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0.2 Crops and Machines Required

The main emphasis is on cotton production. The implements required for cotton mechanization are given in Para. 2.2.1. Both Abu Naama and Khashm El Girba are carrying out experiments on long furrow irrigation system and mechanizing of cotton which are of major interest Para. 2.2.2. The importance of mechanization of groundnuts and sesame cultivation which earn foreign exchange is also of importance. The cultivation of wheat of which the demand is likely to increase needs attention.

0.3 Manufacture of Agricultural Machines

Whereas there is an urgent requirement for manufacture of hand tools, animal drawn implements are not popular.

The manufacturing potential available in the country and the factors affecting the location of this industry have been discussed. There are three alternatives for establishing the agricultural implements factory (Para. 3.6).

Khartoum offers the best possibility in view of available ancilliary industry. In view of the urgent need to establish the factory particularly for manufacturing the locally developed machines it is recommended that this should be in the premises of the Steamers Department Workshop in Khartoum North. The above has been established for more than 50 years with an area of 1 sq.kilometer, with experienced

staff and workers etc.. and is therefore admirably suitable. UNIDO assistance is required, experts 72 m/m and followships 36 m/m to train the counterparts. A proposed production programme is at Annex 5, the firstphase is mainly for locally developed machine.

0.4 Assembly of Tractors

At present Massey Ferguson tractors are being imported in partially knocked-down (P.K.D.) conditions and are erected at Khartoum and Gedaref thereby saving LS. 56 per tractor. The import of completely knocked-down (C.K.D.) parts which will lead to a further saving of LS. 44(3.'), but would involve investment of LS. 100,000 in setting up a proper assembly line. The number of tractors required to be assembled would be 1350 of 55-56 HP and 150 of smaller HP. In view of the low volume and the lack of indigenous components the setting up of assembly line immediately does not appear very attractive. However, if an agreement could be reached with a good firm and autombile ancillary industries could be established, it may be wise to start with an assembly factory. UNIDO should assist in making available the services of Techno-economic Adviser 24 m/m.

0.5 Repair and Maintenance

Various aspects of ensuring that spares are available from supply agents or by setting up small industries have been considered. The manufacture of spare parts required

for replacement of components during a tractor's effective life which would involve the setting up of 8 or 9 factories is recommended (Para. 5.4.2). Central workshops have to be established, in the new areas being developed particularly, New Halfa and Agadi. The use of mobile workshops particularly the heavy type should be reconsidered as these are not mobile in the rainy seasons when the tracks are impassable. Assistance is required from the ILO Technical Tradesman training project at Wad Medani in training of agricultrual mechanics. The UNIDO should assist in training of managers in the field of planning of repair and maintenance 24 m/m.

0.6 Research, Development and Testing

The agricultural research corporation under the Ministry of Agriculture is doing excellent work on various disciplines, but have not been able to give adequate attention to agricultural engineering particularly testing and design of machines in view of shortage of agricultural engineers.

The agriculture engineering department of the Sudan Gezira Board is developing a dozen machines required in the Sudan but these require to be converted into production models. Assistance is therefore required in two aspects:

a) Machinery design (24 m/m). This is also included in the requirement in Para. 3 above as the designer will be located at the agriculture implement factory.

b) Establishment of testing station 24 m/m to be established at Sennar under the control of Agricultural Research Corporation.

There is also a need for setting up an organization to encourage, creative ideas and import substitution under the Ministry of Industry (para 6.3.4).

0.7 Standardization

The selection of the standard tractor 50-60 HP is discussed (para 7.2.2). It is recommended that smaller tractors should be introduced for haulage and small farms; the introduction of 2-wheel tractors is not recommended. It is requested that hydraulics are not necessary for the tractors employed exclusively in the M.F.C. rainfed areas. The standardization of combines should be taken up urgently; in view of high foreign exchanage cost of combines their assembly should also be considered.

Recommendations are made for immddiate action to standardize certain components e.g. 3 point linkage and power take off shafts. Their standardization will enable any tractor to use any implement of different makes. Assistance is suggested from Indian Standards.

0.8 Reaper Binder for Sesame Harvesting

This problem was posed to the experts on their way to the Sudan. The position of various types of machines has been examined.

It is felt that the modification of the Yugoslav reaper binder is not likely to be successful. Claims of the LAVERDA machine which was reported to be in use in Ethiopia across the border appear encouraging. The Agriculture Engineering Department is now considering the import of a machine from this company, and will be arranging comparative preformance trials, ~~to determine which~~ The development of a combine should be considered, but would take much longer.

A cable has just been received from UNDP ADDISABABA stating the MUMERA farmers are using BERTOLINI reaper binders and LAVERDA is not known. A detailed report on BERTOLINI-125 is awaited, which will clarify as to which of the reaper binders is in actual use in Ethiopia.

The above report has been prepared without the benefit of the written report from Mr. Gohlich.

29.1.1972

1. INTRODUCTION

At the request of the Government of the Republic of Sudan the United Nations Industrial Development Organization appointed Mr. Partap Narain an expert in manufacture of agricultural machinery and implements, to analyse the feasibility of manufacturing, assembly of agricultural tools and implements, at present being imported. He was assisted by Dr. Ing GOLICH of Berlin University an FAO expert to determine the types of machinery and implements and their volume required for the agricultural operations.

The team was fortunate in having Mr. Moawia Siddig El Sheikh (Mechanical Engineer) Manager Engineering & Metals Industries Dept., of the Industrial Research Institute as counterpart. He was assisted by Nuri Sabir & Omer El Bakri.

Mr. Moawia was previously incharge of an 8 member Chinese team which investigated the economic feasibility of agricultural Machinery and implements plant during 1970. The results of this investigation were not available.

Working in colloboration with government departments and private industry, the experts studied the background information, visited various projects, diccussed future trends in usage, design and market potential to arrive at a range of products suitable for manufacture.

The report gives the back ground information the conclusions and recommendations for action by government and UNIDO.

To keep the report as short as possible, lists of persons, Government Departments, Industries etc. visited have not been included. The team would like to place on record its thanks to all persons who very kindly offered their helpful advice and assistance which enabled the

compilation of this report, for their kind. Courtesy.

The report is based on study between Nov. 1971 and Jan 1972, Dr. GOELICH'S FAO expert's written report was not available till the time this report was prepared.

1.1 BACK GROUND INFORMATION

1.1.1 GENERAL

The Sudan has an area of about 2.5 million square Kilometres, bulk of the land is owned by the Government. The Northern 1/3rd. of the country is desert with hardly any rainfall where cultivation is only possible along the Nile. The annual rainfall is of the order of 200mm at Khartoum and gradually increases as we move south to 1750mm The Southern 1/3rd. is suitable for a wide range of tropical crops but poor communications and political unrest have limited agricultural development in the area-which was not visited.

The central plains lying 11°-15°north of the equator have been the main areas for traditional farming and are the centre for modern development in irrigation and rainfed mechanized agriculture.

Water supply for cultivation is by irrigation(gravity and pump schemes) and flood from the river Nile and its tributaries. Water is drawn from the Nile according to an agreement with Egypt. Main cultivated area 82% (In the central plains) is rainfed; irrigated areas amount to approximately 15% and the balance flood land to. 2.5%

It is reported that the Republic of Sudan has 100 million feddans of cultivable land(1 feddan = 0.4205 hectare.)

1.1.2 POSITION OF AGRICULTURE IN SUDANS ECONOMY

The economy of the Sudan depends heavily on agriculture. During 1968 gross Domestic product (G.D.P) is value added by agriculture including live stock, forestery and Fishing was 200 million pounds out of a total of 461.6 million for all industries, almost half of the G.D.P.

(Source:- National Accounts and supporting tables 1968- Ministry of Planning July 1970).

Almost all the export earnings are from agricultural products- in 1968 the earning from export of cotton alone amounted to nearly 41 million pounds out of total 84 million, almost half of the total exports.

1.1.3 CROPS AND AREAS UNDER CULTIVATION

The main crops and the areas under cultivation in 1970/71 and the average yield per feddan are given in table below:-

	AREA. FEDDANS	YIELD MT/F	REMARKS
Cotton Long Staple	818.482	.727	
Sudan Gezira Board	588.372	.742	
Agricultural Reforms	230.110	.689	
Private Estates	40.000		1969 Figures
Medium Staple	178.857	.525	Nuba
Short Staple	200.729	.093	- Gedaref
Total Cotton	1,238.068		
Durra	4,698,361	.325	
Dukan	1,731.426	.266	
Maize	86.800	.268	
Rice	12.195	.500	
Wheat	903.309	.389	
Groundnuts	1,772.847	.159	
Sesame	34,616	.499	
Castor	16.901	.648	
Others	37.000		
Total Area	10,531.523		

The area under crops has been increasing , the total area under crop in 1968/1969 was 7.8 million feddans, in 1969/70 it increased to 10.049 million feddans.

1.2 FIVE YEAR PLAN 1971-1975

The plan proposes an increase in agricultural production, some of the main targets are:-

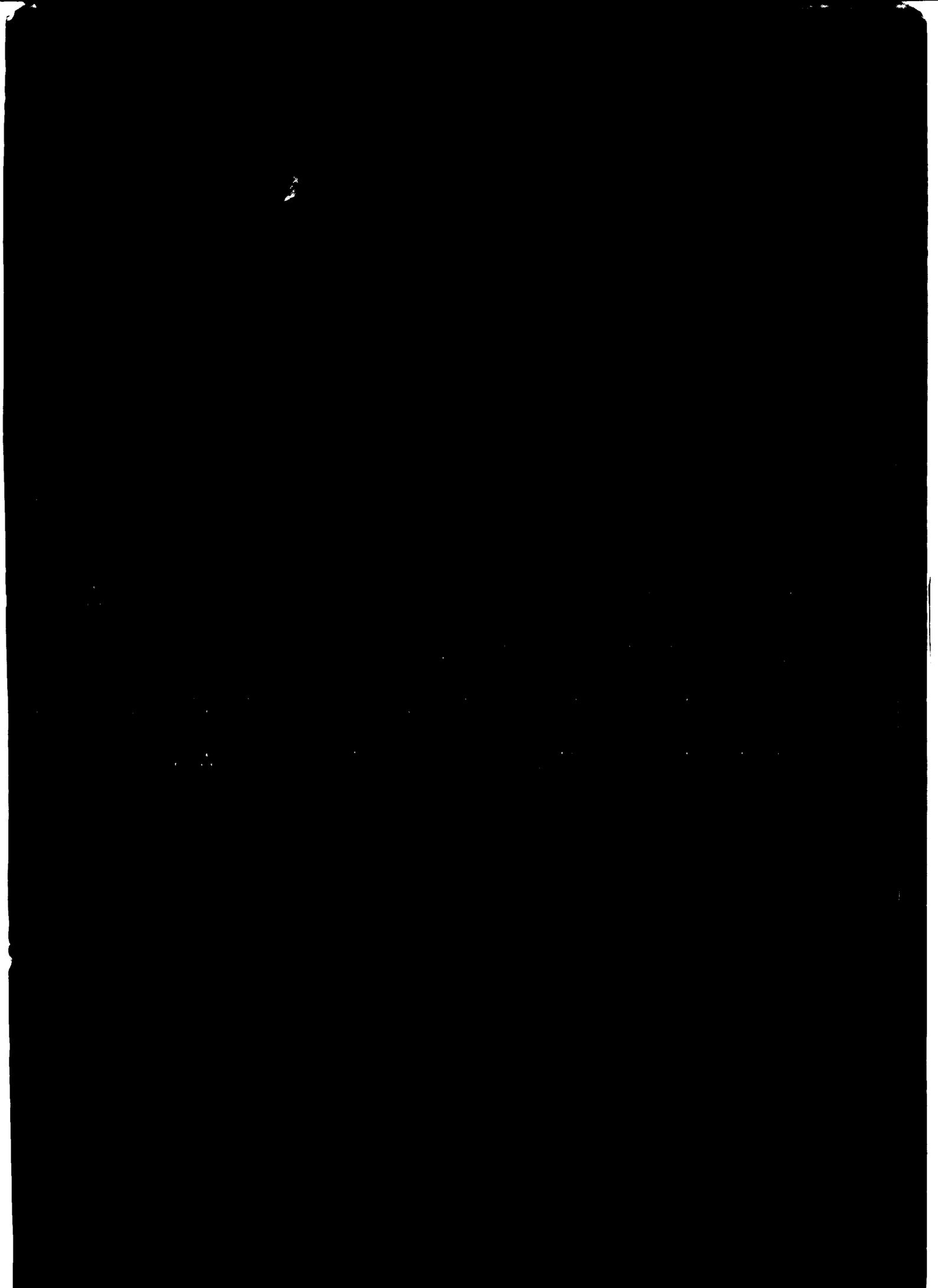
	Production 1969/70	1975	Increase in %
Long Staple Cotton '000 Kantars	3,541	7,450	210
Medium Staple Cotton	852	1,240	145
Short " "	262	412	120
Ground Nuts '000 Tons	380	458	144
Sugar Cane "	938	2,030	216
Sorghum(Durra)"	1,362	2,550	178
Rice "	163	560	342
Wheat "	7.5	22	233
Sesame "	200	240	120

2.1 The increases envisaged, will greatly enhance the importance of agriculture in the national economy of Sudan; the need of agricultural machinery and implements will thus greatly increase.

2.2.2 INCREASE IN CULTIVABLE AREA

5 year plan proposes increase in cultivable area by 2.8 million feddans which are expected to be in the following areas:

Gedaref	-	900,000	feddans
Blue Nile	-	550,000	"
Upper Nile Province	-	450.000	"
Nuba Mts.	-	500,000	"
Darfur Province		400,000	"
		2.800.000	



This increase is to be achieved mainly by mechanited farming.

From this cultivable area there would be a reduction for actual crop production owing to the requirement of leaving 1/3rd of the area in the rainlands as fallow. The increase in cultivated area would this be of the order of two million feddans.

A graph showing the progressive increase in the area under crop and expected expansion is placed at annexure----------1.

1.3. ORGANISATION OF AGRICULTURE IN SUDAN

1.3.1 ADMINISTRATION

There are two main ministries which administer agriculture; the Ministry of Agriculture and the Ministry of Animal Resources which is in charge of livestock. This report being concerned with production of crops, details of Ministry of Agriculture will be discussed.

In addition the Ministry of Cooperation and Rural Development has recently taken over administration of agricultural schemes in the cooperative sector- for details see 1.3.8.

1.3.1.1 THE MINISTRY OF AGRICULTURE

The Ministry controls the major agricultural schemes through five corporations, of which the SUDAN Gezira Board is directly under the Minister. The corporations, their area of responsibility and abbreviations as used in this report are as under:-

		Schemes	Abbreviation
(a)	SUDAN GEZIRA BOARD	GEZIRA MANAGIL GUNEID	SGB
(b)	MECHANISED FARMING CORPORATION	SAMSAM HABILA	MFC
(c)	AGRICULTURAL DEVELOPMENT CORPORATION	TAMBUL SUKI RAHAD	ADC
(d)	PUBLIC AGRICULTURAL PRODUCTION CORPORATION	NUBA-MOUNTAINS KHASHM EL-GIRBA QASH, TOKAR	PAPC
(e)	AGRICULTURAL REFORMS CORPORATION	PRIVATE SCHEMES ON BLUE & WHITE NILES.	ARC

In addition the Ministry has a separat Research Corperation located at Wad Medani, and departments as under:-

Agriculture Engineering
Crop Production
Horticulture
Agricultural Education and Extension
Soil Survey
Seed Production
Agricultural Economics and Statistics

1.3.1.2 THE ORGANIZED SECTOR

Nearly half the land in the Sudan is in the Organized sector as will be seen from the statement below, this is being cultivated generally with the use of agricultural machinery; the holdings of agricultural machinery by the various organizations are given in Table 1 Annexure 2. The figures are fairly accurate and are based on information collected from the Corporations and local authorties.

