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AGRO-INDUSTRIAL DEVELOPMENT GEZIRA SCHEME, PHASE I-ASSESSMENT MISSION*

SI/SUD/77/805
SUDAN

Terminal report

Prepared for the Government of Sudan by the
United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Erik Kissmeyer-Nielson,
agro-industry expert

United Nations Industrial Development Organization
Vienna

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Explanatory notes

The equivalent of 1 feddan is 1.038 acre.

The following abbreviations are used in this report:

CDC	Commonwealth Development Corporation
FAO	Food and Agriculture Organization of the United Nations
WHO	World Health Organization

Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development Organization (UNIDO).

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INTRODUCTION

The Special Industrial Services project "Agro-industrial development Gezira Scheme, phase I - Assessment mission" (SI/SUD/77/805) arose from a request by the Sudan Gezira Board, which was supported by the Government of the Sudan. The project was approved by the United Nations Industrial Development Organization (UNIDO) on 3 November 1977.

The purpose of the project was to assist the Government of the Democratic Republic of the Sudan in conducting a preliminary assessment of new and/or improved integrated agro-industry developments within the Sudan Gezira Board agricultural and agro-industry scheme. Specifically the expert was in accordance with his terms of reference expected to:

1. Review available data, plans and assess the information available concerning the Sudan Gezira Board Scheme.

2. Elaborate a project document and terms of reference for technical assistance aimed at producing a basic master plan for the agro-industrial development of the Sudan Gezira Board Scheme.

The agro-industry expert took up his assignment, originally scheduled for one month, on 2 May 1978. His stay was later extended to two months.

The aim of the Sudan Gezira Board through the further development of agro-industries in the Gezira Scheme is to increase the income and improve the social environment of the tenants by added value through processing of its agricultural products.

A study was made of the present agro-industries. Also the present and potential agricultural crop production was studied in order to determine the feasibility of establishing new and/or improved economically viable

food and fibre processing ventures. Specifically the Sudan Gezira Board Industrial Affairs Department's program on agro-industrial projects for the Gezira Board Six Year Plan 1977/78 - 1982/83 was studied. This plan consists of five major projects (and their ramifications) as follows (also see Annex II) "Programme of Agro-Industrial Projects for the Sudan Gezira Board Scheme six year Plan 1977/78 - 1982/83"):

1 Utilization of cotton stalks in the production of particle boards.

Projected plant production capacity: 30,000 m^3 of 19 mm thick particle boards annually.

Capital investment SL 5 million (five million).

Estimated requirement of cotton stalks is 30,000 tons or six percent of the approximately 500,000 tons produced annually from 500,000 feddans of cotton.

Study in hand: Identification and reports only plus samples of particle boards produced in the laboratory of a manufacturer in the Federal Republic of Germany of particle board production machinery from Gezira Scheme cotton stalks.

2 Groundnut oil mills

Projected annual plant capacity is for the processing of 130,000 tons of groundnut seeds to pro-

duce approximately 60,000 tons of crude groundnut oil and 67,000 tons of oil cakes.
Capital investment SL5.25 million.
Study in hand: Detailed feasibility study.

3 Soybean agro-industrial complex.

Production of soybeans from 400,000 feddans/annually within a suitable crop rotation to produce oil, vegetable protein, oil cakes and beef.
Intograted soybean production, oil mill, feed mill, cattle feed lotting, slaughterhouse, etc..
Capital investment SL70 million.
Study in hand; Detailed feasibility study almost finished.

4 Rice hulling and polishing.

Expansion of present 2 line rice hulling and polishing plant with a third line with a capacity of 2.5 to 3.0 tons rice paddy per hour.
Capital investment SL0.35 million.
Stage of execution; Received tenders, awaiting OK by authorities.

5 Tomato concentrate plant.

Capacity 720 tons of tomatoes/annually
Capital investment SL0.35 million

Study on hand: Tomato field trials are being conducted in Northern Gezira by Jugoslav horticulturists under a Sudan/Jugoslav bilateral arrangement. Feasibility study to follow.

Annex II "Programme of Agro-Industrial Projects for the Sudan Gezira Board Scheme six years Plan 1977/78 - 1982/83" further elaborates on these five projects. In addition to above mentioned five projects Annex II also has a proposal for production of paper based on cotton stalks plus cotton fibers. The reason this project is not included above is the indicated need to incorporate approximately 30 percent long stable cotton fiber in order to obtain a reasonable tensile strength. This dimishes the likelihood of the economic feasibility of the project.

Acknowledgements

The expert wishes to express his appreciation for the extensive assistance and cooperation he received in the Sudan in the course of his project by members of UNDP, the Sudan Government, the Gezira Board, bilateral officials, private and public sector executives. Among above mentioned are the UNDP Resident Representative Charles H. La Muniere, Peter Quennell, Assistant Resident Representative, Hussein Omer Kisha, Deputy Managing Director for Industrial Affairs, Sudan Gezira Board, Osman Mohammed El Hassan, Deputy Director, Administration and Public Relations, Sudan Gezira Board, Barakat.

I. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

The Gezira Board Agro-industrial Projects are very ambitious. Apart from tomatoes for production of tomato concentrate and soybeans to be used in the Soybean agro-industrial Complex growing of the crops to be used in the projects is well established in the Gezira Scheme. There is ample availability of water to cover the crop processing needs and the Gezira Scheme is favored with the best transport facilities in Sudan to reach Port Sudan and Khartoum. It has its own internal railroad system connecting it with the Khartoum-Port Sudan railroad. It has access to the all weather tarmac road, Khartoum - Port Sudan scheduled to be finished in a couple of years.

Among restraints are shortage of skilled labor including management and inadequate electricity supply. The railroad connection to Port Sudan is mostly overburdened and suffers maintenance problems. There are also according to the Ministry of Industry existing overcapacities in oilseed milling and tomato processing into tomato concentrate production. The nature of these overcapacities must, however, be closely examined in order to elucidate whether these are true overcapacities or for instance they are created to cope with frequent stoppages due to electricity shortages or represent

outdated and inefficient production facilities. The existing tomato concentrate manufacturing facilities have according to the Ministry of Industry never produced significant quantities of tomato concentrate not least due to lack of locally produced tomatoes of suitable quality and price.

The inadequate availability of skilled labor including management personnel is partly due to migration to neighbouring countries offering considerably higher wages and the need of intensification of training programs. This must be taken into consideration when judging the economic feasibility of of the projects and if any projects are judged economically feasible in the manner in which they are implemented. Any implementation of projects must be preceeded by training of personnel to man it. It would be desirable to carry out feasibility studies, implementation and the further management of projects through a highly reputable, accomplished international agro-industry company (or companies) to assure successful implementation, management and training of domestic personnel. This will insure the optimum involvement of domestic personnel in all levels of skilled labor and management inputs. It is of particular importance to maintain good relations between the agro-industry management and the tenants. This demands careful training of domestic public relations personnel.

The project on production of particle board from cotton stalks is of less well known and established nature. It is in the Sudan according to the Ministry of Industry preceeded by failure of such a venture. This particle board factory was established north of Khartoum where the production of particle board was based on use of cotton stalks. This project was part of a Sudan/Jugoslav bilateral program. The factory has never been in normal operation and the problem of payment for this factory has not been resolved between the Sudan and Jugoslav Governments. Furthermore cotton production in this area is now insignificant. However, the German Company proposing the plant layout has ample experience in the successful construction of particle board plants using more conventional raw materials. It is, however, said that this company (Inter Bison - Sacks, Springe, Federal Republic of Germany) has built a plant producing particle board from cotton stalks in the USSR. It would be desirable to look further into this before proceeding further with the Gezira Board's project on this.

Also the economic feasibility of production of soybeans has not yet been established. There is therefore a need for extensive variety and cultural trials on soybeans. Brazilian and Italian agro-industrial companies are, ac-

cording to the Gezira Board, already involved in this investigation.

Although cotton production remains successful within the Gezira Scheme, there are indications that production of other crops such as rice and wheat are not quite as successful and profitable. For instance the rice yields vary according to information from the Gezira Board between 0.5 and 3.0 tons per feddan. Among reasons for this are variations in dates of sowing, irrigation, fertilization, weeding and other cultural procedures. Also dates of harvest of the rice vary. There is thus a need to reappraise the entire agricultural production scheme including reassessment of the economically most favorable crops and products to produce.

The tendency of the young to leave the Gezira Scheme in favor of locations offering more diversified freetime activities, better paid jobs and shorter working hours necessitates improvements of the infrastructure and working conditions within the Gezira Scheme. The Gezira Board has this in mind and for instance Annex VII, "Introduction of the Feasibility Study of complete Mechanization in the Sudan Gezira Scheme" indicates this awareness. Mechanization is one manner by which to increase the efficiency of the scheme

and reduce the need of hard manual labor. Further mechanization will, however, enhance the already great problem of maintenance of equipment. This will thus have to be taken into consideration.

B. Recommendations

The Gezira Board's desire further to increase its agro-industrial complex is in keeping with World trends. Successful implementation of such schemes through added value will make it possible to further improve the income and social environment for the tenants. This is needed in order to counter the trend for the young to leave such agricultural schemes and go to more alluring urban areas. Further agro-industries will also create higher paid and more challenging jobs for ambitious young persons.

Consequently, it is recommended to carry out in depth feasibility studies of the five Gezira Board project proposals and where such already are available review and update. It should, however, also be kept in mind that this investigation may arrive at recommendation for implementation of projects other than the five Gezira projects in the course of the study and reviews. For instance the review of the Gezira agricultural scheme may identify production, processing and marketing of more profitable crops. For instance the scheme might be able to create the expertice for production of horticultural crops for marketing in the Middle East and for the off season market in Western Europe. Saudi Arabia, Kuwait and the United Arab Emirates depend on imports for most of their food needs and provide an excellent market for Sudan, provided Sudan can satisfy their quality

requirements.

In view of the special circumstances and in order to assure continuity between the feasibility study stage and implementation of projects found economically feasible, it is recommended to make use of an international, large scale, experienced and successful agro-industrial company with extensive experience in the production, processing and marketing of crops grown under Sudanese climatic and soil conditions. This company (or companies) should carry out the feasibility studies and reviews and be cabable to carry out any identified implementations, management and training programs for the domestic staff and workers. Among several such international companies Commonwealth Development Corporation (C.D.C.) and Booker Agriculture International Ltd., London, are highly involved in such projects included in neighbouring African Countries. C.D.C. furthermore may be able to provide much needed finance.

It is recommended that the selected team of consultants shall arrive in the Sudan during the month of October since the agricultural crops then are in full growth in the Gezira Scheme. This is also climatically a more favo-

rable period of the year in which to carry out the demanding studies and a period where less of the personnel to contact is likely to be abroad.

The needed period for the study is envisaged to be six months with the following suggested work program: Two weeks briefing including visits at UNIDO in Vienna and FAO in Rome, three months field work, data collection and contact work in Sudan, two weeks debriefing at UNIDO and FAO and two months for finalization of feasibility studies and report in home offices. It is realized that this work plan may have to be adjusted to meet specific needs. It is recommended that the selected consulting team has the following experts:

Expert	Man months
1 oil seed crushing	6
1 particle board	6
1 slaughterhouse	6
1 animal production	6
1 slaughterhouse biproducts	6
1 agronomist	6
1 horticulturist	6
1 agricultural economist	6
1 general economist	6
1 farm management	6
1 tomato processing	4
Total	64 man months(mm)

Aproximate cost:	
64 man months @ US$6000	US$384,000
travel expenses @ US$2000	US$-22,000
per dium US$2000/mm (44 mm)	US$-88,000
Total above	US$494,000
25% overhead including report	US$123,500
Overall total	US$617,500

In terms of the basic master plan for the Gezira Board Scheme Agro-industrial Development plans above is recommended as phase one. Phase two is implementation of agro-industrial projects identified as economically feasible including training programs. This may also include improvements of existing agro-industries and redirection of the Gezira Scheme in respect to its management and technical procedures and its production program.

The large size of the Gezira Scheme and its economic importance to the economy of Sudan is why the expert is only recommending involving an agro-industry company with an excellent track record able to carry out high level feasibility studies and implementation with all its ramifications. Following this recommendation will also make it easier for the Gezira Board to obtain the needed finance.

II PRESENT SITUATION

A Present Agro-industries

A,1 Cotton Ginning

At present all the seed cotton in the Gezira Scheme is ginned at the two local cotton ginning factories belonging to the Gezira Board. One is an older cotton ginning plant mainly using manual transport. The other is a more modern cotton ginning plant built in the mid-sixties using mechanical internal transport. All the cotton seed produced from the seed cotton (1976/77 seed cotton production was 1,824,883 kantars) is sold to domestic oil mills. Most of the lint is exported while a small but increasing amount is used by domestic yarn and cloth manuturers. Most of the yarn made from extra long staple cotton fiber is exported at favorably high prices for production of quality high priced cotton materials.

Both cotton ginning plants are getting old and show wear and may thus be in need of improvements and/or renewals.

A,2 Groundnut Decortication

There are five groundnut decortication centers each with six decorticators with a capacity of 2.5 to 3.0 tons/hour. They were put into operation during the 1975/76 season. Only approximately 15 percent of the total Gezira Scheme

groundnut production was delivered to these decortication centers the first season and hardly any during the 1976/77 season. Among reasons for this is that the tenants have to wait some time for their money when delivering to these decortication centers, while when selling the whole groundnuts to private merchants they are paid right away. They prefer this although they according to the Gezira Board get a better price when delivering to the decortication centers. The reason the Gezira Board cannot pay right away is lack of capital. Erection of a groundnut crushing factory within the Gezira Scheme might make it more inviting to the tenants to deliver their groundnuts to the decortication centers rather than to private merchants provided such a factory can assure them a considerably higher price for their groundnuts.

B Agricultural Crop Production

The following table shows the Gezira Scheme agricultural crop production for the 1975/76 and 1976/77 season (see table 1). Wheat, cotton, durra and groundnuts are the basic crops while vegetables, rice and lubia (a feed crop) are very minor crops. Table 2 shows the 1911/12 through

Table 1

1975/76 and 1976/77 Sudan Gezira Scheme Agricultural Production

(thousand feddans)

Crop	Season	
	1975/76	1976/77
Cotton	396	499
Durra	341	352
Wheat	568	505
Groundnuts	424	251
Rice	12	13
Vegetables	24	30
Lubia	1	trace

1976/77 season production of cotton in the Gezira Scheme and the Managil-South-Western Extension. These schemes are of the greatest importance to the national economy of the Sudan and have for many years constituted the major part of the national economy. Figure I shows the Sudan cotton production from 1967 through 1976 and illustrates the great importance of the Gezira Scheme. It was started in 1911 when cotton production was the overall most important part of the scheme. The completion of the dam at Sennar in the Province of Gezira in 1925 made it possible to implement improved irrigation schemes and thus paved the way for the gradual enlargement of the irrigated scheme.

The Gezira Scheme contributes 12 percent of the total area cultivated in the Sudan.

