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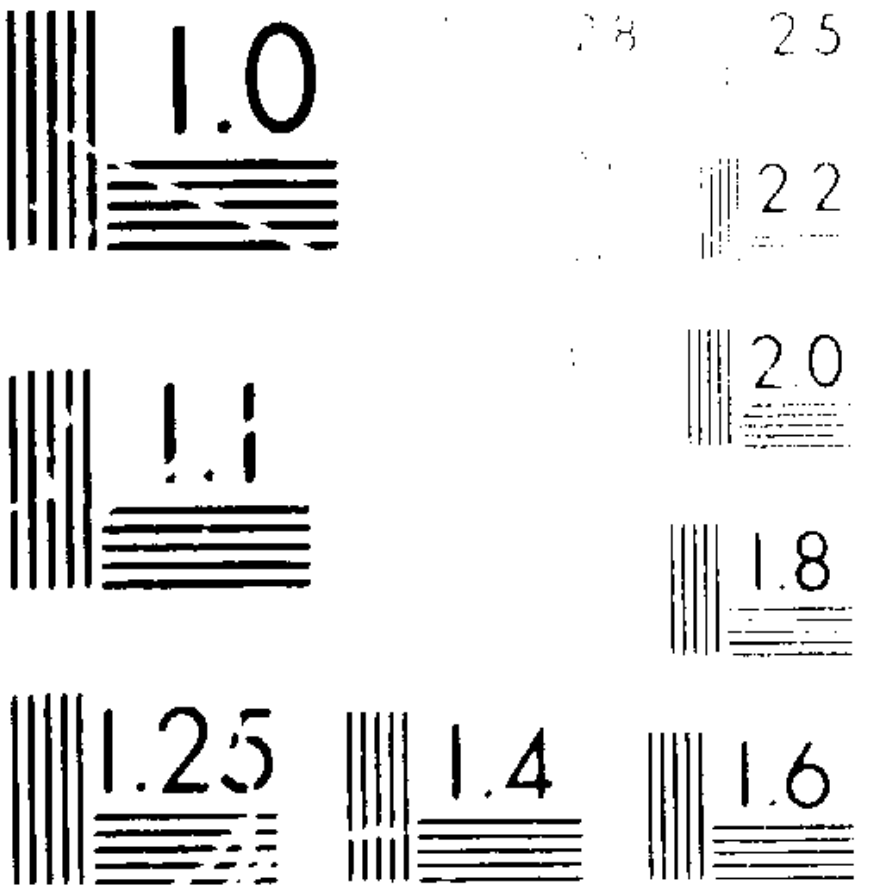
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5 March 1980
English

FEASIBILITY STUDY
FERTILIZER BAGGING PLANT

SI/SOM/79/803

SOMALI DEMOCRATIC REPUBLIC

Terminal Report*

Prepared for the Government of the Somali Democratic Republic
by the United Nations Industrial Development Organization,
executing agency for the United Nations Development Programme

Based on the work of Wybe G. Wals, expert in bulk blending and bagging of NPK fertilizer production

United Nations Industrial Development Organization
Vienna

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1. ACKNOWLEDGEMENT.

1.01 The consultant wishes to acknowledge the whole hearted cooperation extended by the management and the staff of the State Planning Commission and their valuable assistance in the preparation of this study report.
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1.03 Thanks are also due to the international experts of project. UNDP/SOM/78/008 - Project Planning and Development - in the State Planning Commission, in particularly, Mr. M.R.Narayanan, Irrigation engineer, who supplied all information about the irrigated land in the Somali Democratic Republic.
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1.05 Mr. C.Keleti, back stopping officer of UNIDO, Vienna, had taken a keen interest in this consultancy study and had provided useful information and advice, for which the consultant expresses his grateful thanks.

2 SUMMARY AND RECOMENDATIONS

2.01 The main consumers of fertilizers in the Somali Democratic Republic are the National Banana Board (NBB), for Banana crop, and the Societa Nazionale Agricola Industriale (SNAI) for Sugarcane crop.
The consumption of fertilizers for seasonal crops, cultivated by farmers is very low at the moment, due to the high cost of fertilizer compared with other cost like the costs of pesticides, labour and tractor work, as estimated in Annex 1.

2.02 In 1976 and 1977 when the cost of fertilizers was low because of the FAO-grants and government subsidy, the seasonal crop farmers were using fertilizers, see Table 4-1.
Therefore continuation of subsidy of fertilizers to keep the price level bearable by the farmers is recommended.

2.03 The use of fertilizers to increase the crop yields should be used in conjunction with other factors which influence the crop yields, like all kinds of pests, otherwise the increase of yield might be destroyed by the pests (chapter 6 refers).

2.04 As the consumption of fertilizers for seasonal crops are negligible, an estimation has been made based on results of small scale plots done by the Food and Agriculture Organization (FAO) and the Midwest University Consortium for International Affairs (MUCIA), see Table A 1-4 of Annex 1.
The optimum level of nutrients N, P_2O_5 and K_2O for maximum yields has not been applied due to relative high cost of fertilizers and that plot results applied to large scale field conditions are not available.

2.05 The fertilizer consumption for seasonal crops is as follows (paragraphs 4.12 through 4.15 refer):

UREA:	100 kg/ha.
TSP:	50 kg/ha.
K_2SO_4:	0 kg/ha.

2.06 The fertilizer consumption for perennial crops, banana and sugarcane, has also been estimated based on the cultivated area they occupied, as the fertilizer import figures are irregular.

For sugarcane:

UREA: 250 to 300 kg/ha.
TSP: 50 kg/ha.

For banana:

UREA: 350 kg/ha.
TSP: 100 kg/ha.

2.07 As the cultivated areas have a tendency to decrease due to the salinization of the soil:

Sugarcane: from 7006 ha in 1975 to 6000 ha in 1978.

Banana: from 8343 ha in 1975 to 6831 ha in 1978.

the projected demand up to the year 1985 is estimated on the basis of crop intensity and increasing of fertilizer consumption, see chapter 4, as follows:

From 5866 mt. of Urea and 1895 mt. of TSP in 1980
to 6578 mt. of Urea and 2085 mt. of TSP in 1985.

2.08 Because of the fact that the projected demand of fertilizers from 1980 through 1985 are estimated figures and increasing slowly through the years, the Bagging Plant has been designed for a yearly capacity of:

6000 mt. of UREA.
2000 mt. of TSP.

2.09 The capacity of the storage building has been designed according to the following facts:

- The application of fertilizer to the soil just before the rainy season, see Table A 1-2 of Annex 1.
- Handling and storing of the fertilizers in bulk during January, February and March, in which the relative humidities are the lowest of the year from 67% to 76%.
- Minimum quantities of 3000 mt. of Urea and 1000 mt. of TSP per shipment each.

Resulted in a storage capacity of 3000 mt. of Urea and
2000 mt. of TSP
separate from each other to prevent mixing.

2.10 To bag the 8000 mt. of fertilizers for distribution to the consumers on time, the bagging plant has been designed into two lines to be able to handle at least 3000 mt. of Urea in one month to get space to store the next shipment of 3000 mt. of Urea.
The operating hours are as follows:

- 6 hours per day.
- 6 days per week.
- 4 weeks per month.

2.11 Due to the fact that only Urea and TSP are used a Bulk Blending Plant is not viable, because the blended fertilizer causes stickiness and caking.
Other type of fertilizer, like Diammonium Phosphate (DAP) could be blended with Urea, but the response on crop yields by using DAP in not well known in the country.

2.12 Information on CF-prices between the fertilizers in bags and in bulk were received from one of the suppliers of fertilizers to Somalia (Table 7-1 refers).
The differences in savings between bagged and in bulk and imported bags are as follows (para. 7.17 refers):

- UREA US$18.84 (SO.SH.119.77) per metric ton.
- TSP US$28.12 (SO.SH.178.76) per metric ton.

which saves the country, when importing 6000 mt. of Urea and 2000 mt. of TSP:

US$ 169,280 in foreign currency or
SO.SH.1,076,164 using the exchange rate of
US$ 1 = SO.SH. 6.3573

2.13 The yearly operating cost of the bagging plant including the handling of the storage has been estimated in Annex 2 to:

SO.SH. 928,575.

based on 5% interest rate on investment cost.

The total investment cost is estimated,
paragraph 2.31 of Annex 2 refers, at

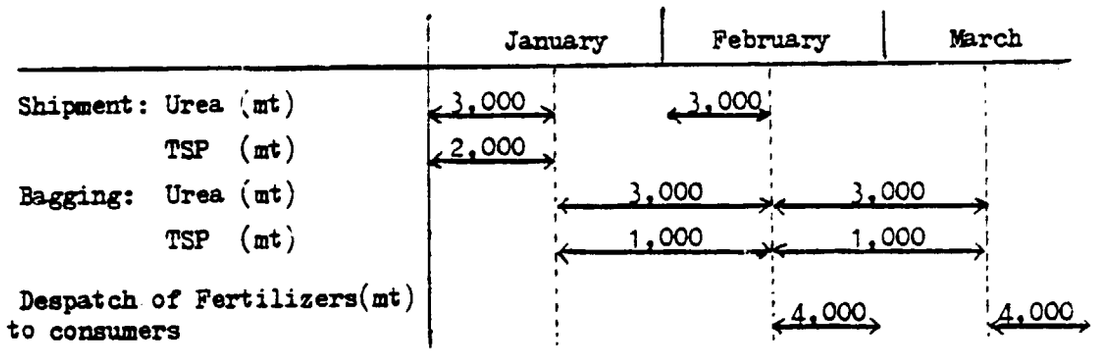
SO.SH. 5,885,900 equal to US$926,000.

2.14 The yearly revenue, which is the difference between the savings from importing fertilizers in bulk followed by locally bagging versus importing fertilizers in bags and the operating cost, is:

SO.SH. 1,076,164 - SO.SH. 928,575 = SO.SH. 147,589 equal to US $ 23,000 per year.

Therefore, it is recommended to implement the bagging plant including the storage facilities, which is based on an operating time of three months in which 6,000 mt of urea and 2,000 mt of TSP, imported in bulk, are bagged.

2.15 Operating schedule of the bagging plant and storage facilities to handle 6,000 mt of urea and 2,000 mt of TSP per year is as follows:



3 INTRODUCTION

3.01 The consultant was in the Somali Democratic Republic, see Index Map, stationed at Mogadishu (Mogadiscio in Italian language), the capital, and attached to the State Planning Commission.
He was in Somalia from 10 November 1979 to 5 February 1980, for the purpose of studying the viability of a Fertilizer Bulk Blending and Bagging Plant in the country.

3.02 To establish the type, cost and quantities of imported fertilizers, the required information has been collected from the following sources:

- Organizazione Nazionale Automezzi e Trattori (ONAT);
- National Banana Board (NBB);
- Societa Nazionale Agricola Industriale (SNAI);
- Settlement Development Agency (SDA);
- Oil Mill and Agricultural Development Corporation (ADC);
- Food and Agriculture Organization (FAO);
- Midwest University Consortium for International Affairs (MUCIA);
- Documentation Center of the Sate Planning Commission.

