.00		
Return	103,165.79		
<b>Total</b>	<b>1,612,622.00</b>	<b>Total</b>	<b>1,612,622.00</b>

Source: Sudan Gezira Board Darwish office: Central district

Acreage: 4 feddans

Cotton variety: Acala

Production: 19.62 kantar seed cotton.

### Summary of Sector Policies Relevant to the Gezira Scheme

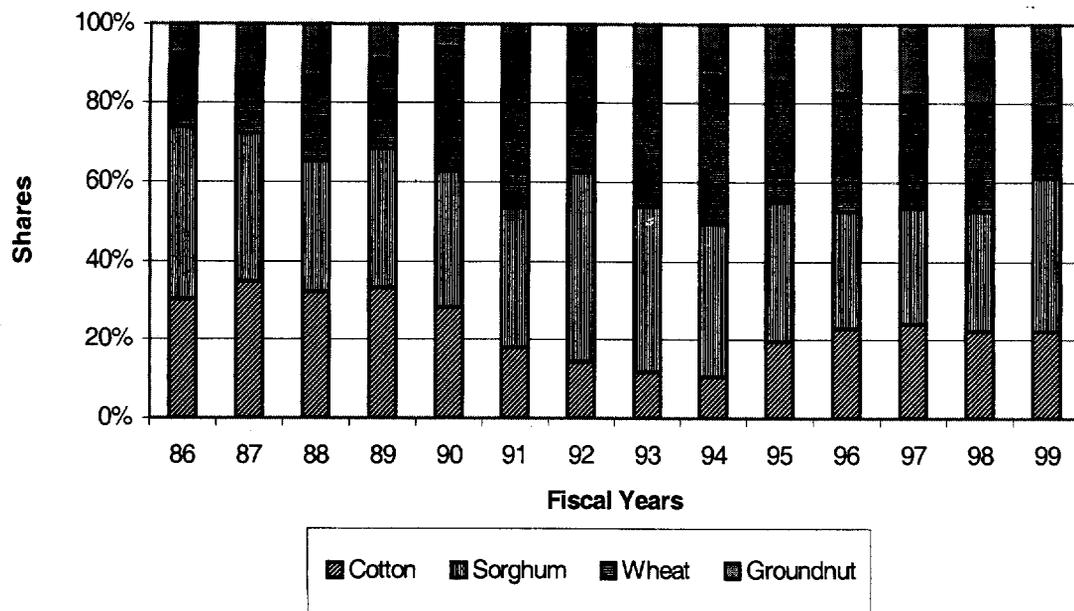
17. In addition to general economic liberalization, the decade of the 1990s has seen a number of major policy changes that have affected the Gezira Scheme.

18. **Food Self-Sufficiency-1991/92-91/93:** This policy required farmers to grow a specified amount of food crops-mainly wheat. As a result, there was an increase in cultivated area of sorghum and wheat at the expense of cash crops, cotton and groundnuts. The result was that foreign exchange earnings fell and imported inputs diminished and at the same time tenants accumulated many debts because wheat did not turn out to be profitable. The compulsion to grow wheat was subsequently rescinded but the aftermath in terms of substantial tenant debt remains.

19. **Farming system integration of livestock-1991/92-present:** The five course rotation replaced the four course rotation in order to integrate livestock, i.e., to incorporate fodder production. There was an animal distribution program in 1991 in which 1,191 cows were given to farmers along with 400 sheep.

20. **Crop rotation Changes and wheat liberalization:** The five crop rotation changed in 1997/98, switching the order of wheat and sorghum, and again in 1999/2000, by making wheat an optional crop for which another winter crop could be substituted (e.g. sunflower, fodder, vegetables).

**Figure 9: Shares of Area Planted by Major Crop**



**Figure 10: Three Scenarios of Gezira Scheme Net Revenue**

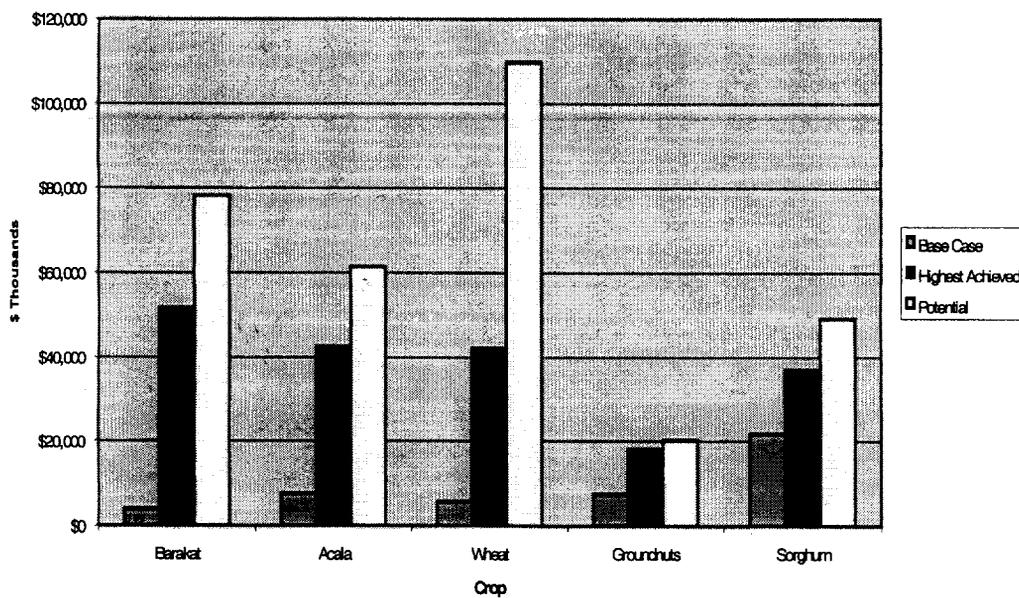


Table 22. Analysis of Domestic Resource Cost and Nominal Protection Coefficient

Crop Year: 98/99		Gen. Comments :		Total Cost	Price	Exch	FINANCIAL VALUE (LS/FEDDAN)			ECONOMIC VALUE (LS/FEDDAN)		
Quantity	FX Comp (%)	mkt p (LS)	US \$	LS/\$	FX Comp	Local Comp	Total	Conversion Factor	FX comp	Local Comp	Total	
<b>A. Main Product Revenue</b>												
World Price FOB	Port Sudan	lb					2333.00					
Yield	kantar/feddan	4.61	1026.52	0.44			2425.00					
Pounds of lint per kantar cotton		92.50					2425.00					
Yield of lint/feddan (lbs):		426.43					2425.00					
Gross Revenue/feddan	fob Port Sudan						437733.79	2425.00			437733.79	1.00
<b>B. Costs</b>												
Less domestic costs:												
Export tax (5% F.O.B)	per feddan	0%	21886.69	0.00	2425.00	18025.00	121574.07	139599.07		17971.82	98235.23	115525.23
State tax	per feddan	0%	26620.81	0.00	2425.00	0.00	26620.81	26620.81	1.00	0.00	26620.81	26620.81
Cotton Comm.	per feddan	0%	17290.48	0.00	2425.00	0.00	17290.48	17290.48	1.00	0.00	17290.48	17290.48
Shipping & other Charges	LS/kantar	0%	4373.93	0.00	2425.00	0.00	20163.83	20163.83	1.00	0.00	20163.83	20163.83
Ginning costs	LS/kantar	70%	22000.00	6.60	2425.00	15400.00	30426.00	45826.00	1.00	16007.29	30426.00	45826.00
Transport costs	LS/kantar	70%	3750.00	1.13	2425.00	2625.00	5186.25	7811.25	0.72	1964.53	3734.10	5624.10
Equals Net Revenue from Lint (ex-ginnery)	per kantar		64671.31	27.72	2425.00			298134.73				339470.25
	per lb lint		699.15	0.30	2425.00			-----				-----
Yield white seed (lb/kantar seed cotton)		205.00					2425.00					
Yield white seed (lb/feddan)		945					2425.00					
Price of cotton seed Ls per lb		107.82					2425.00					
Gross revenue from cottonseed			101892.18	43.67	2425.00	101892.18	0.00	101892.18	1.00	105910.22	0.00	105910.22
Price cotton scarto			533.33	0.00	2425.00							
Yield of scarto (lb/kantar)		17.50										
Gross revenue from scarto			9333.33	0.00	2425.00	0.00	43026.67	43026.67	1.00	0.00	43026.67	43026.67
Total gross revenue								443053.58	1.00	0.00	0.00	488407.14
Less marketing cost												
Transportation from tenancy to Ginerry	Ls/kantar	70%	1000.00	0.30	2425.00	700.00	1383.00	2083.00	0.72	523.87	995.76	1519.63
State tax for cake		0%	7132.45	0.00	2425.00	0.00	32880.61	32880.61	0.00	0.00	0.00	0.00
										523.87	995.76	
<b>C. TOTAL NET REVENUE</b>												
								408089.97				486887.50
<b>D. Tenant actual average price per kantar compared to:</b>												
			82494.00					2425.00				
<b>E. Border-equiv tenant price per kantar</b>												
			88522.77					2425.00				



## ANNEX 5: SOCIAL DEVELOPMENT ISSUES

### BRIEF SUMMARY OF MAJOR FINDINGS

1 **Gezira is at the heart of a much larger economic and social system.** A good year in Gezira signifies a good year for a much larger size of the population than those directly involved in the scheme. A bad year, similarly affects people way beyond the immediacies of the Scheme.

2 A symbiotic, and at times conflictual, relationship exists between various ethnic and social groups – largely consisting of the tenant farmers on the one side and the laborers on the other. Many of the laborers originate from outside the Gezira area, either from Western Sudan or from Western Africa (Chad through Nigeria). The majority of those who were regarded as seasonal laborers have taken up permanent residence in the Scheme, and this status has been recognized by the State, in so far as they are able to form their own Popular Committees separate from those of the tenant villages.

#### Box 1: Elephant's Stomach

The Gezira is like the Elephant's Stomach. It unites and feeds the entire massive body of the Sudan. All the distant organs, legs and limbs are dependent on the stomach feeling satisfied and getting good nutrition.

The Gezira - the Elephant's stomach - provides a huge melting pot for the Sudanese nation forging a new nation and a new sense of national unity. The Gezira provides work to laborers coming from distant parts of the country; the Gezira provides food and export crops, which help, feed and clothe the entire country.

A wise elephant knows to look well after its own stomach.

*Source:* Mr. Ibrahim al Feki Mohamed Babiker, Head of Gezira Trade Union, Financial Secretary

3. **Transitory and chronic poverty on the increase.** Poverty pockets appear to have increased due to the financial difficulties, which the Gezira Scheme is facing. Poverty pockets and chronic poverty are especially prevalent among the migratory labor groups.

4. **Household income and productivity disparity between tenant farmers.** Those tenants who have diversified their income beyond farming (to trading, dairy production, small industry, etc.), have greater adversity resilience. It is also reported that well-off farmers tend to have higher production yields.

