INTERNATIONAL BANK
FOR RECONSTRUCTION AND DEVELOPMENT

GEZIRA STUDY MISSION

MAIN REPORT

October 1966
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At the beginning of 1964 the Sudan Minister of Finance asked the
the World Bank whether it would be willing to make a study of the
intensification of the cropping pattern of the Gezira Scheme and, more
generally, to look into the functions, responsibilities, organization
and structure of the Sudan Gezira Board and to make recommendations
thereon. In the immediately preceding years the World Bank had made
two operations in the area; it had granted a loan for the development
of part of the Managil project in June 1960, and in June 1961 its
affiliate, the International Development Association (IDA) had granted
a credit to assist in the construction of the Roseires Dam. It was
natural, under those circumstances, that the World Bank should express
interest in the request from the Minister of Finance, and in May 1964
a three-man preliminary mission, under the direction of Mr. S.B. McMeekan,
went to Khartoum to reach an understanding on suitable terms of reference
and on arrangements for the study. The terms of reference agreed on
with the Sudan government were defined as follows:

1. Evaluate the technical and economic feasibility of proposed
changes in production patterns, including the development of
animal production.

2. Determine the functions, including the provision of credit,
which must be performed for the expected increased production
and consider how and by whom they may best be carried out.

3. Determine the factors at present conducive or inimical to
sustained economic and social development with special
reference to the motivation of tenants and others.

4. Review the operations and administrative arrangements of the
Gezira Scheme with a view to reducing costs in both present
and future activities.

On August 25, 1964 the Executive Directors of the Bank approved
the sending of a study mission and the above terms of reference. After
the change of government which took place in October of the same year, the new Minister of Finance confirmed his agreement on the Mission. In February 1965, Mr. Leonard Rist, Chief of mission, paid a preliminary visit to Khartoum and to Barakat, headquarters of the Gezira Scheme. On this occasion it became clear that the study should be carried out over the whole cotton crop year, from sowing to ginning seasons, and that work should best be concentrated at Barakat.

The first members of the mission arrived in the Sudan on August 16, 1965 and the last group ended its field work on April 26, 1966.

The task of the mission was greatly facilitated by the assistance extended to it by all concerned. The members of the Cabinet, civil servants at all levels — including the Commissioner of the Blue Nile Province and his assistants — the management and staff of the Gezira Board and of the various Research stations, the University, whose Vice Chancellor was "permanent adviser" to the mission, all contributed help and advice which proved invaluable. In addition, several personalities, eminent in the political, business and banking worlds, kindly answered innumerable questions and offered suggestions. Special mention should be made of the leaders of the Tenants Union, the present ones and their predecessors and of members of the Village Councils and individual farmers. Without their friendly understanding of the concern of the mission and their willingness to discuss frankly individual as well as broad policy problems, the mission would not have been able to grasp to what extent the problems of the Gezira are at the same time the problems of its farmers. The mission extends its sincere thanks to all those who have so generously lent their assistance.

The mission was fortunate not only in being able to receive suggestions and openly discuss the main issues with the Sudanese personalities most conversant with them, but also in being able to draw on the numerous studies which during recent years have investigated the subjects of its inquiry. The bibliography is considerable and a summary of it is given as an appendix. Two studies deserve a special mention. The first is the well-known book of Mr. Arthur Gaitskell on the Gezira, dated 1959, which is indispensable to the historian, the economist, the sociologist and the agronomist. More recently, in December 1963, a "Working Party" was organized under the sponsorship of the Gezira Research Station to appraise the future development of the Gezira Scheme. Its Interim Report became available in April 1965 and the final report is expected before the end of 1966. In addition to published material, the mission was allowed access to a number of recent unpublished or classified documents and research studies relating to the same subjects which were made available by the Gezira Research Station, the Ministry of Agriculture, the Gezira Board and others. Not only did these studies contribute most helpful knowledge and thinking to the mission but the very fact that such inquiries were going on precisely at that time served to emphasize how urgent and lively these problems are in the Sudan.
INTRODUCTION

THE MAIN PROBLEMS

The importance of the Gezira Scheme in the Sudanese economy is well-known. The size of its contribution to national income, public finance and the balance of payments is described in some detail in Chapter I. It is impressive. For this reason, possible technical or other reforms in the Scheme cannot be considered of limited local concern. They affect the national interest. This fundamental point must always be borne in mind in the following discussion.

This report deals not only with specific technical matters such as water, soil, cropping patterns, cultivation, research, organization and finance but in addition it discusses at some length the economic and psychological position of the farmer 1/. It may be useful to point out why all these problems, which are not necessarily interdependent, should come to light at about the same time. They have their source in a few basic facts which are not susceptible to change. Climate and water are obvious ones. Still another is the predominance of cotton in the whole system. Almost immediately after the control of the Gezira Scheme was acquired by the government in 1950, the price of cotton, largely as a result of the Korean war, had reached a very high level. The incomes of government and farmers were correspondingly increased but when the decline in world cotton prices took place, incomes declined also. Partly in view of the restraints imposed on irrigation water, other crops were difficult to develop and the Scheme Management could give only limited help in this regard, and even today, the income to be derived from them cannot be compared with income from cotton.

If cotton yields had revealed an upward trend, the discouraging effect of price stagnation might have been allayed but, although year to year variation continued, average yields remained in the general area of 3.70 k.p.f. It was not enough to improve the share of the farmer in the cotton proceeds, as was done in 1964, when it was raised from 44 to 46 per

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1/ An effort was made to condense in the body of the report the essential factors and the basic reasoning behind the recommendations. More detailed descriptive material, and also some documentation which, although relevant, did not seem to be always readily available to all concerned in the Sudan, will be found in the Annexes and Appendices.
cent, or in 1966, when it was further increased to 50 per cent. The total proceeds to be divided remain the main issue. In other words, yield increases are necessary, all the more as world cotton prices threaten to decline further.

In addition to climatic conditions, basic cultivation problems and the inroads of pests and diseases being invoked as causes of yield stagnation, it was natural that insufficient care given to the fields should be invoked also. The farmers, of course, were reluctant to accept the implication that their work should be subject to criticism. Meanwhile, the Management of the Scheme, not content with dealing with technical problems, was looking for "incentives" which would encourage the farmers to do themselves more of the work usually entrusted to hired labor and also to take more meticulous care of their fields. Managil Extension was divided in smaller rotation units than the Gezira Main precisely in the hope that more farmers would do more fieldwork themselves. Although this objective is said to have been partly achieved, yields do not seem to have been very much different from one section of the Scheme to another.

At the very time when yields stagnated and prices threatened to decline further, most costs, whether incurred by the Management of the Scheme or the farmers, showed a slow upward trend. Even with improved profit-sharing arrangements, the farmers did not fare much better since their income had little chance of improvement. Discontent was rampant and various suggestions were voiced tending at a reform of the organization of the Scheme. They will be mentioned later in Chapter 5. The problems of obtaining higher yields and of providing incentives, however, remain unsolved and require action.

Today more water is becoming available, thanks to the 1959 Nile Waters Agreement with the United Arab Republic and to the building of the Roseires Dam. Intensification, thus, becomes possible. At what pace should it be pushed forward? This issue is still being debated. Diversification also is becoming easier and the search for "other crops" than cotton - an old subject of controversy in the Gezira - is now being revived.

Intensification and diversification, like the potential improvements in yields, can only be carried out with the wholehearted cooperation of the farmer. On the one hand, the findings of the technicians must be conveyed to the farming population by advice and extension work - again not a new problem, but one which requires more persistent action. On the other hand, since the farmer's sense of responsibility is directly involved, financial arrangements must be revised so as to make clear to him that tangible benefits accrue to him when his production improves.

The situation in the Gezira Scheme thus raises serious agronomic, institutional, financial and psychological problems. Their urgency was underlined not only by the unfortunate stagnation of the recent years
in the Gezira itself, but also by the considerable increase in irrigated areas which the Sudan is now preparing for. The Khashm el Girba project, on the Atbara River, is now being developed, plans for irrigation of the right bank of the Blue Nile are being pushed and serious organisation problems have recently arisen in the private estates along the Blue Nile and the White Nile. It is no more possible to discuss the Gezira in isolation. Its problems are those of the Sudan both because of its considerable importance in the economy today and because so many other projects will somehow or other be affected by the solutions adopted for the Gezira.
THE IMPORTANCE OF THE GEZIRA TO THE ECONOMY

The Gezira Scheme with almost two million acres commanded by irrigation is more than the biggest single enterprise in the Sudan: it is a central factor in the economy. Sizeable portions of the nation's resources -- water, land and labor -- are committed. Harnessed by huge capital works which have taken a large fraction of public savings over many years past, these resources produce substantial parts of the country's main crops, notably cotton and generate major portions of the Sudan's national income, public revenues and foreign exchange earnings in the process. Moreover, being the first and most important of its kind, the Gezira Scheme has set the pattern for numerous other irrigation schemes in the country. Changes in its performance and set-up are bound to have wide repercussions throughout the economy.

1. Resources used

Of what is perhaps the Sudan's most precious resource -- water from the Nile -- the Gezira Scheme presently takes up about 80 percent of the approximately 8.5 milliard m$^3$ of water actually extracted. As and when the remaining 10 milliard m$^3$ of the 18.5 milliard m$^3$ allotted to the Sudan under the Nile Waters Agreement of 1959 is utilized, the Gezira's share, including present plans of intensification and extension of the Scheme, will still be of the order of 30 percent.

Land under cultivation in the Sudan is estimated at 17.5 million feddans. Of this total the gross area of the Gezira Scheme of nearly two million feddans represents some eleven percent. About the same proportion holds for the Scheme's share of the area under main crops: of a total of some 8 million feddans of cropped area estimated in 1964/65, about one million feddans is in the Gezira Scheme each year.

The Scheme provides direct employment to over 77,000 tenant-farmers and an estimated 200,000 members of their families of working age. To these should be added an average of 300,000 seasonal laborers. Also directly involved are more than 10,000 employees of the Sudan Gezira Board and an estimated 5,000 employees (including casual labor) of the Ministry of Irrigation concerned with the operation and maintenance of the irrigation works. The total number of people directly employed by, or for, the Scheme thus is of the order of 600,000 or to ten percent of the Sudan's
labor force estimated at about six million.

2. Shares in the Country's Main Crops

The main crops grown in the Gezira Scheme -- cotton, dura, groundnuts and wheat -- constitute major proportions of their corresponding national output. In 1964/65, an average year in terms of crop yields, Gezira cotton accounted for 66 percent of the country's total production of long staple cotton; the share of wheat was 47 percent, groundnuts 14 percent and dura 12 percent. The importance of these crops to the economy is all the greater as all of the Gezira's cotton and most of its groundnut production are exported while its wheat crop substitutes for corresponding imports. The remaining crops grown in the Scheme, fodder crops, vegetables, fruits as well as livestock, contribute little to national output but are of considerable local importance.

3. Contribution to National Income

The contribution of the Gezira Scheme to the national income is not limited to the income generated through production performed within the Scheme itself. In addition, production within the Scheme gives rise to income generation outside the Scheme through manufacturing, transport and trade involving both supplies to and produce of the Scheme. Last but not least, the income thus generated is expended for consumption and investment, thus creating further income to those supplying the goods and services demanded, income which then again is expended, and so on (multiplier effect). While only the Scheme's direct contribution to national income, i.e., income generated within the Scheme itself, can be estimated in quantitative terms, its indirect contribution is substantial and, if anything, bigger than the direct one.

Income generated within the Scheme in 1964/65, a representative year, has been estimated at the order of £3.33 million, the great bulk of it deriving from cotton. This represented some seven percent of gross domestic income, and more significantly, accounted for about 15 percent of value added by the "modern sector" of the economy, of which the Gezira forms an integral part. With an estimated 800,000 people resident in and directly dependent on the Scheme, income generated per head was of the order of £5.41. This is about 25 percent more than income per head for the Sudan as a whole, estimated at £3.33, although less than the average income per head for the "modern sector" as a whole, estimated at £3.55.

1/ Assuming income indirectly generated by the Scheme to have been of similar magnitude the Scheme's total (direct and indirect) contribution to modern sector was of the order of 30 percent.
Of course, a major proportion of the Scheme's income accrues to recipients other than its residents, notably Central Government and migrant labor. Thus income received per head in the Gezira was rather less than the £S.41 generated and may be estimated around £S.25, including the special income deriving from the freezing of tenants' debts in 1964/65 1/

The Scheme's income in recent years has fluctuated widely as may be illustrated by the sequence of income figures for the years 1960/61 to 1964/65: £S.21 million, £S.44 million, £S.27 million, £S.21 million, £S.33 million. These fluctuations were due mainly to similarly wide variations in cotton yield. Year to year changes in cotton prices during that period were comparatively small and in general tended to offset the effect of yield variation to some extent. The relative importance of the Scheme's income, expressed as a proportion of total modern sector income, likewise varied over a wide range, from 21 percent in 1961/62 to only 10 percent in 1963/64. The effects of these fluctuations in the Scheme's income on public finance and the balance of payments were even more marked, as discussed in the following paragraphs.

I. Contribution to Public Finance

The Scheme's contribution to Local Government (in fact Local Councils) in the area -- averaging about £S.300,000 over the past five years -- is of considerable local importance but this amount is so small in comparison to the contribution to Central Government finance that the discussion here will be limited to the latter.

The contribution to Central Government consists of two parts: one is based on Government's partnership in the Scheme and represents remuneration for services rendered, including return to capital; the other and more important one is strictly fiscal in nature. For convenience, we shall refer to these two components as the Scheme's "direct" and "indirect" contribution, respectively.

The direct contribution includes payments of the profit share, interest, dividend and contribution to agricultural research. From this total has to be subtracted the expenditure incurred by Government in operating and maintaining the Gezira irrigation works and providing other services to the Scheme. The balance represents the Scheme's net direct contribution, i.e. the return to capital.

The indirect contribution derives from the various levies on the

1/ A special Government measure in July 1965 "froze" all tenants' debts against the 1964/65 crop. The total involved is £S.5.2 million.
country's exports and imports, and comprises specifically the parts of their proceeds which can be attributed to the Gezira Scheme. The major levies involved are: export taxes and royalties on cotton lint, cotton seed and products, and groundnuts originating from the Gezira. As regards import duties, several definitions of relevant imports are conceivable: (i) imports of goods and services required for the operation of the Scheme, (ii) imports into the Gezira area generally, including consumer goods, and (iii) such proportion of the country's total import bill corresponding to the Gezira's proportionate share of total export earnings since these export earnings made the imports possible. This last definition is the most meaningful from the viewpoint of the economy.

The Scheme's direct contribution during 1962/63 to 1964/65, in terms of actual cash payments on the Government's share averaged almost £S 9 million annually, of which £S 8 million were payments of profit shares. The average conceals wide annual fluctuations from £S.4 million (1963/64) to £S.14 million (1964/65). Current expenditure by Government toward the operation and maintenance of the Gezira irrigation works and other services rendered to the Scheme averaged nearly £S.2 million annually. The Scheme's net direct contribution, or return to capital, thus came to about £S.7 million a year. This net amount if viewed as it should as a source of development finance rather than current expenditure, was equivalent to about 46 percent of Central Government's savings (surplus on current account) and about 22 percent of its development expenditure.

The Scheme's indirect contribution over the same period averaged £S 2.2 million from export taxes plus £S.12 million from import (and consumption) duties, or together £S.14 million per annum. The contribution through export taxes derived almost entirely from the export duty on lint (£S 1.9 million), the balance being accounted for by export taxes on cotton seed and products, and groundnuts. The £S 12 million from import (and consumption) duties is estimated on the basis of "imports afforded by Gezira exports", as discussed above.

Taken together, the Scheme's direct and indirect contribution in 1962/63 to 1964/65 made up nearly a third (31 percent) of Central Government's total current revenue during that period. Thus the Gezira's contributions to Government finance was of impressive proportions in the early 1960's.

1/ Import (and consumption) duties paid on the imports directly required for the operation of the Scheme in 1964/65 can be estimated at about £S 300,000. It should be noted that in computing the duties corresponding to the imports "afforded by Gezira exports", the profits from the sugar monopoly have been included as if they were import duties as during the period considered practically all the sugar consumed in the Sudan was imported.
Recent events indicate, however, that such large contributions may not easily be repeated. Because of the exceptional "freezing" of the tenants' debts against the 1964/65 crop, the Gezira Scheme was not able to make any direct payments to Central Government in 1965/66. Thus Government's current expenses of some £2 million in behalf of the Scheme (mainly irrigation) were not recovered, and the (cash) return to capital was negative in effect. Since then, beginning with the 1965/66 crop, the tenants' share of gross profit from cotton has been raised from 46 percent to 50 percent (both figures including tenants' reserve fund) while Central Government's share has fallen from 40 percent to 36 percent and picking advances have been included in Joint Account. The Scheme's direct contribution in the future will therefore tend to be rather less than what it used to be in the past. On the other hand, the considerable indirect contribution made by the Scheme through import and export duties may well be expected to rise as and when production and exports of the Scheme increase.

5. Contribution to Balance of Payments

The Gezira Scheme affects the Sudan's balance of payments to a major extent through exports of its produce; to a minor extent, through imports of goods and services required for the operation of the Scheme; and marginally, through substituting local production for wheat imports. Exports of Gezira produce involve all of the Scheme's output of cotton lint, most of the corresponding cotton seed, either as such or as oil, cake and meal, and about 60 percent of the Scheme's groundnut production. Imports by the Scheme comprise a great variety of goods and services, notably fertilizers, packing materials, spraying materials and services, spare parts, and machinery and equipment.

Estimated export earnings from Gezira produce, nearly 90 percent of which are provided by cotton lint, ranged from £3 17 million in 1961 to £3 34 million in 1963, the annual variations being closely related to the size and quality of the cotton crops of the same or previous years. The average for 1963-65 amounted to £3 26 million, representing 36 percent of the Sudan's total export earnings. The foreign exchange cost of Gezira inputs during 1963-65 averaged about £3 3 million annually, or about 4 percent of the country's import bill. Thus net foreign exchange earnings of the Scheme over the same three years came to an annual average of about £3 22 million, or 27 percent of total non-Gezira imports.

Foreign exchange savings from the import substitution effect of Gezira wheat have so far been small - less than £3 1 million in 1965 and virtually negligible in previous years - but are sure to increase as the area under wheat is expanded.

6. Concluding Remarks

The Gezira Scheme thus is a central pillar of the Sudan's economy. Contributions broadly of the order of 30 percent to national income (modern
sector), public finance and foreign exchange earnings provide supports to the economy no other economic entity in the Sudan can even remotely compare with. Efforts to bolster the Gezira would be called for under any circumstances, but even more strenuous efforts must be made to increase its production and exports to compensate for present and likely future declines in the prices for its products. Increased exports are also essential to facilitate the purchase of more imports so urgently required for the country's economic development, and indirectly, to increase public revenues, thus making up for a likely decline in the Scheme's direct contribution to public finance.
CHAPTER 2

AGRICULTURAL PRODUCTION

The Gezira Scheme is unique in Africa and is one of the largest gravity irrigation areas in the world. Its great size poses special problems, especially in irrigation control, but offers great scope for economies of scale in farm operations. At the same time, its importance in the national economy (Chapter 1) and its daily impact upon the lives of over 77,000 farmers, their families and helpers (Chapter 5), dictate that changes in agricultural policies and practices should only be made after the most careful consideration.

The progress of agriculture in the Gezira Scheme has been due to the patience, competence and energy of its management and its staff, and of the other bodies connected with it (ministries, agricultural research, University, International Advisory Committee, Working Party, etc.). The amount of knowledge and experience accumulated is considerable. The growing interest in potential new crops, and, generally speaking, the determined policy towards intensification and diversification is testimony to the forward looking attitude of the Scheme. It is not surprising, therefore, that most of the recommendations of the mission essentially aim at improving rather than at changing the agricultural policies of the Scheme.

The Gezira has been fortunate in the high standards of reseach by the Ministry of Agriculture's specialists and their associates at the Gezira Agricultural Research Station and elsewhere: many innovations have originated from the Syndicate's and, later, the Scheme's own staff. Nevertheless, many of the changes in agricultural methods considered by the mission are only made possible by the rapid march of events and advance in technology (some indeed, are not possible at the time of writing) and in some instances the absence of long-term data has forced the mission to recommend further research and experimentation, or the application of new methods on limited areas only.

1. Agricultural Development of the Gezira (Historical Review)

A brief survey of the agricultural development of the Scheme shows why changes have been possible in recent years or are now possible.
The first trials of irrigated cotton, on pump schemes, included studies of hundreds of different rotations and crops. The one selected for the expansion of gravity irrigation from Sennar Dam in 1925 was strikingly similar to that now proposed by the mission as the next step forward: however, the agriculturalist of these days lacked the disease resistant varieties, the pesticides and aircraft to apply them and the benefits of modern machinery which underlie the mission's proposals.

By 1932, with the Scheme ravaged by pests and diseases and severely threatened by perennial weeds, drastic changes in agricultural methods were necessary. The 1929 Nile Waters Agreement restricted the season during which water could be taken from the flow of the Blue Nile. Land, however, was available in plenty. The solution devised, which continued for 40 years, made good use of the available water but did not use the land very intensively: at any one time, more than half the land was lying fallow. The long fallows helped in breaking down the carry-over of pests and diseases (a process soon helped by the introduction of resistant varieties), encouraged build-up of natural nitrates in the soil, and allowed some measures to be taken against weeds. Further plant hygiene measures, including the complete destruction of the cotton residues by pulling up stalks and sweeping up loose debris for burning, were enforced by law. Alternative crops which harbored pests, or were hosts for diseases, were banned or very strictly controlled. These measures were effective but they necessitated an unusual type of holding, in which each man changed his plots in succeeding years. The need for strict enforcement of plant hygiene methods, the organization needed to control the allocation of plots, the fact that few, if any, of the cultivators had any experience of irrigated agriculture, and the fundamental concept of partnership led almost inevitably to the situation in which the cultivators became "tenants" rather than "farmers" and indeed, in some respects, were akin to employees of the Syndicate.