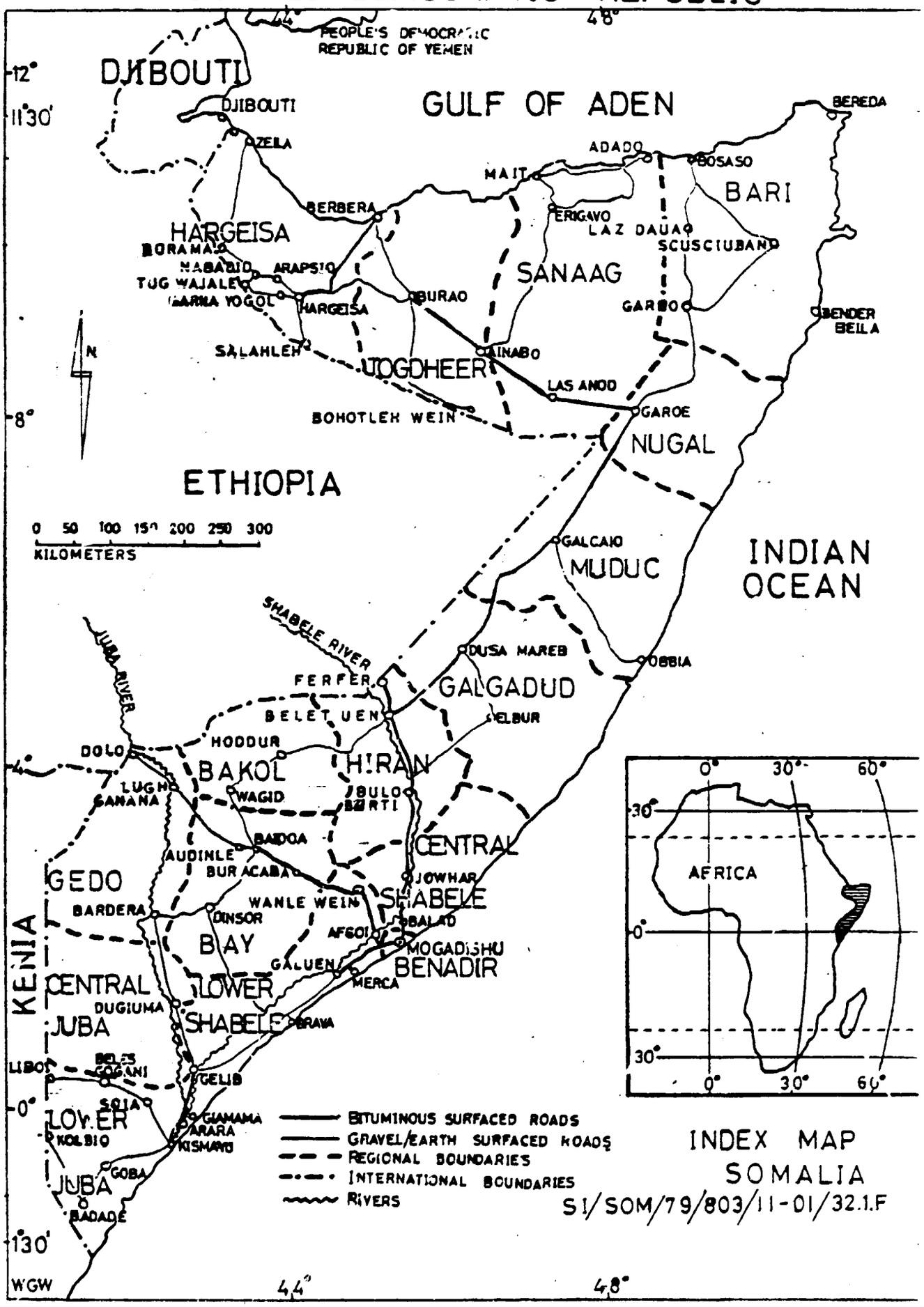
3.03 The collected information has been checked with the fertilizer requirements on existing cultivated, irrigated land to arrive at reliable figures, to investigate the viability of a Fertilizer Bulk Blending and Bagging plant.

3.04 Also the constraints which influence the use of fertilizers has been taken into consideration.

3.05 The operating time and the capacity of the plant and the distribution of the fertilizers to the consumers were determined based on the following information:

- Time of fertilizer application to the soil;
- Quantity of fertilizers;
- Climate conditions like rainfall, temperature and relative humidity;
- Minimum quantity of fertilizer per shipment which relates to the price of the fertilizer.

3.06 Based on the results of the above mentioned information the viability of a Fertilizer Bulk Blending and Bagging Plant has been examined in this report, after having estimated the operating cost of the plant.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PEOPLE'S DEMOCRATIC REPUBLIC OF YEMEN
DJIBOUTI
GULF OF ADEN
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4 FERTILIZER REQUIREMENTS OF THE COUNTRY.

A GENERAL

4.01 The main consumers of fertilizer are :
1. The farmers cultivating seasonal crops.
2. The State Enterprice the National Banana Board (NBB) for their banana plantages.
3. The State Enterprice the Societa Nazionale Agricola Industriale (SNAI) for their sugercane plantages.

4.02 Before June 1978, the fertilizers were imported by the State Enterprice : the Organizione Nazionale Automezzi e Trattori (ONAT) a service department of the Ministry of Agricultar, dealing with lorries and tractors for agricultural purposes.
After June 1978, by Government Declaration, the NBB and SNAI have to import their fertilizers by themselves.

4.03 The fertilizer use in the years 1976 through 1979 is shown in Table 4-1.

4.04 To estimate the quantity of fertilizers for seasonal crops, see Table A 1-4 of Annex 1. the optimum level of nutrients (N, P2O5 and K2O) for maximum yields will not be applied because of the low use of fertilizers.

4.05 For practical reasons, the quantities of fertilizer are estimated to the amount of bags, for instance for Urea (46-0-0) :
46 kg. N, being two bags of 50 kg. of each of Urea, per hectare has been estimated instead of 50 kg. N, being 50 : 0.46 = 108.7 kg. Urea.

4.06 The areas occupied by the perennial crops, banana and sugercane, have been dropped in extent due to gradual salinisation of soil being one of the major factors.

4.07 Salinisation of irrigated land can occur in two ways :
1. In areas of low water table not enough water being applied to leach salt from the root zone.
2. In areas of high water table poor soil drainage affecting crop growth.

4.08 Generally the soils are alkaline, Ph ranging from 7.2 to 8.0 and soil investigation shows very low to low available phosphates in the fields.

4.09 The types of fertilizer mainly used are Urea (46-0-0) and TSP (0-46-0) depending on world market prices, so it is possible, that other substitutes are imported like DAP (18-46-0).

4.10 The areas occupied by the crops under controlled irrigation will remain the same, until the Bardera Dam has been constructed.

4.11 The quantities of fertilizer for seasonal crops, banana and sugarcane are estimated below.

B. FERTILIZER CONSUMPTION FOR SEASONAL CROPS.

4.12 Although the fertilizer consumption for seasonal crop is low, the minimum quantity of fertilizer required will be estimated below.
The cropped areas in hectares under controlled irrigation are shown in Table A 1-3 of Annex 1.

CROPS	CROPPED AREA HA.	FERTILIZER KG./HA. UREA	TSP	SOP	TOTAL QUANTITY OF FERTILIZER IN KG. UREA	TSP	SOP
MAIZE	14250	100	50	-	1425.000	712.500	-
RICE	2689	100	50	-	268.900	134.450	-
SESAME	7691	100	50	-	769.100	384.550	-
COTTON	2050	100	50	-	205.000	102.500	-
TOTAL	26680				2.668.000	1334.000	

4.13 Not estimated are the following crops :
Sorghum : Most of the crop is cultivated on rainfed land.
Pulses etc. : These crops are developping their own nitrogen.

4.14 The above mentioned cropped area has a crop intensity of approx 175 per cent.
The minimum quantity of fertilizer consumption is about 110 per cent of crop intensity, which is :

UREA : 110/175 x 2.668.000 = 1.677.029 kg. = 1.677 mt of Urea.
TSP : 110/175 x 1.334.000 = 83 .514 kg. = 839 mt of TSP.
SOP : Sulphate of Potash (0-0-50) = Nil.

4.15 Because of the shortage of good land along the Juba river, the shortage of irrigation water along the Shabelli river and the construction of the Bardera Dam in the future, the net area under controlled irrigation remains the same and the fertilizer consumptions in the next five years are estimated in accordance with the crop intensity.

YEAR	1980	1981	1982	1983	1984	1985
CROP INTENSITY (%)	110	115	120	125	130	135
UREA (MT)	1677	1753	1829	1906	1982	2058
TSP (MT)	839	877	915	935	991	1029
TOTAL	2516	2630	2744	2841	2973	3087

C. SUGARCANE.

4.16 The cultivated areas in hectares (ha) under controlled irrigation for sugarcane in the years 1975 through 1978 are as follows :

YEAR	CULTIVATED AREAS IN HA
1975	7006
1976	6556
1977	6892
1978	6000
1979	Not available

SOURCE : SNAI.

4.17 The fertilizer rates applied to sugarcane are:
250 to 300 kg. of Urea per hectare.
50 kg. of TSP per hectare.

4.18 The quantity of Potash will not be estimated because the spent waste of the distillery of the sugercane mill sent out as effluent contains 30 to 40 per cent of K20 on ash basis and could be used as a source of potash fertilizer.

4.19 To estimate the quantities of fertilizer in the years 1980 through 1985, the arithmetic average of the cultivated area will be taken, which is 6614 ha., and a gradual yearly increase of the Urea consumption as follows :

YEAR	1980	1981	1982	1983	1984	1985
UREA KG./HA.	250	250	250	300	300	300
UREA (MT.)	1654	1654	1654	1984	1984	1984
TSP (MT.)	331	331	331	331	331	331
TOTAL (MT.)	1985	1985	1985	2315	2315	2315

D. BANANA.

4.20 The cultivated areas in hectares (ha) under controlled irrigation for Banana in the years 1975 through 1978 are as follows :

YEAR	1975	1976	1977	1978	1979
AREAS IN HA.					
NOT YET PRODUCING	2195	2103	1836	2226	NOT
PRODUCING	6148	5319	4547	4605	AVAILABLE
CULTIVATED	8343	7422	6383	6831	

SOURCE : NBB.

4.21 To estimate the quantities of fertilizer for the years 1980 through 1985 the arithmetic average of cultivated area, which is 7245 ha., and the following fertilizer rates are used : 300 to 400 kg. of Urea per hectare, 350 kg./ ha. Urea as an average.
100 kg. of TSP per hectare.

4.22 The quantity of Potash will not be estimated as same has been applied recently.

4.23 The estimated average quantities of fertilizers for the coming years will be kept constant as follows :

YEAR	1980	1981	1982	1983	1984	1985
UREA (MT.)	2536	2536	2536	2536	2536	2536
TSP (MT.)	725	725	725	725	725	725
TOTAL (MT.)	3261	3261	3261	3261	3261	3261

E. SUMMARY FERTILIZER REQUIREMENTS.

4.24 The minimum quantities of fertilizer in metric tons (mt.) required for seasonal crops, banana and sugarcane are summarized as follows :

YEAR	1980	1981	1982	1983	1984	1985
SEASON. CROPS						
UREA (MT.)	1676	1753	1829	1906	1982	2058
TSP (MT.)	839	877	915	935	991	1029
SUB TOTAL (MT.)	2515	2630	2744	2841	2973	3087
BANANA						
UREA (MT.)	2536	2536	2536	2536	2536	2536
TSP (MT.)	725	725	725	725	725	725
SUB TOTAL (MT.)	3261	3261	3261	3261	3261	3261
SUGARCANE						
UREA (MT.)	1654	1654	1654	1984	1984	1984
TSP (MT.)	331	331	331	331	331	331
SUB TOTAL (MT.)	1985	1985	1985	2315	2315	2315
TOTAL (MT.)	7761	7876	7990	8417	8549	8663

TABLE 4-1 FERTILIZER USE

		ONAT [x] (for farmers) IN QUINTALS(QT)	NBB IN QUINTALS	SNAI IN QUINTALS	TOTAL FERTILIZERS IN QUINTALS	SELLING PRICE SO.SH. PER QUINTAL
1	1976					
a	UREA	17356	-	-	17356	131.45
b	SOP	-	(6463)[y]	-	6463	145.10
c	DAP	-	(5994)[y]	-	5994	140.90
	TOTAL	17356	(12457)	-	29813	
	1977 UREA	9687	(20.000)[y]	(10.000)[y]	39687	2) 125.80
	1978 TSP	-	(15.000)[y]	-	15000	220.00
	1979 UREA	-	65.000	25.000	90.000	

SOURCE : ONAT
NOTES :

x Figures shown are net quantities of fertilizer (= excluding losses).
y Handled via ONAT.
1 Fertilizers imported in 1976 are from FAO-grant.
1a Balance from shipment (FAO-grant) cleared on 23 March 1975 and 4 October 1975 carried over for use into 1976.
1b,1c Clearing date from Mogadishu Harbour Authority is 19 May 1976.
2 Subsidized price.

SOP = Sulphate of Potash (0-0-50).
DAP = Di-Ammonium Phosphate (18-46-0).
TSP = Triple Super Phosphate (0-46-0).
UREA = (46-0-0).
QUINTAL = 100 kilograms.

5. THE DISTRIBUTION OF FERTILIZERS.

A. GENERAL

5.01 Prior to June 1978, the Organizicne Nazionale Automezzi e Trattori (ONAT), a well established state enterprise engaged in the sale and hire of lorries and tractors for agricultural purposes, was entrusted with the responsibility for the distribution of fertilizers as well.