Scheme	Area (Feddans	Organization Responsible
(a) GRAVITY IRRIGATED		
Gezira Managil	2,000,000	S.G.B.
Khasim El Girba	330.000	P.A.P.C.
(b) PUMP SCHEMES		
Suki	90,000	A.D.C.
(c) NORTHERN PROVINCES		
i Govt. Irrigated Estates	60,000	Ministry of Cooperation and Rural Development
ii Cooperatives	50,000	" "
(d) BLUE NILE (South of Sennar)	800,000	ARC
(e) WHITE NILE/NILE (South of Jebel Awalia)	150.000	ARC
(f) WHITE NILE South of Kosti	93.000	ARC
(g) FLOOD SCHEMES		
Qash	60,000	PAPC
Tokar	100,000	"
(h) RAINFED SCHEMES		
Sam Sam	140,000	MFC
(i) STATE FARMS		
Gedaref	40,000	"
Reseires	12,000	"
Renk	12,000	"
Habila	23,000	"
(j) KASSALA & BLUE NILE	300,000	Min.of Coop.& Rural Development

Scheme	Area (Feddans)	Organization Responsible
(1) Nuba Mountains	250,000	P.A.P.C
	4,510,000	Feddans

It will be noted that the area of schemes shown above is more than the areas actually sown in any year; this is due to the fact that areas are left fallow in accordance with the crop rotation programmes.

1.3.1.3 THE PRIVATE SECTOR

The areas outside the schemes mentioned above are cultivated by farmers large and small. Whereas the small farmer may be using only hand tools, there is a fairly large use of agricultural Machinery. There is no method of finding out the actual number of machines used; however from the import figures and various firms supplying tractors and combines, their estimated numbers have been assessed.(Shown in Table 1).

Small farmers hire tractors for land preparation and the rates though varying in different localities are quite reasonable. There is a large number of combines which are also operated by private owners. The tractors and combines particularly in the Gedaref area, move from one area to an other doing custom business.

1.3.1.3.1 BLUE NILE & KASSALA PROVINCES

In Dali and Mazmoum area in Blue Nile Province 1000 feddan farms are alloted to individuals or cooperatives or companies who own a tractor; there

may be 200 such farms. Because of lack of drinking water during harvest season, the use of combines is essential. The development of combinable variety of Durra is equally important; the present strain is not popular.

1.3.1.3.2 NORTHERN PROVINCES

In the Northern Province the Government has ten pumping stations, at places such as Shendi, Gurier, Meri etc. The government charges Le. 20 per feddan per year for fruit gardens, and less for Vegetable and other crops. The main crops are Mango, citrus fruits and dates, which are marketed in Khartoum and Port Sudan.

There is a fruit canning govt. factory at Karoima. Dongola is reputed to have good workshop facilities.
Expansion of pumping facilities is being planned.

1.3.2 SUDAN GEZIRA BOARD (S.G.B)

1.3.2.1 GENERAL

The Sudan Gezira Board controls the main irrigated area in the Sudan between the Blue-White Niles; Main Gezira and its South West extension Managil.

The Gumeid pump scheme on the East of Blue Nile, was handed over in 1962 to the sugar factory administration. The total area is two million feddans; the land use in 1968/69 was as under:-

Crop	Area in Feddans			Total Feddans
	Gezira	Managil	Gunied	
Cotton	294.190	280,000	13,532 †	587.722
Durra *	152,653	138,749	-	291,392
Wheat	121,788	9,119	7,119	138,594
Grd Nuts	31,092	48,342	-	79,434
Luba	72,691	60,314	-	133,005
Vegetable	22,117	8,917	-	31,034
				1,261.181

Notes

1.† Acala.

2.* The Durra crop was poor only, 364 kg per feddan at Gezira and 227 kg per feddan at Managil. Use of fertilizers and better seeds was considered necessary.

3. Most of the crops showed low yields for which the SGB gives the following reasons:-

a) poor land preparation
b) lack of adequate and pure seeds.
c) poor husbandry and weed control
d) Inadequate application of fertilizer

(Source SGB Annual Agricultural report 1968-69.)

1.3.2.2 AGRICULTURAL ENGINEERING PROJECTS

1.3.2.2.1 LONG FURROW IRRIGATION

A large number of projects are in hand for improvement of crops eg projects for distribution of fertilizer for cotton; land preparation, improved field layouts etc.

From mechanization point of view the experiment on long furrow irrigation are the most important, as this would lead to smoother and longer travels for the machines. Similar experiments are also in hand at Tamboul experimental farm (para 1.3.4.1) and Kashim El Girba (para 2.2.2).

In the present irrigation system watering is from Abu VI Canals which take the water from Abu XX larger canals and the ridges run across the 5 feddan plots whose width is only 77 m. in the proposed system the watering will be from Abu XX canals along the length of the 5 feddan plot approx 280m. which will make mechanization much easier, as machines will get longer runs.

The work on digging channels-Abu VI will also be reduced.

1.3.2.2.f LOCALLY DEVELOPED MACHINES

Commendable work has been done by the SGB agricultural Engineering Department under the guidance of Mr. Abdel Rahman Ali Galy in development of special purpose machines.

The machines were exibited at the Blue Nile province agricultural exibition held on 1 Jan. 1972, brief description and present status of these machines is given here-under:-

a) Cotton Stalk Pullers

i) N.I.A.E. UK design with rotating tyres under development since 1950's of which six preproduction models have been tried. The mechanical defects are under improvement by Vickers Company of U.K.

ii) A locally developed machine-by a fitter from Hassa-Heissa workshop in 1970. This needs testing, modifications and production engineering assistance.

b) [illegible] machine for cotton fields—locally developed in 1968 stated to be 75% efficient.

c) Channels ([illegible]) and ridges ([illegible]) making machine—under development since 1967 simple attachments for tractors to dig channels and make ridges. Large scale trials were held 68/69 and performance was good. Technical improvements to design are now necessary.

d) <u>Ground Nut Washing Machine</u>

Stationary drum type with forced water spray for removing clay from ground nuts. Production of trial models awaiting approval of the Managing Director

e) <u>Stalk Breakers</u>

For Durra fields towed by tractor and P.T.O. shaft driven machine with a drum and spikes helically spaced for breaking durra stalks.
Tried in one block and found useful, capacity 3-4 feddans per hour which gives cheaper operation than labour.
Choice of materials and heat treatment required for spikes needs consideration, as well as the method of construction.

f) <u>Planter for Cotton</u>

Suitable for consolidated cotton acres—under development.

g) <u>Lifter, Turner for Ground Nuts</u>

Tractor mounted blade for lifting, with a 600 m.m. diameter spiked drum for turning similar to Lillystone machine.

h) Fertiliser Distributor

Hand pulled machine for distribution of fertiliser for cotton. 3 rows at a time, out-put claimed two feddans per hour./ The development of machines is limited by the small budget, there being no independant testing station, nor organized production workshop the introduction of machines is being delayed.

3.3.2.3 AGRICULTURAL MACHINES UTILIZATION

The S.G.B. has approximately 145 tractors with implements for land preparation, agricultural operations such as split ridging, interrow cultivation are done by tenants using private sector tractors which number 700-800. Similarly the harvesting of Durra and Wheat is by private or cooperative owned combined harvestors.
The SGB also has 51 Crawler tractors with a locally made deep plough, for depths up to 12 inches.

3.3.2.4 REPAIR AND MAINTAINENCE

The SGB has its central workshop at Maringan.
This well equipped workshop is responsible for repair for all S.G.B. machines including light railway and ginning factories equipment. It also manufactures hand operated cotton stalk pullers approx 15,000 per year.

A well equipped diesel engine overhaul section has an output of one Tractor Engine per day or 10 locomotive engines per month. There is a separate repair line for LISTER engines used for pumping.
Engines overhauled are tested on Hydraulic testing bench.
Problems of spares is not so acute, as the S.G.B. has its representative at Liverpool and essential spares can be flown out within a

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REPORT-TO

UNIDO

JAN. 1972

Submitted By:-

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Agricultural Machinery Expert

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002221

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fortnight.
The workshop produces its own spares, but metallurgy is not its strong point. The foundry has a gas fired furnace 150 kg capacity and the smithy section has two hammers.

There are two other smaller S.G.E. workshops in the area- the Hasa-Hisa workshop looks after tractor bodies.

There are private workshop at Wad Medani, Hasa Hisa, run by various supply firms who also hold spares.

1.3.3. [illegible]

1.3.3.1 [illegible]

Formed in 1968, and took over "Mechanized Crop production schemes" MCPS started in 1945 under the Ministry of Agriculture. The M.C.C. is responsible for all aspects of rainlands mechanized farming in the Sudan.

HQ of corporation is at Khartoum with provincial offices in Gedaref in the East and Killing in the West.

1.3.3.2 Size of farms has been fixed as 1500 feddans of which 1000 feddans is cultivated and 500 fd is left fallow. The size of farms was fixed taking into consideration the capability of a 65 HP tractor to cultivate 1000 feddans.

1.3.3.3 First Phase of Sam Sam project (60 miles south of Gedaref) was completed in June 1971. It consisted of 140 farms of 1000 feddans each, total 140,000 feddans. Land was leased for 25 years and the govt. charged 5 pisters per feddan as annual land rent to cover part costs, of the extension Service. Project financed by world Bank 4 million dollars.

1.3.3.4 STATE FARMS

There are four state farms :

No.	Location	Present Area	Target
1	Gedaref	40,000	110,000
2	Roseires	12,000	200,000
3	Renk	12,000	70,000-90,000
4	Habila	23,000	30,000

The Gedaref farm which is the largest has planted 40,000 feddans in 1971 and proposes to plant 70,000 feddans in 1972.

The main crops are Durra and Sesame

1.3.3.5 PLANT AND MACHINERY AND REPAIR FACILITIES

The Machinery at Gedaref State farm was:-

Tractors -	30	24	MF.
		6	Zetter
Widelevel	30	24	MF.
Discs		6	JD
Combine Harvesters	5	Russian type not yet used	

It was learnt that repair of these machines also being carried out by M.F.C. main workshop at Sam Sam using the mobile workshop van-but owing to the distance 24 km, this was not likely to be satisfactory.

It is therefore recommended that this state farm should have its own workshops.

A further difficulty with regard to proper maintenance has been the system of having temporary drivers-this is however being changed.

1.3.3.6 MECHANISED FARMING PROJECT-PHASE II

Which has been technically accepted by the world bank but awaits financial clearance is for development of 500,000 feddans: of which

a) 350,000 feddans will be East of Sam Sam Project in Kassala Province; to grow sorghum and Sesame.

b) 150,000 feddans will be in Habila area-where private enterprise has already developed land for Rainfed cultivation of Sorghum and "AKALA" short staple cotton. World Bank's contribution is expected to be 8 million dollars, which would not only cover the cost of development of land; but also of some essential gravel roads in the area .

Drinking water supply in these areas which have rainfall of 500-800mm per year is from "HAFFIRS"- natural storage tanks.

1.3.3.5 MACHINERY REQUIRED FOR CROPS

a) SORGHUM-land preparation by wide level disc harrows, seeding by above, along with seeder box and harvesting by combines.

b) SESAME- land preparation wide land disc harrows, at present being sown by broadcasting, but seeder box is being tried. For harvesting problem see Chapter 8.

c) Cotton(AKALA)was tried in Sam Sam area but was given up as the area is remote, spraying and ginning costs were high.

d) New crops Sun Flower and Safflower are being tried. Ground Nuts are not popular in this area because of heavy clay

The general allocation of equipment is therefore one 65 H.P Tractor- with wide level disc and seeder box per farm.

1.3.3.7 HOLDINGS AND REPAIR FACILITIES FOR MACHINES AT SAM SAM

Details of the present M/c's held at Sam Sam are given in table 1. It will be noted that largest proportion of tractors 150 Nos are of NUFFIELD make- as this firm's tender was the lowest.

The 40,000 feddan state farm about 24 km away holds Massey Ferguson (M.F.) and Zetter tractors.

The Combine harvesters are of three different makes first to be used were John Deere presently in useare IT. The CK 4M USSR harvesters have not yet been used. IT were giving 40% of header losses because of lack of Durra harvesting attachments.

The choice of the general public is for Class harvesters of which large numbers are held at Gedaref area; the price of the Class being slightly higher it is not purchased by the government. The need for evaluation is therefore essential see para.6.4.

Private works shops at Gedaref are good particularly of May Working Corperation for IT tractors 15 workers and state trading corperation for Ford tractors 8-10 workers.

It is recommended that the workshop at Sam Sam which is a well equipped repair shop-should be expanded where the world bank scheme Phase II for Sam Sam is approved. The spares holding also needs to be examined.

1.3.3.8 N.F.C DEVELOPMENT SCHEMES BEDY AND BLUE NILE PROVINCE

In addition to the new proposals under consideration of the World Bank- para 1.3.3.6 the NFC has the following Schemes :

Location	Present Area Fd.	Extension-Feddans	Remarks
Renk	250,000	250,000	
Blue Nile Province			
Dali	33,000	-	
Maamum	106,000	160,000	
Kamtour	10,000	-	
Agadi-East	300,000	-	
Agadi West	100,000	300,000	200,000 feddans expected to be financed by Kuwait
Abu Nuhar (EA et of Nile)	100,000	100,000	
Dinder	142,000	100,000	
Total	1,041,000	910,000	

1.3.3.9 MFC'S ESTIMATED REQUIREMENTS OF MACHINES AND FUNDS

According to the Chairman the requirements of MFC in the coming five years would be of the following order:-

Machines	Nos'	Likely Cost
Tractors	3000	£ 5 million
Wide level Discs with seeder boxes	3000	3
Combined Harvesters	1000	5
		13 million £

of the above amount he expects World Bank financing of 8 M and Kuwait of 1.6 M.

The area proposed to be developed in Renk and Blue Nile province appears excessive, and also the requirements of combines.

For adjusted estimates see table II of Annex 3

1.3.4. <u>AGRICULTURAL DEVELOPMENT CORPORATION</u>

Director—NAIM MOHAD OSMAN.

The scope of this corporation is to develop new schemes for irrigated cultivation. It has the following under its control:-

a) Tamboul Pilot Farm

b) Suki Project

c) Rahad Scheme

1.3.4.1 <u>Tamboul Pilot Farm</u>

This is a pilot farm run by a Dutch company financed by World Bank; for development of Suki and Rahad Projects.

Total area is 500 feddans of which 150 is under cotton and 200 under Ground Nuts. Yields are 1 ton per feddan for Medium staple cotton ; and 1.7 ton per feddan for ground nuts. All Stages of the project are being mechanised; cotton picking is not yet successful. Long furrow irrigation is being practised

M/C's held	Tractors	3
	Ridgers	2
	Grader	1
	Digger Shaker	1

The present contract expires by 30.4.1972.

1.3.4.2 <u>SUKI</u>

This is based on pump irrigation from Suki on Blue Nile Area to be developed 90,000 feddans; of the 85,000 feddans under Cultivation in 1971 crops on 40,000 feddans have perished owing to inadequate irrigation. Ten villages are being developed, each tenant will have a holding of 10 feddans—5 under cotton and 5 under groundnuts, on similar basis to Gezira.

Scheme will be handed over to Suki Agricultural Corporation to be formed later.

Repair and maintenance is done at present by four mobile workshops

at Sukij a new workshop is under construction and the equipment is on order.

1.3.4.3 RAHAD

This project is to be based on LIEK canal [illegible] TO Rahad River 190 km.

Planning is for total area 1-1.2 million feddans of which Phase I will be for 300,000 fds. half the area will be for cotton.

Financing proposal with World Bank is not yet clear

1.3.5 PUBLIC AGRICULTURAL PRODUCTION CORPORATION

Director El TAYIB ABDEL GADIR

This Corporation has four schemes

a) Nuba Mountains (Rainfed)
b) Yashim El Girba (Irrigated)
c) Gash } Flood Irrigated
d) Toker }

1.3.5.1 NUBA MOUNTAINS

Rain fed cultivation of cotton (AKALA) has been traditional on 250,000 feddans in the Nuba Mountains (Dilling and Kadugli) area. Crops sown are cotton, Durra, Sesame and G. Nuts. The corporation is interested in the 45,000 feddans under cotton, crop protection etc. Cotton is picked by hand and is supplied to local ginning factories (6 New) for utilisation in Khartoum Textile mills.
Farms of 1000 feddans each are being demarcated for taking over by M.F.C.

