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MEMORANDUM ON POSSIBILITIES OF IRRIGATION

DEVELOPMENT IN THE SUDAN BY PRIVATE

ENTERPRISE

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MEMORANDUM ON POSSIBILITIES OF
IRRIGATION DEVELOPMENT IN THE SUDAN
BY PRIVATE ENTERPRISE

OCTOBER 1965

Hunting Technical Services
Limited,
6, Elstree Way,
Boreham Wood, HERTS.

Sir M. MacDonald and Partners,
Lion House,
Red Lion Street,
LONDON, W.C.1.

For diagrams of the Nile (incl. Red + Blue Nile) refer to the original booklet.

MEMORANDUM ON POSSIBILITIES OF IRRIGATION DEVELOPMENT
IN THE SUDAN BY PRIVATE ENTERPRISE

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APPENDIX I

DETAILS OF POSSIBLE AREAS AVAILABLE FOR PRIVATE DEVELOPMENT

APPENDIX II

YIELDS AND OUTPUTS

KEY PLAN

Year

1945

1954

1959

1964

There are the following examples of pump projects in

Government Schemes - with a view to private development

including in some cases the use of private

investment.

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MEMORANDUM ON POSSIBILITIES OF IRRIGATION
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1. INTRODUCTION

1.1 The first irrigation in the Sudan was practiced on the Main Nile and generally concentrated in the reach from Kareima to the Third Cataract. The 'saqia' or water wheel, powered by bulls, was used to lift the water. It is recorded that in 1943 there were over 10,000 water wheels registered in the Sudan. Irrigation by pumps drawing from the rivers was introduced into the Sudan early in the present century. It has since steadily developed, and now takes a very important place in the economic life of the country.

1.2 In 1964 the gross area under pump scheme irrigation from records of licences issued was nearly 1,250,000 feddans. The area has grown steadily since 1949, the figures for gross areas licensed being as follows :-

<u>Year</u>	<u>Area Feddans</u>
1949	216,388
1954	430,172
1959	1,165,751
1964	1,249,557

There are the following examples of pumped projects :-

Government Schemes - cultivated by tenant cultivators, ranging in size from 300 to nearly 10,000 feddans.

Private Schemes - with tenant cultivators. These are generally of a fair size and compare with the Government Schemes.

Co-operative Schemes - Private schemes worked by the owner or his agent.

The small diesel engined pump has to a large extent replaced the 'saqia'. The area of Government Schemes is 124,000 feddans. The area under private development is therefore about 1,120,000 feddans.

1.3 While private enterprise has proceeded with development of pumped irrigation, the Sudan Government has concentrated on large gravity irrigation projects such as the Gezira Scheme (982,000 feddans), the Managil Scheme (838,000 feddans) and the Kashm el Ghirba Scheme (130,000 feddans). Although some arrangement might be made to use a proportion of private capital in the Government Projects, it is probable that the development of pump irrigation will continue to be the main field for private enterprise.

2. EXISTING PUMP IRRIGATION.

2.1 General

The first pump irrigation projects were constructed on the Main Nile between Kareima and Third Cataract (See Figure 1). The chief developments have been on the Main Nile from the Third Cataract (above Wadi Halfa) to Khartoum, and on the White Nile as far south as Renk from Khartoum. On the Blue Nile, with the considerable variations in discharge and level, conditions are not so favourable and development has been on a limited scale, except between Sennar and Singa, where the river level is controlled by the Sennar Dam.

2.2 Nile Pumps Control Board

The 1929 Nile Waters Agreement between Egypt and the Sudan restricted the amounts of water which could be taken by the Sudan for irrigation purposes during the period of short supply, January to June. The licencing and operation of all pump schemes is now controlled under the "Nile Pumps Control Ordinance 1939", which set up as a controlling authority the Nile Pumps Control Board. The Board requires prospective licencees to prepare contour plans and irrigation layouts to ensure that the schemes are properly designed and constructed. The Board, through the staff of the Ministry of Agriculture in the various provinces, can control the system of rotation of crops on all schemes and has the right of inspection to see that the regulations and conditions of the licence are properly carried out. The machinery therefore is available to supervise the development of pump irrigation by private enterprise and continue to watch the operation of the schemes.

2.3 Existing Pump Irrigation Projects

There are three classes of licences; 'perennial' licences on which water may be drawn all the year round, 'flood' licences limited to the period 15th July to 31st March, and 'restricted' licences, which are limited to the period from 15th July to 31st December. Restricted licences allow for the irrigation of dura (sorghum) and cotton without using stored water during the restricted period from January to June. The early cessation of irrigation of cotton reduces the yields and with the completion of Roseires Dam (1966) it will be possible to convert the licences to 'flood' licences.

The gross areas under pump irrigation on the various rivers is recorded as follows :-

	<u>Feddans</u> (1)	<u>Type of Licence</u> (2)
Main Nile	271,950	Perennial
Blue Nile	386,916	Flood
White Nile	580,555	Flood & Restricted
R. Atbara	5,796	Flood
R. Rahad	1,666	Restricted

Note. (1) Information regarding the areas irrigated has been got from the Province Agricultural Officer. These differ by about 20% from the 'Licensed' areas.

