THE MANAGIL SOUTH-WESTERN EXTENSION: AN EXTENSION TO THE GEZIRA SCHEME

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THE MANAGIL SOUTH-WESTERN EXTENSION: AN EXTENSION TO THE GEZIRA SCHEME

AN EXAMPLE OF AN IRRIGATION DEVELOPMENT PROJECT IN THE REPUBLIC OF THE SUDAN

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THE MANAGIL SOUTH-WESTERN EXTENSION: AN EXTENSION TO THE GEZIRA SCHEME [1]

An example of an irrigation development project in the Republic of the Sudan

INTRODUCTION

The Gezira Scheme in the Republic of the Sudan is well known as one of the outstanding attempts to establish large-scale agricultural schemes successfully in Africa [2]. In July 1962, a large extension to this Scheme was brought into full production. This addition, known as the *Managil South-Western Extension,* covers an area of some 800,000 feddans [3], and more than doubles the area in the Gezira Scheme cultivated under extra-long staple cotton. Its development has been based largely on the pattern of the Gezira Main Area [4]. There are, however, important differences between the two components of the Scheme. These are partly the result of experience gained in the original Scheme area, and partly the result of differing physical and human conditions.

The Managil Extension is essentially part of a wider programme for developing gravity irrigation in the Sudan (Figure 1). As such, it is inextricably connected with the Roseires Dam project on the Blue Nile. The importance of irrigation water to the economy of Sudan can hardly be over-emphasised. This dam project is at the centre of Sudan's Ten Year Plan (1961/62-1970/71), and the Extension itself is one of the five major projects that form the backbone of the Plan [5].

The first suggestion for a dam at Roseires was made in 1904 [6]. A dam was built at Sennar in 1925 to irrigate the Gezira Scheme. Expansion of the irrigated area required a further dam, but the signing of the Nile Waters Agreement in 1929 between Egypt and the Condominium Government in the Sudan, restricted the use of water and stopped plans for expansion.

The Sudan negotiated a new arrangement with Egypt in 1959. This substantially increased the quota of water available to the Sudan during the annual period of water

[1] See curriculum vitae of the author and acknowledgements at the end of the paper.

[2] The author assumes the reader to have a working knowledge of the Gezira Scheme *vide*: A. GAITSKELL, *Gezira: A Story of Development in the Sudan.* Colonial and Comparative Studies. Faber & Faber, London 1959.

[3] Conversion rates:
1 Feddan = 1.038 acres = 0.42 hectares.
1 kantar (large) = 315 rotls = 312.01 lbs = 141.5 kg.
1 Sudanese pound (£S. 1.000) = £1.0.6d. sterling = US $ 2.872. 1 Sudanese pound contains 1,000 milleims.
1 milliard cubic metres = 1,000,000,000 cubic metres.

[4] To differentiate between the two parts of the Gezira Scheme, the established area will be referred to as the 'Gezira Main Area', and the new extension as the 'Managil Extension', or the 'Extension'.

[5] GOVERNMENT OF THE SUDAN, *Ten Year Plan of Economic and Social Development 1961/62-1970/71: 1962/63 Development Budgets.* The Sudan Survey Department. (Khartoum, Sept. 1962/247), p. 3. The five projects are the Roseires dam, the Managil Extension, the Khashm El Girba dam, constructed to develop an area for the re-settlement of the people of Wadi Halfa and district who will be displaced by the High Dam project in Egypt, the Sennar hydro-electric project, and the Guneid Sugar Factory. These projects will cost £S. 113.9, 40 % of planned public investment.

[6] WILLIAM GARTSIN, *Report upon the Basin of the Upper Nile.* Her Majesty's Stationery Office, cd. 2165. London 1904.

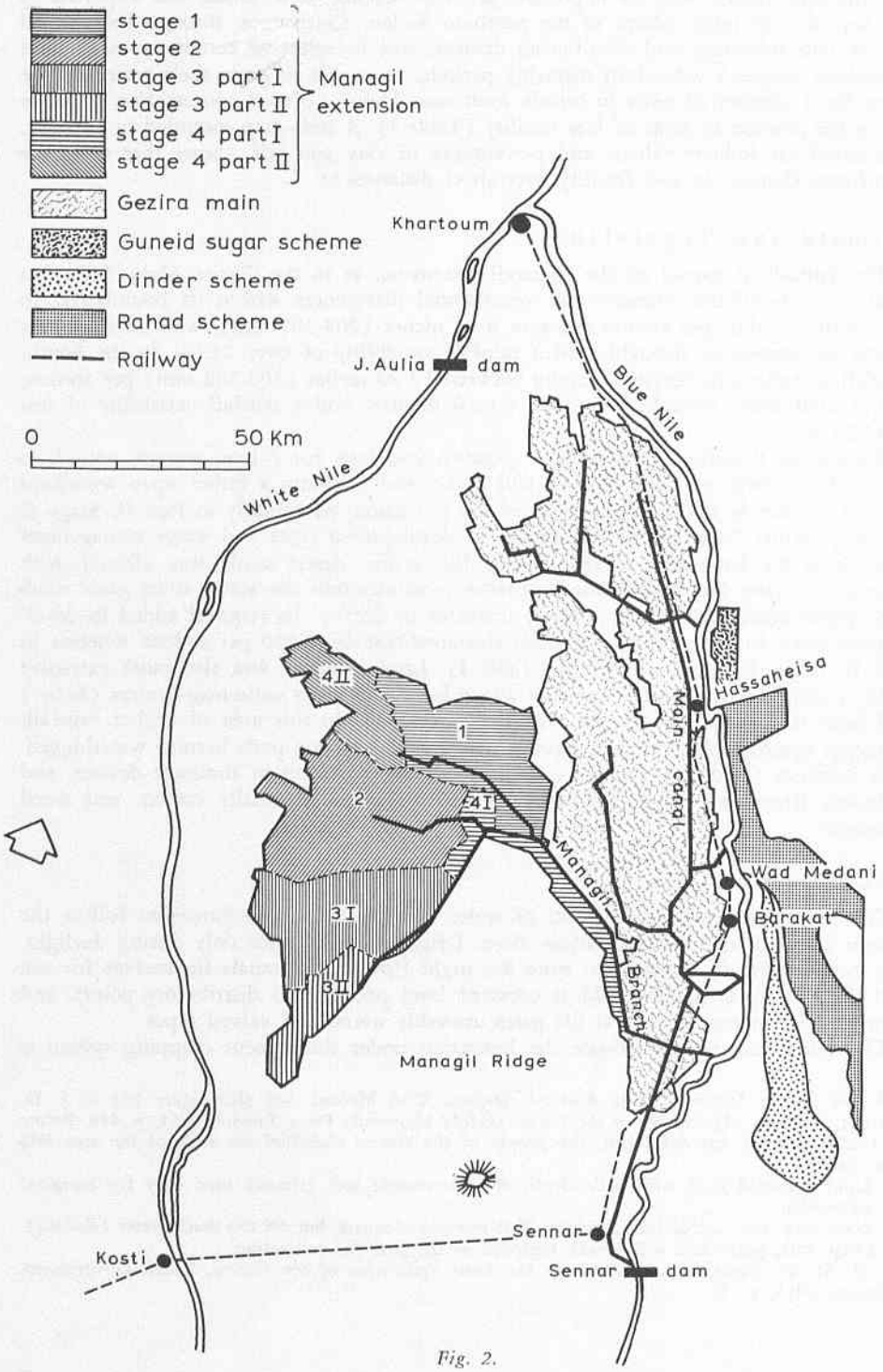

stage 1
stage 2
stage 3 part I
stage 3 part II
stage 4 part I
stage 4 part II
Managil extension
Gezira main
Guneid sugar scheme
Dinder scheme
Rahad scheme
Railway
0
50 Km
Khartoum
J. Aulia dam
Blue Nile
White Nile
4II
1
2
4I
3I
3II
Main canal
Hassaheisa
Managil Branch
Wad Medani
Barakat
Managil Ridge
Sennar
Sennar dam
Kosti

Fig. 2.

shortage (January 1 to July 15) when the flow of the Nile is at its lowest [7]. The new agreement enabled the Sudan Government to proceed with its plans for an enlargement of the Gezira Scheme, and other irrigation projects. Early plans for a dam at Roseires, supported by investigations made in the 1950's [8], could now be put into operation.

The estimated net storage in the first phase of the new reservoir, which is to be completed in 1967, will be 2.7 milliard cubic metres [9]. This will more than double the amount of water available for use during the annual period of shortage. It will also provide irrigation for the Managil Extension, and for an intensification of cropping in parts of the Gezira Scheme. An improvised plan of water distribution to the Extension has been designed until the Roseires dam is completed.

This paper is divided into three sections. Section I describes the Managil Extension, and compares it with some of the features of the Gezira Main Area. Section II evaluates the costs and benefits of the Extension. Section III outlines some of the achievements of the Extension, and some of the problems that have emerged as a result of an enlargement of the Gezira Scheme. It also deals with some of the major difficulties created by large-scale agricultural schemes in Africa against the background of attempts at rapid economic development.

I. The Managil Extension

Capital and water shortages caused the Managil Extension to be developed in four stages, two of which were divided into two parts (Figure 2). Each stage is some 200,000 feddans in area. Stage 1 was put under cultivation in the 1958/9 season. The last section (Part II, Stage 4) was ready for cultivation in July 1962. These stages have important physical and human contrasts that presented different problems when they were developed.

Topography

The Extension fans out from the south-central part of the Gezira Main Area in a west-southwest direction (Figure 2). Its eastern border skirts the Managil Ridge, a tract of high land which rises to a height of over 60 metres above the surrounding land.

[7] The Nile Waters Agreement 1929 divided the year into two periods:
(a) the 'free period' from mid-July to the end of December, and,
(b) the 'restricted period' from January to mid-July.
During the restricted period, Sudan can only draw upon water stored in its reservoirs. Under the 1929 Agreement, the Sudan was permitted to draw up to a maximum of 1.47 milliard m^3 during the restricted period. During the remainder of the year, the Sudan was permitted to take water into the Gezira canals up to a maximum of 168 m^3/second or 14 million m^3 per day, to fill the Sennar reservoir (1929 million m^3), flood areas under basin irrigation in so far as natural flood allows, and extract by pump according to a fixed cycle. At an average water-duty of 400 m^3 to 450 m^3 per feddan (measured at canal outlets) every 14 days, this was sufficient to irrigate some 450,000 feddans, and before the Managil Extension was developed, was adequate for the irrigated area.
Under the 1959 Agreement, the regulated flow of the Nile, after the High Dam at Aswan is in full operation, will be shared out, 18.5 milliard m^3 for the Sudan, and 55.5 milliard m^3 for Egypt. This will provide water for the Managil Extension and expansion of the irrigated areas elsewhere to a total of some 6 million feddans.

[8] Sir Alexander Gibb and Partners, *Roseires Dam Project.* Sudan Government. Khartoum 1954; and, *Estimation of Irrigable Areas in the Sudan, 1951-3.* Sudan Government, Khartoum 1954.

[9] The capacity of the dam when fully completed will be some 7.6 milliard m^3. The Egyptian High Dam by comparison will hold 130 milliard m^3 of water, vide: Ragaei El Mallakh, *Some Economic Aspects of the Aswan High Dam Project in Egypt.* (Land Economics, February 1959, p. 15).

This ridge sets the limits of irrigable land to the east of the Extension. Its western, southern and northern boundary was demarcated where good irrigable lands give way to intractable saline-alkaline clays associated with the White Nile lacustrine beds.

As in the Gezira Main Area, the general westward and northward slope of the land made the Extension easily adaptable to gravity irrigation. The general level of the land in the Managil region has been disturbed, however, not only by the Managil Ridge, but also by two groups of granite hills (*jebels*) which occur in Part II of Stage 3 [10]. Certain areas within the boundaries of the Extension have been omitted from cropped lands as a result, as they are above the command of gravity irrigation. Despite extensive land levelling (Table I), there are areas, particularly around the flanks of the *jebels*, that are lowlying. In years of heavy rains, waterlogging occurs in these places which considerably depresses crop yields.