Since these various measures taken in the 1930's achieved the desired objectives, no major agricultural changes were made throughout the 1940's. The next stage was provided by technological developments. The potential of newly developed insecticides, and of new types of aircraft suitable for agricultural spraying from primitive air strips, was recognized at an early stage and the widespread adoption of cotton field spraying in the early 1950's fundamentally changed the pest/disease/crop

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1/ The agricultural practices and research for this period are extremely well documented. Standard texts are "Agriculture in the Sudan" (ed. J.D. Tothill) and "Agricultural Science in the Sudan", Knight and Boyns.
relationship. At the same time the high price of cotton and a lowering of fertilizer costs made economic the general use of nitrogenous fertilizers and the Scheme management developed a technique of using powerful modern tractors to control perennial weeds. The seasonal restrictions on irrigation still remained, but by changing the levels behind the Jebel Aulia Dam (completed in 1937 to control water for Egypt's benefit), enough water was released for Sudan's use to provide for the needs of Managil Extension during the traditional irrigation season.

As a result of these changed circumstances, and for labor considerations, the agricultural pattern adopted for Managil was markedly different from that established in the Gezira Main in two important respects: only one-third of the land was fallow at any time and tenancies (15 feddans) were smaller even than a half Gezira tenancy (20 feddans). The irrigation layout was modified to suit the new pattern, the module being six 90-feddan "numbers" instead of eight.

Advances in technology had not, however, made possible any change in the cropping pattern. Cotton still retained its dominating position and, in theory at least, everything was subordinate to the interest of the cotton crop. The only other crops grown were dura, the tenants staple diet, and lubia, grown mainly as livestock fodder. The dura and lubia were the tenants' own property and responsibility: in theory, the Board's staff took no interest in them and, although few in fact could ignore their importance in the agricultural system, little was done either by direction or supervision to raise yields.

The Gezira Scheme therefore entered the 1960's with two almost independent irrigation systems, each potentially one million feddans, of different design: on the Gezira Main about 43 percent of the original 40-feddan tenancies had been (or were about to be) split into 20-feddan half-tenancies and the latter unit is standard on land now being developed:

1/ Between 1950 and 1960, between 73 and 95 percent of the cropped area was sprayed. Since 1960, most of the cropped area is sprayed and part at least has received between 2 and 4 sprayings.

2/ Definitions of specialized agricultural terms, Sudanese names for crops, local measures, etc. will be found in the Glossary. For those not familiar with the system a brief description of the irrigation network, watering practices and the agricultural application of the tenancy system will be found in Appendix 2 to Annex II, Agriculture in the Gezira.
on Managil, all tenancies were 15 feddans. In Gezira Main a little more than half, and in Managil about one-third, of the land was fallow at any time. There was a "dead season" of three months when the gravity scheme was closed, with supplies of water for domestic use, livestock and gardens being pumped into the canals. A new factor was the fall in world prices for cotton and wide fluctuations in yields; both affecting incomes, the yield variations were considerable: the 1957/8 crop (1.505 k.p.f.) had been hardly better than the catastrophic one of 1930/1 (1.359 k.p.f.); the 1960/1 yield was a disappointment (2.733 k.p.f.) although a near record crop was to follow in 1961/2 (6.024 k.p.f.).

A further factor contributing to the present situation and to be considered in future changes emerged during the 1950's. Hitherto, the basic cultivations had been carried out by the S.G.B. Ploughs Section, using cumbersome cable-drawn implements. The final preparation of the planting ridges and some weeding were done by bull-drawn "ploughs". In the early 1950's, however, the Board adopted wheeled farm tractors for basic cultivations, and by 1956 it had been shown that wheeled tractors could do the work carried out by the bulls. Because of the short working season, however, about 600 tractors would be needed to replace the working bulls entirely. Daunted by the investment involved, the Board agreed to participation of private contractors but, to protect their existing fleet which was the property of the Scheme, they reserved for the latter a monopoly of the long season basic cultivations. The contractors, who now own over 600 tractors, have therefore developed highly seasonal enterprises, with temporary, mostly untrained operators. In 1962, the need for very expensive combine harvesters for the wheat crop was met in part by private contractors but the Board actively encouraged the formation of machinery cooperatives, who now own 36 out of about 60 combines in the area.

2. Irrigation System and Potential

Meanwhile, plans for more efficient use of the flow of the Nile by Egypt and the Sudan had culminated in the signing of the 1959 Nile Waters Agreement. Account was taken of the proposals for new dams at Khashm el Girba (which was brought into operation in 1964), Roseires (due to come into operation after the 1966 rains) and the Aswan High Dam in Egypt, but temporary provisions allowed some anticipation of the increased potential of the rivers. Up to 1977, the Sudan will be allowed to withdraw 17.0 milliard m$^3$ per annum from the Niles, but thereafter her share will increase to 18.5 milliard m$^3$. 1/ This allocation allows for a great expansion of irrigated land in the Sudan, including if desired, of the area supplied from Sennar Dam. Of greater agricultural interest, however,

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1/ The amount is measured at Aswan. Taking into account evaporation and other natural transmission losses, 18.5 milliard m$^3$ at Aswan is equivalent to 20.55 milliard m$^3$ at Sennar. 17.0 milliard m$^3$ at Aswan is 18.9 milliard m$^3$ at Sennar.
was the removal of the seasonal restriction on withdrawals. Subject to operational limitations, the water can now be drawn when required provided that the annual limit is not exceeded.

In principle, this means that the dead season in Gezira could be abolished, that perennial crops could be grown, that the cropping season could be changed and the area of the Scheme increased. In practice, the seasonal flow of the river and the storage capacity of the Roseires and Sennar Dams must be taken into consideration. 1/

Some of these items will be discussed in more detail: in outline, the mission's conclusions and recommendations are:

a. The limits of expansion are being approached. The mission envisages that the final area of the Scheme will be around 1,970,000 'eddans of irrigated land. This is a little more than foreseen by the consultants. 2/

b. Intensification and diversification in recent years have been on sound lines. In general, the mission's recommendations are merely an extension of present policies, with agricultural adjustments.

c. The peak demand for irrigation water occurs in October-November. The mission proposes some readjustment of planting dates to spread and reduce the peak and a cropping pattern which will make use of the full irrigation system capacity at this period. In the present state of knowledge of fallow frequency, etc., any further gain in production which could be achieved would not justify major works to increase the system capacity. The research into these subjects recommended by the mission should be given highest priority, to ensure that the question can be reviewed before all of the water available under the new Nile Waters Agreement is allocated to new projects elsewhere.

d. The degree of expansion and intensification recommended by the mission cannot be achieved unless the present canal system is maintained in excellent condition and operated in the best

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1/ These problems have been studied in depth by consultants engaged by the Republic of Sudan whose reports were invaluable to the mission. The surveys and studies are summarized in "Memorandum on Utilization of Water from Roseires Reservoir" by Sir Alexander Gibb and Partners, Sir M. MacDonald and Partners, January 1966. (Unpublished.)

2/ See Appendix 2 of Annex II on Agriculture.
possible way. Thus there is need for close liaison with the Ministry of Irrigation and Hydro Electric Power. There is also a need for surveys to determine where restrictions occur, for local improvements to canals and structures and for more accurate measurements of flow, including routine checks to detect deterioration.

e. In practice, the technique of watering fields leaves much to be desired. In order to achieve the highest possible production, the mission recommends three levels of watering, more frequent waterings when plant water requirements are high (wherever local circumstances permit) and an extension program aimed at teaching better methods.

f. In the present stage of knowledge of soil management, the mission recommends that perennial pastures should be confined to pilot schemes. No other perennial crops seem particularly suitable and there is no new annual crop available which would require water during the dead season. Thus, there is no virtue in completely abolishing the dead season. However, the mission believes that cotton yields would benefit from pre-sowing irrigation and that (subject at first to a limitation on area whilst pest and soil problems are evaluated) 11 months of irrigation would relieve the violent seasonal fluctuations in fodder supply which are a depressing factor in livestock production. It therefore recommends that the dead season should be reduced to one month; with the use of draglines, etc., for maintenance of canals, no insuperable maintenance problems arise. The mission also recommends research on methods of cleaning canals and development of techniques to combat water hyacinth, should it appear in the Blue Nile.

g. In total, the mission envisages the use of 6.3 milliard m$^3$ per annum by the Gezira Scheme, including Managil and Abdel Magid. Although based on quite independent assessments, this figure is very close to the consultants estimate. The importance of the recommendations on improving watering techniques is stressed by the fact that the annual need would be nearly a third greater - 8.3 milliard m$^3$ - if present methods are used.

3. Rainfall and Drainage

The irrigation pattern in the Gezira Scheme is unusual in that the planting takes place during the months of highest rainfall. However, the rainfall distribution is unreliable and irrigation water must be released at Sennar in anticipation of dry weather. Once the water has been released, it takes as long as 70 hours to reach remote parts of the network: if rain intervenes, the excess water must be released into drainage
ways onto fallow land or, as a last resort, onto crops. The mission recommends research on leaching of saline soils which may lead eventually to a use for some of this excess water. The only safe method of disposal, however, is through escapes such as those on the Gezira Main Canal which lead the water back to the Blue Nile. The number of escapes is inadequate, and surveys are needed to determine where new ones can be provided.

The heavy rainstorms also cause major surface drainage problems. Some 2-3 percent of the cotton crop is regularly killed by flooding: replanting wastes labor, prolongs the period of pest infestation and reduces yields because the new crop is not planted at the optimum time. The yield is undoubtedly depressed over a much greater percentage of the crop where the damage is not sufficiently spectacular to justify replanting.

The natural slope of the land and the superimposition of the irrigation system present many difficulties in providing an adequate drainage system. Conditions are especially bad in Managil, where some areas have no drainage at all. This is a serious problem and priority should be given to a detailed survey to serve as a basis for designing improvements, which will probably include many siphons and additional fixed pumping stations. Much more attention should be paid to maintenance of the existing drainage system, including provision of more gaps in the banks. Local flooding will always remain a problem, however, and the number of mobile flood pumps should be increased to about 80.

4. **Soils**

The soils of the area are mainly sediments brought down by the river from the highlands of Ethiopia. They vary from place to place but the mission found no evidence whatsoever that soil fertility per se has been responsible for annual variations in yields or that soil fertility has declined since the start of irrigation. The very high yields obtained on carefully supervised experimental plots indicate that Gezira soils are a good medium for, at least, cotton.

Saline and alkaline soils often develop naturally in arid climates and they occur in the Gezira, being concentrated in the north and the west, where other soil characters are also somewhat poorer. For the most part, these poor patches were excluded when the Gezira Main was developed but an unknown though large area of them were included in Managil. These areas create groups of impoverished holdings and in some cases cropping had to be discontinued and the farmers moved to better areas. Because little is known about methods of reclamation of such impermeable soils, trials should be made to attempt to leach the soil (which is very difficult because of its nature) or to grow special crops. Some more areas may have to be removed from general use. They must be delimited as soon as possible, so that displaced farmers can be accommodated in development areas without delay.
Salinity can also increase slowly as a result of a secondary process - the gradual accumulation of salts (of which sodium salts are most deleterious) brought in by irrigation water. Fortunately the Blue Nile water is of excellent quality. After careful study the mission concluded that secondary salinization would not be a serious problem on good soils for about a century; of course, soils which start with a high sodium content will have a correspondingly shorter life. Advances in technology should hopefully produce an answer to secondary salinization before it becomes a serious problem in the Gezira.

The plant nutrient status of Gezira soils is satisfactory: again, the mission found no evidence of deterioration. Because nitrogenous fertilizers are needed for many crops, routine trials should be undertaken to give advance warning of the need for the potassic and phosphoric fertilizers which are likely to be needed as forage and groundnut production increases.

The Gezira soils are montmorillonitic clays. Agricultural and irrigation practices, in particular the need for a fallow year, derive from their physical characteristics. The drying out between crops in the present dead season has a beneficial effect on soil properties. The more prolonged dessication during the fallow year is known to be especially beneficial, but the fallow has many other functions which have not been fully studied in the present series of rotation experiments. On present evidence it would appear to be unsafe to have less than one full fallow in four years but a new series of trials should be laid down to discover whether, with modern pest and weed control methods, fertilizers, etc., a longer interval between fallows can be adopted.

5. Land for Expansion of the Gezira Scheme

The possible expansion of the Gezira gravity scheme is limited by the Blue and White Niles and by high land to the south. While it may be possible to pump water up this higher land (as is already done on land along the southern boundary), it may well prove more economical to use the water in a gravity scheme elsewhere. A number of soil surveys are in progress or planned in the areas adjoining the Scheme. The mission estimates that there are about 160,000 faddans over and above the 1964/5 area which could be usefully developed.

6. Possible New Crops

The selection of a new crop for an area involves consideration of many ecological problems (temperature ranges, day length variations, soil

1/ See Map.
type, etc.) as well as agricultural suitability (pests and diseases, cultivation requirements, water regime, etc.). A variety of studies were available and the mission was able to consider a wide range of crops. A few were found to be ecologically and agriculturally suitable; however, the market potential and world price of possible crops are of overriding importance. Of all the crops considered only groundnuts and wheat are clearly suitable at this time. Groundnuts have already been introduced as part of the intensification and diversification program and are satisfactory on most counts (subject to maintaining the export quality of a crop grown on heavy clay soils). Wheat might not be fully justified in terms of export markets and prices, but is justified as an import substitute.

Among other annual crops, the oilseeds safflower and *simmim* (sesame) could become attractive and the only realistic policy is to accumulate practical experience by growing them on a field scale. The same is true of rice (in spite of soil management problems) which might become a worthwhile crop with a change in local diet preferences. Finally, a vigorous search for new *fodder* and *forage crops* must be launched.

There are many unsolved soil problems in the growing of perennial crops. Pastures, useful for specialized livestock production, should at this stage be limited to pilot schemes totalling about 2,000 feddans. *Kenaf* and *sugarcane* - import substitution crops - could be grown but their processing would involve a degree of discipline which may mean a plantation-estate type organization rather than the present tenant-farmer/Scheme relationship.

Although Upland Cotton is hardly a new crop, the techniques required to grow medium staple varieties - e.g., *Acala* - are sufficiently different from the traditional methods to raise problems. *Acala* and other varieties have done well in small-plot variety trials but when grown on a field scale they have not outyielded Sakels and Lamberts grown with a comparable standard of husbandry and supervision. Obviously, it would be necessary to learn and apply the new methods suited to Upland varieties. On the other hand, Upland cottons have a shorter growing season, need less water, and are easier to harvest - even by hand - than ELS cottons; the market prospects, discussed in Section 11 below, are better. The mission gave serious consideration to a proposal that a part - perhaps five percent - of the Gezira should grow *Acala* but concluded that, at the present time, the available administrative and technical staff would be more rewardingly employed in raising the production and reducing the cost of ELS cotton. The position should be reviewed from time to time and, meanwhile, all staff training programs should include the technique of growing *Acala* and similar varieties, field trips to Khashm el Girba at different stages of growth, etc.
7. **Intensification**

As has been seen, the drying out period between crops plays a vital role in the maintenance of soil properties. And it is not possible to justify more intensive use of the land through any system of double cropping without most thorough and exhaustive testing on a pilot scale. Intensification must therefore come through more use of land which would otherwise lie fallow for the full year.

As mentioned earlier, about half of the land was fallow in any year under the old Gezira Main 8-year rotation, the basic form of which is:

\[
\text{Fallow - Fallow - Cotton - Fallow - Dura - Lubia - Fallow - Cotton}
\]

(I)

With only one year's fallow in four years, it becomes possible to simplify the rotation to a basic 4-year formula:

\[
\text{Fallow - Cotton - a cereal - a non-cereal (preferably legume)}
\]

(II)

Two fallows, underlined in (I), become available for intensification of cropping. At the present time the only crops available for the non-cereal break are the legumes, lubia and groundnuts.

In Managil, the basic traditional rotation was over 6 years as follows:

\[
\text{Fallow - Cotton - Fallow - Cotton - Legume - Dura}
\]

(III)

The mission suggests simplifying this to 3 years:

\[
\text{Fallow - Cotton - Dura/Legume}
\]

(IV)

It will be noticed that this does not release any fallow land for intensification in Managil as to crop a fallow would increase the interval between fallows to one in 6 years. There are two alternatives in Managil: to await research results demonstrating that one fallow in 6 years is safe or to convert to a 4-course rotation. There are obvious advantages in a standard rotation throughout the Scheme and, although the difficulties are formidable, since fewer holdings would be provided in any given area, the mission recommends that Managil should be slowly converted as and when farmers moving out make some land available. The identifiable holdings recommended in Chapter 5 could be fitted into a 3-course rotation system; however, their existence would more or less prohibit subsequent conversion to the 4-course rotation and they should only be established as said conversion is progressively achieved.
The S.G.B. has followed a realistic and praiseworthy program of intensification. The increase in the gross value of production due to intensification and diversification can be estimated at about 18 percent since 1962/3 at constant prices 1/: the recommended degree of further intensification and diversification - particularly of livestock production - is capable of giving a further 15 or 16 percent increase. By contrast, further expansion of the area will give only around 12 percent increase in the value of production, at constant prices.

8. **Diversification**

The extra land released for cropping by intensification cannot be used indiscriminately; it is not possible, for example, to plant it with cotton because the risk of pest and disease carry-over would be unacceptably high. It could be planted with dura, but dura is not a very rewarding crop to the farmer, in spite of the high imports into the Gezira area. It could be planted with lubia, but this would tend merely to accentuate the peaks of fodder supply which are already a problem in planned livestock production.

As noted above, there appears to be no alternative to the two crops already introduced, wheat and groundnuts, together with a limited area of long season irrigated fodders to reduce fluctuations in fodder supply. There is thus no immediate prospects for further diversification of crops. In spite of the progress made in increasing production, only a minority of farmers are yet growing the new crops wheat and groundnuts. The majority rely on cotton as their main - often sole - source of cash income: while most grow as much dura as possible, the full allocation of land for lubia 2/ is seldom taken up. There is still great scope for encouraging more farmers to take advantage of the diversification program.

The mission's detailed proposals for rotations 1/ allow a limited degree of choice among similar crops on the part of groups of farmers seeking to optimize their incomes or follow special interests. This choice must be restricted, however, because of the special requirements of the irrigation system and the need to take advantage of economy of scale in cultivations, spraying and other operations.

9. **Livestock**

Certain measures are necessary to improve the production of communal

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1/ See Annex II, Agriculture.

2/ In 1964/5 there were 71,000 feddans of lubia and 59,000 feddans of groundnuts. The area assigned to legumes in the rotations was theoretically 192,000 feddans.
flocks and herds. The provision of irrigation for 11 months a year will reduce fluctuations in the fodder supply. But there will still be periods when animal feed is scarce. Livestock numbers must be regulated and restricted to the carrying capacity of village lands by a licensing system. After a few years a fee could be charged to contribute to the cost of livestock extension work and of measures to reduce spread of parasites (drinking troughs, spraying, etc.). While longer irrigation of fodder will improve supplies, surpluses will remain: they can be profitably utilized by specialized stock fattening enterprises. There is need for research into fattening and dairy farms which would not necessarily grow cotton. On such farms, cooperative ownership of facilities (milking sheds, stores, etc.) but not of stock is recommended. Other detailed suggestions are given in Annex II.

10. Improving Yields

While there is practically no date on the farmers' own crops, and wheat and groundnuts have been introduced too recently for reliable figures to accumulate, the full and accurate records for the cotton crops on the Gezira Main cover a long enough period to permit very precise analyses of trends. The mission made several such analyses, and is confident that the conclusions drawn may be usefully, if cautiously, applied to other crops.

Both soils and climatic conditions (and probably irrigation conditions) are optimum in the south and become poorer towards the north and west: in Gezira Main, the yield variation is from 5.25 k.p.f. in the south to 4.0 k.p.f. in the north; even these differences are subject to change.

A striking feature is the violent annual fluctuations of cotton yields. Soils play little if any part in these fluctuations: any influence they may have should have been eliminated by nitrogenous fertilizer. Climatic variations and the inter-related pest/disease complex appear to be the main cause of fluctuations. Modern methods, notably fertilizers and spraying, better husbandry and control of planting dates according to location, etc., should reduce the range of fluctuations but they cannot be entirely eliminated. Fluctuations are probably less in other crops than in cotton.

These fluctuations and variations make difficult the choice of a meaningful "average yield". The total production of seed cotton from the

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1/ Some results are given in Annex II; others of more specialized interest in Appendix 2 of that Annex.
Scheme has increased at 3.5 percent per year since the Sennar Dam was opened but this increase has been almost entirely due to expansion of area. From 1934 through 1956, when methods and areas were relatively stable, the average yield increased from 4.17 to 4.42 k.p.f. In recent years, as in other periods of expansion, the fluctuations have been particularly violent and it is probable that this is consistent with the overall decline which must be expected when the area is increased. The recent 5-year moving averages have been 3.69 k.p.f. up to 1964/5 and 3.88 k.p.f. up to 1965/6.

The records of individual Blocks show clearly that some are obtaining better yields than before while others are getting worse: over the Scheme, the net effect is to leave the average unchanged. The nature of these trends shows unmistakably that no natural forces are involved. In some Blocks, everyone is farming in a better way, in others all are slipping back. In any Block, the good farmer always gets better yields than the poor one, regardless of whether it is a "good" or a "bad" season; the position of their plots on the "number" has no influence.

This indicates not only that yield increases are possible, but that the human factor -- the care with which the farmer does the fieldwork or supervises his hired help, the way in which the Block Inspector handles his contacts with farmers, etc. -- makes a major contribution to crop yields. True, the Scheme management can undertake some operations which should favorably affect cotton yields. One is the spreading of fertilizers by machines to make the application more uniform throughout the fields. Another is increasing the number of insecticide spraying. But only better crop husbandry -- a responsibility of each individual farmer -- will ensure that the maximum benefits are extracted from the land.

"Better crop husbandry" implies more work for the farmer, or at least more time spent by him on supervision. The mission does not believe that this can be obtained by edict or exhortation but one can try to create conditions conducive to the adoption of better crop husbandry.

Firstly, holdings should be contiguous, identifiable and permanent. A farmer must know that he, and not the man allocated that plot next year, will benefit from the residual effects of fertilizers, the cleaner crops resulting from particularly careful weeding, levelling of gilgai, local improvements to drainage and irrigation systems, etc. If he is interested in livestock, he must not only have the right to keep cattle other than his own off his land but actually see to it. These proposals, as well as those tending to create further incentives, by allowing him to aspire to a bigger holding, are discussed in Chapter 5.

Secondly, there is a need for a redirection of the field staff's contacts with farmers. This is best described as the creation of an extension service. This does not imply the recruitment of a large new
group of staff but only of a limited number in the course of several years. The aim of their programs, illustrated by Demonstration Centers, will be to encourage farmers to pay more attention to crop husbandry, to encourage Village Councils, specifically in the agricultural sphere and communal herding, to accept responsibility for enforcing the discipline necessary in an irrigation scheme, and to introduce new ideas and methods. Since few of the field staff have enough agricultural training, the creation of this extension service must itself be preceded by an intensive staff training program for the direction of which some additional staff will also be required.

