SOMALI DEMOCRATIC REPUBLIC

STATE PLANNING COMMISSION

TECHNICAL DEPARTMENT

SOM 78/008

APPRAISAL OF A MOGAMBO IRRIGATION PROJECT

SUPPLEMENTARY FEASIBILITY STUDY BY SIR M.

MACDONALD AND PARTNERS LTD

MOGADISHU

NOVEMBER 1979.

I. INTRODUCTION

The Mogambo Project derives its name from Mogambo village located on the sight bank of the Juba river 70 km to the north of Kismayo. The Project covers a gross area of about 8000 ha in a strip of land about 16 km long and 5 km wide. The Mogambo Project is one of several irrigation projects scheduled for development in the Juba valley some of which are in study or implementation stage.

The Project has already been studied by the Consultants Tippetts Abbett Mc Carthy - Stratton of New York and Financial and Technical Services of Cairo (TAMS/FINTECS) for which the final report was submitted in May 1977. Later is was decided to undertake a supplementary study, the Agreement for which was signed on 20th December 1978, the field activities commenced in January 1979.

The principal tasks included in the terms of reference of the study of the Consultants Sir M. Macdonald and Partners Ltd are the following:

(a) Undertake a topographical survey of the whole Project area;

(b) Carry out semi-detailed soil survey and analysis both in field and laboratory;

(c) Review the hydrology of the Juba river with particular reference to the low flow periods, Project flooding and the impact of the Construction of Bardhere dam on the Project.

(d) Carry out a preliminary design of the irrigation and drainage system.

(e) Review the TAMS/FINTECS proposals for cropping pattern and the technical and economic aspects of the livestock component.

(f) Prepare recommendations about the organisation and management of the Project and draw up an implementation schedule.

(g) Prepare detailed cost estimates for the works and carry out economic and financial analyses.

II. EXECUTIVE SUMMARY

Mogambo Irrigation Project, supplementary feasibility study was elaborated and submitted by Sir Macdonald and Partners Ltd, Demeter House, Cambridge, United Kingdom. The study itself is consisting of the main report and 7 annexes.

1) Hydrology and climate were elaborated in the Annex 1. Due to the fact that Lugh Ganana gauging station is too far away from the study area the existing data do not allow an accurate assessment of return periods to flood flow levels at Mogambo. Thus, the consultant stated that it is not possible to guarantee a water supply for the 1985 planning horizon January through March at 80 percent reliability. Also, it is advisable to accept the assumption that sufficient water would not on average be available to plant rice with an 80% reliability until the last week in April. In addition, the consultant openly admitted water for irrigation will be restricted for the first four months of each year from 1990, i.e. for the year when the project is planned to become fully productive, if the river is not regulated, while the consultant is confident for the water supply if the river is regulated from the Bardhere Dam.

2) Soils Survey Report and Land Classification - Annex 2 - gives in 7 points the situation of the soils in Mogambo by:

i) A description of the procedure used for soil survey and details of any calculations made.

ii) Tables with analytical data from observation pits and auger borings sampled and analysed.

iii) A location map 1/20000 scale for all pits and borings.

iv) A taxonomic soil classification map 1/20000 scale showing boundaries of the irrigable areas.

v) A land capability classification map 1/20000 scale for irrigated cultivation.

vi) The effect of land levelling on the fertility of the soils.

vii) Enlarged overlays of map to be provided at 1/20000 scale.

These points have been carefully examined by the study and due replies given to them all with 6900 ha of land classified for agricultural production out of a total of 9952 ha.

Results and interpretation are given for various measurements such as

a) infiltration rates

b) Soil salinity

c) Alkalinity

d) pH

e) Chemical analysis of the Juba river water.

f) Moisture retention

g) Soil fertility.

Comments deal with certain aspects of the Annex 2 Soils:

i) Chemical analysis of the Juba river water and the need to accompany the samples taken from the river with the data of the river flows.

ii) Effect of land levelling and irrigation by sprinkler on the termites colonies.

iii) Calculation of the moisture retention properties not clear in some cases Table V - 10 Profiles D012 and G052.

iv) Correction to be sought to Table V - 10 for profile No.076 and horizon 80 -150 cms.

3) Annex 3 Agriculture is studied in 5 Chapters

Chapter I. describes state of agriculture in the Juba Valley (Mogambo area) private and public agriculture, natural resources and possibility for cooperative action with 200 farm holdings.

Chapter II. discusses map selection and cropping patterns and select RICE MAIZE (clay soil) MAIZE and COTTON for levee soil with crop intensity of 132%, instead of 164% on 4 farms totalling 6400 ha.

Chapter III. Establishes the option for mechanisation of the operation, calculations of tractor and labour requirements and particular and important aspect of training for the personnel and possibility to grow bananas if Bardhere dam is built.

Chapter Iv. Considers the crop processing, the use of seed preparation plant.

Chapter V. Analyses the problem of water requirements and their calculations for RICE, MAIZE, COTTON (or BANANAS) on early or later planting data.

Comments

1) 2000 farm holdings bring the idea of organising a cooperative where the STATE of SOMALIA would help (by technical assistance and land reclamation) the farmers instead using farmers as agricultural workers.

2) Eventual change would have to be brought in the cropping intensities from 132% to 164% with UPLAND RICE on 1000 ha. left during the Gu season on fallow.

3) Seed multiplication field necessary not too far from the project. Headquarters to ensure seed quality.

4) Cropping patterns proposed is poorly limited (in diversification).