1.3.5.2 YASHIM EL GIRBA SCHEME-CONSULTANCY-M. Y.A. DASH

Based on use of waters of River Atbara, a dam was completed at Khasm El Girba in 1964. In accordance with 1959 Nile waters agreement 120,000 feddans was earmarked for resettlement of people of inundated Wadi Halfa; the township is therefore known as New Halfa.

1.3.5.2.1 LAND USE

	Feddans
Rotation of cotton, ground nuts and Wheat crops	330,000
Freehold land for Wadi Halfa emigrants in in compensation, for growing vegetables etc.	25,000
Sugar Scheme	45,000
Forests	2,700
Research Farm	870
	403,570

1.3.5.2.2 IRRIGATION SYSTEM

Main canal 26 Kilometers long which divided into 3 branches which run parallel through 80 km. of the scheme . Abu XX and VI'S as in Gezira scheme; were originally designed for night watering, but, this was not liked by the tenants.

Owing to localized down-pours in July-Sept. and danger of folding, drainage channel has also been provided.

Besides gravity fed channels there are two points on the main canal for lifting water by 4 pumps. Each of 3.5 m^3/sec capacity.

The water pumped is sufficient for 12,000 feddans.

1.3.5.2.3 AGRICULTURE

AFALA cotton is well established, wheat was being planted, but the area for ground-nuts was only partially utilized. Extensive experiments were being made by the research station; and project authorities were carrying out experiments on mechanization of cotton cultivation based on adaptation of UKRA/GEZIRA.

Similarly research for improvement of wheat and ground nut crops were in hand.

Sugar cane was planted on 16,500-18,000 feddans; to eleiminate "SOUT" they are now working on 3 years fallow and 2 years cropping.

1.3.5.2.4 AGRICULTURAL EQUIPMENT AND WORKSHOPS

The scheme has 281 Tractors MF2 50 and over 500 other M/cs,

the present workshop is congested. A new workshop has been planned about 2 km away; the stores and office buildings have been erected but the main workshop building has not yet been built.
Spare parts situation is acute for MTZ 50's- bearings, tyres and tubes electricals etc.
There is a mobile workshop which can be sent to the 19 inspectors yards each having a one Mechanic and an assistant for day to day maintainence.
This mobile workshop also looks after the needs of the small amount of machinery held by the research organization.
It is recommend that urgent steps be taken to :-

(i) Build and staff the new workshop.

(ii) Obtain spares for Russian Tractors particularly as the agents, the Provincial Transport Company Khartoum donot hold adequate spares, nor have they stocks of guarantee spares which should have been supplied by the makers.

(iii) Consider replacement of 110 tractors supplied in 1965 and 110 in 1966.

(iv) Establish additional small workshop-as mobile workshops cannot move during rainy season,

(v) Train additional No. of agricultural M/C Mechanics at the I.L.O. training centre at Wad Medani .

The sugar factory also has 60 MTZ 50's, of which 50 are kept effective by their own workshops-plus heavy earth-moving equipment and approx 40 and 50 trucks which they maintain at their own workshop.

The sugar factory holds 11 sugar-cane harvestors worth £12,000 each, which are not being used, alternative use should be investigated .

1.3.5.3 GASH - During the rains, river Gash near Kassala, forms a delta which is irrigated by the flood. The area varies according

to the intensity of the flood- In 1971 only 35,000 feddans were available against an average of 60,000 feddans.
Castor of dwarf variety is grown from Hybrid Pacific-6 seed imported from USA. yield is approx. 4 Tons per feddan, the seed is hulled in locally copied hullers.

1.3.5.3.1 W/C REPAIR FACILITIES

~~W/Cs held D7 = 2~~
~~D4 = 1~~

~~Wheeled Tractors =~~

~~Motor = 1~~
~~Grader~~

Machines held by the scheme are:-
D7's = 2
D4's = 1
M.F Tractors = 7
Motor Grader = 1
Castor Decorticating Machines = 8

Number 19 Total

~~These are~~ are 8 castor decorticating machines, ~~which~~ are driven by Massey Ferguson Engines.
There are four separate workshops for:-

(a) Cars
(b) Heavy W/Cs.
(c) Tractors
(d) Production of Castor dehulling W/C's .

Considering that only one W/C worth £ 300 is manufactured per year, and the small number of W/C's serviced, the numbers of workshops could be reduced.

1.3.5.4 TOKAR 90 MILES NORTH OF PORT SUDAN

Based on flooding by River Baraka the area various between 50,000 to 100,000 feddans., cotton Akala in grown.
The use of machinery is limited to earthworks for directing the flood water. Animal drawn implements are also used, but the main work is done by manual labour.

1.3.6 AGRICULTURAL REFORMS CORPORATION

Director Abdel Azim Mohd.

This corporation formed in 1968 took over private schemes onthe rivers previously owned by companies; with an idea to convert these into ccoperative Societies.

There are 240 units gross area of 800,000 feddans.

All the farms are at present being irrigated by diesel driven pumps for which the supply of spares is a problem, as these are of various makes. It is proposed to convert these into larger groups and to install electrically driven pumps.

The General pattern of Cropping is 1/3 rd. Cotton
1/3 rd. Durra
1/3 rd. Fallow

The Use of fertilizers is being encouraged and the tenants are being supplied Urea at £ 30 to £ 34 per ton at actual cost. Best application for cotton has been found to be after greenriding 6-10 weeks after planting and watering thereafter. Loans are granted to tenants at various steps:-

Deep Ploughing
Ridging
Sowing
Fertiliser application
1st, 2nd. and 3rd. Weeding etc.

1.3.6.1 BLUE NILE SOUTH OF SENNAR

300000 feddans. Largest farm is MASSARA 10,000 feddans.

Three croprotation, cotton 93,000 feddans, followed by Durra and Fallow.

1.3.6.2 WHITE NILE-SOUTH OF KHARTOUM

50,000 feddans cotton. Wheat was tried at DUEIM (Also at ZEIDIAB when this farm was under ARC) but is not being grown

as the cost sharing 47 1/2 % by the farmer is not economical or fair to the corporation.
Wheat can be grown in this area and in view of the large import of wheat and wheat flour it would be worth reviving the system and adding new lands to these schemes.

1.3.6.3 SOUTH OF KOSTI -

300,000 feddans of which 93,000 feddans is under cotton tenants also grow ground nuts & vegetables. The growing of G. nuts depends on Market conditions.
For development of vegetable seeds & seed propogation stations have been established at HUDEIBA as well as Nuba Mountains(DAMIA).

1.3.6.4 AGRICULTURE W/S'S AND REPAIR FACILITIES

The corporation tookover a large number of tractors of different makes; fair number of FORD-SONS were inherited from Sudan Production Company.

The corporation has now purchased 200 M°S MF 50 Tractors which are alloted to:-

Blue Nile - 80
White Nile - 40
South Of
Kosti - 80

No implements were originally purchased,

DISC Ploughs - 90
Ridgers - 200

are now being purchased.

1.3.6.4.1 One Engineer and two Technicians were sent to HUDEIBA for training for 2-3 months.

Workshops are available for light repairs also
Sennar
Kosti
Dueim

Three mobile workshops have been purchased-two more are due from USSR. Supply of spares is through local dealers.

3.3.7. [illegible]

3.3.7.1 [illegible] As mentioned previously this area was not visited owing to unsettled conditions.
A course for training of tractor drivers (30) and agricultural supervisors is being run at present at Khartoum to develop the mechanisation of the area.
A very important scheme for diverting the white Nile from Jongle to Malakal is under consideration-when realised it will be of great benefit to these parts.

3.3.7.2 RICE PRODUCTION BAHR EL GHAZAL

The area under crop in Bahr El Ghazal is 12000 feddans which will increase to 21,000 feddans by the end of the 5 year plan.
The main localities are Wau and Aweil which have a rainfall of over 1000 m.m. The rice is grown on "Toichor" or may low-lying riverine plains which are inundated by the over flow of the river during rains. The flooding not only provides water but also enriches the soil by deposits of silt which makes the soil fertile.
The soil is prepared by disc ploughing followed by two discing by wide level disc to kill off the weeds. Seeding is by seeder box attached to the wide level disc.
Weeding and Harvesting is by manual labour.

3.3.8 [illegible]

Director Mr. Sadig Bedri

3.3.8.1 This ministry has taken over administration of various agricultural schemes in the co-operative sector recently (during 1971); under the following heads:

A) Direct Administration of Government irrigated estates in the Northern Provinces. Presently there are 60,000

feddans and another 60,000 feddans are to be developed.

B) Administration of existing agricultural cooperative societies in :-

i) Irrigated; Northern area-50,000 feddans

ii) Rainfed; Kassala and Blue Nile - 300,000 Feddans

C) Guidance to cooperative societies for Harvesting and Ploughing and Marketing.

The office of the agricultural cooperatives has a staff of about 16 agriculturists and a mechanical engineer.

1.3.8.2. GOVERNMENT IRRIGATED ESTATES

The largest of these estates is Zeidab-30,000 feddans which was previously under the agricultural reforms corporation, this farm with 3 pumping sets on the Nile has an area of 7,300 feddans under ACALA (cotton) .
There are 9 other farms of area 2000-7000 feddans which are operative It is proposed to change over to production of fruits (Dates, Citrus Mangos and vegetables . An out lay of half million pounds is envisaged of which £ 300,000 would be for Diesel Pumps, it is proposed to standardize on a one m^3 per sec pulsometer type pump, with a total head of 30 m.

1.3.8.2.1 NEW DEVELOPMENT

14 New farms with a total area of 60,000 feddans are to be developed in the Northern province. This will be in two phases 1st phase 20,000 feddans.

1.3.8.3.3 MACHINERY REQUIRED

A tender is under consideration for supply of the following machinery for the development of the existing 60,000 feddans plus 20,000 feddans in phase 1

Tractors - 70HP = 100 DOZER Blades and Back Hoe = 20 Trenchers
Garden Tractors = 15
3 Furrow Reversible Mold Board Ploughs 80 Hydraulic Excavators on
Bedford 4X4 Chass is =5-10
Four wheel drive
Rotary Cultivators = 45
Rear Mounted Grader Blades = 30 Hydraulic Excavators=5-10
Single Furrow Ploughs= 20 Trailers-5 ton= 16
pull type Harvestors= 8
Ridgers = 15
Electric Welding W/Cs= 2
ALFA-CUBING W/C = 1

The specifications of this department are different to the specification of the department of agricultural engineering(See Standardisation Chapter 7.)

1.3.8.2.3 HOLDINGS AND REPAIR FACILITIES FOR W/C'S

It was stated that at present most of the work is being done by animal drawn implements, but it is proposed to stop use of draught animals, as it is uneconomical. At present about 10 tractors are locally hired for the cotton plantation at Zeidab.
Each farm has a mechanic or two with a small workshop. A central workshop is located at Atbara.

There are 4 private workshops at Dongla which are giving good service.

1.3.8.3 AGRICULTURAL COOPERATIVES

1.3.8.3.1 IRRIGATED AREA IN NORTHERN PROVINCE-50,000 FEDDANS

These are of sizes varying from 20-1000 feddans. These were taken over only six months ago and extension service has been started.
The main problem is the high cost of spares required for pumps which are old and need replacement.

1.3.8.3.2 RAINFED AREA 300,000 FEDDANS

These coop. farms are in Gedaref, AGDI.HABILA,RENK, KOSTI districts. At present the department is concentrating on the 17 coops in Renk area, offering Zetter tractor from agricultural bank; the firm of SUHADA agents for these tractors is helping with spares and repairs.

1.3.8.4 MECHANIZED COOPERATIVES

1.3.8.4.1 PLOUGHING AND HARVESTING

There are approx 33 cooperatives in KASHIM EL GIRBA formed by the settlers from Wadi Halfa; they own between them 51 tractors and 25 combines. Repair is carried out in road-side workshops at New Halfa.
The Northern Gesèrfa mechanical Harvesting cooperative located at Kilo 114 Hasand owns ~~nowadays~~ 60 combines; 40 Class and 20 John Deer combines. Similar cooperatives are in Khartoum, Kassala, Northern Provinces.

The main problem is the maintenance of the machines and availability of spare parts.

1.3.8.4.2 MARKETING

These cooperatives are mainly for marketing of Ground nuts in Gezira and other areas.

2. CROPS AND MACHINES REQUIRED

2.1. GENERAL - IRRIGATION

The main irrigation canals are dug by the Ministry of Irrigation, but the ABU-ESHRINI designated as ABU XX which are 1.8 m wide at the top, .6m at the bottom and .75 m deep which are required for watering 90 feddans area, and ABU SITTAS designated as ABU VI which are 12" inches to 16 inches deep are dug and maintained by the agricultural departments.

For digging ABU XX the department uses "MORKIGT" ditchers which are pulled by D6- 200 HP tractors and are imported from Holland. These are received in dismantled condition and are assembled at the SAMUEL COLLEY'S workshop for Caterpillar equipment at Wad Medani.

For construction and maintenance of ABU VI a special blade is pulled behind a D4 tractor, fitted with a toolbar 7½"X 4" . The blade which is V shaped is made of high carbon steel.

This blade can be manufactured locally, the total number in the country would be 100-150 and the requirement per year is limited. This blade can also be pulled by any other 65 HP tracked tractor.

2.2 COTTON (cap)

The production of cotton, the source of main foreign exchange has and will continue to be given top priority. The area under cotton in feddans has been as under:-

	1968	69/70	70/71
Long staple	275,159	824.662	818.482
Medium "	138,917	102,465	178,857
Short Staple	240.867	295.208	200.729
	1.154.943	1.257,911	1.198,068

The normal method of cultivation is to plant after ridging.

2.2.1 IMPLEMENTS REQUIRED

The following agricultural implement afe required for this crop:-

(A) Land preparation	Implement	REMARKS
Deep Tillage	Deep pentetrating blades on D 8 Tractor	Used in Gezira area
Tillage	Disc plough 3 or 4 furrow	
Tillage	Off set. Disc Harrow	Light design
Tillage	Wide level Disc	In Habila rainfed area for short staple cotton
Ridging	Tool bar with Ridging attachment	Massey Ferguson type welded, preferable to Ransome type which is Cast Iron.
Green Ridging	Green Ridging attachment	Locally fabricated for Massey Ferguson.

(B) Planting

Present sowing is by hand

For non-delinted seed Planter	Russian type (under trial)	Preferable to John Deer type which is linted seed.

(c) Fertilizer Distribution

Present method broad casted by hand	Broad cast type Centrifrigal	Not recommended for Economy in fertilizer
	New Distributor	Hand pulled type of local design needs development for production.

(D) (-)

(d)	Harvesting Present method by hand.	Cotton picker Russian type (Under trial) also John Deer Picker under trial	In trial stage; this type is easier to manufacture

(e) Land Clearance, Present method manual

Stalk Puller	NIAE- Design (Under Trial)	Machine to be produced
Sweeper	Trailed type	Local design to be finalized

2.2.2 MECHANIZATION EXPERIMENTS

Both at Research stations at Girba and Tambul; experiments are being conducted on mechanization of cotton cultivation. The experiment at Girba was previously by Russian experts. This year it is on a 100 feddan plot and is of special interest as it not only uses the long furrow irrigation system; but also makes use of special equipments as described under:-

The land is prepared by deep ploughing 25cm, using disc ploughs and levelled. A planter which uses undelinted seeds, plants in 4 rows- 90cm apart, plants at 15-20cm; 3 to 4 seeds per hole. The planter has an attachment which makes small furrows between the rows for irrigation. The furrows are then increased in size using ridger on a frame mounted on tractor.

Weeding is by inter-row cultivator mounted on tricycle tractor, Fertiliserapplication is mechanically done, 5 cm from the plants.

When the plants are ready they are clipped and are sprayed to defoliate; Picking is by a Russian type machine which appeared to be of simpler construction than the Western types.

2.2.3 In the Sudan because of various diseases which must be controlled, one of the most difficult operation is the cleaning of the fields after the sowing season is over. The cost of stalk pulling and clearing a Hawasha (5 feddans) of land is of the order of LS. 10-12 for removal of stalks and LS 5 for sweeping and burning.