Mechanization is an established part of the Gezira agricultural system. Contrary to some widely accepted assumptions, the mission found that there is only limited scope for further mechanization. Efforts should be aimed at mechanizing certain operations, specifically those that compete for labor with cotton picking. Improvements in the use of existing machinery is clearly needed. Cultivations have an effect on yield, in particular, the final split ridging which creates the environment for the seeds and plants. This operation is done by private contractors and it is essential that every assistance be given to improve the standards of their workmanship.

11. Improving Seeds

Improved seed, giving higher yields of better quality, is one of the most promising means of raising production. In the case of cotton, breeding of new types has received constant attention from specialists at the research stations; in the past, disease resistance has been the main criterion for selection but it is clear that yielding capacity should now be given more emphasis than hitherto. The preparation and distribution of cotton seed to farmers is, and always has been, the responsibility of the Scheme management. The methods adopted in the past have been less than satisfactory, as evidenced by the gradual decline in grade and ginning out-turn over the years 1/. Much needed improvement would be achieved by the adoption of a new system of cotton seed multiplication and distribution, which would provide selected planting seed for every farmer as soon as possible. To start this program, and every year thereafter, seed would be collected from good plants, rejecting not only plants with low yield but those with undesirable lint characters or poor growth habit. Enough seed would be collected from these "model" plants to sow the first stage multiplication area of 10 feddans. The crop from this first stage would be ginned separately and the seed used to plant second stage areas of about 400 feddans, which in their turn

1/ See Figure 5, Annex II.
would produce enough seed for a whole block in the third year. Selection would continue year after year, and each year the farmers would receive a new "wave" of selected seed. Plant breeding work would continue independently as at present; as and when it is decided to adopt new varieties, the seed multiplication program would be the mechanism for releasing planting seed to farmers but it is important that the functions of breeding and testing new varieties on the one hand, and the multiplication of planting seed on the other should be entirely separate.

The Scheme management has a somewhat ill-defined role in the distribution of wheat and groundnut seed, and efforts have been made in the past to introduce new varieties of dura, but the Ministry of Agriculture is responsible for plant breeding and variety testing. The mission believes that the Scheme management should assume full responsibility for the multiplication and distribution of planting seed for all major crops; the methods described for cotton are applicable to all of the crops commonly grown.

At the present time, production costs for wheat and groundnuts are unnecessarily high because the sacks contain an undue proportion of broken or damaged seed, dirt, etc. Planting seed should be cleaned and graded before distribution. Treatment of cotton seed will, of course, continue but it would be unwise to add poisonous dressings to wheat, groundnuts and other edible seeds before distribution to farmers.

12. Improvement Potential

The various measures to increase yields could increase production by perhaps as much as 45 percent over 1964/5 levels (as compared with 12 percent for increases in area and perhaps 30 or 35 percent for intensification and diversification combined). Unfortunately, by the time the slow process of increasing yield begins to take effect, the world prices of the cash crops, at least of cotton, are expected to have declined.

13. Market Prospects for the Principal Crops

Market prospects for the Scheme's major crops over the next five to ten years appear mixed, i.e. rather unfavorable as far as cotton is concerned and without discernible trend one way or the other for other crops. Assumptions regarding the future are always hazardous, and actual events are liable to turn out differently. Still, some judgment as to future prices of the Scheme's crops (as well as to their future yields) has to be made, and caution dictates that it be a conservative one.

Cotton. Market prospects for extra long staple cotton (ELS for short) are dominated by a number of adverse factors, namely, (a) increasing synthetic fiber consumption in apparel fabrics; (b) increasing competition
from longer staple upland cotton, notably the Acalas, in the expanding manufacture of blended yarns and fabrics; and (c) the U.S. Food and Agricultural Act of 1965 which allows for downward price adjustments for U.S. cotton and therefore should influence cotton generally. Complete uncertainty exists regarding the future purchases of ELS by the U.S.S.R., Eastern Europe and Mainland China. If not continuing at their recent high levels, will they decline, or will they increase? World market supplies of ELS on the other hand are likely to continue to increase, although presumably less than world population and at a declining rate.

Increasing competition from synthetic fibers and from longer staples of upland cotton has made itself felt already for some time with the result of substantially reducing the price premium traditionally commanded by ELS. The following prices for Sudan Gezira Lambert G5L, a grade representative of the average quality of Gezira cotton in recent years, for California SM-1-3/32"; a closely competing Acala, and for Orleans/Texas M 1", a base cotton grade, are revealing in this respect.

<table>
<thead>
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<th>First nine months</th>
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<tbody>
<tr>
<td></td>
<td>U.S. cents per pound, c.i.f., Liverpool</td>
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<tr>
<td>G5L</td>
<td>43.80</td>
<td>38.99</td>
<td>40.49</td>
<td>37.69</td>
<td>33.25</td>
</tr>
<tr>
<td>SM-1-3/32&quot;</td>
<td>36.30</td>
<td>32.73</td>
<td>35.11</td>
<td>33.24</td>
<td>33.03</td>
</tr>
<tr>
<td>M 1&quot;</td>
<td>30.46 2/</td>
<td>27.76</td>
<td>26.83</td>
<td>25.78</td>
<td>24.70</td>
</tr>
<tr>
<td>Premium on G5L over</td>
<td></td>
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<tr>
<td>SM-1-3/32&quot;</td>
<td>7.50</td>
<td>6.26</td>
<td>5.38</td>
<td>4.45</td>
<td>.22</td>
</tr>
<tr>
<td>M 1&quot;</td>
<td>12.91 2/</td>
<td>11.23</td>
<td>13.66</td>
<td>11.91</td>
<td>8.55</td>
</tr>
</tbody>
</table>


2/ Relates to five-year period beginning August 1, 1955. Average price for G5L during that period was 43.37. Hence premium on G5L of 12.91.
The figures, from I.C.A.C. statistics, show the premium on G5L over California SM-1-3/32" declining at an accelerating pace until by September 1966 it had virtually disappeared. The corresponding premium over the more common upland grade M 1", after keeping fairly stable until the beginning of 1966, was sharply reduced in more recent months but it is still substantial. The figures also serve to illustrate the downward trend and the recent break in cotton prices generally.

Over the same period, synthetic fiber prices declined rapidly as is illustrated by the following prices for polyester fibers in the United States:

<table>
<thead>
<tr>
<th></th>
<th>Average (U.S. dollars per pound)</th>
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<tbody>
<tr>
<td>polyester (Dacron)</td>
<td>Sept</td>
</tr>
<tr>
<td></td>
<td>September</td>
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This downward trend is likely to continue and may even accelerate as competition among synthetic fibers increases.

The enactment of the U.S. Food and Agricultural Act of 1965 brought about a major change in the cotton policy of the United States. The immediate result was to reduce export prices, effective August 1, 1966, by almost ten percent. Also, the legislation makes mandatory a support price for U.S. upland cotton equal to 90 percent of the estimated world price over the three years, 1967, 1968 and 1969. This presumably means the withdrawal of much of the support that the U.S. cotton programs of the last quarter century have given to world cotton prices.

A major factor in sustaining world demand for ELS in recent years has been the substantial purchases by the U.S.S.R., Eastern Europe and Mainland China. During 1960/61-1964/65 these countries took between 35-40 percent of the volume of all world exports of ELS. The Sudan, during the same period, shipped between 25 and 30 percent of her total exports of ELS to these same countries, that is, nearly three times as much, in absolute terms, as the average during 1955/56-1959/60. The corresponding proportion of the U.A.R.'s exports of ELS (in volume more than twice the Sudan's) was much higher, i.e. about 50 percent. It is impossible to say what in future, say by 1975, the Sudan's exports of ELS to these countries will be as these are mostly negotiated through
bilateral trade agreements. For want of something better it is simply assumed here that exports of ELS to the U.S.S.R., Eastern Europe and Mainland China from both the U.A.R. and the Sudan will continue at the same levels as in the recent past.

A positive factor in cotton's favor is the recently established International Institute for Cotton. To support the competitive position of cotton versus synthetic fibers, extensive international research and promotion programs are being initiated under its auspices. Broadening research and promotion programs in Western and certain Asian countries are sure to benefit all cotton. The actual impact of these efforts remains to be seen however, especially on the consumption of ELS.

What then might future ELS prices be by, say the mid 1970's? A tentative estimate for a Gezira standard grade, G5L, is put forward below. It is based on the following major assumptions:

a. World supply of ELS of about 3 million bales. The corresponding figure for 1964/5 was 2.7 million bales, of which about 25 percent were stocks carried over from previous years.

b. Takings by the U.S.S.R., Eastern Europe and Mainland China will be of the same order as in the recent past - 35-40 percent of world exports of ELS.

c. A base price for cotton, Orleans/Texas M 1", of between 19 and 23 U.S. cents per pound c.i.f. Liverpool. The corresponding price was 24.70 in September 1966.

d. A premium on G5L, c.i.f. Liverpool, of 30 percent of the price for M 1". The corresponding figure for September 1966 was 35 percent; and

e. The price differential between c.i.f. Liverpool and ex-store Port Sudan to remain at its recent level of U.S. cents 5.30 per pound, and the rate of exchange of the Sudanese Pound to remain unchanged.

On these premises the assumed price for G5L by about 1975 could be estimated as follows:-
September 1966  About 1975
(Actual) (Assumed)

<table>
<thead>
<tr>
<th>Description</th>
<th>1966</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. cents per pound, c.i.f. Liverpool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price of M 1&quot;</td>
<td>24.70</td>
<td>19.0-23.0, or say 21.0</td>
</tr>
<tr>
<td>Premium on G5L</td>
<td>8.55</td>
<td>5.7-6.9, or say 6.3</td>
</tr>
<tr>
<td>Price of G5L</td>
<td>33.25</td>
<td>24.7-29.9, or say 27.3</td>
</tr>
</tbody>
</table>

The assumed 1975 price of about 27.3 U.S. cents implies a decline by about 18 percent from the corresponding actual price in September 1966. The corresponding 1975 price for G5L ex-store Port Sudan is arrived at by subtracting the differential \(^1/\) of U.S. 5.30 cents per pound and converting the balance into Sudanese currency, and would thus be equal to £5 7-8 per kantar of lint.

It bears repeating that these estimates are very tentative and on the conservative side. However, as already noted, some judgment regarding future prices for ELS from the Gezira has to be made and, considering the various depressing factors at work, the mission feels that assuming higher prices for cotton would not be wise.

Other crops. The seemingly poor prospects for ELS cotton are somewhat alleviated in their effects on the Gezira economy by the expectation of a broadening in the markets for foods, due to rising population and an expected increase in per capita income, both in the Sudan and in other countries. Prices for such products of the Scheme as wheat, dura, vegetables and livestock therefore may be assumed to rise rather than decline over the next decade or so. As in the past, most of these products of the Gezira will be consumed locally or elsewhere in the Sudan, at prices not directly related to corresponding world prices. In the absence of any indications as to what domestic prices in the Sudan might be by 1975 it is here simply assumed that farm prices for Gezira wheat and dura will be up by between five and ten percent on their 1964/5 levels, and farmers' incomes from vegetables and livestock by ten percent.

\(^1/\) It should be noted that this differential between the c.i.f. Liverpool price and the converted ex-store Port Sudan price has been presently reduced to U.S. cents 3.31, due presumably to the temporary measure of reimbursing to exporters 50 percent of the export duty on lint exported between August 29 and February 27, 1967.
Gezira groundnuts and cottonseed and their products will have to be sold abroad in increasing quantities, and their market prospects naturally depend on those for oilseeds generally. The world market for oilseeds is expanding, mainly because of growing demand for high protein meal for livestock feed while demand for vegetable oils is expected to level off. This applies especially to Western Europe, traditionally the principal market for Sudanese oilseeds and oilseed products. However, since present world demand for oilseeds is focused on the meal rather than the oil component, Sudanese products will probably benefit less than other seeds with a more favorable meal/oil ratio. Soya beans are the outstanding case in point; imports into Western Europe have risen rapidly in recent years, and are likely also in future to dominate the field. At the same time, while world demand for all oilseeds is rising, world supplies are expected to rise rather faster, especially after 1970 if and when the substantial increases in export production of groundnuts planned by other African countries as well as the Sudan, and of palm oil in Malaysia, should materialize. World prices for Gezira groundnuts and cottonseed by 1975 therefore had better be assumed to be somewhat lower than in 1964/5 - say, five percent or so. The farm level price for Gezira groundnuts by 1975 however, might nevertheless well be the same as in 1964/5 as the assumed decline in world price may be expected to be compensated for by improvements in quality 1/ and/or marketing.

14. Research

The Gezira Scheme has benefited greatly from research findings and the amount of £5 75,000 which it contributes each year to it is amply justified. Many organizations undertake research and surveys of various kinds in the area but the Research Division of the Ministry of Agriculture bears the prime responsibility. All of them seem well adapted to their particular roles and no changes are necessary. It would be advisable however for the Ministry of Animal Resources, in close collaboration with the Ministry of Agriculture, to increase its research activities, especially in the fields of communal herd development and of pasture and fodder utilization.

1/ Improvements in quality bear especially on groundnuts suitable for direct consumption which sell at a substantial premium. The market is rapidly growing in Western Europe, although even so, the quantities involved are likely to remain small. (World trade in edible groundnuts in 1965 may be estimated at the order of 100,000 tons.) Moreover, in order to be acceptable to the market, these groundnuts have to be free from Aflatoxin, now under investigation as alleged to cause liver disease and a major problem with Gezira groundnuts because cleaning them involves wetting. Rigid controls of Aflatoxin need to be instituted before capitalization on the uptrend in the demand for edible groundnuts becomes possible to any significant extent.
One important step would be to make existing knowledge easily available to research and field personnel. There is need for improvement in the documentation of research findings. It is suggested that the Gezira Agricultural Research Station should undertake the publication of a new standard textbook, which will be needed for training programs, and the preparation and circulation of simple abstracts to keep research and field staff informed of progress of agricultural research in the Sudan and elsewhere.

Another important requirement is the translation of research findings into farm practice. Management must carry out its own "adaptive research" to ensure that new techniques are practical and profitable on a large scale and that they are not incompatible with other normal farm operations. The aim of such trials by managements is not to "check up" on research work. When large scale tests do not confirm research findings, the reason for discrepancies must be investigated in great detail by both sides as a matter of course. The amount of land needed for adaptive research will vary from project to project. One half rotation unit may be enough for some experiments; for others (e.g. large scale mechanization) one full block may be involved.

The progress of large scale trials should be watched by the Agricultural Techniques Conference, mentioned in Chapter 4, which should invite research workers to participate in discussions of their projects. The Conference will recommend proven techniques which will then in most instances be applied, in the first instance, on Demonstration Centers. These Centers must be reserved for their function only and never used for any form of research or testing.

The systematic collection of statistics on all activities in the Scheme is a basic need for research and planning alike. It should be undertaken under the responsibility of the General Manager, Agricultural Services and Planning. His office should ensure that all requests for data sent to field officials are carefully coordinated and that questionnaires and forms are kept to an efficient minimum.

15. Extension Services

The inspectorate system, devised nearly 50 years ago to administer the Scheme and, at the same time, teach the unfamiliar techniques of irrigated cotton farming, has stood the test of time. Although few Inspectors have had the benefit of formal agricultural training, the system has allowed the introduction of new techniques and crops: even the rapid expansion in the Managil Extension was accomplished without serious difficulty.

However, the needs of the Gezira are changing. The policy of
devolution has led to the formation of Village, Block and Rural Councils. These have been successful up to a point, but they lean heavily upon the Block Inspector for support. Likewise, cooperative societies are almost entirely dependent upon official help for their very existence. The stagnation in yields makes it imperative to foster more careful crop husbandry, which can be achieved only by more work being done by the farmers or at least closer supervision of laborers. These changed circumstances have been widely debated in the Sudan and it is generally agreed that they can only be overcome by a reorientation of the relationship between the Management and those who live in the Scheme. A way must be found to reconcile supervisory needs with the introduction of extension and teaching services. The farmers and the local councils must be led by extension workers to take more responsibility.

There is less unanimity as to how specifically extension work should be introduced. There are three basic possibilities:

a. The present inspectorate should remain unchanged and the Ministry of Agriculture should organize an independent extension service throughout the area;

b. A similar arrangement in which the Board would organize an independent service;

c. The reorientation of the work of the inspectorate to embrace extension work.

The first two alternatives suggest the danger of friction between two parallel services and of confusion over responsibilities. The third alternative seems not only the safest but also the most economical both of funds and of scarce trained manpower.

The mission therefore recommends that, while there should be no change in the basic duties and responsibilities of the Block Inspectors, there should be a reorientation of the work of the Junior or Field Inspectors, who work under the Block Inspectors. They should be renamed "Field Advisers". Retraining will be necessary, not only in agricultural methods for all crops but also in extension techniques. The functions of the samads would remain unchanged, although more emphasis would also be laid on their advisory role, and present establishment should be reviewed. An attempt should be made to select those with the necessary basic education and inclination for further training and for possible appointment to full-time posts to assist Field Advisers.

In the future, recruitment of Field Advisers should give preference to graduates of the Shambat Institute or of the proposed National Extension Institute. In addition, suitable candidates may well be found among the graduates of the specialized agricultural schools now planned by the
government. Finally, to the extent the number of graduates coming from these three sources is not sufficient -- and this may well be the case for several years to come -- recruitment from traditional sources should of course be continued but applicants should receive a serious training in agriculture -- three to six months -- before they begin their field work. As to full-time samads, their number may well be increased by recruiting selected trainees of the training schools of the Social Development Department.

The formulation and execution of training programs is a matter of urgency which cannot wait the establishment of the proposed National Extension Institute in Khartoum. It is therefore recommended that an extension specialist should be included in the staff of the General Manager, Agricultural Services and Planning. The Ministry of Agriculture has an Extension division where candidates for this post could be found.

There are many members of the field staff who have an interest in, and aptitude for, extension work. Some 10-15 of these should be trained by the extension specialist to become the first Group Extension Advisers. Satisfactory candidates may also be found in the Extension division of the Ministry of Agriculture.

The work of the specialist and Group Advisers will not be confined to training, although it will always be a major part of their duties. The Field Advisers must be provided with detailed manuals and all the various visual aids, etc., required for mass-participation programs. There is adequate material available already to form the basis of a first class extension campaign. Research will provide material for the future, and an important part of the specialist's work at central headquarters and at regional or group level will be to keep informed of the progress of research programs and advise the General Managers of their implications on the extension programs.

Farmers will not be convinced of the value of improved techniques by word of mouth or by posters alone. The best visual aid is a crop which is demonstrably better than their own but at the same time farmers are justifiably suspicious of good crops grown on "official" fields by hired labor: to be convincing, demonstrations must be on land farmed by members of their own community. It is therefore suggested that Demonstration Centers should be set up, at first one in each Group. These Centers will cover several ordinary tenancies -- perhaps half or a full rotation unit--which will be farmed by normal farmers 1/. They will differ from other

1/ It would, of course, be desirable to try to concentrate a group of 9 (or 18) of the best farmers in the area on the Demonstration Center.
tenancies only in the degree of advice and encouragement the farmers receive from Field Advisers. In short, they will become the focus of extension work in the Group.

As the focus of extension, the Demonstration Centers will serve a subsidiary function as training areas for staff: the best place for them to learn the latest agricultural or extension methods is the very place where those methods are being most vigourously applied. As has been noted in the previous section, however, the Demonstration Centers must not be used for fundamental or applied research. They should only use methods which have been thoroughly proven.

The work of the Field Advisers will not be confined to contacts with the farmers alone. They, and more specialized Machinery Advisers, will work among the private tractor owners. They will have a special responsibility to advise, help and train the members of cooperatives, who must learn to handle their own affairs. Above all, they must work with and for the Village, Block and Rural Councils, advising, helping and encouraging them to play a greater part in the Scheme, especially in those spheres where a degree of community discipline is unavoidable (e.g. communal herds).

This type of extension service will not add greatly to the overall cost of management of the Scheme. From the detailed estimates given in Appendix 5 of Annex II, it will be seen that the recurrent costs will be about £S 30,000 per year. Even when housing, cars, training facilities, etc., are included, the cost over the first 5 years will be only around £S 275,000 in all.
SUMMARY RECOMMENDATIONS

Irrigation

Reduce the "dead season", during which gravity irrigation is suspended, from three to one month.

Readjust planting dates and cropping patterns to spread and reduce peak water requirements.

Study urgently the crop water requirements and the effects of fallow frequency to make sure the Gezira could not economically use more of the Roseires water before all of it is actually allocated to new projects.

Ensure close liaison with the Ministry of Irrigation to assist in supervising the maintenance of the canal system and measure the water discharge more accurately.

Render the field watering system more flexible by introducing three different levels of watering and ask the Extension Service to teach the farmers to exercise the greatest care in this connection.

Expand presowing irrigation of cotton throughout the Scheme.

Allow eleven months' irrigation on, say, one-tenth of the fodder area. Limit perennial pastures to pilot schemes until research has indicated a solution to soil management problems.

Drainage

Increase the number of escapes from the canal system after a careful study of possible new locations.

Initiate detailed survey of improvements needed in field drainage, particularly in Managil.

Improve present field drainage system by increasing the number of gaps in the banks and by increasing the number of mobile flood pumps to around 80.
Soils

Investigate poorer soils, delimit their area, and, if leaching does not appear feasible, take them out of cultivation.

Study the need for potassic and phosphoric fertilizer in addition to nitrogenous fertilizer now being used, when forage and groundnut production increases. Initiate routine trials for that purpose.

Keep at least one fallow year out of four but initiate trials to discover whether, with modern methods of pest and weed control and proper fertilizer application, a longer interval could be adopted.

Land for Expansion

Continue soil surveys in the areas adjoining the Scheme to carefully prepare for the development of, say, 160,000 feddans.

Possible New Crops

Continue search for new crops as only groundnuts and wheat have actually been proven. Try, on a field scale, safflower, simsim and rice. Undertake similar trials of new fodder and forage crops. Limit perennial pastures to pilot schemes, as mentioned above.

Consider that in the future Upland cotton, e.g. Acala, may well prove attractive from a watering, harvesting and marketing point of view, and actively prepare the technical staff to a possible change-over to this type of cotton on a substantial part of the Scheme.