Annex VI "Unprecedented Development Trends in Agricultural Production and Processing in the Sudan Gezira Scheme today" serves to show some of the progress made in this scheme. Annex IV "The Development of Managil South-Western Extension to the Sudan Gezira Scheme" is illustrative of the physical extension of the scheme. At present crop production intensification methods rather than acreage

Table 2

BARAKAT HEADQUARTERS

SUDAN GEZIRA AND MANAGIL YIELDS AND AVERAGES

(FOR SEASONS (1911/1912 - 1971/1972)

(+ 1972/73 to 1976/77 Gezira-Managil)

SEASON	(GEZIRA) AREA IN FEDDANS	(GEZIRA) TOTAL PRODUCTION KANTARS	(GEZIRA) AVERAGE FINAL YIELD K.P.F.	(MANAGIL) AREA IN FEDDANS	(MANAGIL) TOTAL PRODUCTION KANTARS	(MANAGIL) AVERAGE FINAL YIELD K.P.F.	(GEZIRA & MANAGIL) AREA IN FEDDANS	(GEZIRA & MANAGIL) TOTAL PRODUCTION KANTARS	(GEZIRA & MANAGIL) AVERAGE FINAL YIELD K.P.F.
1911/12	250	1330.00	5.320						
1912/13	610	3428.20	5.620						
1913/14	668	2538.40	3.800						
1914/15	2962	15698.60	5.300						
1915/16	3361	11259.35	3.350						
1916/17	4301	14193.30	3.300						
1917/18	3856	12532.20	3.250						
1918/19	3964	15063.20	3.800						
1919/20	3766	19771.50	5.250						
1920/21	3711	12617.40	3.400						
1921/22	9816	38252.40	3.900						
1922/23	10407	39026.25	3.750						
1923/24	22483	64301.38	2.860						
1924/25	21616	47771.36	2.210						
1925/26	80003.50	384016.80	4.800						
1926/27	100057	474270.18	4.740						
1927/28	105587	347381.23	3.790						
1928/29	131351	366296.05	2.789						
1929/30	174133	405388.80	2.328						
1930/31	195623	266054.75	1.360						
1931/32	194019	805714.50	4.152						
1932/33	194975	374896.04	1.922						
1933/34	174887	409686.27	2.342						
1934/35	175183	780939.70	4.458						
1935/36	184740	688055.28	3.724						
1936/37	199125	790326.09	3.969						
1937/38	206653	947098.95	4.583						
1938/39	205321	914404.72	4.453						
1939/40	206319	792679.03	3.842						
1940/41	207018	851263.38	4.112						
1941/42	207121	838861.10	4.050						
1942/43	206474	1003291.46	4.859						
1943/44	206571	648108.22	3.137						
1944/45	206578	1023627.70	4.955						
1945/46	196541	661423.18	3.365						
1946/47	206176	811978.24	3.938						
1947/48	206346	699720.02	3.391						
1948/49	206778	880212.22	4.256						
1949/50	206739	948167.70	4.586						
1950/51	207433	1406810.61	6.782						
1951/52	220950	685165.95	3.101						
1952/53	234715	1106681.22	4.715						
1953/54	234967	1102700.13	4.693						
1954/55	234748	1005660.43	4.284						
1955/56	238925.75	1162401.96	4.865						
1956/57	245359.25	1658535.31	6.759						
1957/58	245405	369334.52	1.505						
1958/59	245348	1156058.28	4.712	65244.75	306971.17	4.705	310592.75	1463029.45	4.710
1959/60	246134.25	1126985.08	4.578	139766.50	484617.29	3.467	385900.75	1611602.37	4.176
1960/61	246154.75	660615.48	2.683	184547.25	516802.83	2.800	430702	1177418.31	2.733
1961/62	240091.67	1593859.43	6.639	228176	1226959.29	5.377	468267.67	2820818.72	6.024
1962/63	239741.70	1035960.23	4.321	244602.25	830677.01	3.396	484343.95	1866637.24	3.854
1963/64	248156.25	449493.25	1.811	260321.75	717516.49	2.756	508478	1167009.74	2.295
1964/65	250905.08	940201.95	3.747	257323.50	866170.98	3.366	508228.58	1806372.93	3.554
1965/66	249834	844837.43	3.382	260215.25	1027969.18	3.950	510049.25	1872306.61	3.672
1966/67	282568	1245110.53	4.406	259660.75	1251365.26	4.819	542228.75	2496476.09	4.604
1967/68	290006.75	1234518.36	4.257	263381	1080900.23	4.104	553387.75	2315418.59	4.184
1968/69	294190.25	1562852.34	5.312	279397.50	1429675.65	5.106	574187.75	2992527.99	5.212
1969/70	296237.50	1560217.12	5.267	281471.75	1352608.71	4.805	577709.25	2912825.83	5.042
1970/71	305193.25	1608753.64	5.271	283178.25	1574888.27	5.561	588371.50	3183541.91	5.411
1971/72	305275.75	1431373.00	4.689	283909.25	1485604.00	5.233	589185	2916977.00	4.951
MANSOUR/ May, 1972									
1972/73							589388	2405434	4.081
1973/74							589517	2965359	5.030
1974/75							588441	2692536	4.576
1975/76							395637	1077445	2.706
1976/77							499435	1824883	3.654

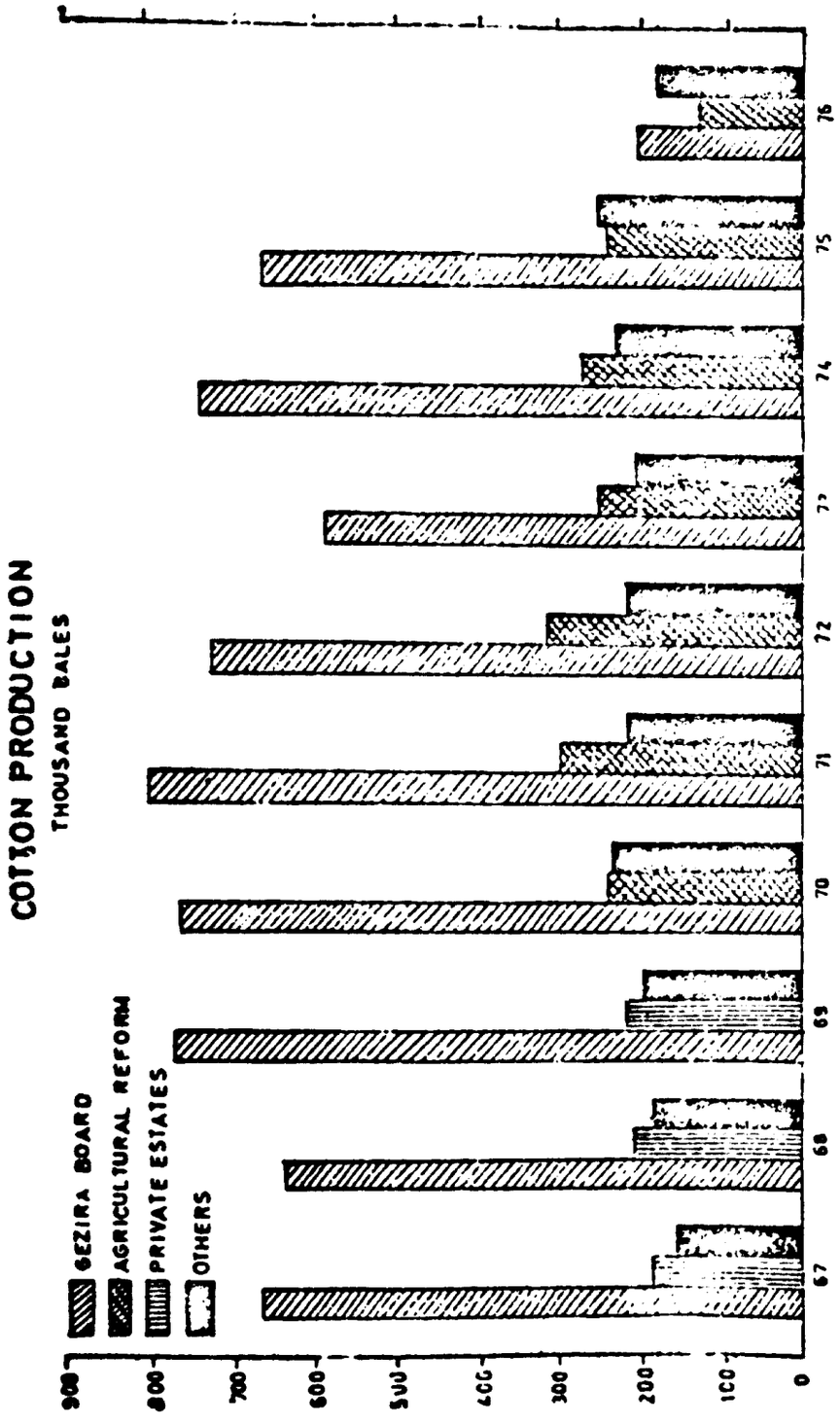
June 6, 1978

All yields refer to final average yield of Seed Cotton per feddan.

Source: The Sudan Gezira Board

Figure I

The Sudan 1967 through 1976 Cotton Production



Source: The Sudan Bank

increase is the goal.

Table 3 shows the Gezira Scheme 1976/77 season production of extra long staple cotton, durra, groundnuts and wheat in percentages of the total Sudan production of these crops.

Table 3

Selected Gezira Scheme agricultural crop production in percent of total Sudan production

Crop	Percent of total Sudan Production
Extra long stable cotton	75
Durra	12
Groundnuts	60
Wheat	85

Above table illustrates the great importance of the Gezira Scheme.

Further details about the Gezira Board Scheme are available at the Sudan Gezira Board Information and Publication Section,Barakat. The Gezira Board has published various brochures and made a movie about the Scheme. The latter is currently being updated under the supervision of a film producer.

Mechanization of the scheme is gradually being increased.

Annex VII "Introduction of the Feasibility Study to com-

plete Mechanization in the Gezira Scheme" shows the great importance the Gezira Board attaches to this. For instance application of chemicals for the control of weeds and diseases in the cotton crop is carried out by airoplanes contracted from the outside.

The scheme has its own maintenance program for equipment but it suffers from some shortcomings. The Sudan Government's lack of foreign currency adds to these problems by making it hard to get foreign currency for import of spare-parts.

C Availability of skilled Labor

There is a shortage of skilled labor including various levels of management personnel. Part of this shortage is caused by migration of skilled labor to Kuwait, Saudi Arabia, the United Arab Emirates and the Libyan Arab Jamahiriya where higher wages are offered. To offset this there is a further need for training programs and improved incentives to encourage the skilled labor to remain in Sudan. Management training is available in the Sudan through the Management Development and Productivity Center, a joint Sudan Government/ UNDP/ILO project located in Khartoum.

A program "In-plant Group Training Programme for Managers and Engineers in the Field of Organization and Management of Agro-industrial Enterprises" is being organized by UNIDO

and the Government of Yugoslavia to be held in Novi Sad from August 28 to Oktober 26, 1978. UNIDO will provide roundtrip by economy class airtransport, a stipend to cover board and lodging plus incidental expenses for unaccompanied participants. This program might be valuable for Sudanese involved in organization and management of agro-industrial enterprises or those to be involved.

III POTENTIAL SITUATION

A Potential new and/or improved Agro-industries

Mention has been made of the Gezira Board Scheme Six year 1977/78 to 1982/83 agro-industrial projects in Section I,A of this report. These are Utilization of Cotton Stalks in the Production of Particle Board, Groundnut Crushing, Soybean Agro-industrial Complex, Rice Hulling and Polishing and Tomato Concentrate Plant. The purpose of these projects is to improve the income and the social environment for the tenants. A pertinent need for such improvements is the tendency for the young to leave the Gezira Scheme and go to the urban centers, where they find more distractions. Apart from the Soybean Agro-industrial Complex and the Tomato Concentrate Plant above projects are based on the use of produce which already is produced in large quantities within the Gezira Scheme. According to the Ministry of Industry there is a previous abortive attempt north of Khartoum to produce particle board from cotton stalks. The plant was erected but has not been put to profitable use. The Gezira Board's project is, however, based on a proposal by an experienced and successful manufacturer of particle board manufacturing equipment from the Federal Republic of Germany. This company is said to have

installed a particle board manufacturing plant based on the use of cotton stalks in the USSR.

This Company has also produced small samples of particle board made from Gezira cotton stalks. Although the concept of producing particle board from cotton stalks is not well known, it is still of particular interest to the Gezira Board, since the Gezira Scheme produces approximately 500,000 tons of cotton stalks per year. It costs according to the Gezira Board at present close to two million Sudanese Pounds per year to gather and burn these in the fields. This is done in order to diminish the spread of the serious cotton stalk bacterial rot and insects. These considerations will have to be given very serious thoughts in studying the economic feasibility of producing particle boards within the Gezira Scheme. Special care must be taken in the collection, baling, transport and factory storage of the cotton stalks to diminish spread of disease and insect infestations. The lack of readily available sources of wood and other sources of cellulose in the Sudan renders such a project highly interesting. The Gezira Board is also looking into the potential use of cotton stalks as a fuel in power plants to deliver

electricity to among others agro-industries. The present supply of electricity is insufficient and unreliable. There are thus ample reasons to conduct an in depth feasibility study on the uses of the Gezira Scheem cotton stalks.

It should be pointed out that Sudan agro-industries produce an alternative source of cellulose, namely bagasses the waste material from production of cane sugar. The high cost of imported fuel makes it, however, dosirable to use the bagasses as fuel at the cane sugar factory.

The groundnut crushing scheme is of more conventional nature. It is intended as an integrated part of a feed mill using the groundnut oil cakes, molasses from a nearby cane sugar factory (the molasses from the cane sugar production is at present mostly wasted), various grain mill byproducts and other fodder crops. The feed is to be used in feedlotting of beef cattle, and the beef cattle is to be slaughtered in a to be erected slaughterhouse and the beef exported to Kuwait and other Middle East countries. This project has thus many ramifications. Allthough there at present is said to be overcapacity for oil seed crushing it remains as previously mentioned in this report to be

seen if this comprises efficient and modern oil seed crushing facilities. Only the crude groundnut oil is to be sent to Port Sudan for export, while the rest of the products from the oil seed crushing remains for local use. This will reduce the weight to be transported to Port Sudan to approximately one third of the whole groundnuts. There is a two year old feasibility study on this project, which would have to be updated. According to the Sudan Gezira Board there is a fleet of railroad tank cars formerly used for petroleum products but idled since introduction of a pipeline. It is thought these tank cars can be cleaned up and used for the transport of the crude groundnut oil to Port Sudan. They may also be used for transport of molasses from the cane sugar factory to the planned feed mill.