5.02 The bagged fertilizers imported from abroad were used to be offloaded by means of slings, either at Mogadishu or Kismaayo, depending upon the nearness of the distribution centres. (See Figure A 1-2 of Annex 1).

5.03 It had been the practice until 1977 to store the bagged fertilizers in the harbours of Mogadishu and Kismaayo till such time they could be transported to the distribution centres in Shalambood, Jamama and Afgoi.
The distribution centres are located at these places being predominantly crop growing area. In 1977, the storage facilities at Mogadishu harbour were destroyed by fire and since then, the bagged fertilizers are straightaway offloaded into truck-trailer combination for direct transport to the distribution centres. Plans have been drawn and are now being considered for rebuilding the storage facility at Mogadishu harbour for a capacity of 1.500 metric tons of bagged fertilizers.

5.04 After June 1978, the Purchase Departments of the National Banana Board (NBB) and the Societa Nazionale Agricola Industriale (SNAI) have taken over the import of fertilizers. However, the storage facilities of ONAT are continued to be made use of. The ONAT is still required to take care of importing fertilizers used for raising seasonal crops. Most of the stock of fertilizers imported by NBB are offloaded at the Merca harbour on account of the proximity of banana growing area.

B. TRANSPORT OF FERTILIZERS.

5.05 The internal transport of fertilizers from the harbours to the distribution centres is by road, using truck-trailer combinations. At the distribution centres in Shalambood, Jamama and Afgoi, the bagged fertilizers are kept in storages. The capacity for storage at these places is 2000, 2000, and 500 metric tons respectively.

5.06 The roads connecting the harbour towns and the distribution centres are generally well paved with tar-mac and are, therefore, serviceable through out the year (See Annex 1, Figures A 1-2). However, the roads to the villages from the distribution centres are mostly unpaved, muddy and sandy. The transport of fertilizers has to be either by heavy trucks or donkey carts. In rainy seasons, these feeder roads are mostly unpassable.

5.07 In view of the unsatisfactory nature of the feeder roads, the transport of fertilizers to the crop growing sites has to be completed before the start of the rainy season. Usually the sowing operations and application of fertilizers take place in the early weeks of the rainy season. Not much storage problems are likely to be encountered to keep the fertilizers in the villages.

6. FACTORS INFLUENCING THE USE OF FERTILIZERS.

A. GENERAL

6.01 Among the various measures adopted to improve the crop yield, the fertilizer use is crucial. Soil conditions and the price of fertilizers would determine the extent, nature and type of fertilizers that can be applied profitably.

6.02 With reference to Somalia, the following problems have to be attended to for improving the crop yield, apart from fertilizer application :

- Water control of the irrigated land for preventing salinity in the soil;
- Use of right type of crop variety;
- Proper and judicious use of pesticides at economical cost to prevent crop damages due to various pests;
- Bird control measures, especially against the Quela quela birds;
- Prevention of crop damage caused by wildlife like hippos and elephants in some areas.

Application of fertilizers would be also dependent upon these factors.

6.03 The main consumers of fertilizers at present are the National Banana Board for banana and the Societa Nazionale Agricola Industriale for sugarcane.
They have long years of experience in fertilizer application.

6.04 It would seem worthwhile to devote more attention to research work on fertilizer application for seasonal crops.
The fertilizer trials conducted in the past by the Central Agricultural Research Institute, Midwest University Consortium and others were known to be on small experimental plots and not on large scale field conditions.
Research findings in experimental conditions may not be altogether applicable in the field.
It is important that fertilizer application is on a scientific basis and in conformity with results of research out specifically for direct applications in the field. The Central Agricultural Research Institute at Afgoi and other research centres should pay more attention to carry out research on fertilizer application, especially for large scale conditions. The FAO projects and other organisations assisting the country in the development of agriculture, may as well extend their support for greater research efforts on fertilizer application.

B. USE OF FERTILIZERS BY THE FARMERS.

6.05 The fertilizers generally used by the farmers are Urea and Triple Super Phosphate (TSP), same as used in the research experiments carried out by the Midwest University Consortium in the Central Agricultural Research Institute.

6.06 In view of acidic property, Urea and TSP seem to have been used in alkaline soils.
However, some of the earlier trials seem to have indicated that TSP has no response on crop yield, especially in crops like maize, when applied to alkaline soils containing negligible P_2O_5.

6.07 The high cost of fertilizers, in addition to equally costly input of pesticides which the farmers are more keen to use in order to save their standing crops from pests and diseases, appears to be a deterrent factor for increasing use of fertilizers.
However, fertilizer use seems to have had a fillip when it became available, perhaps cheaply, during 1975 and 1976 as a grant from FAO.

6.08 It may be observed that the use of fertilizers by farmers is low, if not very low.
As explained earlier, the reasons are high cost, lack of research back-up followed by extension activities to demonstrate the profitability of fertilizer application and not finding adequate solutions to the many problems affecting the yield, such as soil conditions, use of proper varieties, pest and diseases and damages caused by birds and mammals.

C. PRICE OF FERTILIZERS.

6.09 The price of Urea and TSP is given in Table A 1-5 of Annex 1.

6.10 The cost of cultivation of seasonal crops is given in Table A 1-11 of Annex 1.
It may be observed that the price of fertilizers is on a higher side compared to the cost of other inputs.
There is, therefore, a need to bring down the price in order to promote greater use of fertilizers by the farmers.

6.11 If the import of fertilizers is canalised in the hands of one agency, lowering of the CF price may be possible, in view of a bigger transaction of fertilizer purchase.

6.12 Agencies which have already adequate transport and storage facilities may perhaps be in a position to reduce the price to the farmers, especially when delivery of fertilizer can be arranged during the dry season in which most of the crops might have been already harvested.
The return trips after carrying the harvested products may be advantageously used for fertilizer transport.
This would however, imply that storage facilities should be available in the villages.

6.13 In the larger national interests of attaining self-suffiency in food production by increasing the crop yield, there would be adeyuate justification to lower import duty on fertilizers and to subsidise the price to the farmers as done in 1977.
These measures are recommended specially because fertilizer use is a major contributing factor for stepping up crop production.

6.14 It would be advantageous to obtain fertilizers from abroad in bulk rather than in bags.
This would not only cost less but also result in foreign exchange saving.

7. BULK BLENDING AND BAGGING OF NPK FERTILIZER PRODUCTION.

A. GENERAL.

7.01 The nature and kind of chemical fertilizers used so far are mainly Urea and Triple Super Phosphate (TSP) in granular form, and they are imported in bags, and both fertilizers are not blended together before they are applied to the soil.

7.02 To reduce the price of imported bagged fertilizers, the import of fertilizers in bulk is investigated in this chapter and whether a Bulk Blending Bagging Plant or a Bagging Plant is viable for investment in the country.

7.03 Due to the fact that Urea and TSP are well known in the country both fertilizers will be taken under consideration.

B. BULK BLENDING AND BAGGING FERTILIZER PLANT.

7.04 Blending of Urea (NH_2CONH_2) with TSP ($Ca H_4 (PO_4)_2 H_2O$) can result in a chemical reaction that causes wetting. Urea reacts with monocalcium phosphate monohydrate, the main constituent of TSP, to form and adduct, and this reaction releases the water of hydration.
The freed water then forms a saturated solution of the highly soluble adduct and this liquid phase causes stickiness and caking.
When ammoniated superphosphate is used there are no problems.

7.05 The Urea used as a blend material should be delivered in granular form, not in prills, and could be delivered in the particle size of - 6 + 16 Tyler mesh range (-3.36 mm + 1.00mm).

7.06 Care should be taken that the blend materials diverge no more than about 10 percentage points from each other retained on at least 4 tyler screen mesh.
Segregation is the unmixing of a blend, the destruction of homogeneity, that occurs when a blend of poor quality is handled during storing, conveying, transporting or field spreading.

7.07 When using other blend materials the following blends should not be made :

7.08 DAP and Superphosphate in which the ammonia from DAP can react with superphosphate and as a result water of hydration is released thus causing caking.
When ammoniated superphosphate is used there are no problems.

7.09 Urea and Ammonium Nitrate or Ammonium Sulphate Nitrate should not be blended as the critical humidity of the mixture is only 18 percent, which means that under practically all circumstances the mixture becomes sticky in a very short time.

7.10 It may be concluded that the Bulk Blending and Bagging Fertilizer Plant, in which Urea and TSP are blended, is not viable.

7.11 To blend DAP (18-46-0) instead of TSP (0-46-0) with Urea is viable, but the response of DAP on crop yields is not available.

C. BAGGING PLANT

7.12 The viability of a Bagging Plant is investigated below by setting the savings due to bulk import of fertilizers followed by locally bagging as compared to import of bagged fertilizers, against the operating cost of the fertilizer bagging plant estimated in Annex 2.

7.13 The working capital of the fertilizer bagging plant is not taken into consideration because same will be about equal to the working capital when importing the fertilizers in bags.

7.14 The price difference between fertilizers in bags and in bulk were only available from the International Chemical Corporation Industries (ICCI) B.V. in Amsterdam, Holland, owners of Windmill's fertilizer complex in Maassluis, Holland.
The ICCI is well known as one of the suppliers of fertilizers in Somalia.
The differences between CF-prices Mogadiscio of fertilizers in bags and in bulk are shown in Table 7-1.

7.15 The CF-price of bags, which should be imported from Singapore, is US$0.45 = SO.SH.2.86 per bag of 50 kg. of fertilizer, which is 20 x SO.SH.2.86 = SO.SH.57.20 per metric ton of fertilizer.

7.16 The bag is made of a woven outer bag of polypropylene and an inner bag of polyethilene.
This type of bag has proved to be able to stand the service conditions of transportation to the final consumer.

7.17 Using the exchange rate of US$1.00 = DM1.83 and the exchange rate of DM1 = SO.SH.3.47, the savings per metric ton, when importing fertilizers in bulk instead of in bags, are as follows:

FERTILIZER	DIFF.BAG - BULK SEE TABLE 7-1		BAC COST	SAVINGS/MT. 3-4	
	DM	SO.SH.	SO.SH.	SO.SH.	US$
UREA	51	176.97	57.20	119.77	18.84
TSP	68	2. .96	57.20	178.76	28.12

7.18 The savings on foreign currency when importing yearly 6000 mt. of Urea and 2000 mt. of TSP in bulk followed by locally bagging instead of importing the fertilizers in bags would save the country an amount of:

6000 x US$18.84 + 2000 US$28.12 = US$169,280 or:
SO.SH. 1.076,164.

7.19 The operating cost of bagging the fertilizer in bulk into 50 kg. bags is SO.SH. 116.07 per metric ton (see Annex 2) and compared with the savings per metric ton of fertilizer as follows:

FERTILIZER	SAVINGS SO.SH./MT.	OPERATING COST SO.SH./MT.	REVENUE SO.SH/MT.
UREA	119.77	116.07	3.70
TSP	178.76	116.07	62.69

7.20 Consuming yearly about 6000 mt. of urea and about 2000 mt. of TSP, the revenues would be:

6000 x 3.70 + 2000 x 62.69 = SO.SH.147,580

7.21 On a yearly basis the 3 months operating fertilizer bagging plant is able to store, see Annex 2:

- Bulk storage capacity 12/3 x 8000 = 32000 mt. of fertilizers in bulk.

- Product storage capacity of 4050 mt. of fertilizers in bags.

Resulting in a total storage of 36050 mt. of fertilizers.

7.22 An announcement was made in European Chemical News, December 3 1979, page 31, about negotiations which are underway between the Government of Somalia and the Italizan contractor Snam Progetti which could lead to the setting up of an integrated Ammonia/Urea plant at a capacity of 50,000 mt. of Urea (150 mt./day) in Somalia.

As the storage capacity of the fertilizer bagging plant is ample to store the production of the Ammonia/Urea integrated plant and to bag part of the production, it would be worthwhile to consider the integration of the Urea plant with the bagging plant.

7.23 It may be concluded that it is worthwhile to established a fertilizer bagging plant, keeping in mind that the plant is working only 3 months per year, and the rest of the year the empty storages could be used for other purposes, which therefore will reduce the operating cost by putting the burden of the interest, depreciation and maintenance of the building not only on the fertilizer operation; or to integrate the fertilizer bagging plant with the Ammonia/Urea integrated plant.