Intensification (Rotations)

Continue the present intensification policy but accelerate the process a little by modifying the Gezira rotation to a four-course and the Managil one to a three-course system. Encourage a progressive change-over in Managil from a three- to a four-course rotation.

Diversification

Encourage farmers to actually use and cultivate all the land now available or to become available to them for wheat, groundnuts and lubia.

Livestock

Regulate size of herds and flocks and provide for parasite control drinking troughs. Encourage stock fattening during peaks of fodder supply and experiment with livestock farms not growing cotton, possibly with cooperative ownership facilities (sheds and stores) but not of stock. As
indicated under "Irrigation", allow eleven month irrigation of one-tenth of the fodder area.

**Improving Yields**

Extend the number of cases where spreading of fertilizer is done by machines and increase the number of insecticide sprays.

Starting with Gezira Main, make farmholdings contiguous, identifiable and permanent (see Chapter 5).

Improve use of existing machinery, particularly by supervising standards of workmanship of privately-owned tractors.

Develop extension services (see below.)

**Improving Seeds**

Introduce a new system of year by year seed selection and multiplication both for cotton and for the other crops commonly grown.

**Market Prospects**

In estimating future cotton prices and income, exercise great caution since a decline of the price of G5L lint to a level of between fS 7 and fS 8 per kantar by the mid 1970's is not unlikely.

On the other hand, accept as reasonable the assumption that prices for wheat and dura may increase over the next ten years by 5 or 10 percent compared with 1964/65, while vegetables and livestock could rise by 10 percent. Although groundnuts and oilseed may decline somewhat in the world markets over the same period, they could remain stable at farm level if quality and marketing can be improved.

**Research**

Encourage close collaboration between the Ministries of Animal Resources and Agriculture on research regarding communal herd development and pasture and fodder utilization.

Request the Gezira Agricultural Research Station to publish a new textbook to serve all those who would undergo new agricultural training and to prepare and circulate simple abstracts on the progress of research in the Sudan and elsewhere.

Develop "adaptive research" by organizing large scale trials under field conditions of new methods which have proved satisfactory on experimental plots.
Set up in the Scheme an "Agricultural Techniques Conference" under the General Manager, Agricultural Services (see Chapter 4) and improve collection of statistics under the same official

Extension

Add to the present functions of the field staff the responsibility for extension work. Change the title of "Field Inspectors" to that of "Field Advisers" and give them training in agriculture (all crops) and extension methods.

Establish Demonstration Centers first at the Group level and later at the Block level, to illustrate the advantages of new and better husbandry techniques.

Encourage revival of Local Councils.

Select a few samads for special training and eventually make them full time assistants to the field staff.

Appoint extension specialists in the office of the General Manager, Agricultural services and Planning, and extension advisers at Group level to plan and supervise the execution of extension programs.
CHAPTER 3

SERVICES TO AGRICULTURE

Ever since the inception of the Scheme, account has been taken of the value of economies of scale which can be achieved by providing services to the farmer. Supply of irrigation water is the function of the Ministry of Irrigation but almost all other collective services related to agriculture are provided by the Scheme management. Even social development is supported by the Gezira Board, although some aspects of it could well be said to be more within the province of the Local Government authorities. The services discussed here are costs of production which are in fact incurred by others than the farmer but inevitably have to be covered out of the proceeds of his crops. There is constant search for ways to improve these services or to carry them out at less cost. The purpose of this chapter is to review briefly the main collective services. The importance of efficient maintenance and operation of the irrigation network has been stressed in the previous chapter. It will, therefore, not be referred to here. The subjects covered are machinery ownership, spraying, transportation and communications, ginning and marketing procedures.

1. Machinery Ownership

The heavy soils of the Gezira rule out the use of small tractors and motor cultivators. A 50/60 hp farm tractor is the minimum size likely to be useful and to make full use of such a tractor the area served by it should be at least one rotation unit (720 feddans). The mission foresees cooperative action by the groups of farmers whose combined holdings could include a rotation unit. One of the group would own a tractor (purchased perhaps with cooperatively-subscribed capital) and would provide services for the whole unit as a contractor. The mission does not recommend cooperative operation of machinery, which has been shown to be unsatisfactory in too many countries. For many years, however, farm machinery must be provided as it is today, i.e. partly by a centralized pool managed by the Scheme and partly by contractors. The present division of functions between these fleets of tractors does not have to be preserved in the long run. It is not necessarily in the interest of the Scheme to continue to own a tractor fleet. Its essential interest is the efficiency and standards of the work performed. There seems to be no reason why responsible contractors could not carry out this work under proper supervision. The first prerequisite would be a policy statement to that effect.
Many privately-owned tractors will soon be due for replacement and even preservation of the present fleet will require confidence and credit. Training programs at all levels, including drivers, will be necessary; the tractor manufacturers could probably assist in providing them. If furthermore a Contractors' Association were established, it could negotiate with the Scheme, the Farmers' Union and local tractor distributors on matters such as work specification, agreed rates, spares and service facilities. The Scheme field staff would be made responsible for checking that the work specifications including standards of work in the field are strictly adhered to by the contractors.

This, however, will take several years. In the meantime, the S.G.B. Ploughs' Section fleet must continue to provide services and the mission makes a few detailed recommendations for minor economies. With regionalization (see Chapter 4) the wheeled tractors should be decentralized to Blocks, and the tracked tractors to Regions. Finally, the field staff should protect the farmers' interest by inspecting and if necessary rejecting the work performed by private contractors (e.g. split ridging).

2. Spraying

Until recently spraying was carried out from the ground by the Ploughs Section's wheeled tractors, and from the air, by contractors. For the past two seasons, however, all routine spraying has been done from the air, by contractors: this operation appears to be a success. The cost accounting system does not produce an accurate statement of what tractor spraying had cost and estimates given the mission ranged from 5 to 12 PT per feddan. At first sight this seems low in relation to the aerial contract charges of around 25 PT but ground spraying involves many subsidiary costs (e.g. knocking down and rebuilding messir, damage to plants etc.). Above all, spraying from aircraft is efficient, fast and can be carried out to any desired schedule, regardless of ground and crop conditions. For these reasons the mission wholeheartedly endorses the decision to use aircraft for all routine spraying.

The spraying contracts are normally divided between three or four local chartering companies, not all of which work on a fully commercial basis. Tenders are based on areas of different sizes. Quotations in some instances appear to be higher than should be the case if all the participating companies had the capacity to undertake large-scale operations. Nevertheless, the contract rates seem reasonable and there is no indication that the Scheme would be able to reduce costs by purchasing its own aircraft and engaging its own pilots. The present system should therefore be continued for a period of several years and estimates of forthcoming operations should be made in advance so that charterers and contractors be prepared to submit bids. With the increased number of sprayings recommended in Chapter 2 (Agriculture) rates per feddan should be expected to fall. Contracts should be awarded on a
regional basis when and if Regions are established.

3. Communications (Roads)

It is very difficult to make satisfactory all-weather roads on Gezira soils. These soils, when they are dry, provide good, though dusty roads, with a minimum of maintenance. When they are wet, however, many of them are almost impassable. There is, however, no need for heavy materials to be moved in the wet season. At present, therefore, earth roads are adequate within the Scheme provided they are properly maintained. The completion of the Khartoum-Wad Medani all-weather road would provide much better communications northward but probably would not decrease the demands on the Gezira roads. The result may rather be increased demands over all roads.

The main through-roads which usually follow the main or major canals are under the jurisdiction of the Ministry of Irrigation. More frequent maintenance of these roads appears to be needed. The Scheme management maintains local roads and this will continue to be necessary until the various local authorities are really able to accept responsibility for the work. Roads should be temporarily closed when there is danger of damage by traffic after heavy rain or flooding. Authority to do so should be given to the senior local representative responsible for maintenance.

4. Communications (Telegraph and Telephone)

The need for improving telephone services is so obvious that it hardly requires detailed comment. Serious efforts are now being made to improve the situation in Khartoum and this should affect the quality and continuity of the services between the capital and Wad Medani and Barakat. But equally important is the permanency and reliability of the links within the Scheme between Blocks and Groups (and tomorrow, Regions) and between these centers and Barakat. It is essential that instant exchange of information and advice or instructions be ensured at all times, including the rainy season which is the cotton sowing season when roads are often impassable. The mission was not able to go into this problem in detail. A technical survey should be undertaken forthwith to ascertain whether telegraph and telephone lines and exchanges could be maintained more efficiently and possibly extended or whether, as many residents seem to think, a network of radio telephones could be established at a reasonable cost. There may well be a case for the organization of an independent network serving only the Gezira offices and the related irrigation services.

5. Transportation (Railways)

The Sudan Railways provide an indispensable network of communication along the Blue Nile and from the Gezira to Port Sudan. Most products
imported for the Scheme and exported from it travel by rail. On the whole, railway tariffs appear to be reasonable under Sudanese circumstances and there has recently been a great improvement in the speed of delivery to, and hauling from the Gezira. The provision of adequate service is particularly important to the ginneries where the main outbound traffic originates.

Internal transportation, other than the road system, is the concern of the Gezira Light Railway, which has a network of some 700 km of narrow gauge lines. It deals with long hauls of cotton and bulk material, such as fertilizer, insecticides, seeds, sacking, etc. Generally speaking the mission was well impressed by the organization and efficiency of the Light Railway and there is no reason for road transport to be substituted for the existing GLR lines. Whatever suggestions can be made relate more to possible studies than to actual operations (for details see Annex III). Instances are: a survey of the means by which communications could be improved with both stations and trains, as the present telephone system seems inadequate; a survey of possible ways of making more efficient the loading and unloading process, especially for seed cotton; an examination of the advantages of accepting other freight than that at present being hauled, which is directly related to the needs of agriculture. Finally, a warning must be sounded against the temptation to extend further the present network: road transport may be more economical where rail lines have not yet been established.

6. Ginneries

The ginning factories are located at Meringan and Hassa-Heissa and there is an overflow (standby) ginnery at Jebel Aulia. All told, according to the information given the mission, there are 1,048 gins capable of processing 356 million pounds (162,000 metric tons or about 3.6 million small kantar) of lint based on 24 hour operation over 135 producing days. Of this total slightly less than one-tenth is at Jebel Aulia, the balance in the two major factories. The capacity is sufficient to gin all cotton to be produced up to a yield of 5.8 k.p.f. over the present area plus the extensions contemplated. At a yield of 6 k.p.f. the ginning capacity would still be adequate assuming that the 10 percent margin allowed in the planning forecasts for equipment breakdown could be reduced to 5 percent. At a still higher average yield of 6.5 k.p.f. some additional gins would be needed unless the season could be extended by say 12 days. This latter solution would perhaps entail new covered storage space at the ginneries, as a protection against possible rains, and dry covered transportation on the Sudan Railways. This would be preferable to an additional heavy capital expenditure in new gins. In short, barring a bumper crop, the present capacity is adequate.

In addition, the ginneries seem to be fairly efficiently run. There is room, however, for a number of improvements. (see Annex III)
The main points are:

a. need for stricter agreements with the Sudan Railways for hauling lint and seed to Port Sudan. The present arrangements are not always satisfactory. Constant revision of the train schedule is necessary. This is one case where improved telephone connections should be most helpful.

b. The new ginneries seem to have resulted in greater efficiency and in manpower savings. Further studies should be encouraged.

c. The time required for factory operations should also be clarified. A seasonal labor force of some 8,000 is employed at present. Their cost may perhaps be reduced on the basis of modern work analysis methods especially as labor contractors are responsible for the performance of most of the seasonal work.

d. Some internal reorganization may well result in greater efficiency, with clearer lines of command within the factories and greater delegation of responsibilities (to "managers" rather than "inspectors").

But on the whole the factories seem to be fairly well run and their proximity to headquarters gives them both the assistance of headquarter engineers and the incentive of close supervision. There have been suggestions that ginning, like marketing, not being a strictly agricultural operation, could be separated from the Scheme. However logical, this proposal should, in the opinion of the mission, not be pursued further unless there is full assurance that a new organization would result in more or at least equal efficiency in the factories.

7. Marketing Services

Marketing of agricultural products in the Gezira is concerned primarily with cotton. The Sudan Gezira Board auctions cotton lint through its sales office and sells cottonseed on the basis of competitive bids. Wheat is sold by the Scheme on the basis of a price fixed and supervised by the Government. Groundnuts are sold privately or through cooperatives sponsored and assisted by S.G.B., the Agricultural Bank and the Ministry of Commerce. Dura is either used for the personal needs of the farmers or sold privately. The same is true of fruits, vegetables, lubia and livestock.

Cotton. The marketing system for cotton is well established. The collection and grading of seed cotton, transporting, storing and auctioning bales of lint cotton are in many ways excellent and superior to many other countries. For this reason most of the changes suggested
here are not major innovations.

The most important suggestion has been publicly discussed in the Sudan. It relates to the possible organization of a Cotton Marketing Authority which would be independent of the Gezira Scheme. It would be made responsible for the sales, storage and grading which the Scheme today performs for its own cotton and for that produced by other government schemes. It has also been suggested that they might even take care of the cotton produced by private estates for which present sales procedures are different from those followed by the Gezira Sales office. The mission agrees that marketing is not an agricultural operation and could logically be organized separately from the Scheme. The problem seems to be more one of expediency than of principle. The same applies to the question of whether ginning should also be separated from the Scheme. The mission recommends that cotton marketing and ginning not be entrusted to a separate authority until there is full assurance that efficiency of operations will be preserved.

Further suggestions concerning cotton are discussed in some detail in Annex III. They are relevant regardless of who is responsible for the sales organization. The most important concern: (a) a tightening of the Sudanese system of cotton standardization and classing; (b) the establishment of a modern cotton testing laboratory in Port Sudan; (c) a re-examination of present sampling procedures to determine their adequacy; (d) a revision and improvement of cotton market reports and statistical information services; (e) a critical appraisal of the productivity of the funds spent by the Sudan Publicity Committee; (f) an examination of the relative advantages of shifting cotton auctions from Khartoum to Port Sudan where most traders have their main offices and (g) the practice of stamping the grade on the bales should be maintained.

So far as selling procedures are concerned there appears to be no reason to abandon the system of public auctions which has been successful in the past. The mission must express concern, however, about the drawbacks of publishing the level of the reserve prices, which may cause rigidity in sales policies. Flexibility of reserve prices must be maintained. This will become all the more important if, as suggested in the following chapter, the broad decisions as to reserve prices are supervised by the Agricultural Committee of Ministers.

Finally, since quality and grade do imply substantial differences in sales price, it is in the general interest that they should be as high as possible. At present only the first "profit" payment to the farmers takes account of the grading at the ginnery. There is no apparent reason why all the payments to the farmers should not follow the same standard. This should act as an incentive to improve the quality of cotton production.
Other Crops. Groundnuts and wheat will expand further as a result of intensification. For over one half of the groundnuts and most of the wheat, the present Gezira Board is already partly involved in the marketing process. Its field staff assists in the management of groundnuts' cooperatives, and it facilitates transport and sales of wheat to the flour mills. There seems to be no reason why the Scheme management should not assume responsibility for marketing both these cash crops to the local traders or mills just as it should assume responsibility for seed distribution. The special expenditures incurred by the Scheme in selling or in assisting cultivation or even in granting advances to the farmers should, of course be deducted from the price paid to each farmer for his deliveries.

Possible improvements are discussed more fully in Annex III. So far as groundnuts are concerned, the main points would be: (a) continue to explore the possibility of establishing a small pilot plant for cleaning, sorting and shelling nuts in the Gezira; (b) test the feasibility of using hand shellers; (c) work closely with dealers, shellers and crushers in Khartoum to expand possibilities of marketing through private channels and (d) proceed with a systematic study of grading and quality control.

Other crops cannot be considered "cash crops" in the same sense as it would not be practical for the Scheme to handle their proceeds, and as a substantial part of the production is consumed by the producer and his family. Nevertheless, a few suggestions are in order.

Since export prospects for dura are not negligible, a grading system and eventually bulk handling will be necessary if the Gezira is to compete with the rainland mechanized farms where these facilities are being provided.

The marketing of livestock in the Gezira is mainly the concern of local traders and butchers, with some government inspection and supervision. It should be possible to improve procedures by (a) improved grouping and penning of animals, (b) regular reporting of prices and sales information when auction selling is feasible, (c) centralizing meat hygiene control under one authority, (d) since the Wad Medani market seems to be distinctly cheaper than Omdurman, enquire whether shipping live animals, particularly sheep, for export from Wad Medani would not open up attractive markets.

As to dairy products, the mission believes that the market could expand but a comprehensive study of costs, pricing and transportation problems should be undertaken forthwith in different sections of the Scheme. In addition, marketing would be made easier if a committee of representatives of the Ministry of Animal Resources and the Ministry of Health were to agree on (a) minimum standards of quality and hygiene, and (b) licensing of producers, processing centers and retailers.

Finally vegetables should be mentioned. They are grown for local
consumption and markets. The system of marketing in Khartoum Province has recently been studied in detail. It would seem that the margin between the price paid by consumers and those received by farmers appears high and it should be liable to some reduction. Marketing boards or cooperatives are probably not practical because of the perishable nature of the produce and because the producers are scattered over a wide area. On the other hand, encouraging contracts for sales of entire crops between producers and dealers should be considered seriously. They are common in other countries and the quality control which they imply may well operate in favor of both consumers and producers.

SUMMARY RECOMMENDATIONS

Machinery Ownership

Instruct the field staff to inspect carefully the work performed by all tractors whether owned by the Scheme or by private contractors.

Encourage the organization of a Contractors' Association to negotiate rates and work specifications with the Farmers' Union and the Scheme management.

Announce publicly that the Scheme management supports the present private contractors and that in the future it will be its long-term policy to encourage private contractors progressively to undertake the work now performed by the fleet belonging to the Scheme.

Encourage cooperative organization among holders of contiguous plots on one or several rotation units so as to make it possible for one of them to become a tractor contractor providing services to his neighbors.

Spraying

Continue the present system of spraying by air and announce publicly the Scheme's intention to do so for several years. Prepare the future spraying contracts on a regional basis when Regions are established.

Communications (Roads)

Improve maintenance of all roads whether they are within the jurisdiction of the Ministry of Irrigation or that of the Scheme. Give their local representative the right to close roads to traffic when they could be damaged by traffic after heavy rains or flooding.

Communications (Telephone)

Improve lines and exchanges wherever possible. Launch an engineering survey to compare cost of improving and extending telegraph and telephone lines with cost of establishing a network of radio telephones throughout the Gezira.
Transportation (Railways)

Make efforts to improve further the availability of rail transportation from the ginneries to Port Sudan. Stricter agreements with Sudan Railways allowing for greater flexibility in train schedules are necessary.

As regards the Gezira Light Railway, undertake three studies: first, to compare the cost of improving the present inadequate telephone network with the cost of developing the special network of radio telephones of the G.L.R.; second, to survey possible new loading and unloading methods; and third, to examine the possibility of accepting freight not directly related to agricultural needs.

Ginneries

Study the possibility of further modernization of the ginning factories, keeping in mind however, that present capacity, assuming good maintenance, appears sufficient.

Study carefully the performance of seasonal labor with a view to simplifying or standardizing some operations and possibly saving on manpower contracts.

Review the internal organization of the ginneries, establish clear lines of command and delegate more responsibilities by substituting factory "managers" for the "inspectors" now in charge.

Marketing Services

Cotton. Leave marketing (and ginning) an integral part of the Scheme's responsibilities until the government has full assurance that a new Marketing Authority would be more efficient than the present system.

Tighten the cotton grading procedures.

Establish a modern testing laboratory in Port Sudan.

Review and study the adequacy of the present sampling procedures.

Improve cotton marketing reports and statistical information service.

Reappraise the effectiveness of present appropriation by the Sudan Publicity Committee.

Study the possible advantage of holding auctions in Port Sudan rather than Khartoum.
Maintain the present auction system and the custom of stamping grades on the bales.

Maintain flexibility in reserve price policies and refrain from publishing reserve prices.

Make an attempt to pay farmers a price more closely corresponding to the grade of seed cotton delivered by them.

Other Crops. Make the Scheme management responsible for the marketing of groundnuts and wheat.

Explore the possibility of establishing a pilot plant for cleaning, sorting and shelling groundnuts (and the possibility of using hand-shellers).

Actively develop contacts with private groundnut dealers and crushers.

Study grading and quality control of groundnuts.

**Livestock**

Improve grouping and penning of animals in the markets.

Investigate possibility of developing auction sales and improving price reporting.

Centralize meat hygiene control under one authority.

As far as dairy products are concerned, several studies should be undertaken in different parts of the Gezira to investigate cost pricing and marketing as well as quality and hygiene.

Licensing of dairy producers and retailers should be actively considered.

**Vegetables**

Encourage contracts between producers and dealers for the sale of the entire crops from individual plots.
CHAPTER 4

ORGANIZATION AND ADMINISTRATION

Many years ago the Scheme ceased to be a "partner" in the financial arrangements. True, it covers its expenses out of a so-called "share" of 10 percent but since its share is subject to paying to the Government as "dividend" any excess income over and above actual expenses, the Scheme does not "share" in the profits in the same sense as government and farmers. In other words it manages the Gezira for the Government and is naturally responsible to it.

The main responsibilities delegated to the management of the Scheme relating to agricultural production have been outlined in the previous chapters. There are many others such as social development, developing new areas and assisting in the choice of farmers for them, etc. In addition the Government which provides the land and the water and the other basic investments, has delegated to the Scheme organization the duty to ensure that each farmer draws the greatest benefit from the land at his disposal. The reason for this delegation of powers is not really that the present Scheme has inherited the system organized by the Syndicates, but rather that a traditional and reasonable method of public administration is to place the management of special sections of the economy in the hands of "autonomous government agencies". This is as it should be. Two questions will be discussed in this chapter: first, the relationship with the Government and the top organization, and second, the internal administration of the Scheme.