(2) This gives the type of licence in general use; other varieties do of course also occur.

The climate and general conditions of operation for each river reach are given in the following chapters.

3. NEW PROJECTS

3.1 Reconnaissance and Semi-detailed Soil Surveys

In 1962 the Government arranged for Reconnaissance Soil Surveys to be carried out by Consulting Engineers to select the lands for Semi-detailed Soil Survey. The area for survey was restricted to lands lying below the 20 metre 'isopotamon', which is defined as the 'contours' relative to the mean low river level, and thus limits the static pumping head to a maximum of 20 metres.

3.2 Areas available for Pumped Irrigation Projects.

From these surveys, and from earlier surveys in 1952/3 on the White Nile between Malakal and Kosti carried out by Sir Alexander Gibb and Partners, the following areas which are considered suitable for pumped irrigation have been defined :-

TABLE Areas for Development by Pump Irrigation in Feddans

River Reach	Area (1) Feddans
Main Nile	
Kareima to Third Cataract	17,000
Khartoum to Kareima	43,000 (2)
White Nile	
Khartoum to Rabak	7,000
Rabak to Melut	200,000 (2)
Blue Nile	
Sennar-Khartoum (Right Bank)	8,000
Abu Haggar - Sennar (Left Bank)	32,000 (2)
Roseires-Sennar (Right Bank)	120,000 (3)
TOTAL	427,000

Notes: (1) The gross irrigable area has been adjusted by a factor of 0.85 to give the net irrigable area.

(2) Semi-detailed soil survey not yet completed, area estimated from Reconnaissance Soil Survey.

(3) Area included in the Roseires Irrigation Project and could be served either by gravity from Roseires or by large pumping stations at Suki and Kassab ed Doleib,

Thus the total area which might be irrigated by pumping is 427,000 feddans, of which 120,000 feddans might be irrigated by gravity from Roseires.

4. MAIN NILE - KHARTOUM TO THIRD CATARACT

4.1 General Conditions

The agriculture is located in the strip of flood plain and alluvial terrace up to 10 kilometres wide on both banks of the main Nile. The area lies in a region of desert and semi-desert, rainfall being negligible in the north, increasing to an average of 165 mms. per annum in the south at Khartoum. The desert zone has practically no vegetation and in the semi-desert region vegetation is limited to grass, herbs and small bushes.

The population of the Khartoum to Kareima area is approaching half a million. There are three towns; Atbara, Berber and Shendi. No precise figures are available for the northern area from Kareima to the Third Cataract. There are two towns, Dongola and Kareima.

4.2 Existing Agriculture - Flood Irrigation

Traditional "seluka" cultivation on river silts exposed by the receding floodwaters is practiced, dura (*Sorghum vulgare*) being the most important crop.

Basin irrigation is also practiced; the Nile flood water is poured into the basin or depression, and then after the ground is sufficiently soaked, returned to the river. There are twenty basins in the area, but the area flooded varies greatly from year to year depending on the height of the flood. In the southern area, from Khartoum to Kareima, the range is from 6,000 to 41,000 feddans, a fair flood giving 30,000 feddans. In the north, from Kareima to the Third Cataract, the variation is much greater, from 5,000 to 70,000 feddans, and an expectation of 40,000 feddans on a fair flood.

In the southern area 80% of the flooded area is usually cultivated with millet or chick pea. In the northern area no more than 10% of the flooded area is cultivated, the benefit being increased grazing.

The fact that the area flooded from year to year is so variable and unpredictable generally precludes established agriculture in the basins and pumped irrigation has been introduced into a number of the smaller basins.

4.3 Khartoum - Kareima - Pumped Irrigation

Perennial irrigation is provided by 'saqia' and pumps. In the reach from Khartoum to Kareima there are also some 2,000 feddans of 'saqia' irrigation, but this is being replaced by motor pumps. There are some 90,000 feddans of existing private pump schemes and 17,700⁽¹⁾ feddans of Government schemes. The latter are generally divided into 10 feddan tenancies. The crops grown on these irrigated areas are as follows :-

Winter (Nov/March)	- wheat, barley, lubia, (<u>Dolichos lablab</u>)
	lucerne, haricot beans and tick beans.
Summer (May/Aug)	- Dura, maize, castor and lucerne.
Flood (Aug/Nov)	- Dura, lubia, maize.

Perennial fruit crops and a range of vegetables are also cultivated. Groundnuts are grown in one area. American cotton (Acala 4-42) is grown as a summer crop on the Zeidab Estate (23,600 feddans).

4.4 Kareima to Third Cataract - Pump Irrigation.

Although the small diesel powered pump is replacing the 'saqia', numbers of these still exist,

(1) Note: These areas are from Province records of areas irrigated. They are less than the gross areas for which licenses are issued.

and dates are the main crop.