5) 5 years feasibility study gives no projection for the future and possibility for diversification.

Conclusion - Annexes 2 and 3 are well studied, soils delineated and land classified but limited on agricultural sector to 3 crops - RICE, MAIZE, ...jection on future with TOBACCO, SUNFLOWER or FRUITS and

PROFITABILITY RELIES heavily on INPUTS price evalution when INTERNAL MARKET is limited on its capacity (prices fixed for produces) ECONOMIC ANALYSIS to decide future of the project.

4) The consultants designed a cattle feedlot enterprise which could produce 10,000 head a year and utilise a major part of the useful crop residues and by-products complemented by molasses from the Juba Sugar Project. The design, and the technical parameters, are basically acceptable. Nevertheless, the consultants conclude that on the best assumptions developed in the study the feedlot is not financially or economically viable, due largely to the narrow margin between the buying and selling price of cattle per unit of live-weight. They propose that the project should initially cooperate with the adjacent Trans Juba Feedlot until margins improve and greater experience is gained in feedlot systems. Some apparent errors in the study have been noted, and some technical alternatives suggested, but they are unlikely to affect greatly the viability of the feedlot.

5) The project area on the right bank of Juba river is at present generally bush covered land that will need to be cleared. It will also need land levelling thereafter. If the project comes into being much earlier than the Bardhere reservoir it will need flood protection. Improvement of the Mogambo flood relief channel, and construction of a protective embankment on the west of the farm and improvement of the existing eastern embankment are proposed to provide flood protection. Front mounted rakes on 200 HP crawler tractors with rear mounted plough for rooting out, are proposed for bush clearing. Land levelling of basin clay soils to receive surface irrigation will be done using elevating scrapers and motor graders, while levee soils with large level differences will only be land planed for sprinkler irrigation. Surface irrigation units will be 32.5 ha. (gross) and 27 ha (net).

A main pumping station on the Juba will pump upto 6.5 cubic meters per second into a main canal 16.25 km long. Distributary canals off-taking from main canals feed the unit channels which water the surface irrigated fields.Pumping stations suitably placed on some of the distributaries serve the sprinkler system through buried mains, submains, hydrants and laterals. A feature of the proposed system is the provision of storage reservoirs at the head of distributaries to absorb the flow from a constant flow main canal when some of the distributaries serving surface irrigated fields are not operating at night.

A system of drains consisting of unit drains, collector drains, main or outfall drains will be constructed to remove surface run off due to rainfall or excessive irrigation. Both the canal and drain systems will have adequate structures that to enable their regulation, and bridges and culverts to cross the canals and drains.

The road net work will consist of a 6.0 M wide primary road connecting the project HQs to the main Kismayo/Gelib road, and to other villages of the project area; embanked secondary roads (6.0 M wide) and inspection roads (4.0 wide). One project HQs and four other suitably located villages will contain the necessary facilities and buildings for the management of the farm.

Project proposals provide adequately for staff, and equipment needed to operate and maintain the system.

The cost of construction to be completed over a three year period is estimated at 284,931 M. So.Sh. of which 185,024 M.So.Sh. will be in foreign exchange.

6) As a project objective the consultant put forward a fully operational state farm. However, a number of projects of similar character as Mogambo are in various stages of development (preliminary design, design phase, construction phase, etc. They are already overtaming the

apsorbtive capacity of the Ministries and the respective parastatal agencies. It could be explored whether for such projects as Mogambo a type of company similar to existing parastatal agencies could be set up. This type of company would have a large authonomy of operation and would be able to process all equipment and other inputs of the project, disposing of an adequate allocation of the necessary foreign exchange, etc.

7) The Annex 7 - Economics contains three main aspects and some considerations on economic and agricultural background.

Market prospects and prices were approached and elaborated well and the main factors were taken into account. That resulted into well established pricing of all crops envisaged in the project. However, this Annex lacks analyses of supply of inputs, especially those from imports.

In financial analyses a set of alternatives has been elaborated to get the most appropriate option to come to this the cropping pattern was to be determined and this is done on the budget bases for each crop. Findings led to select paddy rice, maize cotton and bananas and to take into account only the alternative when the Bardhere Dam is completed and bananas replaces maize on levee soil. This alternative form an Internal Rate of Return of 4.15 percent. This analyses was based on the forecasted 1985 prices for outputs, but not for inputs.

For the prupose of economic analyses the consultant assumed an opportunity cost of unskilled labour at 67 percent, a shadow rate of foreign exchange of So.Sh. 9.5 = 1US$ and the opportunity cost of capital at 6 percent. All this resulted in an Internal Rate of Return 5.72 percent a benefit - cost ratio 0.936 and a net percent worth at 576,000 So.Sh. However, more precise calculations will show that IRR amounts to 5.20 percent, the Benefit cost ratio to 0.974 and the net present worth to negative 23.7 million.

It is suggested herewith that some new considerations should take place in order to clarify economic and financial viability of the project.

III. MOGAMBO IRRIGATION PROJECT

Supplementary Feasibility Study

ANNEX 1 - HYDROLOGY AND CLIMATE

1. Flood Hazards

It is made readily obvious by the Consultants that existing data do not allow even a remotely accurate assessment of Return Periods to flood flow levels at Mogambo. Lugh Ganana gauging station is too far away (400 km) from the study area. The table (2.3) giving high flows and return periods should be viewed with extreme caution.