TABLE 7-1

FERTILIZER PRICES IN DEUTSCHEN MARKS (DM)

		1 FOB ANTWERP		3 DIFF.	4 5 CF MOGADISCIO		6 7 8 FREIGHT ANTWERP-MOGADISCIO			9 TOTAL DIFFERENCE OF PRICES MOGADISCIO BAGS - BULK
		IN BAGS	IN BULK	1-2	IN BAGS	IN BULK	IN BAGS 4-1	IN BULK 5-2	DIFF. 6-7	3+8
1) DAP	18-46-0	591	554	37	740	687	149	133	16	53
1) UREA	46-0-0	363	335	28	520	469	157	134	23	51
2) TSP	0-46-0	452	427	25	627	559	175	132	43	68
2) SOP	0-0-50	402	3)	-	577	-	175	-	-	-

NOTES:

- Prices valid till February/March 1980

1) Prices based on minimum quantity of 3000 metric tons.
2) Prices based on minimum quantity of 1000 metric tons.
3) Sulphate of Potash (SOP) cannot be offered in bulk.

SOURCE: ICCI

ANNEX 1 A1-1

AGRICULTURAL INFORMATION

1.01 Somalia is located between the latitudes 11°30'N and 1°30'S with an area of over 638,000 square kilometers.
The topography consists mainly of plateaus sloping from the Ethiopean highlands to the Indian Ocean in the East and the Gulf of Aden in the North.
These plateaus are broken by chains of mountains in the North and they end in a broad coastal plain in the South.

1.02 Total population in 1978 was estimated at around 3.7 million with an annual rate of growth of around 2.6 %.
The majority of Somalis live in rural areas and practice subsistence crop production and nomadic animal husbandry.
The country's two main exports, which amounted to So.Sh.689.1 million in total, are livestock (82.8 %) and Bananas (8.6 %), which in 1978 accounted for 91.4 % of total export.

1.03 Somalia is divided into 16 Geo-political administative regions subdivided into 78 administrative districts, see figure A1-1.
Each region is administered by a Governor and each district by a District Commissioner.

1.04 Land use, as reflected by the existing sketchy statistics, may be described as follows:

Controlled Irrigation at Present:		Potential Irrigated Land:
Shabelli River	35,000 ha	71,000 ha
Juba River	14,000 "	123,800 "
North West	1,000 "	20,000 "
Total Irrigated	50,000 ha	214,800 ha
Flood Irrigation	110,000 ha	
Rainfed Farming	540,000 "	
Total Cultivated	700,000 ha	
Cultivable but Uncultivated	7,500,000 ha	
Total Cultivable	8,200,000 ha	
Range Land	28,800,000 ha	
Unusable	26,800,000 "	
Total Area	63,800,000 ha	

1.05 The same of the total cultivated land of 700,000 ha may bedivided in the regions as shown in Table Al-1,and subdivided in the principal crops in Somalia.
The regions themselves could be classified into Zones.

1.06 The expansion of the total irrigated area by over 160,000 ha, depends on the construction of the Bardera Dam in the Juba river.
The construction of the Dam will take at least 6 years, if ordered in 1980.

1.07 Two distinct rainy seasons exist- the "Gu" season and the "Dar" season, see Table Al-2.
The "Hagay" rains of July and August prolong the "Gu" season in certain coastal areas, as do the "Karen" rains in the North West.

1.08 Also shown in Table Al-2 is the average monthly rainfalls in mm, temperatures in °C, and relative humidities in percentage, collected from the Ciuil Aviation Department files, for the villages Gelib and Genale (also written as Janaale).
These villages are located in the vicinity of the harbours of Mogadishu and Kismaio, where the fertilizers are off-loaded from the ships.

1.09 Possible cropping patterns of seasonal crops are also shown in Table Al-2 to provide a basis for the time to provide the soil with fertilizers.

1.10 Perennial crops occupy the land they are established on for many years at a time and do not therefore figure in the crop pattern shown.
Citrus, like grape-fruit will be replaced in the form of young trees after 35 years.
Bananas will be replanted in the form of suckers every 4 years, and Sugarcanes after 4 ratoon crops.

1.11 Most of the fertilizers are consumed in the irrigated areas along the two rivers, the Juba and the Shabelli (also written as Shabele or Shabeelle or Shebeelle or Shebelli).

1.12 About two thirds of the cropped area under controlled irrigation (as distingt from flood irrigation) lies along the Shabelli river between Johar and the swamps.
From these swamps of the Shabelli river, located downstream of Falcheiro, the water flow is very much reduced and eventually lost through evaporation and seepage.

1.13 Although the catchment area of the Juba river is very similar to that of the Shabelli, the average annual flow appears to be 3.5 to 4 times greater.
The shortage of good land along the Juba river, soil of marine plain origin, makes it difficult for optimum use of this water, in contrast with the available good land along the Shabelli river, which has a shortage of water to meet the irrigation needs.

1.14 Flood irrigation is mostly along the Juba river, during the DER season, as DER floods reach higher levels.
Fertilizers are not used on these flood irrigated lands, for economic reasons.

1.15 The existing cultivated areas under controlled irrigation in 1977 along the two rivers are divided in reaches, which are subdivided in schemes, settlements etc. see Table A 1-3.
Also shown in the Table are the crops cultivated by the reaches.

1.16 The villages, after which the reaches are named, are shown in Figure A 1-2.

1.17 The area occupied by the perennial crop amounts to 16,000 ha, see Table A 1-3.
The intensity of cropping for seasonal crops will be:
$\frac{48925 - 16000}{34845 - 1600} \times 100\ \% = 174.71\ \%$,
which is a very satisfactory crop intensity and therefore subject to fertilization.

1.18 The yields of irrigated land are shown on Table A 1-4 it is obvious, that using better variety of crops and by using pesticides the yields are increasing. The yield increase by using fertilizers for most of the crops, as tested by the United Nations Development Programme / Food and Agriculture Organization / Midwest University Consortium for International Affairs. (UNDP/FAO/MUSCIA) is also shown on the same Table.

1.19 The consumption of fertilizers by farmers cultivating seasonal crops is low at the moment. A reason may be found in the cost of fertilizers compared to other costs. The costs per hectare are shown estimated below for some seasonal crops and summarized to arrive at the production cost per hectare.

1.20 TABLE A 1-5 : SELLING PRICE IN SO.SH. PER QUINTAL (qt) OF BAGGED FERTILIZERS IN 1979 FOR CROPS.

	TSP	UREA	
		KUWAIT	IRAQ
COST AND FREIGHT (CF)			
IN US $	28.0	21.0	19.6
IN SO.SH.	178.00	133.50	124.60
INSURANCE, IMPORT TAX, HANDLING AND STORAGE = 30 % CF - PRICE	53.40	40.05	37.38
TRANSPORT AND OTHER COST	25.60	25.45	25.02
SELLING PRICE	257.00	199.00	187.00

SOURCE : ONAT

1 Somali Shilling (SO.SH.) = 100 cents
and pegged to the U.S. Dollar (US $)
1 US $ = 6.3573 SO.SH. (Selling)
1 US $ = 6.23 SO.SH. (Buying)

A1-5

1.21 TABLE A 1-6 : FERTILIZER COST IN SO.SH. PER HECTARE (HA) FOR SEASONAL CROPS.

TYPE	UREA		TSP		TOTAL
FORMULA	46 - 0 - 0		0 - 46 - 0		FERT.COST
COST SO.SH./KG.	1.87		2.57		PER HA
	KG/HA	COST/HA			IN SO. SH.
COTTON	100	187	50	129	316
RICE	100	187	50	129	316
MAIZE	100	187	50	129	316
SESAME	100	187	50	129	316

1.22 TABLE A 1-7 : SELLING PRICE IN SO.SH. OF SOME PESTICIDES

PESTICIDES		1976	1977	1978	1979
NUVACRON ULVAR	SO.SH./LITER	36.60	-	54.65	77.85
DIMACRON ULVAR	SO.SH./LITER	33.65	-	-	71.35
STAM F 34	SO.SH./LITER	-	-	26.40	-

SOURCE : ONAT

The cost for pesticides per hectare is shown in Table A 1-8

1.23 TABLE A 1-9 : TRACTOR RENT IN SO.SH. PER HOUR (HR) IN 1979

TYPE OF TRACTOR	PUBLIC SECTOR SO.SH./HR.	PRIVATE SECTOR (INCL.COOPERATIVES) SO.SH./HR.
S 100 (CRAWLER)	115	65
DT 75-DT 54 (CRAWLER)	75	50
50 TO 90 HP (WHEELED)	50	35

SOURCE : ONAT

A 1-6

1.24 TABLE A 1-10 : SEED - AND CROP - PRICES IN SO.SH. PER KG. IN 1979.

SEEDS	BUYING PRICE FROM FARMERS SO.SH.PER KG.	SELLING PRICE (CROP PRICE) SO.SH.PER KG.
COTTON	2.60	3.01
RICE (BASARAH)	3.50	3.91
RICE (MIXED)	2.40	2.81
RICE (CHINESE)	2.20	2.61
MAIZE	0.75	1.16
SESAME	2.40	2.86

SOURCE : Oil Mill and ADC (Agricultural Development Corporation).

1.25 Labour required for weeding, birds control, irrigation and harvest for mixed crop on irrigated land is 134.000 mandays for 936 hectares during "GU"- and "DER"- seasons according to information from the Libsoma Agricultural Project.
The average mandays per hectare per season is:

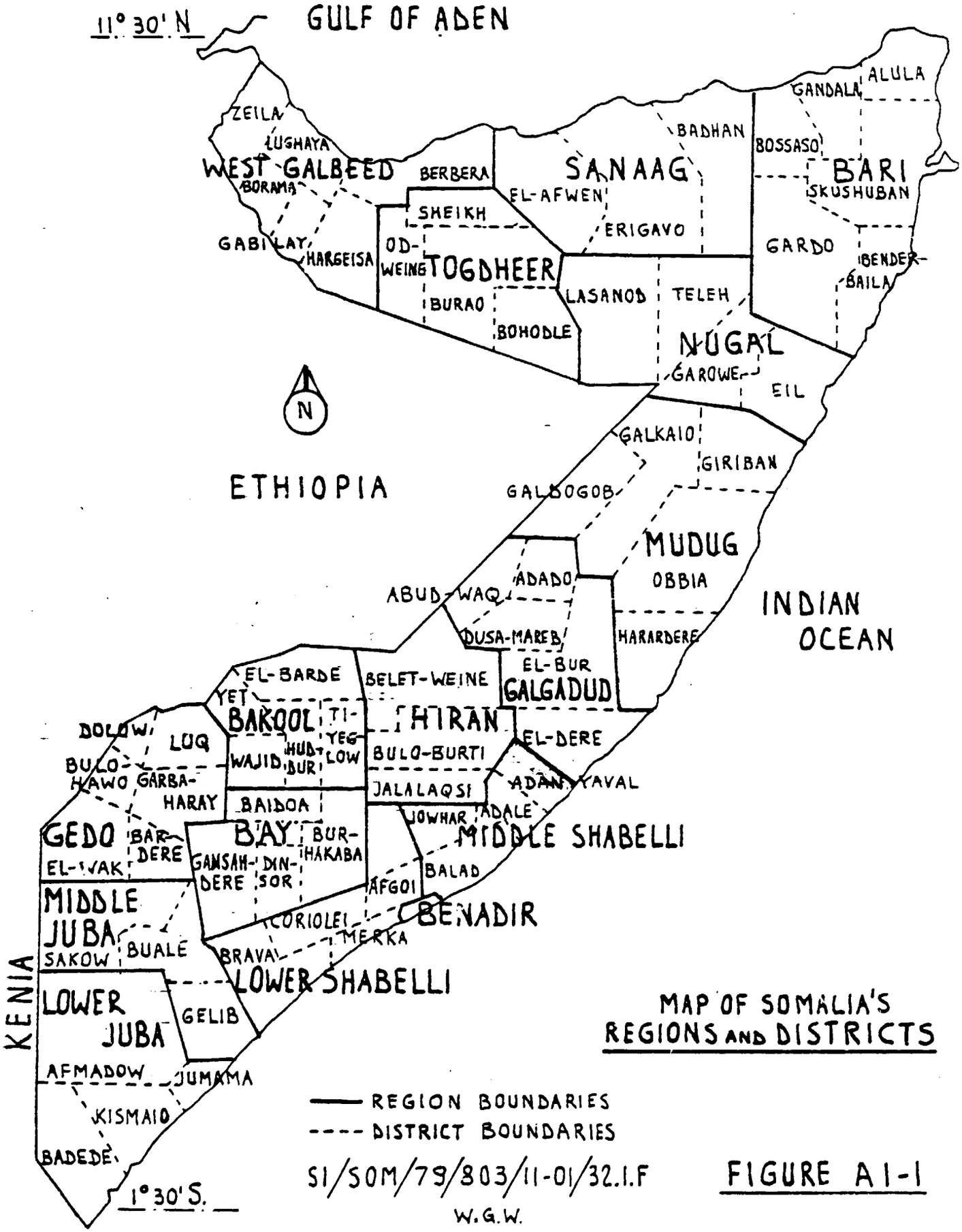
$$\frac{134.000}{2 \times 936} = 71.6 \text{ Say } 72 \text{ mandays / ha.}$$

Adding per hectare for seeding 6 mandays pesticides 3 mandays (3 applications) and for fertilizers 3 mandays (3 applications) the total is 84 mandays/ha as an average.