5. **Increasing household level indebtedness.** The preferred method of credit is through the Gezira Board itself. Banks also provide some credit; however, Banks tend to lend largely to the most successful farmers with firm collateral. If formal credit is not available, sheil credit from informal sources is often sought. This informal credit system is a very expensive credit system provided by merchants and better-off farmers. The sheil system tends to lead to cycles of increasing indebtedness.

6. **Decline in social services.** With the change in the production relations from "Joint Account" to "Individual Account" in 1981 and the abolition of the Gezira Board's Social Services Department has led to a clear decline in access to social services such as clinics, midwifery training, dispensaries, nutrition and hygiene awareness training, etc. This has

especially affected the women and children in the Scheme who were prime beneficiaries of the services provided.

7. **Dropping levels of school attendance.** School and even university attendance among the children of tenant farmers is high while lack of school attendance among the children of the laborers is prevalent. With the liberalization introduced in 1992 and the subsequent introduction of school fees, some of the poorer tenants are unable to send their children to school.

8. **Increasing reliance on hired labor.** At its inception, the Scheme anticipated that farming labor inputs would be provided by the extended families of the tenants. With increasing farmer wealth, educational achievements and social aspirations, it is estimated that, on average, the tenant and his family provide less than 20 percent of the labor, with the rest being covered by hired labor. This varies, however, with some wealthy farmers, being absentee farmers and other poorer farmers relying on family labor to a much higher degree. With the steady deterioration in the performance of the Gezira Scheme, there has also been a reported steady decline in seasonal labor supply resulting in shortage of agricultural labor.

9. **Increasing fragmentation of tenancy size coupled with a drop in productivity.** In Gezira, the size of one full tenancy holdings is 40 feddans while it is 30 feddans in Managil (based on a five-fold rotation. The minimal holding for any one farmer is half a tenancy, which corresponds to 20 feddans in Gezira and 15 feddans in Managil. An increased fragmentation of holdings, means that 15 percent of the farmers now hold the minimum size holding, 16 cultivated feddan in Gezira and 8 cultivated feddans in Managil. There appears to be a direct correlation between the increasing fragmentation and the drop in productivity.

10. **Farmers' willingness and ability to pay for water.** Farmers expressed clear and keen willingness to pay for water and services supplied. At present fixed charge for water, services, administration and cleaning of canals is being levied on all farmers. Some farmers receive insufficient water or receive their water too late, others stated that the Board failed to clean the canals; yet the same levy was assessed to all farmers. Farmers are therefore keen to see a fairer system which links payments to services or inputs provided.

11. **Desire for Change - Fear of Change.** Farmers clearly want to have a greater control over the production choices, the level of quality of services provided to them and the costs of these services. There is thus an expressed desire for change. At the same time, there is a great fear of what the effects of any radical change might be on the security of their livelihood, the socio-economic structure of their society and on the potential social and financial costs, which these changes might bring.

## STAKEHOLDER SOCIAL DYNAMICS AND POPULATION ANALYSIS

### INTRODUCTION

12. The Gezira Scheme has for the last 75 years been woven into a new social fabric in the heart of the Sudan. The Scheme has acted as a magnet, attracting economic activity and thus the settlement of a variety of social and ethnic groups to form an urban center in Wad Medani and other Gezira towns, as well as either tenant farmer villages or labor camps on the Scheme itself. The Scheme has therefore played a key role in transforming the cultural, ethnic and socio-economic texture of society in the Central Sudan, and the pulse of the Scheme continues to determine the lives of the millions of people whose lives are intertwined with the Scheme.

13. In recent years, and with aging, the Scheme has showed signs of diminishing returns. The level of production and productivity has declined and as a result the living standards of the population living within and outside the Scheme have deteriorated. Although many people have benefited in the past from the Scheme, there is a growing disillusionment and discontent on many sides. A good year in Gezira used to signify a good year for a much larger size of the population than those directly involved in the Scheme. Similarly, a bad year affects people way beyond the immediacies of the Scheme.

#### **The People of the Gezira**

14. **Social and Ethnic Profile of the Population:** The current population estimate of Gezira State is 3.2 million. The population of the Gezira State grew from 2.0 million in 1983 to 2.7 million in 1993, amounting to an annual growth rate of about 3.0 percent. The average size of the household was estimated to be 6.2 persons per household. The age distribution of the population showed that 14.6 percent were under 5 years, 28.6 percent were between 5-14 years, 51 percent between 15-59 years and 5.7 percent were 60 years and over.

15. Only 19 percent of the population of the State live in urban areas, and the largest urban settlement is Wad Medani with a total population of about 210,000. The other important towns include Managil with a population of about 65,000 and Hassahisa with a population of about 21,000. The 1993-population census of Sudan showed that the majority of the population of Gezira State is of Arab origin.

16. The creation of the Scheme altered the composition and traditional social organization of the area as land and labor became economic values. At the time of establishment of the Scheme, preference for allocation of tenancies was given firstly to local inhabitants; failing that to other subsistence farmers or nomads, who lived in neighboring areas, and thirdly to other Sudanese. Scheme managers traveled long distances recruiting tenants, who were then settled in residential units on the Scheme. Added to the problems of reorientation and adjustment of the new settlers, intertribal tensions at times led to conflict in many of the newly settled villages.

17. Today, over 2.7 million people live in and adjacent to the Gezira Scheme and depend on it for their livelihood either as tenants, as agricultural laborers, as sharecroppers, traders or as providers of various services. There are about 120,000 tenancies in the Scheme with an associated population of about 896,000, (with an average family size of about seven persons per tenancy).

18. The growing population numbers, both in the labor camps, but also in the settled villages, are adding a large pressure on land. At present, however, land cannot be legally exchanged within the Scheme and re-structuring of land ownership is therefore not possible.

**Table 23: The Ethnic Composition of the Population in Gezira State**

<b>Ethnic Group</b>	<b>Total</b>
Total	2,715,605
Arab Groups:	83.3
Baggara	03.0
Dar Hamid	01.5
Bederiya	00.4
Gaaliyin	17.9
Guheina	12.2
Other Arab Groups of central Sudan	48.3
Beja	01.0
Nuba	02.2
Nubians	02.3
West Darfur	05.9
S. Sudanese	00.9
Nigerians	02.9
Other Non Sudanese	00.8
Tribe Not Stated	00.6

Source: The Central Bureau of Statistics; 1993 National Population Census of Sudan, Khartoum. Total Non-Arab groups make up 16.6 percent of the total population of the State.

19. **An Aging Tenant Farmer Population:** Although the general age structure of the population suggests a young population, with about 43 percent under the age of 15 years, the tenant population is relatively old, and there is a strong indication that this group is an aging population. Studies<sup>69</sup> have observed that the majority of the tenants (66.4 percent) fall within the age group 20-59 years. However, 30 percent of the tenants were aged 60 and above, and only 3.6 percent were under 20 years of age. Two studies gave average ages of the tenants to be 49 and 56 years, respectively. In a sample of 50 farmers who attended the group discussion sessions during the mission, the average age was found to be 56 years.

### Migration

20. At the inception of the Scheme, it was assumed that the extended families of the tenant farmers would be able to supply the required labor for the farming. With the economic crisis of 1931, many tenants abandoned the Scheme due to financial difficulties and the Scheme administration thus allowed non-Sudanese to become life-tenants. This led to an increase in migration from Western Sudan (Kordofan and Darfur) as well as large numbers from West Africa (from Chad through Nigeria). A number of these migrants initially held tenancies, while many more came for seasonal labor en route to or from the pilgrimage in Mecca.<sup>70</sup>

21 However, when the economic conditions improved, many of the original tenants returned to claim back their tenancies. In 1945 a rule was passed by the Scheme, which stated that when a non-Sudanese tenant died, the tenancy could not be passed to his heirs. This made it possible for the Sudanese ex-tenants to re-claim their tenancies or for these tenancies to be resold to other

<sup>69</sup> Kamil Ibrahim Hassan; Production Relations in the Sudanese Agriculture: The case of the Gezira Scheme, DSRC Seminar No.54, November 1984

The Republic of Sudan, Gezira Rehabilitation Project; Gezira Scheme Tenants Household Survey, 1987/88, Final Report, June 1991. Mohamed Abdel Gadir Adam; (1996); The Policy Impacts on Farmers Production Resource Use Efficiency in the Gezira Irrigated Scheme of Sudan, Van Kiel Verlag, Germany

<sup>70</sup> Personal communication, Ms. Iqbal Ahmed Hagar, Manager Planning, Social and economic Research, Gezira Board.

Sudanese. As the West African tenancy holders passed away, their heirs continued working as seasonal laborers on the scheme.<sup>71</sup>

22. The need to employ seasonal labor was greater for the small nuclear family tenant units who had migrated from their original residences, and tenants therefore continued to hire laborers to work their land.

23. In 1929, the majority of migrant laborers in the Gezira were from West and Central Africa, (25.8 percent from Nigeria, 35.7 percent from Central Africa and 38.5 percent from Western Sudan). By 1954, it was estimated that 16 percent of the total population of the Gezira was made up of labor migrants. It was further estimated that the labor migrants were mainly Nigerians and Tchadians.<sup>72</sup>

24. Labor camps for the seasonal laborers were established in designated areas; housing was supposed to be built of non-permanent materials, such as straw or wood, with more permanent structures of bricks and clay buildings banned. A condition for residence in the camps was ready availability for Scheme related work at all times.

25. As generations of seasonal laborers have established themselves within the Scheme, these conditions have tended to erode. Unplanned settlements are spreading and basic services are often absent. Moreover, settlements on agricultural land are now fairly frequent. Thirty-three percent of the camps are along the canals, 30 percent inside tenancies, 19 percent near villages and 18 percent in other places.<sup>73</sup> In some parts of the Scheme, the two settlement types (village and camps) are neighbors with an open space separating them, clearly forming a symbiotic unit. In others, the two settlement types are further apart and not in a direct symbiotic relationship with one another.

26. The mission found that approximately 70 percent of the camp populations originate from Darfur, followed by West Africans, Kordofan and the rest from other parts of Sudan. The majority of the tribes from Darfur include the Tama, Messeriya, Zaghawa, Marareet, Masalete, Gimir and Fur.

27. In interviews with tenant farmers and administration officials, it was expressed that the migrant population was considered to constitute a problem to the Scheme. A number of reasons were enumerated:

- The camp population settles inside tenancies thus decreasing the area cultivated and hinder operation of land preparation and impede aerial spraying.
- The camps and their population obstruct canal clearing due to their presence near canals.
- The camp population's animals attack the crops in the fields.
- The camp population brews alcohol, which affects the morals, the physical health and hence the productivity of tenants and laborers.
- One farmer interviewed expressed that the camps "were a cancer to the villages" causing disease and social disintegration.