A great deal images on

(a) Bardhere Dam and

(b) Juba Sugar and Fanole Projects,

only when these issues are resolved can an accurate statement be made about possible flooding of the Mogambo Project Area.

2. Estimation of Flows

In their Conclusions on this subject the Consultants are objective about their approach to filling-in the deficiences in data given. They state, it is Not possible to guarantee a water supply for the 1985 planning horizon January through March at 80% reliability.

3. Available Water in April

It is admisable to accept the assumption that sufficient water would not [illegible] be available to [illegible] on 80% reliability until the last week in April. River flow for rainfall available in mid-April in most years.

4. Future Water Availability Without River Regulation

The Consultants openly admit water for irrigation will be severely restricted for the first 4 months of each year from 1990. This is the year when the Project is planned to become fully productive.

5. Future Water Availability with River Regulation from Bardhere Reservoir

The Consultants are confident that the Reservoir can cater for ALL water demands put on it with a very high level of reliability.

6. Drainage Rates From Cropped Areas

Rice	flood irrigation
Maize	surface irrigation in bunded and levelled fields.
Cotton other crops	sprinkler irrigation.

From the agronomic standpoint cropping in relation to soil type appears sound. Drainage characteristics of the soils are very similar to that at the near-by Irrigated Fodder Farms belonging to the Trans-Juba Livestock Project Scheme.

ANNEX 2 - SOILS

Seven points are to be contained in the Soil Survey Report and land classification. After careful examination of Annex 2, Soils, the aims here are to see: first, whether these seven points have been fulfilled; second, the results found and their interpretation; third, comments on the work carried out by the Consultant.

1. EXAMINATION OF THE SEVEN POINTS:

1) A description of the procedure used for soil survey and details of any calculations made.

This point has been studied as follows:

Air photo interpretation of the Mogambo area dated 1963, 1/33000 scale, after field observations helped identify the major soil units and subdivisions. A topographic map 1/20000 scale was used to plot data collected from the field Soil.mapping units were establsihed based on physiographic units (see page 2.7, table 2.5). The soil mapping units were put into correlation with previus studies made in Somali and with the International systems (FAO-UNESCO).

Soil survey techniques were used by the Consultant and the most i important was the one's for Survey of the area:

419 observation sites (5 per square km) with 78 fits (35 sampled and 43 not sampled, 4 Termitaria sites tested for Na); the observation sites oriented EAST-WEST on 17 line A-G. Augering to 5 meters carried out of 28 of the pits; the sampling programme involved had to collect 4 samples for alternate bore sites at 4 different depths 0-25, 2550, 50-100, 100-150 cms. In addition samples were to be collected every 0.5m below 2 m from the 5 m bore sites and a selection of these included in the routine analysis programme.

Area measurements

The data collected from the field survey are plotted on a topographic map 1/10000 scale. The soil mapping units were delineated and are shown on Plates No.4 27-30. The table (2-3) page 2-14 shows the percentage of the total number of sites that fall within the different soil mapping units:

51% area occupied by basin clays

36% " by levee soils

7% " by depressional soils

2% " by beach remnant

Details of calculations made are given in certain cases but methods and techniques of the calculations are always offered. As an example, see Table V.10 page V.10 where the method for determination of moisture retention properties is explained on page V.7.

For chemical analysis, the methods are given; see page 11-1 to 11-5; those methods are the ones used by US Department of agriculture and FAO and the analyses were executed by "THE HUNTING LABORATORY"...

2. Tables with analytical data from observation pits and auger boring sampled and analysed.

The following procedure has been implemented:

35 pits with horizon varying form 0-190 cms have seen their profile described and mechanically (particles %), chemically analysed. They were considered in the analyses exchangeable cations, boron, soluble cation Me/liter, soluble anion Me/liter, total carbonate, total phosphorus, available phosphorus total NITROGEN, organic carbon, extractable Zn and Cu, total Gypsium and exchangeable sodium percentage (see pages 11-6 to 11-109).

From pages IV-1 to IV-21 Appendix IV, Bore analysis results are given profile 0-150 cms for 166 sites. The depth of the horizons are given with their respective pH(by KCl method) ECe, Exchangeable NA/Me/100gr C.E.C me/100gr, E.S.P. for different soil mapping units.

3."A location map 1/20000 scale for all pits and boring:"

Plate No. 23, 1/20000 scale provides all the necessary information with regard of:

BORE Sites sampled or not

PIT. Sites " "

INFILTRATION SITES "

TERMITE OBSERVATIONS "

4."A taxonomic soil classification map 1/20000 scale showing boundaries of the irrigable areas."

Plate n° 24 1/20000 scale gives the soil classification map and plate n° 26 shows the boundaries of the irrigable area.

5."A land capability classification map 1/20000 scale for irrigated cultivation, classifying according to US Bureau of Teclamation standard but adjusted. ..."

The Consultant used the land classification method established by the USBR (1954) but brought to it some modification by introducing two new factors (CROPPING PATTERNS AND METHOD for IRRIGATION). Hence, the land suitability for RICE and CROPS other than rice.

Mogambo area has the following land classes:

Class 1 Highly suitable arable but does not exist, due to low permeability and infiltration;

Class 2 Suitable - arable soils of Jh Jb and Jt if no topographic restriction;

Class 3 Soils of Jb_3 moderately suitable arable;

Class 4 Special use for sprinkler 45.

Tables (3-9) and (3-10) give respectively land classification specifications for upland crop and special sprinkler 45 (symbols $4_2, 4_3$,) and land classification specification for rice (Symbols R_2, R_3 ...).