The Rice Hulling and Polishing line is intended as an improvement of the present rice hulling and polishing plant, which was delivered by the Peoples Republic of China. The quality of the polished rice presently produced in this plant is rather inferior containing some impurities and approximately 35 to 40 percent broken grains. The latter is considered mostly due to irregular harvesting and inadequate handling procedures. Should rice consump-

tion in Sudan increase to become an important part of the basic diet of the Sudanese, it will be necessary to add vitamins to the polished rice in a parboiling step in order to escape serious vitamin deficiencies such as beri-beri (lack of B-vitamins).

Production of tomato concentrate is a conventional process hinging on the economic production of suitable tomatoes. A Yugoslav team of horticulturists are among others engaged in testing out various varieties of tomatoes for production of tomato concentrate. There are several plants in Sudan for the production of tomato concentrate. They are located in different parts of the country and so far have one thing in common namely not being able to obtain a sufficient supply of economically priced suitable tomatoes. Tomato concentrate in large containers is being imported and packed in small consumer size cans by some of these factories. There is thus a need very closely to examine the economic feasibility to produce tomato concentrate in the Gezira Agro-industry Scheme before proceeding with the implementation.

The shortage of skilled manpower for schemes such as the Gezira Board Agro-industry projects brings out the

need to make use of an experienced international agro-industry company to undertake feasibility studies and implement projects which are found feasible (if any). Such companies will undertake feasibility studies, implementation, manpower training, management and marketing of the products on a fee basis. Among such are Commonwealth Development Corporation (CDC) a pseudo Government Corporation with main offices in London, and Booker Agriculture International Ltd., London. Both have extensive international experience in agro-industry and CDC may in addition be able to provide much needed finance.

B Miscellaneous Agro-industry Projects

There are other potential agro-industry projects than the ones mentioned above. For instance Annex V - "The Sudan Gezira Board Milk Production Project" brings out a potential modern dairy industry. This would not only be export oriented but there is a unsatisfied domestic market for dairy products. Annex VIII "Introduction of the Study of Wheat Storage in the Sudan Gezira Scheme" shows the need for additional central crop storage facilities.

There are also oppportunities for production, grading, packing and marketing of high quality horticultural products

for export to Middle East Countries and off-season exports to Western Europe. Some preliminary trials indicate that Sudan has excellent climatic condions for the production of a wide variety of horticultural products which could be sold during the off season in Europe when Europe imports significant quantities of vegetables.

Improved animal production may lead to fringe benefits such as improved skins and hides and thus form the basis for more higher grade tanned skins and hides, which could increasingly be used in the domestic leather goods industry. Should an improved mechanization scheme for the Gezira Scheme take place there may be extra manpower available for a leather goods industry within the Gezira Board Agro-industry Scheme. There is a large volume international market for leathergoods provided they are of the right design and quality. This would make it desirable to cooperate with a successful international leather-goods manufacturer (or manufacturers) and marketers.

There are thus many possibilities creating added value from the Gezira Scheme produce. Some are on the fringe of actual agro-industry projects. Such a sophisticated development can only be broughtabout slowly and under the most careful guidance.

C Potential new and/or improved Agriculture Crop Production

The emphasis of the Gezira Board in regard to crop production is to increase this through intensification and improvement of production practices rather than increasing the cultivated area. There does appear to be a tendency for the yields of the conventional crops to decrease and thus an opportunity to increase these through improved cultural practices including introduction of better seeds, varieties and strains.

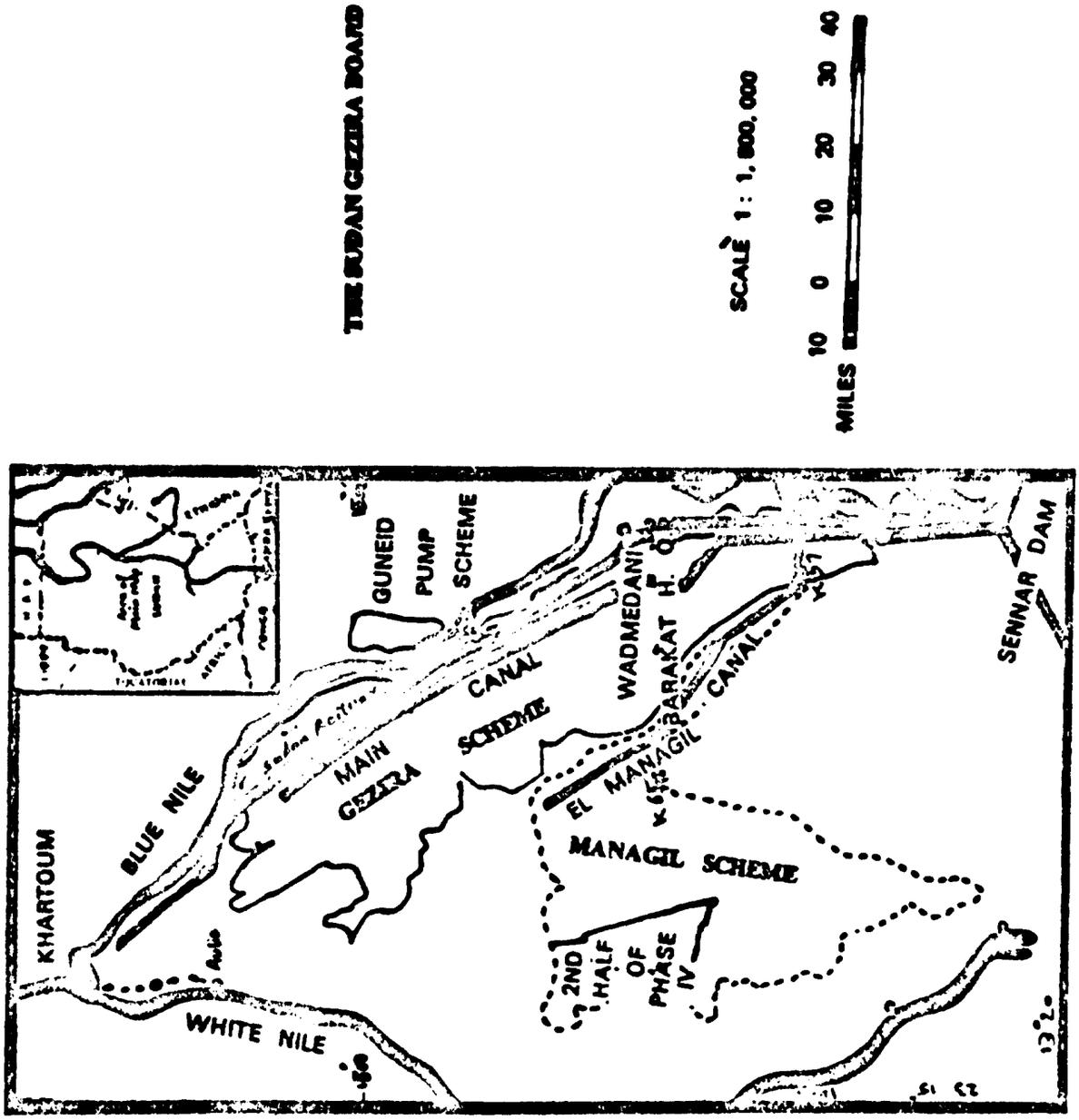
Some consideration has also been given to production of more lucrative crops such as horticultural crops for the Middle East and Western European (off season) markets.

In respect to animal production it is the Gezira Board's intention to improve this and intensify feeding procedures. This might also improve the quality of the skins and hides when combined with controlled and improved handling.

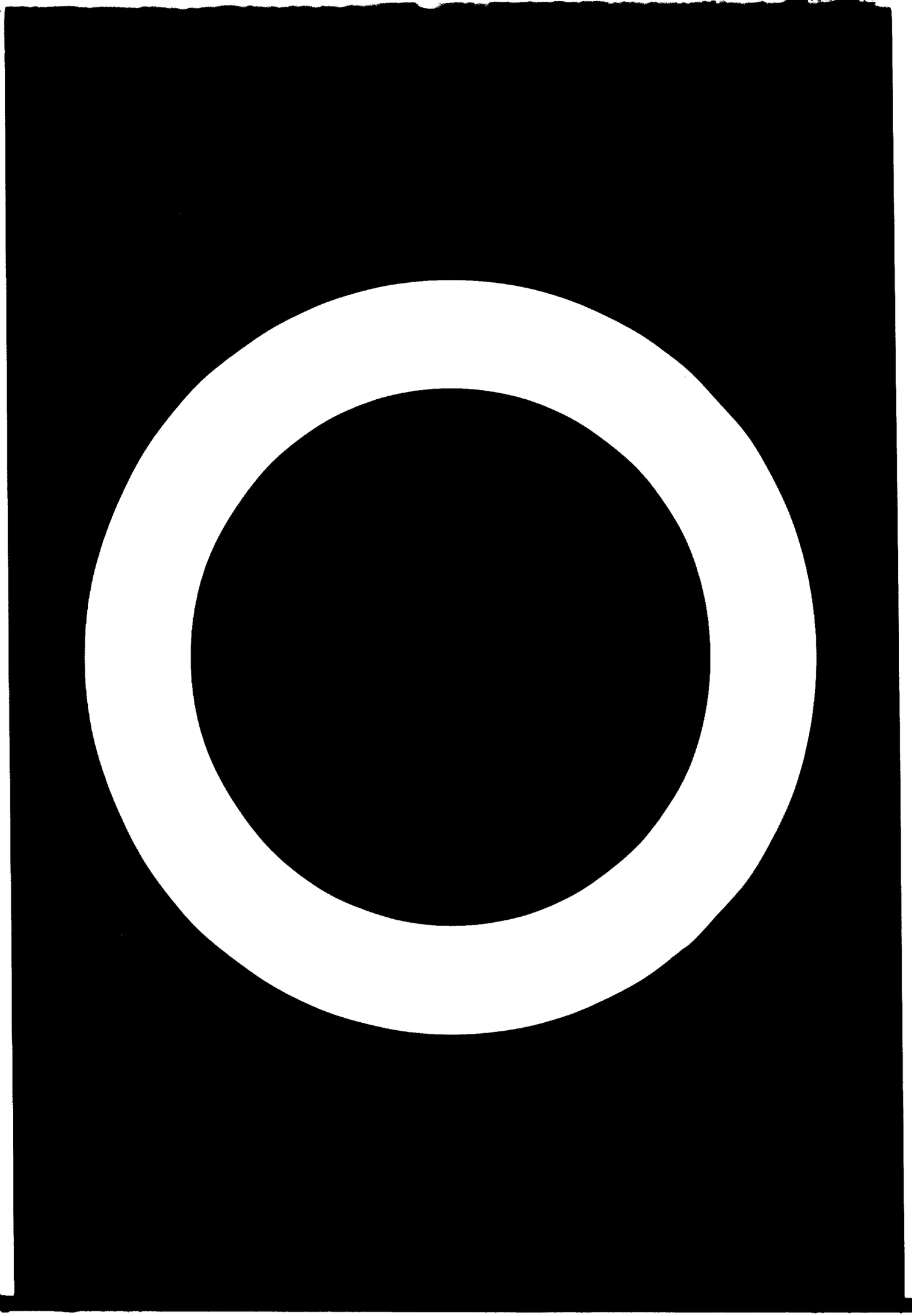
The favorable climatic conditions combined with controlled irrigation and reasonable soil conditions provide a wide scope for introduction of new and more profitable agriculture and horticulture crops provided the needed skilled manpower can be created.

Figure II is a rough map of the Gezira-Managil Scheme to give an impression of its size and its location south of Khartoum.

Figure II



Source: The Sudan Gezira Board



Annex I

LIST OF CONTACTS

1. UNITED NATIONS DEVELOPMENT PROGRAM, Khartoum, Sudan

   a. Charles H. La Muniere, UNDP Resident Representative

   b. Peter Quennell, Assistant Resident Representative

   c. K.L. Hla, Programme Officer

   d. M.P. Hyland, Deputy Resident Representative

   e. Adnan A.K. Soghair, F.A.O. Representative

   f. G.E. Ayben, World Food Programme, Senior Advisor

   g. Stephen J. Szivos, Senior Industrial Field Advisor UNIDO (Duty Station, Cairo UNDP, Egypt)

2. THE SUDAN GEZIRA BOARD, Barakat, Gezira Province

   a. M. Soleiman, Public Relations Officer, the Sudan Gezira Board Liason Office, Khartoum, Sudan

   b. Hussein Omer Kisha, Deputy Managing Director, Agro Industries

   c. Hamad Abdulla Muhammed, Chief Egineer

   d. Abrahim Massalem, Planning Division Officer

   e. Taha Eljak, Senior Planning Division Officer

   f. Nas Eldin, Manager Crop Protection Department

   g. Osman Mohammed El Hassan, Deputy Director, Administration and Public Relations, Sudan Gezira Board, Barakat, Sudan

3. THE SUDAN MINISTRY OF INDUSTRY

   a. Achmed Eldawi, Director of Planning

   b. Wiodatala Abdelatiff, Undersecretary of Industry

4. THE SUDAN MINISTRY OF PLANNING, IBRD PLANNING ASSISTANCE PROJECT

   a. B.A. Azhar, Fiscal Advisor and Acting Team Leader

   b. M.A. El Shinnawy, Manpower Advisor

c. A. Sattar, Agricultural Advisor

d. T. Prazal, Advisor

5. MINISTRY OF PUBLIC SERVICE AND ADMINISTRATIVE REFORM, MANAGEMENT DEVELOPMENT AND PRODUCTIVITY CENTRE

a. S. Theocharides, I.L.O. Chief Technical Advisor

b. W.N. Harrison, I.L.O. Expert

6. SUDANESE DEVELOPMENT CORPORATION

Harry de Waal, Director of Projects

7. INDUSTRIAL BANK OF SUDAN

Yousif Mustafa, Deputy Managing Director

8. THE EMBASSY OF THE FEDERAL REPUBLIC OF GERMANY

Monica Koch, 1'st secretary

9. EUROPEAN ECONOMIC COMMUNITY (EEC) DELEGATION

a. Mr. Watersen, Delegate

b. Mr. Slothuiwer, Agricultural Officer

10. THE SUDAN MINISTRY OF INDUSTRY AND MINING, INDUSTRIAL PRODUCTION CORPORATION

A.A. Higgins, Project Manager, Improvement of the Efficiency of the Public Sector Industries

11. UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID), KHARTOUM, SUDAN

Gordon Pierson, Director

12. U.S. EMBASSY, KHARTOUM, SUDAN

Larry Nelson, Commercial Attache

13. THE FIRST NATIONAL CITY BANK OF NEW YORK, KHARTOUM OFFICE

J.L. Shrier, Regional Manager

14. TANMIAH CONSULTING (MOSTLY AGRICULTURE AND AGRO-INDUSTRY)

    Ali ElTom, Managing Director

15. EL GEZIRA TANNERY, WAD MEDANI, GEZIRA PROVINCE

    Ahmed Mohamed Ahmed, General Manager

16. GEZIRA OIL COMPANY, WAD MEDANI, GEZIRA PROVINCE

    SEID EL RAZAK, Chief Engineer

17. THE GOVERNOR OF THE GEZIRA PROVINCE

18. EMBASSY OF THE HUNGARIAN PEOPLES REPUBLIC

    Peter Demetrovics, Commercial Secretary

19. THE SUDAN GEZIRA SCHEME TENANTS' UNION

Annex II

1/1/1978

PROGRAMME OF AGRO - INDUSTRIAL
PROJECTS FOR THE SUDAN GEZIRA BOARD SCHEME
SIX YEARS PLAN 1977/78 - 1982/83

CROP	PROJECT	PROJECT NO.
COTTON	Chipboard from Stalks	1
	Paper from Stalks	2
GROUNDNUTS	Oil Extraction	3
	Animal Feed and Mutton Production	4
SOYBEAN	Feed, Oil, Protein and Beef Production	5
RICE	Hulling and Polishing	6
VEGETABLES AND FRUITS	Tomato Concentrate and Canning	7

PRESENTATION OF AGRO-INDUSTRIAL PROJECTS FOR THE SIX YEARS PLAN IN THE GEZIRA SCHEME

Project Number	1
Project Title	Utilization of Cotton Stalks: Particle Board Plant.
Project Description	Samples of chipboard produced from 100% cotton stalks at laboratory level proved superior to those produced from natural wood. Gezira burns about half a million tons annually at high cost.
Product	Chipboard, size 2.5M x 7.5M x 19MM.
Use	Manufacture of furniture, prefabricated houses, roof lining, etc.
Study in Hand	Identification and reports only.
Raw Material	100% cotton stalks.
Plant Capacity	30,000 M3 of boards.
Process	Dry glued plus veneering where necessary.
Location	Northern Se[illegible]
Market	Domesti[illegible] t and West Europe.
Capital Investment	[illegible]
Commercial Profitabili[illegible]	Present [illegible] aw material renders competitive [illegible] n.
Internal Rate of Return	-
Pay-back Period	-
Time Schedule	Execut[illegible] 1/1/79. Operation 1/1/81.
Participation	S.G.B., T[illegible] nts, Local Council, and Private Sector.
Position	Raw material preservation trials initiated. Detailed feasibility study is following.