'Seluka' cultivation is practised on river silts exposed by the receding flood, dura, millet, maize, wheat barley and haricot beans being the main crops. Lupins are grown as a pioneer crop on recently formed islands in the Dongola area. Saqia irrigation is used, dates being the main crop. A total area of 77,623 feddans was licenced for private pump schemes in 1962. The schemes are generally small, half being less than 50 feddans and $\frac{3}{4}$ less than 200 feddans. There are also five Government pump schemes totalling 15,740 feddans, let in 10 feddan tenancies. The crops are dates, citrus, mango, wheat, dura, beans, peas, lubia, sesame, beerseem, vegetables. Communications are difficult and would require improving if development is considered.

4.5 Yields of Crops

The yields of the crops are of the following order :-

<u>Crop</u>	<u>Yield</u>	<u>Unit</u>	<u>Remarks</u>
Barley	0.2-0.35	tons/feddan	
Wheat	0.5-0.75	tons/feddan	
Maize	0.5-0.35	tons/feddan	
Dura	0.3	tons	under basin irrigation.
Cotton	3.0-4.0	kantars	for Zeidab pump scheme.
	1.6	kantars	in Shendi/Berber area
(Pink bullworm is troublesome particularly in Berber area).			
Chickpea	0.3-0.4	tons/feddan	
Haricot bean	0.3-0.4	tons/feddan	
Tick bean	0.3-0.4	tons/feddan	
Castor	0.8-1.0	tons/feddan	
Groundnuts	0.75	tons	
Sesame	0.3	tons	
Onion	1-2	tons	
Mangoes	100	kg. per tree	
Dates	40	kg./palm	only suited to climate north of Atbara.

Soyabean have shown some promise in trials at Shendi. Citrus and bananas are also cultivated. Of the fodder crops Berseem yielding up to 50 tons green matter per year appears best for this area.

Although agriculture in this area is intensive, the favourable climate and soils should make increases in yields above these levels possible in many cases. *management?* Some cattle manure and sulphate of ammonia is used at present, but little information on quantities or benefits.

4.6 Soils and Land Classification

The project lands consist of a narrow and discontinuous strip of basins and terraces lying between the existing irrigated lands and the desert plateau.

The soils of the basins and terraces vary considerably in texture from extremes of sands to clays, but most are medium textured loamy soils with an appreciable silt fraction. Permeability is moderately high so that the soils are drainable, salts can be leached out and, under good irrigation management, the lands should remain in production indefinitely. Because the soils are stratified and show no development of natural horizons they are classified as Entisols. Most profiles belong to the Entisolic sub-order of Ustents because of the arid environment which inhibits leaching and the accumulation of organic matter and nitrogen. Where waterlogging occurs in the low parts of the basins, however, some soils belong to the sub-orders of Aquents and Udents.

4.7 Possible Project Areas

A semi-detailed soil survey in the reach from Kareima to the Third Cataract on 10 isolated blocks of land showed 26,845 feddans suitable for arable crops, 6,390 being designated special use land due to coarse texture, high permeability and low water holding capacity. A further 43,940 feddans were recommended for

further study as although ESP and/or EC exceeds accepted limits for arable cropping their permeability may enable leaching of excess salts to produce a satisfactory soil for cultivation of arable crops. These areas are located in three basins on the right bank of seven high level silt terraces on the left bank of the main Nile. A reconnaissance soil survey of the area from Khartoum to Kareima has selected 18 blocks of land for semi-detailed soil survey. In addition to project areas listed above there is a further area of 70,000 feddans which lies more distant from the river and might require second lift pumping for irrigation. It is estimated that this will yield 50,000 feddans of arable lands. The projects may vary from about 1,000 to as much as 20,000 feddans in extent.

Allowing for the land used by canals, villages, etc., (15%), the estimated lands available for development are as follows :-

TABLE 4.1 Main Nile Project Areas

	Arable Area Feddans	Net Irrigable Area Feddans
Khartoum to Kareima		
Pump projects at up to 18 sites on Main Nile and R. Atbara	50,000	43,000(est)
Kareima to Third Cataract		
Affat	3,000	
Letti	7,000	
Kerma	7,500	
7 small areas	<u>2,500</u>	17,000

The locations are shown on Figure 1.

4.8 Agricultural Proposals

In the Northern Province of the Sudan, where both soil and climatic conditions are in sharp contrast to those of the Central Rainlands, the type of agriculture practiced differs considerably from that of the Gezira. During the cool dry winter season Mediterranean type arable crops such as wheat, Egyptian beans, lupins and berseem clover grow well and give good yields. Because of the cool winters and the hot dry summers date palms flourish and constitute one of the most important commercial crops. On the permeable soils there are commercial orchards of citrus fruits and mangoes, vegetable gardens flourish and cash crops such as castor and the large groundnut (confectionery bambarra) that do not thrive on clay soils grow well. In addition, the commercial crops of the Central Rainlands, cotton, dura, dukhn, sesame, safflower, haricot beans, onions, garlic, sugar cane and tobacco can be grown.

Intensive irrigation can and should be practiced on these arable soils, with an appreciable area under perennial orchards and truck crops and considerable double cropping.

markets?

4.9 Engineering Considerations

Surveys have established cross-sections at 4 kilometre intervals on the project areas. For planning and design, contour plans will be required.