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<sup>71</sup> The Republic of Sudan, Planning and Socio-Economic Research Unit Sudan Gezira Board, Gezira Rehabilitation Project; Migratory Labor Settlements in the Gezira Scheme, Final Report, Jan. 1994

<sup>72</sup> See also: The Republic of Sudan, Planning and Socio-Economic Research Unit Sudan Gezira Board, Gezira Rehabilitation Project; Migratory Labor Settlements in the Gezira Scheme, Final Report, Jan. 1994

<sup>73</sup> Information from Planning and Socio-Economic Research Unit, Gezira Board.

28 The different ethnic groups and the associated different cultures have made assimilation difficult. In spite of the long period of co-existence, there are clear divergent group dynamics. Cultural, ethnic and socio-economic differences mean that the existence of the two groups, while symbiotic, is largely separate.

29 In spite of these social relations, a large number of factors have acted as pull factors for in-migration and for camp settlements. Aside from job opportunities on the Scheme, factors also include:

- Encouragement by the Scheme to the laborers to settle in the Scheme by giving them areas to cultivate sorghum (the tenants called the sorghum produced “*fellata dura*” – “*fellata*” being a reference to West Africans);
- Encouragement by tenants through providing laborers help in establishing the labor camps
- Recruitment by the Gezira Board administration of laborers for cotton picking
- Sharecropping and “land lease systems” which provides laborers the opportunity to become producers (in the “land lease system”, the laborer leases the land from the tenant, and the produce belongs to the laborer. This system increases the income of migrants and raises their standard of living).
- The trend for West Africans to take up Sudanese nationality
- Encouragement by some political parties for Sudanese migrants to settle in the area to increase the voting population.

30. Available literature and studies by the Socio-economic Unit of the Gezira Board show that the Scheme saw in-migration of laborers up to the 1998/90 season. Since then, there has been a decline in the number of migrants seeking work in the Scheme. Seasonal laborers have also been affected by the poor performance of the Scheme. The Scheme has not been able to continue attracting large number of laborers due partly to the process of urbanization, and the multiplicity of development projects, in industry as well as agriculture, elsewhere in the country, where incomes are higher and relatively regular.

31. The Gezira Scheme was the main recipient of seasonal labor migrants, particularly between January and April, with a slack period immediately following the sorghum and sesame harvest. Since 1985/96 the number of seasonal migrants started to decline sharply and this coincided with the decline in the area under cotton production. As a consequence wages became less attractive in the Scheme compared with those in other agricultural schemes like the Gadaref rainfed mechanized schemes. Moreover, the Gezira Board stopped recruitment campaigns because of the high cost. Seasonal migrants were involved mainly in cotton picking and sometimes in the harvest of groundnuts and vegetables. Seasonal labor is paid either in cash or in kind (the tenants give part of the produce). In view of the poor performance, many tenants are no longer able to pay the laborers on time because of lack of money.

32. **Increasing reliance on hired labor.** Studies conducted by the Socio-Economic Unit of the Gezira Board found that with increasing farmer wealth, educational achievements and social aspirations, less than 20 percent of tenants rely on family labor in agriculture and that hired labor is a dominant factor.<sup>74</sup> Most of the contribution of family labor is in watering of cotton and wheat. However, laborers who are sharecroppers in sorghum, groundnuts and vegetable

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<sup>74</sup> The Republic of Sudan, Planning and Socio-Economic Research Unit Sudan Gezira Board, *Gezira Rehabilitation Project; Migratory Labor Settlements in the Gezira Scheme*, Final Report, Jan. 1994

production, are responsible for almost all the operations in agriculture.

33. Studies<sup>75</sup> observe that over 30 percent of the tenants lease or rent their land to others who are mostly laborers. In addition the system of delegating a person (wakeel) to be responsible for cultivating one's tenancy is common – about 15 percent of the tenancies are estimated to be farmed under the wakeel system. The general impression is that productivity under these arrangements is generally lower as there is less care for the land under the delegation system.<sup>76</sup>

### **Access to Social Services**

34. Gezira State is considered to have some of the best social services in the country and it is second only to Khartoum State, and the Gezira Scheme has been the most important contributor to this high standard. However, the quality of these services is threatened by the poor performance of the Scheme. Moreover, the population in the labor camps who lack such services within the camps, which have now become permanent settlements, are increasingly demanding the use of these services, and this has produced additional pressure on them.

35. During the early period between 1925-1950, the Scheme did not attempt to supply social services to the villages of the Scheme let alone to the labor camps.<sup>77</sup>

36. In the period after 1950, however, under the "Joint Account" system, two percent of the return from cotton was allocated to cater for the social development of the communities in the irrigated area. A multiplicity of social services was provided, which made the Gezira one of the most socially developed areas in Sudan. The social services targeted were in the fields of education, public health and popular mobilization. These services were delivered by the Social Services Department of the Gezira Scheme and were greatly valued by the tenants working on the Scheme.

37. With the change in production relations and the introduction of the "Individual Accounts" in 1981, the Social Services Department came to an end in 1983. This created a vacuum in the Gezira rural society, particularly in the areas of education and health. Farmers with whom the Mission spoke stated that the two percent of the return from cotton is still being collected by the Farmers Union, but that it appears that little of it goes to supporting the social services for the tenants.

38. After the closure of the Social Services Department, some efforts were made by Blue Nile Health projects (part of the World Bank funded Gezira Rehabilitation Project), to support social services in the region. However, with the end of this project, these services also came to an end.

### **Social Services - Tenant Villages**

39. **Education:** Today Gezira has more schools than most States in the Sudan. Adult literacy rate for the population 10 years and over is above the national average at 64 percent, (73 percent for males and 55 percent for females), compared to 53 percent (64 percent for males and 42 percent for females), for the whole country.

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<sup>75</sup> Mohamed Abdel Salam; " *Institutional Impediment to Development in Sudan Gezira Scheme*", in, Elfatih Shaaeldin (ed), *The Evolution of Agrarian Relations in the Sudan: A Reader*, The Hague, 1987

<sup>76</sup> For further discussion of this phenomenon, see section 3.1.5 of this report.

<sup>77</sup> Galal Mahmoud Yousif; (1997); *The Gezira Scheme: The Greatest on Earth Under One Management*; Africa University House for Printing, Khartoum- Sudan.

40. The creation of the Social Development Department had its greatest impact on the children of the tenants. The 1993 census suggests that the majority of the tenants above 45 years were illiterate, 47.6 percent for males and 90.4 percent for females. The majority of those with some education achieved primary level education, and a very small percentage achieved education above primary school level.

41. Today, over 90 percent of the tenant villages are served by primary schools, while less than ten of the villages have secondary schools. In the past, it was customary for most secondary schools to be located in large urban centers, and most of these were boarding schools. Secondary schools in villages are generally rare in Sudan, and this is true for the Gezira, too.

42. However, with the abolition of boarding schools in the 1970s, Gezira Scheme parents found ways to pay for their children in secondary schools. The general practice continues to be for parents in the Gezira to send their children to stay with relatives in towns where they can attend secondary school.

**Table 24: Highest Education Attained by Population 6 years and above in Gezira State**

Education	Total Northern Sudan	Total Gezira	Age (years)				
			6-14	15-24	25-34	35-54	55+
None	47.3	36.7	29.3	16.9	30.0	58.5	81.3
Khalwa	35.9	40.6	65.9	33.2	32.9	27.8	16.4
Primary	7.7	10.7	4.7	26.0	11.5	4.2	0.9
General Sec.	4.6	6.7	0.1	18.1	9.4	3.2	0.6
Senior Sec.	3.6	4.4	0.0	5.5	13.4	4.4	0.4
Above Senior	0.9	0.9	0.0	0.3	2.8	1.9	0.4

Source: Sudan Population Census, 1993

**Table 25. Distribution of Educational Background of Tenants**

Education	<15 Years	15-24	25-44	45+	Total
Illiterate	0.1	0.5	8.1	44.4	53.1
Khalwa	0.0	0.0	1.4	10.6	12.1
Primary	1.2	2.4	11.7	8.3	23.6
Intermediate	0.6	1.8	2.6	0.5	5.5
Secondary	0.3	0.6	2.9	0.6	4.4
Post Secondary	0.0	0.2	0.7	0.4	1.3

Source: Planning, Social and Economic Research Department, Sudan Gezira Board

43. **Health:** Access to health services is also higher in the Gezira than that for the whole country. In 1994, there were a total of 36 hospitals in the Gezira, while the total of health centers and primary health care units were estimated to be 133 and 215 respectively. The number of hospital beds in the Gezira was 2,640; there were 59 medical specialists, 246 medical doctors and 561 medical assistants.

44. At the Scheme level, 52 percent of the tenants have access to health centers within the village; 47.9 percent seek such services from adjacent villages and the average distance from a village to a clinic was 3.7 kilometers. 36 percent of the tenants sought hospitals services, only 2.9 percent had such services in the village, 97.1 percent sought such services in large villages and towns, with an average distance of 12 kilometers.

45. Urban hospital services are only enjoyed by a small number of tenants (one percent) due to transportation difficulties. Private clinics are far from the villages and only 0.7 percent has access to such services. The average distance to these facilities is 28 kilometers.

**Table 26: Access to Education and Health Services by Villages in the Scheme**

Type of service	Inside the village	Outside the village	Average distance in Kilometers
<b>Education</b>			
Primary school: For girls	486 (81.8%)	108 (18.2%)	0.8
For boys	431 (80.4%)	110 (19.6%)	0.8
Co-education Primary School	505 (84.5%)	92 (15.5%)	0.9
Intermediate School : For girls	339 (39.7%)	763 (60.3%)	6.4
For boys	365 (33.6%)	721 (66.4%)	5.3
Secondary School: For girls	31 (2.8%)	1047 (97.2%)	26.9
For boys	29 (2.7%)	1033 (97.3%)	24.8
<b>Health</b>			
	167 (52.0%)	154 (48.0%)	3.7
Health center	12 (2.9%)	391 (97.1%)	12.0
Rural Hospital	4 (23.5%)	13 (76.5%)	11.7
Town Hospital	4 (50.0%)	4 (50.0%)	27.8
Private clinics	57 (31.4%)	124 (68.6%)	19.4
Traditional Doctors	184 (89.1%)	20 (10.9%)	0.6
Other Health Institutions			
<b>Other Social Services</b>			
Local market	140 (14.0%)	860 (86.0%)	12.0
Cooperative shop	426 (85.8%)	70 (14.2%)	1.2
Bus station	574 (67.4%)	325 (32.5%)	2.7

Source: Planning, Social and Economic Research Department, Sudan Gezira Board.

The Gezira State is relatively better off than the states making up the former Central Region as Table 27 shows.