Table I. *Land Development*

stages	total area (feddans)	area affected by continuous dura cultivation (%)	bush clearance heavy (%)	bush clearance medium (%)	bush clearance light (%)	cost per feddan (£s)	land levelling (a) (cubic metres)
1	197,468	30.28	5.37	15.50	45.83	0.909	166,525
2	221,277	27.12	14.24	20.90	54.23	1 008	56,009
3 I	138,671	37.12	35.70	21.00	1.10	1.613	217,830
3 II	86,264	10.55	59.51	13.33	1.52	1.796	160,780
4 I	60,193	72.02	0.83	0.00	21.93	0.796	100,500
4 II	75,477	10.30	0.00	0.00	31.00	0.750	185,000
total extension	779,350	29.70	18.42	15.10	32.06	1.159	886,644

(a) Includes the removal of former village sites, rain storage devices (*hafirs*), and field ridges (*terras*) constructed to channel rain-water for former dura cultivation.

Soils

In certain areas of the Extension, notably in Stage 1 and Part II Stage 4, the soils are generally similar to those of the Gezira Main Area. They are mainly fertile clays which give good yields if properly managed. The overall average yield of the Extension has been lowered, however, by other areas where soil fertility is lower, and by freak rains and rat attacks in the 1962/63 Season (Table II).

Table II. *Average cotton yields (Kantars per feddan)*

area	seasons				
	1958/59	1959/60	1960/61	1961/62	1962/63
Managil Extension	4.705	3.515	2.800	5.377	3.370
Gezira Main	4.710	4.176	2.733	6 638	4.300

There are important differences in soil fertility within the Extension. These differences have been created to some extent, by the cultural practices adopted in the area before it was developed under gravity irrigation. Before it was drawn into the Scheme,

[10] These hills are, however, fortuitously placed to provide stone for construction work. If they did not exist, building stone would have been transported over considerable distances, increasing construction costs.

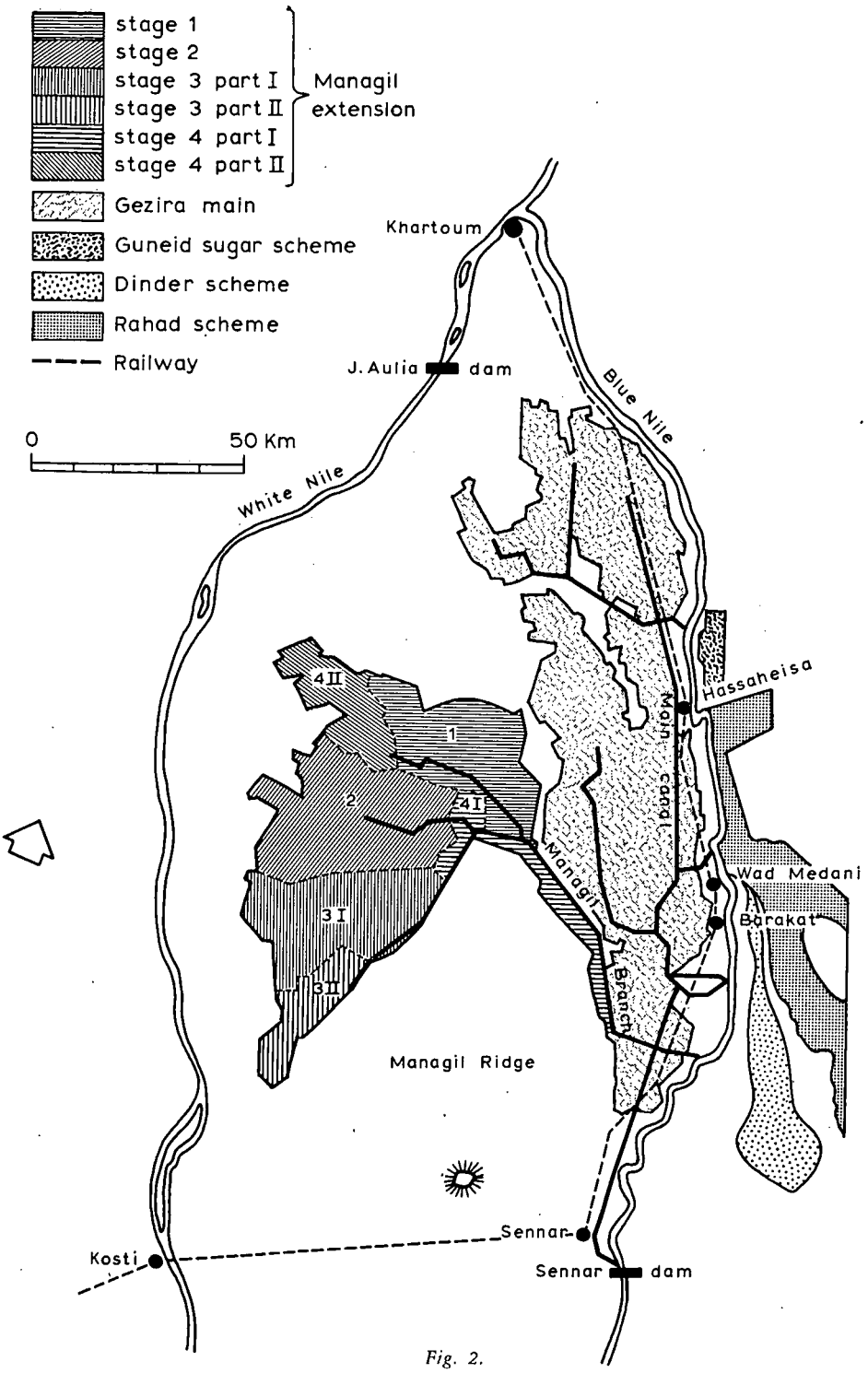

stage 1
stage 2
stage 3 part I
stage 3 part II
stage 4 part I
stage 4 part II
Managil extension
Gezira main
Guneid sugar scheme
Dinder scheme
Rahad scheme
Railway
0
50 Km
Khartoum
J. Aulia dam
Blue Nile
White Nile
Hassaheisa
Main canal
Wad Medani
Barakat
Managil
Branch
Managil Ridge
Sennar
Sennar dam
Kosti
4II
1
2
4I
3I
3II

Fig. 2.

the Managil region was an important grain producing area. Grain was exported to the capital, and other places in the northern Sudan. Cultivators, through the skillful use of rain collecting and distributing devices, and by selecting certain types of dura (*Sorghum vulgare*) with short maturing periods, were able to grow their grains on the rains for a number of years in certain locations. Absence of soil conservation practices led to the creation of areas of low fertility (Table I). A soils map compiled in 1961/62, and based on sodium values, and percentages of clay and salt, shows that there are significant changes in soil fertility over short distances [11].

Climate and Vegetation

The latitudinal spread of the Managil Extension, as in the Gezira Main Area, has resulted in significant climatic and vegetational differences within its boundaries. In the North, rainfall per annum averages 8-12 inches (203-305 mm), with an 8 months period of continuous drought, and a rainfall variability of over 25 %. In the South, rainfall is noticeably heavier, ranging between 12-20 inches (305-508 mm) per annum, with a continuous drought period of 4 to 6 months, and a rainfall variability of less than 20 %.

Rainfall is, therefore, sufficient in quantity, and lasts for a long enough period, to permit the growth of many grasses and herbs, and maintain a rather open woodland type of country in the southern parts of the Extension, particularly in Part II, Stage 3.

These factors have led to differences in development costs and water management throughout the Extension. In the North, the acacia desert scrub was cleared with comparative ease. Southward, the Extension protrudes into the acacia short grass scrub zone where acacia bush (*Acacia* spp.) increases in density. Its removal added to development costs. In Part I, Stage 4, bush clearance cost £s. 0.750 per feddan whereas in Part II, Stage 3, it cost £S. 1.796 (Table I). Land levelling was also more extensive in the southern parts of the Extension where large rain-water collecting devices (*hafirs*) had been constructed before the area was developed. In this area of higher rainfall, irrigation control becomes much more difficult, and lowlying parts become waterlogged. This increases fixed and variable costs through the provision of drainage devices, and increased labour inputs in re-sowing of various crops, especially cotton, and weed clearance.

Irrigation

The irrigation layout and system of water distribution in the Extension follow the pattern adopted in the Gezira Main Area. Irrigation takes place only during daylight. The canal system is designed to store the night flow in the canals themselves for use next day. Water is thereby held at constant level pools at all distributory points, and controlled by means of vertical lift gates, movable weirs, and valved pipes.

The water required to irrigate the Extension under the present cropping system is

[11] Soil Science Section, Gezira Research Station, Wad Medani. See also figure 181 in J. D. TOTHILL (Editor), *Agriculture in the Sudan*. Oxford University Press. London 1954, p. 448. Before the Gezira Scheme was developed, the people of the Gezira classified the soils of the area into three classes:

(a) Light coloured land with little depth of impermeable soil (*Azaza*) used only for marginal cultivation.
(b) Black clay land, useful for cultivation if it receives adequate, but not too much water (*Badoba*).
(c) Deep, soft, permeable soil (*Fud*) regarded as the best for cultivation.

See, H. ST. G. PEACOCK, *A Report on the Land Settlement of the Gezira*. Sudan Government. Khartoum 1913, p. 53.

Photo 1.
Tenant weeding his cotton field.

Photo 2.
'Westerners' picking cotton.

Photo 3.
Cattle scavenging for fodder on a canal bank.

Photo 4.
A roof top view of a village

Photo 5.
Women at a village well

Photo 6.
A water control point

about 2.4 milliard cubic metres annually. The available quantity of stored water in the Sennar dam reservoir is sufficient for Stage I and part of Stage 2 of the Extension. The Nile Waters Agreement of 1959 made available the necessary quantity of stored water for the remainder of the Extension. An improvised plan of water distribution to the Extension has been designed until the Roseires dam is completed. The level of the Jebel Aulia dam on the White Nile (Figure 2) has been raised by 40 cumecs. This has increased the volume of stored water in the reservoir by 300 million cubic metres, and has allowed the Sudan to draw more water from the Blue Nile in low flood while maintaining the flow of water to the U.A.R. by release from this reservoir. A quantity of 450 million cubic metres of water is a loan to the Sudan from the U.A.R. until the first phase of the Roseires dam is completed.

In 1959, a new Main Canal was constructed parallel to, and slightly larger than, the former Gezira Main Canal, leading from the Sennar dam where a new head regulator had been built (Figure 2). From this new Main Canal, water is diverted into the 76 kilometre long Managil Branch canal, and in turn into 136 kilometres of other branch canals [12].

Land Use and Distribution

The cropping pattern in the Managil Extension differs from that of the Gezira Main Area in two ways.

1. In the Extension there is a 6-course rotation of cotton - lubia - dura - fallow - cotton - fallow, whereas in the Gezira Main Area there is an 8-course rotation of cotton - fallow - dura - lubia/fallow - fallow - cotton - fallow - fallow [13]. Cropping is, therefore, more intensive in the Extension. Some 67 % of the land there is available for cropping in any one year, while in the Gezira Main Area, over 50 % of the land is left fallow (Table III). Cropping is not continuous throughout the year so that on a monthly basis the percentage of cropped land is even lower, being 25 % for the Gezira Main Area, and 39 % for the Extension [14].

The shorter rotation in the Managil Extension has allowed a greater area to be cultivated under cotton than is possible under the 8-course rotation. The absence of two consecutive fallows in the Extension is feasible because it has just been brought under cultivation, and weeds, especially *seid* grass (*Cyperus rotundus.* L), have not yet become serious. The 6-course rotation provides a more compact tenancy and gives greater ease of supervision, but dura yields are somewhat reduced. This could be overcome by encouraging better cultural practices on the lubia crop before the dura in the rotation, and on the dura crop itself, and also by using nitrogenous fertilisers on the

[12] The total length of the new Main Canal is 57 kilometres, its bed width is 50 metres, and its capacity is 188 m^3/second. The capacity of the Gezira Main Canal is 168 m^3/second. Other construction works associated with the development of the Extension (excluding Part II, Stage 4) include some 220 kilometres of railway track, 570 major and 1,036 minor regulators, 94 bridges, 12,000 field outlet pipes, 145 senior and 1,640 junior staff houses, and 64 social service buildings. Ginnings capacity has been increased from 728 to 1,076 gins.