Preliminary surveys have been carried out for pump sites and supply channels. These present certain problems due to the erosion of the banks and variation in the low river channel which means that the pumps may lose the water. The river level varies over a range of about 7 metres between flood and low river conditions. The maximum lift ranges from 9 to 14 metres,

and water can usually be delivered to the irrigated areas by a canal having up to 30 metres command.

4.10 Conclusions

There should be up to 60,000 feddans available for development in this area; the projects would vary in size from about 1,000 to as much as 20,000 feddans.

Although the climate and soils are suitable for a wide variety of crops with exception of the Zeidab Pump Scheme in the south where cotton is grown, there has been little development of cultivation of cash crops, suitable for export and which might encourage private enterprise. Apart from Bergeig Pump Scheme, the Government projects are not prospering. Before private capital is committed for comparatively large scale development, it will be necessary to define a rotation and cropping which will ensure a return on the capital invested.

5. WHITE NILE - KHARTOUM TO MALAKAL

5.1 Khartoum to Rabak

The area is in a region of semi-desert, average rainfall ranging from 165 mms. in the north to 400 mms. in the south. Rain cultivation of dura is practised throughout the area. As a result of construction of Jebel Aulia Dam some 50 kilometres south of Khartoum, this reach as far as Rabak is ideally suited for the extraction of irrigation water by low lift pumps.

There is a total of over 140,000* feddans of irrigated area, of which 43,000 is included in eight

* From records in Province Agricultural Offices of areas irrigated.

Government Pump Schemes and the remainder has been developed by private pump schemes, varying in size from about 40 feddans to as much as 6,000 feddans. Although lubia, groundnuts, vegetables and fodder crops can be grown, cotton is the cash crop and is grown throughout the area, with dura as the second crop. Cotton yields are rather low, being of the order of 3 kantars per feddan. Yields are rather higher on the Government Schemes which average about 3.5 kantars per feddan.

A semi-detailed soil survey is in hand; the greater part of the lands not already irrigated are excessively saline/alkaline or sandy and uneven. The soils are classified in two groups, Entisols consisting of Orthustents and Vertisols consisting of Aquerts and Usterts. It is probable that no more than 8,000 feddans of arable land will be available. No survey has been carried out on the Left Bank of the river.

5.2 Rabak to Malakal

The rainfall of the area ranges from 400 mms. in the north to 600 mms. in the south. As for the reach upstream, there has been extensive development of private pump schemes which now irrigate about 150,000 feddans on the left and right banks of the river. The agriculture is based on cotton, with dura for the subsistence crop.

From exploratory soil surveys carried out in 1951/53 for the "Irrigation of Irrigable Areas in the Sudan" and in 1964/65 as part of the Roseires Soil Survey, it appears that the soils are Grumaquertic Orthustents and Grumusteric Orthustents. The project

lands are of the cracking clay type, although the clay content tends to be much more variable and on average lower than on the Blue Nile and the intensity of cracking is less. Permeability is everywhere very low so that the soils are virtually undrainable and the intensity of irrigation development would be of the Gezira-Managil type. South of Rabak-Kosti, the project lands are confined to the bed of ancient White Nile lake; in the north these lands are generally strongly saline-alkali, but about the vicinity of Geiger-Renk the (salinity) alkalinity is no longer limiting for irrigation development. Between Renk and Gelhak there is some land of non-saline, non-alkali soil of relatively low clay content (30-50%) on which long-staple cotton yields may be marginal but which should be suitable for other arable crops, orchards, vegetables, pastures and irrigated forest plantations. South of Gelhak where the present high level of the White Nile has caused extensive flooding on both banks, the only lands suitable for development appear to be the islands of clay plain in the Melut bend as delineated by Sir Alexander Gibb and Partners (1953).

The exploratory soil survey on the right bank has recommended an area of 157,500 feddans for semi-detailed soil survey between Rabak and Geiger. It is possible that additional lands are also available between Geiger and Melut and this, together with the pump scheme development, which has been found possible by Sir Alexander Gibb and Partners on the left bank and between Melut and Malakal, might total 200,000 feddans of lands for development.

5.3 Crops and Cropping Pattern - White Nile

On the higher ground in the north east of the area, rain grown dura is cultivated. Millet is grown in the sandy dune area near Rabak. Groundnuts are grown on sandy ridges in North Renk district; yields however have only averaged 0.22 tons/feddan over the past six years. Dura yields on a mechanical scheme near Renk average, only 0.17 tons per feddan. Cotton yield is of the order of 4.0 kantars per feddan.

5.4 Engineering Problems - White Nile Rabak-Malakal

The effect of the Jebel Aulia Reservoir is felt as far as Renk ; thus until the end of March and the period of irrigation of cotton the pumping head in the reach from Rabak to Renk is low. It may vary from 3.5 to a maximum of 8.0 metres, depending on the flow in the White Nile. The average head is about 6.5 metres.

From Renk to Malakal the lift may vary from 3 to 8 metres, with an average value of about 5.0 metres. The pumping head throughout the reach is low.

Sites for pump stations can be found throughout the reach. The northern section is already fully developed; in the south flooding either from the river or from inland might be a problem.