**Table 27: Access to Health Services in the States making up the former Central Region State**

State	Hospitals	Health Center	PHCU	Hospital Beds*	Medical Specialists*	Medical Doctors*	Medical Assistants*
Gezira	36	133	215	2640/97	59/2.1	245/8	561/21
W. Nile	14	34	31	1135/92	22/1.8	225/5	204/17
B. Nile	5	6	44	260/50	7/1.3	62/5	104/20
Sennar	11	17	75	939/96	15/1.5	36/5	203/21
<b>Total Central</b>	<b>66</b>	<b>190</b>	<b>365</b>	<b>4974/84</b>	<b>103/2</b>	<b>569/6</b>	<b>107/20</b>

\*Second figure in columns 5 – 8 refers to numbers per 100,000 people

Source: Ministry of Health, Sudan 1994

46. **Water, Electricity and Sanitation:** The population in the Scheme depends on two main sources for domestic water consumption, surface (canal) and ground water. Underground water is available in major formations and utilized through boreholes, hand pump wells and shallow wells. Some treatment is done through slow sand filters in some areas of the Scheme. However, in many areas, such water is not treated. Many communities, in particular the camp population, depend on canals as sources of drinking water.

47 A study conducted by the Social Development Unit in 1988 found that most of the tenants (75 percent) had piped water for their domestic use either within or outside their houses. The role of the Social Development Fund was clearly noticeable here, as the fund had played a major role in providing most of the tenancy villages with drinking water through the program of deep bore wells. Thus relatively few tenants (25 percent) still rely on surface wells or canals for their domestic use. These figures show that the Gezira State population is slightly better off than the average for Gezira State (see Table 28).

**Table 28: Households Access to Water, Sanitation and Domestic Energy**

Service	Gezira State	All Northern Sudan
<i>Water:</i>		
Piped Water	70.3	35.0
Well	11.8	43.0
Canal/River	16.7	10.0
Other	1.2	12.0
<i>Sanitation:</i>		
Public/Private Sewage	1.7	0.8
Pit Latrine	63.2	44.8
Others	0.2	15.9
None	34.9	38.5
<i>Energy for Lighting</i>		
Electricity		
Kerosene	30.9	17.3
Others	63.1	54.0
None	3.0	17.6
	3.0	11.1
<i>Energy for Cooking</i>		
Electricity		
Gas	0.4	0.4
Kerosene	1.4	2.6
Charcoal	0.3	0.8
Wood	41.2	27.9
Others*	41.3	64.0
	15.4	4.3

\* Others = cotton and sorghum stocks

Source: Central Bureau of Statistics, 1993 Population Census, and Khartoum.

48. Electrification of villages started as part of the Social Development Unit. About 30 percent of the tenants in Gezira State have access to electricity compared to 2.7 percent in Managil. Even with electricity available, 80 percent of the tenants still depend on kerosene for (part of) their lighting needs. The majority of households depend on wood and charcoal for cooking. Gas cooking is still very insignificant (one percent). The majority of the tenants (52 percent) use open space as toilets while 46 percent use pit latrines.

### Social Services - the Camp Population

49. The Social Development Fund mentioned above provided most of the villages with social services, and while in existence, the Department served the villages of tenant farmers. The Department did not have a presence in the camps and while the residents of the labor camps were never excluded from the services provided to the villages, the mission was informed that they rarely were beneficiaries of these services.

50. The laborers, with whom the mission had discussion, expressed the view that they should be provided with social services and they are willing to contribute to the cost of these services. In the villages where they live alongside with the tenants, they claim to pay the monthly contribution for water and schools through the village committees, although their children do not go to school and they do not have piped water in their houses.

51. **Education:** Although the Gezira area is considered to have the highest literacy rate in the country, the greatest majority of the camp population is illiterate. Khalwa (Koranic schools) education is the most commonly available in the camp. The number of pupils from the camp population attending schools in the villages is very small. Studies by the Socio-Economic Department of the Gezira Board indicated that 74 percent of the population was illiterate, 26 percent attended a khalwa, less than two percent of children in camps are enrolled in primary school, less than 0.5 percent senior schools and less than six percent attended adult education classes. Dropout rates among these children are very high; in particular among girls who tend to leave school/khalwa once they reach the age of 13-14 years of age.

52. **Health:** The health condition in most of the labor camps is extremely poor, and camp residents walk long distances to receive basic health services. This coupled with the high cost means that the majority of the camp population uses traditional healing for ailments and disease. Health hazards to the camp population are increased by their proximity to the canals and the lack of clean drinking water, which result in a high incidence of Schistosmiasis, malaria and Bilharzia, among the camp residents. The Blue Nile Health Project introduced some water hand pumps and sand filters in some of the camps, but it was reported to the mission by the camp residents that many of these are now in disrepair.

53. The housing condition in the camps was described as generally very bad. Houses were built of straw or mud, crowded without or with poor ventilation. Seventy-four percent of the houses of migrants had single rooms, which in most cases were used for sleeping, bathing and as a kitchen. Latrines were completely absent and defecation was in the open spaces, which increased the presence of disease-carrying vectors.

### Decline in Social Services

54. The change in the production relations from "Joint Account" to "Individual Account" in 1981 and the abolition of the Gezira Board's Social Services Department has led to a clear decline in access to social services such as clinics, midwifery training, dispensaries, nutrition and hygiene awareness training, etc. This has especially affected the women and children in the Scheme who were major beneficiaries of the services provided.<sup>78</sup>

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<sup>78</sup> Mohamed Hashim Awad, (1987); *The Evolution of Land Ownership in The Sudan*, in Elfatih Shaaeldin (ed), *The Evolution of Agrarian Relations in the Sudan*, The Hague, 1989.  
Awadalla Mohd. Rahamtalla; (1998), *Differentials in levels of Human development in Areas of Gezira Scheme: The case of Tayba and Abu Guta: Areas*; Unpublished M.Sc: Thesis, University of Khartoum (in Arabic), Khartoum, See in Particular Chapter 4 on "Development of Social Services".

**Table 29:..Access to Services by the Camp Population**

Type of Service	Gezira	Managil
<i>Water:</i>		
Well	7	5
Canal	57	71
Filter	5	4
Pipe from nearby village	14	9
Other	17	11
<i>Health: (Both Gezira and Managil)</i>		
Dressing Station: Inside camp		--
In Village		49
Dispensary: Inside camp		--
In Village		53
Health Center: Inside camp		0.2
In Village		32
Hospital: Inside camp		--
In Village		85
Midwife: Inside camp		2
In Village		80
<i>Education:</i>		
Khalwa: Inside camp	70	
In Village	2	
Primary: Inside camp	0.1	
In Village	85.5	
Intermediate: Inside camp	--	
In Village	56	
Secondary: Inside camp	--	
In Village	36	

Source: Planning, Social and Economic Research Department, Sudan Gezira Board

55 With liberalization of the economy, citizens have to pay for building of classrooms, schoolbooks, health services and other social services. The costs for both health and education and other social services have risen accordingly following liberalization. Meanwhile the income derived from the Scheme is insufficient for general household and farming budgets, and is insufficient to meet the rising costs of social services. This applies to both tenants as well as for laborers. At the same time financing of social services from projects funded by the international community has also been largely discontinued.

56. In recent years, the Sudan Government introduced fundamental changes in the way social services are to be financed. Today the states and the local Councils (mahaliat) are responsible for financing salaries, and infrastructure expenses related to primary, intermediate and senior schooling. Similarly, health services below the hospital level are now the responsibility of the states and local councils.

57. Most local councils are weak financially and their support to health and education is very limited and inadequate. Collection and payments from users is therefore commonplace. The share of the local communities in the social services budget has increased considerably and has

by some estimates reached above 60 percent. When comparing with other states in the Sudan, however, the Gezira State is better off than most other States because of its revenue base derived through taxes from the Scheme.

58. Preliminary results of a recent study conducted in 1998 by the Socio-Economic Planning Unit of the Gezira Board, indicated that there has been a steady deterioration in the quality of social services in the Gezira scheme area. Schools and health facilities are in poor state and require maintenance. The number of primary health care units has declined, although some have been up-graded to health centers.

### **Dropping School Attendance**

59. The total number of primary schools under the authority of the local councils is 1,549 with a total of 16,291 teachers. Sixty-five percent of these schools are in the Scheme area.<sup>79</sup> The Mission was informed that thus far, the Councils have been able to pay for the teachers' salaries on a regular basis. However, observations made during the mission showed that the conditions of some of the school buildings have deteriorated, indicating poor maintenance.

60. With the liberalization of 1992, citizens have to pay for building of classrooms, schoolbooks, etc. and parents of children were therefore required to pay schools fees and other school related costs. Records from the State Ministry of Education show that the dropout rate is increasing among children aged 13 to 14 years. This is still not very significant among the Gezira tenants.

61. Recent studies have indicated dropping levels of school attendance especially among the children of laborers and the poor tenants. A study conducted in 1995 showed that out of a total of 163 children of laborers registered in first year primary in 1992, only 15 percent proceeded to the fourth class of primary school. The drop out among children of tenants was generally high for girls in the 7th year of primary school.<sup>80</sup>

### **Health Situation Deteriorating**

62. The local Councils are responsible for the following categories of health workers and facilities: Health personnel: medical assistants (1,005), nurses (4,173), health visitors (2,300), midwives and traditional birth attendants (560). Health facilities include health centers (4,948), dispensaries (172), dressing stations (778) and primary health care units (445).

63. The Gezira, like most parts of the country, still experiences a relatively high incidence of diseases. In the Gezira, water-borne diseases such as malaria, Schistosomiasis (Bilharzia), and intestinal worms and diarrhea, especially among children, are very common and endemic in many parts of the Scheme and evidence suggests these diseases may be on the increase.

64. In the Gezira area, malnutrition among children was found to be 13.3 percent in 1994 with high rates of 33.3 percent in some parts of the state e.g., Managil, (MOH, 1994). Malnutrition was largely concentrated among the camp population.

65. It is reported that prior to the Scheme, Schistosomiasis was virtually unknown in the area and that the high prevalence of vector borne diseases such as malaria and Schistosomiasis are immediately linked to the Scheme. In 1930's the infection rate was found to be 30 percent of the

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<sup>79</sup> Gezira State, Ministry of Education.

<sup>80</sup> Gezira State, Ministry of Education.

Gezira population; by 1972 it was 60 percent. The Blue Nile Health Project (BNHP) was implemented in 1982 to control malaria and Schistosomiasis as well as diarrhea diseases. By the end of the project it was estimated that the end infection rate had reduced diseases to 6.9 percent. However, with the end of this project, these services also came to an end. Research conducted by the Department of Community Medicine, University of Khartoum, between 1994 and 1997 suggested an increase in the incidence of malaria and Bilharzia had reached an infection rate of about 20 percent by 1997.

66. In an effort to stem the decline in social services, communities have collectively invested in self-help for social services. In all the tenant villages, each household is charged a monthly contribution of between SD1,000 to SD1,200 for water and electricity. The Farmers Union collects a yearly subscription fee of SD 700 from the tenants in addition to other charges the Union levy on the tenants.