[13] Egyptian type cotton (*Gossypium barbadense*) BAR XLI is grown exclusively in the Managil Extension, and covered 244,602 feddans in the 1962/3 season. In the Gezira Main Area, BAR XLI took up 84,455 feddans, BAR 14/25 91,018 feddans, Domain Sakels 61,001 feddans, Pima S. I 270 feddans, and Ashmouni A. 34 2,355 feddans. A small area of 643 feddans of American upland type cotton (*G. Hirsutun*), Acala 4.42, was also grown. Dura (*Sorghum vulgare*) is the staple food of the tenant farmer. Lubia (*Dolichos lablab.* L.) is a legume which is beneficial to succeeding crops in the rotation. Its seed is used as food by the tenant farmers, and its foliage as fodder.

[14] N. R. FADDA, *An approach to the intensification of the cropping system in Gezira and Managil.* Miscellaneous Paper No. I (Series II), Agricultural Research Division, Ministry of Agriculture, Republic of the Sudan. (Cyclostyled). March 1962, p. I.

dura land. The long-term effects of the more intensive rotation might not be as favourable as the 8-course rotation, but sufficient time has not elapsed to make a comparative evaluation [15].

2. The size of tenancy in the Extension is 15 feddans, whereas in the Gezira Main Area, the 'standard' tenancy is 40 feddans. The tenancy was reduced in size largely to spread the benefits of the Extension over a greater number of people, and enable a tenant and his family to work their holding without recourse to hired labour.

Managil tenancies are composed of 5 feddans for cotton, 2½ feddans for dura, and 2½ feddans for lubia each year, with the remaining 5 feddans fallow. This contrasts with the Gezira Main Area where the 'standard' tenancy has 10 feddans for cotton, 5 feddans for dura, up to 2½ feddans for lubia, and some 22½ feddans fallow in any year. In the Extension, lubia is compulsorily included as an essential part of the more intensive rotation. The area allotted to it is greater than in the Gezira Main Area where only certain tenants are given lubia plots. These tenants are regarded by the field staff of the Sudan Gezira Board to have performed their cotton operations well, and are given these areas as incentives. Groundnuts (*Arachis hypogea*) are often grown in the place of lubia, and have assumed the position of second cash crop in the Scheme. Similarly, competent tenants are also given small gardens in which they grow vegetables for home consumption and local sale. An expanding area is also being given over to wheat, as part of the country's import substitution programme [16], although it is not planned to grow it permanently in the Extension. There is a shortage of woodfuel and timber for building in the Scheme. Some 2,500 feddans of fuel plots were available for over 73,000 tenants in the 1962/63 season. A small area was grown under safflower, a crop that might be included in plans for intensification of cropping. 49 % of the irrigable area was left fallow in the 1962/63 season (Table III).

Table III. *Land use: 1962/63 season*

Land use	Managil Extension (Fds)	(%)	Gezira Main Area (Fds)	(%)	Total Gezira Scheme (Fds)	(%)
Cotton	244,602.25	32.2	239,741.70	25.1	484,343.95	28.2
Dura	107,930.84	14.2	123,888.30	13.0	231,819.14	13.5
Lubia	61,741.50	8.1	43,409.25	4.5	105,150.75	6.1
Gardens	4,906.00	0.7	11,406.25	1.1	16,312.25	1.0
Groundnuts	19,739.00	2.6	14,084.50	1.5	33,823.50	2.0
Fuel Plots	738.50	0.1	1,777.50	0.2	2,516.00	0.1
Fallow	319,806.66	42.1	522,558.75	54.6	842,365.41	49.1
Total Area	759,464.75	100.0	956,866.25	100.0	1,716,331.00	100.0
Wheat (a)	6,981.00	0.9	14,245.00	1.5	21,226.00	1.2
Safflower (a)	237.50	0.03	—	—	237.50	0.01

(a) Grown in land affected by heavy rains.

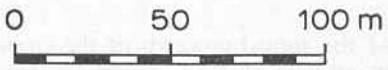
The distribution of tenancies in the Extension was governed by the *Gezira Land Ordinance 1927*. Land was compulsorily rented from registered land owners for 40 years standing at a fixed annual rent of £S. 0.100 per feddan, as in the Gezira Main Area. Landowners were prevented from demanding any rent from those who cultivated

[15] N. R. FADDA and A. Y. KORDOFANI, *Prospects of Cotton Production in the Republic of the Sudan.* (Studies of Factors Affecting Cotton Yields. International Cotton Advisory Committee. Washington 1961, pp. 241-242).

[16] Wheat is grown either in place of lubia, or vegetables, or in certain fallow areas. 120,000 feddans of wheat are planned to be sown throughout the Scheme. In 1961, wheat flour imports cost £S. 1.3 million.

KAMIL NOMAK VILLAGE CENTRE

1 Medical assistant's house
2 Veterinary dispensary
3 Bakery
4 Filter well
5 Post office
6 Village hall
7 Mosque
8 Teachers' houses
9 Boys' school
10 Girls' school



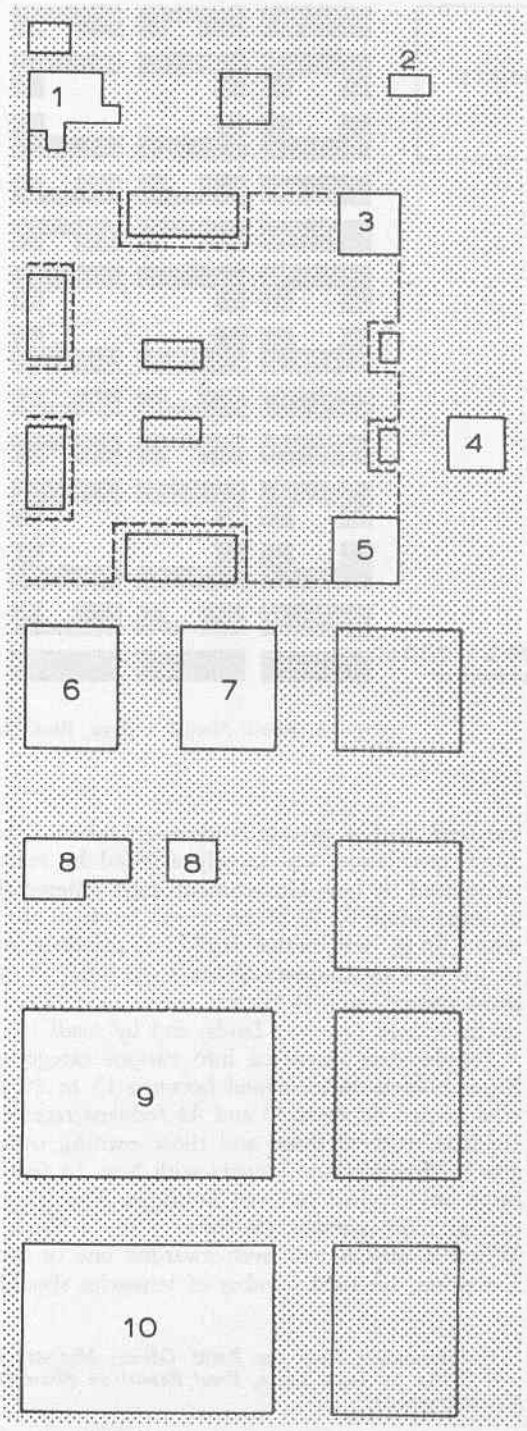


Fig. 3a.

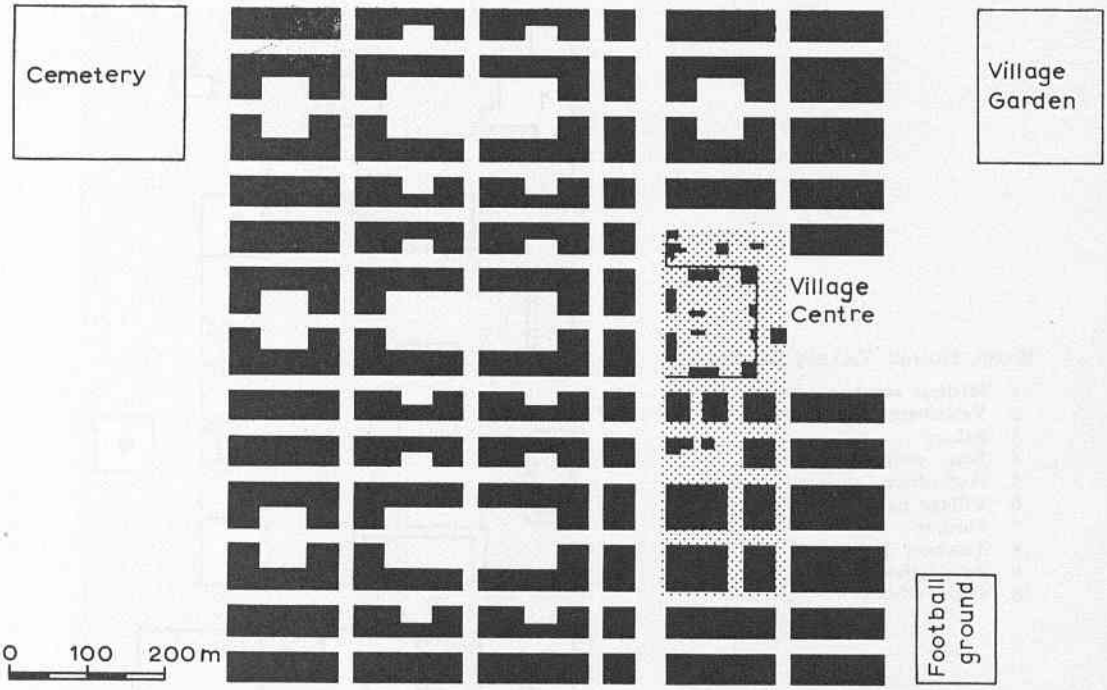


Fig. 3b. Kamil Nomak village, Blue Nile province Managil Extension.

the land, and so private landowners take no share of the annual proceeds of the crops. Land speculation was largely avoided by restriction on sale of land, except to those recognised by law. Government itself entered the land market so that by the beginning of 1963 some 62 % of registered lands of the Extension were owned by Government, while 36 % was native land, i.e. privately owned land that had been compulsorily rented by Government. At the same time, 57 % of the Gezira Main Area was Government owned, and 41 % was native land. The remaining land in both areas was taken up by village (*haram*) lands, and by roads [17].

People were classified into various categories for the purpose of land distribution. Right holders, who owned between 15 to 29 feddans were allotted one tenancy, those who owned between 30 and 44 feddans received two, those owning between 45 and 59 feddans received three and those owning over 60 feddans were awarded four tenancies [18]. Smaller land owners with 5 to 14 feddans were given one tenancy after all the large holders had received holdings. The large holders also had the right to nominate one or more persons (*nominees*) for a tenancy or tenancies within their entitlement. Where a person had been awarded one or more tenancies in a previous stage of the Extension, his total number of tenancies should not exceed four. There was an attempt

[17] Information from the Rents Office, Ministry of Local Government, Wad Medani.
[18] TAHA EL JACK TAHA, *Final Report on Phase II Tafriga (Land Distribution)* (Barakat 1959, Mimeographed).

to locate all tenancies awarded to a person in one place for ease of work and supervision.

Land remaining for distribution after all large and small holders had been given tenancies was divided amongst persons who used to cultivate, but not own, land in the area, and who had not received a holding either through titlehold, or nomination by a right holder. These persons (*ommars*) must have paid a crop tax (*ushur*) during the two previous seasons. Women were granted tenancies in all categories, and tenancies awarded to persons under the age of 16 years were registered in the names of guardians.

Table IV. *Tenant returns: 1962/63 season*

Category	Managil Extension No.	%	Gezira Main No.	%	Total No.	%
Males	36,739	89.1	29,026	89.1	65,765	89.1
Females	4,213	10.2	2,262	6.9	6,475	8.7
Minors	254	0.7	43	0.01	297	0.4
Non-Sudanese	27	0.06	1,358	4.0	1,386	1.8
Total	41,233	100.0	32,563	100.0	73,796	100.0

In the 1962/63 season there were 41,233 tenants in the Extension compared with 32,563 tenants in the Gezira Main Area. The majority of the 73,796 tenants in the Scheme are male (Table IV), but there is a significant number of female tenants in the Extension, and a higher proportion of Non-Sudanese tenants in the Gezira Main Area (See Table VI).