PRESENTATION OF AGRO-INDUSTRIAL PROJECTS FOR THE SIX YEARS PLAN IN THE GEZIRA SCHEME

Project Number	2
Project Title	Utilization of Cotton Stalks: Pulp and Paper Mill.
Project Description	Samples of writing paper produced from 60% cotton stalks plus 40% long fibre pulp at laboratory level proved that cotton stalks form excellent basis for paper manufacture. Gezira burns about half a million tons annually at high cost.
Product	Wide range of bleached and unbleached paper.
Use	For writing, printing and wrapping, etc.
Study in Hand	Pre-feasibility prepared in 1971.
Raw Material	75% cotton stalks plus 25% long fibre pulp for commercial production.
Plant Capacity	15,000 tons/year liable for expansion.
Process	Suda cooking without chemical recovery.
Location	Northern Gezira.
Market	Domestic towards self-sufficiency.
Capital Investment	£15 Mn.
Commercial Profitability	Import Substitute.
Internal Rate of Return	-
Pay-back Period	-
Time Schedule	Execution 1/1/80 Operation 1/7/83
Participation	S.G.B., Tenants, Executive Council and Private Sector.
Position	Field trials initiated. Detailed feasibility is following.

PRESENTATION OF AGRO-INDUSTRIAL PROJECTS FOR THE SIX YEARS PLAN IN THE GEZIRA SCHEME

Project Number	3
Project Title	Ground-nuts Oil Mills
Project Description	Gezira production of ground-nuts from 250,000 acres liable for increase. Supply of shelled nuts from Decorticate installed at field centres.
Product	Crude oil and cakes.
Use	Edible oil and animal feed.
Study in Hand	Feasibility (detailed).
Raw Material	130,000 tons of seeds per year.
Plant Capacity	60,000 tons of crude oil. 67,000 tons of cakes.
Process	Pre-pressing followed by solvent extraction.
Location	Meringan.
Market	Oil and excess cake for export.
Capital Investment	£s. 5.25 Mn.
Commercial Profitability	51%
Internal Rate of Return	39%
Pay-back Period	3.years.
Time Schedule	Execution 1/7/78 Operation 1/7/81
Participation	S.G.B., Tenants and Executive Council.
Position	Awaiting approval of Ministry of Industry

PRESENTATION OF AGRO-INDUSTRIAL PROJECTS OF THE SIX YEARS PLAN IN THE GEZIRA SCHEME

Project Number	5
Project Title	Soy bean agro-industrial complex.
Project Description	Supply proposed from 400,000 acres in rotation and 40,000 acres for complex. Oil plus vegetable protein plus cakes plus beef, etc.
Use.	Food
Study in Hand	Detailed Feasibility almost complete.
Raw Material	Soy bean plus green fodders.
Plant Capacity	-
Process	Oil mill, feed mill, feed lots, slaughtery, etc.
Location	Northern Gezira.
Market	Foreign and local.
Capital Investment	L.s 70.00 mn.
Commercial Profitability	-
Internal Rate of Return	-
Pay-back Period	-
Time Schedule	Execution 1978 Operation 1981
Participation	S.G.B., Kuwaiti Corporation, Private, etc.
Position	Steps taken to register public company.

PRESENTATION OF AGRO-INDUSTRIAL PROJECTS FOR THE SIX YEARS PLAN IN THE GEZIRA SCHEME

Project Number	6
Project Title	Rice Processing - Third Line and Factory Building.
Project Description	Two existing lines in operation. Expansion in cultivated area for self-sufficiency makes third line necessary. Proper factory building and site are essential for quality and efficient production.
Product	White rice.
Use	For local consumption.
Study in hand	-
Raw Material	Paddy rice.
Plant Capacity	Third line 2½ to 3 tons per hour of paddy.
Process	Cleaning, hulling and polishing.
Location	Baraket.
Market	Domestic.
Capital Investment	£s. 0.35 Mn.
Commercial Profitability	Import substitute.
Internal Rate of Return	-
Pay-back Period	-
Time Schedule	Execution 1/7/78 Operation 1/7/80
Participation	S.G.B.
Position	Tenders already vetted and awaiting Authorities approval.

PRESENTATION OF AGRO-INDUSTRIAL PROJECTS FOR THE SIX YEARS PLAN IN THE GEZIRA SCHEME

Project Number	7
Project Title	Tomato Concentrate Plant.
Project Description	Rotation includes vegetable-tomato production. Partial supply from specialized area.
Product	Tomato concentrate and canned vegetables.
Use	To satisfy the needs of existing tomato factories and supplement future demand.
Study in hand	Pre-feasibility study.
Raw Material	Fresh tomatos and vegetables.
Plant capacity	720 tons of tomatos per annum.
Process	Modern.
Location	Northern Gezira.
Market	Local.
Capital investment	£0.35 Mn.
Commercial Profitability	42%
Internal Rate of Return	-
Pay-back period	2 years.
Time Schedule	Execution 1/1/79. Operation 1/1/81.
Participation	S.G.B. Tenants and Yugoslavian Corporation.
Position	Field trials are conducted in Northern Gezira under protocol with Yugoslavia. Detailed feasibility study is following.

Annex III

THE SUDAN GEZIRA BOARD'S

PROJECT PROPOSAL

Title:	Pre-investment studies for the Development of Agro-Industries
Country:	The Democratic Republic of the Sudan
National Agency:	The Sudan Gezira Board
Executing Agency:	FAO of the United Nations in cooperation with UNIDO (Particle board and paper manufacture)
Donour Contribution:	U. S. $35,000
Duration:	Two months

Background and Justification:

1. The Sudan possesses immense potential for agricultural development. The cultivated area of about 17 million feddans, of which 3.4 m.f. irrigated and 13.6 m.f. unirrigated, represent 8.5% of the total cultivable land and 3% of the total land area.

2. The Government is engaged in massive and intensive efforts to increase food production and develop agro-industries in order to reach self-sufficiency, to increase exports and decrease food losses.

3. The Sudan Gezira Board (SGB) is an autonomous public corporation which is responsible for the management of about two million feddans of irrigated farming. The Gezira system of land utilization and land tenure is unique, where the net proceeds of crops is shared by the three partners: Sudan Government, SGB and Tenants.

   The crop sharing system mainly focused on cotton at present is 36% Government, 54% tenants (including social services and reserve fund) and 10% Management of the net proceeds.

4. Agricultural production in the Gezira Scheme is based on highly intensified and diversified rotation system. The cropping pattern for 1977/78 is planned (in 1,000 feddans) as follows:

Cotton	500	Vegetables	50
Wheat	500	Rice	15
Groundnut	250	Fodders & Other Crops	135
Sorghum	350		

5. The SGB had in 1975 considered to integrate Agro-Industries in its system, in line with the national policy of increasing food production and reducing post-harvest losses as well as to promote social development of the Tenants in the Scheme. A new unit for Industrial Affairs was established in the management structure of the SGB to take over responsibility for project preparation, implementation and participation in management.

6. As a result, a programme for new Agro-Industrial activities to be implemented in the Gezira Scheme was included in the six year national development plan 1978-83. The programme includes the utilization of a portion of the produced crops in such industries as cotton ginning and processing of groundnuts, rice, vegetables, meat, milk and animal feed as well as farm by-products.

7. Project ideas for possible agro-industrial development in the Gezira Scheme are identified and discussed in the Appendix. The feasibility of these identified ideas need to be assessed and formulated in a master plan of agro-based industries before the projects are considered for investment.

Objectives:

Long term objective is the establishment of investment oriented processing industries and agro-industries development in the Gezira Scheme.

Immediate objectives are to conduct pre-investment studies:

- To plan a master scheme for possible agro-industrial development in the Gezira Scheme.

- To prepare studies (present ones taken into consideration) including management, organizational, labour, financial, etc., aspects for potential agro-industries.

- To suggest source of finance for implementation.

Work Plan:

FAO will provide for the following experts:

	m/m
• Economist (Marketing and Finance)	2
• Management (Organization)	1
• Agronomist	1
• Food Technologist (Edible Oils)	1
• Food Technologist (Rice and Tomato Processing)	1

UNIDO will provide an expert in particle board and paper manufacture from agricultural by-products (cotton stalks and groundnut shells) 1

TOTAL	7

The mission will spend 3 weeks in the Sudan and the rest in Rome for report writing. The report will take in consideration the general situation of agro-industrial development in the Sudan.

Donour Contribution:

	m/m	U.S. $
FAO	6	30,000
UNIDO	1	5,000
TOTAL		35,000

APPENDIX

POTENTIAL AGRO-INDUSTRIAL DEVELOPMENT IN THE GEZIRA SCHEME

1. GROUNDNUT PROCESSING

1. The area under groundnuts in the Gezira Scheme is reaching 250,000 feddans with average yield about one ton per feddan. Production of groundnuts in the Sudan was as follows:

Year	Area 1000 Feddan		Production 1000 Tons		Yield Kg Feddan	
	1	2	1	2	1	2
1972	232	1512	124	388	534	257
1973	330	1643	288	567	873	345
1974	295	1724	241	544	817	316
1976	424	1065	325	931	861	451

1 Blue Nile Province including Gezira

2 Total Sudan

2. Cottonseed and groundnuts are the main raw materials used in the edible oil industry. At present, there are about 35 oil plants in the Sudan with total designed capacity of 700,000 tons Cottonseed, of which 4 plants with 150,000 tons capacity are Public Sector. However, total utilized capacity is estimated at about 370,000 tons due to old equipment and the lack of foreign exchange for their replacement. Only two private mills at Port Sudan are utilizing expellers followed by solvent extraction.

In addition, there are many primitive camel-driven mills for the extraction of sesame oil which is locally used.

3. The Government is now prohibiting the export of cottonseed but shelled and unshelled groundnuts are exported after obtaining export permits.

The future plans are to expand export of oil rather than oilseeds in order to benefit of the added value and the oil cakes for animal production.

4. Marketing of groundnuts is usually carried out by private traders and middlemen and the Government fixes minimum prices every season at the farm level and Port Sudan level. However, the S.G.B. often interferes as a buyer to protect the Gezira farmers from exploitation.

5. The Sudan Gezira Board has lately installed 36 decorticators in six of the production centres in order to reduce cost of handling and transportation through decortication of the crop as well as its preparation for possible crushing into oil. The total capacities of these decorticating units is considered sufficient for the planned production of groundnuts since each unit has an actual daily capacity of 40 tons of shelled groundnuts and the shelling season is 120 - 130 days (January to May).

6. A study is needed to assess the feasibility of establishing oil mills for the extraction of groundnut oil in the Gezira taking in consideration the underutilized capacities in the neighbouring areas.

II. RICE PROCESSING

7. Rice has been recently introduced and is now grown mainly in the Gezira and to a less extent in the Southern Region. Production of paddy rice was as follows:

Production Centre	1974/75 Area 1,000 Fed.	1974/75 Production Tons	1974/75 Yield Ks/F.	1975/76 Area 1,000 Fed.	1975/76 Production Tons	1975/76 Yield Ks/F.
Gezira	9.8	6335	650	12.3	6145	500
Bahr El Ghazal	1.6	115	71	1.4	183	133
Equatoria	3.3	795	238	3.6	859	240
TOTAL	14.7	7245	492	17.3	7187	417

8. Consumption of white rice is estimated at 15,000 tons per year, the balance between consumption and production, after keeping about 20% for sowing seeds, has been imported. White polished rice is said to be more acceptable by consumers than parboiled rice.

9. The S.G.B. is planning to increase the area for rice production in the Gezira to 15,000 feddans and expects to increase the yield to about one ton per feddan.

10. A rice mill was lately installed with two lines for the hulling and polishing of paddy rice, with total actual capacity of 1.5 tons per hour. Paddy rice is now stored in bags under temporary sheds. The mill is supposed to work two shifts/day for 250 days/year.

11. The present mill production contains 30 - 40% broken rice and is not received favourably in the market. There is a need for an advisory service to improve harvesting, handling and milling operations.

12. The development plan of S.G.B. includes the establishment of another rice mill about 3 tons/hour capacity and special stores to process the whole rice crop of the Gezira.

III. ANIMAL FEED

13. The number of cattle in the Gezira has been stable about 600,000 head which graze most of the year on farm residues but during the dry season (March - June), they are driven into the bordering provinces due to the lack of feed. Cattle for slaughter is usually brought from outside the Scheme, because of social prestige where the owner does not want to decrease his herd.

14. Efforts are being made to improve the cattle breeds through artificial insemination which has started last year by bilateral assistance from U.K.

15. Slaughtered animals in the Gezira Scheme are estimated at about 8,000 head per week (400,000 per year), mostly on dirt grounds in villages and few abattoirs in towns but the blood, organs and tissues are not utilized.

16. The S.G.B. development plan includes the utilization of all possible farm and processing by-products such as groundnut all cakes, wheat and rice brans, slaughter by-products and molasses from the nearby sugar factory at Sinnar and the establishment of mill for the manufacture of animal feed.