The labour intensity for Cotton is 50 percent and for Rice 100 % more than for Maize and Sesame.

The labour cost is SO.SH. 2 / manday included food and lodging.

1.26 In Table A 1-11, the above mentioned costs are summarized to arrive at the production cost per hectare for some seasonal crops.
It may be concluded that the cost of fertilizers is the highest (except for rice) in comparison with other costs. Because of the high cost of fertilizer, the quantity of application of fertilizers for seasonal crops is low.



MAP OF SOMALIA'S
REGIONS AND DISTRICTS

—— REGION BOUNDARIES
---- DISTRICT BOUNDARIES

SI/SOM/79/803/11-01/32.1.F

FIGURE A1-1

W.G.W.

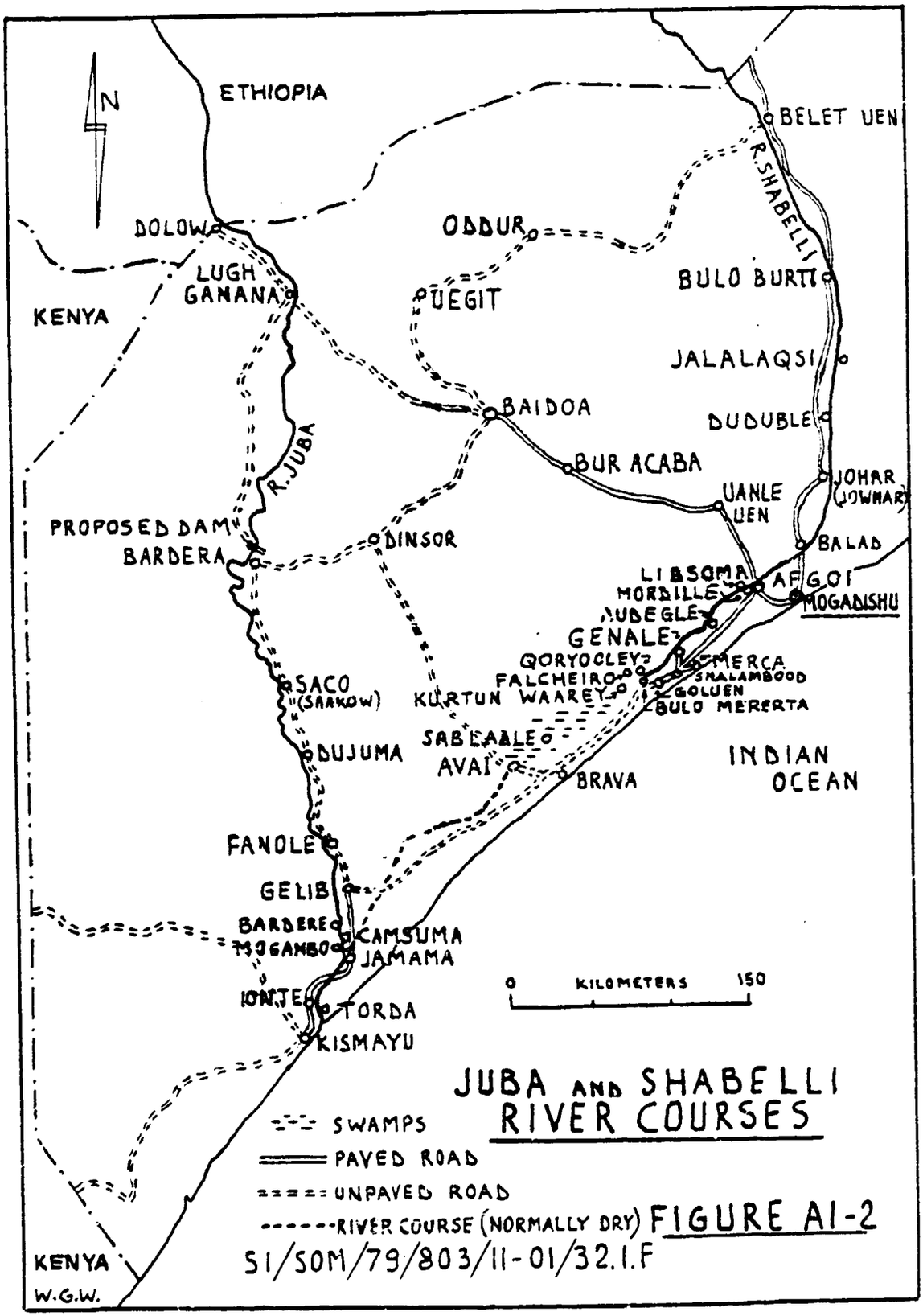

N
ETHIOPIA
BELET UEN
R.SHABELLI
DOLOW
ODDUR
LUGH GANANA
KENYA
UEGIT
BULO BURTI
JALALAQSI
BAIDOA
DUDUBLE
R.JUBA
BUR ACABA
JOHAR (JOWHAR)
UANLE UEN
PROPOSED DAM
BARDERA
DINSOR
BALAD
LIBSOMA
AFGOI
MORDILLE
MOGADISHU
AUDEGLE
GENALE
QORYOCLEY
ERCA
FALCHEIRO
SHALAMBOOD
SAACO (SHAKOW)
KURTUN WAAREY
GOLUEN
BULO MERERTA
SABLEABLE
DUJUMA
AVAI
BRAVA
INDIAN OCEAN
FANOLE
GELIB
BARDERE
CAMSUMA
MOGAMBO
JAMAMA
0 KILOMETERS 150
TORDA
KISMAYU
JUBA AND SHABELLI RIVER COURSES
SWAMPS
PAVED ROAD
UNPAVED ROAD
RIVER COURSE (NORMALLY DRY)
KENYA
W.G.W.
FIGURE A1-2
SI/SOM/79/803/11-01/32.1.F

TABLE A 1-1 CULTIVATED LAND DIVIDED IN REGIONS AND PRODUCTS IN HECTARES

	REGION	SORGHUM	MAIZE	SESAME	BANANA	OTHERS	TOTAL
	NORTH WEST ZONE						
1	West Galbeed	52.000	4.000	-	-	4.000	60.000
2	Togdheer	16.000	-	-	-	2.000	18.000
	NORTH EAST ZONE						
3	Sanaag	11.000	-	-	-	2.000	13.000
4	Nugal	1.500	-	-	-	500	2.000
5	Bari	1.500	-	-	-	500	2.000
	CENTRAL ZONE						
6	Mudug	1.500	-	-	-	500	2.000
7	Galgadud	3.500	-	-	-	1.500	5.000
	SHABELLI RIVER ZONE						
8	Hiran	46.000	4.000	1.000	-	3.000	54.000
9	Middle Shabelli	8.000	32.000	12.000	-	9.000	61.000
10	Lower Shabelli	30.000	78.000	45.000	4.500	13.500	171.000
11	Benadir	-	-	-	-	-	-
	INTER RIVERINE ZONE						
12	Bakool	25.000	-	-	-	3.000	28.000
13	Bay	134.000	-	-	-	8.000	142.000
	JUBA RIVER ZONE						
14	Gedo	30.000	15.000	3.000	-	4.000	52.000
15	Juba Middle	28.000	39.000	9.000	5.500	8.500	90.000
16	Juba Lower						
		388.000	172.000	70.000	10.000	60.000	700.000

TABLE A 1-2 SEASONS AND CROPS

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	J.	F.	YEAR
Rainfall in Genale (mm)	1.3	0.1	6.1	77.7	69.1	77.6	62.4	49.1	20.7	28.6	54.0	23.8	1.3	0.1	470.5
Rainfall in Gelib (mm)	2.2	1.4	8.0	138.5	111.2	54.0	52.5	18.0	17.7	74.6	59.7	48.3	2.2	1.4	585.9
Temp. in Genale (^{o}C)	26.7	27.3	28.2	28.2	27.3	25.7	24.9	25.1	25.8	26.3	26.5	26.7	26.7	27.3	26.6
Temp. in Gelib (^{o}C)	28.7	28.9	29.0	28.3	28.0	26.5	25.8	26.1	26.6	27.3	28.0	28.1	28.7	28.9	27.6
Humidity in Genale (%)	76	74	76	77	80	82	83	82	82	81	82	79	76	74	80
Humidity in Gelib (%)	69	68	67	73	78	79	77	75	73	73	76	74	69	68	74

SEASON	JILAL-Season Dry Season			GU-Season Rainy Season			HAGAY-S.(2) Dry Season		DER-Season Rainy Season					
MONTH	JAN	FEB	MAR	APRIL E-M-L	MAY	JUN	JUL M	AUG E-M-L	SEPT E-M-L	OCT E-M-L	NOV	DEC E-M-L	JAN E-M-L	FEB E-M-L
MAIZE				---x	———	———	———	——o	vvvx	———	———	———	——o	
RICE			vvvvvx	———	———	———	———	——o						
COTTON				x———	———	———	———	———						
PULSES				vvx———	———	———	——o							
GROUNDNUTS				x———	———	———	———	——o	vv	x———	———	———	——o	
SORGHUM				vvx———	———	———	———	——o	vv	x———	———	———	———	——o
SESAME									vx———	———	———	——o		

NOTE : E = Early ; M = Mid and L = Late
X = Planting ; O = Harvesting
(1)= Average Monthly Rainfalls

(2) Rainfall in HAGAY-Season only in Coastal Areas
vvv Sowing time recommended by FAO.

TABLE A 1-3 EXISTING AREAS (HA) UNDER CONTROLLED IRRIGATION 1977

REACHES	PERENNIAL CROP LAND				SEASONAL CROP LAND								TOTAL CROPPED AREA HA.	TOTAL NET AREA UNDER CULTIVATION HA.
	BANANA	SUGAR	CITRUS	OTHERS	MAIZE	SORGHUM	RICE	GR.NUTS	SESAME	COTTON	PULSES	MISC/VEG		
1.JOHAR REACH														
SNAI Sugar Estate	-	7150	50	-	-	-	-	-	-	-	-	-	7200	7200
Smal Farms	-	-	-	-	260	-	50	100	120	100	-	-	630	320
2.BALAD/AUDEGLE REACH														
Balad/Audegle Pump	350	-	80	-	4500	-	-	-	3500	1200	1000	1000	11630	6630
Balad/Cotton Scheme	-	-	-	-	360	-	-	-	300	700	-	-	1360	1000
Afgoi/Hordile	-	-	-	-	540	-	324	360	216	-	-	-	1440	1500
3.GENALE REACH	3650	-	100	250	6000	-	500	-	2500	-	-	-	13000	8500
4.GENALE/AVAI REACH														
Kurtun Waarey Settl.	30	-	-	-	340	-	215	-	185	-	-	165	935	595
Sa blaale Settl.	30	-	-	-	320	220	270	-	440	-	370	160	1810	1030
Avai Rice Scheme	-	-	-	-	200	-	500	-	-	-	-	-	700	500
5.UPSTREAM FANOLE														
Upper Juba Small Sch.	30	-	-	-	400	430	-	80	160	-	-	900	2000	1140
Dujuma Settl.	30	-	-	-	180	-	-	-	180	-	-	210	600	450
6.DOWN STREAM FANOLE														
Lower Juba Small Sch.	4000	-	80	-	950	700	280	40	90	50	-	160	6350	5260
State Farms	-	-	-	-	200	-	400	200	-	-	-	-	800	400
Mogambo Irr.Project	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Torda Irr.Project	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ionte Rice Farm	-	-	-	-	-	-	150	-	-	-	-	150	300	150
Juba Sugar	-	170	-	-	-	-	-	-	-	-	-	-	170	170
Trans Juba Livestock Project	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8120	7320	310	250	14250	1350	2689	780	7691	2050	1370	2745	48925	34845