These operations have to be carried out in the middle & summer when the tenants go away, labour is difficult to obtain so the mechanization of stalk pulling & sweeping are very important.(see para[illegible] development M/C's)

2.3 GROUND NUTS

The production of ground nuts was increasing upto 1965/66 after which area under cultivation and production decreased as shown undert-

	1965/66	1968/69
	Feddan	
Irrigated area	130.700	93.300
Rain-fed area (Kordofan & Darfur)	804.200	626.300
TOTAL	934.900	719.600
Production	304.600 tons	163.600 tons

However in 1970/71 the area increased to 903,309 feddans and the production was 351,133 tons

Ground Nuts are a source of foreign exchange earning which was of the order of £ 10 million in 1964/65 but reduced to £ 4.6m in 1968, thereafter there has been an increase The problem of production is related both to market conditions as well as the degree of mechanization.

Yields in the irrigated areas are almost double, but harvesting is more difficult owing to type of soil, nuts have to be washed before marketing for which machine has been fabricated by the agricultural research Corporation.

At Hashim Girba only 10% of area designated for Ground nuts is at present being cultivated as tenants are not so interest in the crops

2.3.1 The following special agricultural implements have to be considered for this crops

	Machine	REMARKS
(A) Planting	Planters; John Deer type modified	Undercorticated ground-nut, planter is required.
(B) Harvesting Digger, Shaker & Windrower	Bonthall Type or Lillyastone	Slat type convey or could be manufactured locally
Lifters	Locally fabricated blades attached to purchased Shanks	They are being manufactured at Girba workshop
Thresher	Bonthall stationery type. Capacity 300 tons/12 hrs	35Threshers are at Girba and 60 at Suki. These are of timber construction and can be copied.
(C) Marketing Washer	Locally developed machine(S.G.B)	Washing of ground nuts grown in clay soil areas is necessary.
Decorticator	30 Ton/shift	A locally copied machine available from SHUMADA. Company at Khartoum.

8.4 Durra (Sorghum)

This is the main cereal crop of Sudan. The areas under cultivation and production during the last 3 years was under:

1968/69		69/70		70/71	
Area	Production	area	Production	Area	Production
2,823,423	890,046	4,344,885	1,498,913	4,668,361	1,529,277

It will be noted that both the area under crop and the production has been increasing. The mechanized farming corporation which will develop the rainfed areas, will contribute to further increases.

The implements used for Durra production are the wide level disc with seeder box, used both for land preparation as well as planting.

The main problem in harvesting; there is little drinking water in the rain fed areas at harvest time, & labour is not available. Size of the farms 1000 feddans makes harvesting by combines obligatory.

The Massey Ferguson combines need a special attachment for harvesting Durra otherwise there are up to 40% header losses. The Class company has developed a special Durra harvesting header which costs 1600. The Massey Ferguson header attachment can be manufactured locally.

2.5 WHEAT

The present production is in the following areas:-

Gezira-Ag	155,000	feddans.
Agricultural Production corporation	110,000	will be extended to 170,000 by 1978
Private	45,000	
	360,000	feddans.

The import of wheat & wheat flour in year 1970 was worth LS 3,258,544 further it is estimated that usage of wheat will increase from 9.25Kg per head/annum to 21Kg by 1980. Expansion is envisaged both horizonally and vertically; high yeilding Mexican varieties with higher application of fertilizers are proposed.

The actual areas and production in thepast 3 years were:-

1968/69		69/70		70/71	
262,476	128,195	290,167	115,254	294,055	134,524

The problem of wheat production is not limited by abailability of machines and implements, but by social and agronomical problems.

Sudan requires a variety which is:-

Late sowing
Matures early
Is Rust resistant
& shatter " "
and requires least number of waterings.

The operations for production of wheat are fully mechanized from seed bed preperation to harvesting. Implements required are, off set discs, wide level discs for planting & combines.

2.6 Sesame

This is again one of the main foreign exchange earning crops. The main problem is of harvesting which is dealt with under chapter 8 The production & areas under cultivation in the past 3 years were:-

1968/69		69/70		70/71	
1,320,494	154,353	1,356,002	175,152	1,772,847	282,275

2.7 Ganter

This is mainly grown in Gash area for export of its oil seed.

The actual areas and production in the past 3 years were:-

1968/69		69/70		70/71	
24,823	10,940	44,893	23, 182	34,610	17,276

Hullers are manufactured at Gash workshops using existing design, with imported engines:

The problem of harvesting would be easier when combinable variety as seen at Houdiba experimental farm is developed.

2.8 Rice

Mainly grown in southern states see para the actual areas & production in last 3 years were:-

1968/69		69/70		70/71	
Feddans	tons	Feddans	Tons	Feddans	Tons
6500	?	7890	2905	11,555	6,098

Rice is planted by seeder box attached to wide level disc directly bot by transplanting. Weeding and harvesting is by hand. Threshing is partly by machines, hulling by hullers imported from Germany & Japan.

2.9 Sugar Cane

At present is being mainly cultivated at Guneid and Hashim El Girba along with the two sugar factories. A third factory is planned in the Sennar area.

At Girba factory 42,000 feddans are cultivated of which nearly 18,000 feddans were under crop during the season Nov-June 1971-72. To get rid of smut disease the pattern of cropping is 3 years fallow and two years crop.

The following special machines implements have to be considered for this crop:-

	IMPLEMENT	REMARKS
(A) Land Preparation	Special plough Rome-type T.Y.H.H Disc's 50" ex USA	effect disc harrow penetrates 25"
(B) Planting	Device for planting of sets	locally developed shuts.
(C) Harvesting Present harvesting is by hand	Combines	The present types at Girba are not successful
(D) Transport	Trailers "Bunger" type	Local manufacture possible

* Claas company of West Germany has developed a sugar cane harvester capable of harvesting

35 Tons/hr of Green sugar cane
30 " Burnt " "

it is driven by a 170 H.P Mercedes Engine and converts the sugar cane into lengths 30-35 cm.

The cost is reported to be of the order of 120,000 DM-FOB
The cost be worth trying out, though very expensive.

3. MANUFACTURING PROPOSAL-FOR AGRICULTURAL TOOLS AND IMPLEMENTS

3.1 General

The Government of Sudan had made a provision for setting up a factory for agricultural machinery in its five year plan 1971-1972---1974-75. This is to be first of the twenty industries planned for the public sector, total capital investment is 36.4 million.

3.1.1 Requirement of Machines and Implements

No reliable, detailed and up-to-date figures are available of agricultural machines and implements at present in use nor a dependable estimate of the future requirements could be obtained. The team therefore tried to obtain information on the figures, from various sources which included:- Foreign trade statistics agents, corporation etc.

The estimated holdings of agricultural machines as in November 1971 are given in table 1 annexure 2 and their likely requirements in the five year plan is shown in Table II annexure-3

The volume of production of tractors (Para 4.2.3) has been estimated on the basis of these tables; the numbers of Implements to be manufactured have also been assessed from these tables, but will need confirmation by market survey.

3.1.2 Hand tools

Hand tools such as shovels, spades, Rakes, axes, shears and secouteurs are imported. Others such as hand hoes (Torea), NAGAMA'S, KADANKAS GARAYA'S, Sickles and Kahs, are fabricated blacksmiths from scrap iron. WASUG'S & SALUKA'S which are of timber mainly are manufactured by village carpenters.

It was not possible to arrive at an estimate of future requirements however from inquiries made at the department of horticulture it was learnt that the annual demand for their department would be of the following order, and the demand will double every two years:-

Shovels	1000
Hand Hoes(Torea)	1000
" Rakes	1000
Shears, secouteurs	300
Budding &grafting Knives	300
Wasug- (Timber)	300
NAGAMAS	2000
SICKLES	3000

The spade in general use appears to be inefficient, being too small and light, the NAGAMA, SICKLES, KADANKA'S being in more common use should be taken up for manufacture, from suitable rough forgings and steel to be imported.

A sketch showing the special tells used in the Sudan is at annex 4

3.1.3. Animal Drawn Implements

There is a deep rooted prejudice against the use of animal drawn implements, which is partly due to the high cost of maintaining farm animals which require feeding all the year round and only work for short periods in the year.

The only organisation which was willing to consider use of animal drawn implements was the Savanna development project but their requirements would be too small.
Manufacture of animal drawn implements is therefore not recommended.

3.2 **Manufacturing Potential**

The major manufacturing facilities are in government workshops, but a certain number of workshops are coming up in and around Khartoum which are taking up manufacture of agricultural implements either on behalf of importing firms or against tenders.

3.2.1 **Foundries** are located at :-

(a) **Atbara** Railway workshops
4 cupolas for cast iron.
4 oil fired furnaces for Non Ferrous.

Present production 53 tons cast iron and 20 tons Non ferrous castings per month

(b) **Khartoum** Workshop of Sudan Gezira Board has two oil fired furnaces-rotary capacity 100 Kilos- production of spares 300 Kg per day.

(c) **Wad Medani Irrigation Workshops**

Two oil fired furnaces 150 kg capacity for production of spares.

(d) **Khartoum North**

Ministry transport steamers department workshop. At present makes non-ferrous casting using oil fired furnaces.

A 400 Kg capacity cast iron coke fired cupola is on order with Atbara workshops.

(e) **Khartoum Central Ministry of Works**

2 small oil fired furnaces each 250 Kg capacity. New foundry being set up building 61 m x 19m with imported 1 ton capacity oil fired rotating furnace is under construction. It has a good pattern shops

(f) **Khartoum Central Foundry**

Under planning, Yugoslavs UNDO Assistance proposed capacity 2,500 tons per year

One coke fired cupola.
Maximum weight of casting 1.5 tons

(g) The Kashim el Girba sugar factory has a small oil fired 50 Kg capacity furnace, which is being used for production of spares; the Guniad sugar factory workshop is also reported to have similar facilities.

(h) The mechanical transport department under the army has a foundry cast number plates produced are good

(i) An imported coke fired cupola was tried by glass works in 1969 but it was not a success

(j) In the private sector there are:-

(I) Teckne Works -500 Kg per day oil fired cupola
(II) Omdurman Engineering workshop

3 Crucibles 60 Kg capcity each

3.2.2 Forging Shops

These are located alongside the foundry shops as mentioned in paras (a)-(e) above.

The best equiped shop is at Atbara railway workshp with four Massey hammers up to 20 cwt capacity; a drop stamp Massey and a Ryder-Reding hammer.

Heat treatment facilities were seen only at the irrigation workshop Wad Medani- the equipment is out of order since it was supplied by the July Corporation. Atbara workshop and marine works at Khartoum have heat treatment facilities.

3.2.3 Machine shops & Welding facilities- Khartoum

In addition to the machine shops located at all the government work shops mentioned above, there are some fairly good machine shops and welding facilities at private workshops approximatly 8 in and around Khartoum. Details were submitted with visit reports attached to interim report.

3.231 These firms are manufacturing the following, with imported components like springs, bearings & wheels etc

(a) Trailers 5 Ton welded structural steel body 4000 X 1900 turn table steering

(b) Tankers- Water & Fuel

(c) Greenridger-Blades

(d) Decortieator for Ground Nuts capacity 30 tons per shift

(e) Flour Mills-small

and are capable of manufacturing small machines under technical guidance if supplies of raw materials and critical parts can be arranged.

3.2.4 Other Supporting Industries

At present the main industries in Sudan are agro-industries but there are the following industries in production which could have a bearing on the production of agricultural implements & Tractors:-

(a) [illegible]ed trucks assembly plant at Port Sudan-capacity [illegible] trucks per year

[illegible] takes complete assembly &Welding & Painting of cabs.

(b) Liquified gases, welding electrodes at Khartoum.

(c) Paints factory at Khartoum

(d) Storage Batteries- manufactured under licence from

Belden (Sweden)
at Khartoum.

It is understood that import of batteries with tractors & vehicles is now forbidden.

3.2.4.1

small scale industries for which development plans were suggested by a previous UNIDO expert have not been developed at Kassala and New Halfa . The railways at Atbara build railway coaches but import fittings; which could have been supplied by small scale industries.

3.3 Location

The need for development of production facilities for agricultural implements is urgent and therefore only four possible locations were considered namely; Port Sudan, Atbara, Khartoum and Wad Medani places like Sennar and Gedaref which are not yet connected by road and do not offer:-

(a) Inter-Industry Economies
(b) Urbanisation economies
(c) access to commercial establishment laboratories etc. were not seriously considered.

Although Sennar is at the centre of railway communications, it is 360 Km further from Port Sudan than Gedaref and the extra cost of railway freight will be 22m/s per 10 Kg + 10% surcharge.

Cost wise Gedaref would thus be preferable to Sennar

3.31 Transportation

All raw material including steel and timber would have to imported through Port Sudan till Suakin is developed. There being no proper road link from Port Sudan to the other parts of the country main reliance has to be on Railway which in on a single line, unballasted tracks with small number of locomotives, hence has limited capacity:-

The costs of transportation & time are as under:-

	Atbara	Khartoum	Medani	Time
per 10 Kilos	28m/m tyres 78m/m	41 m/m 112 m/m	47 m/m 132 m/m	15 Days
	Assembled 28 m/m	41m/m	47 m/m	
	By lorries 5 ton £65	£ 80	£ 90	4 Days

Plus 10% surcharge on railway consignment.

3.311 With the transportation bottle-necks and very much higher costs of lorry transport, government allots priorities to movement by railway. These are:-

1st Priority - Cotton & cotton seed - March to June
2nd " Ground Nuts, Sesame & cotton seed cakes Jan-June

The movement of these commodities for export being to Port Sudan the returning wagons would be available to the location in mid country. Cotton is mainly loaded at Wad Medani, Ground nuts and cotton seed cakes from Khartoum.

3.32 Power & Water supply

Power is available in plenty from Roseires up to Khartoum. Atbara & Port Sudan have their own power stations. ~~as well as Diesel Fuel power stations.~~

The rates for power supply for industry are the same all over the country as under for supply at 11 kvs:-

First	30,000 KWH	12m/m
Next	50,000 "	10 "
Next	50,000 "	8 "
Over	130,000 "	7 ½m

Minimum annual demand £ 14.5 per KVA of the max demand in 12 months.

3.321 Water is available in all areas at 35 m/m for cubic meter; there is a shortage at Port Sudan & the cost there is 40 m/m per cubic meter.

3.33 Port Sudan

Would be suitable from point of view of ease of receipt of components and raw materials, but has the following disadvantages:-

(a) The road to the marketing centres is so rough that it would not be possible for implements to be towed by tractors; all despatch of would have to be rail on lorries which would more expensive as these would be in assembled condition.
Informed sources stated that it would not be possible even for assembled tractor to be driven to its destination.

(b) There is no inter industry economy, except that the truck assembly line could, if free; assist in spot welding of sheet metal parts.

(c) No support from technical training institutes or testing laboratories

In view of the above Port Sudan is not considered suitable.

3.34 Atbara

is near the Port and therefore transportation charges of imported materials will be less, but not being connected by road to marketing area will have the same disadvantages as Port Sudan.

There is no supporting industry in the area. The railways workshops have no spare capacity. There are no urbanization economies, the railways provide all amenities to their staff which when copied would be undue financial burden. There is no access to commercial and governmental organizations; hence not recommended.

3.35 Khartoum

with its three cities has many advantages.

(a) Raw Material: Stocks of steel etc are available in the market and fabrication facilities are freely available. So much so that the truck assembly plant at Port Sudan obtains prefabricated chassis strengthening plates from Khartoum.

(b) It is a at the centre of communications by road, rail air, river transport. Post and telegraph facilities are best.

(c) Offers urbanization economies, excellent medical & social services. Housing for staff and workers will not be a problem.

(d) Centre of government and commercial activities.

(e) Yugoslv -UNIDO project mechanical workshop and central foundry will be of assistance in training of personnel & supply of parts.

(f) Khartoum University laboratories carry out testing of materials.

3.351 Existing workshops

There are two large government workshops namely the:-

(a) Steamers Department shop - Khartoum North
(b) Works " " " Central

} which are not working capacity

There is a vacant workshop in Khartoum North belonging to the government which could be used.