IV. VEGTABLE PROCESSING

17. Total area under vegetables In the Gezira Scheme was 29,000 and 24,000 feddans in 1975 and 1976 respectively, with tomatoes as main crop. This area is planned to reach 50,000 feddans in 1978. Tomato production is scattered in small fragmented plots and is mostly of local varieties for fresh consumption.

18. Tomato paste is at present manufactured at two Public sector plants at Kareima and Wau and at some small privately owned plants. Both Public plants are suffering from underutilized capacities due to the lack of raw material supply in their locations.

19. As a result, concentrated bulk packed tomato paste is being imported by these two plants for further dilution and re-packing in tin cans to meet domestic demand which is estimated at about 2,000 - 3,000 tons. However, the imported quantities of concentrated paste is much less than required due to the lack of foreign exchange.

20. The S.G.B. has therefore, planned within its development programme, to establish a plant for tomato processing into concentrated paste to supply the other existing plants for repacking. Before launching the project, an investigation needs to be made in the production pattern, varieties and the expected quality and raw materials to be supplied as well as the economics of processing of concentrated paste.

V. NON-FOOD PRODUCTS PROCESSING

21. The S.G.B. plan also envisages the establishment of other industries as particle boards and paper from the non-utilized agricultural wastes and by products. Particle boards are specially needed in the ongoing rural housing projects.

22. Cotton stalks, about 500,000 tons per year, are being burned to avoid insect infestation to the following cotton crop. After the cotton crop is picked, the stalks are manually pulled from the ground by pullers. Disposal or removal of the stalks has to be done within three weeks, before the start of the rainy season.

23. Groundnut shells may also be used for the manufacture of particle boards. Shells account for about 35% of the total weight of Groundnuts to be decorticated for export or oil extraction.

Annex IV

THE DEVELOPMENT OF MANAGIL SOUTHWESTERN EXTENSION TO THE GEZIRA SCHEME

A CASE STUDY BY

TAHA EL JACK TAHA

SENIOR PLANNING & DEVELOPMENT OFFICER

SUDAN GEZIRA BOARD

HISTORICAL BACKGROUND:

The Managil South-Western Extension is rightly considered a continuation of the early pumping irrigation trial at Zeidab (1908), Tayiba (1911), Um Sunit - Barakat (1913), Hag Abdalla (1921) and Wad El Nau (1924). The experience gained in irrigated settlements under these pumping trials established a firm background for large-scale irrigated farming in the Gezira Scheme after the construction of Sennar Dam in 1925.

The limiting factor to the expansion of irrigated agriculture in the Gezira Scheme between 1925/26 and 1952/53, was the limited canal capacity and the restrictions imposed by the 1929 Nile Waters Agreement which gave the Sudan 4 milliard cubic metres out of the Nile Waters' share, and gave Egypt 48 milliard cubic metres.

PROJECT AREA:

The Managil Extension area lies to the South-West of the Gezira Scheme.

The conclusion of the Second Nile Waters' Agreement between the Sudan and Egypt in 1959 raised the Sudan's share of the Nile waters to 18.5 milliard cubic metres and empowered the Government of the Sudan to proceed with the construction of Roseires Dam with a storage capacity of 2.7 milliard cubic metres of water in its first phase.

SOILS:

The Managil South-Western Extension was developed between the years 1957/58 and 1962/63 in five phases. Limitations arising from heterogeneity of soil types in phase 5 brought about a change in the development plan and recourse was had to suitable pockets of land in the vicinity of the Gezira/Managil area. Hence suitable tracts of land were brought under irrigation during the years 1965/66 - 1969/70 and the following table shows the phasing of development:

SUMMARY OF LAND DEVELOPMENT & SETTLEMENT IN MANAGIL SOUTH-WEST EXTENSION AND THE GEZIRA EXTENSIONS IN THE SUDEN FROM 1957/58 TO 1969/70 (AREA IN FEODANS)

YEAR	PHASE	GROSS IN FED.	NO. OF HOLDINGS	NO. OF TENANTS	COTTON	DURA	LUBIA GROUNDNUTS VEGETABLES
1957/58	I	197,467	13026	10962	65244	32670	32766
1958/59	II	221,277	14638	12390	73702	36794	36815
1959/60	III Part I	138,671	9035	7074	46063	23124	23238
1960/61	III Part II	86,263	5606	5079	28896	14447	14288
1960/61	IV Part I	60,193	3900	3142	19994	10035	9897
1961/62	IV Part II	75,477	4960	4271	25130	12618	12565
1962/63	V Part I	57,976	3245	2371	16736	8394	7151
TOTAL MANAGIL SOUTH-WEST EXTENSION		837,324	54410	45289	275765	138082	136720
1965/66	Gez./Man. Extensions	79,797	4174	3606	21393	10838	10207
1966/67	Gez./Man. Extensions	60,844	3098	2826	15994	8233	8203
1967/68	Shawal Extension	63,415	3002	2794	15814	7806	7349
1968/69	Gez./Man. Extensions	33,850	1632	1360	8399	4245	4234
1969/70	A/Magid Extension	19,870	1250	1250	6621	3300	3284
TOTAL MANAGIL AND GEZIRA/MANAGIL EXTENSIONS		1,095,100	67566	57225	343986	172504	170497

n.b.
N.B. Area under fallow is included in the Gross Area

1 Feddan = 1.038 Acres = 0.42 Hectare.

LAND TENURE AND CROPPING PATTERN:

The Gezira system of land utilization and land tenure, the sharing of the net proceeds of the cotton crop by the three partners i.e. Sudan Government, Sudan Gezira Board and Tenants according to an agreed ratio and the permission of the tenants to grow in the rotation dura (sorghum) for consumption and lubia as animal fodder was introduced into the Managil S.W. Extension from the very beginning. The only points of divergence were the 15-feddan holding designed for the Managil S.W. Extension compared to the original Gezira holding of 40-feddans. The Managil's tenant plants every season 5 feddans to cotton, 2½ feddans to dura and 2½ feddans to either lubia or groundnuts leaving 5 feddans as fallow to be planted to cotton in the following season.

The reasons for the adoption of the 15-feddan holding in the Managil S.W. Extension are as follows:

1. That the small-size holding will provide full employment to the tenant and his family.
2. That the net returns will be sufficient to afford the tenant and his family a decent standard of living.
3. The small-size holding means the distribution of holdings to more families and thus ensures a wide distribution of income within the project.

The tripartite partnership on the cotton crop was an ingenious device combining the resources of the Government which provided the land and water. Through investment in the construction of Sennar Dam and major canalization network and paying land rents to land owners with the resources of the Managing agency

and the tenant cultivators who contributed no capital to the enterprise but entered the effective partnership by dint of their own labour on the cotton crop from planting through to harvest and delivery of the crop for processing and marketing. The duties of every partner were clearly set out in the Gezira Scheme Ordinance (1950) revised (1960).

IDENTIFICATION, PREPARATION AND APPRAISAL:

In the early years of the twentieth century surveys were carried out which came to the conclusion that the only natural asset was the Blue Nile and the fertile Gezira Plains which with their gentle slope from the South to the North and from the East to the West made irrigation by gravity flow possible. Furthermore the Government with its very meagre resources was in dire need for a solid economic base. To put matters in a nutshell, the very problems facing the Government at the turn of the century initiated the embarkation on the construction of the Sennar Dam and the development of the Gezira Scheme. The total capital outlay in the Gezira canalization, infrastructure, the Sennar Dam and canalization, was £15 million. The appraisal of the Gezira loan although unwritten is easy because in 1950 i.e. 25 years after the construction of Sennar Dam and the launching of the Gezira Scheme into operation, the Government had obtained a cumulative surplus of £16 million in addition to the 9% dividend of the shareholders (SPS) and the net profit of the average tenant was £200 per annum.

The capital sunk in the construction of Roseires Dam was £60 million and the total investment in the Managil S.W. Extension's Five Phases was £46 million.

The principal items of investment in the project area were the excavation of the main and minor canals, the eradication of the bush cover, land-leveling, the construction of regulators and crossings on the main major and minor canals, the construction of divisional and sub-divisional Headquarters and water-control points. The total investments also catered for the Sudan Gezira Board's infrastructural development in the extension of the Gezira light railway's network, the construction of Field Staff residential quarters and offices, warehouses, the sinking of borewells, the extension of the ginning factories and procurement of additional agricultural machinery and implements.

There is no official record to prove that the sequence of agricultural project identification, preparation and appraisal was followed previously in the Gezira Scheme or later in the Managil S.W. Extension. However, the solvency of the Gezira Scheme is proven by the repayment of the loan some thirty years after the inauguration of Sennar Dam and the Gezira Scheme under gravity irrigation. The economic soundness of the Managil S.W. Extension is indicated by the cash flow, internal rate of return and the share of the net proceeds of cotton and the net profits from other crops which belong exclusively to the tenants.

The net returns after the deduction of the joint account costs for the Gezira Scheme and the Managil South-Western Extension (combined) for the years 1970/71 - 1971/72 are given below:

SEASON	AREA IN FEDDAN	AV. YIELD K/F.	TOTAL YIELD KANTAR OF SEED COTTON	GROSS RETURN Ls. m/m s.	JOINT ACCOUNT EXPENSES Ls. m/m s.	NET DIVISIBLE SHARE Ls. m/m s.	SUDAN GOV'T. 36% Ls. m/m s.
70/71	588.371½	5.411	3,183,678.185	44,917,976.385	19,673,860.743	25,244,115.642	9,087,881.631
71/72	589.185	4.984	2,936,498.040	40,022,445.475	21,541,130.940	18,481,314.535	6,653,273.233

SEASON	TENANTS Ls. m/m s.	TENANTS RESERVE FUND Ls. m/m s.	LOCAL GOV'T. 2% Ls. m/m s.	SOCIAL DEVELOPMENT 3% Ls. m/m s.	S. G. B. 10% Ls. m/m s.
70/71	11,864,734.352	504,882.313	504,882.313	757,323.469	2,524,411.564
71/72	8,686,217.831	369,626.291	369,626.291	554,439.436	1,848,131.463

MANAGIL S.W. EXTENSION'S CONTRIBUTION TO THE SUDAN'S ECONOMY:

The net returns from cotton and other crops are not the Gezira and Managil total contribution to the Sudan's national economy, because there are indirect contributions deriving from levies on exports and imports i.e. export taxes and royalties on cotton lint and groundnuts, imports of goods and services.

NET RETURNS FROM CASH CROPS PER 15-FEDDAN HOLDING IN 1973/74 SEASON:

The following table shows the net return from cash crops per 15-feddan holding in Managil S.W. Extension in 1973/74 season:

	COTTON	G/NUTS	WHEAT	TOTAL
GROSS RETURN	67.928	34.922	32.267	-
JOINT COST OF PRODUCTION	36.561	15.581	14.545	-
NET RETURN TO THE THREE PARTNERS	31.367	19.341	17.722	-
NET RETURN TO TENANT EXCLUDING INDIVIDUAL ACCOUNT FOR COTTON (49%)	15.370	19.341	17.722	52.433

N.B. - Cost of production for G/Nuts and Wheat is the total cost (Individual Account).

Source: Agricultural Economics Section Planning and Development Department, S.G.B. Extracted from Annual Economic Surveys Report 1973/74.

NET RETURNS FROM CASH CROPS PER 15-FEDDAN HOLDING IN MANAGIL S.W. EXTENSION L.s.:

	YIELD/FED.	NET RETURN PER FED.	NO. OF FEDS.	TOTAL
COTTON	5.243 (Kantar)	15.370	5	76.850
WHEAT	0.509 (M.T.)	17.722	3 3/4	66.458
GROUNDNUTS	0.599 (M.T.)	19.341	2 1/2	48.353
TOTAL				191.661

TENANTS OTHER INCOME PER 15-FEDDAN HOLDINGS:

	YIELD M.T./ FED.	GROSS RETURN Ls. m/m s.	COST OF PRODUCTION Ls. m/m s.	NET RETURN Ls. m/m s.	NO. OF FEDDANS Ls. m/m s.	TOTAL
DURA	0.375	16.963	8.760	8.203	1 1/4	10.253
LUBIA	-	-	-	-	-	-
LIVESTOCK VEGET. & PHILIP.						30.000
					TOTAL	40.253

TENANTS NET ANNUAL INCOME (Ls. m/m s.):

RETURNS FROM CASH CROPS (COTTON, G/NUTS, WHEAT)		191.661
RETURNS FROM OTHER ENTERPRISES		40.253
	TOTAL	231.914
MINUS: HIRED LABOUR COST FOR COTTON AT THE RATE OF Ls. 5.686/FED.		28.430
	TOTAL	203.484

HOW DID THIS SUCCESSFUL SCHEME MATERIALISE?

First Stage of Design:

1. Agencies Involved in Various Phases of Planning:

The Sudan Gezira Board set up in 1956 a new Department viz the Development Department to undertake all activities relating to the Sudan Gezira Board and to liaise with all Government Units concerned with the development of the project area. However, in an endeavour at more coordination between Ministries and Departments of Government and the Sudan Gezira Board, the Managil Joint Committee was created under the chairmanship of the Under Secretary, Ministry of Irrigation & Hydroelectric Power with a direct responsibility to the Minister of Irrigation & H.E.P. The functions of the Managil Joint Committee were as follows:

i. To study, coordinate, follow up and consolidate the work of the Ministries & Departments entrusted with the extension of the Managil S.W. Extension.

ii. The execution of the Scheme implied the following:

   a. Preparation of designs of major and minor canalization, major and minor regulators and construction of houses for Field Staff and workers.

   b. Execution of designs.

   c. Survey of the project area and assessment of the amount of bush cover and leveling requirements.

   d. Conduction of a land settlement or resettlement if need be, survey work and mapping of the registration sections and land plots to ascertain title to agricultural land.

e. Alphabetical listing of landowners for the distribution of holdings to landowners and land-users alike after the former category is satisfied.

f. Conduction of a social survey of the project area to establish the necessities of social services for a semi-nomadic rural population.

CHOICE OF THE AREA FOR CULTIVATION AND SETTLEMENT:

The Managil Extension which adjoins the Gezira Main Scheme in a South-Westerly direction, was the granary of the Sudan before the Scheme. However, it was left undeveloped for years to provide a reservoir of cotton pickers for the Gezira Scheme. However, after the attainment of independence and in an attempt to utilize the land and water resources to generate revenue demended by the expansion of services to an expanding population, the development of the Managil South-Western Extension was fitted into the closing 5-year development plan (1951-56) and the ten-year plan of Economic & Social Development 1961-70/71. The last Gezira/Managil Extension development was duly covered by the 5-year plan 1970/71 - 1974/75.

FINANCING OF DEVELOPMENT:

The Four Phases of the Managil South-Western Extension Project were originally planned for development in four equal phases of 200,000 feddans each, on the assumption that the net proceeds of sale of cotton from each phase would finance the subsequent phase. However, the recession in cotton prices which occured in 1958 made this impossible and necessitated a revision of the development plan to reduce the pace of development. Eventually a loan of 15.5 million U.S. Dollars was obtained from the World Bank in 1960 to meet the

foreign currency requirements of the development of phases III & IV. According to the World Bank Mission's appraisal report, the standard Managil Extension Holding was expected to yield a net return of Ls.90 to the individual tenant from cotton and other crops after the deduction of the cost of hired labour. The return on the investment worked out by the World Bank Mission in 1960 was 11.6%.