Tenancies are allotted on a year-to-year lease, renewable subject to concurrence with the *1941 Standard Conditions of Tenancy* agreement between the tenant and the other partners. The lease is, in fact, indefinitely renewed for the majority of tenants. In the ten seasons between 1951/52 and 1960/61, 370 tenants, or 37 per year, were evicted for not complying with the tenancy conditions.

Population

The physical transformation of the Managil area has had a considerable impact on the population. Before the Gezira triangle was developed under gravity irrigation, it was occupied by peoples ranging from agriculturalists to nomadic cattle owners. Cultivation depended on rainfall. Dura was sown with the coming of the rains in June/July and harvested in November. The inhabitants of the area then moved to the permanent village sites near wells, or on the banks of the Niles, while cattle were taken on the customary migrations in search of water and pasture. The amount and occurrence of rainfall strongly determined the pattern of movement.

The central position of the Managil area on the Gezira plain made it the meeting place of many tribes in their travels between the two Niles. A market economy developed at an early date. The Gezira plain, and especially the Managil area, was an important grain producing and exporting area. It also lay astride the pilgrim route from West Africa to Mecca. Managil town, situated in the centre of the plain, and close to a main route linking the two Niles, developed a flourishing trade in dura, and livestock and their by-products. The Managil district also had a reputation for cotton cultivation. Cotton was grown in natural basins of low land with favourable soils in which rain collected from the surrounding higher land. During the 19th century, there was a large local market for native cotton, which was also transported to Northeast Africa. By the

beginning of the present century, cotton cultivation had almost ceased owing to the disruptive forces at work during the Mahdia period (1881-1898) [19].

The establishment and expansion of the Gezira Scheme have influenced both the tribal composition and occupational structure of the area. The First Population Census of the Sudan, 1955/56, was carried out before the Managil Extension was developed. It enables a comparison to be made between the two parts of the Scheme, one part of which was already well established, while the other part was later to be developed.

1. *Tribal composition*

The Census showed the extent to which the Gezira plain had become a tribal melting pot. A wide range of tribal representation exists in both parts of the Scheme (Table V). The main contrasts are that the Gezira Main Area contained a larger number of 'westerners' (people from the Western Sudan, the former French Equatorial Africa, Nigeria and West Africa), and expatriates, at the time of Census (Table V).

Table V. *Tribal composition in the Gezira* [20]

People	Managil Area (%)	Gezira Main Area (%)
Arab	90.3	76.5
Miscellaneous	0.6	0.8
Nuba	0.4	0.6
Beja	3.3	1.6
Nubiyin	2.0	3.1
Southerners	1.0	1.3
Westerners	1.8	12.9
Foreigners (a)	0.1	0.2
Foreigners (b)	0.5	3.0
Total Population (No.)	369,632	517,697

(a) With Sudanese Status (b) With Non-Sudanese Status.
(Source: Compiled from *First Population Census of Sudan 1955/56*. Ministry of Social Affairs, Population Census Office, Khartoum 1957, Table 7).

There was a steady flow of people from the western part of the Sudan, and from across the western frontier, before the Gezira Scheme was started. This movement was induced by political unrest, or the desire to visit Mecca. Many of these migrants were attracted to the Gezira Scheme at its inception. Over time some acquired tenancies, but more were encouraged to settle in isolated villages within its boundaries to provide a readily available source of labour. By 1958, it was estimated that there were 21,260 West Africans permanently residing in these labour villages. In the 1960/61 season, 7 % of all tenancies in the Scheme were held by 'westerners', and over 64,000 or 27 % of the total picking labour force came from the West. The influx of people of this origin has been less marked in the Managil Extension. Since 1958 there has been a policy of restricting holdings to Non-Sudanese (Table VI).

[19] For descriptions of the Gezira area before the Gezira Scheme was implemented see: W. GARSTIN, op. cit., pp. 121-2 and, H. St. G. PEACOCK, op. cit. p. 18.

[20] The figures for Table V and Table VII have been calculated from the returns for the census areas either wholly or partly within the Scheme with the exception of the town of Wad Medani. The author is grateful to Dr. G. BRAUSCH of the Department of Social Anthropology in the University of Khartoum for calculating these figures.

Table VI. *Origin of tenants: 1960/61 season*

Origin	Managil Extension		Gezira Main	
	No.	%	No.	%
A. *Sudanese*				
Right Holders	8,414	27	4,453	14
Local Inhabitants (b)	20,021	67	25,763	79
Other Arabs	1,968	6	326	1
Western Sudan	40	+	712	2
Totals	30,443	100	31,254	96
B. *Foreigners*				
Central African Republic & Chad	19	+	953	3
Fellata, Berno, Hausa	1	+	346	1
Western Sudan	—	—	79	+
Ethiopia	—	—	2	+
Egypt	—	—	6	+
Totals	20	+	1,386	4
C. Grand totals	30,463	100	32,640	100

(a) Excluding Part I, Stage 4.
(b) Former cultivators (*ommars*).
(+) Less than 1 %. Percentages to nearest whole number.

The large percentage of foreigners in the Gezira Main Area was the result of an influx of expatriates to take up administrative and technical occupations.

2. *Occupational Distributions*

The figures for occupational groups in the two areas show the secondary or indirect benefits of the Gezira Scheme in the development of secondary and tertiary activities in the Gezira Main Area over some thirty years (Table VII).

Table VII. *Occupational groups* [20]

Occupation (a)	Managil Area (%)	Gezira Main Area (%)
Farmers	88.4	50.6
Farm Labourers	1.0	22.8
Animal Owners	0.3	0.0
Shepherds	3.9	1.8
Shop-keepers & Assistants	1.6	4.6
Craftsmen & Mechanics	1.2	4.2
Machine Operatives	0.6	2.4
Labourers (Non-farm)	1.3	8.8
Others	1.7	4.8
Gainfully Employed (No.)	117,157	143,130

(a) Primary occupations only.
(Source: Compiled from the *First Population Census of Sudan 1955/56*. Ministry of Social Affairs, Population Census Office, Khartoum 1957, Table 8).

Over 15 % of those gainfully employed in the Gezira area were engaged in industries and public utility work while some 3 % were similarly employed in the Managil area. 4.6 % were also engaged in shopkeeping compared with 1.6 % in the Managil area.

Planned Settlement

The distribution of population over the Managil area was not uniform when it came under development. Whereas a number of permanent and semi-permanent villages already existed in the northern stages, there was a marked decline in their number southwards (Table VIII).

Table VIII. *Size, number and density of settlements*

Area	Size of settlement: Under 1000 persons		1000-2000 persons		Over 2000 persons		Total	
Managil Extension	No.	Density *	No.	Density *	No.	Density *	No.	Density *
Stage 1	42	1.3	27	0.8	8	0.3	77	2.4
Stage 2	28	0.8	16	0.4	13	0.3	57	1.5
3 I	13	0.6	8	0.4	5	0.2	26	1.2
3 II	4	0.3	10	0.7	—	—	14	1.0
4 I	7	0.7	4	0.4	4	0.4	15	1.5
Total Managil Extension (a)	94	0.8	65	0.6	30	0.3	189	1.7
Total Gezira Main	488	3.1	120	0.8	99	0.6	707	4.5
Total Gezira Scheme (a)	582	2.2	185	0.7	129	0.5	896	3.4

(a) Excluding Part II, Stage 4.
(*) Per Square Mile.

Irrigation in the Gezira Main area was developed in a region in which a large number of villages already existed (Table VIII). The task there was to adapt the irrigation lay-out to the existing settlement pattern.

In the Extension, new villages and services have been created. This has made the dovetailing of settlements, services and irrigation works easier as all have been planned together. It has had the disadvantage, however, of resulting in a re-settlement policy on a scale that was never necessary in the Gezira Main Area. Re-settlement has proved to be a sensitive affair owing to the presence of a mixed tribal population with sectional interests.

Villages and social services have been planned to fit into the physical background of the irrigation lay-out. Thirty-six civic centres have been strategically situated throughout the Extension to provide services for the areas around them. Each village has been allocated a certain area of land for settlement. Village plans have been laid out on a grid pattern. Within the boundaries of each village, a person is given a plot of 400 square metres on which to construct his own dwelling [21] (See fig. 3, plans of Kamil Nomak village).

It has been planned that as far as possible villages should have the following characteristics:

I. A minimum size of not less than 500 people to make each village eligible for a village council. The village council is one of the units in the machinery of devolution which is designed to transfer management for agricultural operation from the Board to the tenants themselves.

II. An optimum number of tenants to most closely approach the density of six persons to five feddans, i.e., the size of a cotton plot. The optimum size of village was, therefore, related to the area worked by the members of the village. Initial planning stipulated that a farmer should not have to travel more than five kilometres between village and tenancy.

[21] DEVELOPMENT DEPARTMENT, SUDAN GEZIRA BOARD, *An Account of the Activities of the Development Department in the 1957/58 Season.* Typewritten (Barakat, July 8, 1961). For an analysis of the problems of village development in the Gezira Main Area see: GEORGES BRAUSCH, PATRICK CROOKE and JOHN SHAW, *Barshagra Settlements 1963.* A case study of village development in the Gezira Scheme. University of Khartoum, 1964.

III. Wherever possible, each village should have representatives of one tribe to avoid inter-tribal disputes. Where there was more than one tribe represented, there should be one headman with one village council.

IV. In the centre of each village there should be a school, village hall, market, mosque, coffee house, dispensary and veterinary station. Public latrines are to be installed throughout each village, and on the periphery, space has been set aside for a recreation ground, a village vegetable garden, and a cemetery. Each village is to have a filter- or bore-well, and telephone links.

V. New villages are to be located, wherever practicable, on market roads, or near a railway line. Footbridges over canals are to be placed near schools and dispensaries. Diversions to these crossings are not to be more than 1½ kilometres.

An attempt is being made to make these village structures economically and socially viable. It is hoped that they will act as a binding force throughout the Extension, and ease problems associated with settling formerly nomadic peoples. The Netherlands organisation for international aid (NOVIB), W.H.O., and various Government Ministries, are financing and administering a pilot scheme to run a model community development centre in one of the Managil villages. This experiment contains a complete dispensary with 20 beds, a child welfare centre, a maternity centre, and a preventive health unit, a training centre for animal husbandry, poultry and milk processing, and a training centre for horticulture and rural crafts. If this project is successful, similar units will be set up over the whole Extension.

Organisation and Management

The organisational structure of the Managil Extension is essentially according to the framework established in the Gezira Main Area. There is a form of collaboration between three 'partners', Government, tenant farmer and Sudan Gezira Board. Government provides the land, either as Government land or as land rented from landowners in the area. It also supplies water by executing, operating and maintaining irrigation works. The tenant farmers supply the labour for the production and harvesting of cotton.

The Sudan Gezira Board, established in 1950 when the lease of the cotton concession company (Sudan Plantation Syndicate) expired, is an independent entity with the rights and liabilities of an independent corporation. It is composed of a managing director, appointed by Government to act as a link between day-to-day management of the Scheme and Government, representatives from the Ministries of Finance and Economics, and Commerce, Industry and Supply, the Director, Department of Agriculture (*ex-officio*), and the Governor of the Blue Nile Province in which the Scheme is situated.

The Board is responsible to Government, through the Ministry of Finance and Economics, for:

1. managing and financing cotton production, transportation, ginning and marketing;
2. promoting social development to improve the standard of living of the tenants, and other persons living within the Scheme area; and,
3. promoting research to increase the productivity and stability of the Scheme [22].

The headquarters of the Board is located at Barakat on the eastern side of the Scheme (Figure 2). A 'sub'headquarters has been set up in Stage 2 of the Extension for the overall administration of production in the new area. For efficiency of supervision, and on account of irrigation considerations, both parts of the Scheme are divided into six large units called *groups*. Each group has its own headquarters from which the

[22] GOVERNMENT OF THE SUDAN, *The Gezira Scheme Act, 1960 (1960 Oct. No. 30)* (in: Legislative Supplement to The Republic of the Sudan Gazette No. 950. Sudan Govt. Khartoum, 15th September, 1960), pp. 113-131 and The Gezira Scheme (Amendment) Act, 1961 (1961 Act No. 8) (in: Legislative Supplement to The Republic of the Sudan Gazette No. 936. Sudan Govt.. Khartoum, 15th March, 1961), p. 20.

group inspector supervises the area under his charge. Each group is divided into a number of smaller administrative units known as *blocks*. There were 42 blocks in the Managil Extension, and 45 in the Gezira Main Area, in the 1962/63 season. Each block is controlled by a block inspector who is aided by two or three assistants, depending on the size of the block. These, in turn, are supported by able tenants (*samads*), and by village councils, in the running of the block (Table IX).