The land class area measurements are broken down as follows:

UPLAND Class 2	1092 ha	12%
UPLAND Class 3	4942 "	51%
UPLAND Class 4	2042 "	25%
UPLAND Class 6	1124 "	12%
TOTAL	9199 ha	100%

Subclasses are established and can be used when single or multiple factors intervene. Plate No. 25 is designed as a land capability classification and Plates No. 27, 28, 29, 30 for the farm soil capabilities.

6. "The effect of land levelling on the fertility of the soil should be given adequate and in depths consideration."

The Consultant thinks that land levelling in deep alluvial soils of the clay basin units presents no problem. But in areas of severe micro-relief development, where more levelling and soil removal may need to be carried out an additional hazard is exposure of more variable or limiting soil horizons. But there were not limiting factors for 68% of sites examined. In certain cases, land levelling can down grade the land capability classification.

7. "Enlarged Overlays of maps to be provided at 1/10000 scale."

The Answer:

Plates No. 13 to No. 22 are specially designed for.

II. RESULTS AND INTERPRETATIONS

As examined above, the seven points have been carefully executed by the Consulting Firm and the results and interpretations given below permit a good use of the study for implementing the Mogambo Irrigation Project if it is economically feasible.

1. INFILTRATION RATE expressed in mm/hour shows that the optimum for land irrigated by gravity to be 7 to 35 mm/hour. Page 2-17 figure (2-6) indicates the range of data obtained in the tests for all soil mapping units:

- Coarse textured eolian sands offer high terminal intake rates;
- Alluvial soils very similar intake;
- Least cracked soils show the most marked slow down in the terminal intake rate.

2. SOIL SALINITY (expressed in mmhos/cm, ECe value salinity results for the soil mapping units Jl, Jb, Jmxl, Jmxd, Jd, Jt and BM, compared to FAO salinity class show: 71% of the samples having a negligeable salinity class with a value of 2,4 mmhos/cm or less.

16% of the samples fall in low salinity class with values of less than 4,9 mmhos/cm and a small percentage of samples have moderate to high salinity values (see page 3-7 Table "3-2").

Salinity with depth average values at 150 cm do not exceed 4 mmhos/cm.

3. ALKALINITY expressed by E.S.P. (exchangeable sodium percentage).

When ESP exceeds 15, there is generally deterioration in the soil (physical properties affected). No danger exists for the soil mapping units since 93,8% of the total routine samples examined have an ESP less than 15 and most of the upper horizons have values of less than 5. The soils contain considerable reserve of gypsum and exchangeable Calcium to prevent alkalinity.

4. pH MEASURED (with KCl method)

Values are clearly between 8,1 and 8,5 and there is no consistant relationship between pH and soil depths.

5. CHEMICAL ANALYSIS OF JUBA RIVER WATER

The chemical analysis dealt with: EC, pH, TDS, Mc/l for cations Ca Mg, Na, for anions HCO_3, SO_4, Cl, silt/gr per litre and Boron, SAT.

The quality of the water is very high. The 13 samples were collected from 8/2/79 to 12/4/79.

6. MOISTURE RETENTION PROPERTIES expressed in available moisture % by weight or % by volume for 120 cms profile. The moisture retention for 5 soil mapping units shows a variation between 15 and 33 cms. Clay soils allow a maximum irrigation interval from 10-14 days for crops with rooting depths of 0.8 to 1,20m respectively.

7. SOIL FERTILITY, according to the analyses, gives the following results:

Soils with heavy clay 2:1 expanding lattice clays present a very high cation exchange capacity to retain mineral nutrients against leaching.

The level of organic carbon is very low.

Total nitrogen fairly low, nitrogen fertilizer needed to maintain fertility and ensure a good yield.

Total phosphorus level fairly high, but a very small amount is in the available fraction.

C/N indicates fairly rapid incorporation of organic matter in these soils and there is little variation between the mapping units.

Phosphate fixation is related to high pH recorded and formation of Calcium phosphate can occur, reducing phosphate availability (poor solubility).

Exchangeable potassium is considered deficient when values fall below 0,5 me/100gr but high level of exchangeable Ca and Mg values give high CA+Mg:K ratios which reduce the potassium availability. However, the level of exchangeable potassium are very high and there should be no major requirement for potassium as fertilizer.

Level of water extractable boron are appreciable in the surface horizons suggesting that close watch be maintained for symptoms of boronstoxicity. Toxicity occurs between 0,3 and 4 mgr/litre and annual

crops are more tolerant of boron toxicity while perennial crop more susceptible.

III. COMMENTS

As said before, the study has covered all the aspects raised by the terms of reference as far as the soils are concerned. The location of the major mapping units ensured a quite fair representation of each soil mapping unit. The soil survey techniques used and the results with their interpretations convince of the work carried out by the Consultant.

However, some points merit to be raised:

1. Chemical analysis for the Juba River Water does not provide any information on the flow of water in the Juba River when the samples were collected. Samples drawn from 8/2/79 to 12/4/79 seem to coincide in time with the first Gu season rains. Do the samples represent a good average of the river water throughout the year! The state of the river at each sampling catch would help support the average results given in table (3-1) page 3-6.

2. Effect of land levelling has been discussed and treated in the study (68% no adverse effect because of clay soil) but on the loamy textured soils, where termites colonies are still active, the alternative is sprinkler irrigation to avoid high cost of land levelling and also of spraying salt (Na) brought by the termites from subsoil. Nothing has been said about the effect of irrigation in the surrounding of those termite colonies (3 to 10 as density for ha) and their behaviour when the lands will receive more water by overhead sprinker irrigation .