HUMAN AND ECOLOGICAL FACTORS:

The inhabitants of the Managil South-Western Extension were the traditional picking labour force of the Gezira Main Scheme.

The picking labour force in the Gezira Main Scheme coming from Managil in 1957/58 season i.e. the year preceding the cropping of phase I of the project area was 75,000. This labour force dwindled year after year because each developed phase not only robbed the Gezira Main Scheme of its traditional cotton pickers, but entered into direct competition with it for labour because the pickers of the past were established as tenant-cultivators on their own. Hence, the policy adopted by the Government and the Sudan Gezira Board with effect from the 1961/62 season to facilitate the inflow of labour from the Western Sudan into the Gezira and Managil for cotton picking and the offering of subsidies to the Gezira and Managil tenant cultivators to recruit labour from the Eastern Banks of the Blue and White Niles.

The following table gives in tabloid form the labour force engaged on picking the 1973/74 cotton crop in the Gezira Main and Managil S.W. Extension:

	AREA	TENANTS & FAMILIES	RESIDENT LABOUR	IMPORTED LABOUR	CASUAL LABOUR	TOTAL
GEZIRA	305471	77987	39284	151547	6365	275183
MANAGIL	284046	60992	18174	184377	2889	266432
TOTAL		138979	57458	335924	9254	541615

PLANNING OF SETTLEMENT:

The Managil S.W. Extension was superimposed on the existing pattern of villages. Large villages not lying on the central lines of main, major and minor canalization and drainage lines were left in situ and re-planned. Furthermore, scattered villages accessible to one another were grouped on new sites with a view to the provision of social services and in completely uninhabited areas of part II of phase III, new villages were carved out and provided with social services.

The village planning committee, a sub-committee of the Managil Joint Committee decided from the very beginning that each village precinct should not be less than 270 feddans for the smallest village and 540 feddans for the largest. The residential plots in every village were planned to meet the immediate requirements of tenant-cultivators and the local inhabitants and also to suffice for 50% of further demand. The villages are located within a radius of not more than 5 kilometres from the agricultural rotations where tenant-cultivators

had their holdings. A number of villages were selected to become civic centres where all the social services were concentrated i.e. schools for boys and girls, human and veterinary dispensaries, public stations, bore-wells or filtration plants, village halls, bakeries and flourmills, etc. However, most of the ordinary villages were provided with bore-wells where underground water was found to be fresh or with surface water treatment plants (filtration plants) where underground water was saline and unwholesome to drink.

At Huda village in Shendi Block in phase I Managil, is located the Huda Community Development Centre which was financed jointly by the Government and by a grant from the Netherlands Organization for International Aid (NOVIB). The Centre is a rural experiment in community development, environmental health and social research. The Centre contains a 20-bedded rural health centre, elementary schools for boys and girls, a rural handcraft unit, a livestock and poultry husbandry section and human and veterinary dispensaries. Staff on secondment from Unicef and W.H.O. worked at the Centre in the early formative years and the Centre is now run by Sudanese administrators and technicians. The Centre was established as a rural development model for other parts of the Managil Project.

THE PLANNING OF SPECIALIZED SERVICES:

Specialized services in Managil S.W. Extension were planned by the village planning committee which was a sub-committee of the Managil Joint Committee and all the social services were financed centrally from the Development Budget. The provision of social services in phases I - IV cost Ls.2.5 million out of a total capital investment of Ls.46 million.

In addition to this expenditure, other social services were provided by the Social Development Department out of its 3% share of the net proceeds of the cotton crop such services covered training farms for tenants' sons, social research, grants for school building, recreational and sports clubs, circulation of the Arabic weekly El Gezira newspaper, the operation of mobile cinema units, assistance to the cooperative movement, horticultural services, establishment of forestry plots for the production of firewood, poles and rafters for building, building research programme aimed at the investigation of low-cost building techniques, drilling of borewells, anti-malaria and anti-bilharzia campaigns in collaboration with the Ministry of Health, spraying of villages with D.D.T., social welfare work, adult education services, apprenticeship classes for young artisans, etc. This is a full range of social services provided for the tenants and inhabitants of the Scheme. The rising standard of living of the tenants and the local population create more social needs and the rapid pace of urbanization is gap between the town and the countryside.

THE PLANNING OF COMMUNITY DEVELOPMENT PROGRAMMES:

The Managil South-Western Extension is divided into 6 groups. The Adult Education Team in the whole project is composed of two resident Adult Education Officers and nine local Adult Education Officers deployed in the selected Blocks.

The adult education activities in Managil S.W. Extension started after the development phase was over in 1962 when Local Adult Education Officers were deployed in phase I Blocks (Administrative Units) for 4 years of continuous

service. At the end of this period, the whole team of Local Adult Education Officers were shifted to phase II to start a similar cycle. Meanwhile, the period of residence was extended to 5 years in order to allow the semi-nomadic settlers time for the change to a settled agricultural community.

In phase I a Resident Adult Education Officer was left behind for the discharge of the necessary follow-up work. The team of Local Adult Education Officers shifted to phase III for a full cycle of 5 years in residence.

The women welfare workers followed in the wake of the Local Adult Education Officers later (1963) and continued in residence for 4 years. They shifted to phase II in 1967 and remained until 1970. Currently they are serving phase III Managil for a full cycle of 5 years in residence.

SELF-HELP ACTIVITIES:

The purpose of self-help projects is to make the tenants and local inhabitants alive to their day-to-day needs. Furthermore, through self-help projects they are given the chance to participate effectively in the improvement of their social life.

The basis of self-help projects is to offer a grant-in-aid to any approved social project not exceeding 50% of the total cost. The other half of the cost has to be contributed by the Local Community.

To date a sum of 20,000 pounds Sudanese was awarded to self-help projects in Managil S.W. Extension villages.

TENANTS' PARTICIPATION IN THE RUNNING OF THE SCHEME:

The strict supervision of agricultural operations in tenants' holdings was centrally undertaken by the Block & Field Inspectors who used to weild great disciplinary powers. However, the inspectors' gripe was gradually loosened on the establishment of Village Councils which enabled the tenants to have a say in the management of their agricultural affairs.

The table below shows the distribution of Village Councils and the Administrative & Technical Personnel over the Scheme area:

Distribution of Agricultural Village Councils

GEZIRA	MANAGIL	TOTAL
483	232	715

DISTRIBUTION OF FIELD STAFF AND CROP PROTECTION:

	GROUP INSP.	A/GROUP INSP.	BLOCK INSP. LARGE	BLOCK INSP. SMALL	FIELD INSP.	SENIOR ENTOMO-LOGIST	ENTOMO-LOGIST	A/ENTOMO-LOGIST	SENIOR TECHNI-CIAN	TECHNI-CIAN	ENUMERATOR
GEZIRA	6	6	29	25	91	1	-	5	3	8	70
MANAGIL	6	6	37	12	139	-	2	2	-	12	60
TOTAL	12	12	66	37	230	1	2	7	3	20	130

TIMING OF PLANNING & EXECUTION OF PLANS:

The execution of phase I Managil S.W. Extension started 2 years ahead of the planting season. The execution of phase II also started 2 years ahead of the planting season. Phase III was hit by the recession in international cotton prices and depressingly low yields in 1957/58 season with the result that the development of phase III was split into two sub-phases. The execution of part I phase III was started 9 months ahead of the planting season and the staff and labourers had to work overtime and rush land-leveling and bush eradication operations with the result that some of the development commitments especially in connection with the construction of staff residential quarters had to be deffered and members of the staff had no alternative to sharing accommodation and living in separation from their families. The settlement of new tenant-cultivators was most problematical because new villages had to be started from scratch and the late allocation of holdings did not leave the new settlers much time for putting up shelter. The village Planning Committee realized from the very outset that the new settlers were poor and needed a subsidy for constructing dwelling houses which was granted by the Central Government.

The execution of part II phase III and part I phase IV started 18 clear months ahead of the planting season. Part II phase III was practically devoid of settlements because of the lack of fresh underground water. Hence, number one headache to the Managil Joint Committee was the design and construction of filtration plants fed from the Irrigation canals.

The execution of part II of phase IV started 12 clear months ahead of the planting season and the area being densely populated and dotted with hand-dug wells, there was no settlement problems.

The execution of part I phase V started 10 months ahead of schedule and the development work dragged on for two more seasons in view of the excavation of the canalization and drainage lines, field ditches and laterals on the result of a reconnaissance soil survey which was made available in January 1963. The publication of the semi-detailed soil survey and land classification report conducted by a foreign consulting firm necessitated many changes in the alignment of canalization and the revision of the allocation of holdings. The trouble taken in phase V part I was of great significance to Sudanese Planners and the lesson was learnt with the result that development work in the following extensions was proceded by a semi-detailed soil survey and land classification.

The execution of the Gezira/Managil Extensions in the years 1965/66 - 1969/70 was started 6 - 9 months ahead of planting season. The distribution of social services to these extensions as an inseparable part of the development budget was discontinued for lack of resources and the tenant-cultivators had to cue up for social services from the 3% of the net proceeds of sale of the cotton crop which is apportioned out to the Social Development Department from year to year.

CHANNELS OF COMMUNICATION:

The agricultural extension service was set up in season 1969/70. A full-time Director of Extension was appointed for the first time assisted by a group of extension officers who had training abroad. In 1969/70 five Blocks were selected for the start of the agricultural extension service among the tenant-cultivators. The aims of the agricultural extension service were stated as follows:

1. Making use to the utmost of existing potentialities in the Scheme for the enhancement of production in the interest of the tenant and the country at large.
2. Absorption and dissemination of agricultural research results.
3. The gradual relaxation of central supervision and control by the Field Inspectors and introduction of extension officers by training the Field Inspectors in extension methods.

Now 12 Blocks out of 103 in the Scheme area are covered by the extension service, three Blocks being in the Managil area.

The Sudan Gezira Board and the Agricultural Research Corporation are also working closely and a number of Technical Committees representing both sides are very active. The Gezira and Managil Tenants' Union also meets regularly with the management representatives to discuss matters of mutual interest. Hence, the Managil Tenants although late comes to the Scheme are now well intc the main stream. The weekly newspaper 'El Gezira' offers an important forum the tenants and the administration to express their view on matters of interest.

LINKAGES WITH INTERNATIONAL ORGANIZATIONS:

The salinity of underground water in phases II and III of Managil and the presence of a granite layer obstructing prospecting for underground water, made the Managil Joint Committee's panel of engineers design a filtration plant, taking crude water from a minor canal passed through a strainer to a sedimentation tank, and a filtration tank from which clean water is pumped up into a reservoir perched up 20 feet high for the supply of potable water to the village community.

W.H.O. was approached to help in modification of design, routine maintenance of the filtration plant tanks and chlorination of the potable water before use. W.H.O. seconded a short-term consultant for 3 months in 1965 and offered a scholarship at the Imperial College of Science and Technology for one of the Civil Engineers of the Board to study sanitary engineering for one academic year.

The consultant submitted his report to both W.H.O. and the S.G.B. in the light of which modifications were introduced and routine maintenance and chlorination were effected and filtration plants are still providing hygienic drinking water to the rural population in the Managil area.

W.H.O. assisted in 1966 by seconding Technical Staff for the training of water supply personnel in Gezira/Managil and municipal authorities in the Sudan for six months.

MANPOWER AND POPULATION PLANNING:

The Rate of Population Increase and Its Social & Economic Implications for the Future of the Settlements:

The last population census was taken in the Gezira and Managil in April 1972, and the results are not yet handy. The previous population census was taken in 1956 according to which the population in the Gezira/Managil Scheme was 880,000. If allowance is made for a rise in the population at the rate of 2.8% which is the recognized growth rate in the past 15 years, the Gezira/Managil Scheme population would have grown to 1,250,000.

Another indication of the population explosion in the irrigated area is the rising number of 20-feddans holdings in the Gezira Scheme which comprise 66% of the total number of holdings as a result of the sub-division of the standard 40-feddan holdings to accommodate a rising population.

In the Managil S.W. Extension 82% of the holdings are 15-feddan holdings.

COMPOSITION OF HOLDINGS IN GEZIRA AND MANAGIL:

	5 FED. FEDS.	5-9 FEDS.	10-19 FEDS.	20 FEDS. & OVER
GEZIRA	66%	12%	21%	1%
MANAGIL	82%	6%	11%	1%
AVERAGE	74%	9%	16%	1%

EXISTING OPPORTUNITIES FOR ABSORBING EXCESS POPULATION:

The capacity of the fixed holdings in the Gezira and Managil Scheme to absorb a rising population must be the subject of intensive research.

The rural population in the Gezira and Managil tends to prefer salaried jobs in key towns where industrial and services sectors are offering fixed wages. Furthermore, there is a disparity between the agricultural and industrial wages. The rate of urbanization although presently low, is gathering momentum through industrial and non-industrial servicing sectors which will attract more rural dwellers. Hence, agriculture will be robbed of its labour force unless remedial measures are taken to locate processing industries in rural areas in order to maintain equilibrium between investment in agriculture and industry and town countryside.

CHRONIC POSITION ON FIXED LAND:

The chronic position of the Gezira and Managil tenants on fixed land calls for immediate measures to raise the income levels and standard of living of the tenants and labour force in agriculture with the object of improving their efficiency. This will require increased investment in agriculture and agricultural extension and training aimed at the encouragement of more intensive methods and greater investment in human development.

RESEARCH AND EVALUATION:

Fixed land and sub-division of the original 40-acre Gezira holdings as a result of population pressure call for continuous research and evaluation for the following reasons:

1. There has always been a tendency to consider the success of the Gezira Scheme in terms of agricultural output and productivity from a national and not from an individual tenant's point of view. Hence, global production figures reigned supreme in any report or accounts analysis sheet.

2. Such considerations are essential for the evaluation of the performance of the Scheme as a leading national production sector, but there is an advantage in considering the point of view of individual tenant-cultivators. A microscopic view of agricultural holdings gives support to the conception of agricultural holdings as production units rather than administrative units in a land distribution scheme. Furthermore, this microscopic view lays emphasis on the economic factors of production at work in every single holding viz, land, labour and capital as well as on the optimum size of holding, the amount of labour which can be economically employed viz family and hired labour or machinery and the extent to which production requisites can best be brought into operation.

3. In the Gezira and Managil reference is made to the size of holding in terms of the cotton land being the principal crop so far but this conception is repudiated by many circles in view of specialization in crop production which is remunerative on small holding in vegetables and milk dairying and poultry enterprises especially when there are markets close at hand.