67. However, it is evident from the recent study conducted by the Socio-Economic Unit of the Gezira Board, the decline in the income of the tenants from agriculture is severely affecting the ability of individuals to contribute to the financial support of water services. So far, remittances from family members who are migrants in the Arab oil producing countries are helping to reduce the impact of the decline in agricultural production, and consequently earnings, on the population in the Gezira.

## **MAIN CONCLUSIONS OF STAKEHOLDER SOCIAL DYNAMICS AND POPULATION ANALYSIS**

### **Constructed Social Inequality**

- The Gezira Scheme has produced social stratification, which can be traced back to the early establishment of the Scheme. Distinct ethnic groups were given tenancy privileges, while other distinct ethnic groups were expected to work as laborers. One group was denied the right to build housing of permanent structures, of inheritance of land, and was only allowed to live on the Scheme provided it would supply its labor at any and all times required.
- This social stratification still exists today, with non-existent services provided to the labor migrants, many of whom for generations have lived in poverty in temporary camps with no real access to social services.
- The symbiotic relationship that existed between the various ethnic and social groups – largely consisting of the tenant farmers on the one side and the laborers on the other- appears to be threatened by many factors. The decrease in income from agriculture and limited off-farm employment opportunities appears to cause increasing levels of poverty and a decline in living standards.

### **Aging Tenancy Population and Increase in Hired Labor**

- As the sons of tenants attain education, they are reluctant to maintain the tenancy. This has led to an increase in absentee farmers, to some tenancy fragmentation and to a variety of private arrangements for farming (wakeel, sharecropping, land lease and others) as well as to an increased reliance on hired labor.
- With the aging population, innovations are not quick to filter into agriculture partly because

the old generation of tenants is either illiterate or have low education levels. The problem of labor shortage appears to be increasing.

- The departure of the sons of tenants has also opened up opportunities for women tenancy holders. Women now hold some 16 percent of the tenancies.

### **Unequal Access to Social Services**

- In comparison with the national average, the Gezira is relatively well served by social services; however the quality of these services is declining as a result of the poor performance of the Scheme. Moreover, there is unequal access to these services.
- The village Popular Salvation Committees are contributing to the maintenance of some of the social services, in particular water, health and education. However, their financial ability to support these services is dependent on the contribution of the communities and these are not always easy to raise. The decline in the income of tenants has further restricted their ability to contribute to the support of these services.
- In the short-term, improving the income potential of the communities will make it possible for them to contribute to the support of the social services. The contribution paid to the Farmers Union should also be used to support the services in the villages.
- The reduction of Government expenditure in the provision of social services has increased the responsibility of individual communities. The decline in the incomes of tenants has affected the quality of the social services. Poorer tenants with small tenancies are having a hard time to keep up with the required payments for these services, while the camp population, does not receive any meaningful services.
- Although the majority of tenants in the Gezira Scheme have access to treated water in or near their houses, sanitation is still poor, as many households have no pit latrines and thus use the open spaces as toilets.
- The provision of services to the migrant and camp population by the local Councils is imperative to ensure greater social integration of the distinct communities, and thus to avoid any potential future social unrest. The laborers living in the main villages share the social facilities with the tenants. However, those living in camps, though not excluded from using these facilities, have no real access to them.

### **Deteriorating Health Situation**

- Water-borne diseases such as malaria, Schistosomiasis, Bilharzia, and intestinal worms and diarrhea are reportedly increasing in the Gezira due to lack of funds for disease control. A general infection rate for water borne diseases is now estimated to be a 20 percent of the Gezira population – an increase from 6.9 percent in 1987.

## **ECONOMIC ANALYSIS OF STAKEHOLDERS**

### **Land Tenure**

1. **The Historic Perspective:** The immediate land tenure system is simple: Land was originally expropriated from the landowners at the time of the creation of the Scheme. These landowners were to receive annual rent from the Government for the expropriated land. Many of the original landowners were also granted tenancies. Once a tenancy has been secured, this

cannot be sold. However, it can be inherited. A tenancy can officially only be fragmented to half the size of a full tenancy. There is an increasing rate of half tenancies in the Scheme. A farmer is not allowed to own more than one tenancy, but his wife and sons can also own tenancies.

2. The above describes the basic land tenure system of the Scheme. However, beyond the immediacies of the Scheme presented above, the present land holding and management system between and within families is not well documented and the mission did not have sufficient resources to investigate in-depth the complex issues relating to land holdings and management.

3. There are a wide variety of different arrangements in existence for land management, sharing and holding. A Committee under the State Minister of Agriculture was formed to investigate the land tenure arrangement in the Gezira and it has submitted its report. The content of that report has not been made available to the Mission. However, it is the understanding of the Mission that one of the recommendations relates to the present land rent system.

4. Historically, and prior to the establishment of the Scheme, land in Gezira plain was used for rainfed cropping and grazing under a land tenure pattern that involved private ownership. With a view to establish the Scheme, under the 1921 Gezira Land Ordinance, the Government either leased or bought land from the owners. The 1927 Gezira Land Ordinance governed the distribution of tenancies. Land was compulsorily rented from registered landowners for a fixed annual rate of LS 0.100 per feddan for 40 years. Landowners were prevented from renting land to others, and speculation was avoided by placing restrictions on sale of land. As a result, about 60 percent of the land is today Government land and 40 percent freehold land, which has been rented by compulsion from its owners. The Sudan Gezira Board manages all the land in the Scheme.<sup>81</sup>

### **Size of Holdings**

5. **The Historic Perspective:** In Gezira, the size of one full tenancy holdings is 40 feddans while it is 30 feddans in Managil (based on a five-fold rotation (cotton-wheat-sorghum/groundnuts-fodder-fallow). The minimal holding for any one farmer is half a tenancy, which corresponds to 20 feddans in Gezira and 15 feddans in Managil. However, it appears that during the initial period of distribution, individuals were classified according to the area of land they owned pre-Scheme in the area. For example, in the Managil extension those who owned between 15 and 29 feddans before expropriation were given one tenancy, while families which had 30 - 44 feddans were given two tenancies, three tenancies to families with 45-59 feddans and four for those with 60 feddans.

6. **Productivity:** From studies conducted on the productivity of the Gezira, it appears that factors such as decline in yields, particularly that of cotton, coupled with the rapidly increasing cost of living, have made many tenants loose interest in farming. It further appears that delay in payment of tenants is a main concern for most of the tenants. There are reports of payments for cotton that have never been made and it is further reported that when there finally is some payment, the wealthier tenants receive the lion's share. Payment one year after delivery of the harvest is commonplace.

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<sup>81</sup> See also Sharif el Dishouni, (1989); Traditional and Modernization in Sudanese Irrigated Agriculture: Lessons from Experience, DSRC Monograph Series, No.36; Mohamed hashim Awad, (1987); The Evolution of Land Ownership in the Sudan; in Elfatih Shaaeldin (ed); The Evolution of Agrarian Relations in the Sudan, The Hague, 1989.

7. Several studies in the past have concluded that productivity is highly correlated with the ability to hire labor.<sup>82</sup> Since most activities require hired labor, only those who have liquidity are able to hire labor on time to complete the required work. Poor tenants therefore have to turn to moneylenders to meet labor costs. As a consequence, poor tenants with smaller tenancies, tend to abandon their tenancies at a faster rate compared to wealthy tenants.

8. **Gender and Land Tenure:** There are presently some 120,000 tenant farmers of which about 13 percent are women. Recent statistics from the Gezira Board's Department of Planning, Social and Economic Research indicates that the present number of tenants is decreasing and that the number of women farmers is therefore dropping accordingly. Several factors were responsible for the small number of female tenants. According to the 1927 Gezira Land Ordinance, females had the right to own tenancies, but male relatives should be appointed as responsible tenants of their behalf. In practice no tenancy was allotted to women. According to the same Ordinance, after the death of a tenant, Islamic Laws, which would have provided a share of the tenancies to the daughters of the tenancy holder, did not govern inheritance, because the land was Government property. The tenancy would thus be transferred to an adult male, and if there was no male relative, then it could be transferred to a female. However, few women benefited from this rule.

9. **Increasing Fragmentation of Tenancy Size:** The issue of land fragmentation is recognized by most of the farmers as being one, which seriously affects the viability of Scheme. As mentioned above, tenants cannot, in theory, sell their land and fragmentation through inheritance is not allowed. The Gezira Land Ordinance of 1921 specifies that "the tenant may not transfer, assign, sublet or part with the possession of the land comprised in the tenancy or any interest there in or in the crop grown there on, except with the consent of the government or such person or persons as the government may appoint as aforesaid". However, in spite of this regulation, the average size of the allocated tenancy has tended to decline with the creation of many half-tenancies, while on the other hand, there is some evidence that absenteeism by tenants and the use of the wakeel system of delegation have been increasing. This has therefore caused an increased fragmentation in the actual farm size and holding size, while the registered and official land holding has not necessarily diminished in size.

10. The Gezira Scheme Household Survey of 1987/88 found that 17.5 percent of the sample of 1,118 tenants had more than five feddans and 82.5 percent had less than five feddans in a 4-rotation system. In accordance with both a study by Mohamed Abdel Salam<sup>83</sup> and further reinforced by the Household Survey, the sub-division of the 40-feddan tenancies of the main Gezira area has steadily increased since the mid 1940s. A number of factors were (and continue to be) behind this phenomenon. These include population pressure and scarce off-farm employment opportunities, decreasing reliance on extended family labor due to changing social patterns and the emergence of nuclear families in the tenancy context, and actions imposed by the Scheme management on those tenants who repeatedly failed to cope with the instructions of the field staff with regards to cotton cultivation. Today some 15 percent of the farmers hold the minimum size plot, - 16 cultivated feddan in Gezira and 8 cultivated feddans in Managil; (i.e. half

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<sup>82</sup> D.S. Thorton; *Agricultural Development in the Sudan Gezira Scheme*; in Elfatih Shaaeldin (ed); *Evolution of Agrarian Relations in the Sudan*, The Hague, 1987;  
 Mohamed Abdel Salam, *Institutional Impediments to Development in the Sudan Gezira Scheme*, in Elfatih Shaaeldin (ed); *ibid*;

Farah Hasan Adam; *Evolution of the Gezira Patterns of Development within the Context of the History of Sudanese Agrarian Relations*. In Elfatih Shaaeldin (ed); *ibid*.

<sup>83</sup> Mohamed Abdel Salam, *Institutional Impediments to Development in the Sudan Gezira Scheme*, in Elfatih Shaaeldin (ed); *op.cit*.

a tenancy, based on field-fold rotation with one plot fallow).