6. BLUE NILE

6.1 Existing Irrigation

There has been extensive development of pumped irrigation on the Blue Nile since 1949.

The areas irrigated from records of the Ministry of Agriculture Provincial offices are as follows :-

	<u>Feddans</u>
Private Schemes	341,500
Government Schemes	43,800

With exception of about 11,500 feddans which lies north of Guneid, all the private schemes lie between Roseires and the Dinder Confluence. The cash crop is long staple cotton.

Of the Government Schemes, one is the Sugar Project at Guneid (38,000 feddans). The second is Dairy Farm south of Khartoum (2,800 feddans), and the third is the Umm Beneim Dairy Scheme, pstream Sennar on the right bank (3,000 feddans)

6.2 Soil and Land Classification

Reconnaissance and semi-detailed soil surveys have been carried out on the right bank from Roseires to Khartoum and on the left bank from Abu Hagar (near Roseires) to Sennar. The outcome of these surveys is as follows :-

Sennar to Khartoum The lands are part of the Blue Nile plain sloping gently towards the river. They experience a monsoon type rainy season with maximum rainfall in July and August and an average rainfall of about 300 mms. per annum. The soils are dark coloured cracking clays, similar to those of the Gezira area, but with appreciably lower clay contents. They are virtually non-drainable so that rotations would be of the non-intensive types similar to those practiced in the Gezira and Managil projects.

An area of 12,000 feddans adjacent to the Guneid sugar scheme area is suitable for an extension of that scheme. A total of 8,000 feddans adjacent to the Blue Nile between Sennar and Guneid are suitable for development in small projects. An area of about 120,000 feddans is being considered as part of the Guneid gravity project supplied from the Rahad Link Canal.

Roseires to Sennar (including Blue Nile to Dinder area) There has been extensive development of the areas adjacent to the Blue Nile both upstream and downstream Sennar.

On the right bank there is an area of 120,000 feddans which might be irrigated either by gravity from Roseires or by large pumping projects taking water from the Sennar reservoir at Suki. The annual rainfall varies from 480 mms. at Sennar to 588 mms. at Singa. The great majority of the soils are "cracking clays" and are classed as Vertisols. In the north, where the clays have the friable surface mulch and other profile characteristics of the Gezira soils, they are classed as Grumusterts. To the south, however, the friable surface mulch becomes thinner and less well defined. The soil pattern here

consists partly of grumusterts (friable surface) and mazusterts (crusty surface) and partly of the poorly drained grumaquerts and mazaquerts.

On the left bank, upstream of Sennar, there has also been considerable private development. A semi-detailed soil survey of selected areas is in hand and may find 32,000 feddans suitable for development.

The lands are part of the Blue Nile clay plain. They are virtually non-drainable soils of the Gezira type. The area has an average annual rainfall of approximately 600 mms., increasing from north to south. Vegetation consists of Acacia mellifera thicket and Acacia seyal - Balanites aegyptiaca savannah. Population is of the order of 25,000.

6.3 Crops and Cropping Patterns - Blue Nile

For the pump schemes on the left and right banks cotton is the main crop; dura is also cultivated, largely on rain. On the left bank existing agriculture consists of 'Seluka' cultivation of silt terrace growing maize, lubia, fruit and vegetables for Singa market, rainland cultivation of dura, sesame, millet and groundnuts, animal husbandry and the cultivation of cotton and dura on private pump schemes.

The soils are virtually non-drainable. They should therefore be used for a relatively non-intensive rotation of the Gezira-Managil type.

6.4 Blue Nile Project Areas

The areas which might be developed by private enterprise on the Blue Nile are therefore as follows :-

<u>Location</u>	<u>Net Irrigable Area Feddans</u>
Downstream Sennar	
Hurga Pump Scheme Extension	8,000
Upstream Sennar (Right Bank)	
Es Suki, Kassab ed Doleib & Tabat	120,000
Upstream Sennar (Left Bank)	
Possible Pump Schemes	32,000
Total	160,000 feddans

6.5 Engineering Features

The development downstream (8,000 feddans) Sennar will be extensions to the existing pump scheme at Hurga. The lift is high, of the order of 15 to 20 metres.

For the large projects on the right bank, Suki, Kassab ed Doleib and Tabat, conditions are much more favourable, because water can be pumped from the Sennar reservoir and the lift will vary from 6 to 9 metres.

On the left bank the projects in between Sennar and Singa will have similar conditions, but further south the head increases until it may be as much as 20 metres. In this area the comparatively heavy rainfall will require a system of surface water drains, and the clearance of the acacia thicket also would increase the first cost of construction.

7. POSSIBLE CROPS AND CROPPING PATTERNS FOR PRIVATE PUMP SCHEME DEVELOPMENT

7.1 Main Nile (North of Khartoum)

For the areas north of Khartoum, the cooler winter and generally more permeable soils permit the

cultivation of a wider range of crops. The very low rainfall for this area would make necessary irrigation throughout the year. Considerable further investigation is necessary before a detailed cropping pattern could be suggested but wheat, cotton, beans, castor, groundnuts and berseem would appear the most promising crops.