Either of these could form the nucleus of the new factory without waiting for construction of new structures etc thereby saving time. There are a fair number of mechanical engineering shops in the private sector which can be used as feeder shops.

3.3.6 Wad Medani

This town being in the centre of Gezira, has many advantages:-

(a) Good communications except towards south; but roads are planned to Sennar and Gedaref.

(b) Excellent road to Khartoum which makes visits to Government and commercial organizations easy.

(c) Offers urbanization economies.

(d) Various tractor and implements supply companies have workshops and stores.

(e) Proximity to SGB engineering development centre.

3.4 Recommended Location

In view of above factor, the best location would be Khartoum; starting in one of the existing buildings.

If however the government considers Khartoum too crowded or for socio-economic reasons wants to develop industrial base elsewhere, then Wad Medani may be selected.

3.5 Agricultural Implements Factory (A.I.F)

3.5.1 Implements to be produced :-

A table showing the agricultural implements proposed to be manufactured is at Annex 5. The products have been divided into three phases; the first phase includes manufacture of some of the locally developed machines, such as fertilizer distributor, Ground Nut digger, washer and stalk breaker. At this stage only one implement a disc harrow of light design- is included.

Products requiring know-how have been relegated to later phases, to allow for time for arranging technical colloboration agreement.

3.5.2 Volume of Production

In view of the fact that prote types of these implements would have to be tested, redesigned where necessary and production would depened on actual demand the plant will be a low volume production unit in phase I , therefore its costs should be as low as possible. Growth of the plant should be catered for and the site selected should space for expansion.
The production of hand tools should taken up from imported rough forgings & market for better tools should be developed.

3.53 The design centre para--5--3-- should be located along -side & possibility inside the plant premises.

3.6 Alternative methods of establishing A.I.F

This study has yielded three alternative courses of action namely:-

(a) To encourage the diversification of existing engineering industries to include the manufacture of a selected range of agricultural implements, the implements to be manufactured by them as per the designs by the design centre, and assistance to be given by the A.I.F by issue of raw material & critical components.

The final inspection to be by the AIF, who would be also responsible for marketing.

(b) to establish a new agricultural implement industry with the assistance of the UNIDO with technical know how agreements and import of critical components for the selected implements from the original manufacturers. The factory would produce implements of own design; and of designs of selected manufacturers under separate agreements with them.

To keep the costs down the factory would utilize the engineering capacity available in the local industry for fabrication and supply of parts of machines against specific contracts. Assembly would be at the factory who would be responsible for quality, marketing etc .

(c) To invite one ofThe existing exporters of agricultural implements, to set up a factory in Sudan. This, may be in conjunction with the factory for assembly of tractors (see chapter 4)

The establishment of a new agricultural implements factory (b) although probably the best long term solution for Sudan will present higher risks then (a) in terms of finance speed of implementation etc.

Alternative (c) offers the greatest number of advantages with the lowest financial risks. However the implementation of such a scheme will take too long as the collaborating firm will not be in a hurry to set up local production facilities and would be more interested in exporting implements for as long as possible.

Alternative (b) is recommended as the best long term solution.

3.7 Recommendations

In view of the urgent need for starting manufacture, discussions were held with BRIG. SALAH. MOHD SALEH- General Manager and with Mr. Khalid Abdullah- Chief Mechanical Engineer of the steamers Department workshops. This workshops which was established over 50 years ago, has an area of approximately one square Km; 8 large shops with total covered area of 50,000 sq meters.

The staff includes four senior mechanical engineers of over 20 year's experience, ten junior engineers with 2-8 years experience and a dozen senior administrative staff. The work force includes ten senior foreman, twenty charge hands and 700 trademan.

The works, has foundry, forging, machining and structural fabrications shops as well as a timber shop. In view of the change in policy, new workshops for repair of steamers are to be established at Kuala and Malakal and this works has surplus capacity which the management is keen to utilize.

They are willing to allot space for the start of the assembly shop for the implements. The works is served by a railway siding; has a tool room with heat treatment facilities and a drawing office which understands ordering of components etc.

The agreement of the management should be accepted and the assistance required by it for establishing the industry should be given.

3.8 UNIDO ASSISTANCE

The management requires the services of the following specialists to start the industry:-

(a) One design Engineer for two years- see para 6.3.3

(b) One planning Engineer for two years
Mechanical engineer with production engineering experience.
For planning requirements of raw materials components. Machine timing and allocation.

(c) One expert in sales and service - for one year
an expert in marketing and providing after sales service, with engineering background

(d) One project Manager- one year
Mechanical Engineer with wide experience

Experience in production of agricultural implements. To coordinate the work of the above three experts and to start the factory production on correct lines.

3.8.1 **Counterparts**

The management would like to train counterparts for the above specialists to be provided by UNIDO and suggest the following arrangements:-

(a) **Design Engineers**

Suitable counter parts are not available, two engineers would be specially recruited. Two fellowship of one year each should be arranged for their training. One will work with the UN. expert while the other is away on training.

(b) **Planning Engineer**

Counterpart will be selected from the existing staff of graduate mechanical engineers and should be given a one year's training fellowship

(c) **Sales and service Engineer**

Counterpart will be selected from existing staff and will be trained on the job by the UN expert

(d) **Project Manager**

Counterpart will be a graduate Engineer with experience who will be selected from the existing staff and will be trained on the job.

Summary:	UN experts	72 man months
	Fellowships	36 man months

4. ASSEMBLY OF TRACTORS

4.1 GENERAL

The May Working Corporation has been importing partially knocked down (PKD) Massey Ferguson tractors in the past and are again doing so for the 1000 tractors which are due to be supplied in early 1972. The tractors in PKD condition are erected at the Company's workshops at Khartoum and Gedaref. A proposal from Massey Ferguson for supply of completely knocked down tractors in (CKD) condition is under consideration of the government, in addition to some old offers by Duets and Fiat companies.

4.2 ECONOMICS

The Sudan Industrial Research Institute has prepared a paper which deals with assembly of motor vehicles and tractors. The Institute estimated a saving of Ls. 100 per tractor in foreign exchange by importing tractors in CKD condition-which would be approx 6.9% taking the CIF price of tractor at Ls. 1450.000.

4.2.1 P.K.D. The Company by importing P.K.D. tractors already saves £ 56 per tractor approx 3.9% ; this is largely due to reduction in Ocean freight, which is not an absolute saving to the country in terms of nett foreign exchange, as the ships of the Sudan Shipping Corporation can and are able to bring this cargo in its own ships. The company is paid approx. Ls. 25 per tractor for erection and therefore the nett saving to the Govt. is only of Ls. 31 per tractor.

4.2.2 C.K.D. The additional saving in terms of importing CKD tractors instead of PKD tractors would thus be of foreign exchange-£ 44(3%only).

As against this savings; the company would have to invest in

workshop Building (2000 sq.m)	= £	50,000
Tools & Equipment (assembly rail, baking oven, paint booth, cranes.)		25,000
Installation of M/Cs. office equipment		5,000
Furniture etc.		1,000
Storage bins, hand tools and work-benches		2,500
Services		10,000
		93,5000
Contingency 6%		5,610
		99,110
	£	100,000

Note:

Above approximate costing is for an assembly line capable of assembling 2500 CKD tractors per year.

4.2.3 VOLUME OF PRODUCTION

As against the costs of assembly line, then other important factor is the number of tractors and types of tractors required annually.

The present number of tractors in Sudan is of the order of 6000 of which 1/6th. may require replacement, therefore there would be a replacement requirement of 1000 tractors annually.

The five year plan estimates a requirement of 8000 tractors; from the analysis of estimated new requirements in table II it appears that the additional requirement would be of the order of 500 tractors per annum; making a total of 1500 per year.

On basis of 300 working days per

On basis of 300 working days per year this would mean only 5 tractors per day of these 1500 tractors; about 10% or 150 would be of 35 H.P. and the balance 1350 of 55-65 HP. Both these models could however be of the same make, even then common parts will be limited.

4.3 INDIGENOUS COMPONENTS AND MATERIALS

From the study of the May Working Corporation's assembly line at Port Sudan it is estimated that only the following components could be substituted at present:-

(a) Sheet metal parts such as fenders, battery box, Hood (if redesigned for welding)which could be made from imported sheet metal pressings.

(b) Batteries-which are locally available.

(c) Seat Cushions

(d) Paint-manufactured locally but the price Le.3.885 per gallon at Khartoum is expensive

4.3.1 CANOPY

It is noted that tractors in the Sudan are operated without any sort of protection from the sun. It is recommended that simple canvas type canopy should be provided, this can also bemanufactured locally.

4.3.2. AIR COOLED ENGINES

All the tractors seen in the Sudan exept 13 No's T 40 tractors imported by the Agricultural Bank in 1969/70 are water cooled. It is suggested that the aircooled tractors should be tested, to determine whether there would be a need to set up a radiator manufacturing industry.

4.3.3 AUTOMOBILE ANCILLARY INDUSTRY

As mentioned before except batteries, there is hardly any other automotive ancilliary industry.
By pooling the requirements of cars, lorries, tractors, heavy road machines etc. it is possible to establish small scale Units formanufacture of components such as filters and gaskets which are required in large numbers and;

a) Radiators see 4.32
b) Lights, bulbs, and wiring harnesses
c) Steering wheels
d) Electrical Parts-Dynamos, starters, Horns etc.
e) Instruments-Amperemeters, Fuel gauges, speedometers etc,
f) Special bolts and nuts
g) Fuel injection pumps etc.

When the local industry is able to provide replacement parts for the assembly and as spares, the saving to the government in terms of foreign exchange will be substantial. The establishment of ancillary industries to cater for supply of spare parts is discussed in para 5.4.2.

4.4. RECOMMENDATION

In the present context where the substitution of parts is of limited value there does not seem to be much economy in setting up an assembly line based on imported CKD parts; the assembly from PKD parts at present being done at Gedaref and Khartoum is satisfactory. However there are other considerations, such as the need to develop the industry.

4.41 If the government is able to enter into an agreement with a reputed manufacturer on favourable term and the collaborator is willing to cooperate by giving prices of components etc it may be worth while setting up the assembly line now.

This would have an immediate effect in reduction of number of types of tractors-(See standardisation Chapter 7) but will also have a disadvantage from point of view of being in a bargaining position. Parts and service must continue to be provided for the existing tractors during the "interim period" in which the number of tractor makes will be reduced. Failure to make such provision will penalize the present owners and will seriously reduce the effectiveness of farm mechanization.

4.4.2 The assembly factory during the first phase should restrict its programme to:-

a) Acting as collection point for imported components and sub contracted parts
b) Assembly painting and quality control
c) Marketing and spare parts supply.

The main development function of this factory would be to assist small scale industries by providing industrial engineering and quality control services to secure approved components. This would be a major contribution to farm mechanization as not only would the tractor industry develop, it would make supply of spare partseasier.

4.5. UNIDO ASSISTANCE

To assist the government of Sudan in realisation of the tractor manufacturing project, the services of an techno-economic adviser for tractor and agricultural manufacturing project would be adviseable.
The expert should advise on matters concerning final evaluation of manufacturing proposals, negotiation, selection of location etc. He should be attached to the theMinistry of Industry.

QUALIFICATIONS	Degree in Mechanical Agricultural Engineering with practical experience in having set up tractor manufacturing line.
Duration	2 years
Location	Khartoum with travel to other parts.

9. REPAIR & MAINTENANCE

9.1. General: There are a large number of non-operative machines, mainly of the old types, not only in the agricultural sector, but also in the Irrigation & Road Departments.
The reason for accumulation of obsolete machine is not apparent, but can be attributed to management, as far as known there has been no systematic disposal of old machines, which makes the situation look worse than actual.

9.2. DISTRIBUTION SYSTEM

The usual practice is for the suppliers of equipment to offer service, spares and training facilities.
The main suppliers and their status is below:-

Firm	Agency	Service	Spares	Training
May Working Corporation	Massey Ferguson	✓	✓	✓
SUHADA. Trading Corporation	John Deer	✓	✓	?
State Trading Corporation	Ford	✓	✓	?
Sudan Diesel	Duffield Ransome	?	✓	?
Provincial Transport Coy	UNIC	?	✓	?
Mahgoub Brothers	International	?	?	?

It will be seen from above that standard of service by the selling firms varies greatly. The only company with standard forms for free services and offering training is the May Working Corporation- though no courses have been held by them lately. The sale agents must also supply operation manuals and spare parts catalogues.

9.2.1 Another factor is that Agricultural Bank is now the main importer of tractors and implements, in 1970 /71 its imports included:-

Tractors Massey Ferguson	-	400
Zetter 5011	-	450
UTZ.50 & 52 & Supur	-	552
T 40	-	213
		1415

Implements - WIDELEVEL DISCS	Massey Ferguson	600
	John Deer	850
Trailers - 2 Wheel M.F.		200
Combine Harvestors		20

After sale through the Agricultural Bank the firms show little interest in respect of their obligations for free service, spares holdings and training particularly in instructing the owner/drivers in care and maintainence .

In India we are preparing a standard for services to bd given by suppliers it may be worth-while for Sudan to enforce a similar standard.

5.3 SPARE PARTS

5.3.1 DIESEL ENGINES SPARES:

No doubt that most of the difficulties of the workshops visited are due to non-availability of spare parts. There being a large number of types of tractor, engines, combine engines and diesel engines for pump-stations; the greatest difficulty is always with fast moving spares for engines. These range from filters, gaskets which need to be replaced periodically to pistons, pistonpins and rings, fuel injection pump parts, seals etc.. which are required at overhaul time.

Until the indigenous automobile industry is developed, possibly in conjunction with the assembly line for tractors(see para-4.3.3) there is no alternative but for the government, to ensure that the original suppliers keep adequate stocks.

5.3.1.1 One of the effects of the recent take over of certain engineering firms has been that, except for a few, most of the firms are now controlled by the government. Some of these firms such as the May Working corporation, State Trading Corporation have been dealing with Massey Ferguson and Ford Tractors respectively for years and have experienced personnel both in their offices, stores and workshops. There are however other firms whose expertise in these matters is limited or being privately owned firms may not have enough capital to invest in spares. To ensure compliance it should be possible to lay down stocking limits for spares, which must be replenished on reaching lower limits. The government helping these firms with licences where required and authorization of commercial loans.

5.3.2 TYRES & TUBES

Next to the engine spares, the provision of tyres and tubes is a big problem. In this respect it may be possible to standardize the types and sizes of tyres to reduce the variety and arrange for bulk imports through a nationalized corporation. (see also para 7.5.6).

There is only one tyre retreading unit at Khartoum which is reported to be working unsatisfactorly. Reasons for this should be investigated and more units encouraged to set up plants. There is no unit for reclaiming rubber, rubber reclaimed from old tyres etc. can be used, when mixed with new rubber for retreading tyres.

5.3.3 ELECTRICALS:

The number of armatures for generators and starters awaiting rewinding seen at most workshops is too many. There appears to be a prejudice or perhaps there is lack of materials & training in repair of these parts. The I.L.O training centre at Wad Medani is well equipped and can train tradesmen where required.

5.3.4 IMPLEMENT SPARES - such as discs, bearings, cutter blades etc. would have to be imported for the present, but cutter bar fingers, springs and other faster moving spares could be manufactured under the auspices of the Implement factory proposed in ~~para~~ Chapt. 3.

5.4 MANUFACTURE OF SPARE PARTS

5.4.1 CENTRAL FACTORY

The government has had under its consideration the setting up of a factory for manufacture of spare parts for public sector enterprizes. The Yugoslav-UNIDO central Khartoum Foundry and Machine Shop would be able to assist in this; but this work would have to be distributed to a large number of small and big workshops-each specialising in a particular type. For repairs of tractors the fast moving spares which require frequent replacement and should be produced are discussed here-under.