TABLE A 1-4 YIELDS OF IRRIGATED CROPS IN qt/ha

MUSCIA IRRIGATED PLOTS RESULTS

CROP	VARIETY (L = Local)	SEED RATES kg/ha	PESTICIDES TYPE	PESTICIDES kg/ha	FERTILIZER kg/ha N	FERTILIZER kg/ha P	FERTILIZER kg/ha K	YIELD qt/ha	FAO Rec.Practices Incl.Insecticides SEED 1) kg/ha	FAO Rec.Practices Incl.Insecticides N P K	FAO Rec.Practices Incl.Insecticides YIELD qt/ha	Country Yields Excl.Fertilizers Incl.some Pesticides qt/ha
COTTON	Akala 4-42 (L)	N.R.	Not-Treated	-	0	0	0	1.2	15	80 50 0	25	7
	"	N.R.	DDT + Sevin	14+14	0	0	0	17.0				
	B PA 68.(N.R.)	N.R.	"	N.R.	40	0	0	30.0				
UPLAND RICE	Dawn (N.R.)	100	Not-Treated	-	0	0	0	15.7	100	70 45 0	30-35	15
	Dawn (")	100	"	-	100	50	0	31.6				
	Dawn (")	100	"	-	150	50	0	33.9				
	Saturn (N.R.)	100	"	-	100	50	0	44.1				
MAIZE	Afgoy (L)	N.R.	Sevin + Furidan 10 G	N.R.	0	0	0	36.0	20	68 45 0	30-35	15
	"	N.R.	"	N.R.	0	100	0	46.1				
	"	N.R.	"	N.R.	50	100	0	52.0				
SORGHUM	Local	N.R.	Not-Treated	-	0	0	0	2.8	40	23 0 0	N.R.	3
	(From Bay Region)	N.R.	Diazion	1.5	0	0	0	5.3				
	Dabar (Sudan)	N.R.	N.R.	-	0	0	0	26.8				
WHEAT	Mexicani (N.R.)	130	Sevin	N.R.	0	0	0	10.7	N.R.	N.R.	N.R.	N.R.
	"	130	"	N.R.	50	0	0	14.8				
GR.NUTS	N.R.	N.R.	N.R.	-	0	0	0	25.1	160	20 80 0	20-25	7
	N.R.	N.R.	N.R.	-	50	0	0	27.1				
SESAME	-	-	-	-	-	-	-	-	4	55 45 0	5-6	3
MISC.	-	-	-	-	-	-	-	-	-	20 50 0	-	-

N.R. = Not Reported
N.P.K. = N (Urea)-P205 (T.S.P.)-K20
qt = Quintal = 100 Kilo grams
1) Average Quantity of DER and GU Seasons in 15 M² plots

TABLE A 1-8 PESTICIDES REQUIREMENTS FOR SETTLEMENTS PER HECTARE (HA)

CROP (SEED RATE)	PESTICIDE	DOSAGE PER HECTARE	NUMBER OF APPLICATION	TOT. PEST. PER HA.	REMARKS	COST IN SO.SH.PER KG/LITER	MINIMUM COST/HA IN SO.SH.
COTTON	Mercol or	3 gr. per kg seed	1	45 gr.	Seed Dressing		
(15 kg/ha)	Cerason	3 gr. per kg seed	1	45 gr.	- dito -	27.70	1.25
	Dimecron 50 or	0.5 liter	3 - 8	1.5-4.0 L	Insecticide	71.35	107.03
	Sevin 50 WP or	1.0 kg	3 - 8	3.8 kg.	— do —		108.28
	Rogor 40 EC or	1.0 liter	3 - 8	3.8 Liters	— do —		
RICE	Mercol or	3 gr. per kg seed	1	300 gr.	Seed Dressing		
(100 kg/ha)	Cerason	3 gr. per kg seed	1	300 gr.	— do —	27.70	8.31
	Stam F-34 or	4.0 liters	2	8 Liters	Herbicide		
	Nuvacron or	1.0 liter	2 - 3	2 - 3 L	Insecticide	77.85	155.70
	Dimecron	0.5 liter	2 - 3	1.0-1.5 L	— do —		164.01
MAIZE	Mercol or	3 gr.per kg seed	1	60 gr.	Seed Dressing		
(20 kg/ha)	Cerason	3 gr. per kg seed	1	60 gr.	— do —	27.70	1.66
	Endosulfan or	1.0 liter	2 - 3	2 - 3 L	Insecticide		
	Nuvacron or	1.0 liter	2 - 3	2 - 3 L	— do —	77.85	155.70
	Sevin 50 WP or	1.0 kg	2 - 3	2 - 3 kg	— do —		157.36
SESAME	Mercol or	3 gr. per kg seed	1	12 gr.	Seed Dressing		
(4 kg/ha)	Cerason	3 gr. per kg seed	1	12 gr.	— do —	27.70	0.33
	Endosulfan or	1.0 liter	2 - 3	2 - 3 L	Insecticide		
	Sevin 50 WP or	1.0 kg	2 - 3	2 - 3 kg	— do —		
	Nuvacron or	1.0 liter	2 - 3	2 - 3 L	— do —	77.85	155.70
							156.03

SOURCE : S.D.A.

TABLE A 1-11 PRODUCTION COSTS OF SEASONAL CROPS (SO.SH./HA) IN 1979 ON IRRIGATED LAND

	SEED TABLE A 1-10 SO.SH. KG.	KG. HA.	COST	FERT. COST TABLE A 1-6	PESTICIDES TABLE A 1-8	TRACTOR WORK SO.SH.50/HR TABLE A 1-9 HRS.	COST	STORAGE SO.SH.30/TON YIELD TON/HA	COST	LABOUR SO.SH.2/DAY MAN DAYS HA.	COST	OTHER COST 1)	TOTAL PROD. COST	GROSS REVENUE CROP SO.SH. KG.	REV.	NET RETURNS SO.SH. HA.
COTTON (SEED)	3.01	15	45.15	316	108.28	5	250	2.0	60	126	252	60	1091.43	2.60	5200	4108.57
RICE BASARAM (MILLED)	3.91	100	391.00	316	164.01	8	400	2.0	60	168	336	60	1727.01	3.50	7000	5272.99
MAIZE (GRAIN)	1.16	20	23.20	316	157.36	6	300	2.5	75	84	168	60	1099.56	0.75	1875	775.44
SESAME (SEED)	2.86	4	11.44	316	156.03	4	200	0.4	12	84	168	60	923.47	2.40	960	36.53

1) Makes an allowance for hand tool depreciation.

REFERENCES:

1. World Bank Document
   - Agricultural Extension and Farming Management Training.
   Project Staff Appraisal Report Nº 2170 a - SO.

2. Annual Report and Statement of Accounts, 18th Financial Year 1 Jan. - 31 Dec. 1978, by the Central Bank of Somalia.

3. Three Year Plan 1979 - 1981 by the State Planning Commission.

4. Prefeasibility Study of NH3 /UREA Intergrated Plant by Snamprogetti.

5. Somalia Irrigation Practices and Crop Production by UN /FAO, Rome, 1975.

6. Annual Progress Report, Year 1977 by the Ministry of Agriculture assisted by UNDP / FAO / MUCIA.

7. Rehabilitation and Improvement Programme for the Snai Sugar Plant at Jowhar by V.Guruswany, Cane Sugar Industry Consultant.

8. Visitreport at Jowhar Sugar Estate by M.M.Kassim (State Planning Commission), M.R.Narayanan (FAO) and L.J.Marenah (FAO).

9. The 1978 Statistics by N.B.B.

10. Agriculture Plan of Work for the Year of 1979 by the Settlement Development Agency (SDA).

ANNEX 2

FERTILIZER BAGGING PLANT.

A. BUILDING SIZE.

2.01 The quantities of fertilizer in metric tons (mt) in the coming years are estimated in Chapter 4 paragraph 4.24 and are as follows :

YEAR	1980	1981	1982	1983	1984	1985
UREA (mt).	5866	5943	6019	6426	6502	6578
TSP (mt).	1895	1933	1971	1991	2047	2085
TOTAL(mt)	7761	7876	7990	8417	8549	8663

2.02 To estimate the size of the bulk storage building an average of 6000 mt of Urea and 2000 mt of TSP have been taken into account, divided as follows :

2 shipments of 3000 mt of Urea in bulk each and
1 shipment of 2000 mt of TSP in bulk.

Therefore the size of the building is estimated for 3000 mt of Urea and 2000 mt of TSP, both fertilizers delivered in bulk.

2.03 The dimensions of the bulk storage building are calculated with fertilizers having an assumed bulk density of 0.9 mt/m^3 and an angle of repose of 27°.
The bulk storage building is divided into bins, each having a length of 22 meters (m) and a net width of 4.8 m.
At a material cross section of 148 m^2 each bin has a capacity of 148 m^2 x 4.8 m x 0.9 t/m^2 = 639.36 m.tons of bulk fertilizer.

2.04 The storages of TSP and Urea have been separated from each other to prevent mixing, to avoid caking problems.
The TSP storage is divided into 3 bins having a capacity of 3 x 639.36 = 3196.8 m.tons, say 3000 m.tons and the Urea storage into 5 bins having a capacity of 5/3 x 3000 =5000 m.tons.

2.05 The product storage building in which the bagged fertilizer is piled to about 5 meters high has a storage capacity about : 20 m x 45 m x 5 m x 0.9 mt/m^3 = 4050 m.tons of bagged fertilizer.
This means, that during the bagging of 5000 m.tons of fertilizers about 1000 m.tons should be despatched to the consumers.

2.06 The bulk - and product storages are shown on Sketch A 2-1 .

B. HANDLING BULK FERTILIZER.

2.07 The equipment handling the bagging of fertilizer in bulk in the Bagging Plant is located in the Product Storage Building and the flow of material from bulk to bagged is shown in the bulk storage - and bagging - equipment diagram on Sketch A 2-1.

2.08 The fertilizer in bulk is dumped via lorries into Dump Hopper 1 and via Belt Conveyor 2 and Bucket Elevator 3 to TSP Belt Conveyor 4 or Urea Belt Conveyor 11 depending on the type of fertilizer.
Via Tripper Carriage 5, 12 , Shuttle Belt Conveyor 6, 13 and Distribution Chute 7, 14 the fertilizer is stored in the bins.
The Shuttle Belt Conveyor may be manually removed from one side to the other side of a bin over Rail 8, 10.
To transfer between bins, the Conveyor is rolled to center position lifted from rails, swung parallel with the Belt Conveyor 4, 11 on Catwalk 9 and moved to the other rails of the bin by hand.

2.09 Each bin is provided with Roller Curtain 10, 16, made of polyethylene(PE) film 0.15 - 0.20 mm. thick to cover the pile of bulk fertilizer in the bin to prevent moisture absorption during storage.
Specially for Urea the Roller Curtains should be used, as Urea is hygroscopic and therefore has a tendency to absorb moisture as water vapour from the air.
The critical relative humidy (CRH) at 30°C(86°F)is for Urea 75.2% while for TSP is well over 85 %.

2.10 As shown in Table A 1-2 of Annex I, the relative humidy is low in the months of January, February and March from 67% to 77%.
A set of ovens should be provided to burn charcoal, made from the autogenously burning of wood during 7 - 8 hours and which is available in Somalia, as open fire when the relative humidity of the air is above CRH.
Charcoal should be used for the open fire because its combustion products dc not contain water vapour.

2.11 By means of a 1.5 - 2 ton diesel Forklift Truck 17, which has a compact turning circle, equipped with a hydraulic tilting shovel of about 0.8 m^3 capacity, the bulk fertilizer is reclaimed from the storage bin and dumped into the receiving hopper of Belt Conveyor 18.
The retaining lumps on the screen of the receiving hopper should be manually removed and crushed by means of sledge - hammers.

2.12 From the Belt Conveyor 18 the about 0.7 mt of fertilizer, same discharges into the 1.5 mt Bagging Hopper 19 from which the fertilizer flow is operated manually to the Bagging Machine 20, a volumetric type of machine, see Sketch A 2-2.
Transported on Bag Conveyor 21 the inner bag of the filled bags is sealed by Bag Sealer 22 and the outer bag is stitched by Sewing Machine 23, before being transported by Hand-operated Bag Truck 25 to Product Storage.
Check Weighing Scale 24 is used for checking the weight of the filled bags, after which the Bagging Machine is readjusted if required.