3. Calculations of the moisture retention properties are not clear in some cases, table (V-10) page V-10.

For the respective profiles D012 and G052, the percentage moisture

at 1/10 ATM was not calculated or at least does not appear in table (V-10) but a final value is given to the available moisture at 120 cms profile: respective values 33,1cms and 17,4cms, while horizons 59-123cms and 44-150cms do not show up with any available moisture.

3. Correction is to be brought on table (V-10). The available moisture in % seems to be 9 instead of 7 for profile No. 076 and horizon 80-150cm; consequently the moisture retention properties is to change for that profile.

From an areas of 9199 ha surveyed and delineated as far as land capability is concerned, 2/3 of the land appear in the classes (U_3R_2, U_3R_3) if no restriction intervenes. The areas to be considered by the irrigation project will oscillate around 6000 ha. This supplementary feasibility study, Annex Soils, provide thus the tools and means to further studies (irrigation, agronomy).

ANNEX 3 - A G R I C U L T U R E

Mogambo irrigation project - Supplementary feasibility study Annex 3 - Agriculture - provides along 5 CHAPTERS a clear view of the Juba Valley, the MOGAMBO area and the technical tools to implement the irrigation project in 5 years.

CHAPTER 1 prepares an excellent introduction to the Mogambo irrigation project. It describes natural resources found in the Valley, the state of agriculture and the various public services met.

Two facts may draw attention in the document:

a) 1500 to 2000 farm holdings exist in the Mogambo area with their size varying from 0,5 to 5 ha, most of the farms with an average of 1 ha.

b) Private tractor hire services are being developed due to the diminishing services from ONAT.

With such a dynamic private sector (individual farmers, tractor owners) there seems to exist the possibility to improve production by regrouping the farmers on irrigated land (clay soils or leves soils) and organising the tractor services for land preparation. A cooperative delivery of inputs and marketing could be studied in which cooperative the government would provide its assistance by building the irrigation system and financing some inputs. The cooperative would avoid to resettle the farmers or convert them into workers for the State Farms.

CHAPTER II discusses the crop selection and the cropping patterns. The reasons given for the selection are justifiable: Rice, Cotton, Maize represent commodities of national interest and economically can ensure some returns. However, there is no any knowledge for sunflower, castor or tobacco since they are able to improve substantially the cropping patterns and Somali economy in the future and special effort is to be made by Research Station in Somalia for those crops.

The crop agronomy is very well presented and raises only one minor COMMENT on land preparation for the upland rice. Land plane is necessary to facilitate the harvest by the Combine harvestor.

The yields will build up gradually and seem as envisaged reasonable or acceptable, but there is no experiments which confirm some of them in the field or around.

The cropping patterns reflect the choices made respectively for clay and levee soils and it is really necessary to wonder why crop intensities of 164% are not proposed in the document when the maximum intensity is to be developed as a major objective. On levee soil it is proposed the crop intensities of 132% (supplementary feasibility study).

Gu Season		Der Season	
132%	Upland Rice 1000 ha or 32%		Maize 1000 ha END OF SPT. PLANTIN DATE
	(-) (-)	65%	Maize " FIRST "
		35%	Cotton 1100 ha " Aug. Planting

ON LEVEE SOILS, CROP INTENSITIES CAN BE

Gu Season		Der Season	
164%	Upland Rice 1000 ha or 32%	65%	Maize 1000 ha End Sept. Planting d.
	Upland Rice 1000 ha or 32%		Maize 1000 ha " " "
	Fallow	35%	Cotton 1100ha. First Aug. Planting

Such a change in the crop intensities will bring an extra requirement for tractors, labourers and personnel.

The relative profitability (given on page 2-23 Table 2.2) ranks paddy rice, upland rice, cotton and maize as the best to be cultivated in the cropping patterns. The amount of net margins appears to be high for the first five years when derived from gross revenues and attributable costs and it will be necessary to know whether in the attributable costs, depreciation of the equipment and irrigation costs are included;

these factors are essential in considering the project feasibility.

The farms, as presented (4 of different sizes) raise no objection and the organisation submitted is welcome.

CHAPTER III establishes the options for mechanisation of the operations and the reasons are supported by facts

1) High intensity of the cropping programme which curtails time available to carry out operations.

2) Nature of the heavy soils requires considerable inputs of power.

The permanent labour force at the farms has been determined (900 at maturity and recruitment of casual labours when necessary). BAR-DHERE DAM will change the permanent labour force and will bring it to 1500 if Banana replaced maize in the cropping pattern (levee soils). The workers efficiency have not been examined and the average taken is subject to modification.

Calculations for the agricultural machinery and their implements have been seriously made and provisions arranged to meet any peak period within the hectarage planned for cultivation. Purchase of 6 combine harvesters equipped with half track for harvesting rice when conditions are difficult may partly drop our suggestion for land plane of the levee soils before any planting of upland rice.

There will be a need to add: 1 tracked tractor crawler 150 HP, 3 wheeled tractor 4WD 110 HP and their implements if the intensities for levee soils are pushed to 164% and if the tractors in reserve cannot match with the 1000 ha to be cultivated under upland rice, in the Gu season.