North of Khartoum, the relatively larger population in relation to available arable land and the intensive nature of agriculture as presently practiced make the development of further areas for irrigated agriculture very desirable. Present yields in the area are rather low but for winter crops are better than are obtained further south. The area offers scope for diversification of crops not possible on the heavier soils and in the more uniform climate of the south.

7.2 Blue Nile and White Nile

For the areas south of Khartoum on soils which are predominantly heavy cracking clays, cotton and groundnuts are the most attractive crops from an economic point of view. Near urban centres the production of milk and fruit and vegetables might provide a satisfactory return. In general however rotations similar to that practised in the Gezira and those recommended for the Rahad and Roseires projects would seem to promise the best returns, namely :-

- 1/3 cotton
- 1/3 groundnuts
- 1/6 dura or some substitute crop.

In the heavy rainfall areas on the Blue and White Nile, rice has been suggested as a substitute for cotton, and sugar cane could also be considered. The climatically adapted crops which can be grown on clay soils in central Sudan in addition to cotton (long, medium and short staple), dura and groundnuts are wheat, pigeon pea, onions, garlic, sugar cane and forage crops. Other potentially important crops, not yet grown on a commercial scale, are jute, kenaf, sunn hemp, maize, rice, safflower, sunflower and new fodder crops.

7.3 Yields of Crops

Yields from private pump schemes appear more variable than those of Government operated schemes. This is no doubt due to lower levels of management and supervision combined with less technical knowledge in many cases. The lower management costs of private schemes will offset to some extent the higher initial development costs of these small areas, but the lower yields anticipated may adversely affect the cost/benefit of such a scheme as compared with larger Government enterprises (e.g. Rahad Project). It is necessary to investigate the management/yield relationship for private schemes and to ascertain what safeguards can be provided to ensure that a reasonable standard of agriculture is maintained.

8. COSTS AND BENEFITS

8.1 Costs of Development

Accurate information of costs of private schemes is not available. The I.B.R.D. Report of 1961 used a figure of £32 per feddan. It is thought this rate has increased and that an approximate figure is LS.45 per feddan made up as follows :-

	<u>L.S. per feddan</u>	
Mechanical Plant	17	
Civil works, pump stations, etc.	16.5	
Canalisation	<u>11</u>	44.5
		Say <u>LS.45.</u>

This is put forward as no more than an average figure. The actual cost of construction will of course vary from site to site, depending on pump station, pump channel, lift, etc.

8.2 Benefits

On the Blue Nile, two rotations can be considered. That in general use on the private schemes and the more intensive rotation proposed for the Rahad Project.

	<u>Private Schemes Rotation</u>	<u>Rahad Rotation</u>
Cotton	1/3	1/3
Groundnuts	-	1/3
Dura	1/6	1/6

In Appendix II are given the estimated outputs from the various crops per feddan. For the existing rotation with one third of the area under cotton, the value of this crop will be LS. 19 to LS. 20 per feddan, of which practice would allow the pump scheme owner 50% or LS. 10 per annum.

If the 'Rahad' rotation can be established, then the value of the cotton and groundnuts will be about LS. 30 per feddan, of which LS. 15 will be due to the pump schemes owner. This increased cropping will

probably require additional pumping plant, and the revenue may not justify additional first cost and recurring charges for the groundnuts.

On the White Nile, the returns will be similar to the figures for the Blue Nile development, the rotations will be much the same, the yields may be rather lower, but pumping costs should also be reduced due to lower head.

For the Main Nile, north of Khartoum, it is not possible to make any forecast of the benefit. The Zeidab Pump Scheme is based on the cultivation of cotton and is presumably giving returns similar to the Blue or White Nile projects. On the other hand, the Government Pump Schemes with the exception of Bergeig (near Dongola) are not prospering (no cotton is included in the rotation).

The soils and climate however are suitable for an intensive rotation and it should be possible to evolve a cropping pattern and system of management which will lead to profitable development of irrigated agriculture.

Running Costs Figures have been obtained for the operating costs of the eight White Nile pump schemes which range in size from a gross area of 1,870 feddans to 11,670 feddans. The cropping pattern is similar to the private pump schemes, namely cotton (1/3), dura (1/6), with the addition of some lubia (about 1/6).

These figures are as follows :-

	<u>L.S. per feddan</u>
Maintenance of Canals	0.665
Running Costs of Pump Stations	
Wages	0.431
Fuel	0.338
Sundries	<u>0.081</u>
	<u>0.850</u>
Total	LS. <u>1.515</u>

Private pump schemes will probably economise in the cost of wages; on the other hand the cost of maintenance of the mechanical plant is not included in the White Nile estimates. If this is taken at 2% per annum of the first cost of the plant, this will be about LS. 0.350 per feddan. This will bring the total cost to LS. 1/865 per feddan (gross area). It is probable that the running costs for private pump schemes (excluding interest charges or renewals) will be of the order of LS. 1.5 to LS. 2.5 per feddan gross irrigable area. No provision is made for 'management', except in the case of the very large pump schemes. This is a service provided by the pump scheme owner himself, or a relative.