5.4.2 ANCILIARY INDUSTRIES

Requirement of spare parts producing industries based on our experience in India relating to the frequency of replacement of components during a tractor's effective life is:-

1-	Filter Elements	15 Nos.	Setting up of factory packing already approved
2-	Gaskets	10	Sets
3-	Brakelining	6	one factory for both
4-	Clutch Lining	4	
5-	Oil Seals	4	
6-	Battery	4	
7-	Piston Rings	4	Allied factory
8-	Pistons	2	
9-	Piston Pins	2	
10-	Inlet & Exhaust Valves	4	
11-	Valve guides	2	
12-	Timing Chain	4	

13- Fuel Injector Pump Nozzle		6	One Factory
14- Fuel Injector Pump Elements		4	
15- Fuel Injector Delivery Valve		4	
16- Silencer Muffler	3	3	Can be undertaken by any existing unit.
17- Tie rod ends		3	
18- Drag Links		3	One Factory
19- King Pins		4	*
20- Tyres		8	*

* Figures doubled to cater for Sudan conditions.

It will be seen from the above that approximately nine factories or units of production are required to manufacture tractor spares, which are used in larger numbers. These units could also meet the needs of automotive industry as well as for engines used for pumping stations.

5.5 REGIONAL DISTRIBUTION OF WORKSHOPS

Where as there are adequate workshop facilities in certain places, there are areas in which there is a shortage of capacity now and other areas which are being developed where workshops establishment/expansion must be planned now to provide adequate backing.

The New Halfa workshops which is held-up owing to some procedural difficulty must be established urgently. (see para 3.5.1.1.) It will have nearly 1000 diesel engines dependant on it for repair and an engine overhaul line on the same basis as at Merigan or Steamerla Depot. workshops, need to be provided.

5.5.1 The Mechanised Farming Corporations is going to increase its operations in Sam-Sam

Nuba Mountains
Nouk and Blue Nile Province

There is likely to be a large additional population of tractors (1000) and combines (500).
The Samsam workshop should be expanded (see para 3.3.7). For the Blue Nile area it is reported that the North-Korean government had offered to supply a workshop at a cost of £100,000 at AGADI. Inspite of repeated inquires no information on its present status could be obtained.

It is recommended that urgent steps should be taken to expedite the setting-up of repair workshop in Agadi area & Shala farm GEDAREF.

5.6 TRAINED PERSONNEL

5.6.1 The government of Sudan has a training centre at Tozi for tractor operators. At present, two batches of 60 each are trained in a six months course; training is 30% theory and 70% practical ; training includes theory and practice of maintenance. The institute is being expanded to train double the number in 1972 as well as 20 mechanics per year.

The training on the mechanical side needs to be improved. The centere is in process of purchasing the tools and equipment. Request has been received by UNIDO for massive assistance.

5.6.2 The government is also setting up an agricultural training centre at Gedaref. The syllabus was discussed by Dr. GÖLSCH and it was felt that it was too theoratical and that the centre should give more emphasis to machines, engineering and practical workshop training.

There is a lack of mechanical engineering skills; the numbers of mechanical engineering graduates qualifying from Khartoum University was 13 only last year and agricultural engineers who are sent abroad for training are few and far between.

5.6.3 I.L.O. PROJECT SUDAN 21

This project with its excellent training facilities at Wad

Medani is doing good work. The Sudan Gezira Board is training two batches of 16 of its plant operators on a 3 months course at present.

The I.L.O. centre has also run two courses for shop floor supervisors and instructors in diesel engines in Oct. 1970 and Jan. March 1971

It is proposed to run special courses for agricultural machine mechanics-these courses have not yet been approved. It is strongly recommended that this centre should be authorised to establish these special courses as also advised by the world Bank Team.

5.7. UNIDO ASSISTANCE

Whereas steps are in hand to improve the training of first line supervisors and workmen; there appears to be a gap in the training of workshop managers. Assistance is therefore necessary in direction of repair and maintainence systems.

This training should be practical and within the industry. For example diesel engine overhaul lines were seen at six workshop, it was however felt that these could be improved both in the layout and method of working. The system of keeping spare repaired engines for installation could well be considered; if the goverment would agree to provisioning of a % of spare engines.

The training of workshop managers is required by conducting case studies of existing workshops to indentify the problems and deficiencies and to suggest their solutions. Also to advise on the equipment, manpower and the inventory of spares and materials to be held. The proper use of diagonastic equipment for location of faults; the application of flowline; incentives, time and motion studies to achieve maximum output.

For achieving these objective it is felt there is an urgent requirement for an expert. Job description is attached.

5.8 RECOMMENDATIONS

5.8.1 The supplying firms should be forced to keep adequate spares and should be legally liable to offer service, spares and training-Assistance can be taken from Indian Standard on this subject which is under preparation.

5.8.2 Tyre retreading units should be encouraged and waste rubber should be reclaimed.

5.8.3 Training in rewinding of armatures and supply of materials should be arranged.

5.8.4 Implement spares such as cutter bar fingers, cutter blades should be manufactured through the proposed Implement factory.

5.8.5 For manufacture of spare parts tyres requiring frequent replacement, factories should be set up early.

5.8.6 The workshop at New Halfa should be established urgently, with a proper diesel engine overhaul line and spare diesel engines.

5.8.7 The North Korean offer for setting up a £ 200,000 workshop at ASALI should be followed up.

5.8.8. The I.L.O. Project El-at Wad Madani should undertake training of agricultural machine mechanics.

5.8.9 The UNIDO should assist in training of managers in direction and planning of repair and maintenance.

and

6. RESEARCH, DEVELOPMENT/TESTING

6.1. National Research Council

At the national level the National Research Council located at Khartoum under the ministry of Higher education and scientific Research controls and directs activities in various fields through councils.

6.2 Agricultural Research Corporation

Ministry of Agriculture

Director Dr. Mohamed Osman Mohd Salih

6.2.1 General

Headquarter located at Wad Medani this corporation runs eight multi-crop research stations with the following disciplines:-

(a) Agronomy
(b) Soil science
(c) Plant Pathology
(d) cotton Breeding
(e) Agricultural Engineering
(f) Economy of Mechanisation
(g) Horticulture

The stations are located from Nouadeb in the north Kadugli in the south . The station in southern has been closed down.

6.22 Agricultural Engineering

The tasks of the agricultural engineering department are:-
(a) New designs M/C'S to meet local conditions
(b) Testing and experimentation with new M/C'S
(c) Initial Selection of M/C'S suited to tenants
(d) Field trials
(e) Modifications and Adaption of imported M/C'S

Unfortunately at present this division is not effective. There being no agricultural engineers; a couple of them are now undergoing training in UK/USA. and will available shortly.

6.3 Design & Development

There is an urgent need for setting up a design and development centre. It is felt that in the begining it should concentration adaption of machines imported from abroad to suit local condition and on improvement of designs of locally developed machines.

6.31 Adaptation of Imported Machines

The draw backs and the modifications needed to imported

machines would mainly emanate from the testing station whose establishment is discussed in para 6.4

There would also be ideas from other sources particularly the users which would need to be evaluated and would finally lead to the desired modifications.

6.32 Conversion of locally developed machines into productions models

This requires special skills in design of machines and production techniques, and the organization has to be located alongside the production shop, otherwise there is continued friction between the designers and the production people. There is a considerable time lag at present in the conversion of prot types to useful machines as will be seen from (para 1.3222) in fact no locally produced machines have been brought into service except for the Ground nut lifters; the hand operated cotton stalk pullers and the sugar cane planting device at Girba sugar factory.

6.33 UNIDO Assistance

It is recommended that the UNIDO should make available the services of an agricultural machinery design & should assist in the training of Sudanese design engineers to enable them to take over this important function when the UNIDO expert leaves the Sudan.

The services of the expert would be required for a minimum period of two years; the expert selected should be one with practical experience in a manufacturing firm, with knowledge of metalurgy.

Location- Khartoum.

6.3.4 Encouragement of creative ideas

The development of new means to improve production are dependant on the flow of ideas. The encouragement of the people to put forward ideas is therefore an important function of the government. It is understood that a committee of engineers was once formed at the Industrial Research Institute to evaluate inventions claimed by various persons.

The need for encouragment is a continous process and it is recommended that the Ministry of Industry/Mining should consider the establishment of a full time inventions promotion Board to assist people by monetary grants to develop their proposals; help them in patenting the same, and grant prize awards to encourage them.

This board can also look after import substitution awards, the present system which even allows for import of timber for prodution of wood wool appears in-equitous.

6.4 Testing Station

6.4.1 General

The need for a testing station for selecting suitable machines and implements by actual testing and to investigate technical agricultural problems must be accepted. Testing is all the more important for imported machines, tests in foreign countries are based on different conditions of climate and soil of therefore additional local tests are required.

For proper testing it is necessary to provide instruments and laboratory and in view of the large size of country and different conditions mobile units in which instruments could be easily packed & stored and a few machines for repair are installed are required.

The need for a testing station was discussed at a conference held at Gedaref in 1970 and a recommendation for setting it up was forwarded to the Ministry for Agriculture. In addition to the requirement of testing of imported machines, where several instances can be quoted of wrong imports which have cost the people of Sudan loss of foreign exchange there is a pressing need for evaluation of locally developed machines.

A number of agricultural implements have been and are being developed by individuals and organizations but in view of the lack of properly organized testing facilities their usefulness has not been established which has led to delays of some years in certain cases in their adoption.

Substations should later be established at Kadugali for tillage experiments. This could be followed up by a small set up at Houdeba in the Northern provinces to deal with the special problems of orchards on the Nile.

6.4.2 Location

The Sudan has varying types of soils from desert, semi desert to heavy clay. There are two major systems of agriculture namely irrigated and rainfed; so that the testing station must be located in a place where machines can be tested in varying of soils & systems of cultivation.

It is recommended that the testing station should be located at Sennar which would be central for the present and future areas for cultivation both in the irrigated and Rainfed zones. Road to Sennar is to be improved shortly

A sugar factory and a fertilizer factory are expected to come up in this area; their establishment will add to the importance of this town improve its social conditions.

6.4.3 Control

The station should be located at the Research farm of the Agricultural Research Corporation -Under its control. This has been informally discussed with Dr. Mohd Osman the chairman of the Agricultural research Corporation.

The directors of the testing station should include representatives from:-

Ministry of Industry -Agricultural Machinery Production Corporation
Ministry of Agriculture-Agriculture Engineering Dept Mechanized Farming Corporation

Sudan Gezira Board - Abdel Rahman Ali Cully.

* or under control of agricultural engineering department of the Ministry

6.44 The Scope of the Testing Station

Should be to:-

To test tractor operated implements; power operated pumps and stationery engines, power drivers agricultural machinery, both imported and manufactured in Sudan with a view to assessing:-

(a) their Durability
(b) functional suitability ease of maintenance etc
(c) performance characteristics under different operating conditions.

6.441 The testing station would publish test results which would:-
(a) Serve as a basis to decide the make and type of machines best suited for the Sudan which may be encouraged for import production and popularization.

(b) Provide engineers and extension workers, the basic material for giving guidance to farmers and other purchases in proper selection of agricultural equipment.

(c) form basis of standard specifications to be used by manufacturers and distributors.

(d) Evaluate locally developed equipment.

6.442 It will be noted that the testing of agricultural tractors has been omitted from the scope of the testing station.

The testing have now been finalized, which if obtained from any recongnized testing station such as Nerbaska (USA NAIE (UK) or USSR need not be repeated. Only the tests peculiar to Sudan conditions such as dust, heat etc will need to be performed.

Phase

6.44) The testing station should therefore confine itself to special climatic tests for tractors, testing of combines and agricultural implements in the first phase.

Other equipments should follow later in the following suggested orders-

(a) Testing of irrigation pumps and engines
(b) Testing of plant protection equipment
(c) Testing of seed processing equipment.

6. UNIDO Assistance

It is recommended that the UNIDO should assist in the setting up of this station by providing the services of an expert for a period of 2 yrs to train and assist the Sudanese engineers in establishing a testing station.

7. STANDARDISATION

7.1 GENERAL

The Government of Sudan passed the Organisation and Promotion of Industrial Investment Act in 1967, which authorised the establishment of the Organisation for Standard Specifications.The appropriate regulations published in 1968 gave the composition of the organisation; and gave authority to the Chairman to form technical committees for preparation of specifications. The Industrial Research Institute has accordingly produced approximately 18 draft standards which are awaiting approval and publication.Those mainly relate to consumer products and cotton fibre. Some more standards are under preparation.

7.1.2 AGRICULTURAL MACHINES AND IMPLEMENTS

In view of the various sources of purchase there is a proliferation of types and sizes. This is inevitable as the supplies are from various channels:-

(a) Old machines held were largely of UK origin. Further machines were imported from UK owing to familiarity with these types.

(b) Loan funds from various countries are tied to purchase of equipments.

(c) East European Countries offer P/C's under barter agreements.

(d) International financing institution's loans, stipulate purchases against lowest international tenders.

The diversity of types must however be reduced for ease of repair and maintainence.

7.2.3 APPROPRIATE TECHNOLOGY

In their efforts to keep ahead of developments in the world, managements are inclined to accept latest technological improvements as presented to them in various sales publications. It is recommended that all such changes should only be accepted after these have been evaluated from point of view of:-

(a) Cost benifit ratio
(b) Repair and Maintainence problems
(c) Eventual production capability in the country.
(d) Simplicity in design.

A case in point is the possible introduction of the sprinkler system of irrigation, one of the departments is considering use of overhead type, whereas the ground lay system would be more appropriate.

7.2.4 UNIDO ASSISTANCE

To assist in testing of agricultural machines and formulation of standard specifications an expert has been requested for two years see Para 6.5 .

It is also learnt that UNIDO is already taking steps to recruit a specialist to advise on the paper set up for the Sudan Standards Organisation. The Government, it is hoped, will take full advantage of this assistance and will strengthen this organisation with posting of adequate staff.

7.3 TRACTORS

7.3.1 TYPE : The number of tractors in the country is approximately 8000 not taking into account pre 1963 ie. more than 10 yrs. old tractors some of which are possibly still in use. Massey Ferguson claim a percentage of almost 45%, with the 1000 M.F.Tractors to be imported early this year, this figure will rise further for the

three types MF 165,175 S(No longer in Production) and MF 185. Other makes are MTS 50, MTZ 52, T 40 from UCMR,Nuffield,Zetor 50 super and 5511; John Deer and smaller numbers of Ferdson, Belgar, International, Yugoslav. IMT'S etc.

7.2.2 SELECTION OF TRACTOR

Tractors in use are generally of 50 H.P and above; there is a need for tractors of 50-60 H.P because most of the present and future farming operations depend on large scale farming. For tillage and cultivation in both irrigated and rainfed areas the draught requirement is for :-

(a)	Ploughing	3 or 4 furrow plough
(b)	Disc Harrowing	2.m. Wide disc harrow

Draught for 1 m. wide 3 furrow polugh (a) = (b)
Draught for 3 furrow-deep ploughing =1200-1500 KP
Speed =1.5-2.5m/second
Hence the required draught power is $\frac{1200\times1.5}{75}$ $\frac{1500\times2.5}{75}$ =24-30 H.P

Engine Power = $\frac{\text{Draught Power}}{6}$ = 40 + 05

From Specific weight point of view HP = 50 + 60

From the above calculations it is clear that for the operations envisaged for tillage using a wide level disc or 3 to 4 furrow plough a tractor of 50-60 H.P is required as the standard tractor.

It should have the following characteristics to fulfill requirement of tillage with implements-

(a) Hydraulic Operated = 3 Point Linkage
(b) Power Take Off
(c) Electric Starter

(d) Comfortable Seat and Protection from Sun

(e) Low Turning Circle.

(f) Wheel base Adjustment-52 " - 72"

(g) Additional weights on Rear Wheels.

It is however felt that hydraulic system is not essential for Operations in rainfed areas, where trailed implements(wide level discs) are used. Elimination of this requirement could lead to a saving of LE 300 per tractor.

Power steering is an unnecessary sophistication and is not recommended.

7.3 SMALL TRACTORS

In addition to the standard tractor there is a requirement of smaller tractor for use by town councils and others for haulage purposes. At present as only large tractors are available, these are being used; they cost more to purchase, maintain and run.
The number of tractors imported for non-agricultural use in 1968-was 145 and in 1969-148.
There is also a requirement of tractors for small farms on the Nile which should be met by approximately 35 HP tractors. Further investigation is required.