4. The intensification and diversification of cropping is one of several ways of increasing the size of business on the same agricultural holding of fixed land area i.e. departure from the prevailing culture and the adoption of double cropping or specialization in intensive livestock and horticultural production. The greater intensification and diversification of crop and animal production will enable tenant-cultivators and family and hired labour to be constantly engaged and spread more evenly over the year thereby reducing unemployment and underemployment.

5. More intensive cultivation could be practised by using more irrigation water and fertilizers.

6. There has been a continuous debate on whether the small or large agricultural holding is more productive. Hence, the importance of economic studies in tenancy farming to gather data for several years on numerous and representative holdings before passing a judgement.

7. The Gezira/Managil Scheme is undergoing a vast change in cropping patterns. In September 1974 it was announced that (a) low-yielding areas amounting to 200,000 feddans will be removed from cotton-growing; (b) wheat and groundnuts areas will be increased to 600,000 and 400,000 feddans. rep. (c) vegetables will be grown on 50,000 feddans; (d) rice will be increased to 25,000 feddans; (e) the three-course rotation in Managil will be 100% intensive and the 4-course rotation in the Gezira Scheme will be 75% intensive; and (f) areas removed from cotton will be planted to summer fodders, groundnuts or vegetables.

8. In addition to these changes which seem to be attributed to slow cotton disposal, other changes are under consideration:

   a. Increasing mechanization i.e. full mechanization of an area of 50,000 feddans to be planted to groundnuts in 1975/76 and 40,000 feddans to be planted to cotton.

   b. Provision of warehousing of 400,000 tons of wheat.

   c. Establishment of decortication plants to cope with the groundnuts crop.

   d. Establishment of oi extraction plants.

   e. Beef and sheep production for local consumption and export through production of concentrates from grain, oilcake, molasses, dura stover, groundnuts hay.

9. All these problems warrent intensive investigation in the short--and long-term.

N.B.

This paper was presented on February 10, 1975 at the EDI/BRD Sudan Agricultural & Rural Development Projects Seminar (February 1 - March 13, 1975) held at the University of Khartoum, Democratic Republic of the Sudan.

Annex V

THE SUDAN GEZIRA BOARD
DEPARTMENT OF PLANNING AND DEVELOPMENT

MILK PRODUCTION PROJECT

Objectives:

A. Production of 5,000 pounds of fresh milk daily.

B. Betterment of nutritional standards.

C. Creation of a model for milk production for tenant farmers to adopt.

The project is designed to start on an area of 500 feddans with 330 milking cows for the production of 5,000 pounds of fresh milk daily.

The farm will use artificial insemination techniques for improvement of the local breed.

MILK PRODUCTION PROJECT

Serial No.	Quantity	Description	Local Ls.	Foreign Ls.	Total Ls.	Remarks
		A-Capital Cost				
1	1	Senior House				
2	4	Middle Houses	51,400	25,100	76,500	
3	10	Small Houses				
4	12	Pens	47,000	23,000	70,000	10 m x 20 m.
5	1	Milking Centre	3,500	1,700	5,200	
6	1	Office				
7	2	Feed Stores	14,900	6,900	21,800	
8	2	Milking rooms & accessories				
9	2	Wheel Tractors with Trailers				
10	2	Land Rover Pick-ups	13,500	6,500	20,000	
11		Milking equipment	1,000	500	1,500	
12	100	Cows				
13	50	Calvers	13,000		13,000	
		B-Operation Budget	131,500		131,500	
		Training		4,600	4,600	
			275,800	68,300	344,100	

Annex VI

THE SUDAN GEZIRA BOARD

UNPRECEDENTED DEVELOPMENT TRENDS IN AGRICULTURAL PRODUCTION & PROCESSING IN THE GEZIRA SCHEME TODAY

The renewal of the sluice gates of Sennar Dam and the modifications of the regulators on the main and major canals have guaranteed sufficient irrigation water effective from first June for all crops. Hence the newly announced agricultural intensification of the cropping pattern in the Gezira Scheme and the Managil S. W. Extension which will come into operation on 1st June 1975 is well-timed. The area to be planted with each crop is as follows:

Long-staple cotton	160,000 Hectares
Wheat	240,000 "
Groundnuts	160,000 "
Dura Sorjhum	60,000 "
Vegetables	20,000 "
Rice	10,000 "
(Mixed crops - Sorghum, Fodder, Groundnuts)	70,000 "
Fallow	120,000 "
TOTAL	840,000 Hectares

The unprecedented intensification of cropping pattern in the Gezira will bring the weed infestation and pest population into sharper focus. The staggering of planting dates for the various crops will help in weed control during dry spells but in view of labour shortages experienced

In the Gezira Scheme and the Managil S. W. Extension during the establishment of the different crops, there is a dire need for submitting the following vital projects for financing:

I. Farm Mechanization Project

This project is intended to cover the additional fleet of tractors, rotary cultivators, planters, ridgers, seed drills, groundnuts diggers and harvesters, wheat combines and last but not least balers for fodder conservation.

II. Wheat Silos

This project intended to meet requirements for field silos cater for two thirds of the wheat production on 240,000 Hectares in 1975/76 season, i.e. 400,000 M. Tons. The economic benefits from the 100 silos (capacity 1000 tons each at the rate of 4 units per site) both to the local mills and to the country at large by releaving Sudan Railways Wag ons for the transportation of capital goods up country are tremendous.

III. Groundnuts Decorticators

This project caters for the erection of 100 field decorticators in the field and the construction of 10 Oil Mills. The increased area planted to groundnuts which may reach 200,000 Hectares if areas removed from cotton are planted to groundnuts makes investment in decortication plants and Oil Mills essential for increasing the value added to agricultural raw materials. The by-product of

groundnuts, i.e. oil cake is an important ingredient in animal and poultry feed. The resultant reduction in haulage through decortication and removal of trash in the groundnuts crop is an immense gain.

IV. Tomato Paste Processing Units

Vegetables will be grown on an area of 20,000 Hectares in 1975-76 season. The yield is expected to meet local consumption and leave a sizeable spillover for export of fresh vegetables and processed tomato paste.

The feasibility studies were undertaken by the Food Processing Centre and the return on the capital outlay is encouraging.

A Processing Unit is proposed to be fed from a farm measuring 200 Hectares. The expected yield ranges between 8 - 10 tons per acre.

The objectives of the tomato paste processing units are:
(i) To diversify agriculture and encourage expansion of vegetable production.

(ii) To decrease the import of tomato concentrates;
(iii) Eliminate waste when supply is greater than demand, especially in the absence of cold storage at marketing centres.

Totai capital cost is about £500,000 and rate of return on the investment is satisfactory.

V. Dairy for milk supply to urban centres

The two centres proposed for siting the Dairy Farms are Kamlin in the Northern Gezira and Barakat in the Centre. The former is intended to provide miik for the Three Towns and the latter is intended to feed Wad Medani Town.

An area of 16,000 Hectares around Kamlin which is deleted from cotton growing is planned to support 25 units each composed of 200 cows.

An area of 3200 Hectares around Wad Medani will support 5 units of 200 cows each.

The Sudan Gezira Board will be responsible for management and the provision of agricuitural and production services, animal care and marketing.

VI. Production of Beef and Mutton for Export

The abandonment of cotton growing on low-yielding areas will make available about 160,000 Hectares for fodder and groundnuts production. Hence both green and dry fodder will be abundant for developing a beef and sheep fattening project for export purposes.

Two centrai feed iots, one in the Northern Gezira and the other in the Managil area, are proposed.

The tenant-farmers will keep foundation herds, and the Sudan Gezira Board will undertake technical management and supervision.

A breeding programme will be launched to take care of multiplication of animal population to prevent erosion through daily slaughtering for export.

The preliminary feasibility study has shown a high return on the investment.

CONCLUSIONS:

I. The foregoing projects which are presented for financing aim at achieving an orderly and integrated approach to agriculture which knit together production, processing and marketing.

II. The maximization of production through introduction of technology and provision of production requisites to the tenant-farmers' aims at maximizing the value added to agricultural raw materials through processing.

III. The integration of animal and crop production in the Gezira Scheme will initiate food, milk and meat processing with greater diversification in products range. This means the full utilization of all agricultural products and by-products, e.g. fodder and molasses, whey, bones and blood.

IV. The Sudan Gezira Board is aiming through the foregoing projects to establish a broad biologically based industry which is based on the processing of biological raw materials, i.e. meat, milk, molasses, etc. This is a huge potential which is still untapped.

V. The projects described above aim at doubling livestock and sheep herds in the decade 1975-85.

VI. The great availability of agricultural products and by-products in the Gezira and Managil demand technological inputs, skills and capital. However, opportunities are greater for the linkage between agriculture and agricultural based industries.

Annex VII

INTRODUCTION TO THE FEASIBILITY STUDY OF COMPLETE MECHANIZATION IN THE SUDAN GEZIRA SCHEME

The Sudan Gezira Board is seeking every possible means in its endeavour to develop the Gezira Scheme according to the set intensification and diversification program. Many problems have been solved by this endeavour and nearly all requirements for this development have been incorporated. Mechanization has always been one of the major demands and series of trials and piloting were made to establish mechanization in the Scheme. The study has been prompted by the insisting need to find radical solutions and set solid grounds for complete mechanization in the Gezira.

A complete mechanization project has been proposed in this study. Taking into consideration the existing cultural practices, areas, rotation and conditions of the Gezira and modifying certain agricultural operations, the total requirements of agricultural machinery has been established with the elimination of the existing capacities. Similarly the requirements of maintenance facilities and spare parts for this equipment were established.

Scheduling of Agricultural Operations and their timeliness together with scheduling of maintenance programs and spare parts procurement was also outlined in the study.

Cost analysis of Agricultural Operations and determination of the total requirement of the projects were undertaken. The total capital investment needed is Ls. 53,846,430 Sudanese Pounds out of which the equivalent of Ls. 32,708,645 Sudanese Pounds is a foreign component.

Economic assessment of the project has shown that it is economically feasible and a benefit/ cost ratio of more than one is indicated. Benefits were calculated on the basis of a percentage increase (10% and 20%) over cost of field operations as profit.

As for organization and management of the proposed mechanization project, it is found that the best alternative to shoulder the responsibility of this project is the cooperative sector and accordingly a set up of five cooperative mechanization centres has been recommended and plans have been set for their execution and completion in phases. This will allow more time for the financing to be raised and help to identify problems which may arise in the first phase. Phasing will also give a grace period for the successful and efficient recruitment of staff and their training.

The complete plan shall mature in six years. The first year shall be spent for procurement of machinery, structural equipment and building and some recruitments. The application of machinery shall start from the second year in the first centre and then the development of the remaining four centres will follow, one centre every year.

The crop areas of the proposed mechanization projects are:

a. 400,000 Feddans of cotton

b. 500,000 Feddans of groundnuts

c. 600,000 Feddans of wheat

d. 300,000 Feddans of dura

e. 16,000 Feddans of rice

The attached two tables show the machinery requirements and the capital investment and operating costs.

TABLE (1)

TOTAL CAPITAL COST OF AGRICULTURAL MACHINERY REQUIREMENTS (Ls.)

	MACHINE OR IMPLEMENT	NO. OF UNITS	TOTAL CAPITAL REQUIRED		
			FOREIGN	LOCAL	TOTAL
1.	Wheel Tractor	2,000	5,000,000	5,000,000	10,000,000
2.	Crawler Tractor (D7)	78	2,154,558	1,015,950	3,200,806
3.	Combine Harvester (Dura & Wheat)	395	3,752,500	1,429,110	5,181,610
4.	Combine Harvester (Rice)	12	126,000	47,796	173,796
5.	Groundnut Combine	371	1,298,500	511,238	1,809,738
6.	Groundnut Digger - Shaker	761	532,700	145,351	678,051
7.	Ridger (4 Body)	1,550	775,000	229,400	1,004,400
8.	Disc Plough (4 Bottoms)	459	275,000	78,030	353,430
9.	Off-set Disc Harrow	725	725,000	170,375	895,370
10.	Land Levellers	745	745,000	175,075	920,075
11.	Root Plough	70	502,250	111,510	613,760
12.	Abu VI Ditcher	61	15,250	4,514	19,764
13.	Abu XX Ditcher	78	390,000	185,250	575,250
14.	Planters (4 Rows)	886	753,100	197,578	950,678
15.	Rotovators	79	86,900	22,673	109,573
16.	Gross Ridgers	260	-	52,000	52,000
17.	Inter Row Cultivators	692	519,000	132,172	651,172
18.	Wide Level Disc	363	580,800	326,700	907,500
	TOTAL		18,262,258	9,834,722	28,096,980

TABLE (11)

TOTAL CAPITAL AND OPERATING COST REQUIREMENTS FOR THE MECHANIZATION OF THE GEZIRA PROJECT

	COMPONENTS	FOREIGN CURRENCY Ls.	LOCAL CURRENCY Ls.	TOTAL Ls.
1.	Machine & Implements	18,262,258	9,834,722	28,096,980
2.	Spare Parts	1,010,024	419,160	1,429,184
3.	Fuel & Lubricant	5,507,041	898,796	6,405,837
4.	Building & Equipment	4,800,000	4,950,000	9,750,000
5.	Service Cars	293,040	106,960	400,000
6.	Running Cost for Service Cars	30,520	29,265	59,785
7.	Salaries & Wages	-	3,333,120	3,333,120
8.	Management, Maintenance and Machine Drivers	-	-	-
	TOTAL	29,902,883	19,572,023	49,474,906
	Interest 8%	2,392,231	1,565,762	3,957,993
	GRAND TOTAL	32,295,114	21,137,785	53,432,899