Table IX. *Average supervisory units: 1962/63 season*

Area	No. of field inspectors	Average units supervised		
		Feddans cotton	Feddans all crops	Tenants
Managil Extension	151	1620	5030	273
Gezira Main	119	2015	8041	273
Total Scheme	270	1794	6357	273

The field inspector's chief concern is with cotton cultivation. A benevolent interest is taken in other crops. For example, tenants receive help for their dura crop through the supply of fertiliser and threshing machines, and their lubia crop by having it mechanically baled for conservation for summer feed. Moreover, the mechanical production of groundnuts and wheat is being extended through the Scheme, and cooperative marketing for these crops is being encouraged. A start is also being made to establish cooperative dairy herds. But the field inspectors' first duty is to keep technical efficiency on cotton production high. He has powers to compel tenants to carry out their cultural operations on cotton within fixed periods, and to harvest and deliver the cotton to the loading stations for transport to the ginneries. If a tenant falls behind in any cotton operation, the block inspector may hire labour on behalf of the tenant to ensure that the work is carried out in time. The cost of the hired labour (*tulba*) is charged against the profits from the sale of the tenant's cotton yield. In this way a high standard of farming is maintained on cotton cultivation.

II. The costs and benefits of the extension

Plans for economic development in the Sudan are centred on the increased use of irrigation water made possible by the Nile Waters Agreement of 1959 [23]. The Managil South-Western Extension is one component of this drive to expand the area under irrigation. Its important conceptual aspects are to extend the use of existing capital works, and help maximize the use of future capital constructions, and increase Gezira cotton production. The vital position of cotton in the National Economy makes the project a significant one in terms of the economic development of the country.

The estimated capital investment in all four stages of the Extension is £S. 39 millions of which £S. 24.8 millions (63 %) is supplied by the Ministry of Irrigation, £S. 14 millions (36 %) by the Sudan Gezira Board, and £S. 0.2 millions (1 %) by the Department of Posts and Telegraphs [24]. Based on this estimate, capital investment per irrigable feddan is £S. 51, and £S. 160 per feddan of cotton. But these figures are based on the present irrigation arrangements. When the Extension is irrigated from the

[23] The Economic Planning Secretariat, Ministry of Finance and Economics, *The Ten Year Plan of Economic and Social Development 1961/62-1970/71*. Govt. Printing Press, Khartoum, 1963.

[24] Government of the Sudan, *Ten Year Plan of Economic and Social Development 1961/62-1970/71: 1962/63 Development Budgets*. The Sudan Survey Dept., Khartoum, Sept. 1962/247, pl. 11.

Roseires dam, it will take 0.8 milliard cubic metres from a reservoir of 2.7 milliard cubic metres. The distribution of the cost of the Roseires dam of £S. 23.4 millions, based on the use of stored water, would give a share of costs to the Extension of:

$$\frac{0.8}{2.7} \times \text{£S. } 23.4 \text{ millions} = \text{£S. } 6.9 \text{ millions}$$

Capital investment per irrigable feddan would then become £S. 60 and £S. 188 per feddan of cotton. These unit investments compare favourably with irrigation developments in other parts of the world [25].

On the basis of a unit yield of four kantars of seed cotton per feddan [26], for an area of 244,602 feddans under cotton (Table III), the gross value of cotton production in the Extension would be £S. 13.6 millions, or £S. 56 per feddan of cotton, before deducting export duty.

The gross value of crops other than cotton, and the returns to livestock activities, are difficult to estimate, partly because of the absence of reliable information, and partly because of local consumption of some products which are difficult to value precisely. An attempt is made in Table X to estimate gross returns to all crop activities on the basis of the feddanages for each crop given in Table III, and various estimated yields and prices. Areas, yields and prices fluctuate from year to year. The areas allotted for certain crops, noticeably lubia, are not always fully cropped, owing to such factors as failure of rains, or too much rain at sowing, pest attacks, and shortage of labour and capital. Wheat and safflower were grown in areas affected by heavy rainfall in the 1962/63 season. Their yields were negligible owing to attacks by rats, and they are omitted from the calculations. Fuel plot returns are also left out because of the smallness of the sum involved.

Table X. *Gross value of crop production in the Managil Extension*

Crop	Gross value		
	Per extension (£S. million)	Area grown (feddans)	Per feddan (£S.)
Cotton - Lint (a)	11.84		
Cotton - Seed (b)	1.75		
Cotton - Total	13.59	244,602	55.569
Groundnuts (c)	0.25	19,739	12.692
Vegetables (d)	0.05	4,906	10.000
Dura (e)	1.20	107,931	11.102
Lubia (f)	0.31	61,742	5.000
All Crops	15.40	438,920	35.083 (g) 20.297 (h)

[25] D. GROENVELD, *Investment for Food*. North-Holland Publishing Company, Amsterdam, 1961, p. 132.

[26] One kantar of seed cotton is 312 lbs, which gives approximately 110 lbs. of lint cotton, and 202 lbs. of cotton seed after ginning. Cotton yields have been calculated on a five year average 1958/63 for the Extension. The basic mean for the Gezira Main Area over the period 1935/36 to 1947/48, i.e., the period between the standardisation of rotation and clean-up measures, and the introduction of new agronomic practices, is 4.04 kantars per feddan. Cotton f.o.b. Port Sudan prices are taken as £S. 11.000 per 100 lbs of lint, and £S. 20.576 per metric ton of seed. The prices for extra long staple cotton are unstable, and a warning has been given by the International Cotton Advisory Committee regarding the possibility of over-supply of this variety. The average price of the Lambert variety of cotton fell from £S. 12.910 per 100 lbs lint ex store Port Sudan in 1960 to £S. 11.640 in 1961, to £S. 10.520 in 1962. The price stood at £S. 10.240 for the first half of 1963.

(a) Yield 440 lbs per feddan. Price £S. 11 per 100 lbs f.o.b. Port Sudan.
(b) Yield 0.37 metric tons per feddan, and five year average overall price (1959-63) of £S. 21.073 per metric ton.
(c) Yield 1604 lbs per feddan of the Ashford variety at £S. 0.600 per 90 lbs., plus £S. 2 per feddan for green fodder.This yield is 75 % of the average yield obtained in the 1962/63 season in the supervised Village Farming Experiment at the village of Kheir Bejeik in Stage 2 of the Extension. The local market price quoted is for those tenants outside groundnut marketing cooperatives. In the 1962/63 tenants in the two marketing cooperatives received £S. 1.400 per 90 lbs.
(d) Assuming the garden contains groundnuts and onions, and is worked by a temporary labourer who shares costs and returns equally with the tenant.
(e) Yield 0.74 long ton per feddan at £S. 14.136 per long ton, plus £S. 0.500 per feddan for the fodder value of the stubble after harvest.
(f) Yield 0.53 long ton per feddan from two cuts at £S. 9.418 per long ton.
(g) Per cropped feddan minus fuel plots (Table III).
(h) Per irrigable feddan (including fallows) minus fuel plots (Table III).

The total gross income of crop production in the Extension of £S. 15.4 millions would represent 39 % of total investment under the present system of irrigation, and 33 % under the arrangement when the first phase of the Roseires dam is completed. The percentage of annual gross value of crop production to investment can be affected by changes in price and yield. If the price of one kantar of cotton lint rose or fell by £S. 1 f.o.b. Port Sudan, the percentage would increase or decrease by some 3 %. An increase in yield of 0.5 kantars (156 lbs) of seed cotton per feddan would, assuming cotton grades remained constant, increase the percentage by 5 %.

Annual Costs of Production

Annual production costs for cotton are borne by the three partners as laid down in the Gezira Scheme Act of 1960. Estimation of production costs involves a number of difficulties. The calculation of depreciation rates on capital equipment of various kinds is arbitrary. Determination of labour costs of units paid in kind and not cash is approximate. The apportionment of items of Sudan Gezira Board expenditure to the Managil Extension is difficult because costs and returns are not recorded separately for the two parts of the Scheme. Drawing upon estimates from various sources, however, current annual costs of operating the Extension may be calculated as in Table XI.

Table XI. *Annual cotton and other crop production costs in the Managil Extension* (a)

Partner	Per feddan cotton (£S.)	Per Extension (£S. million)
I. Ministry of Irrigation	4.000	0.978
II. Government Services	1.455	0.356
III. Sudan Gezira Board	2.415	0.591
IV. Joint Collective Charges	14.713	3.599
V. Tenants Costs	7.984	1.953
Total Cotton Production Costs	*30.567*	*7.477*
VI. Tenants Production Costs on other crops	3.866	**0.815**
Total Production Costs All Crops	*34.433*	*8.292*

(a) For a yield of cotton 4 kantars per feddan.

I. Ministry of Irrigation costs of maintenance and operation cannot as yet be assessed accurately. They would be lower per unit than in the Gezira Main Area in the past as expansion of the irrigable area would result in a spread of various overhead costs over more farming units. The costs of operation, maintenance and land rent in the Gezira Main Area have been estimated at £S. 5 per feddan of cotton in the recent past. In the Extension they are estimated at £S. 4 per feddan of cotton [27].

[27] Information from Ministry of Irrigation and H. E. P., Government of the Sudan.

II. Government Services are supplied through the Local Government officers in the Scheme area, and the Social Development Department of the Sudan Gezira Board. In the newly developed area, where costs on social overheads are high, it is assumed that both agencies will use up their share of 4 % of the distributed cotton profits (Table XII).

III. Sudan Gezira Board annual costs of operation per feddan of cotton have been calculated on the basis of a five year average 1957/8 to 1961/2 (Table XVI) [28].

IV. Joint Collective Charges are costs of operations on cotton production performed by the Board and charged to the Joint Account of the Government, tenants and Board [29]. These costs have been calculated on the basis of a five year average, 1957/8-1961/2 [28], and adjusted for a four kantar per feddan cotton crop.

V. Tenant Cotton Production Costs are largely farm labour costs. The tenants do not invest capital in cotton production.

VI. Tenant Other Crops Production Costs. Production costs for all other crops should be added to those of cotton. These are estimated at £S. 3.866 per feddan [30] at yields given in Table X.

The net value of crop production, before deduction of export duty, can be estimated at £S. 7.11 millions (Tables X and XI).

Capital-Output Ratio [31]

With the share of the Roseires dam included in total investment, the gross capital-output ratio is 2.81. Capital is the value of capital goods at cost purchased or built. Output is value added, i.e. the value of sales minus expenditure on goods and outside services. Salaries and wages are not deducted.

Most of investment is spent on building and civil engineering. The amount of depreciation on equipment is therefore negligible. The gross capital-output ratio and net marginal capital-output ratio are thus equal.

The level of the capital-output ratio depends markedly on the price of cotton lint. With a rise or fall of £S. 1 per kantar, the gross capital-output ratio would become 2.58 or 3.10 respectively. An accurate forecast of cotton prices is impossible. This uncertainty is a serious draw-back for any investment in a raw material producing project like the Managil Extension.

The length of the gestation period, i.e. the period between the commencement of construction and the moment the project's full economic effects are felt, also provides disadvantage for an agricultural scheme like the Managil Extension when compared with certain manufacturing industries. The lag between investment and revenue is three years for the Extension. In the early stages of development, work is concentrated on the long irrigation channels leading to the land, but later work is carried out on land that is to be irrigated. In many manufacturing enterprises, the lag is one year.

Distribution of Benefits

According to the Gezira Scheme Act, 1960, the 'gross profits' of the cotton crop, i.e. "... the balance remaining of the price actually obtained by the Board by the sale of

[28] SUDAN GEZIRA BOARD, *Annual Report and Statement of Accounts, 1958-1962.*

[29] These charges include such items as supply of cotton seed to tenant, provision of fertilisers, bulk pest control operations, collection and transport of cotton from collecting stations to ginneries and from ginneries to market, ginning, baling, storage and marketing of cotton, conduct of agricultural research, insurance of the cotton crop, export duty, and the cost of pulling out cotton stalks after the cotton harvest is over. The Gezira Scheme Act, 1960, op. cit. Schedule II, Part V, pp. 127-8.