As rightly pointed out by the document, special training has to be given to workshop staff, drivers and tractor operators since the efficiency factor for the machinery and their expected life depend heavily on those who run them. If the training or its result is poor,

the efficiency will be affected and the expected life of the machinery will be reduced by 10 to 35%, increasing the attributable costs with their consequencies. So, the success of the agricultural mechanisation rests on the quality of the personnel in-charge of the project and the risk is a factor of experience and continuity. The monitors are to be recruited and trained also.

CHAPTER IV considers the crop processing at full development for the project. It shows that during the Gu season 4319 ha are cultivated while in the Der season 5404 were planted. The Gu season could have avoided the fallow on 1000 ha of levee soils and increase the production of rice by 3493 ton.

A seed preparation plant is really important for a project like Mogambo. The provisions made for are welcome. The Mogambo Irrigation Project has considered and analysed fully every aspect of the crop agronomy by starting with the varieties to be used in the project; but, and it is important, there is no place where it is envisaged to multiply selected seed and pure seed coming from the Research Station. Rice is particularly subject to "HYBRI DISATION". The choice of a field not too far from the Headquarter could be used to multiply the seeds in close cooperation with Afgoi Research Station. Success of the project relies on the seed qualities.

CHAPTER V analyses the problem of crop water requirements and their calculations. It is proved that without BARDHERE DAM, irrigation is still possible during 240-260 days a year on 6430 ha according to the cropping pattern choosen. Early or late planting as far as water requirements are concerned does not modify the net water requirements for rice, maize grows favourably with early planting and demands less water. Rice is nevertheless subject to heavy damages by birds if too late planting occurs.

CONCLUSION: The Mogambo Irrigation Project in its section Agriculture supplementary feasibility study Annex 3 - is scientifically

and technically a very good study, analysing in depth all aspects which would have raised some pertinent questions. Few points got our remarks:

a) Relocation to new lands, recruitment of the farmers as agricultural workers.

b) Land plane before planting upland rice.

c) Eventual change in the cropping intensities for the levee soils.

d) Seed multiplication.

The cropping patterns bring a minimum of crops (rice, cotton, maize) with an enormous importance in the national economy but rice constitutes the only crop with a very good profitability, but its production in such a project is relatively limited to the Gu. Cotton is really a difficult crop with 100% crop intensity only and is inheritantly demanding in labour force. Maize is a staple food and complete harmoniously the rice rotation with 200% crop intensity but its price (grain) is very low; the composite, yellow seeded is not yet known by consumers and may face some difficulties to be accepted in the diet. No mention is made of vegetable or fruits production in the cropping patterns.

The cropping patterns are poorly limited in regard of diversification and constitute a constraint on an economical basis for the first five years. Skilled workers and labourers may also constitute a restraint in the application of the crop intensities for the first five years.

The use of the agricultural machinery is of great importance and the future of the project rests on it. There will be also a correlation to be considered between the future cost of spare-parts, machinery (international market) and the local prices paid for rice, cotton and maize.

Lastly, the feasibility study made the analysis for 5 years but did not give any hope for change of the cropping patterns in the future with introduction of new crops (tobacco, sunflower, vegetables and fruits). It neither invites Research Station to find knowledge about some of the above mentioned new crops (by applied research).

As seen, the planting of rice, cotton and maize is technically feasible in the Mogambo irrigation project, the project acceptability lays also and mainly on the economic analysis of different costs for machinery, preparation of the land, construction and irrigation.

ANNEX 4 - L I V E S T O C K

1. The consultants choice of a cattle feedlot as the most promising livestock entreprise to integrate with crop production at Mogambo is basically sound. They propose a feeding system for about 10,000 cattle per year which utilises a major part of the useful crop residues and by-products from the project, complemented by molasses anticipated from the Juba Sugar Project, and the basic parameters used are, on best available evidence, correct. Except for a few details which do not greatly affect costs, the design of the feedlot, the choice and manner of operation of equipment are suitable for the conditions and follow conventional standards. They propose three phases of development — Feeding Trials at Km7 in Mogadishu, followed by Pilot and Commercial at the project site — which under present circumstances at least is justifiable.

2. However, the consultants conclude that on the assumptions developed in the study the proposed feedlot is not financially or economically viable, due largely to the narrow margin which currently exists between the buying and selling price of cattle per unit of liveweight. They also point out that there is so far very little operational experience with feedlots in Somalia, and that there are a number of issues critical to their development which have yet to be resolved in practice — the more important being:

i) the availability of an adequate and regular supply of feeder quality cattle at reasonable cost , and

ii) the marketability of large numbers of intensively fattened cattle at a premium price.

The consultants therefore propose that the Mogambo Project should initially cooperate with the adjacent Trans-Juba Feedlot, by providing [illegible] if and when margins improve and the critical issues are resolved in practice, the feasibility of a feedlot componont should be re-examined.

3.

3. Correction of the errors, and some technical changes proposed below, should improve the financial analysis and may make the project marginally viable. But at this stage of Somalia's development, and in view of the collapse of the feedlot industry in some nearby countries, it is believed that effort should be concentrated for the time being at the three feedlots already built or nearing completion at Km7, Balad and the Trans-Juba Project.