2.13 The bagged fertilizer from the Product Storage is then despatched to lorries, by using Bag Elevator 26, for further transport to the consumers and/or to storages from the distribution centers.

2.14 A dust - system containing a dust fan, cyclone, bag filter and ducting may be installed later if the dust will give problems. The ducts should be connected to places where dust occurs, and are mostly those places where the bulk fertilizer discharges from one equipment to the other.

2.15 As already mentioned above the months January, February and March have the lowest relative humidity, for which reason the first shipments of 3000 mt of Urea and 2000 mt of TSP should be offloaded in the beginning of January and the second shipment of 3000 mt of Urea in the beginning of February.

2.16 As the Urea storage is designed for 3000 mt of Urea and the next shipment of 3000 mt of Urea will take place one month later, the bagging plant should be designed to handle at least 3000 mt of Urea in one month.

2.17 The hours to operate the Bagging Plant and the handling of the Storages are estimated as follows :
- 6 Hours per day
- 6 Days per week
- 4 Weeks per month

Resulting in 6 x 6 x 4 = 144 hours a month.

2.18 One Bagging Machine can handle 5 bags per minute which is 5 x 60 x 50 kg/bag = 15 mt/hr. or 15 x 144 = 2160 mt of fertilizer per month.
Therefore 2 lines with one Bagging Machine each are designed having a capacity of 2 x 2160 = 4320 mt of fertilizer per month in total, sufficient to empty the Urea - storage in time for the next shipment.
The Equipment Outline Specification and Sketch A 2-1 are shown in next sub - chapter C.

2.19 Moreover at the end of March the fertilizer should be sent to the consumers of fertilizers who apply the fertilizer to the soil just before the start of the rainy season in April, see Table A 1-2 of Annex 1.

2.20 Resulting of above, the handling of fertilizers from bulk to bagged can be done within three months during the months January, February and March in which the relative humidity is the lowest of the year.

▲ 2-6

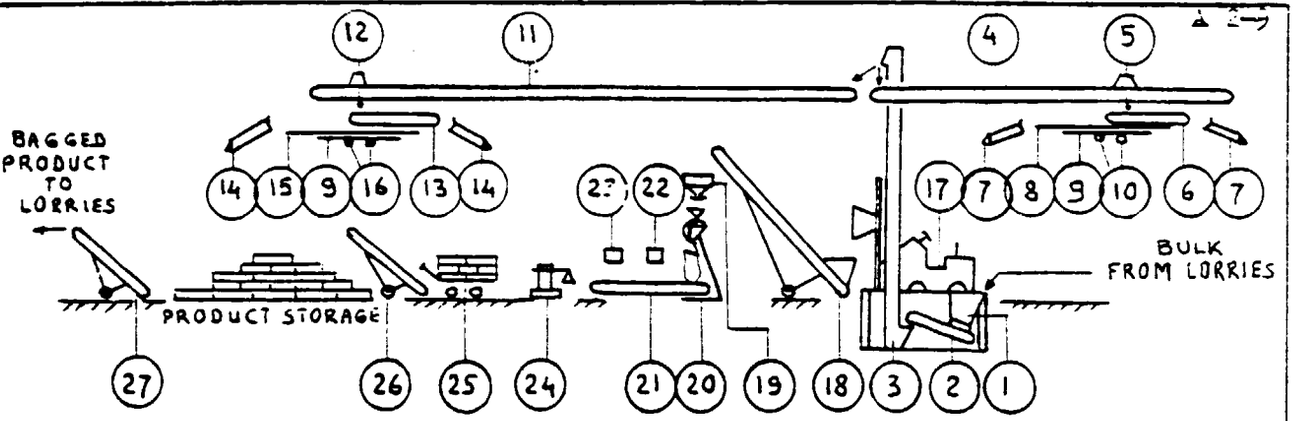
C. EQUIPMENT OUTLINE SPECIFICATION.

The items mentioned below refer to Sketch A 2-1.

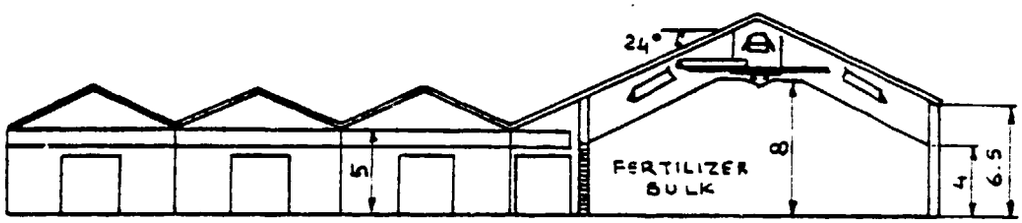
ITEM	Q'TY	DESCRIPTION	MOTOR HP.	CHARACTERISTICS PER UNIT
1	1	Dump Hopper	-	Opening 3 x 1.75 m ; included screen.
2	1	Belt Conveyor	1 x 5	Size : 3.5 m x 0.6 m width. Incination : 15°. Capacity : 60 t/h.
3	1	Bucket Elevator	1 x 10	Centrifugal discharge type. Length : 15 m. Capacity : 60 t/h.
4	1	TSP - Belt Conveyor	1 x 5	Troughed type. Capacity : 60 t/h. Size : 17 m x 0.4 m width.
5	1	TSP - Tripper Carriage	-	Manual movement.
6	1	TSP - Shuttle Belt Conveyor	1 x 2	Size : 4.5 m x 0.4 m width. Incl. speader and reversible drum motor.
7	6	TSP - Distribution Chute	-	Diam. 0.35 m x 3.5 m length. Incl. spreaders.
8	6	Rail	-	Mild steel angle of 9 m length. For support of item 6.
9	1	Catwalk	-	Length : 45 m with deck crating.
10	6	Roller Curtain	-	Poly Ethylene film of 4.75 m x 15 m, 0.15 mm thick. Complete with steel tubing and bearings.
11	1	Urea - Belt Conveyor	1 x 5	Troughed type. Capacity : 60 t/h. Size : 26 m x 0.4 m width.

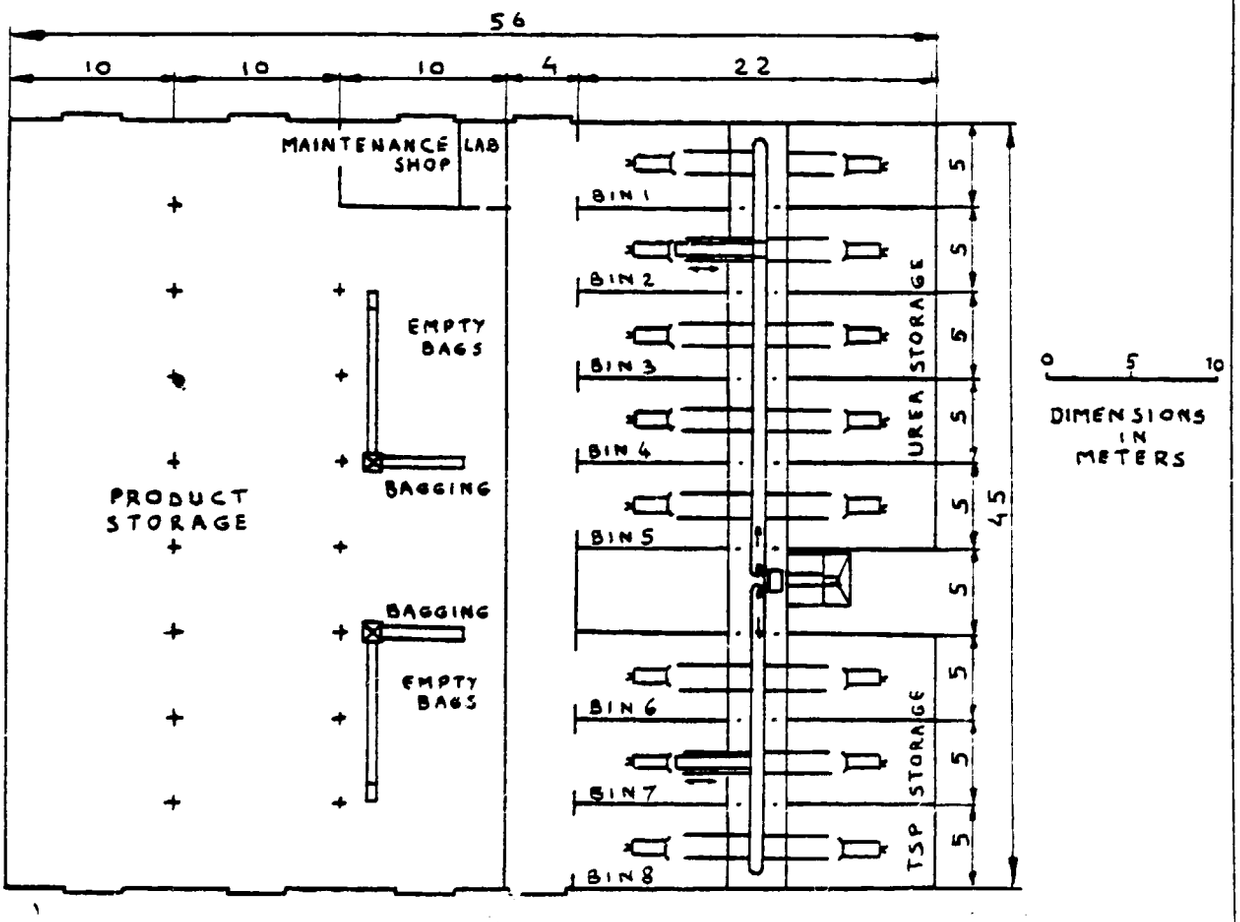
ITEM	Q'TY	DESCRIPTION	MOTOR HP.	CHARACTERISTICS PER UNIT.
12	1	Urea - Tripper Carriage	-	Manual movement.
13	1	Urea - Shuttle Belt Conveyor	1 x 2	Size : 4.5 m x 0.4 m width. Incl. spreader and reversible drum motor.
14	10	Urea - Distribution Chute	-	Diam. 0.35 m x 3.5 m length. Incl. spreaders.
15	10	Rail	-	Mild steel angle of 9 m length. For support of item 13.
16	10	Roller Curtain	-	PE film of 4.75 m x 15 m , 0.15 mm thick. Complete with steel tubing and bearings.
17	2	Forklift Truck	-	Diesel engine. Lifting height 4 m complete with hydraulically operated shovel of 0.8 m^3 capacity.
18	2	Belt Conveyor	2 x 5	Inclined troughed belt conveyor included receiving hopper with screen to remove lumps. Size : 10 m x 0.4 m width. Capacity : 60 t/h.
19	2	Bagging Hopper	-	Opening : 1.1 m x 1.1 m. Straight height : 1 m. Capacity : 1.5 t. Included discharge gate.
20	2	Bagging Machine	-	Volumetric type. Included supports.
21	2	Bag Conveyor	2 x 2	Rubber belt conveyor. Size : 5 m x 0.4 m.
22	2	Bag Sealer	-	For plastic film bags. Capacity 10 bag / min.
23	2	Sewing Machine	-	For woven bags. Capacity 10 bag / min.

ITEM	Q'TY	DESCRIPTION	MOTOR HP.	CHARACTERISTICS PER UNIT
24	1	Check Weighing Scale	-	For bags of 50 kgs complete with weights.
25	4	Bag Truck	-	Hand-operated bag truck with four small tires. Capacity : 500 kg.
26	1	Bag Elevator	1 x 5	Portable belt conveyor with height adjustable from 1.5 m to 4 m. Capacity : 30 bag / min.
27	1	Bag Elevator	1 x 3	Portable belt conveyor with height adjustable from 1.0 m to 2.5 m.
-	1	Dust System	-	To remove dust from the air. Included dust fan, cyclone, bag filter and ducts.
-	1	Set of ovens for open fire by combustion of charcoal.		
-	1	Set of structural steel not forming part of the building.		



BULK STORAGE-AND BAGGING - EQUIPMENT DIAGRAM





FERTILIZER
BULK STORAGE AND BAGGING PLANT
CAPACITY: 5000 MT

SKETCH A2-1

W.G.W. SI/SOM/79/803/11-01/32.1.F

D. PERSONNEL REQUIREMENTS

2.21 The personnel required to operate the Bagging Plant (2 lines) and the storage may be divided into permanent staff and temporary employees, who may be hired, for an operating time of 3 months.