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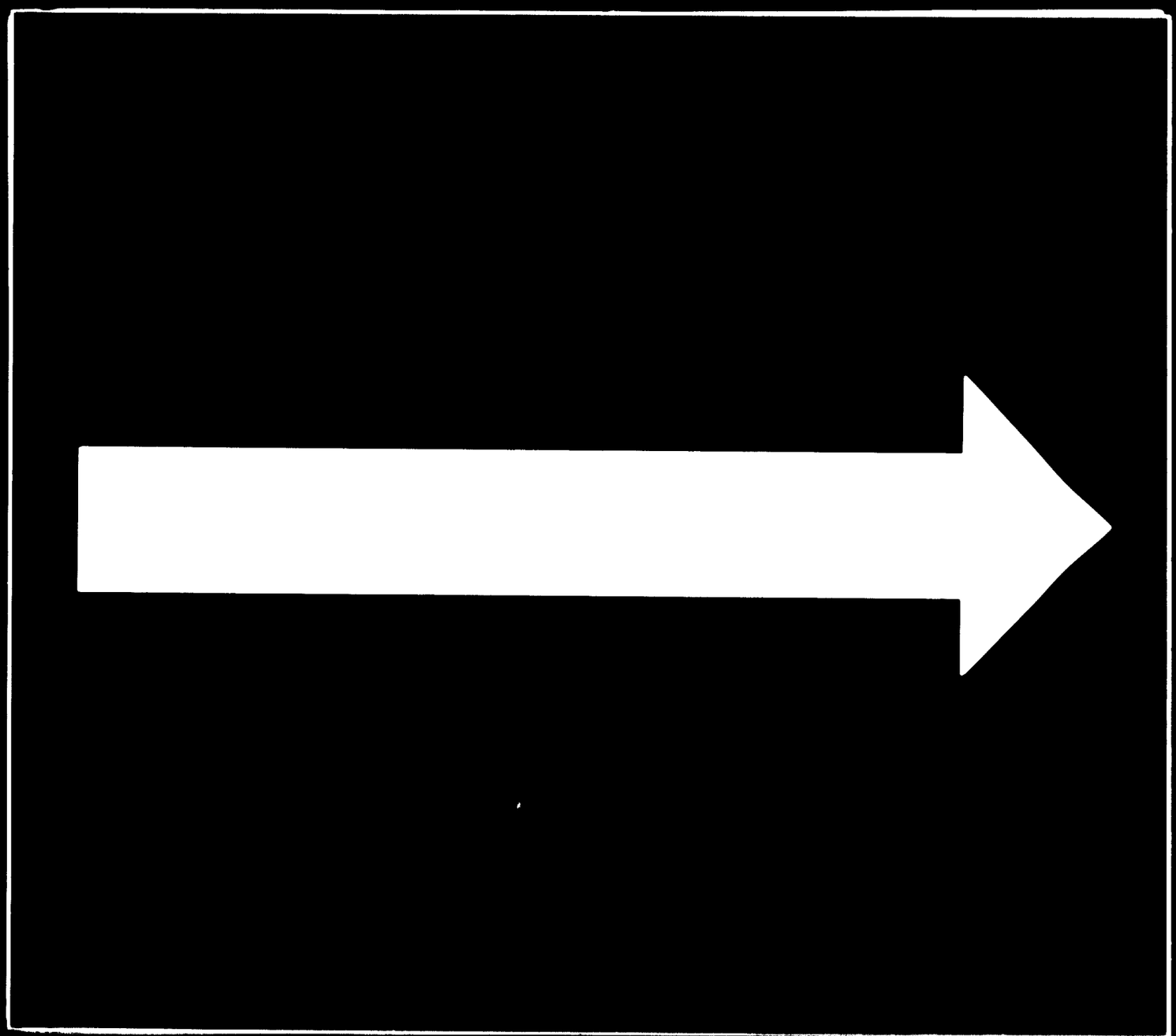

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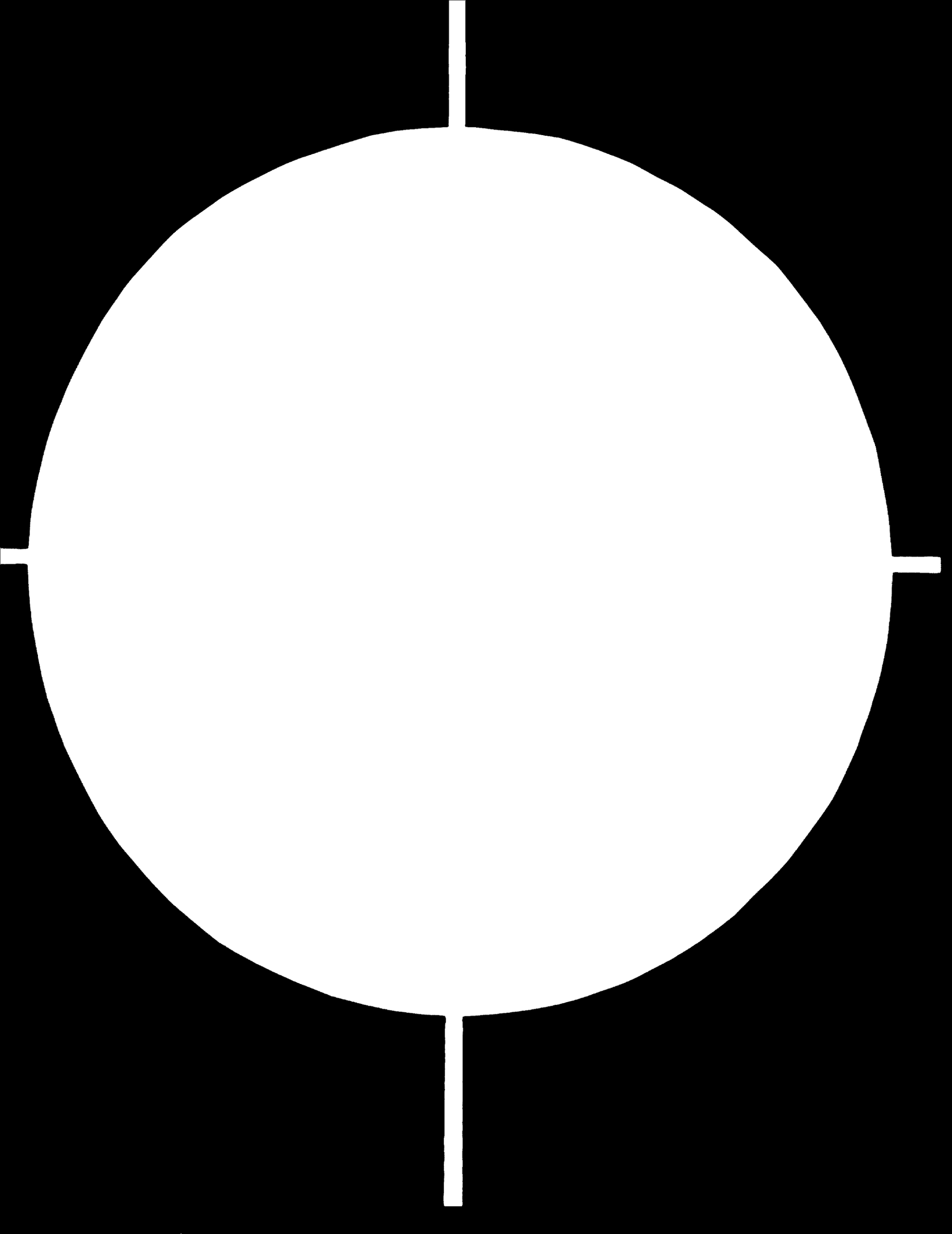

Annex VIII

INTRODUCTION OF THE STUDY OF WHEAT STORAGE IN THE SUDAN GEZIRA SCHEME

The strategy of the Sudan Government in wheat production is to achieve self-sufficiency and realize an exportable surplus through substantial increase in acreage and a significant rise in yields. The main increase is planned to be in the Gezira. It was recognized that without an efficient disposal system, the mere increase in production will not realize the policy targets.

The movement of the crop, its storage and disposal in a manner which will reduce costs and ensure maximum delivery becomes an urgent problem.

In this study the production figures for wheat were based on the areas planned within the ten-year period 1975/76 - 1984/85.

The yields were based on figures ranging from .75 T.P.F. in 1975 to .8 in 1980 and to .9 in 1985.

With complete reliance on local production as targetted, the movement of wheat will be outward from the Gezira (and later on also from Kassala) to the mills. The element of seasonality will become an important factor. Whereas imports were spread over the year, wheat produced locally will become available in a period of two months.

On the basis of analytical studies of production and consumption levels and patterns, a national plan for the movement and disposal of wheat grain and wheat flour was formulated.

According to the study, the Gezira will be reducing about 70% to 80% of the total national output (about 454,000 tons in 1975/76 and

576,000 tons in 1984/85). This will be equivalent to about 85% to 95% of the national consumption.

After allowing for milling by traditional methods and for farmer's own use, the study came to the conclusion that the Gezira storage system should cater for the movement of some 400,000 tons from the farms to the storage facilities in a very short period of time, and from there to cater for regular supplies to the mills and for export.

To meet these requirements at the least cost the best system recommended by the study was a combination of a central complex of a 100,000 ton silo and 5 warehouses located at H/Heissa, plus field storage centres composed of 39 warehouses located at 10 groups in the Gezira along the G.L.R. route.

The G.L.R. will be the main means of transport. Road transport will be required from the field to the stores.

The cash inflow generated from the project was calculated through the approximate quantification of direct benefits such as: reduced storage waste, reduced cost of transport, saving in cost of sacks, saving in handling, rental of augers, harvestors and silo. The internal rate of return was found to be ranging between 12% to 17% according to wheat prices.

Management and ownership were recommended to rest with the S.G.B. as it meets the criteria set out. The proposed system is based on maximum utilization of existing management structure of the S.G.B. and follows the present channels of responsibility and communications.

The attached 3 tables show the initial investment, annual operating expenses and local and foreign exchange; and location of field stores.

INITIAL INVESTMENT OUTLAY OF THE PROPOSED WHEAT STORAGE AND HANDLING SYSTEM

		Ls.....
1.	Construction of 44 warehouses	4,050,000
2.	Modification of 8 warehouses	1,200,000
3.	Construction of one 100,000 silo	
	a. Buildings Ls. 3,600,000 b. Machinery 5,600,000	9,200,000
4.	Motor vehicles	100,000
5.	Weighing Machines	55,000
6.	38 Modified Combined Harvestors	570,000
7.	78 Seven ton Augers	1,140,000
8.	Houses	585,000
9.	Offices and Auxiliary facilities	50,000
10.	Fumigation Equipment	220,000
	SUB TOTAL	17,170,000
11.	Engineering costs (8%)	1,374,000
	SUB TOTAL	18,544,000
12.	Contingency (10%)	1,854,000
	GRAND TOTAL	20,398,000

APPROXIMATE ALLOCATION OF THE CAPITAL INVESTMENT COSTS OF THE PROPOSED SYSTEM INTO LOCAL & FOREIGN EXCHANGE

CAPITAL INVESTMENT COST ITEM	LOCAL %	LOCAL Ls.	FOREIGN EXCHANGE %	FOREIGN EXCHANGE Ls.	TOTAL Ls....
1. Warehouses	60	2,835,000	40	1,215,000	4,050,000
2. Warehouses' Modifications	30	360,000	70	840,000	1,200,000
3. SILO:					
a. Buildings	70	2,520,000	30	1,080,000	3,600,000
b. Machinery & Equipment	20	1,120,000	80	4,480,000	5,600,000
4. Motor Vehicles	20	20,000	80	80,000	100,000
5. Weighing Machines	20	11,000	80	44,000	55,000
6. Combined Harvestors	20	114,000	80	456,000	570,000
7. Augers	20	228,000	80	912,000	1,140,000
8. Houses	100	585,000	-	-	585,000
9. Offices & Auxiliary Facilities	100	50,000	-	-	50,000
10. Fumigation Equipment	20	44,000	80	176,000	220,000
11. Engineering Costs	50	687,000	50	687,000	1,374,000
12. Contingency	50	927,000	50	927,000	1,854,000
TOTAL	44.6	9,501,000	55.4	10,897,000	20,398,000

AVERAGE ANNUAL OPERATING EXPENSES OF THE PROPOSED WHEAT STORAGE AND HANDLING SYSTEM

		Ls.....
1.	Salaries and Wages	250,000
2.	Water and Electricity	75,000
3.	Transport	900,000
4.	Fumigation Expenses	5,000
5.	Depreciation	1,000,000
6.	Interest (10%)	123,000
7.	Other Expenses (10%)	235,000
		2,588,000

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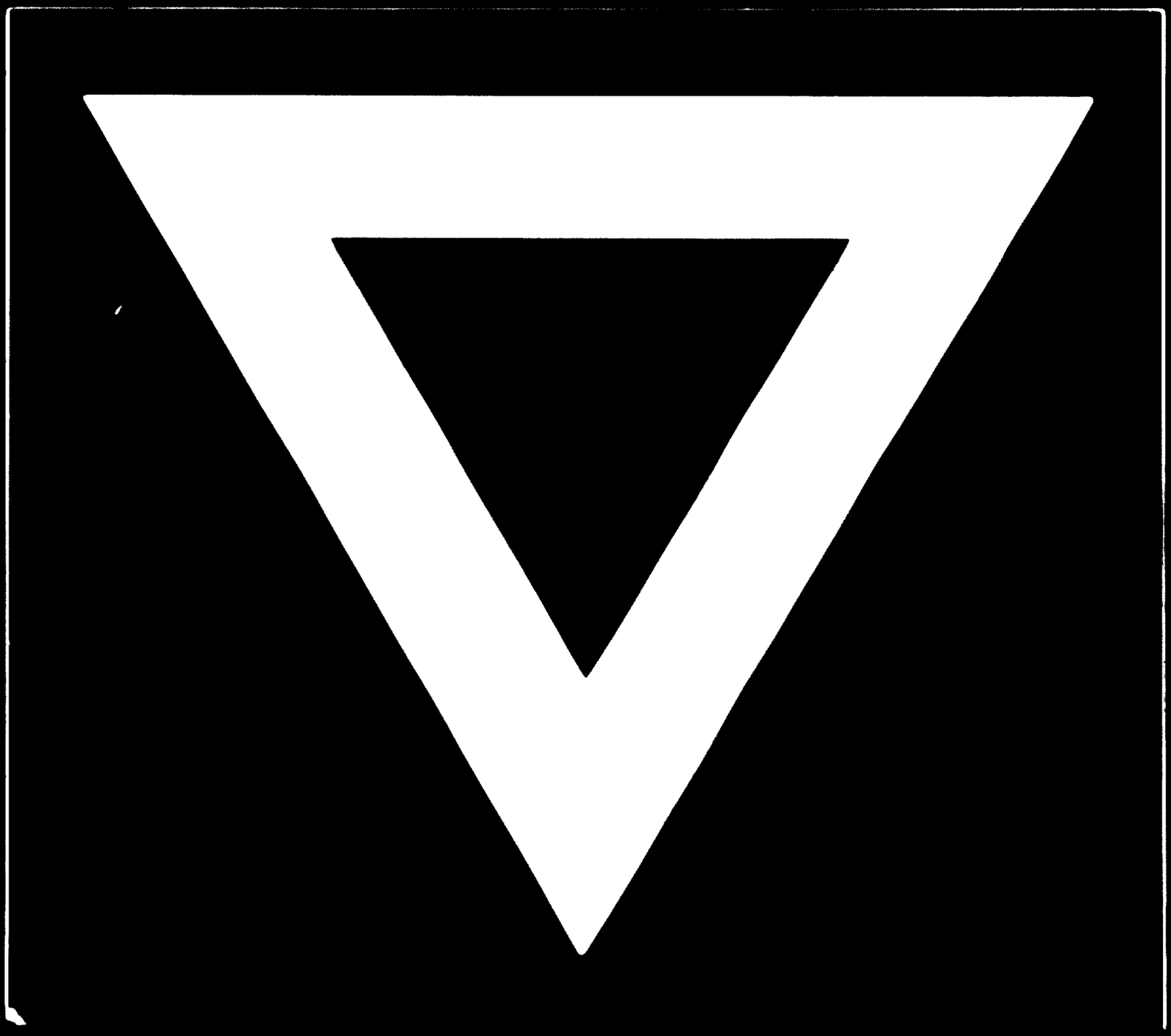

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