SUNMARY AND CONCLUSIONS

The following areas may be available for development by private enterprise :-

	<u>Feddans</u>	<u>Feddans</u>
1. Main Nile (and R. Atbara) Kareima to Third Cataract Khartoum to Kareima	17,000 (1) <u>43,000</u> (2)	60,000
2. White Nile Rabak to Khartoum Melut to Rabak	7,000 (2) <u>200,000</u> (3)	207,000
3. Blue Nile Sennar-Khartoum Roseires-Sennar - Rt. Bank Lt. Bank	8,000 (1) 120,000 <u>32,000</u>	160,000
	Total	<u>427,000</u>

- (1) From semi-detailed soil survey.
- (2) From reconnaissance soil survey.
- (3) From exploratory soil survey.

Reference has not been made to development on the Rahad or Dinder rivers. For perennial irrigation water will be required from Roseires Dam and therefore the possibilities of private development are not considered in this note.

This memorandum has endeavoured to describe the background and potential areas for development by private enterprise. There are inevitably certain questions still to be answered and problems to be solved for the various river reaches.

For the Blue Nile the possibility of establishing comparatively large scale pump schemes (40,000 feddans) by private enterprise requires special study. Pump sites will have to be selected and preliminary designs prepared to take account of the possibilities of erosion. The cropping pattern requires study and a conclusion reached as to

whether or not a more intensive rotation will show an advantage to a private project. In the area south of Sennar some of the project lands may have a comparatively high rainfall and the cost of forest clearance will have to be considered in the estimates for construction. In this area also there may be problems of settlement, since there is little established population. In spite, however, of these problems the development by private enterprise of irrigation should proceed. Something over 1 million feddans has already been developed on the three main rivers of the Sudan, and although further development may be in areas which are rather less easily developed, it is reasonable to assume that between 200,000 and 400,000 feddans might be irrigated and thus ease the burden on the Sudan Government, both for financing and operating developed projects.

For the Main Nile north of Khartoum, a rotation and cropping has to be established. A study is also required of the reasons for the unsatisfactory economic operation of a number of pump schemes in the area. The engineering studies require to be extended to fix pump station sites, type of station and the estimates of cost of construction.

For the White Nile, semi-detailed soil survey of the area from Rabak to Malakal is still required, selection of pump sites and studies of the protection necessary to avoid flooding either from inland or the river. The population may be adequate to settle the projects, but in the southern areas their aptitude for irrigation work should be confirmed.

DETAILS OF POSSIBLE PROJECT AREAS AVAILABLE FOR PRIVATE DEVELOPMENT.

River Reach	Sub Total Feddans	Total Feddans
<u>Main Nile</u>		
Kareima to Third Cataract		
Affat Basin	2,500	
Letti Basin	6,000	
Kerma Basin	6,500	
Other Areas (Small Projects)	2,000	17,000
<u>Khartoum to Kareima</u>		
Medisisa		
Salawa-Habashi		
Guweir -Kelli-Kitiab		
El Bauga		
Basabir		
Kabushiya		
Hassa (Estimated area)	28,000	
Kineidra (on R.Atbara)	8,500	
Other Areas (8 small projects)	6,500	43,000
	Total Main Nile	60,000
<u>White Nile</u>		
Khartoum to Rabak		
Rabak and Heglig	7,000	7,000
Rabak-Malakal		
Tentative forecast of irrigable areas to be defined by Semi-detailed Soil Survey	200,000	200,000
	Total White Nile	207,000
<u>Blue Nile</u>		
Sennar-Khartoum		
Hurga Extension	8,000	8,000
Roseires to Sennar		
Right Bank		
Es Suki	50,000	
Kassab ed Doleib	70,000	120,000
Left Bank		
Singa and north (Wad Rabaa, Wad Abati, Abidin, Maiurno, Sennar)	25,000	
South of Singa (Tabit, el Teifigiz, Umm Marrih).	7,000	32,000
	Total Blue Nile	160,000

YIELDS AND OUTPUTS

Crop	Yield per feddan	Price f.o.b. Port Sudan	Output ⁽¹⁾ L.S. per feddan
Long Staple Cotton Bar 1425 (GOT 30%)	4.0 SK	12.26 LK	57.0 ⁽²⁾
Medium Staple Cotton Acala 4.42 (GOT 39.5%)	4.5 SK	9.57 LK	60.0 ⁽²⁾
Groundnuts (SOT 70%)	0.75 Ton	54.4 p.ton (shelled)	28.6
Castor	0.8 ton	50 p.ton	40.0
Dura	0.6 ton	18.0 p.ton	10.8
Barley	0.35ton	25.0 p.ton	8.8
Wheat	0.75 ton	27.0 p.ton	20.0
Chickpea, etc.	0.35 ton	45.0 p.ton	15.7
Sesame	0.3 ton	67.3 p.ton	18.1
Mangoes	100 kg/Tree		300
Dates	40 kg/Tree		20

SK = Seed Kantar (315 lbs)