4. Errors

i) The cost of molasses and the total cost of Ration 10 in Table 5.3 should read Sh. 251 and Sh. 1010 respectively instead of Sh. 124 and Sh. 883 — although the correct values are actually used in subsequent calculations of recurrent costs, the error invalidates the reasoning behind eventual choice of this ration at the basis for calculating project costs.

ii) The number of cattle to be purchased for Phase I should read 240 in table 5.6 instead of 340 — the error has no effect on subsequent calculations.

iii) The cost of the cattle pens per unit of area for Phase III is twice that of Phase II (Sh. 99.2 compared Sh. 48.4 per m^2) as shown in tables 7.4 and 7.2, due to greatly increased earthworks, coral base and sand layer, without any apparent justification — if the lower cost was used in both Phases (but in fact there ought to some economy of scale) the total capital costs of the project would be reduced by 16%.

iv) There appears to be a major miscalculation in the volume and cost of the silos in tables 7.2 and 7.4 — a total of 55,000m^3 is included as reserve capacity for the 100 tons of oilcake and 200 tons of maize justified in the text, whereas common standards (oilcake at 2.0m^3 and maize at 1.3m^3 per ton) indicate that 460m^3 would be sufficient and would greatly reduce what seems to be an unnecessarily large component (36%) of total capital costs.

v) The increase in number of feedwagons and tractors in direct proportion to the progressive increase in number of animals and daily feed consumption is incorrect — as the 24 tons of feed to be consumed daily at project maturity would normally be fed in two portions of 12 tons, and each 3-ton feedwagon could make several trips, the number of tractor/feedwagons combinations could be reduced well below the proposed figure of 9. I suggest a maximum of 5, which would reduce capital costs by 3%.

5. Technical Criticisms

i) Cattle pen design

a) the feedtrough is too shallow, giving inadequate capacity per unit of length for a high bulk ration;

b) the 2-meter gates are too narrow for tractors with scraper blade or trailer to enter for manure removal;

c) for mechanical feeding it would be better if the feed-trough was continuous (ie unbroken by gates) and access to the pens provided at the rear — this would involve reversal of the present pairing of pens, which would also lead to reduction in weight-bearing service roads;

d) if shade is to be provided at all, it is probably best over the feedtroughs where it also protects feed from rain — this arrangement combines well with c) above.

ii) Feedlot capacity - The layout proposed includes 56 pens for 100 cattle each: a maximum capacity of 5600 cattle at any one time. If, as is proposed, half the cattle are fed for 90 days and half for 120 days, the theoretical maximum throughout is 19,600 per year. Although an annual throughout of 14-14,500 is discussed in the text the subsequent calculations are based on only 10,200 — this is only 52% of the theoretical maximum and is too low. 70-75% would be a more realistic level to aim at, leaving enough pens vacant for cleaning or repair, delayed shipments etc. Rather than push the throughput of the presently proposed 56 pens upto 14,5000 (73% of theoretical maximum), I suggest that the same throughput of 10,200 should be aimed at from a lesser number of pens — ie 40 pens at 73%. This would reduce investment in pens by about 30%.

iii) Quarantine Facilities - No provision is made in the proposed layout for the quarantining of cattle on arrival at the project, or on other possible occasions — I suggest that two standard design pens should be sited about 500 meters from the main

pens and that the plunge dip should be incorporated there. This of course would offset some of the savings proposed in ii) above.

iv) Rations - Amongst the rations considered, some should have been included in which urea is used as a protein substitute. Urea combines especially well with high levels of roughage and molasses such as are proposed at Mogambo, and would reduce the dependence on oilcakes which, the study emphasises, would only be available at reasonable cost if an oil mill was constructed near Kismayo, and which exceeds the production of seeds from Mogambo anyway.

v) Feeding Trials - Whilst agreeing that the trials proposed are necessary (and in a wider context are long overdue), the short series with small numbers of animals are unlikely to produce conclusive results. Such work should be continuously in progress at the Km7 Feedlot whether or not a feedlot is planned for the Mogambo Project and should not require financial inputs from individual projects.

6. Economics - If I am not mistaken in my identification or errors, and my suggestions above are adopted, it should be possible to reduce the capital cost of the project by about 20% and improve the cash flow in the early stages. As the price assumptions taken seem reasonable under present circumstances I can see no way of substantially reducing operating costs — although the reduction in number of tractor/feed-wagons, in number of pens, and possibly the use of urea in the feed, should have some small economic effect. Generally in feedlot operations there is substantial economy of scale — but this does not come through in the present study. I think it is likely that if the consultants took the foregoing into account and reworked the economic analysis the feedlot might appear to be marginally viable. But in the absence

of experience, this would be a more than usually theoretical exercise and very dependent on fairly optimistic assumptions for the two big "unknowns" — the availability and cost of incoming stock, the market and price for outgoing stock. Furthermore, whilst contemplating further investment in feedlots consideration should be taken of the fact that in nearby countries feedlot entreprises, which were developed under more favourable circumstances than prevail in Somalia now, have already collapsed.

7. Conclusion - Although the consultants have not produced quite the best case for a feedlot component at Mogambo, I support their overall conclusions. I commend especially their proposal that consideration of further feedlot development in the south should await the experience of fullscale operations of the Trans-Juba Feedlot — but from my recent visit there I gained the impression that such experience may not be available for 1 - 2 years from now. Moreover, as pointed out by the consultant, the future scale and nature of operations of the Kismayo Meat Factory are also of direct relevence to the development of feedlots in the south — and we are aware of considerable problems at KMF which may take some time to resolve. I therefore endorse the consultants' view that these and other problems discussed in the study underline the need for coordinated planning within the livestock and other related sectors for the area.

ANNEX 5 - ENGINEERING

Annex 5 of the draft report deals with the engineering aspects of the setting up the irrigation system, its operation, maintenance and costs. Flood protection, bush clearing, land levelling, methods of irrigation and drainage and infrastructure facilities are discussed and costed.