11. In the North West Extension of the Scheme, 20 feddan tenancies were officially allocated in 1950, mainly in reaction to population pressure. When Managil South Western Extension was started in the late 1950s, a 15 feddan tenancy was adopted, with a cropping intensity of 66.7 percent (up to 1974) and 100 percent since 1975/76. This 15 feddan holding was considered small enough by the planners to be cultivated by the tenant and his family without recourse to hired labor, but large enough to provide an adequate and a decent standard of living. It was therefore adopted to enable more families to be absorbed as tenants in the Scheme. However, the smaller farm size did not reduce the reliance on hired labor as tenant families have not dispensed with hired labor; this has partly been attributed to the very tenure system itself, which, it is argued, leads to an alienation of the tenant cultivator from the land and thus enhances the sense of being a foreman as opposed to a farmer, irrespective of farm size. It is thus argued that the land tenure system adopted in the Gezira Scheme alienates the tenant from the land he cultivates and thus adversely affects his attitude toward working and investing in land.<sup>84</sup>

12. The present form of the tenancy contract and the present range of the Gezira Board functions over land are resulting in a sub-optimal allocation of resources in the Scheme. The restriction on tenancy size and the insecurity of tenure for those who actually farm the land, under the wide variety of arrangements on the ground (wakeel system, share cropping, land lease system, etc) do not facilitate stability, long term land improvements, or investments, which may improve land productivity. The restrictions further limit the growth of incomes of those tenants who may be competent and ambitious enough to aspire to larger farm operations with increased capital input it implies.

13. Sub-division and smaller holdings did cause more families to be absorbed in the Scheme, thus aiding a sense of equity and social justice. But farm size remains a critical constraint, particularly as smaller tenancies did not necessarily mean greater effort (per unit area) by the tenant and his family, or greater intensification of cropping system or purchased inputs which are subject to a high degree of centralized control.

14. The main argument is that "the institutional organization arrangements in the Gezira Scheme fail to provide any incentives for working and investing on the farm. The system suits the average but penalizes and frustrates the innovative and self-reliant. In consequence, the latter group directs its effort to other outlets, not frequently, off the Scheme. Aged men and women are left behind in control of tenancies; the overall outcome being the process of decay and stagnation."<sup>85</sup>

15. From discussions with Gezira Board officials, it appears that the minimum holding to sustain a 5-7 person family is 2 feddans in a five-rotation system, i.e., 10 feddans. The general conclusion from discussions with Block Inspectors in the Scheme was that the following distribution of tenancy sizes in the area is probably accurate based on their records.

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<sup>84</sup> Mohamed Abdel Salam, Institutional Impediments to Development in the Sudan Gezira Scheme, in Elfatih Shaaeldin (ed);op.cit.

<sup>85</sup> Ibid.

TABLE 30: DISTRIBUTION OF TENANCIES BY SIZE

Size of tenancy in feddans	Percentage of farmers
8	15
10	30
20	50
40	5

Source: Block Inspectors of the areas visited during the Mission

16. Among the farmers, there is an awareness of the social benefits, which the fragmentation brings; however, there is also a realization that this fragmentation is only possible as long as full costs are not enforced on the smaller holdings. Consolidation would clearly squeeze out the poorer tenants and a consideration of the social costs associated therewith will need to be considered.

17. A study by Farah<sup>86</sup> observed, using a Chi-Square test, that there is a significant positive correlation between the tenancy size and the generated additional income at the 5 percent level. Hence, the tenants operating the small-size tenancies are not only incapable of financing most of the agricultural operations, but also sometimes fail to cover their family expenses. As a consequence, a large proportion of these tenants resort to borrowing from rich tenants and local moneylenders, who insist on 'sheil'. Farah's study further showed that there is an inverse relation between tenancy size and those who experienced the sheil system.

18. Furthermore, although women's participation in agricultural activity is becoming important in many tenancies, a significant difference seems to exist with respect to the contribution to family and wage labor between the wives of the large tenancy holder and the wives of the smaller tenancy holders' wives. While the wives of larger tenancy holders only participate in a very limited way and only on their husbands' farms, wives of small tenancy holders participate effectively in agricultural activities and contribute to both family labor as well as wage labor.<sup>87</sup> Thus it could be argued that in the case of poor tenants' households, the deteriorating economic conditions force the women into taking on the double burden of domestic work and (self or waged) farm work to help in securing the basic necessities of their families' survival.

19. The rich farmers have considerable economic advantage with regard to their access to technology. Through their access to important leadership positions in the Farmers' Union and machinery and marketing cooperatives, and to the Gezira Board, they are able to control agricultural machinery, such as combine harvesters, tractors and inputs. They are subsequently able to hire out such services to small holder tenants at high rental fees.

20. Therefore, it is argued that the present organization of the Scheme does not entirely stifle the creative energies and faculties of the tenants. Some of better off have developed into affluent owners of tractors, flour mills, lorries, shops etc., and others have large farming undertakings in the other parts of the State and elsewhere in the Sudan.<sup>88</sup>

21. **Tenants View on the Land Tenure System:** The practice of selling tenancies is currently being practiced in the Scheme, but is highly restricted by the Scheme management. The trend of acquiring land through sale will increase, according to the tenants, because of the present adverse economic conditions. The view expressed by many tenants is that the sale of tenancies should be

<sup>86</sup> Mohamed Abdel Salam, *ibid.*

<sup>87</sup> Mohamed Abdel Salam, *ibid.*

<sup>88</sup> Mohamed hashim Awad, (1987); The evolution of Land Ownership in the Sudan; in Elfatih Shaaeldin (ed); The Evolution of Agrarian Relations in the Sudan, The Hague, 1989

de-regulated. However, the tenants are aware of the possibility of land speculation and the increased possibility of land accumulation at the hands of few rich landowners, which could lead to the widening of the gap between the tenants and laborers.

### **Assets Ownership, Credit and Debt**

22. **Assets Owned by Tenants:** In the tenant villages, household properties include refrigerators, radio, TV sets, and gas cookers. It was reported that while 50 percent of the households have radio sets in their houses, less than 10 percent own TV sets and refrigerators. In recent years, the number of tenants with these household amenities has increased because of the number of migrants working abroad.

23. The Mission was informed that the number of tenants with tractors and harvester is less than 5 percent in the Gezira. Vehicles are more common among the big tenants and the number of cars has increased in recent years because of remittances from the migrant laborers abroad. It is estimated that about 8 percent of the tenants own pick-up vehicles. Those who own lorries are mostly traders and they make up less than 2 percent of the tenants in the Gezira. The recent study conducted by the Socio-Economic Unit of the Gezira Board showed no significant increase in the number of tenants owning agricultural machinery and vehicles. Migrants in the Arab oil producing countries appear to be the main suppliers of the vehicles in the Gezira, as it is the case in many parts of Sudan.

24. The existing distribution of vehicle and large machine ownership in the Gezira Scheme is rather skewed in favor of the rich tenants who combine farming with trade. The result of a survey on machinery conducted in 1979 in the Gezira Scheme indicated that about 80 percent of the tractors and 68 percent of the combine harvesters operating in the Scheme were owned by trader-tenants. This was largely due to the credit policy adopted by the Agricultural Bank of Sudan and encouraged by the Gezira and Managil Farmers Union Executive Board. The Agricultural Bank offered credit only to those who satisfied the principle of credit-worthiness, irrespective of whether they were tenants or not. This therefore benefited the traders and the rich tenants. The same study argues that the Farmers' Union often uses its political power to influence the Agricultural Bank to offer credits to the wealthy tenants. This fact is important because the private sector machines perform large parts of the dura, groundnut and vegetable production operations.<sup>89</sup> The Mission was informed that the existing situation is very similar to that observed by the 1979 survey.

25. According to the Gezira Board, 40 percent of farmers have animals, while 60 percent do not. Studies conducted by the Social and Economic Development Department observed that on average, tenants have an average of 12.4 animals per household, of which 2.7 were cattle and 8.6 were small ruminants and the rest were donkeys. Big tenancies generally have more animals than the small tenancies.

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<sup>89</sup> Farah Hasan Adam; Evolution of the Gezira Patterns of Development within the Context of the History of Sudanese Agrarian relations. In Elfatih Shaaeldin (ed); *ibid*.

**Table 31: Average Number of Animals Owned per Household**

Size of Tenancy	Sheep	Cows	Goats
All Sizes	4.4	2.7	4.2
Large	7.5	5.5	5.0
Small	3.7	2.1	4.0

Source: Sudan Gezira Board; Gezira Rehabilitation Project, Gezira Scheme Tenants Household Survey, 1987/88, Final Report, 1991.

26. In conclusion, therefore, those tenants who have diversified their income beyond farming (to trading, dairy production, small industry, etc.) clearly have greater resilience to adversity.

27. **Assets Owned by the Laborers:** The laborers, who are predominantly migrant population, make up a distinct social group in the scheme, although in some villages they live along side the tenants. They live under extremely difficult conditions without access to basic social services. However, it is evident that through the sharecropping system many of the long-term laborers are acquiring wealth and some now own sheep, goats, poultry and cows. A study conducted by the Socio-Economic Department in 1993 found that goats were the animals mostly owned by the camp population. It was estimated that 75 percent of the camp households had goats and 56 percent had sheep. However, the average number of animals owned by the households in camp is very small, estimated to be less than 3.

#### **Informal Credit System and Increasing Debt**

28. The formal credit system through the Sudan Gezira Board and the debt owed by tenants to the commercial banks is discussed elsewhere in this report. The informal credit system will be discussed here.

29. Farmers observed that the Gezira Board and Banks tend to lend largely to the most successful farmers with firm collateral. If formal credit is not available, credit from informal sources is often sought. This informal credit system (the "sheil" loan system which is provided against future production) is a very expensive credit system provided by merchants and better-off farmers. The sheil system is an important source of credit for tenants in the Gezira, especially among the small tenants with less than 10 feddans; it is especially used for sorghum and other farm crops (not for cotton and wheat). However, the sheil system tends to lead cycles of increasing indebtedness. Though available to women, women farmers tend to more cautious/reluctant to enter into debt for social and cultural reasons.

30. The sheil system compels the borrower to pledge part of his crop at or after the planting dates as collateral. A tenant may borrow from a village merchant or any other moneylender who will specify in what form he must be repaid. There is usually a large difference between the loan received and the value of the repayment, and this is one of the causes of the poor economic condition for the majority of the tenants.

31. The borrower repays the loan in kind and the crops that are readily accepted are those which can be easily stored. The sheil system is not used frequently for financing groundnut production because of the dominance of sharecropping system in groundnut production.

32. The sheil system is not generally used for productive investment, rather, in most cases it is used for the purchase of items for family consumption or for fulfilling social obligations. The credit offered under sheil system usually leaves the tenant worse off and tied to the lender. When

the creditor is the village shopkeeper, the farmer may not receive the full value of the credit in cash; part of it is usually received in the form of consumer goods. There is also a tendency for the prices of such goods to be higher than the normal market prices since the farmer is not in a position to bargain.