A. Government and Board of Directors

Relationship with Government. The Board of Directors is responsible to the Council of Ministers through the Minister of Finance who thus acts as the link between the Scheme and the Government. The Council of Ministers as a whole appoints the Chairman of the Board, the Managing Director and a number of Directors, including the representatives of the farmers. Some Ministers individually appoint Directors, e.g. the Ministers of Finance or of Commerce and Industry. The Minister of Finance receives from the Board of Directors the budget estimates approved by it as well as financial statements and other reports. With the approval of the Council of Ministers, he has the power to change the allocation of expenditures as among various accounts, to amend any provision governing the supply of irrigation water and, more broadly, he "may give directions of a general nature to the Board in matters which appear to the Council
of Ministers to affect the national interest." 1/

In addition to the Minister of Finance a number of other Ministers are concerned with the welfare of the Scheme, and others like it, in the context of the broad policy matters which may call for Government decisions. It would be an advantage if consultation among them and coordination of their views on these issues became automatic. It is therefore suggested than an "agricultural committee" be created within the Cabinet, including the Ministers of Finance, Agriculture, Irrigation, Animal Resources, Commerce and Industry, Transport and Communications and Local Government. This committee would advise the Council of Ministers on matters of "national interest" concerning agricultural development and policies as well as broad marketing policies. It is not suggested here that day to day decisions as to the "reserve price" be a matter for the Committee of Ministers. The present arrangements involving the Gezira Board of directors and its sales office are adequate. But the general order of magnitude of the reserve prices as well as the timing of their changes - in other words marketing policies - are a matter of national interest. The directives issued by the Government on these matters would automatically be based on that advice and published in the Gazette. The mission does not believe that this need result in delays on important decisions but rather the directives given to the agricultural schemes (and other schemes than the Gezira would be involved) or to the Marketing Authority, if one is created, will represent the considered view of all the Ministers concerned. It is clear, however, that the subjects considered to be of "national interest" should remain exceptional and that the autonomy of the Gezira Board of Directors should be respected in all other matters.

Board of Directors. The coordination among Ministers suggested above is already realized within the Board of Directors at the technical level. Besides the Chairman and Managing Director it includes eleven other members: five farmers appointed on the recommendation of the Farmers' Union, two officials of the Ministry of Agriculture - one for agriculture and one for research - one official each from the Ministry of Irrigation, the Ministry of Finance and Economics, and the Ministry of Commerce and Industry and the Commissioner of the Blue Nile Province ex officio. This means that almost all the parties which are interested in the welfare of the Scheme have a voice in its general policy and have an opportunity to be fully informed of its problems. It would seem, however, that two more members could be added. A number of new agricultural schemes are now in the planning stage and the Gezira Board of Directors should be fully aware of the possible implications this may have for it. An official from the Planning Department of the Ministry of Finance, or from the Planning Board if one is created, could therefore be added. Moreover, the improvement and development of livestock in the area has become important and again an official from the Ministry of Animal Resources could be useful in the deliberations of the Directors. The mission suggests later in this Chapter that the Scheme be divided into

1/ The Gezira Scheme Act 1960, Section 15.
four regions. With five representatives of the farmers sitting on the Board, it would appear appropriate that one should come from each of these Regions.

Some seemingly minor matters of procedure may also be mentioned here. It is the wish of the Board of Directors to sit as often as possible in Barakat rather than Khartoum. This practice has considerable merit. It provides an opportunity for members of the Board to discuss with the officials some problems of immediate concern to them. The presence of the top officials of the Scheme during the meeting of the Directors is usually limited to the Managing Director who is ex officio a member, and in attendance, the General Manager (or Deputy Managing Director, if his title is changed), the Financial Controller and the Secretary. The mission recommends that more high officials of the Board be invited to attend on a regular basis and not only when matters directly concerning them are discussed. This would include the new Regional General Managers and the three or four top officials at Headquarters. It would not only raise their status but also make them fully conversant with the views of the Directors.

Furthermore, the task of the Board could be lightened if most secondary administrative matters did not need to be brought to its attention. True, the budget must be approved by it and faithful adherence to its terms must be enforced. But by including in it a modest contingency fund one would avoid the need to refer to the Directors all unforeseen expenses which are even slightly in excess of the original forecast. This fund would be at the disposal of the Managing Director subject to his reporting to the Directors on its use. Finally, should the Chairman be incapacitated or unable to attend, a Deputy Chairman must be designated. It is suggested that the Managing Director automatically be Deputy Chairman for that purpose.

B. Administration

One cannot but admire the manner in which the present Scheme management handles the countless duties incumbent upon it. They have to be administered from one central office although both the area and the number of people involved are considerable. The following comments should therefore not be considered as a criticism of the present organization but only as recommendations for improvements. The Scheme has reached a size where more delegation of responsibility would lighten the burden of its staff. All policy decisions are made either by the Board of Directors or by Management but one may well ask whether the execution of these decisions should rest with the same people who have reached them after careful study or be entrusted to officials who are closer to the field. In addition a considerable amount of detailed work is dealt with at headquarters which probably leads to higher administrative costs than actually necessary and tends to delay the
availability of information. The time has now come when decentralization would be a distinct advantage. A number of operations could be carried out better or at least just as well if some responsibilities were delegated by headquarters to regional authorities.

Organization by Regions. One can visualize four regions, two for Gezira Main and two for Managil, each encompassing about 400,000 or 500,000 feddans. Direct responsibility for the groups and blocks in each region would be entrusted to a "Regional General Manager". The groups and blocks would not need reorganizing. The following responsibilities could be given to the regional management: crop production, accounting and control, payroll, extension, experimental and demonstration units, tractor operations, civil engineering, road and transport maintenance, stores and purchasing in accordance with general purchasing policy etc. (for details see Annex IV). Decentralization should allow for the agricultural management to adapt more closely and more quickly to local conditions. It may in some respects entail slightly higher expenses (perhaps for buildings) but on the whole one should expect some savings per unit of production. Regional administration would in addition provide more opportunities for the executives of the Scheme to undertake new and broader responsibilities and to develop their talents. Supervision of regional operations by central headquarters would be a matter of course and so would continuous reporting by the regions. This added flexibility would become all the more important as the advisory functions of the Scheme develop and assistance to the farmer increases for crops other than cotton.

Finally, an improvement and increase in the statistical and reporting organization at Barakat would be the consequence and more emphasis could be given to agricultural economics in this division.

Central Headquarters. Headquarters would be in charge of all policy decisions, supervision and planning and central services, including central accounting. The Managing Director, rather than being assisted by a General Manager, could preferably have a Deputy Managing Director who would assume all his duties in case of his absence and be fully familiar with all phases of the operation. These two officials would instruct and supervise the four Regional General Managers and, in addition, be assisted at headquarters by the General Manager, Central Services and the General Manager, Agricultural Services and Planning, who would be responsible for all central operations and policy recommendations applicable to the area as a whole and supervision under the authority of the Managing Director. Details of their functions and the divisions under them are summarily described in the outline organization chart attached to this report. The Financial Controller and all central financial services could be placed either directly under the Managing Director or under the General Manager Central Services. The Cotton Marketing Manager would also come directly under the Managing Director, that is unless a Cotton Marketing Authority is
organized, in which case the whole cotton marketing organization would of course be transferred to that Authority.

The present system of committees can easily be adapted to regional organization but liaison with regions, Agriculture, Research and Irrigation is a basic necessity. Technical staff committees should therefore be encouraged where participation would include, besides Management and regions, the Ministries of Irrigation, Agriculture (including Research and Extension), and Animal Resources. Furthermore, three new standing internal committees should meet at frequent intervals. These would be a Coordinating Committee, where all top officials would meet under the chairmanship of the Managing Director, a Farmers' Consultative Committee, where group managers and farmers would meet under the chairmanship of the Regional General Manager, possibly with headquarters' officials in attendance, and third, an Agricultural Techniques Conference under the chairmanship of the General Manager, Agricultural Services and possibly with representatives of Research and the Ministry of Agriculture in attendance.

Emphasis on Agriculture. Besides decentralization there would be an advantage in streamlining. Not all the activities of the Scheme management can be said to relate directly to agricultural production which is and should remain its main field of activity. As mentioned above, suggestions have been made in the Sudan, that marketing, and perhaps ginning, could be entrusted to autonomous government agencies to be created. This mission's opinion has been recorded above. Assuming - and this is a most important assumption - that efficiency can be preserved, these two operations could be carried out independently from the Gezira Scheme without harm to the farmers or to the nation.

Social development is another department which is not exclusively agricultural. Some of its activities clearly belong to the Scheme, namely animal husbandry, horticulture, forestry, the Village Farming Experiment, training schools, cooperatives. But a number of them concern exclusively the welfare of the residents and their families. Anyone who was privileged to be a witness to some of the social work done by this Department must express admiration for its achievements and the Scheme management is rightly proud of them. The problem is not whether these activities should be continued - if anything they should be extended further - but the responsibility for purely social operations seems to rest logically with the Local Government rather than with the Scheme. The mission does not recommend a hasty transfer of responsibility to Local Government but contemplates that Local Government could take over the strictly social functions of that Department within a period of say 3 to 5 years, while its agricultural operations could be entrusted to the General Manager, Agriculture Services at headquarters. To facilitate the task of the Provincial Government the "Gezira Local Committee" should be maintained. It is now chaired by the Commissioner and includes farmers and various Government officials. Its functions as an adviser
in social development could and should be preserved after the transfer of responsibility.

Other Suggestions. There are also a number of steps that could be taken to simplify and increase the efficiency of the Scheme administration. Mostly they relate to such matters as accounting and cost accounting and will be dealt with in Annex IV.

Finally, in line with the suggestion to have the Gezira Board concentrate on agricultural problems there might be an advantage in changing its name. The present words "Gezira Board" are well-known and have a well-earned prestige of their own. It is therefore with some hesitation that the mission recommends a new title, namely "Gezira Agricultural Scheme". The point is only to underline the importance of its agricultural functions and to avoid confusion between the Scheme itself and its "Board" of Directors.

Timing. A reorganization as extensive as the one outlined here cannot be carried out overnight. Careful planning is necessary if confusion and overlapping are to be avoided. The mission is of the opinion that a year is needed merely to define accurately the functions of each of the incumbents and the manner in which this should proceed. The manuals existing at present in the Gezira are a good example of how the future instructions could be drafted. Particularly important will be the definition of the accounting and reporting procedures at regional level. It should be pointed out that, in addition, new financial arrangements suggested in Chapter VI may be put into force at about the same time. Although they should eventually simplify the farmers' accounting at the block level, their introduction in combination with the passage from a centralized to a regional system would increase the transition problems for accountants, clerks, inspectors and controllers. Finally, a new organization will require new appointments or promotions, adding advisers (e.g. in the extension field) and generally giving some training even to the high-ranking officials at group level. In short, the mission feels that it would be reasonable to foresee that implementation would be completed about two years after the decision is announced to carry out the reforms suggested.
SUMMARY RECOMMENDATIONS

Government

Establish an "Agricultural Committee of Ministers" including the Ministers of Finance, Agriculture, Irrigation, Animal Resources, Commerce and Industry, Transport and Communications and Local Government to co-ordinate the preparation of government directives on agriculture production, development and marketing where "national interest" is involved and to advise the Council of Ministers in these matters.

Publish the government directives on agricultural matters of national interest in the Gazette.

Board of Directors

Add to the Board of Directors of the Gezira Scheme one official of the Planning Department of the Ministry of Finance (or of the Planning Board if one is created) and one official of the Ministry of Animal Resources.

Select the farmers who are to be members of the Board of Directors in such a manner that they will originate from different parts of the Gezira (e.g. the four Regions to be organized).

Make the Managing Director Deputy-Chairman of the Board of Directors.

Hold as many Board of Directors meetings as possible at Barakat rather than Khartoum.

Ask more top officials of the Scheme to attend meetings of the Board (e.g. Regional General Managers and Headquarters General Managers).

Include in the budget a contingency fund which would be at the disposal of the Managing Director.

Internal Administration

Decentralize management by dividing the Scheme into four Regions which would be responsible for all the tasks which do not need to be centralized, including management of the Groups and Blocks.
Leave with central headquarters responsibility for central financial services, all other central services and, of course, agricultural policy, planning, development and supervision.

Improve the statistical and reporting organization at the center and add to it a section on agricultural economics.

Give the Managing Director the assistance of a Deputy Managing Director rather than a General Manager.

Encourage the inclusion of representatives of the Ministries of Agriculture (including Research and Extension), of Irrigation and of Animal Resources in the technical committees of the Scheme when practicable. Organize a Coordinating Committee including all General Managers at headquarters level, a Farmers' Consultative Committee at regional level, and an Agricultural Techniques Conference to assist the General Manager, Agricultural Services.

As mentioned in the previous chapter, allow the separation of cotton marketing -- and possibly ginning -- from the Scheme but only when efficient operations are fully ensured.

Prepare for the separation from the Scheme of the strictly social activities of the "Social Development Department", which could logically be transferred to the Provincial Government. In case of transfer, preserve the status of the "Gezira Local Committee".

Consider changing the name of the "Sudan Gezira Board" to "Gezira Agricultural Scheme".
CHAPTER 5

THE FARMER

The farmer is, of course, the man who actually grows the crops. Much has been said and written to explain his attitudes and his hopes, the sum of it indicating that considerable unrest exists in the farming communities, and that the main issues revolve around the position of the farmer in the Scheme. The facts are that considerable changes have taken place, particularly over the last ten years. The near doubling of the irrigated areas, along with the doubling of the tenancy holders, would have been enough to raise new issues, but in addition yield stagnation and more recently the threatening further decline in cotton prices have introduced an element of anxiety concerning the farmer's future. This raises the fundamental point that the morale and motivation of the farmer is a vital factor of production. There are social problems in the Gezira which are associated with the economic issues, and the size of the population dependent directly or indirectly on Scheme production makes it essential to the future of the Gezira that the issues be settled.

The central issue, it seems to the mission, is one which is found in any society where a large group of people is engaged in the same endeavor or profession: how much can they be reasonably expected to contribute to the nation (or the Scheme which is owned by the nation) and how much can they reasonably expect the nation (or the Scheme) to contribute to them. Obviously, a meaningful answer to this question must vary with time. The human element is the variable determining factor, in that the contribution of the farmers will depend largely on the satisfactions they in turn can expect.

After extensive discussions with all concerned, the mission feels that it has reached conclusions which could provide the basis of a satisfactory resolution of the issues, to which all parties could agree and which could remain valid for a long period. The crux of the matter is easily stated: more incentives to the farmer. In the present chapter an attempt is made to summarize the main elements bearing on the farmer's position in the Scheme: first, by considering the relationship between the farmers and the land allotted to them, the Scheme Management, their village and the labor force; second, by analyzing their income and financial position; and third, by suggesting ways of relating income more directly to production, thus making clear the direct link between reward and individual effort.
A. THE FARMER AND HIS SURROUNDINGS

1. The Land

The history of land ownership in the area is well known. Before the Scheme was launched, land registration identified the original owners and the State received the right to either purchase or rent that land. The prices paid may appear low today but it must be remembered that they apply to non-irrigated land and that the irrigation was contributed by the nation. Before the opening of the canals, part of the land was cultivated under rainfed conditions. Some of the residents owned cattle, some grew dura; some were engaged in both activities. Among the original landowners, some worked the land themselves but quite a few were chiefs or other prominent persons who used laborers or servants for that purpose.

Having been purchased or rented, the Gezira land was redistributed to the tenant-farmers 1/, and priority in allotments was given to the former landowners, up to a maximum of 80 feddans, 2/ after that to their "nominees" or to residents of the area. The same system prevails today for the extensions which are now being developed by the Scheme.

In the course of time more and more land was purchased by the Government but about one-third is still leased by it from the original landowners. It may be mentioned incidentally that in the legislation, this lease was supposed to be for 40 years renewable. The mission suggests that since, in a number of cases, this period has now elapsed, it would be wise for the Government to take action to officially renew the lease for another period of say, 40 years, in order to avoid any confusion or future contestation.

Land in the Scheme is placed at the disposal of the farmer for a period of one year renewable 3/ and originally the farmer signed a so-called "tenancy agreement" every year. Since the 1950's, however, this agreement has not been signed by the farmers. This has had no adverse effects because legislation on the one hand and tradition on the other

1/ They are usually called tenants but in this report we have consistently used the word "farmer" which is closer to the Arabic "Musari".

2/ 80 in Gezira Main and 60 feddans in Managil.

3/ Cf. Section 15 of the 1941 Standard Conditions of Tenancy.
clearly implied that the farmer's right to till a given unit of land was renewable automatically and without time limit. If, however, the farmer is found guilty of neglect in the cultivation of his crops, or in not following the instructions of the Scheme officials, the Scheme may initiate action to terminate the tenancy. In other words, the farmer's right to cultivate the land allotted to him can only be terminated if he is evicted or if he abandons the land of his own accord. Even in the case of death, preference is given to his heirs to succeed him in his rights. While the conditions of termination of "tenancy" have merit and must be preserved, it may be wise to eliminate the confusion which may arise from the legal definition of the farmer's title as valid for "one year renewable". There would be some advantage in recognizing the present position of the farmer by clearly stating (in any new legislation or administrative document) that the farmer is entitled to keep the tenancy units allotted to him on a permanent basis, subject only to the restrictions mentioned above (eviction or abandonment). On the other hand, since his title is not the same as the legal title of a landowner, it is legitimate to maintain the existing provisions barring mortgages on tenancy units.

2. Relationship to the Scheme Officials

The daily relationship between the farmer and the Scheme officials, including the inspectors and the accountants deserves some comments. Some of the functions of these officials are considered quite natural and are now part of the established tradition. Such is the role of the Block office as paying agent through which all cash payments are made to the farmer, such are also all the agricultural and related operations for which the Scheme officials are responsible, irrespective of whether they are "Joint Account" or "Board Account" items, for instance deep ploughing, spraying, ensuring the water supply at the appointed time, providing seeds, sacking and fertilizer, transportation, ginning and marketing and, of course, administration. The farmer also expects the assistance of the field staff to help him find contractors for such operations as cross-ridging or find hired labor, or help run the groundnuts cooperative, or be aware of village requirements for social services.

Difficulties arise, however, where the field staff exercises its supervisory functions, either directly or through "samads". The Agriculture Chapter has described at some length not only the restraints under which rotations should be organized but also the great care which must be exercised at every stage of the cotton crop. The inspector gives instructions. He can also reprimand and impose sanctions. Eviction is the hardest one and is only carried out after due notice and consultation with the Village Council and the headquarters of the Scheme. Others include fines (e.g. when water is allowed to spill over the road), toulba (i.e. work ordered by the inspector and carried out by hired labor at the expense of the farmer) and sometimes cutting off water from the dura fields. Eviction,
fines and toulba cannot be avoided: they are indispensable for the common good. The mission recommends, however, that the water sanction should be discontinued. The important point is not the possibility of imposing sanctions but the personal relationship established between inspector and farmer. Too often the inspector is considered simply an agent in charge of discipline. The problem is largely one of changing human attitudes. It is to this end that the field inspectors should become field advisers, as recommended in Chapter 2. They should be fully conversant with agricultural techniques in all crops as well as cotton, and even with local traditions and dialects. This should help convince the farmer that the field staff is there to help and teach, not only to supervise.

3. Village Councils and Farmers' Organizations

The main instruments of the policy of devolution which was initiated many years ago are the Rural Councils, and, at a lower level, the Block Councils and the Village Councils. The functions of the latter as an intermediary between the farmers and the staff of the Scheme — field advisers and Block inspectors — are of the utmost importance. Not only is the Village Council a meeting ground for all sorts of technical discussions, its advice on such matters as evictions is a guarantee of better understanding. The mission was pleased to learn that new local elections were being considered for the near future and sincerely hopes that the Village Councils will more fully play the role assigned to them.

It is of course not possible for the local councils to take a leading role in deciding on rotations and similar technical matters. These must be left to the Scheme management which alone is aware of all the restraints imposed by an irrigation regime and other soil and climatic conditions.

Another channel through which the farmers can make their voice heard is the Farmers' Union. In 1947 a Tenants' Representative Body was formed and it was succeeded in 1952/3 by the present Farmers' Union. The latter played a considerable role in negotiations with the Scheme management for many years. Since 1964 they are represented on the Board of directors and they have now (since October 1966) five seats. This should be a great help in informing the Scheme management of the wishes and concerns of the farmers and at the same time making the farmers fully aware of the agricultural and financial policy issues the Scheme is confronted with. Since the problems may vary from region to region, it has been suggested in Chapter 4 that of the five farmers representatives on the Board of directors four should originate on a geographical basis, one from each Region.

4. Labor

The originators of the Scheme had assumed that a high proportion of the work would be performed by family labor. Over the years, however,
it has become the custom that most farmers hire labor, particularly for picking and pulling out cotton, and also during the sowing and weeding seasons. In recent years planning has aimed at increasing the proportion of the work performed by the farmer's family. The size of the Managil tenancy was determined accordingly (5 feddans cotton). The half-tenancy in the Gezira Main should also allow for more family work. But these hopes have in part been disappointed. Even in the standard Gezira tenancy of 10 feddans cotton, one could have expected a larger contribution by the farmer's family than is the case now. All sources agree that in general a high percentage of the work is done by hired labor. The margin of uncertainty is, however, considerable. The following estimates based largely on the findings of the Working Party can only be considered indicative:

TABLE A: Approximate Percent of Work Performed by Hired Labor

<table>
<thead>
<tr>
<th></th>
<th>Low Estimate</th>
<th>High Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managil 15 feddans</td>
<td>50%</td>
<td>75%</td>
</tr>
<tr>
<td>Gezira 20 feddans</td>
<td>25%</td>
<td>75%</td>
</tr>
<tr>
<td>Gezira 40 feddans</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Other Crops</td>
<td>67%</td>
<td>67%</td>
</tr>
</tbody>
</table>

Overall about 70/75% 85%

Two reasons may help explain this situation. One is that strongly rooted social traditions have had a considerable influence in this respect. The other is that since the beginning of the Scheme people of different origins have flocked to the area, keeping wages low and encouraging even the poorest farmers to rely on hired labor. Some of the workers reside locally and are interested in a regular and extended period of work during the year; they constitute about 40 percent of the labor force at picking time, the busiest season. Others are neighboring Arabs, largely from the Right Bank of the Blue Nile, who may come to the area with their cattle for a few months, look for seasonal forage for their animals and occasionally even take care of the farmers' cattle when they leave after picking or cleaning up time. They represent 35 to 40 percent of the labor force at picking time. Finally, Westerners contribute about 25 to 30 percent
of the cotton pickers. Quite a few are pilgrims, but for others it is customary to travel to the Gezira after their own harvest. They usually come without their families. Their recruitment is either handled by farmers, often representing several villagers, or by the Government and the Scheme management when shortages are feared. The Government offers them transportation facilities through railway warrants.

Competition among farmers for recruiting pickers seems to be less in the form of wage rates than in the form of incentives and additional facilities (food, advances, grazing rights, gifts,) which may become a rather heavy burden on the employer.