7.3.4 TWO WHEEL TRACTORS

The operation of the small two wheeled type tractor requires skills and strenuous work for which the fellaheen are neither trained nor inclined. The better way which is being practised in Egypt is to hire, four wheel tractors, the costs are of the order of 70 piastres per feddan for discing.
For vegetable crops such as tomatoes it was noted that the farmers do not plough the land, and depend entirely on the four wheel

tractor using ridging equipment. There is also the problem of obtaining fuel and servicing facilities away from large towns; we have to be careful in taking tractors to villages where there is not even a black-smith. The introduction of two wheel tractors is therefore not recommended at this stage.

7.3. COMBINES

There are approximately 500 combines at present in Sudan, these again are of various makes. The largest number is claimed to be of Class-(Matador and Mercator) these are popular with the private owners. Other types in use are.

John Deer; Massey Ferguson, Arbos (Italy)
ERHAJ (YUGOSLAV)
SVN 4. (USSR)-
RANSOME
INTERNATIONAL 8

The Class and John Deer combines both have Perkins Engine. It is understood that John Deer are planning to export 100 more combines in the next 3 years. Class are also very active and claim to have produced a special attachment for Durra Harvesting (Cost £1600) and are developing a sesame harvesting machine.

An East German harvester is under test at ARADI and a RANSOME combine is expected shortly.
The types in Sudan are thus over nine which is too many; it is recommended that comperative tests be conducted by the government, to reduce the types to 3 or 4 only.
In view of the high foreign exchange cost involved in import; assembly of combines would also have to be considered soon.

7.4 TRAILERS

Trailers are and can be manufactured easily within the Country

with imported wheels, springs, bearing etc. yet these have been imported recently and unfortunately of an unsuitable type. The laying down of standards will help and guide the manufacturers and restrict import of unwanted trailers.

7.5 RECOMMENDATIONS

Immediate action should be taken to standardise the followings-

7.5.1 THREE POINT LINKAGE AND POWER TAKE OFF

As a first step before the Sudan Standards are published and enforced it is essential that the "Three point linkage" and "Power take off" shaft dimensions should be standardised so that full dimensional interchange-ability and any make of tractor can be used for driving any power take off driven machine implement.

In this connection assistance may be taken from:-

Indian Standard	4468/1967	Dimensions for three point Linkage
Indian Standard	4931/1968	Power Take off Shafts

The Sudan standards could be based on dimensions for Category 2 Tractors for hitch points and for nominal 35 mm power take off shaft, with six straight splines, running at 540 revs/min.

7.5.2 THE LINCH PIN ASSEMBLY AND PALLS

The linch pin assembly for the three point linkage should also be standarised as per Indian Standard documents ARD 20 (992) C and (993) C; unless these are also standarised the users of tractors will experience difficulty in securing their implements at the time of mounting of implements in the three point linkage hitch and the proper fixation of linch pins.

7.5.3 WHEELS AND TYRES

Wheel and tyres are being specified by the Agricultural Engineering Department for tractors:- Front- Tyres of 600 X 16 or 750 X 16; Rear- tyres 1200 X 38; 6 ply

It is noted that tyre sizes are not being specified by other organisations wheel and tyre sizes must be kept to the minimum not only for tractors, but also for trailers and implements as interchangability where possible would reduce stocking problem at present and manufacturing problems at a later stage. The sizes selected should be suitable for the varying types of soils in Sudan; selection of suitable tread is also important.

0. SUMMARY

The report is divided into eight chapters. The main points discussed in each chapter are given hereunder:

0.1 The Ministry of Agriculture controls the major agricultural schemes through five corporations. In addition to the Ministry of Agriculture, the Ministry of Co-operation and Rural Development has taken over administration of agricultural schemes in the co-operative sector. Details are given of the various schemes particularly Gezira and Khashm El Girba which are the two main irrigated areas.

The only irrigated scheme likely to come up in the near future is the Rahad. The mechanized farming corporation (M.F.C.) which looks after the development of rainfall cultivation is responsible for the major expansion of the cultivable areas.

A graph showing the increase in the area under crops is placed in Annex I which shows that the area is likely to increase to 12 million feddans by the end of the five year plan i.e. increase of 2 million feddans in the next 4-5 years.

The requirement of machinery by M.F.C. will be for tractors, wide level discs with seeder-box and combine harvesters. Funds are expected from World Bank and from Kuwait

8. SESAME REAPER BINDER

8.1. General: The greatest single factor affecting profitability on the mechanised farms of the Sudan is timely harvest of Sesame. Harvesting has to be done over a very short period otherwise considerable crop losses result from shattering. To date no successful high yielding non-shattering Seasme varieties have been bred, through work along these lines continues. In addition labour is becoming scarce and more expensive.

Sesame is the one crop grown in the Sudan where the market prespects are good, the constraint on export volume will be on the supply side. In recent years exports have increased to almost 100,000 tons per annum, of the current crop some 90,000 tons have already been sold at an average price of £S.96 per ton. The acreage under this crop in the 1970/71 crop season on mechanised farms was 282.000 feddans. The total area under crop was 1,772,847 feddans.

Harvesting problems have reduced the acreage grown by individual farmers and at the expense of increasing the sorghum acreage, where exports to the food grainmarkets are somewhat limited and prices paid for food grains are such that increasing export amounts may require Government subsidy-the last thing the Sudan can afford.

Consequently it is of considerable national importance that the possibilities of mechanising or partially mechanising the sesame harvest be investigated and that a solution be found as rapidly as possible. Conventional models of the reaper binder have not proved satisfactory but are considered the right type of machine for the operation if modified.

8.2. THE POSITION AT PRESENT IS AS UNDER:-

8.2.1 Yugoslav M/CS- Imported two years ago.

This has been inspected by Mr. MOWIA, Dr.GOLICH and the undersigned at University of Agriculture Khartoum. On 10th. November. Professor Hassan who has been carrying out modification called it the designed machine, and we are in agreement with his views. It is not

likely to become an effective reaper binder suitable for sesame harvesting and we should not depend on it. This machine has been tried by Dept. of Agriculture Engineering and has failed to produce good bundle, according to Mr. Mohamed Bedri Director of the Department.

8.2.2 Spanish M/CS: OF SECODORA-ATADORA COY: has been ordered for trials by Department of Agricultural Engineering Ministry of Agriculture on recommendation of Prof. George.B. Nutt Director Emeritus extension service Clemson College S. Carolina U.S.A.

The machine is expected in about April 1972 and will be tried next season Oct. 1972.

8.2.3 ITALIAN M/CS

8.2.3.1 4 No's Model 622-11a were ordered by the Mechanised Farming corperation but were received too late, these were shown at AGADI Festival (Dec.71): but were found to be walking type.

8.2.3.2 LAVERDA Company of Italy exibited a machine reported to be capable of doing work of 100 men at ASMARA Exhecition in Feb. 1969 and this machine was tried at SETIT-HUMERA. It is claimed that this machine can Cut and tie an estimated half hectare per hour at a speed of 4Km/h.

8.2.3.3 No one in Sudan has seen this M/C. or its working so far. The undersigned had written for more information from E.C.A.Addisababa, but no reply has yet been received. A letter was also addressed by the resident representative Khartoum to the U.N. office at ADDISABABA on 30th. Nov. 1971 asking for trial report-but no reply has been received to date.

8.2.3.4 Information was therefore sought through commercial channels. Messers SEFERIAN & CO.(ASMARA) Ltd in their letter of 20th. Dec.1971 informed us through Sudan Diesel company that this machine had been developed by Laverda Company in collaboration with them & gave further information as under:-

The machine that can be offered for Sudan is the one that has given quite good results during the seasen ended few weeks ago and which is roughly shown in the attached photostatic copy of two photos made at the factory.

We are giving you here under the performance of t is machine as follows-

1 machine is making about 900 bundles per hour but, in size, one bundle made by the machine corresponds more or less to three bundles made by the workers therefore in one hour you get 2700 bundles of the usual size, which represents 7/8 hella (400 bundles) in one hours with a total of about 80 hella per day of 10/12 hours.

To make the bundles the machine requires a special type of twine and for the production of one hella about 280 meters of twine are needed. This twine is supplied in reels of 400 meters each and the cost of one reel is about Sh.S. 13.-

The machine is driven by a diesel engine of 15HP.

This information was convyed to Mr. Mohd. Badri Director of the Agriculture Engineering Department of the Ministry of Agriculture on 8 January and he is taking steps to import a machine for trial.

8.3. RECOMMENDATION

8.3.1 The modifications being carried out by the Department of Agricultural Engineering at the agricultural college Khartoum to the Yugoslav Reaper-binder are not likely to be successful as the machine is unsuitable.

The Class company of Germany is also reported to be producing a prote-type machine, they should be invited to send their machine at the time of comparative trials.

8.3.2 Comparative trials of the Spanish, Class and Laverda machines should be arranged and one of these (or any other on world market) should be accepted for immediate use.

6.1.3 As a long term measure the development of a combine for harvesting sesame and the production of a combinable variety should be continued. Other methods for harvesting such as:-

(a) Application of defoliants before ripening

(b) Shatter prevention by baling where pods ripen inside the bale and therefore seed is not lost even though the pods pop. The bales are then cut open & fed into combine or thresher.(Agricultural Engineer's hand book-McGRAW Hill page 279 refers)

(c) VACUUM harvesters should be considered.

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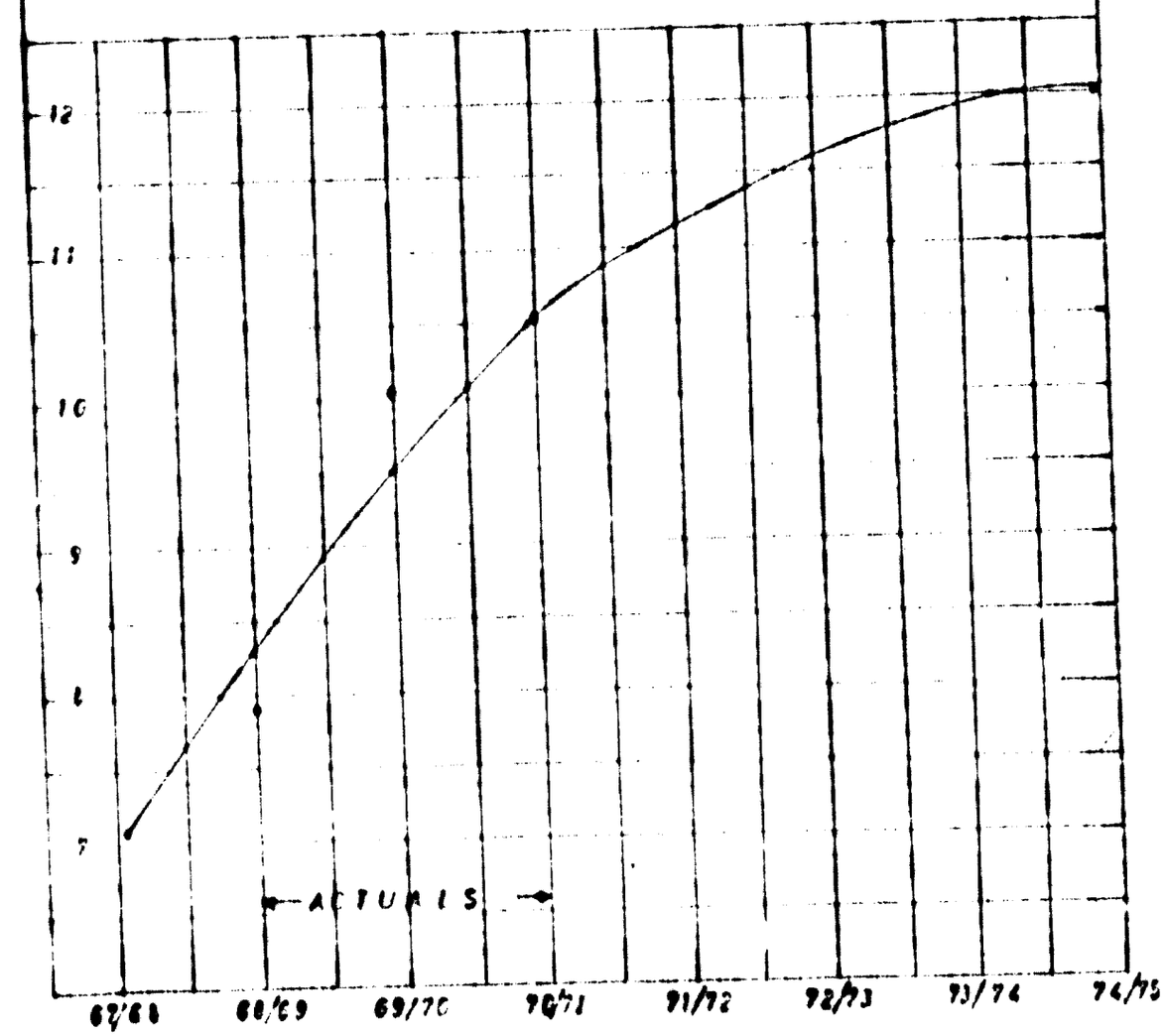
ANNEX 1

GRAPH SHOWING AREA UNDER CROPS

AREA UNDER CROP

IN MILLIONS FEDDANS



Annex No - 2

TABLE I

ESTIMATED HOLDINGS OF AGRICULTURAL MACHINERY NOV. 78

No.	Item	S.G.B ind. Private	M.F.C ind State farms	A.D.C	P.A.P.C Girba	P.A.P.C Others	A.R.C	M.C.R.D	E.P.S	Total
1-	Tractors	996	237	150	341	151	200	30	4000	6105
2-	Wide level Disc	60	237		60	850			1400	2607
3-	Disc Ploughs	-		15	34	7	50		450	556
4-	Border Disc	-		8	18	-				26
5-	Offset Disc	22		24	80	-				126
6-	Ridgers.	200	-	202	243	2	100		2000	2750
7-	Planters	71	16	124	69	15	?			295
8-	Fertilizer Sprayer	265	-	-	-	-	-	-	-	265
9-	Combines	200	59	-	65	23	-	-	145	422
10-	Groundnut lifters	32	-	60	70	-	-	-	-	182
11-	" Thresher	2	-	84	36	-	-	-	-	122
12-	Trailers	100	80	-	73	122	-	-	300	675
13-	D 8	53	6	2	5	-	-	-	-	66
14-	D 7	-	4	-	-	26	-	-	-	30
15-	Scrapers	-	1	12	2	-	-	-	-	13
16-	Graders	-	5	-	2	3	-	-	-	10
17-	Land Planers	-	-	12	4	2	-	-	-	18
18-	Ditchers	200	-	-	59	-	-	-	-	259

N.B.
- S.G.B - Sudan Gezira Board
- M.F.C - Mechanized Farming Corporation
- A.D.C - Agricultural Development Corporation
- P.A.P.C Public Agricultural Production Corporation
- A.R.C - Agriculture Reform Corporation
- M.C.R.D Ministry of Cooperation & Rural Development.
- E.P.S Estimated Private Sector.

Annex No - 3

TABLE XI

ESTIMATED REQUIREMENT OF TRACTORS & AGRICULTURAL M/C's FIVE YEAR PLAN

No.	ITEM	S.G.B	M.F.C	A.D.C	R.A.P.C		A.R.C.	M.C.R.D	S.P.S	Total
					Girba	Others				
1.	Tractors	134	940	350	60	10	100	115	800	2509
2.	Wide Level Disc	100	940	350	60	1	-	-	200	1711
3.	Disc Ploughs	-	-			14	100	-	11	125
4.	Mould Band Plough	-						80	-	80
5.	Offset Disc Harrow	22				25		-	50	87
6.	Ridgers	100					150	15	50	315
7.	Rotary Cultivaters	-						45	-	45
8.	Planters, Groumut & Cotton	66	110		110	6		-	50	372
9.	Fertilizer Sprayers	250		-	100	-	-	-	50	400
10.	Combines	-	675	-	-	-	-	8	100	783
11.	Groundnut lifter	32	110	-	-	30		-	50	212
12.	Groumnut Thresher					20	-	-	10	30
13.	Groundnut Washer	50		-	-	-	-	-	-	50
14.	Trailors & Tankers	100	132	-	-	100	-	16	200	536

Note : (1) The MFC Requirements are based on development of :-

a)	Remie Area	- 250,000	feddans
b)	Blue Nile Area	- 760,000	"
c)	Phase II World Bank	500,000	"
		1410,000	"

(2) AGRICULTURAL Development Corporation demand is based on realization of Phase 1 of RAHAD 350,000 feddans.