33. It was reported to the mission that tenants' indebtedness has increased markedly in the period following the shift from "Joint Accounts" to "Individual Accounts". For some tenants the tenancy has become a liability. They stay on the farm hoping that the next year will make ends meet. Many farmers complained of constant indebtedness, since as soon as they pay one set of debts, others accrue. Many farmers noted that the only way for them to survive from one season to the next is by going further into an ever-increasing debt.

### **Water Pricing and Management**

34. All farmers are required to pay a fixed water assessment every season. All farmers, in accordance with the size of their tenancy pay the same fixed price. However, most farmers with whom the mission discussed, complained that they rarely received the amount of watering, which are stipulated in the agreement with the Board. Farmers therefore felt they were charged unfairly for the water, as they often did not receive the allocated amount. In addition, many farmers complained that if they were on the end of the canal, at times they received nothing at all, and their crops therefore failed accordingly.

35. From discussions with tenant farmers, the mission found little appreciation for what "the economic price" or the "market price" of water might be. Rather there was the expectation that the Board should provide them with all necessary water so that they might produce the crops required. Given the years of poor and unreliable delivery of services by the Gezira Board, farmers preferred to pay by the watering. Some farmers expressed that if they could pay per required watering on actual delivery, they would be willing to pay a higher water price.

36. The laborers, in particular those involved as sharecroppers, expressed that they would like to be involved in the water management, including the maintenance of canals, allocation of water and payment of water charges. At the moment, it is the tenant who has a direct connection to the Scheme management, while the sharecropper, who has a direct interest in the water supply, is not involved in any of the discussions with respect to the water supply or charges.

### **Off-Farm Employment**

37. While the full picture is not available to the Mission and would require further social studies, it is apparent that some of the tenants engage in non-agricultural income earning activities. For the wealthier and better-educated tenants, this includes work in Government jobs or in private businesses or trading in Khartoum or Wad Medani.

38. For the laborers of the camps, work includes day laboring in the brick kilns and casual work in urban markets. It is estimated that about 20 percent of the camp population are engaged in such activities. The nearer the camp is to the town, the higher the possibility of involvement in non-farm activities.

### **Poverty Pockets and Chronic Poverty on the Increase.**

39. Researchers estimate that poverty in Sudan has increased by an annual rate of 4.8 per cent from 45 percent in 1978 to 91 percent in 1993. This increase in poverty is manifested in upward trends in infant mortality and malnutrition.<sup>90</sup>

40. Life in the Gezira is characterized by pervasive social inequality. The different socio-economic strata are living distinctly different lives. Absentee farmers with other incomes are living in Wad Medani or Khartoum; on-farm tenants with larger holdings are braving the odds to continue to make ends meet in Gezira, while farmers with smallholdings are falling into ever-increasing debt.

41. In the Gezira the social setting of the village communities and the close inter-relationships between different communities in different villages provide some social support mechanisms during times of adversity and depressed incomes. Family members are bound to assist and provide support for social occasions, e.g. circumcisions, marriages, deaths, etc. In almost all villages, migration of young people to the urban centers and to oil producing countries in the Gulf is providing an important source of remittance income to tenants in the Scheme.

42. At the far end of the spectrum, and in a group all by themselves, are the camp populations, who live lives with no security buffer such as grain stocks; savings, remittances or access to credit and with little resilience within the community to withstand adversity. These groups live in an environment with no social services, with high health risks caused by poor sanitation, contaminated water supply; with insecure incomes and with ever more uncertain futures.

### **Child Labor**

43. Official statistics from the census do not indicate that there is a large proportion of children in the labor force. However, these statistics appear to have entirely missed the children of the labor camps.

44. Children of tenants appear to constitute a very small percentage in the labor force engaged in agriculture, estimated to be less than 10 percent. The majority of these children between 6 and 16 years are indeed attending school. Their participation in farm related labor is generally after the school session, when they assist their parents in agriculture or domestic work.

45. However, among the migrant laborers, the involvement of children in labor is large, particularly girl child laborers. Less than 10 percent of these children are in school, thus the majority is engaged in agriculture with their parents. It was clear from observation that there were a large number of children working with their parents in agriculture involved in cotton picking, harvesting of groundnuts and vegetables. Girls usually accompany their mothers to the fields to assist them. Boys do field work as well as look after animals.

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<sup>90</sup> Sudan Government, Ministry of Manpower in collaboration with ILO, (1997), *Trends and Profiles of Poverty in Sudan, 1990-1997*, Khartoum; Abdel Nasir Moh. Zein Moh. Salih, (1999); *Poverty and Child Health: A Case Study of Wad Medani Town*; unpublished Ph.D Thesis, University of Khartoum, Khartoum; Fergany Nadir, (1997): "Map of Relative Poverty in the North, 1993", a paper presented to the National workshop on Poverty, UNDP and Ministry of Social Planning, Khartoum; UNDP, *Sudan Human Development Report, 1998* (draft)

## MAIN CONCLUSIONS OF ECONOMIC ANALYSIS

### Land Tenure Issues

- There is an urgent need to address land tenure issues. Land fragmentation is increasing at a rapid pace and reform of the rules pertaining to land transfer, sale and consolidation is of paramount importance.
- The increasing numbers of absentee landlords is also in need of being addressed. The land of the absentee landlords is reportedly farmed sub-optimally, as those who farm it may not have the same level of security or long term interest in land care.
- New arrangements must also be made with the original landowners, whose land was expropriated and who receive a laughable rent for the land they were obliged to make available to the Scheme.

### Box 2: Gender Aspect

A number of factors have contributed to the increased importance of women in the labor force:

- Education resulted in reluctance of sons of tenants to work in agriculture. Sons of tenants are attracted to white collar jobs; this has opened up opportunities for women tenants as well as women laborers and sharecroppers.
- The out-migration of men during seasons of low productivity and low prices resulted in low economic returns for tenants and high indebtedness. In such situations, men migrate in search for better employment in urban centers in the country or migrate to the Arab oil producing countries. Women fill the labor gap created by this movement.
- Poverty and bad economic conditions induced women to enter the labor market to contribute towards the maintenance of the families.

The participation of women as laborers has become very significant. The number of seasonal male migrants has declined, while that of females has increased. It is estimated that 80 percent of seasonal migrant laborers are women, and they are involved in cotton picking, although they are also engaged in the harvest of groundnuts and vegetables.

Women migrants practice sharecropping with tenants on a large scale in groundnuts and vegetable production. They also sub-let plots of land from tenants. It is reported that the tenants trust them more than they do the men.

Most of the women tenants work in their tenancies themselves, and sometimes they supervise and manage work in the tenancies, while relying on hired labor for agricultural operations. Women who do not work on their tenancies are either from wealthy families, are old or disabled. Women tenants have equal access to production inputs, e.g. irrigation water, seeds and chemicals.

Women generally have limited access to extension and training agricultural extension services due of socio-cultural reasons: the Gezira Board does not organize separate demonstration programs for women tenants, and the social traditions prevent women from attending male gatherings. Moreover, the high rate of illiteracy among women makes it difficult for the extension services to reach the women.

*Source: Ms. Iqbal Ahmed Hagar, Manager, Planning, Social and Economic Research, Gezira Board*

### **Credit**

Women generally have weak bargaining power. This is why few female tenants resort to the sheil system. A study by the Social Development Unit found that 48 percent of the female tenants rely on self-finance, i.e. their own funds (savings), to grow their crops, 14 percent borrow from individuals, 11 percent obtain loans from relatives without interest, and 11 percent rely on sheil borrowing.

#### **Marketing:**

Crops marketed directly by tenants included sorghum, groundnuts, and vegetables. Women generally delegate to men, mainly relatives or middlemen, to market their crops. A very small minority of the women sell their own crops. However, there appears to be some variation in the type of crops sold through these channels. 76 percent of the women sold their sorghum through their relatives and 16 percent through middlemen at the farm gate, 8 percent marketed it by themselves. However, with regards to groundnuts, 55 percent sold to the middlemen at the farm, 36 percent sold through their male relatives and only 9 percent marketed it by themselves.

#### **Women's in Decision making**

Gezira tenants participate in decision making and management of the Scheme through their representatives from the grass root level to the Board. The Village productive Council is the lowest level of representation. The Farmers Union, which was formed in 1953, played an important role in decision making in the scheme. Women were and are not represented in these organizations, although they are considered members of these bodies and have the right to vote. Illiteracy and the social traditions prevent women from exercising this right. Their feeling of subordination and the attitudes of men towards women contribute to the exclusion of women.

#### **Women organizations**

Gezira women have organized themselves into a number of associations and cooperative societies as part of their support mechanisms and survival strategies. The most important and popular women association is the Rotating Credit Association (the sandug), which is a monthly collection of contributions by members in a village. The monthly collection is given to a different member of the group each month. It helps the women to save and spend their own money in the manner they want.

### **Gender Issues**

- Women tenants are a growing phenomenon in the Gezira. The Scheme needs to develop outreach and extension, which is delivered so that women tenants can have access to these services. Female extension officers need to be recruited and extension packages need to be tailored to illiterate women tenants.

### **Desire for Changes in Cropping Patterns**

- The Gezira Board has been slow to examine the possibility of fundamental changes in cropping pattern, which is the expressed desire by many of the farmers. It is reported that disillusioned tenants lost interest in the Scheme due to high cost of farm operations and the low financial returns on wheat and cotton; as a result productivity has declined. There is a clear distinction in farmers' mind between "the tenants' crops" (legumes, vegetables, sorghum and groundnuts) which are money makers, and the "the government crops" (cotton and wheat), which are generally money losers. The tenants are dependent on income from other sources to compensate for their low income from cotton and wheat.

### **Credit Issues**

- Facilities for small-scale credit need to be developed to avoid the high interest payments required through the sheil system. Credit facilities need to be developed so that sharecroppers and women farmers, who increasingly make up a sizable proportion of the farming communities, can have access to cheaper forms of credit. Some farmers suggested the need for a “tenants credit and reserve fund” under the Gezira Board.

### **Asset Ownership and Diversification**

- Farmers and laborers who have cattle, sheep and goats are generally fairing better, as they have an alternative income source as well as nutritional supplements from dairy production. Further encouragement of cattle and other livestock would greatly enhance the creation of poverty and adversity buffers in the communities.
- Other forms of diversification of income generation could also be encouraged to improve resilience to adversity.
- Alternative employment opportunities are limited in the Scheme and in the surrounding areas. Poor migrant laborers are limited in their ability to seek alternative employment opportunities outside the Scheme due to poor transport facilities and low incomes.

### **Water Pricing and Management**

- Among the farmers there is not a full appreciation of what a fair water price might be, however, there is a view that the present system of fixed water charges is not working and is in need of reform. There is a clear need to align the price charged for the water with the number of waterings and the reliability of the delivery of the water.
- Sharecroppers and others who are farming under the many private arrangements, need to have a say and involvement in the water management and water payments, so as to increase the efficiency of production at the farm level. At present the Sudan Gezira Board deals only with tenants on water and service questions and as a result the concerns of sharecroppers are not taken into account. This introduces inefficiencies in the system.