[30] On the basis of £S. 4.616 per feddan dura, £S. 3.583 per feddan lubia, £S. 2.500 per feddan vegetables, and £S. 4.765 per feddan groundnuts.

[31] DEPARTMENT OF STATISTICS, *Capital Formation and Increase in National Income in Sudan in 1955-1959* (Mimeographed, Khartoum, April, 1961).

that season's total crop of ginned cotton and cotton seed after deduction therefrom of the joint collective charges and expenses" [32], are distributed in the following way (Table XII).

Table XII. *Distribution of cotton profits*
(£S. millions)

Gross returns from cotton		13.592
Less: Export duty lint (a)	1.076	
Export duty seed (b)	0.030	
Joint Collective Charges	3.599	4.705
Net cotton returns to be distributed		8.887
Distribution to:		
(a) Government	42 %	3.732
(b) Tenants	44 % (c)	3.910
(c) Social Development Fund	2 %	0.178
(d) Local Government in Scheme Area	2 %	0.178
(e) Sudan Gezira Board	10 %	0.889
Total	100 %	8.887

(a) At £S. 1 per 100 lbs lint.
(b) Taking 5 year averages for the period 1959-63, 43 % of total cotton seed production is exported through Port Sudan, 52 % is sold to factories in Khartoum North, and 5 % is reserved for sowing Export duty for cotton seed is calculated at 3 % of the f.o.b. value of the seed, plus royalties.
(c) This includes releases to the Tenants' Reserve Fund, an equalization fund to cushion the effects of low yields and prices. This fund has a maximum of £S. 25 per feddan of cotton.

Returns to Government

Government and Board net revenue from the Managil Extension is composed not only of the percentage share of cotton profits, but also of export duty on cotton lint, and export duty and royalties on cotton seed, plus freight revenues from the transport of cotton lint and seed from the ginning factories in the Gezira to Port Sudan. (Table XIII).

Table XIII. *Government revenues from the Managil Extension*

Item	£S. millions
Cotton proceeds (a)	4.619
Export duty on cotton lint and seed (b)	1.106
Royalties on cotton seed (c)	0.013
Freight charges (d)	0.700
Gross Revenue	*6.438*
Less: Annual operation and maintenance costs (e)	1.925
Net Revenue	*4.513*

(a) 52 % of distributed cotton proceeds (Table XII).
(b) See Table XII.
(c) At 15 % of the f.o.b. Port Sudan value of cotton seed.
(d) At a charge of £S. 7.450 per metric ton of cotton lint and £S. 3.750 per metric ton of cotton seed between the ginning factories in the Gezira and Port Sudan.
(e) Ministry of Irrigation, Government Services, and Board annual costs as in Table XI, but excluding running costs of Sudan Railways. Depreciation costs are assumed to be negligible.

Net revenue to Government, including the Sudan Gezira Board, would be 12 % of total investment under the present irrigation arrangement, and some 10 % with the share of Roseires dam costs included.

[32] The Gezira Scheme Act, 1960, op. cit. Schedule III, p. 128.

The Position of the Tenant

Tenants' gross income is made up of their share of distributed cotton proceeds, plus the full returns from all other crops for which they pay neither a land nor water rent.

Table XIV. *Tenant returns*

Item	£S. millions
Gross Returns Cotton (a)	3.910
Gross Returns other Crops (b)	1.810
Total Gross Revenue	*5.720*
Total Production Costs (c)	2.768
Total Net Revenue	*2.952*

(a) 44 % of distributed cotton proceeds (Table XII).
(b) Table X.
(c) Table XI. Total production costs represent 48 % of gross revenue to tenants. As there were 41,233 tenants in the Extension in 1962/63 (Table IV), this would give an average net cash income per tenant of £S. 72. To this figure would be added earnings from any secondary occupations performed by the tenant [33].

Tenants returns are affected by fluctuations in yields, grades and prices of cotton. An increase of 0.5 kantars (156 lbs) of seed cotton per feddan would, assuming cotton grades remain constant, increase net average cash income per tenant by 11 %. A rise or fall in export price of £S. 1 f.o.b. Port Sudan for a kantar of lint cotton would increase or decrease the average net cash income per tenant by 7 %. There would also be an increase in net cash income if the tenant and his family contributed more labour to total labour demands. To this extent, low net cash income is, at least in part, a reflection of social values which place a high price on leisure, and on certain traditions and customs which restrict the use of female labour.

In order to calculate the net benefit of the Extension to the occupants of the area, some estimate must be made of the value of production in the region before it was developed. For this purpose it is assumed that the value of livestock production in the area has remained unchanged. Although dura yields may have doubled per feddan, there has been a reduction in the area under dura by some 50 % [34]. If it can be assumed that the value of dura production has remained the same, the increase in the annual gross value of production in the Extension through irrigation is of the order of £S. 14.2 millions or £S. 19 per feddan. On these assumptions, net primary benefits of irrigation development per tenant in the Extension may be evaluated at £S. 55.

The inhabitants of the pre-developed area also worked as cotton pickers in the Gezira Main Area. Some 34,000 people from the Extension region went to pick cotton in the Gezira Main Area in the 1955/56 season. In a survey of the socio-economic conditions of the Extension before it came under development, it was calculated that an average family of 6.1 persons earned £S. 31.897 from picking cotton [35]. Total earnings from

[33] It is estimated that national income per caput for the Sudan is £S. 30, see, The Economic Planning Secretariat, Ministry of Finance and Economics, op cit., p. 40, and £S. 68 to £S. 75 in the Gezira Scheme in 1960/61.

[34] 29.7 % or 231,522 feddans of the total area of the Extension was affected by continuous dura cultivation (see Table I). In 1962/63, there were 107,931 feddans under dura in the Extension (see Table III).

[35] *Analysis of the Sample Survey Conducted in the Managil Extension Area on the Socio-Economic Conditions,* Social Development Department, Sudan Gezira Board. Cyclostyled, Barakat, 1958. Cotton picking extends from January to the end of March. There are five or six picks owing to the extended maturing period of extra-long staple cotton. Pickers are paid per basket (*guffa*) which holds 32 lbs of seed cotton. The rate per basket in 1958 was about £S. 0.050-£S. 0.070 per 32 lbs, increasing to £S. 0.100 at the end of the season.

cotton picking would be £S. 178,900. These earnings have been off-set by the secondary or indirect benefits that irrigation has brought, such as the increases in earnings from social services.

The Managil Extension has added to the importance of the Gezira Scheme in relation to the National Economy. It has more than doubled the area in the Scheme under extra-long staple cotton, and cotton provides over 50 % of the total value of domestic exports [36]. It represents a principal source of investment of public funds, and contributes significantly to Government revenue. In the 1962/63 season, it provided employment and food for over 41,000 tenants and their families, and a casual labour force of 175,000 during the cotton harvest.

The Extension, with the Gezira Main Area, is a unique experiment in scientific farming which while ensuring the participation of the tenant farmer in the operation of the farm enterprise, enables Government to siphon off automatically a part of the profits through its own participation. This has been particularly advantageous for capital formation and economic development, when note is taken of the difficulties experienced by other developing countries, like India, in diverting part of the income of the agriculturalist to the National revenue by taxation [37]. The existence of a modern agricultural sector also had advantage for a generation of surplus for development. Both parts of the Gezira Scheme have considerable growth potential, and, with careful planning, can give impetus to the development of other sectors of the economy.

This section has been largely concerned with the primary benefits and costs of the Managil Extension. Experience in the Gezira Main Area has shown that the secondary and intangible benefits brought by irrigation development also have their importance. Secondary benefits, and the lack of job opportunities outside, have kept tenants in the Gezira Scheme in bad years. Over time these secondary benefits of the Scheme have become the primary ones for certain tenants who have made the tenancy their secondary occupation. Job opportunities are also increasing outside the Scheme as economic development takes place. This will encourage those now earning negative economic rent in the Scheme to migrate to more profitable alternative employment.

The intangible benefits that the Extension has brought cannot be evaluated in monetary terms. Yet, as elsewhere in developing countries, their importance and impact can be considerable. They are part of the net incremental benefits brought by development projects, and in years of low cash returns, act as a retaining force on the population. Apart from a cash income from cotton, a Managil tenant now enjoys a permanent and adequate supply of water, and less fluctuating yields of dura owing to irrigation. Improvements in health facilities, and an increased social well-being, the introduction of scientific knowledge into farming and other skills, and the expansion of literacy, have also come with development. These intangible benefits have their costs. Irrigation has brought new diseases, notably bilharzia, to the population, and it has yet to be seen what social and physiological costs will be involved in the change-over from a nomadic to a sedentary existence.

III. Problems

The physical, economic, and social transformation of the Managil area from a region once occupied by dura-growing and cattle-owning, semi-nomadic and nomadic peoples,

[36] D. J. Shaw, *A Note on Sudan's Ten Year Plan of Economic and Social Development* (ECA/FAO Agricultural Economics Bulletin for Africa, June 1963, p. 72).

[37] R. N. Poduval, *Role of Agriculture in the Economic Development of Less-Developed Countries* (Sudan Economic and Financial Review, 1963, p. 17).

into one cultivated under a highly regimented, irrigated system of agriculture based on a partnership arrangement, has been no less impressive than the development of the Gezira Main Area. This metamorphosis has brought many benefits. It has also thrown up new problems, and accentuated difficulties which existed in the Gezira Main Area before the Extension was developed. These problems relate a: to the Extension itself, b: to the Gezira Scheme as a whole, and c: to the economic growth of the country. Some of these problems will be touched on here.

a. Problems relating to the Extension

I. The undulating nature of the Managil land surface in the western parts of the Extension has led to waterlogging in the rainy season (July to September), and called for greater skill in water management. The extension of the Scheme to the West and South-west has also taken it into areas where the soils are less uniform in relation to clay content, and less constant regarding composition of salt. The Extension was brought under development on the basis of a soil reconnaissance that took only sodium content into consideration. Recent research has favoured clay content as a superior criterion of soil evaluation for cotton growing [38]. A recently compiled soil evaluation map of the Managil Extension area based on clay and salt percentage, and sodium content, shows considerable variation from place to place in the quality of the soil from the point of view of cotton production. Furthermore, salt accumulations in the upper soil layers in the northern and western parts of the Extension where rainfall is lower than elsewhere, can depress cotton yields. Salt content varies from 0.25 % to 0.5 % in the top 4 feet of soil in these areas. Soils containing 0.35 % salt are considered to be poor for cotton production. It is possible that a zoning of agricultural production might emerge over time what would take into account changes both in topography and soil values. This might be considered in plans for intensification and diversification of agricultural activities throughout the Scheme.

II. The extension of the Scheme to within a few miles of the private cotton pump schemes that line the White Nile has also increased the risk of pest and disease attacks. Cotton hygiene is of a lower standard on these schemes, and precautions will be necessary to see that cotton management is improved there.

III. Clearing and levelling operations to prepare the Extension for cultivation have laid bare the soil, and exposed standing crops to the effect of wind. Parts of the perimetres of Stage I and Part II Stage 4 have been encroached upon by moving sand, and an area of 75,000 feddans within the Extension boundaries has been affected by sand drifts. It has been proposed to establish shelter belts in this, and possibly other parts of the Scheme, and to trap the sand at its source by planting suitable grasses. The risk of trees harbouring pests has to be investigated, and water consumption evaluated. Shelter belts of *Eucalyptus microtheca* and *Prosopis juliflora* placed strategically throughout the Scheme could cut down wind velocity. The amount of evaporation loss from the water surface of canals and irrigated fields could be reduced. Wind erosion could be reduced making canal dredging costs less expensive. Yields of all crops in the lee of the shelter belts would be increased. Wood fuel would be provided as well as timber for building. Both are in short supply. Forestry development could fit in with plans for mixed farming in the Scheme. Small scale experiments have shown that certain fodder crops can be sown between the trees. They could provide a cover which would help to smother weeds and reduce weeding costs. If trees were grown on a ten year

[38] A. FINCK and L. H. J. OCHTMAN, *Problems of Soil Evaluation in the Sudan* (Journal of Soil Science, March 1961, pp. 87-95).

rotation, and fodder crops planted during the first two years, a fifth of the total forestry area would be under fodder crops. This would provide an addition to animal fodder supply within the Gezira [39].