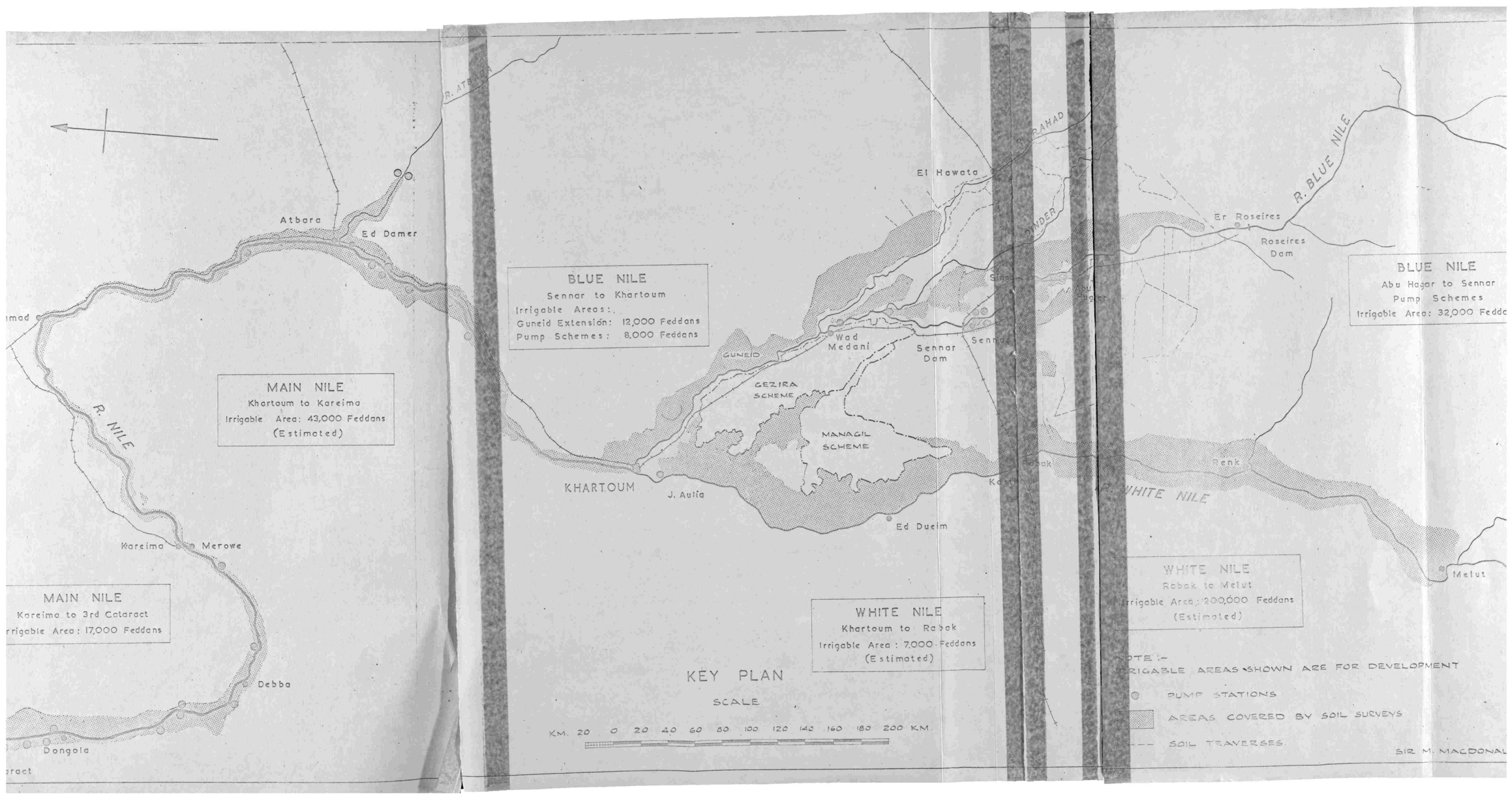
LK = Lint Kantar (100 lbs)

SOT = Shelling Out turn

GOT = Ginning " "

(1) The 'output' is the value of the crops sold in Port Sudan or Khartoum.

(2) Includes for value of seed at Port Sudan at LS.26.7 per metric tonne.



MAIN NILE
 Khartoum to Kareima
 Irrigable Area: 43,000 Feddans
 (Estimated)

BLUE NILE
 Sennar to Khartoum
 Irrigable Areas:
 Guneid Extension: 12,000 Feddans
 Pump Schemes: 8,000 Feddans

BLUE NILE
 Abu Hagar to Sennar
 Pump Schemes
 Irrigable Area: 32,000 Feddans

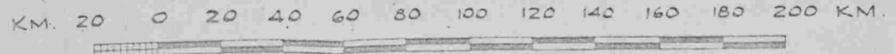
MAIN NILE
 Kareima to 3rd Cataract
 Irrigable Area: 17,000 Feddans

WHITE NILE
 Khartoum to Rabak
 Irrigable Area: 7,000 Feddans
 (Estimated)

WHITE NILE
 Rabak to Melut
 Irrigable Area: 200,000 Feddans
 (Estimated)

KEY PLAN

SCALE



- NOTE:-
- PUMP STATIONS
 - ▨ AREAS COVERED BY SOIL SURVEYS
 - SOIL TRAVERSES.