### **Labor Union Organization**

- The Farmers’ Union derives its strength from the tenants’ desire to protect and further their own interest vis-à-vis the other parties. In the past, the Union achieved successes in the form of an increasing diversion of cotton proceeds either directly in the form of increased share or in terms of social development resources.
- By contrast the wage laborers employed by the tenants have never been organized and their wages and conditions of service have been determined entirely by a free market on the one hand and by restrictions placed on their camp conditions by the Scheme, on the other.

### **Future prospects**

46. From an socio-economic viewpoint, the management of the Gezira is at a clear crossroad:
47. Continuation of the status quo will lead to increase of tenancy abandonment, to greater numbers of absentee farmers, land fragmentation and the associated loss of productivity. The

perseverance of the policy originating in the 1920s of denying rights and services to the migrant labor population will inevitably provide a fertile growing ground for increased poverty and disease as well as lay the potential for future social unrest.

48. If major reforms are introduced pertaining to land ownership as well as to water policy and management, including reforms to the rights of the migrant labor group engaged in most of the actual farming activities, it would appear that productivity of the Gezira Scheme could improve dramatically. An improved performance of the Scheme will also mean an improved tax base for the State of Gezira and thus improved social services.

49. The Scheme continues to be the lifeline for the majority of Sudanese people in the State of Gezira and beyond. Improved performance of the Scheme will not only increase income of tenants and laborers but will have positive ramifications way beyond the Scheme and its farmers, agricultural laborers and other workers who indirectly benefit from it.

## **ATTACHMENT 1 - GROUP MEMBERS – SOCIAL DEVELOPMENT**

- Ms. Iqbal Ahmed Hagar, Manager, Planning, Social and Economic Research, Gezira Board
- Mr. Ibrahim al Feki Mohamed Babiker, Head of Trade Union, Financial Secretary
- Sheikh Omar Beshir Sallam, Member, Executive Council of Farmers Union
- Mr. Mohamed Abdel Rahim Said , Manager, Training Unit, Gezira Board
- Ms. Bakheita Baballah, Manager, Archive Dept., Gezira board
- Mr. Mokhtar Ahmed Mokhtar, Ministry of Agriculture, Khartoum
- Dr. Paul Wani Gore, University of Khartoum
- Ms. Inger Andersen, World Bank

## ATTACHMENT 2 – SOURCES OF DATA

1. The main sources of data for this report are the reports from the Gezira Board (in particular those from the Socio-Economic Development Research Unit), official census results, in particular the 1993 census, research reports (published and unpublished). Additional data was collected from group and individual interviews with farmers and laborers during the one-week Mission visit to the Scheme in Gezira.
2. The basic information on the social and demographic profile of Gezira include:
  1. The total population in the State and age-sex structure,
  2. The ethnic origin of the population,
  3. Size of households,
  4. Educational background of the population, access to drinking water, household sources of energy and sanitation facilities; health services and health issues (e.g. impact on malaria and Bilharzia)
3. Interviews and group discussions with farmers and laborers supplemented some of the above information together with observations during the field. The main issues discussed with farmers and laborers covered the following:
  - (a) Relationship between various ethnic and social groups; tenant/laborer relationship
  - (b) Hired labor – family labor issues
  - (c) Poverty issues; employment and food security
  - (d) Sources of household income and productivity issues.
  - (e) Ownership of animals, household and farm assets
  - (f) Availability and access to credit, formal/informal credit system and household level indebtedness.
  - (g) Availability of social services, and financing of social services and decline in social services
  - (h) Matters on education, health and social services
  - (i) Sharecropping systems and other land management arrangements,
  - (j) Farmers' opinion on decision making processes and water management
  - (k) Land tenure arrangements
  - (l) Views of the migrant laborers on decision making processes and role in water management.
4. A total of five tenant villages were visited in the main Gezira Scheme during the Mission, and discussions were held with group of tenants during these visits. The average number of tenants in each group was 10. In addition to the tenant villages, six labor camps were visited. One of the camps was established following the 1984/85 drought in Western Sudan. Discussions were held with group of laborers and the average number of laborers in each discussion group was 8. Women laborers were not available for interviews, in spite of attempts by the female member from the Gezira Board who was with the Mission during the visits.

**ATTACHMENT 3 ESTIMATED EXPENDITURES ON EDUCATION, HEALTH SERVICES AND  
OTHER SOCIAL SERVICES (WATER AND ELECTRICITY).**

**Education**

1. The average monthly salary of a basic schoolteacher is about SD 7,500 (or \$ 29.1 at the current rate of exchange 1\$ = SD 257.5). The total number of teachers in the state is about 16,290. The total monthly salaries, for which the Local Authorities (mahaliat) are responsible, amount to \$ 474,039. The cost of textbooks, maintenance of building/water and electricity, and stationary are generally met by the parents of the pupils, through a monthly contribution which varies between SD 100 to 500, in addition to the a yearly fee of about SD 1,500. The mahaliat are also responsible for paying the salaries of other non-teaching staff, like watchmen.

**Health**

2. The average salaries of health workers are shown below:

- Medical Assistant: SD 12,500 per month (\$48.5);
- Mid-wife: SD 12,500 per month (\$48.5)
- Nurse: SD 8,000 per month (\$31.1);

The total monthly salaries for 1005 medical assistants, 4,173 nurses, 2,300 midwives are estimated to be equivalent to \$289,612.8 at current rate of exchange. These salaries are also paid by the mahaliat. Additional salaries are paid to watchmen, and the mahaliat are also responsible for paying water and electricity charges. Drugs and other medical supplies are provided on a cost-recovery basis under the current health policy.

**Water and Electricity**

3. Water and electricity are provided and maintained by the communities through their monthly contributions to the village "Salvation Committees". This contribution varies between SD 500 and 700 per month. Villages currently without electricity usually make collections after the estimated cost of bringing electricity to the village and for connection on the main streets.

In order to keep the teachers and health personnel working in the villages, communities usually make additional contributions to pay for incentives of these personnel. Thus, the burden on the communities have increased.

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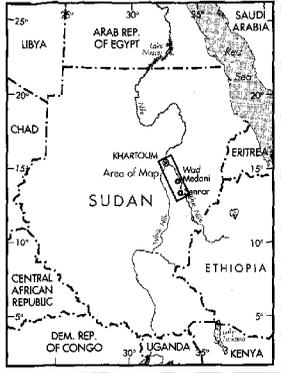
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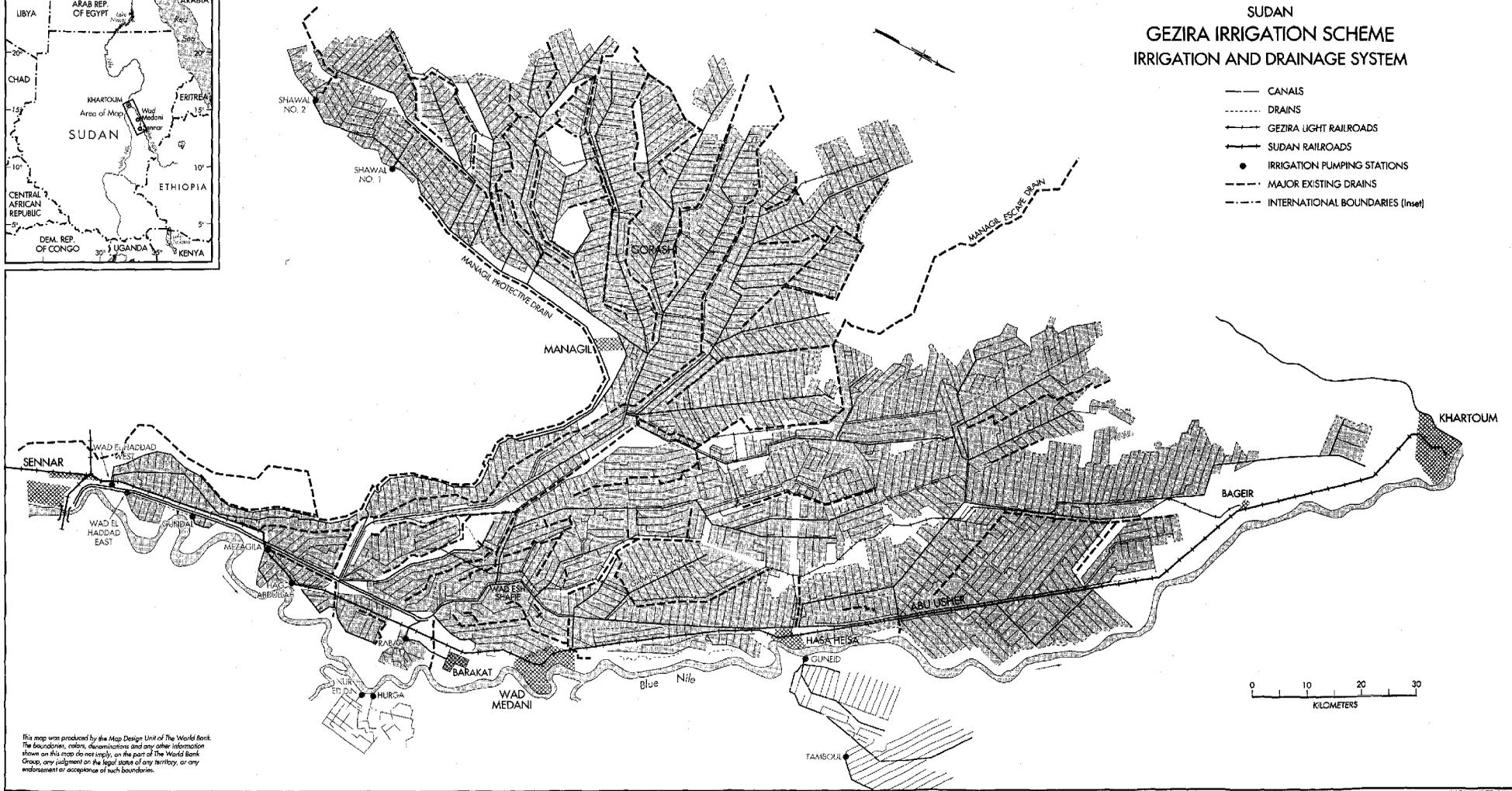
**MAP SECTION**





### SUDAN GEZIRA IRRIGATION SCHEME IRRIGATION AND DRAINAGE SYSTEM

- CANALS
- - - DRAINS
- GEZIRA LIGHT RAILROADS
- SUDAN RAILROADS
- IRRIGATION PUMPING STATIONS
- - - MAJOR EXISTING DRAINS
- - - INTERNATIONAL BOUNDARIES (Inset)



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