2.22 The permanent staff consist of:

No.	FUNCTION	IN SO.SHILLINGS MONTHLY WAGES	YEARLY WAGES
1	Plant Manager	1000	12000
1	Ass. Manager	800	9600
1	Foreman	600	7200
	TOTAL	2400	28800

2.23 The temporary employees.

OCCUPATION	NUMBERS
- Handling intake fertilizers	1
- Distribution to bins	2
- Intake fertilizer bagging plant	2
- Regulating bagging hopper	2
- Filling bags(incl.weight checking)	4
- Sealing bags	2
- Sewing bags	2
- Transporting to product storage	4
- Piling incl. dispatching to lorries	8
TOTAL	27

Hired at a rate of SO.SH. 2/hour during 3 months the temporary employees cost:

3 months x 144 hr/month x 27 men x 2 SO.SH./hr.man = SO/SH.23,330.

2.24 Total cost for personnel is:

SO.SH. 28,800 + SO.SH.23,330 = SO.SH.52,130.

E. EQUIPMENT COST

2.25 The cost of the mechanical equipment required for the Bagging Plant and Storage are estimated based on European prices as all the equipment has to be imported.
The erection is done locally.
The cost of mechanical equipment is shown in Table A 2-1.

2.26 Electrical equipment has also to be imported, except for erection and installation, which are done locally.
The cost is estimated as follows:

DESCRIPTION	SO.SHILLINGS
1 Set of Motors (12 Units)	17,550
1 Motor Control Center	27,500
1 Transformer	22,750
1 Lot of Electrical wires, starters etc.	18,150
1 Lot of Lighting fixtures, switches etc.	20,000
Electrical equipment cost	105,950
1 Lot of Spare Parts (5% of Electr.Equipm.Cost)	5,300
Electr.equipm.cost incl. spare parts	111,250
*) Erection (50% of Electr.equipm.cost)	52,750
TOTAL	164,000

*) Included expatriate installer:

300 man-hours at US$15 = US$4,500 = SO.SH.28,600.

2.27 The Electrical Energy cost is estimated as follows:

	KILO WATT (KW)
- Motors 53 HP x 0.736	39.1
- Sewing and Sealing Machines 4 x 0.400	1.6
- Lighting 15 x 2 x TL 40 W (IP 55)	1.2
TOTAL	41.9

At SO.SH. 0.60/KWH the Electrical Energy Cost amounts to:

$$41.9 \frac{\text{kwh}}{\text{hr}} \times 3 \frac{\text{months}}{\text{year}} \times 144 \frac{\text{hr}}{\text{month}} \times 0.60 \frac{\text{SO.SH.}}{\text{kwh}} = \text{SO.SH.10,860 per year}$$

2.28 The laboratory equipment contains the following:

1 Set of sampling equipment for granular materials.
1 Balance.
1 Set of Test Sieves.
1 Set of thermometers, hygrometers, psychrometers etc.
1 Set of general lab. equipment.

The estimated cost for the laboratory equipment would be about SO.SH. 18,000.

2.29 The total equipment cost amounts to:

	SO.SHILLINGS
Mechanical equipment cost	959,500
Electrical equipment cost	164,000
Laboratory equipment cost	18,000
EQUIPMENT COST	1,141,500

F. BUILDING COST

2.30 The building cost is estimated on volume basis. For the Bagging Plant and Storages, see Sketch A 2-1, the building cost amounts to:

	SO.SHILLINGS
Product Storage + Corridor 9,180 m^3 at SO.SH. 170/m^3	1,560,600
Bulk Storage 8,910 m^3 at SO.SH. 300/m^3	2,673,600
TOTAL	4,233,600

Included concrete foundation, civil works and roofs made of corrugated asbestos - cement sheets.

G. ESTIMATED INVESTMENT COST

2.31 The investment cost is estimated as follows:

	SO.SHILLINGS
Equipment cost	1,141,500
Export crating, delivery freights 30% of equipment cost	342,450
Imported equipment cost	1,483,450
Erection	
Mechanical	87,000
Electrical	52,750
Sub-total erection cost	139,750
Building cost	4,233,600
Start-up supervision (300 man-hours)	28,600
INVESTMENT COST	5,885,900

H. OPERATING COST

2.32 The operating cost per year of the Bagging Plant and the Storages, of which the investment costs are:

EQUIPMENT	SO.SH.	1,483,950
BUILDING	"	4,233,600
ERECTION	"	139,750
SUPERVISOR	"	28,600
TOTAL	SO.SH.	5,885,900

is as follows:

		SO.SHILLINGS	SO.SH/MT.
1) - INTEREST ON INVESTM.OF EQUIPMENT	5%	74,200	9.28
1) - INTEREST ON INVESTM.OF BUILDING	5%	211,680	26.46
1) - INT.ON ERECTION + SUPERVISION	5%	8,420	1.05
- DEPRECIATION OF EQUIPMENT	10%	148,395	18.55
- DEPRECIATION OF BUILDING	5%	211,680	26.46
- INSURANCE EQUIPM.+BUILDING	2%	114,350	14.29
- MAINTENANCE OF EQUIPMENT	3%	44,520	5.56
- MAINTENANCE OF BUILDING	1%	42,340	5.29
- SALARIES		52,130	6.52
- ENERGY		10,860	1.36
- MISCELLANEOUS (TRAVEL,COMMUNICATIONS)		10,000	1.25
TOTAL		928,575	116.07

1) Based on a soft loan at a 5% interest rate and 5 year grace period.

The operating cost amounts to SO.SH. 928,575 for the production of 8000 metric tons (mt.) of fertilizer in bags per year, which is:

SO.SH.116.07 per metric ton of bagged fertilizer, or at an exchange rate of:

US$ 1 = SO.SH. 6.3573:

US$18.26 per metric ton of bagged fertilizer.

TABLE A-2-1 MECHANICAL EQUIPMENT COST

ITEM	QUANTITY	DESCRIPTION	TOTAL COST IN SO. SHILLINGS	
1	1	Dump hopper	4,220	
2	1	Belt Conveyor	16,625	
3	1	Bucket elevator	225,000	
4	1	TSP - Belt conveyor	46,000	
5	1	TSP - Tripper carriage	3,500	
6	1	TSP - Shuttle Belt Conveyor	20,500	
7	6	TSP - Distribution chute	11,700	
8	6	Rail	840	
9	1	Catwalk	35,000	
10	6	Roller curtain	-	1)
11	1	Urea - Belt conveyor	57,500	
12	1	Urea - Tripper carriage	3,500	
13	1	Urea - Shuttle belt conveyor	20,500	
14	10	Urea - distribution chute	19,500	
15	10	Rail	1,400	
16	10	Roller curtain	21,000	
17	2	Forklift truck	30,240	2)
18	2	Belt conveyor	54,000	
19	2	Bagging hopper	5,600	
20	2	Bagging machine	14,700	
21	2	Bag conveyor	46,000	
22	2	Bag sealer	70,000	
23	2	Sewing machine	70,000	
24	1	Check weighing scale	3,500	
25	4	Bag truck	7,000	
26	1	Bag elevator	29,150	
27	1	Bag elevator	17,500	
-	1	Set of ovens	2,800	
-	1	Dust system	-	3)
-	1	Set of structural steel	35,000	
		Equipment cost	872,275	
		Lot of spare parts (10% of equipm.cost)	87,225	
		Equipm. cost incl. spare parts	959,500	
		Erection(~ 10% of equipment cost)	87,000	
		TOTAL	1,046,500	

NOTES:

- The equipment has to be painted against corrosive condition and humid climate.

- Truck - Weighing scale, capacity 20 tons to be used from harbour facilities.

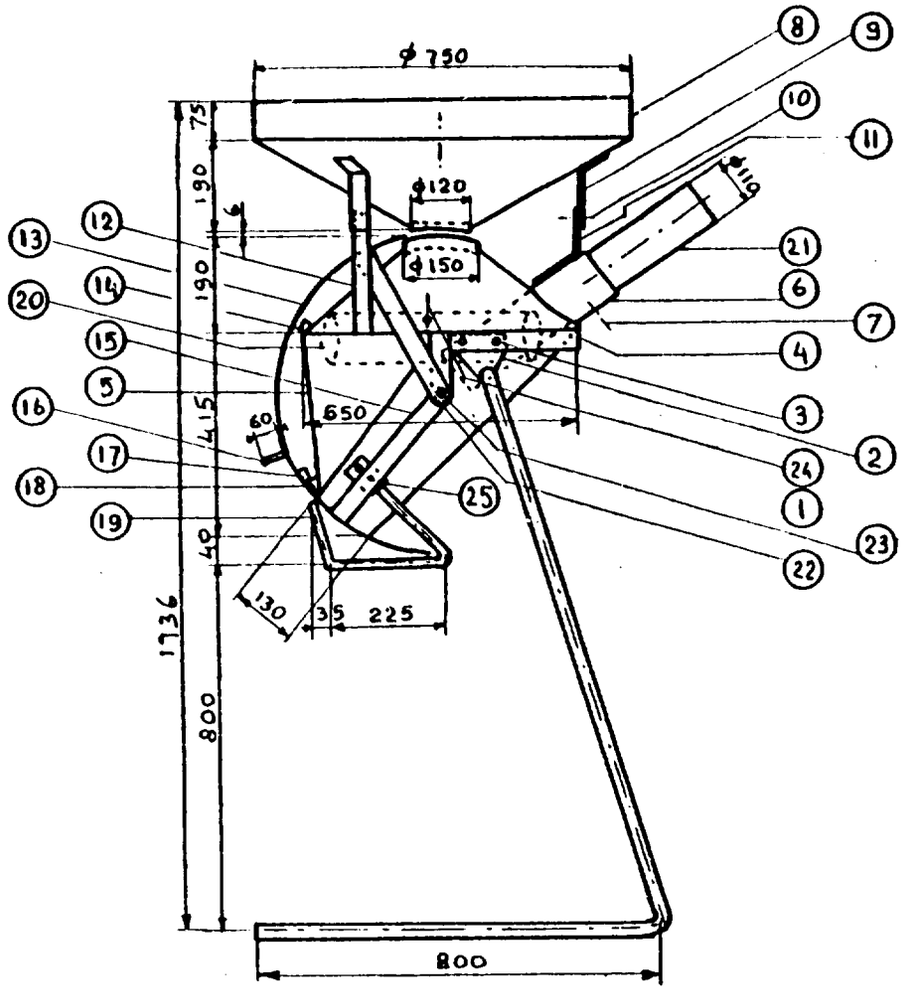
- Erection including expatriate installer: 300 man-hours at US$ 15 = US$ 4,500 = SO.SH. 28,600.

1) Roller curtains are not necessary, when bagging TSP during January, February and March.

2) Two forklift trucks are rent at SO.SH. 35/hour each during three months which is 2 x 3 x 144 x 35 = SO.SH.30,240.

3) Dust system is not estimated, only if required.

- 1 US Dollar = 6.3573 Somali Shillings



DIMENSIONS IN MILLIMETERS

QTY	No	NAME
2	25	BRACKET 40 × 6 × 70
2	24	BOLT ½" UNC × 250
2	23	BOLT ⅝" UNC × 38
4	22	WASHER 40 × 16 × 3
1	21	DISPL. CYL. 110 D × 600
2	20	DISPL. CYL. 110 D × 400
1	19	BAG HOLDER
1	18	STOPPER
1	17	STOPPER
1	16	HANDLE 16 D × 250
2	15	SUPPORT ARM 40 × 6
1	14	STOPPER
1	13	VALVE PLATE 165 × 5
2	12	SUPPORT ARM 40 × 6 × 250
1	11	SUPPORT ARM 40 × 6 × 200
3	10	BOLT ½" × 25
3	9	SUPPORT ARM 40 × 6 × 120
1	8	HOPPER
1	7	SET SCREW ½" × 38
1	6	COLLAR TUBE
1	5	RECEPTACLE
1	4	SUPPORT BRIDLE 65 × 6
4	3	BOLT ½" × 32
2	2	PLATE
1	1	FRAME, TUBE OD 34

VOLUMETRIC BAGGER DRAWING

ITEM 20

CAPACITY: 5 BAGS/MIN.

SKETCH A2-2

WGW SI/SOM/79/803/11-01/32.1.F

SOURCES.

1. United Nations Monograph N°8.
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