The numbers involved are high and figures for pickers are available from S.G.B. Annual Reports. In recent years the highest on record was 396,590 pickers (1961/2). In 1966 the number was about 280,000 hired labor in addition to 150,000 tenants and members of their families.

The question is often raised of whether the productivity of labor is high enough and whether the work of the pickers is supervised closely enough, but it was not possible for the mission to form an opinion on this point. On the whole, however, a sufficient number of pickers has been obtained even during the most recent peak years, and the cost of labor does not seem to have increased more than other costs. In short, manpower seems to be available.

On the other hand, the continuity of manpower availability is a matter of some concern. As and when agricultural development proceeds in other parts of the Sudan, and more particularly when the irrigation projects on the Right Bank of the Blue Nile become a reality, it is likely that some laborers now working in the Gezira will be induced either to settle as farmers or to look for work in these new projects. True, the rate of population growth in the Sudan is such that an overall manpower shortage does not appear likely, but temporary shortages in the special categories which are required for seasonal work in the Gezira and other potential cotton growing areas are definitely possible. This should be taken into account in the planning of the new irrigation projects.

This should also be an incentive to the farmers to increase the labor input of their families. Hired labor cannot be completely replaced but there is general agreement that more fieldwork could probably be carried out by many of the farmers' families in Gezira Main, and even in Managil where the family participation is already higher. This issue will become even more pressing if the intensified rotation suggested by the mission is realized in practice.
B. THE FARMER'S INCOME

Many social changes have taken place in the Gezira over the years and the farmer now enjoys a privileged social status. That he appreciates this status can be illustrated by a few instances. One is the concern that his children get an education. Another is the wish of many farmers that their children remain settled in the irrigated area, and this is easily explained by a casual comparison between the straw huts of the villages outside the Gezira and the brick houses in the Scheme villages, a symbol of improved standard of living. Moreover, illegal sales and transfers of "tenancies" which are said to occur from time to time emphasize the positive economic value attached to the position of "farmer". Another factor considered as a privilege is that in the Gezira the only taxes the farmer pays to the Local Councils are on houses and animals, while in neighboring areas land and crops are also subject to taxation; however, there is an explanation for this apparent exemption, namely that the proceeds of the Gezira cotton crop are shared between the farmer and the government. As a result of these status factors the attitudes and accepted social obligations of Gezira farmers are to a large extent unrelated to differences in individual income.

Prosperity among farmers differs greatly. At one extreme is the entrepreneur-minded farmer, generally the holder of more than one unit, managing his land directly or through an employee, but possibly receiving most of his income from other sources. At the other extreme is the smallholder, living off his farm, trying to observe the standards of a gentleman-farmer but actually finding it difficult to raise himself above the level of paid labor. In between fall gradations caused by such factors as farm size, farming skills, the proportion of work performed by the family, etc. This simply means that there is no "typical" farmer. In estimating farmers' income therefore one can only try to roughly estimate "average" positions. The following computations may not be meaningful from the point of view of an individual farmer but they are useful in assessing the relative prosperity of the farmers in relation to the Scheme as a whole.

1. Crop Income

The amount of income accruing to the farmer is a matter of current controversy and the figures quoted here can only be rough indications. A basic distinction must be made between cotton, the proceeds of which are distributed among the two so-called "partners" (farmers and Government), and the proceeds of other crops which accrue entirely to the farmer.

Out of the gross proceeds of the cotton sales a deduction is made under the caption "Joint Account"; this includes a great number of common expenditures, from marketing and ginning down to spraying, provision of seeds and deep ploughing, etc. The balance after this
deduction is called "Gross Profits" and is now distributed as follows: 10 percent to the Gezira Board, 38 percent to the Government (including 2 percent to Local Government), 50 percent to the farmers (including 2 percent to a Reserve Fund), and 2 percent to the Social Development Fund.

This is the distribution of proceeds for the crop year 1965/66 as announced in July 1966. It was announced at the same time that the advances made to the farmers for picking would be included in the Joint Account, i.e. charged to all the "partners" instead of being charged individually to each farmer. Over the last 6 or 7 years a number of changes had taken place, always intended to improve the relative position of the farmer. Thus in 1963/64 the farmer's share had been raised from 44 to 46 percent and the cost of ploughing added to the Joint Account.

The Government's share is meant to cover all government expenses, in particular the cost of carrying out irrigation and remunerating the capital invested in the irrigation works. As indicated in chapter 4, the Board's "share" (10 percent) is not a partner's share. It covers its own administrative expenses, including £2,000,00 paid to government representing 6 percent interest on the capital paid by the Government at the termination of the concessions and a contribution of £75,000 to Agricultural Research. In keeping with its true status as an autonomous government agency, any surplus over its expenditures is paid over to the Government as dividend, and any deficit is covered by government advances.

As to the farmers' share it now amounts to 50 percent, of which 2 is paid into the Reserve Fund and 48 into what is called the Farmers' Collective Account, to be distributed among them on the basis of their cotton deliveries. Substantial deductions have, however, to be made from each farmer's share since various advances have usually been extended to him by the Scheme. They represent part of the cost of production which is incumbent upon the farmer himself but for which he does not have enough cash available (sowing, cultivating, watering, picking, cleaning-up). Now that ploughing and picking advances are included in the Joint Account, these deductions will be greatly reduced. It can be mentioned in passing that the Reserve Fund is more and more frequently paid out to the farmer in the same year in which it has been set aside.

An important feature of the system is that the payments to the farmer are spread over time and divided into two categories. The first three payments, representing roughly 60 percent or more of the expected farmer's share, are called "Profits" and made between the end of the picking season and the end of the calendar year. Further payments are made later (in fact, when the following crop is being picked) when a clearer view of the real sales proceeds is available and are called "Appreciation".

In trying to estimate what the income of the farmer may be under present circumstances, one must make assumptions as to the amounts
represented by field costs. In the table below the assumption will be that some 85 percent of the field work is done by hired labor (a conservative estimate). Moreover, assumptions must be made as to output of and income accruing from the crops other than cotton on which no partnership sharing system exists (see Annex to this Chapter). Under those assumptions and on the basis of actual sales prices and yields in 1964/65, the total net income of the Gezira farmers could be estimated at £S 2,850,000 or if "frozen" advances are taken as farmers' income, at £S 8,020,000. This is illustrated in Table B.

TABLE B: Gezira 1964/65: Aggregate Gross Output, at Farm Prices, and Farmers' Net Income

<table>
<thead>
<tr>
<th>Area</th>
<th>Gross Output at Farm Prices</th>
<th>Farmers' Net Income</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousand Feddans</td>
<td>£S thousand</td>
</tr>
<tr>
<td>Cotton</td>
<td>508</td>
<td>16,340</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>60</td>
<td>1,080</td>
</tr>
<tr>
<td>Wheat</td>
<td>75</td>
<td>638</td>
</tr>
<tr>
<td>Dura</td>
<td>255</td>
<td>2,104</td>
</tr>
<tr>
<td>Gardens</td>
<td>24</td>
<td>369</td>
</tr>
<tr>
<td>Livestock</td>
<td>1</td>
<td>328</td>
</tr>
<tr>
<td>Total Irrigable Area</td>
<td>1,782</td>
<td>20,859</td>
</tr>
<tr>
<td>Plus: Frozen Debts</td>
<td>5,169</td>
<td></td>
</tr>
</tbody>
</table>

1/ No specific allocation of area is possible. Balance between total irrigable area and crop areas listed is made up as follows (in thousand feddans): Lubia 71, Forest Plots 5, and Fallow 784.

2/ Farm value of cotton crop per feddan as shown in Table 1, item (5) of Annex to this Chapter, i.e. £S 32.15 x 508.228 feddans

3/ Assuming 85% of all labor at farm level done by hired labor which is probably a high estimate.

4/ Farmers' net income per feddan from cotton crop as shown in Table 1 of Annex to this Chapter, item (10), i.e. £S 3.19 x 508.220 feddans.

5/ Due to special government action, tenants' debts against the 1964/65 crop were "frozen". The mission estimates that the total "frozen" advances amounted to £S 5,169,000 corresponding to an average of about £S 8.3 per feddan under cotton, £S 1.7 per feddan under dura, and £S 7.- per feddan under wheat.
To arrive at some idea of what the income per farm unit may have been in the same year (1964/65), the mission has made computations which are based mainly on estimates made by the Working Party and on the actual accounts of the Gezira Board. Detailed figures are given in the Annex to this Chapter (Farm economics). In summary, assuming 85% of the work is performed by hired labor, the total net income after farm production costs would be:

<table>
<thead>
<tr>
<th></th>
<th>Cotton</th>
<th>Other Crops</th>
<th>Total per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managil 15 fed. unit</td>
<td>15.95</td>
<td>17.19</td>
<td>33.14</td>
</tr>
<tr>
<td>Gezira 20 fed. unit</td>
<td>15.95</td>
<td>17.19</td>
<td>28.69</td>
</tr>
<tr>
<td>Gezira 40 fed. unit</td>
<td>31.90</td>
<td>22.24</td>
<td>54.14</td>
</tr>
</tbody>
</table>

1/ Wheat seems to give a negative result in 1964/65 in the southern part of Gezira but not in the north.

It should be kept in mind that these approximations are very tentative and probably conservative. But even so, it is clear that in 1964/65 the farmer's income was not high. This provided background for the government's decision to "freeze" the farmers' debts to the Scheme. One can estimate that on the average this must have raised the net cash income per unit roughly as follows on the same assumptions as above:

<table>
<thead>
<tr>
<th></th>
<th>&quot;Frozen&quot; Advances</th>
<th>Total Net Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managil 15 fed. unit</td>
<td>45.60</td>
<td>78.74</td>
</tr>
<tr>
<td>Gezira 20 fed. unit</td>
<td>56.15</td>
<td>84.84</td>
</tr>
<tr>
<td>Gezira 40 fed. unit</td>
<td>112.30</td>
<td>166.64</td>
</tr>
</tbody>
</table>

If the new profit sharing announced for 1965/66 had applied in 1964/65, the results would not have been as favorable as after the freezing but they would have been materially improved because the picking advances would have been charged to Joint Account and the tenants' share (including Reserve Fund) raised to 50 percent.
On the basis of the highest assumption in regard to the proportion of work entrusted to hired labor (85%, see Table A above), the new formula would have resulted in an improvement of £S 3.17 per cotton feddan, £S 15.85 for a 5-feddan holding and of £S 31.70 for 10-feddan cotton (see Annex). In other words, the total income would have been:

- For a Managil 15 feddan holding: £S 48.99 instead of £S 33.14
- For a Gezira 20 feddan holding: £S 44.54 instead of £S 28.69
- For a Gezira 40 feddan holding: £S 85.84 instead of £S 54.14

Even these improved figures are not high remembering that these are usually family incomes. However, those estimates do not fully reflect the true position of the farm family. First of all, whenever more work is performed by the farmer and his family, the income rises steeply. Second, individual "farm" income figures do not give a true indication of the extent to which "farmers" earn their livelihood. The larger farmer frequently has other sources of income and among the smaller farmers there is often more than one tenancy unit in the same family. The fact remains nevertheless that the additional earnings which a farmer can count on as a result of added work on his part are not much higher than the wages he would have paid to have the work done by others. This overall picture underlines once more the urgency of rapidly increasing output and income in the area.

2. The Credit System

The Gezira farmers benefit from a rather complex but complete system of short-term crop-production credit. As regards cotton, it has been the responsibility first of the Syndicate and later of the Gezira Board.

First, all costs of all collective operations involving technical inputs for cotton are covered by the Scheme management and accounted for in the "Joint Account" to be shared between partners. The average for 1961-1965 was £S 8.4 per feddan of cotton for farm operations and £S 6.3 for ginning and marketing.

Second, the Gezira Scheme also helps the farmer with "individual cash advances" usually covering part of labor costs but sometimes helping him in poor years; this amount varies greatly from year to year. During the last five years, the minimum was £S 3.4 and the maximum £S 10.7 per feddan. All these operations are interest free.

For "other crops" there is no such regular credit system; but facilities are also available to the farmer:

Dura: the farmer is entitled to obtain, from the Block Inspector, credit for ploughing and fertilizer. Little use is being made of this facility perhaps partly because substantial advance notice is necessary.
Wheat: as this is a highly mechanized crop, practically all operations and inputs are covered in full by advances from the Scheme (about £S 7 per feddan).

Groundnuts: credit is not the responsibility of the Board, but of the "Agriculture Bank" which grants short-term advances to marketing cooperatives about one month before harvesting until crop disposal. The loans covering about 75 percent of the probable value of crop (about £S 13 per feddan), are guaranteed by the crop which is sold under the Bank's control. Interest rate is 6 percent.

As concerns farm equipment, credit operations are not usually handled by Government agencies. The purchase of tractors and machinery has been mostly assisted by the sales agents. But both the Scheme and the Agriculture Bank have helped in the purchase of wheat-combines through loans to farmers' cooperatives. The latest figures are a total of £S 44,000 from the Bank at 6 percent interest and £S 22,000 from the Scheme. Until 1965/66 neither the Scheme nor the Bank had experienced difficulties in obtaining repayment of advances, thanks to their control of crop marketing.

In short, the agricultural credit system available in the Gezira seems adequate. If industrial or livestock organizations required new investments, it is likely that the facilities of the Agricultural Bank or perhaps of the Industrial Bank or the local banks would be available.

Consumer credit is a different matter. Private indebtedness (sheil) is an important part of the social pattern and tradition in the Gezira. This type of loan is usually sought by the farmer from retail traders or wealthier farmers for subsistence or consumption expenditures. While not apparent, the burden of interest arising therefrom is extremely high. It is noteworthy that these debts are not necessarily associated with poor years or misfortune. They are higher in years of good cotton crops, and they are incurred frequently in connection with social events within the family, (weddings, pilgrimages, etc.). The law does not allow the farmer to mortgage crops any more than land, but sheil means that a crop (mostly dura or groundnuts) is in fact sold in advance and it is not surprising if this results in neglect of the field and poor standards of cultivation. This is perhaps also one of the reasons why nearly half the groundnut crop is sold outside the cooperatives and indeed at much lower prices. It is even said that "sheil" may be one of the reasons why some cotton is sometimes smuggled out or transferred to other farmers.

The mission is aware of the social problems involved but does not feel that it is in a position to make positive suggestions in this respect. It can only hope that with the expansion of the savings account system of the Post Office, and of the commercial banks, the habit to save may spread. It is not inconceivable that small savings linked to the
possibility of receiving small loans may encourage thrift among the farmers in spite of the traditional objections to interest rates.

C. POSSIBLE INCENTIVES

The philosophy of the Scheme is expressed in the present financial arrangements. They reflect the basic idea that Government and farmers share as partners in the proceeds of one crop, cotton. The division of these proceeds is naturally enough a matter of continuous controversy. It is not only a matter of percentages, the main difficulty is that until now the efforts made to demonstrate to the farmer that the Sudanese nation provides both capital and resources such as water and land and that it is entitled both to recovery of these expenses and to a return on its investment have not been successful. And, indeed, under the present system, the remuneration to the Government varies from year to year. The farmers, therefore, instead of recognizing that they are in debt to the State for its services, tend to feel that the Government simply takes a share out of the income produced by their own work. To them the basic fact is that their own income does not rise in direct proportion to their production. In other words, the principle of partnership (or share-cropping) is not attractive to them even though it is an old tradition of the Sudan. One cannot help feeling that this misunderstanding may well be at the root of the stagnation in yields. The collective large scale operations of the Gezira Board are in general carried out quite efficiently but, as has been mentioned before, operations at the farmer's level cannot be said to be generally satisfactory.

Solutions have been openly debated in the Sudan. One of them would be to strengthen the authority of the Board, and to give it more responsibility and authority over the farmer, including stricter regulations, larger powers to impose sanctions such as eviction, etc., in one word, to increase the "discipline". Another suggestion would be to rely on the collectivity of the farmers to elect their own cooperative management which in turn would have to carry the burden of all the functions now assumed by the Board.

The first one raises a great number of human, political and technical problems. It would, in fact, tend to establish a "plantation" or "estate" system which would deprive the farmers of their present status. The second would either imply the same type of discipline as the first or encourage a disregard for the necessary restraints imposed by irrigation, rotations and crop management. It would also tend to neglect the legitimate interests of government and nation whose support is necessary in terms of administrative, technical and financial assistance and who must be recognized as the owners of the Scheme.
A third solution is favored by the mission. It involves building up the sense of initiative and responsibility of the farmer to induce him to tend his crop more carefully and to increase production and thus improve his income by making it increase in direct proportion to his yield. The means by which such a policy could be implemented include the following, besides improved extension and demonstration efforts recommended in Chapter 2: (1) the physical identification and consolidation of the "holding" of each farmer; (2) acknowledgment of the possibility to transfer holdings and increasing their maximum size; and last but not least (3) better money incentives, which would make the farmer more completely and directly interested in the size and quality of his production.

1. Identification of holdings

The consolidation of each farmer's holding in one contiguous and compact plot (including cotton, other crops and fallow) is considered essential by the mission. The "tenant" will consider himself a more responsible "farmer" if he can be sure of continuity of tenure on the same land, if he is responsible for the weeds carried over from season to season and for all cultivation operations on the same land from year to year.

One difficulty would be that large scale operations, now carried out by the Board, may become more complicated and therefore slightly more expensive. The simplification of rotations examined in Chapter 2 and its Annex should help solve this problem for full standard units (and, of course, larger ones). In the case of the Gezira half unit and for Managil, however, technical problems may arise. Agreements will be necessary (e.g., for irrigation purposes) between the two farmers sharing the same "howasha" in a single "serial". With reference to "numbers", while cotton will always cover a full number, cultivation of half-number strips will have to be accepted if two different cereals or two different legumes enter in the rotation.

In the opinion of the mission, these difficulties -- even if they mean somewhat higher costs of cultivation -- must be accepted for the sake of increasing the direct interest of the farmer. At the same time, it should be stressed that the Gezira half-standard unit (20 fed.) and the Managil unit (15 fed.) remain the minimum plots acceptable, and should be allotted to one single physical person.

All the farmers on the same rotation area (Gezira: 720 fed.; Managil: 540 fed.) -- that is a maximum of 36 farmers -- should be encouraged to organize themselves into cooperative units in order to facilitate joint action on agricultural operations of common interest, particularly choice of crops to the extent they are optional, watering, drainage, cultivation, control of grazing, etc. A group like this might be singularly receptive to the advice and help of the field advisers, particularly if a "samad" could act as a secretary to each or several of these small field-cooperatives.
2. **Size and Transferability of Holdings**

If identification is effective in inducing the farmers to take better care of their holdings, the same should be true of new regulations allowing them to hold more than 80 feddans, which is the present maximum. It is not suggested here that this type of holdings should be generalized, but simply that it should not be prevented. Some farmers endowed with a particularly strong sense of initiative should be able to crop successfully areas larger than two tenancies. The mission, therefore, recommends that a farmer be allowed to hold as much as a half rotation unit, or 360 feddans, in the Gezira and 270 feddans in Managil. This is the smallest area which is suitable for simple full-time mechanized equipment.

To facilitate the movement of farmers from one section of the Scheme to another, especially if they wish to take care of larger holdings such as those suggested here, the right to a "tenancy" should be openly recognized as transferable among farmers. This right must be subject, naturally, to the acceptability of the new holder to the Village Council as advised by the Block Inspector. More exchanges of holdings among farmers would probably be the result.

One objection to larger holdings could be the number of cases where a farmer wishes his heirs, particularly his children, to settle on the land he has tilled. But there seems to be no reason why the existence of some larger holdings should prevent the creation of new half units if it becomes necessary, remembering of course that holdings below 5 feddans of cotton should be avoided since they could not provide an adequate livelihood to the farmer. On the other hand, when new irrigated areas are opened in the neighboring areas, they should offer great opportunities not only for young men but also for enterprising farmers having had experience in the Gezira.

3. **Money Incentives**

Under the present financial arrangements government and farmers are called partners — the Gezira Board just covering its own costs. It is actually share-cropping and sometimes the farmers are tempted to view a potential increase in their own share as almost more important than increasing the total production. The recommendation here is to make his position closer to that of a leaseholder. He would pay a fixed amount to the government as a charge for the land and water supplied by the nation, and after that will have the full benefit of his crops, subject of course to reimbursing the Scheme management for the collective cost of production incurred for his benefit. In good years the farmer would see his income rise in direct proportion to the increase in his production, instead of less than proportionately as at present. Moreover, the better farmer would earn more, and also in direct proportion to this improved yield. True, since the charge for land and water would not change, returns
to the farmer in poor years could drop even lower than now and it is therefore proposed that the government should provide the difference between payments due to the farmer for his crop and receipts he could have expected at some minimum standard (say 3 k.p.f.)

The Scheme could also undertake the sale of both groundnuts and wheat in addition to cotton. The land and water charge could then be withheld from the proceeds of these two cash crops as well as from cotton. This should tend to eliminate the traditional feeling that the Gezira is only a cotton producing scheme.

Finally, there would be definite advantages in changing the timing of payments to the farmers for their cotton. At present, except for advances made during the picking season, payments are made only after the end of that season. They are staggered over an extended period (10 to 12 months), including the months in which the next crop is harvested. The reason is that the payments are in principle made out of the proceeds of the sales, or as profits can be ascertained. It is proposed to make the link between each crop and the payments related to it much closer by starting the payments as soon as the crop begins to be delivered to the gins and staggering them over a period which would not extent later than the same calendar year. The implementation of this plan would involve of course a financial advance to the Scheme and the need to forecast the future sales value of cotton. But these practical difficulties should be amply offset by the feeling given to the farmer that the more cotton he delivers now, the more cash he will receive within a short period.

Details of the proposed new income formula are given in the following chapter. The mission feels confident that this formula would serve as a powerful incentive to the Gezira farmer.
SUMMARY RECOMMENDATIONS

A. The Farmer and his Surroundings

The Land

Announce officially the renewal of the Government lease on Gezira land for another period of, say, 40 years.

Clarify the position of the farmer by officially recognizing that he is entitled to the land on a permanent basis, subject only to certain restrictions (eviction or abandonment).

Continue the prohibition of mortgages on tenancy units and on crops.

The Scheme Officials

Maintain sanctions such as eviction, fines or toulba but discontinue the one consisting of cutting off water from the dura fields.

Change the functions and the title of the field inspectors to those of "Field Advisers" and give the latter the role of extension workers (see Chapter 2).