IV. The optimum size of holding provides a dilemma for the Scheme's planners. One reason for the smaller size of tenancy in the Extension was to reduce, or remove entirely, the need for outside labour, as the family unit could theoretically supply most, if not all, the labour requirements for the various agricultural operations. This is not possible on the larger holdings of the Gezira Main Area. It is questionable, however, whether there are sufficient returns from the smaller unit to support a tenant and his family throughout the year.

Moreover, a survey of labour demand during the picking of the 1958/59 cotton crop showed that the number of hired workers per feddan was least on tenancies ranging from over 5 to 10 feddans. Only 11 % of the tenancies in the Managil Extension at that time were within this size-range [40]. Therefore, looking at cotton labour requirements alone, a case has been made for making all tenancies fit into the range of over 5 to 10 feddans of cotton. But the tenant farmer produces other crops besides cotton, and from his position as a mixed farmer, there may be a case for a wider range of size of holding to accommodate food and fodder crops, other cash crops like groundnuts, and vegetables, and ultimately perhaps livestock. Moreover, the present fairly rigid system of land holding in the Managil Extension, as in the Gezira Main Area, while perhaps attempting to satisfy the social principle of equal shares, does not accommodate for differences in the managerial ability of tenants. A more flexible system of land holding might be more appropriate which would take into consideration the various requirements of the tenant as a mixed farmer, the demands of new cash crops and livestock as intensification and diversification of cropping develops, and the different managerial abilities of the cultivators.

b. Problems relating to the Scheme as a whole

I. The creation of the Extension has considerably increased demand for casual labour, especially during the cotton harvest (January to April), in two ways. First, a significant number of the New Managil tenants were former pickers in the Gezira Main Area before the Extension was developed. 63.5 % of the picking labour force in the 1955/56 season came from the Managil area. Therefore, the Gezira Main Area has lost a considerable number of experienced pickers. Secondly, the new Managil tenants have entered into competition with the tenants of the rest of the Scheme for casual labour. Land distribution in the Extension resulted in a number of families receiving more than one tenancy. In these cases, the size of holding per family is too large and too dispersed to be worked without resort to hired labour. Many of the new tenant families are young and contain few adult members. Others are organised in such a way that one or more members of the family look after the livestock on the fringes of the Extension, while the rest work in the Scheme. It has also been reported that there is a tendency for some of the new Managil tenants to copy the tenants for whom they used to work. They, too, are beginning to contribute less family labour to field work. This is based on a complexity of reasons including the prevailing social attitude against agri-

[39] Written communication, Director of Forests, Ministry of Agriculture, Government of the Sudan.

[40] DEPARTMENT OF STATISTICS, *Survey of Labour Conditions in the Gezira and Managil*. Occasional Statistical Paper No. 1. Sudan Survey Department, Khartoum, September 1959.

Table XV. *Picking labour: season 1961-'62*

Part of Scheme	Labour from inside Scheme			Labour from outside Scheme					Grand total (No.)	Cotton area (Feddan)	Picking labour per feddan cotton
	Local people (%)	Foreigners living locally (%)	Total (%)	White Nile (%)	Blue Nile (%)	West Sudan (%)	Others (%)	Total (%)			
Stage I	17.8	5.8	23.6	30.8	25.0	14.8	5.8	76.4	51480	65275	0.788
Stage II	24.8	2.1	26.9	38.5	9.1	21.2	4.3	73.1	57485	76681	0.750
Stage III	36.0	2.1	38.1	35.3	11.2	13.2	2.2	61.9	53131	74852	0.711
Stage IV (a)	53.5	1.3	54.8	5.6	26.6	12.7	0.3	45.2	13173	16236	0.822
Managil Extension (a)	28.3	3.1	31.4	32.8	15.7	16.3	3.8	68.6	175242	233043	0.752
Gezira Main	34.6	10.9	45.5	8.3	19.6	21.1	5.5	54.5	216033	235225	0.920
Gezira Scheme (a)	31.8	7.4	39.2	19.3	17.9	18.9	4.7	60.8	391275	468268	0.837

(a) Excluding Part II Stage 4.

cultural work, the physical and administrative framework of the Scheme, and the ability to pay for hired labour after the bumper season of 1950/51 [41].

Managil tenants have particular difficulties concerning picking labour:

1. They are generally financially weaker, being new tenants, and having on the average much smaller holdings, and, therefore, cannot match the established Gezira Main tenant in the spiral of the overall price for labour [42].

2. Being poorer, they cannot afford to give as much dura, their staple food, as part of the contract price.

3. There is a greater reliance on imported labour (Table XV) in all stages except Part I Stage 4 which is closest to the Gezira Main Area. The Extension area was formerly sparsely populated. Relatively few labour villages have been established to anchor a permanent labour force in the region.

4. Social services are as yet fewer in the newly developed area than in the Gezira Main Area where casual labour can find markets and entertainment.

5. The well-established Gezira tenant has built up close social ties with his casual labourers. There is a marked tendency for labourers to return to the same tenants every year. Managil tenants have yet to forge such links with casual labour.

It is uncertain whether the increased demand for casual labour can continue to be met in the long run. Half a million pickers will be required to harvest the 1963/64 cotton crop in various parts of the country. This is a point in time when rapid development has overtaken the slower increase in the amount and efficiency of labour. The high rate of increase of population, estimated at 2.8 % per annum for the country as a whole, increased mobility of labour, and the use of labour-saving devices might help toward solving certain problems. The process of urbanisation, and the multiplicity of development projects, in industry as well as agriculture, elsewhere in the country, is unlikely however to leave the Scheme with unlimited supplies of casual labour.

II. Land tenure and the agricultural framework of the Extension is similar to Gezira Main Area. The cultivator does not own the land he works, but farms it on an annual lease renewable indefinitely, subject to concurrence with the conditions of the 1941 Standard Conditions of Tenancy. The lease is, in fact, indefinitely renewed for the majority of tenants. There remains nevertheless something less than the position of an owner-cultivator, and hence less sense of personal interest and responsibility for the land. Moreover, a tenancy is not a compact unit, but owing to the irrigation lay-out and rotations practiced, is composed of a number of plots which may or may not be adjacent to one another.

These factors make it difficult to create a class of true farmers in the Scheme. They also act as a disincentive for tenants to invest either in improved immovable property or in their holdings. Plans for improved housing have been halted partly because tenants will not invest in higher priced constructions on land which they do not own. The cultivation of crops other than cotton is less efficient in technical and economic terms, again partly because the cultivator is unwilling to invest in improved cultural methods on leased land. This will become more serious when the opportunity to grow

[41] D. J. SHAW, *Labour Problems in the Gezira Scheme.* ECA/FAO Agricultural Economics Bulletin for Africa, April, 1964, pp. 1-41.

[42] The overall price includes not only the money wage paid to hired labour, but considerable other costs such as hire of lorries to transport labourers from and to their homes, food and shelter, presents to take home at the end of harvest, loans and advances, the contract price of securing labour at the beginning of each season in cash and kind, and free feed for animals brought into the Scheme by hired labourers.

a greater range of crops occurs when extra water will become available to the Scheme in 1967.

III. As in the Gezira Main Area, the engineering and agronomic aspects of the Managil Extension have been developed without essential services, such as a good transport system, and adequate credit, marketing and agricultural extension facilities for the tenant farmers' crops other than cotton. There was also little build-up of technical and agricultural education to prepare the new tenants for their new tasks. In this recently developed area, the tenant has to resort to the moneylender to meet his production costs for crops other than cotton. (The Sudan Gezira Board issues advances to contribute towards the cost of cotton operations). This thwarts attempts at improved marketing for crops other than cotton, and surplus for sale is reduced through high interests rates on loans often payable in kind. Returns to the tenant are decreased, and ability to save and invest in the farm lowered.

The opportunity was not taken to place crops other than cotton in the same partnership position as cotton, so that they too would be supervised by the Board's field staff. Dura yields could be substantially increased with better management, and as lubia contributes to increased cotton yields in the rotation [43], better supervision of this crop would bring benefits to all three partners. Agricultural efficiency is noticeably lower on most crops when compared with cotton cultivation. Only cotton operations are closely supervised by the Board's field staff. The far-reaching technical and economic changes which have been brought about by the development of the Gezira Area have yet to be accompanied by a corresponding change of outlook or ability on the part of the tenantry. This will become more serious as new crops are brought into the Scheme. An effective agricultural extension service will be required to teach the tenant to grow these new crops efficiently so that the highest possible returns to the scarce capital invested in the Roseires dam might be achieved. A critical assessment of the market potential of the new crops will also have to be made together with the development of marketing organisations and channels. Some cooperative marketing societies have been set up to market groundnuts, vegetables and milk. These have already brought increased returns to the producer.

IV. The enlargement of the irrigated area in the Gezira to almost twice its former size has added appreciably to the tasks of management. A sub- headquarters has been established in the Extension. This has resulted in a duplication of administrative machinery which is essential, under the present organisational framework, for an efficient management of the newly developed area. Even then, distances to be covered within the irrigated area are large, and the variable costs of administration continue to increase, especially as roads within the Scheme are generally bad. During the rainy season roads become impassable, and travelling between the two parts of the Scheme is restricted. The overhead costs of the Gezira Light Railway could be reduced if it were employed throughout the year to transport labour, materials and equipment, instead of being used mainly for collecting cotton from the field and delivering it to the ginneries (Table XVI).

[43] The rotation cotton — lubia — fallow produces on average 0.56 kantars per feddan more than that of cotton — dura — lubia. D. K. DUTTA ROY and A. Y. KORDOFANI, *Study of Long-term Rotation Effects in the Sudan Gezira* (Journal of Agricultural Science, Vol. 57, 1961, pp. 387-392).

Table XVI. *Management costs (a): 1958-'62*

Unit	Per Unit Costs in £S. Current Prices				
	1958	1959	1960	1961	1962
Per Irrigable Feddan	0.461	0.622	0.659	0.709	0.727
Per Feddan Cotton	2.279	2.338	2.361	2.518	2.584
Per Kantar Seed Cotton	0.384	0.498	0.565	0.970	0.434

(a) Based on annual expenses and charges of the Sudan Gezira Board, excluding deductions for interest and appropriations which are applicable to the Gezira Main Area only. These costs include salaries, wages and allowances; office expenses; transport expenses; annual maintenance and depreciation on buildings, roads and vehicles; insurance, audit and provident fund; and electricity, water, sanitation and other expenses.

Intensification and diversification of cropping can add to the problems and magnitude of management. This will involve the introduction of crops with which the Board has had little supervisory experience. A new type of field officer will be required with a knowledge of a range of crops, and livestock, and with an ability to pass on the findings of the research stations to the farmer. The rôle of the field staff in the recently developed area will be particularly important, especially as the new tenants have had little or no experience of farm management in irrigated agriculture.

A case might be made for de-centralising administrative control when diversification, and perhaps a zoning, of production takes place, and for varying the size of the supervisory unit as the agricultural pattern changes in different parts of the Scheme. Until this occurs, the similar cropping pattern and administrative and agricultural tasks performed in the two areas make it perhaps more technically efficient for control to be in the hands of one body which has built up considerable experience in the administration of this particular type of agricultural system. On the other hand, if two separate management authorities were created, an element of competition might be encouraged between the two parts of the Scheme.

V. The gap between economic and social change in the Extension, and in the Scheme as a whole, has presented its own problems. The physical transformation of the Managil area was completed in five years. The new Managil tenant now finds himself in a totally different agricultural system. Yet his attitudes and aptitudes are still largely those of a nomadic livestock owner. There is some evidence that he invests any profits he makes in more livestock, and not in agricultural operations in the Scheme. From the point of view of livestock management, he has essentially retained the outlook of a nomadic cattle owner in a different agricultural framework. He has yet to see the value of reserving fodder for lean days, and his lack of capital prevents him from giving his livestock adequate concentrates, even if he wished to improve their performance.

A gradual change in management efficiency can be achieved through an extension service, linked up with such organisations as the village farming experiment [44], and cooperatives. Livestock and crop management can be taught to young people in the area. Incentives to change attitudes might be provided through an integration of the livestock and crop economies. At present, livestock are not integrated into the Scheme, but are scavengers, feeding of whatever is available on canal banks, and on dura stalks, lubia and cotton leaves. An examination of the possibilities of integrating cattle raising

[44] The objectives of the Village Farming Experiment are:

I. to investigate the possibilities of wider farming practices and interest villagers in mixed farming on a cooperative or otherwise basis by experiment and demonstration;

II. to convert the tenant from a purely cotton producer into a farmer;

III. to develop a form of agricultural economy which in the absence of cotton monoculture will maintain a satisfactory standard of life.

in the rainlands in the eastern and western parts of the country with cattle fattening in the irrigated areas might prove rewarding. Local breeds would be replaced by new and improved types. Adequate supervised credit for better production, and marketing facilities would also provide part of the basis for a change in managerial outlook.