(3) Full Type Harvesters.

B-804

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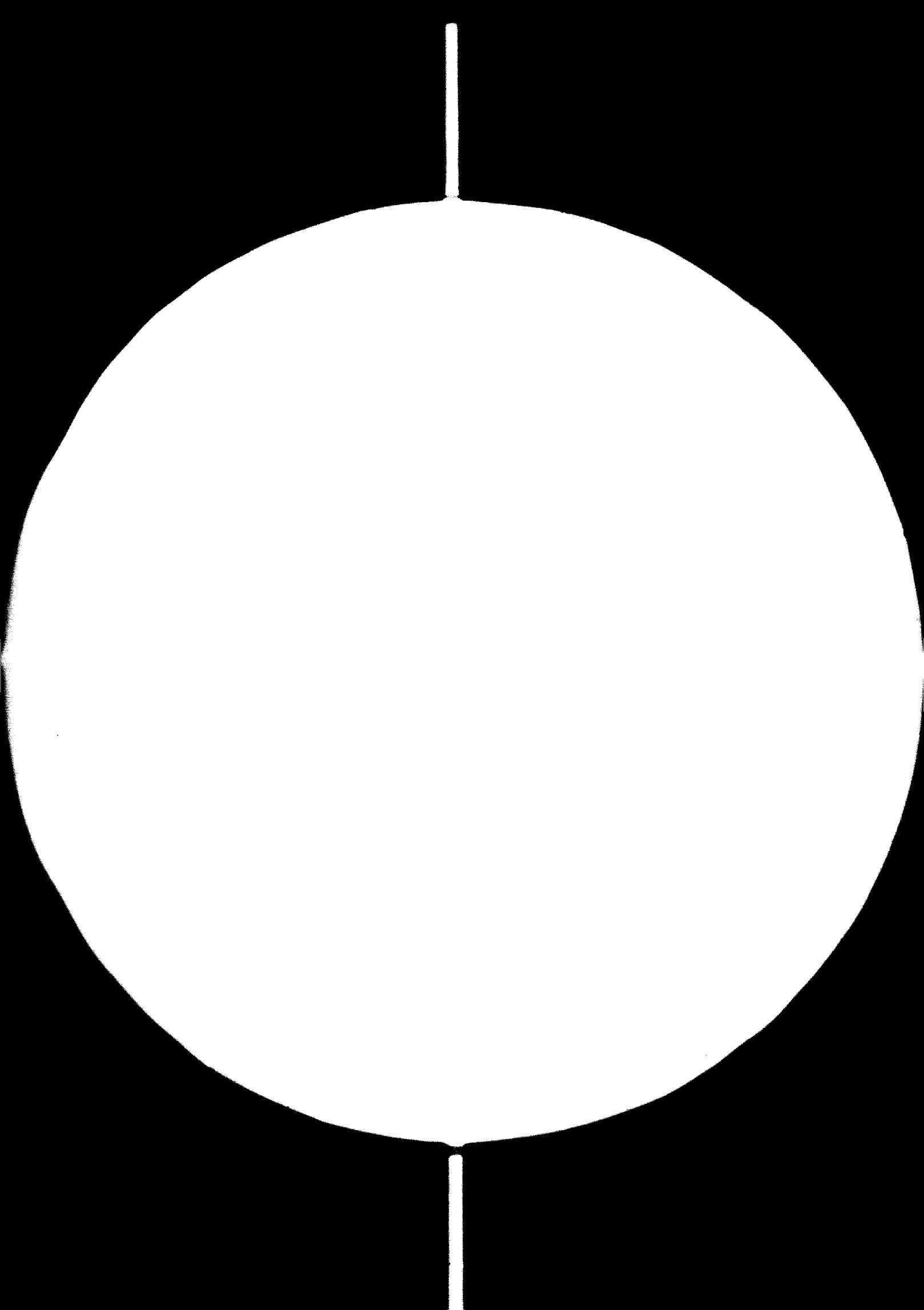
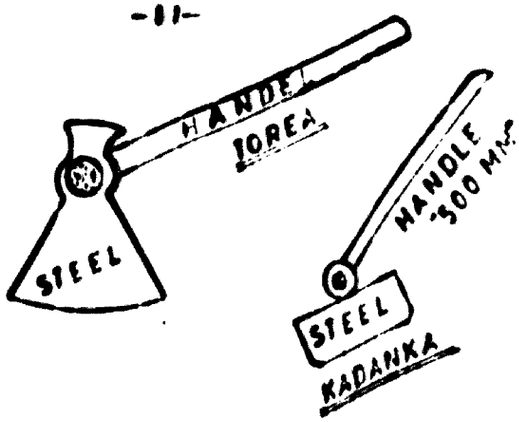
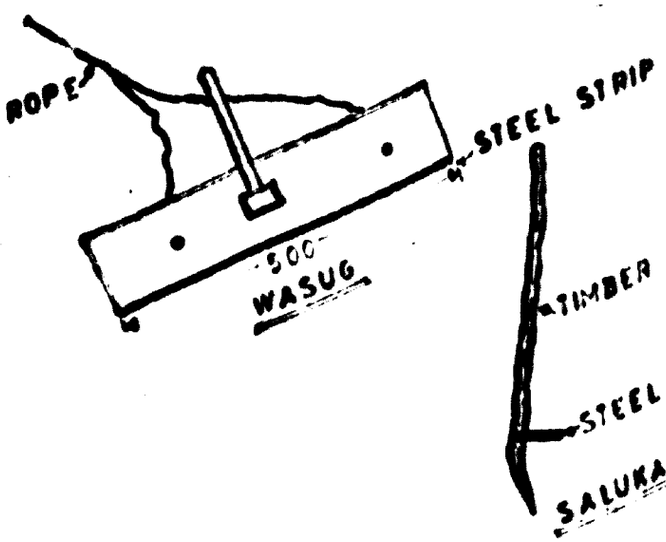
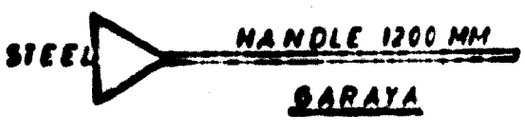
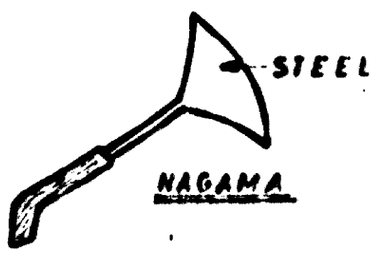


ANNE. 4









HAND TOOLS USED
IN THE SUDAN

PROPOSED

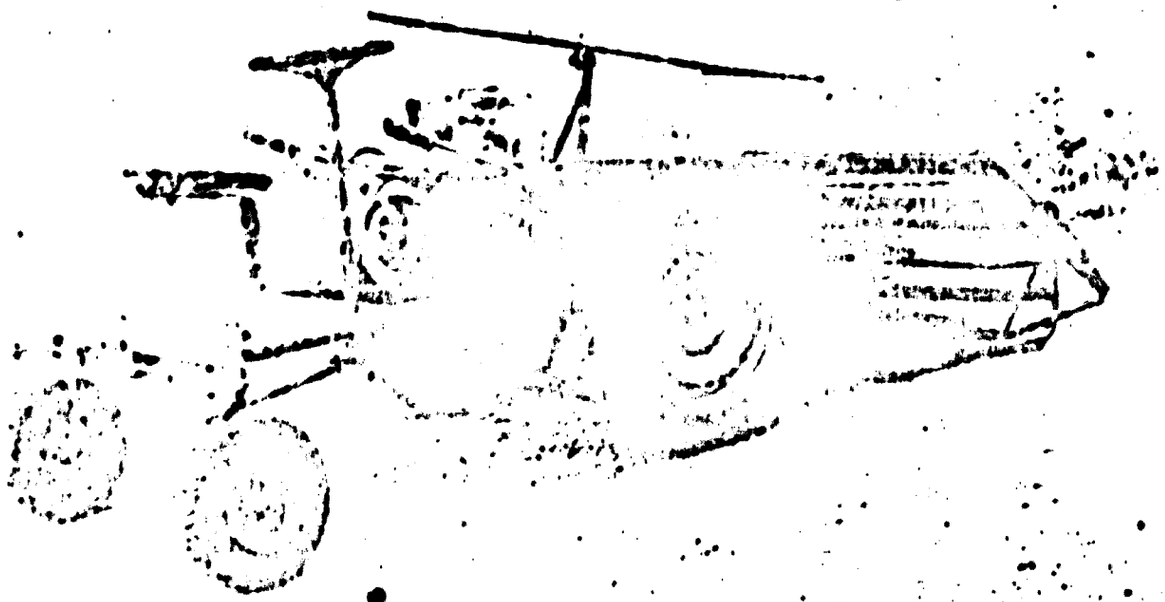
ANNEXURE - 5

PRODUCTION PROGRAMME - IMPLEMENTS

OPERATION	IMPLEMENT	No's per annum	PHASE 1	PHASE 2	PHASE 3	REMARKS
A. TILLAGE	DISC Plough 3-4furrow	81		✓		• Replace Discs and Bearings
	Offset Disc Harrow	39	✓			Light type. Indian
	Tool Bar with Ridging attachment.	201		✓		Massey Perguson welded type. Blades sets 1680 per year
	GREEN Ridging blades		✓			Already manufactured
	MIDDLEVEL DISC	513			✓	•Replace discs bearings and wheels.
C. PLANTING	Planter Non dlinted Cotfonsced.			✓		Russiantype
	Non-Decorticated GROUND NUTS etc	112		✓		John Deer type modified
	SEEDER BOX			✓		
D. FERTILIZER DISTRIBUTION	ROW DISTRIBUTER HAND PULLED.	113	✓			S.C.B. design

OPERATION	IMPLEMENT	No's per annum	Phase 1	Phase 2	Phase 3	REMARKS
E. Harvesting	Cotton Picker				✓	Russian type
	Digger, shaker, windrower groundnuts		✓			S.G.B Design
	Lifters "		✓			already manufactured at Birba
	Thresher (Benthal) "			✓		Timber construction
	Sesame - Reaper Binder				✓	Collaboration preferre
G. Marketing	Washer groundnuts		✓			SGB design
	Hullers - castor	2				Cash workshops manufac ures at present
H-Land Clearance	Stalk puller		✓			MIAE design to be finalized
	Sweeper		✓			Trailed type S.G.B design
	Stalk Breakers		✓			" " "
K-Misc.	Trailers-"Bunger"type					For sugar factories
	Trailer - 5ton					
	Tankers					
L-Hand Tools	Shovels	1000	✓			Target
	Spades	1000	✓			
	Hand Hoes (Torea)	1000	✓			
	Shears	500		✓		1000 tons/year
	Knives	300		✓		
	Mogumas	2000	✓			
	Sickles	5000	✓			
	Rakes	500	✓			

.....Main



Annex 7

United Nations Industrial Development Organization

Request from the Government of the Democratic Republic of the Sudan

Job Description

Post Title: Expert on Repair and Maintenance, Workshop Operation Planning

Duration: Two years

Date: As soon as possible

Duty Station: Khartoum . The expert will be required to work for some months at the time, in various workshops such as at Wad Medani, Khashm El Girba, Sam-Sam etc.. to improve their operational effectiveness.

Purpose of Project: To assist the Agriculture Engineering Department of the Ministry of Agriculture in formulating proposals for new workshops and improving the working of existing units.

Duties:

1. To advise the managers of repair workshops for agricultural machines on modern methods of programming of work. Layout of repair lines; incentives systems etc..
2. Assist in formulating programme for effective ulitization of all the existing workshops.
3. Examine the necessity of setting up new workshops and advise on their layout and operation.
4. To co-ordinate the training requirements of agricultural machinery mechanics as well as diesal engine overhaul mec-hanics.

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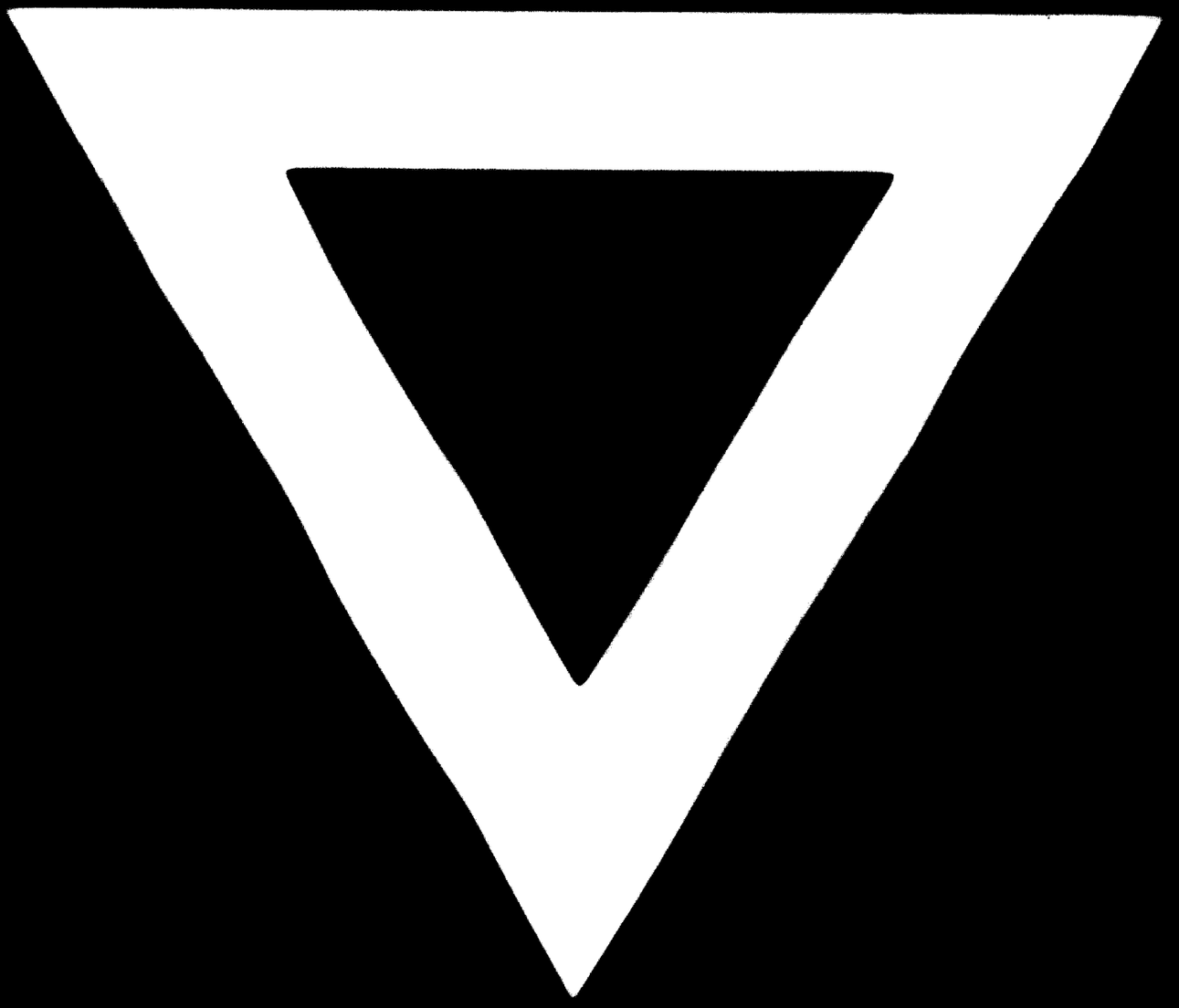

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