Village Councils and Farmers' Organizations

Encourage the revival of Village Councils.

On representation of farmers on the Board of Directors, see Chapter 4.

Labor

Continue the present role of Scheme and Government in facilitating the movement of seasonal labor to the Gezira.

Take account of possible manpower shortages in the Gezira in planning the irrigation of new areas in the Blue Nile Province.
B. The Farmer's Income

Credit

Continue the present system which is adequate.

Encourage the Agricultural and the Industrial Banks to search for credit opportunities in livestock farms and in small industrial plants.

C. Possible Incentives

Identification of Holdings

As suggested in Chapter 2, ensure the continuity of tenure on contiguous and compact plots which farmers will till from year to year.

Encourage the farmers on each rotation unit to organize themselves in cooperatives to decide together on cropping, to supervise watering and grazing, etc.

Size and Transferability of Holdings

Increase the maximum area which can be held by one farmer from 80 feddans to one-half rotation unit.

Allow transfers of holdings from one farmer to another, subject to concurrence of the Village Council and of the Scheme management.

Money Incentives

Substitute for the present income formula which is, in fact, share-cropping, a new one which would place the farmer in the position of a lease-holder by:

a. instituting a fixed land and water charge per irrigable feddan to be paid to the Government by the farmers and collected by the Scheme;

b. paying the farmer the value of his three cash crops (cotton, wheat and groundnuts) after deducting from it all collective expenses incurred by the Scheme in connection with their production;

c. changing the timing of the payments to the farmers so that they correspond more closely to the time of harvesting of the crop.

Details are given in following Chapter.
CHAPTER 6
PROPOSED INCOME FORMULA

The proposed income formula replaces the concept of profit sharing of the Scheme's main cash crop by the principle of recovering from the farmers the cost of the collective services rendered them by the Scheme and the government: the value of all the Scheme's output over and above these costs would accrue to the farmers only.

The devices through which the costs of these collective services would be recovered are simple and straightforward. The cost of the services rendered by the Scheme to facilitate production and/or marketing of the three cash crops would be deducted from the sales value of these crops. Services provided by Government in the form of land and water and other benefits would be paid for by a fixed "land and water charge" (LWC) levied on each irrigable feddan.

The following sections describe in detail the practical application of the proposed income formula and its financial implications for the farmers, the government and the Scheme.

1. Computation of farmer's prices for cash crops

In line with the Mission's recommendations (see Chapter 5) the Scheme would undertake the marketing of groundnuts and wheat, in addition to servicing cotton which would continue to make up the bulk of the Scheme's expenses.

a. Farmer's price for cotton. The Scheme's services regarding cotton would cover all operations which are at present included in the Joint Account, except that picking and stalk pulling would be regarded the farmers' responsibility and hence paid for by him out of the (correspondingly larger) payments he receives from the Scheme for his cotton; if necessary advances could be made to the farmers toward these expenses. The Scheme's services would include its general administrative expenses.

The price to be paid to the farmer per kantar of seed cotton delivered would be computed as the difference between the budgeted sales price for the lint and cotton seed per kantar on the one hand, and on the other, budgeted collective cost of the Scheme divided by the total number of kantars budgeted for.\footnote{For the complete formula of this computation, see Annex VI, pp. 7-8.}
based on budgeted forecasts because at the time seed cotton deliveries will begin to be paid, neither the final sales prices for lint and cotton seed nor the actual crop yield or the actual costs incurred by the Scheme will be known. However, at the end of the calendar year the price for cotton to be paid to the farmer would be re-computed on the basis of the actual selling prices and the Scheme's actual costs during the year just ended; any differences would be added to or deducted from the outstanding payments still to be made to the farmers for the crop delivered during the same year.

Regarding the budgeting procedures to be followed, the Mission recommends that the sales price be forecast at 90% of the average of the previous three years' actual sales prices for lint and cotton seed, per kantar of seed cotton. The cost of the Scheme's services per feddan of cotton and in real terms, are for the most part virtually fixed and therefore can be budgeted independently of crop yield. This holds especially for all operations regarding crop establishment and broadly speaking, crop production, as well as for the Scheme's general administrative expenses. The costs of ginning and marketing, on the other hand, vary with crop yields as more kantars produced mean more ginning, more baling materials, more ton-kilometers of transport, etc.; but since the existing ginning and marketing facilities are sufficient to handle crops of up to six kantars per feddan, these costs will vary rather less than proportionately, so that with rising yields, unit costs should actually decline. In any event, crop yield would have to be budgeted as well, and the Mission recommends that the average yield of the last five years be used for this purpose. Whatever the volume of the services thus budgeted, their cost should be assessed realistically, taking into account foreseeable increases in wages and salaries, and in the prices of other cost elements.

b. Computation of farmer's prices for groundnuts and wheat. So long as the Scheme's output of groundnuts and wheat is still comparatively small and hence can be disposed of quickly, the prices paid to the farmers for these two crops would be computed on the basis of the actual sales prices realized per ton of either commodity, from which would be deducted the average costs per ton incurred by the Scheme in marketing (and possibly other servicing of) these crops. The corresponding costs would, of course, include a proportionate share of the Scheme's general administrative expenses.

As and when the output of groundnuts and wheat reaches the higher levels which the Mission considers feasible within the foreseeable future, the prices paid to farmers for these crops may have to be computed in a similar fashion as outlined for cotton in the preceding paragraphs, i.e., on the basis of budgeted sales prices and budgeted costs, with subsequent adjustments for any differences between these and the corresponding actual figures.

2. Calculation of land and water charge (LWC)

The land and water charge (LWC) is to compensate the government for the costs incurred in providing to the farmers the land, the water,
agricultural research and assistance in moving pickers into and out of the Scheme area. The costs of these services include both current and capital costs, the latter in terms of a return on the huge investments made by the nation in the irrigation works and the numerous other facilities of the Scheme.

It might be argued, in theory, that the rate of the LWC should be so calculated as to yield an adequate rate of return on the capital invested. Possible yardsticks for what might be considered an adequate rate of return would be the return to capital in similar enterprises elsewhere in the Sudan; or, as a minimum, the rate of interest Government has to pay on its own borrowings. Such an approach would not seem wholly realistic, however, and would certainly conflict with the principal objective of the proposed income formula, which is to provide a powerful incentive to the farmers and thereby help bring about the badly needed increases in the Scheme's output and productivity. The Mission, therefore, considers that calculations of the initial rate of the LWC would best be based on the profit sharing as between farmers and Government actually existing at the time the new formula goes into effect.

For illustrative purposes only, Annex VI presents detailed calculations of the LWC based on the present (1966) profit-sharing formula if it had been applied to the cotton crop in 1964/65, the most recent year for which actual data are available, and it is to be noted that yield and sales prices of the 1964/65 crop are closely similar to the averages for the five-year period 1960/61 - 1964/65. On this basis, the LWC would have been LS. 3.71 per irrigable feddan. This is the rate at which both the farmers' and the government's gross income from the Scheme would have been the same under the profit-sharing or the proposed formula. It should be noted that the LWC as here calculated includes the 2% profit shares each to Local Councils and Social Development, for Government to pass on to the agencies concerned.

Government's net income from the Scheme, i.e., net of the cost of the services provided by it -- in other words, the return to capital, would have amounted to 5.9% on the book value of the Scheme's assets, and 3.7% on their estimated replacement costs (see Annex VI, Table A).

3. Implications of proposed income formula for farmers' and Government's gross incomes

The salient feature of the new income formula lies in the fact that it produces sharply increasing payments to the farmer as his output of cotton (and other cash crops) goes up. This is because the costs of the collective services rendered him by the Scheme vary but little with output, as discussed above; and the LWC, assessed as it is per irrigable feddan, is a fixed charge completely unrelated to crop yields. Thus, while farmers' incomes under the proposed formula are highly variable, payments to Government would be limited to the proceeds from the LWC and remain constant, whatever the Scheme's performance.
Annex VI compares farmers and Government income under both the present and the proposed income formula. The calculations are on the same basis as those of the LWC discussed in the preceding paragraphs, i.e., the present (1966) profit-sharing formula applied to the 1964/65 cotton crop. For the results of these calculations to be comparable the LWC had to be charged entirely against the cotton crop.

Regarding the farmers' incomes under the two formulae, two types of calculations have been made: the first in terms of the average farmer's income at various average yields, for the Scheme as a whole; the second regarding the income of individual farmers producing yields different from the Scheme's average yield.

The following figures indicate the differences in gross payments to farmers, under the two formulae, for an "average" farmer, i.e., one who produces the average yield of the Scheme in any year.

<table>
<thead>
<tr>
<th>Gross Payments</th>
<th>Individual Farmers Producing Yields of</th>
</tr>
</thead>
<tbody>
<tr>
<td>When Average Yield is</td>
<td>Present</td>
</tr>
<tr>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>Formula</td>
</tr>
<tr>
<td>2 kantars per feddan</td>
<td>54</td>
</tr>
<tr>
<td>3 &quot; &quot; &quot;</td>
<td>89</td>
</tr>
<tr>
<td>3,554 &quot; &quot; &quot;</td>
<td>108</td>
</tr>
<tr>
<td>4 &quot; &quot; &quot;</td>
<td>124</td>
</tr>
<tr>
<td>5 &quot; &quot; &quot;</td>
<td>160</td>
</tr>
<tr>
<td>6 &quot; &quot; &quot;</td>
<td>195</td>
</tr>
</tbody>
</table>

The following figures indicate the differences in gross payments to farmers who when the average yield for the Scheme as a whole is 3.554 k.p.f., produce different yield levels.

The following salient points emerge from these comparisons:

a. At an average yield of 3.554 k.p.f., the gross payments to farmers are the same since this is the basis on which the comparisons are made.
b. At an average yield below 3.554 k.p.f., farmers would receive lower gross payments.

c. At an average yield above 3.554 k.p.f., farmers would receive higher gross payments.

Corresponding calculations of net income to Government and return to investment yield these results:

<table>
<thead>
<tr>
<th>Average Yield</th>
<th>Net Income</th>
<th>Present</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Formula</td>
<td>Formula</td>
<td>Formula</td>
</tr>
<tr>
<td>2 kantars per feddan</td>
<td>- 703,043</td>
<td>3,699,648</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2,117,430</td>
<td>3,699,648</td>
<td></td>
</tr>
<tr>
<td>3.554</td>
<td>3,699,648</td>
<td>3,699,648</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4,922,741</td>
<td>3,699,648</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>7,795,636</td>
<td>3,699,648</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10,628,527</td>
<td>3,699,648</td>
<td></td>
</tr>
</tbody>
</table>

Return on Investment

<table>
<thead>
<tr>
<th>Average Yield</th>
<th>At Book Value Assets</th>
<th>At Current Cost Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present Formula</td>
<td>Proposed Formula</td>
</tr>
<tr>
<td></td>
<td>Present Formula</td>
<td>Proposed Formula</td>
</tr>
<tr>
<td>2 kantars per feddan</td>
<td>minus 5.9% p.a.</td>
<td>minus 3.7% p.a.</td>
</tr>
<tr>
<td>3</td>
<td>3.4% p.a. 5.9% p.a.</td>
<td>2.1% p.a. 3.7% p.a.</td>
</tr>
<tr>
<td>3.554</td>
<td>5.9% p.a. 5.9% p.a.</td>
<td>3.7% p.a. 3.7% p.a.</td>
</tr>
<tr>
<td>4</td>
<td>7.9% p.a. 5.9% p.a.</td>
<td>4.9% p.a. 3.7% p.a.</td>
</tr>
<tr>
<td>5</td>
<td>12.8% p.a. 5.9% p.a.</td>
<td>7.8% p.a. 3.7% p.a.</td>
</tr>
<tr>
<td>6</td>
<td>16.8% p.a. 5.9% p.a.</td>
<td>10.6% p.a. 3.7% p.a.</td>
</tr>
</tbody>
</table>

The following salient points arise from these comparisons:

a. The income to Government would by definition be constant under the proposed formula, whatever the yield.

b. At an average yield of 3.554 k.p.f., the net income to Government, of Ls. 3,699,648, is the same for both the present and the proposed formulae since this is the basis on which the comparison is made. It gives a return on investment of 5.9% p.a. on book value assets and 3.7% p.a. on current cost value assets.

c. At an average yield below 3.554 k.p.f., Government's net income would be higher under the proposed formula than it is under the present one.
d. At an average yield above 3.554 k.p.f., Government's net income would be lower under the proposed formula than it is under the present one.

4. Individual farmers' accounts

Each farmer would have an individual account with the Scheme, either for all cash crops combined, or for each of them separately. It would be through these individual accounts that all payments due to, and required from, the farmers would be settled.

Payments due to the farmer would be for deliveries to the Scheme of his cash crops, at prices computed as described above, and his account credited accordingly.

Considerable importance attaches to the timing of crop payments. The Mission recommends, as a further incentive to the farmer, that the payments for cotton be accelerated and reduced in number. Payments for groundnuts and wheat would be made as and when these crops have actually been sold by the Scheme. Crop payments might be staggered as follows: for cotton in February, April, June, August, October, December; for wheat in December; and for groundnuts in February. Thus the bulk of all crop payments would be made during the crop year concerned (July–June), and cotton payments would be settled by the end of the calendar year in which the crop is harvested.

On the debit side of the farmer's account there are likely to be advances received from the Scheme, either in cash, or in the form of payments made on behalf of the farmers, e.g. to contractors for tractor and harvesting operations; and possibly, tulba and fines. One item would automatically appear on all individual farmers' accounts, normally, the land and water charge on their individual holding. This is of course to be paid to the government, but the Scheme would be the collecting agent.

LWC like the other debit items, would be deducted from the payments made to the farmer for his crops, and the fraction of LWC charged against the cotton crop would be deducted in equal instalments from each of the bimonthly payments. Since, as noted earlier in this section, these crop payments would extend over the entire calendar year, the Mission recommends that the LWC be levied per calendar year rather than per crop year. The LWC due for a given year should actually be paid by the end of that year.

As the LWC is charged for services benefitting all crops grown in the Scheme it is logical that all three cash crops should contribute towards its payment. To this end, the total LWC to be paid by the individual farmer would be divided up in such proportions as the payments for each cash crop separately bear to the total of all crop
payments combined, or some rough approximation thereto. On this basis and for the average farmer at the present time, six-sevenths of the LWC could be charged against his payments for cotton and one-seventh against the other two crops. As and when the likely increases in both area and yield of groundnuts and wheat begin to materialize -- say, after four years -- a more even distribution of the LWC as between the three crops would become possible, perhaps by charging two-thirds to three-quarters to cotton, and the balance to the other two crops.

5. Financing of Scheme operations

The proposed income formula would leave the Scheme without any income of its own: by definition its revenue would just suffice to cover the cost incurred by it. As the great bulk of these costs would have to be incurred some time before any revenue from crop sales is cashed in, the Scheme would require substantial cash advances in order to be able to carry out its operations. These advances would be needed to finance (i) the cost of services to farmers, as already mentioned; (ii) advances to farmers to help them finance their own production costs, e.g. picking; and (iii) the early -- say, the first two or three -- cotton payments to farmers.

The Mission recommends that the advances required by the Scheme, as substantiated by detailed and comprehensive annual budgets, be provided by the Ministry of Finance or the Central Bank. The Scheme would pay interest charges on these advances, but for any given cotton crop these interest payments would cease in the month of August of the calendar year during which the cotton was harvested.

6. Practical problems regarding the proposed income formula

A number of practical questions arising under the proposed income formula remain to be dealt with. They concern the rate of LWC and its possible revisions and the contingency of crop failure.

a. Fixing the rate of the LWC. In order to make the LWC an effective instrument its administration has to be simple. The Mission, therefore, recommends that it be fixed at a flat rate throughout the Scheme, i.e., each and every irrigable feddan in the Scheme area would bear the same charge. This might be regarded as not quite fair because of possible differences in soil fertility and feasible cropping patterns. However, the Mission could not find conclusive evidence of appreciable and consistent differences in soil fertility; as for differences on account of feasible cropping patterns these are likely to narrow down as the plans for further intensification and diversification, especially in the Gezira Main, are being implemented. Whatever the actual importance of such differences within the Scheme area, the difficulties involved in objectively taking them into account would be so great as to seriously jeopardize the practical efficacy of the proposed income formula.
As noted earlier in this chapter, calculations of the initial level of the LWC would, in principle, be based on the profit sharing as between farmers and Government actually existing at the time the new formula goes into effect. In fixing the actual rate of the LWC the time period for which it would remain in effect needs to be determined. The Mission recommends that the amount of the LWC be fixed for periods of, say, eight years, or two full Gezira rotations under the proposed agricultural regime. This would allow the farmer to count on a minimum of stability and continuity. At the end of this period the LWC would automatically come up for review and if necessary, be adjusted to take changing circumstances into account.

In this context it should be recognized that over the eight-year period for which the LWC would be fixed, the costs of the services rendered by Government are likely to increase on account of the secular up-trend in labor and other costs. Possibly even more important increases in these costs are likely to result as and when the Mission's recommendations regarding improvements in canal maintenance, drainage and escapes, or further extensions of the Scheme are carried out. In addition, the Gezira Scheme is going to be supplied with more water, thanks to the Roseires dam, and it would only be fair to recover a proportionate share of the costs of this dam from the Gezira farmers. In short, while the costs of Government services to the farmers are bound to increase over the eight-year period for which LWC would be fixed, the payments for these services would remain constant, so that the government's net income would actually decrease. The Mission, therefore, recommends that in fixing the rate of the LWC for any eight-year period adequate allowance be made for likely increases in both current and capital costs in order to prevent Government net income from being eroded.

b. Crop failure. Under the proposed income formula the risk of production is entirely the farmer's. This is to his advantage only so long as crop yields are increased to and sustained at the higher levels which the Mission considers possible to be achieved in the foreseeable future. However, based on past experience in the Gezira, sudden drops in crop yields for reasons beyond the farmers' control cannot be ruled out. If and when unexpectedly low yields occur, the farmers' income under the proposed formula would be close to zero, if not negative. It is clear that in such emergencies the Government would have to support the farmers, as it has done in the past. The Mission recommends that to all the extent possible, this emergency assistance take the form of cash subsidies, the amount of which would be determined according to individual needs. This would avoid even the appearance of a temporary waiver of the LWC which would only set undesirable precedents.
## Possible Income in the Gezira around 1975

Any forecast is open to question. But in the course of this report attempts have been made to estimate the possible effects of the various recommendations offered. A tentative estimate of what their combined effect could be by the mid-1970's is given in some detail in Annex VI. It relates to farm units of 15 feddans in Managil and 20 feddans in Gezira; for the standard Gezira tenancy of 40 feddans the figure would be about double.

Very briefly, these computations could be summarized as follows. They assume that world cotton prices could decline by about 30 percent, compared with 1964/65, but that cotton yields could increase by over 40 percent, that the areas under other crops increase as suggested, that yields of other crops also increase substantially and that wheat and dura prices increase slightly at farm level. They also assume that Scheme costs and wages for hired labor rise by about 20 percent but that the farmer performs twice as much work in the field as in 1964/65. The results have been computed on the basis of two possible LWC rates: £S 4 per irrigable feddan and £S 5.

On that basis the gross income of the farmer would be as follows:

<table>
<thead>
<tr>
<th></th>
<th>Gross Income before farm costs</th>
<th>Net Income after farm costs</th>
<th>Recomputed 1975 for 1964/65 (see Page 67)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>£S</td>
<td>£S</td>
<td>£S</td>
</tr>
<tr>
<td><strong>Managil 15-feddan unit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for Cotton, Groundnuts &amp; Dura</td>
<td>259.5</td>
<td>131.3</td>
<td></td>
</tr>
<tr>
<td>for Livestock &amp; Gardens</td>
<td>n.a.</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>259.5</td>
<td>138.3</td>
<td></td>
</tr>
<tr>
<td>Less LWC at £S 4 per feddan</td>
<td>60.0</td>
<td>60.0</td>
<td></td>
</tr>
<tr>
<td><strong>Balance</strong></td>
<td>199.5</td>
<td>78.3</td>
<td>£9.0</td>
</tr>
<tr>
<td>or less LWC at £S 5 per feddan</td>
<td>75.0</td>
<td>75.0</td>
<td>£9.0</td>
</tr>
<tr>
<td><strong>Balance</strong></td>
<td>184.5</td>
<td>63.3</td>
<td>£9.0</td>
</tr>
<tr>
<td><strong>Gezira 20-feddan unit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for Cotton, Groundnuts, Wheat &amp; Dura</td>
<td>294.8</td>
<td>150.4</td>
<td></td>
</tr>
<tr>
<td>for Livestock &amp; Gardens</td>
<td>n.a.</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>294.8</td>
<td>156.4</td>
<td></td>
</tr>
<tr>
<td>Less LWC at £S 4 per feddan</td>
<td>80.0</td>
<td>80.0</td>
<td></td>
</tr>
<tr>
<td><strong>Balance</strong></td>
<td>214.8</td>
<td>70.4</td>
<td>£4.5</td>
</tr>
<tr>
<td>or less LWC at £S 5 per feddan</td>
<td>100.0</td>
<td>100.0</td>
<td>£4.5</td>
</tr>
<tr>
<td><strong>Balance</strong></td>
<td>194.8</td>
<td>56.4</td>
<td>£4.5</td>
</tr>
</tbody>
</table>
However tentative these forecasts may be, they indicate clearly that on balance under the proposed payment system, the farmer could see his income improve in spite of declining cotton prices, provided he increases somewhat his own contribution to production.
SUMMARY RECOMMENDATIONS

Computation of price to be paid to the farmers for cash crops (cotton, groundnuts and wheat). The Scheme should undertake to sell the three cash crops for and on account of the farmers.

For groundnuts and wheat, base the price on the actual proceeds of the sales as long as the sales can be made quickly after the harvest. For seed cotton where payments will be made ahead of sales, take as a basis 90 percent of the average actual sales price for the three preceding years.

Deduct from these sales prices the collective costs to be incurred by the Scheme on the basis of its budget, and allocate these costs to the three crops, proportionately to their expected sales proceeds.

Announce the price to be paid to the farmers for their seed cotton at the beginning of each season (July).

If either actual cotton prices or actual Scheme costs are different from these forecasts, credit or debit the farmers with the difference at the end of the year.

Scheme budgets should be based on average yield for the last five years.

Calculation of land and water charge.

Fix L.W.C. at the same rate per irrigable feddan throughout the Scheme.