There is little cooperation amongst tenants throughout the Scheme in a situation where many advantages could be gained through working together. The population is composed of representatives of many tribes. There are a number of religious brotherhoods. Sectional interests have therefore developed. The Scheme has brought different social conditions. Cleavages that are beginning to emerge between traditional and modern social relationships should be carefully analysed, since these would influence social behaviour and institutional growth, and influence the acceptance or otherwise of innovations.

c. The Scheme and Sudan's Economic Development

I. Cropping policy in the Managil Extension has in no way attempted to minimize problems associated with overemphasis on cotton production at local and national levels. Average yields of cotton have fluctuated in the recent past between 6.78 kantars per feddan in the 1950/51 season, and 1.51 kantars per feddan in the 1957/58 season. Cotton prices have also been unstable. Therefore, returns to the three partners have varied widely (Table XVII).

Table XVII. *Distribution of cotton proceeds to partners in £S. thousands*

Partner	1950/51 (a)	1957/58 (b)	1958/59 (c)	1959/60 (d)	1960/61 (e)
Government	17,200	443	5,956	9,224	3,962
Board	8,600	106	1,418	2,196	943
Tenants	17,200	443	5,956	9,224	3,962

(a) Record year. Share out was then Government and Tenants 40 % each, and Board 20 %.
(b) Lowest returns in recent years. Share out-Government and Tenants 42 % each, Board 10 %.
(c) First Stage of Managil Extension included.
(d) Stages 1 and 2 included.
(e) Stages 1 and 2, and Part I, Stage 3 included.

The question is posed whether the Sudan in developing the Extension under extra-long staple cotton is not over-supplying this type of cotton in relation to world demand. The International Cotton Advisory Committee has stated that there is a tendency for supplies of extra-long staple cotton to outrun effective demand [45]. Long-term price forecasting for extra-long staple cotton should be done with caution because of the uncertainties on the demand and supply side. On the supply side, some of the major issues are:

1. U.S.A. policy regarding releases from stocks which have been accumulated for strategic purposes over the years for export, increases in acreage under extra-long staple cottons, and its dual price policy.

2. Increases in irrigated areas in Peru which might go under extra-long staple cotton.

3. Egypt's decisions regarding resource allocation following the completion of the High Dam. Population pressure is so great in Egypt that a substantial part of the newly developed areas will go to food crop protection. Yet the recent drains on Egypt's foreign exchange earnings may necessitate an expansion in cotton exports. The supply

[45] INTERNATIONAL COTTON ADVISORY COMMITTEE, *Report on Extra-Long Staple Cotton*. Doc. 10, XXI. Washington: I.C.A.C., May 1962, p. 14.

situation might also be changed if Egypt succeeds in becoming an important exporter of fine yarns and fabrics instead of continuing primarily as an exporter of raw cotton.

The recent growth in consumption of extra-long staple cotton has been substantial, but it is uncertain whether the anticipated large growth in output will be absorbed. Some of the main considerations on the demand side, so far as they affect the Sudan, are:

1. Whether Britain will enter the European Economic Community, and the final structure the Market will take. In 1961 the United Kingdom imported 21 % of the total value of Sudan's cotton exports. The EEC took 32 %.
2. Developments in India which became the largest importer of Sudan cotton in 1962 owing to the disruption of production in the country in that year.
3. The policies of Communist bloc countries which have taken up an increasing amount of Sudan cotton through barter agreement in recent years.
4. Increasing competition from the man-made fibre industry, and improvements in textile machinery to produce finer cloths from shorter cottons. The latter factor is leading to a high elasticity of substitution between different varieties of cotton.

II. The completion of the first phase of Roseires dam in 1967 will provide the opportunity for the introduction of new crops into the Scheme, and a more intensive cropping of those already grown, as well as the integration of livestock into a mixed farming economy. Plans for intensification and diversification of farming in the Scheme are, however, limited, and built round the fact that no single crop has been found to compete with cotton as a cash crop. There is also little pressure for additional food crops. However, the introduction of a mixed farming economy into the Scheme would seriously modify thinking in connection with an intensification/optimization programme, and help to cushion the effects of fluctuations in cotton yields, grades and prices. The long-term downward trend in extra-long staple cotton prices, and the upward trend in production costs, is resulting in serious thought being given to the introduction of medium staple cottons in certain parts of the Scheme.

Several suggestions have been made to intensify cropping in the Scheme. Water and not land is the limiting factor in the Gezira. All suggestions for a modified system of cropping should take into account not only water availability in the restricted period, and the capacity of the canal system, but also labour resources and managerial abilities at the Board and tenant levels. The economic as well as the technical feasibility of each suggestion should be evaluated bearing in mind the costs of production of a new farming system, the risks involved, and the market potential for any new commodity.

It has been suggested that wheat and groundnuts may be grown as cash crops, and the legume, phillepesara, as extra fodder for a developing mixed economy through the introduction of livestock. This would increase the cropped area within the Scheme. It may be argued that for greater economic and technical efficiency, dura should be taken out of the rotation. The exhausting effect of dura would be removed, and the income earned from increased cotton yields could be supplemented by other lesser cash crops, and livestock and their by-products. Dura could be bought from the large quantities produced in the rainlands. This suggestion would meet with the opposition of the tenant farmer who wishes to grow and control his own staple food. Wheat has been introduced into the Scheme as part of a national import substitution programme. It is not planned at present to grow it in the Extension. There is some doubt about the introduction of wheat. Its harvest partly clashes with that of cotton. Mechanisation of wheat operations would be required if the crop is to be grown on a large scale. The present field and irrigated arrangements need modification if mechanisation is to be introduced. Tree crops cannot be grown at present because of the lack of perennial irrigation. Increased fodder production and its rational use can result in much improved and pro-

fitable livestock. Livestock could be brought in from the rainlands for intensive fattening. The alternative husbandry experiments are also showing that a significant supplementary income can be gained from vegetable production and small livestock [46].

III. One of the most intractable problems to resolve is the relationship between tenant and the other partners in the Scheme. Government is intent on a high degree of technical efficiency. This is particularly important considering the position occupied by the Gezira Scheme in the National Economy. The tenant has his own set of values and customs which often conflict with the aims of the other partners. He is concerned with growing his food and fodder crops as well as cotton. He resents the compulsion which is necessary at present to operate the Scheme. Much benefit might be forthcoming with the objectives of the partners reconciled. Direct Government interference in the running of the Scheme might not only antagonise the tenantry, but also rob the Scheme of a strictly business footing.

Future developments

When the Managil Extension was embarked upon in 1955, the Sudan had just become an independent Nation. Its leaders wished to establish the country economically as quickly as possible. Cotton prices were still relatively high. When the first stage of the Extension was completed, prices for extra-long staple (*Sakel G5S*) stood at over £S. 15 per pound C.I.F. Liverpool. There was the chance of another 1950/51 season when cotton yields, grades and prices were at their highest. Rapid economic returns to the country could only come through an extension of areas under irrigation. Preliminary surveys had revealed potential in the Managil lands. Agricultural research conducted until that time strongly suggested development along the lines of the Gezira Main Area.

A large-scale extension to the existing Gezira Scheme would bring, other things being equal, economies of scale in the use of the scarce factors of capital and management. Returns to capital investment promised to be both quick and large. This could result in re-investment in the Scheme, as well as supplying capital for other projects. The flight of the expatriates on Independence left the Scheme, and the country at large, short of personnel with skills and experience. In a country of some one million sq. miles, maximizing the use of scarce capital, and the scarce skills and managerial abilities of the remaining trained personnel, for quick results, lay in concentrating their effects in an area which offered the immediate prospects of rapid returns, rather than in dissipating them over the vast area of the Sudan. Economically, therefore, it seems sound that investment of scarce resources were concentrated in the Gezira at that time. Indeed, it might be further argued that sheer necessity, and the desire for rapid economic development on the part of a young nation, dictated that this had to be the course to take.

The dilemma is that large-scale agricultural schemes might solve problems, and, once established, give the promise of relatively quick, and large, returns, but in the long run they throw up problems which threaten their continuing success. The development of the Managil Extension may be criticised on the grounds that insufficient note was taken of the problems that had arisen in the Gezira Main Area. There were inadequate pre-investment surveys into the physical and human resources of the area to evaluate the cost of the project and to illuminate its difficulties. Insufficient attention was given to the effects of developing a new area into the existing Scheme. The result has been that difficulties are now arising, both in the Extension itself, and in the Scheme as a whole.

[46] H. Ferguson, *The Gezira Scheme.* (World Crops, March 1955, p. 16), and *Reports of the Village Farming Experiments at Wad El Naeim in the Gezira Main Area, and Kheir Bejeik in the Extension.*

The situation is being made more complicated by the emergence of new factors which are forcing a re-appraisal of the whole structure of the Scheme. An increase in water available for irrigation from the Roseires dam, and changing demand/supply and price relationships for various varieties of cotton, have initiated discussions on intensification and diversification of cropping and optimization of land and water use. Increasing attention is being given to crops other than cotton, and to the introduction of livestock.

Proposals for future developments will be influenced by a number of external factors as well as by forces at work within the Scheme itself.

a. *Factors external to the Scheme:*

Externally, there are the effects of demand elasticities and price movements for cotton, and other commodities such as groundnuts, wheat, and livestock and their by-products in international and national markets. In world trade, regional economic groupings like the European Economic Community, will have to be taken into account. Inside the Sudan, the position of the Scheme in the total economy, and its changing function as the economy develop, is likely to affect future policy relating to the Scheme and the position of the tenant farmer. One objective of the recently announced Ten Year Development Plan (1961/2-1970/1) is to broaden the composition of exports. Cotton's percentage share of the value of domestic exports is anticipated to fall from 65 % to 61 %, while that of oilseeds (groundnuts and sesame) will increase from 13 % to 19 %. A decline in the importance of cotton as a foreign exchange earner might reduce the tensions which now surround the Scheme and lead to a more flexible attitude towards its future development.

Within the Sudan, the effects of rapid population growth (estimated at 2.8 % per annum), an increasing tendency toward urbanisation, and increasing real incomes per capital, particularly in the urban areas, will lead not only to an increase in demand for crop and livestock products, but also to a change in the pattern of demand as incomes rise. The extension of existing, and the development of new communications, (noticeably the new road from Khartoum to Wad Medani), will also expand the influence of markets, and help to create greater mobility of labour throughout the country. This latter development can have an important effect on the Scheme's casual labour supply.

b. *Forces at work in the Scheme:*

These external and internal factors are likely to influence developments in the Gezira Scheme, but if planning is to be effective in the long run, careful note will have to be taken of conditions operating within the Scheme itself at the individual tenancy level: the tenants' resources in land, labour and capital, and their changing demands for these factors of production following upon the introduction of new enterprises; their attitudes of mind; their managerial capabilities; and the interests of the tenant family in social as well as economic terms.

The inflexibility of the Scheme's structure in both the old and new areas tends to add to difficulties impeding the creation of a farming sense. Opportunity might have been taken in the new extension to introduce greater flexibility. Plans for greater diversity of agricultural production within the Scheme might now contain elements of greater flexibility conductive to engendering a sense of pride in farming, perhaps through stronger emphasis on village and community development, and the creation of investment opportunities.

In many ways the Gezira Scheme stands at the threshold of a number of important developments. If mixed farming is successfully introduced, this will have repercussions

on the division of responsibilities and returns to the three partners. Revision of the partnership arrangement will be a sensitive affair. It will on the one hand have to ensure a high standard of agricultural efficiency in cotton culture, but on the other provide sufficient incentive and initiative for the farmer to invest in the new farming enterprises without distracting him from cotton. Perhaps the real problem is, as in other parts of the world [47], to change the cultivator into an active partner in important decision-making on all levels of farm and business management, and thus assure his full participation in development planning.

[47] ERICH H. JACOBY, *Agrarian Unrest in Southeast Asia.* Asia Publishing House, London, 1961

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