Initially fix a rate corresponding closely to the income received by the Government from the Scheme during the most recent period. But preferably add margin of safety to offset upward trend of Government costs and improve rate of return on its investment.

Provide for revision of the L.W.C. rate at infrequent intervals, say, only every eight years.

___________________________

1/ In 1964/65 this would have been £3 3.7 per irrigable feddan.
Individual farmers' accounts will be kept for each cash crop, if this is practicable. These accounts will be credited with the net proceeds from groundnuts and wheat after completion of the sales, and with computed net proceeds of cotton sales in six instalments, one every second month beginning in February, i.e. as soon as deliveries have started.

Debits to these accounts should include (a) the advances and other debts which may be owed by individual farmers and (b) the L.W.C. Initially the L.W.C. could be allocated six-sevenths to cotton and one-seventh to other cash crops; these proportions being subject to revision when production of groundnuts and wheat rises substantially.

Subsidies in case of hardship. In case of a sudden and dangerous drop in average yield below subsistence levels, emergency assistance should be provided by the Government to the farmers whose production is at, or below, this average.

Financing the Scheme's operations

The Scheme will need financial advances from the Ministry of Finance or the Bank of Sudan at least from January onwards. For a given cotton crop, interest should cease to accrue in the month of August following the picking season.
The recommendations offered in this report should, if they are carried out, result in a number of improvements in the Gezira Scheme. The efficiency of management should be enhanced and the farmer should feel encouraged on two counts. First, his relations with the "field advisers" should improve as he realizes that their main purpose is to assist rather than supervise, and second, the quality of his work should also improve as the new money incentives are made clear to him. As a consequence production as a whole should rise.

Some time will be required to put the proposed reforms into practice. Two years will be needed for the administrative and financial reorganization. Four or five years will be needed to convert all of the field staff into an effective extension force, and about the same time may be necessary to establish clearly the system of identified and contiguous farm holdings throughout Gezira Main (Managil requiring even longer). But the mere announcement that the new policies outlined in this report are being adopted should fairly quickly bring about better crop husbandry and higher yields.

The potential benefits of the mission's recommendations to the farmer and to the Gezira Scheme have been described at some length. The following remarks concern their implications for the Sudan in general. Some relate to the financial arrangements in other schemes, others to public finance and the Sudanese economy.

It is likely that several technical recommendations included in this report could be applied either in the existing Government and private schemes or in the new gravity schemes which are now being planned. This will have to be looked into carefully by the responsible authorities, but it is certain that a change from sharecropping to a new system involving a fixed land and water charge will inevitably have repercussions on other schemes in the Sudan. Precedents set in the Gezira have often influenced the demands of farmers elsewhere in the country. This mission was not able to go into this in any detail but a few points come to mind.

First, other existing Government cotton schemes have traditionally followed the changes in profitsharing initiated in the Gezira. They might also consider adopting a fixed land and water charge. Since however, neither current nor investment costs may be comparable, great care should be taken to make sure that current costs are fully covered and that the return on investment (already markedly low in the Gezira if the land and water charge is of the order of £S 4.00 or £S 5.00 per irrigable feddan) should be reasonable. This may mean higher rates for the land and water charge on these schemes than in the Gezira.
Secondly, plans are now being made to irrigate new areas with the water available from the Roseires Dam. The studies made on some of these prospective schemes already envisage a similar land and water charge system but at a distinctly higher rate than the one suggested here for the Gezira. As has just been pointed out, there seems to be no valid reason why the rates should be the same throughout the Sudan. In fact, the investments required to irrigate new areas will probably be more costly than the investments in the Gezira Scheme. For this reason alone, it would be natural for the Government to charge higher rates for the new areas. An additional argument is that a new investment usually requires a higher rate of return than an investment which has already had a long useful life, like the Sennar Dam and some of its main canals. Moreover, if the cropping patterns envisaged for the new areas prove feasible, the intensity of cultivation may turn out to be higher than in the Gezira and so might the returns to the farmers.

Thirdly, private pump schemes are numerous in the Sudan, particularly in the Blue Nile Province. Their status and financial organization is at present the subject of an intensive review and its conclusions are not known at the time of writing. There are indications that some of them may become cooperative enterprises, but others may remain, for some time at least, under a license system. It is conceivable that in certain cases a system similar to that of the land and water charge could be adapted to private schemes and encourage higher productivity. The mission is not in a position to express an opinion on this important problem; it can only recommend that in studying possible solutions, careful consideration be given to the possibility of introducing some amendments to the present sharecropping arrangements which might allow, in suitable cases, the farmer to pay a fixed contribution to the licensee and thereby be induced to produce more.

Turning to the possible implications of the suggested reforms on the Government and the economy, it may seem that the Government is being called upon to accept in the long run a relatively low direct contribution from the Scheme and, indeed, under the new income formula the Government will no longer share in the cotton profits but will only receive limited fixed payments from the farmer. Consequently, the Government's direct earnings from the Scheme will remain stable and modest even if yields improve, but may, in effect, decline in years of very poor average yields if farmers have to be subsidized. But there are important elements which should more than compensate for this.

The Sudan as a whole is threatened with lower foreign exchange earnings if, as is likely, the present downward trend of world cotton prices continues. Increasing the production of cotton and other crops in the Gezira and elsewhere in the country is the only way to offset this threat and the new policies suggested by the mission are aimed at achieving precisely this goal. If they are successful, foreign exchange
earnings from that source should at least be maintained on the average despite further declines in prices. In addition, production of other crops should rise and the foreign exchange earnings or savings they can bring about should tend to improve the balance of payments.

It was pointed out in Chapter 1 that the indirect contributions of the Scheme to public finance were even more important than its direct contribution. Export duties and royalties are assessed on the volume of the crops sold abroad. Unless their rates are modified, and this possibility cannot be ruled out, the proceeds from this source are likely to increase if production responds to the suggested incentives. As to the very substantial contribution offered by the import taxes, it may well increase as the foreign exchange earnings from additional exports make sizeable imports possible. In short, if by accepting an apparent reduction of the direct contribution of the Scheme to public finance, the Government can actually induce higher and better production, the foreign exchange earnings of the nation may well improve on balance, as may the indirect financial benefits it draws from the Scheme.
<table>
<thead>
<tr>
<th>Year</th>
<th>Cotton</th>
<th>Dura (Fed.)</th>
<th>Labor (Fed.)</th>
<th>Lupia (Fed.)</th>
<th>Rotation Garums</th>
<th>Groundnuts (Fed.)</th>
<th>Wheat (Fed.)</th>
<th>Fallow (Fed.)</th>
<th>Total Gross (Fed.)</th>
<th>Fuel Plots (Fed.)</th>
<th>Resting (Fed.)</th>
<th>Registered Area (Fed.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955/6</td>
<td>238,926</td>
<td>119,710</td>
<td>2,118</td>
<td>2,027</td>
<td>61,425</td>
<td>5,873</td>
<td>940</td>
<td>519,590</td>
<td>770</td>
<td>2,027</td>
<td>61,25</td>
<td>959,956</td>
</tr>
<tr>
<td>1956/7</td>
<td>245,359</td>
<td>122,643</td>
<td>2,017</td>
<td>1,999</td>
<td>68,215</td>
<td>5,289</td>
<td>469</td>
<td>512,931</td>
<td>763</td>
<td>1,096</td>
<td>8,383</td>
<td>979,422</td>
</tr>
<tr>
<td>1957/8</td>
<td>245,405</td>
<td>122,358</td>
<td>2,010</td>
<td>1,961</td>
<td>62,668</td>
<td>6,069</td>
<td>1,266</td>
<td>603,119</td>
<td>763</td>
<td>1,370</td>
<td>7,958</td>
<td>979,436</td>
</tr>
<tr>
<td>1958/9</td>
<td>310,593</td>
<td>155,579</td>
<td>2,030</td>
<td>1,961</td>
<td>82,668</td>
<td>6,598</td>
<td>5,790</td>
<td>603,119</td>
<td>763</td>
<td>1,168,336</td>
<td>3,752</td>
<td>1,212,223</td>
</tr>
<tr>
<td>1959/60</td>
<td>385,901</td>
<td>192,057</td>
<td>2,322</td>
<td>2,172</td>
<td>111,337</td>
<td>7,872</td>
<td>10,436</td>
<td>671,379</td>
<td>7,755</td>
<td>1,383,475</td>
<td>2,738</td>
<td>1,529,553</td>
</tr>
<tr>
<td>1960/1</td>
<td>430,702</td>
<td>217,903</td>
<td>2,575</td>
<td>2,314</td>
<td>115,896</td>
<td>9,929</td>
<td>12,883</td>
<td>699,911</td>
<td>1,529,553</td>
<td>3,235</td>
<td>16,028</td>
<td>1,515,381</td>
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<tr>
<td>1961/2</td>
<td>468,267</td>
<td>234,176</td>
<td>2,692</td>
<td>2,934</td>
<td>89,138</td>
<td>10,238</td>
<td>56,623</td>
<td>775,277</td>
<td>1,662,380</td>
<td>3,035</td>
<td>18,212</td>
<td>1,660,592</td>
</tr>
<tr>
<td>1962/3</td>
<td>484,334</td>
<td>226,091</td>
<td>2,501</td>
<td>3,227</td>
<td>105,151</td>
<td>16,312</td>
<td>33,824</td>
<td>81,136</td>
<td>1,734,014</td>
<td>2,516</td>
<td>22,023</td>
<td>1,758,580</td>
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<tr>
<td>1964/5</td>
<td>508,228</td>
<td>254,824</td>
<td>2,925</td>
<td>2,926</td>
<td>71,265</td>
<td>21,578</td>
<td>59,961</td>
<td>75,065</td>
<td>1,782,059</td>
<td>29,289</td>
<td>1,311,369</td>
<td>1,811,369</td>
</tr>
</tbody>
</table>

Source: S.G.B. records.
### COTTON - MAIN FIGURES FROM OKRAH MAHAR ACCOUNTS

1955/56 - 1966/65

<table>
<thead>
<tr>
<th>Year</th>
<th>Average 1960/61-1966/65</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955/56</td>
<td></td>
</tr>
<tr>
<td>1955/57</td>
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</tr>
<tr>
<td>1957/58</td>
<td></td>
</tr>
<tr>
<td>1958/59</td>
<td></td>
</tr>
<tr>
<td>1959/60</td>
<td></td>
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<tr>
<td>1960/61</td>
<td></td>
</tr>
<tr>
<td>1961/62</td>
<td></td>
</tr>
<tr>
<td>1962/63</td>
<td></td>
</tr>
<tr>
<td>1963/64</td>
<td></td>
</tr>
<tr>
<td>1966/65</td>
<td></td>
</tr>
</tbody>
</table>

#### 1. Area In Cotton

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Field</td>
<td>Value</td>
</tr>
</tbody>
</table>

#### 2. Yields

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 3. No. of Tenants

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 4. Cottons of Cotton per Tenant (overall average)

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 5. Sales - Proceeds of Cotton (lint and seed)

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 6. Cost of Joint Account of Whose:

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 7. Gross Profit of Cotton of Whose:

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 8. Tenants:

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 9. Total to Tenants per Field

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 10. Average per Tenant on Basis of Average Cotton Holdings (lint & above)

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 11. Average per Tenant from Collective A/C only

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

*Note: Due to the nature of the image, some data points might be missing or incorrectly transcribed.*
SUDAN
RAINFALL and TOPOGRAPHY

Average annual rainfall
in millimeters

Elevations in feet
1500-3000
3000-6000
Over 6000

LIBYA

JULY 1963
**GLOSSARY**

**TABLE OF CONTENTS**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Main Abbreviations</td>
<td>i</td>
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<td>2.</td>
<td>Sudanese Measures</td>
<td>ii</td>
</tr>
<tr>
<td>3.</td>
<td>Agricultural Terms, etc.</td>
<td>iii</td>
</tr>
</tbody>
</table>
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASL</td>
<td>Above sea level</td>
</tr>
<tr>
<td>Abu XX</td>
<td>Abu ishreen</td>
</tr>
<tr>
<td>Abu VI</td>
<td>Abu sitta</td>
</tr>
<tr>
<td>Å</td>
<td>Angstrom units</td>
</tr>
<tr>
<td>e.s.p.</td>
<td>Exchangeable sodium percentage</td>
</tr>
<tr>
<td>Fed, Feds</td>
<td>Feddan(s) See under Measures below</td>
</tr>
<tr>
<td>F.O.P.</td>
<td>Field outlet pipes</td>
</tr>
<tr>
<td>G.A.R.S.</td>
<td>Gezira Agricultural Research Station</td>
</tr>
<tr>
<td>G.O.T.</td>
<td>Ginning Out Turn</td>
</tr>
<tr>
<td>G.L.R.</td>
<td>Gezira Light Railway</td>
</tr>
<tr>
<td>hp</td>
<td>Horsepower</td>
</tr>
<tr>
<td>K</td>
<td>Chemical symbol for potassium</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>k.p.f.</td>
<td>Kantar per feddan (See under Measures below)</td>
</tr>
<tr>
<td>kg.p.f.</td>
<td>Kilograms per feddan</td>
</tr>
<tr>
<td>LS or £S</td>
<td>Sudanese pound = 100 PT = 1000 millieme</td>
</tr>
<tr>
<td>lb.p.f.</td>
<td>Pounds per feddan</td>
</tr>
<tr>
<td>LWC</td>
<td>Land and water charge</td>
</tr>
<tr>
<td>m³</td>
<td>Cubic meter</td>
</tr>
<tr>
<td>m.e./g</td>
<td>milli equivalents per gram</td>
</tr>
<tr>
<td>mt</td>
<td>metric ton</td>
</tr>
<tr>
<td>m/m</td>
<td>milliemes (one thousandth of a Sudanese pound)</td>
</tr>
<tr>
<td>N</td>
<td>Chemical symbol for nitrogen. Also used as 1 N, 2 N, etc to indicate dressings of nitrogen fertilizer: in Sudan 1 N = 40 rotls nitrogen per feddan</td>
</tr>
<tr>
<td>P</td>
<td>Chemical symbol for phosphorus</td>
</tr>
<tr>
<td>PR</td>
<td>Plant requirements (in Tables only)</td>
</tr>
<tr>
<td>PT</td>
<td>Piastre (one hundredth of a Sudanese pound)</td>
</tr>
<tr>
<td>SDD</td>
<td>Social Development Department</td>
</tr>
<tr>
<td>S.G.B.</td>
<td>Sudan Gezira Board</td>
</tr>
</tbody>
</table>
VFE Village Farming Experiment

WR Water release (in Tables only)

The following abbreviations for crops are used in describing rotations and in Tables:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Crop</th>
<th>Abbreviation</th>
<th>Crop</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Cotton</td>
<td>D</td>
<td>Dura</td>
</tr>
<tr>
<td>F</td>
<td>Fallow</td>
<td>L</td>
<td>Lubia</td>
</tr>
<tr>
<td>GN</td>
<td>Groundnuts</td>
<td>Leg</td>
<td>Legume</td>
</tr>
<tr>
<td>Ph</td>
<td>Phillipesara</td>
<td>Cer</td>
<td>Cereal</td>
</tr>
<tr>
<td>W</td>
<td>Wheat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Sudanese Measures

**Ardeb**
- unit of capacity = 198 liters
- Used for measuring grains, etc.
- 1 ardeb dura = about 243.3 kg

**Keila (Kela)** one twentieth of an ardeb

**Rotl**
- unit of weight
- 100 rotls = 99.05 lb
- = 44.9 kg

**Kantar**
- unit of weight. In Gezira
- (a) 1 kantar unginned seed cotton (also called large kantar) = 315 rotls
  - = 312.01 lb
  - = 141.523 kg
- (b) 1 kantar cotton lint or other produce (also called small kantar) = 100 rotls
  - = 99.05 lb
  - = 44.9 kg

**Feddan**
- unit of area
- 1 feddan = 1.038 acres
  - = 0.42 hectares (4200 sq.m)

**Angaya**
- Sometimes used as an indication of area
  - (normally 0.714 feddan) See Agricultural Terms below.
### Agricultural Terms, etc.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abu ishreen</td>
<td>A field channel (Abbr. Abu XX)</td>
</tr>
<tr>
<td>Abu sitta</td>
<td>A lateral channel (Abbr. Abu VI)</td>
</tr>
<tr>
<td>Angaya</td>
<td>Strip of land bounded by a gadwel and a tagnet running across howasha. Normally 20 x 150 m = 0.714 feddan. Unit for piece-work</td>
</tr>
<tr>
<td>Asal</td>
<td>Lit. &quot;honey&quot; (Ar.) Applied to sticky secretions of aphids</td>
</tr>
<tr>
<td>Ardeb</td>
<td>See under Measures above</td>
</tr>
<tr>
<td>Buda</td>
<td>Striga hermontica, a parasitic weed of dura</td>
</tr>
<tr>
<td>Badob</td>
<td>Cracking clay soil</td>
</tr>
<tr>
<td>Bamia</td>
<td>Hibiscus esculentus, okra, lady's finger</td>
</tr>
<tr>
<td>Bersim or berseem</td>
<td>Medicago sativa, lucerne, alfalfa</td>
</tr>
<tr>
<td>Blading</td>
<td>Used by the mission to describe the special type of cultivation, developed in Gezira, used to control perennial weeds. See Mechanization appendix</td>
</tr>
<tr>
<td>Bor</td>
<td>Lit. uncultivated or barren land (Ar.) In Gezira, applied to resting land, usually in rotation.</td>
</tr>
<tr>
<td>Cross ridging</td>
<td>Making lines for gadwels and tagnets</td>
</tr>
<tr>
<td>Dukhn</td>
<td>Pennisetum typhoidem, millet</td>
</tr>
<tr>
<td>Dura</td>
<td>Sorghum vulgare, sorghum, Guinea corn.</td>
</tr>
<tr>
<td></td>
<td>See also Feterita, Milo.</td>
</tr>
<tr>
<td>Escapes</td>
<td>Channels from irrigation canals to river, etc. to discharge excess water safely.</td>
</tr>
<tr>
<td>Feterita</td>
<td>Commonest dura type in Gezira, open headed, tall, slow maturing</td>
</tr>
<tr>
<td>Field Outlet Pipes (F.O.P.)</td>
<td>Pipes in bank of Minor canal supplying Abu ishreen</td>
</tr>
<tr>
<td>Gadwel</td>
<td>Channel for distributing water in field</td>
</tr>
<tr>
<td>Gafir</td>
<td>Waterman. A Board employee controlling release of water from Minor canal</td>
</tr>
<tr>
<td>Gassab</td>
<td>Lit. cane (Ar.). Commonly dura straw</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ginning Out Turn</td>
<td>Percentage by weight of lint produced from seed cotton at ginnery.</td>
</tr>
<tr>
<td>(G.O.T.)</td>
<td></td>
</tr>
<tr>
<td>Gilgai</td>
<td>Ridges and mounds which appear on surface of certain clay soils due to swelling on wetting.</td>
</tr>
<tr>
<td>Green ridging</td>
<td>See Torade</td>
</tr>
<tr>
<td>Hafir</td>
<td>Lit. a pit (Ar.) Applied esp. to large man-made pits to collect and store surface water.</td>
</tr>
<tr>
<td>Hashish</td>
<td>Cannabis sativa, Indian hemp. Grows well - an alternative crop but forbidden by law.</td>
</tr>
<tr>
<td>Hish, hishing</td>
<td>To weed. Weeding, normally by hand.</td>
</tr>
<tr>
<td>Hod</td>
<td>Lit. basin or trough (Ar.) The small unit or basin, in distribution of water.</td>
</tr>
<tr>
<td>Howasha</td>
<td>Basic land unit for irrigation, tenancies, crop allocations, etc., 10 feddans</td>
</tr>
<tr>
<td>Kantar</td>
<td>See under Measures above</td>
</tr>
<tr>
<td>Keila</td>
<td>See under Measures above</td>
</tr>
<tr>
<td>Kenana</td>
<td>Area south of Sennar. Also applied to breed of cattle from the area.</td>
</tr>
<tr>
<td>Lateral pipes</td>
<td>Pipes in bank of Abu ishreen supplying Abu sitta.</td>
</tr>
<tr>
<td>Lugud</td>
<td>A clay soil, heavier and stickier, and not so freely cracking as badob.</td>
</tr>
<tr>
<td>Messir (massih)</td>
<td>Channels and banks forming a basin in a howasha</td>
</tr>
<tr>
<td>Milliard</td>
<td>100 million cubic meters</td>
</tr>
<tr>
<td>Millieme</td>
<td>10 milliemes = 1 piastre</td>
</tr>
<tr>
<td>Milo</td>
<td>Introduced dura type. Short, high yielding Bermuda grass.</td>
</tr>
<tr>
<td>Nagil (nageel)</td>
<td>Cynodon dactylon, a weed of arable land.</td>
</tr>
<tr>
<td>Night storage</td>
<td>The system of irrigation in Gezira</td>
</tr>
<tr>
<td>Number</td>
<td>90 feddan (9 howasha) land unit</td>
</tr>
<tr>
<td>Pulling (pulling out)</td>
<td>Removal for burning of all cotton stalks after picking completed. A hygiene measure enforced by law.</td>
</tr>
</tbody>
</table>
- v -

Qassab
See Gassab

Remessir (remassih)
Remaking the messir

Regulators
Structures of various sizes and design to control flow of water in canals.

Ridging
The basic cultivation method in Gezira. Often called "ploughing".

Rotation unit
Basic irrigation land unit, 720 feddans in Gezira Main, 540 in Managil.

Resting
Applied to land taken out of the rotation

Robats
Small earth banks.

Rotl (rotls)
See under Measures above.

Samad
The lowest level of official in the Scheme. For details of duties and status and future proposals see Extension Appendix

Sodium value
A method of comparing sodium content of soils developed in Sudan

Se'id
Cyperus rotundus, nut grass (Tothill gives "dis" as alternative). Spelled "Seed" in some documents.

Split ridging
First ridges are split after germination of weeds to prepare final planting ridges. Primarily a weed control operation.

Sweeping up
Debris is swept up, as many as 3 times, after pulling to prevent carry over of pests and diseases into next cotton season.

Simsim
Sesamum orientale, sesame, an oil seed.

Tagnet
Small ridge at right angle to robat.

Torade (torading)
Earthing-up of ridges after sowing to control weeds and repair damage done by rain. All cotton is toraded. Also called "green ridging"

Tulba (toulba)
Employment of labor by the Board on behalf of a tenant when the latter fails to complete necessary work on his cotton crop.

Wad Fahl
Dura type. Close headed, very palatable grain.