The irrigation system is to consist of a main pump station on the Juba river, a main canal down the project area and distributory canals off-taking from the main canal and serving areas of surface and over head spinkler irrigation. Because of inadvisability of levelling areas that would involve large earthwork quantities, and expose saline soils, it is proposed to apply surface irrigation to some parts - generally basin soils, and overhead irrigation to others - generally levee soils. The distributories supply the unit channel system, for surface irrigation, and buried mains for the sprinkler system, for application of water to the fields.

Some of the other features of the proposed system are the provision of a large settling basin at the head of the main canal to reduce silt load passing into the canal system; provision of storage reservoirs at the head of distributaries, so as to enable the main canal to flow with constant discharage, and maintain flow in the distributaries as required.

Details of the proposals are summarized in the following pages, and comments follow the summary.

1. Flood Protection

The flooding of the project area is said to occur because of insufficient capacity of both the Mogambo relief channel and Dhesheeg Arbo in the northwestern corner of the project area (into which the

relief channel discharges) and consequent over flow into the project area. The project area has existing flood protection bunds to its east and south to safeguard the Banana plantation.

The study proposes the remodelling and extension of the relief channel to Dhesheeg Arbo and adjacent depressions. A new embankment is proposed to be built on the western boundary of the farm, to contain and guide the overflow from the Dhesheeg eventually to Dhesheeg Wamo. The total earthwork involved in the remodelling proposals is estimated at 595,000 cubic meters. The alternative of closing the flood relief channel and improving the existing eastern embankment is not favoured because of increased risk to the Banana plantation by flooding from the river side.

Damage to crops and civil works by a 1 in 10 years flood, if left unprotected after full completion of project is estimated to be 54.76 million So.Sh. Bardhere reservoir would provide protection, but other protection works as proposed above are considered necessary if the time lag in the completion of the two projects is more than a few years. The cost of proposed flood protection measures is estimated would be 9.765 million So.Sh.

2. Bush Clearing

The project area is covered with vegetative growth ranging from open grass land to dense bush.

The study proposes the use of front mounted rake on a 200 HP crawler tractor with a root plough mounted behind for bush clearing work. Bush is cleared by the rake and the plough cuts through the roots and forces it to the surface all in the same operation. The estimated rate of clearing is 0.6, 0.9 and 1.2 hectares per hour for dense, medium and light bush. Cost per Ha of bush clearance is put at 600 to 1400 So.Sh. depending on the denseness of the bush. Total area to be cleared is 8065 Ha.

Burning and use of chemicals are considered unsuitable because of difficulty in their proper control and inadequacy in removing the roots. Mechanical clearance by buldozers or by chaining are also not favoured as they may fail to clear springy bush, without heavier work load, and soil disturbance.

3. Land Levelling

Land levelling proposals are based on the analysis of eight representative sample areas of 300m X 300m, for estimate of the volume of earthwork involved. Land survey of these areas on a 25m grid has been made. Level differences over the representative plots vary from 0m to over 0.5m.

Presence of sand lenses and saline soil layers restrict the depth of cut to 0.5m. The depth of fill is also restricted by the need to avoid excessive settlement after levelling. Of the eight areas examined four have clay soils and four levee soils. Clay soils are proposed to be levelled in plots of 1 to 9 ha depending on level differences in the area. Levee soils areas, broken and frequently bisected by old river channels and fartas are considered unsuitable for economic land levelling and land levelling is not therefore recommended. Such soils are proposed to be sprinkler irrigated.

Laser controlled elevating scrapers and motorgraders are proposed for land levelling as ground checking with reference pegs and profile boards requiring many surveyors to set out work would not be needed with [illegible]ed. Land levelling is proposed to be followed by land planning to smooth out the land. Land planing is proposed to be done on levee soils also after prior loosening of soil by chisel plough. A medium sized land plane of 14 M. long frame with a 4 M blade drawn by 70-80 HP tractor is the proposed equipment for land planing. The output of such a machine is expected to be 5 to 6 Ha per day.

Saline termite hills found on the lighter levee soils are proposed to broken up by dozers and spread over. The total cost of land levelling is about 18m. So.Sh. and of land planing about 2m. So.Sh.

4. Irrigation System

Surface irrigation in levelled basins is proposed for rice and maize. Sprinkler system is proposed to be used where land levelling is inappropriate.

4(a) Irrigation Units

Surface irrigation areas are proposed to be divided into units of 570m X 570m with a gross area of 32.5ha. and net area of 27 ha. per each unit. This area is further sub-divided into plots of 1 ha. each (170m X 60m approx.) arranged in 3 rows of 9ha. in each. This unit of 27ha. is proposed to be served by a unit channel off-taking from a distributary (connected in turn to a main canal). The unit channel will carry a discharge of upto 115 L/S. The basins will be watered by siphon pipes. Only one basin of a unit is proposed to be irrigated at any one time thereby keeping the unit channel size uniform, and reducing labour requirement in attendance at watering and reducing the number of division structures needed at head of each branch.

For sprinkler irrigation, one unit of 42.5 ha. gross (40.8 ha. net) and of dimension 625mX625m divided into two halves, each served by a separate buried sub-main (deriving supply from a buried main) is proposed. The buried sub-main is set in the middle of each half. There are 12 hydrants in each sub main to serve a total of 72 lateral positions. Laterals are 153M long with risers 18M apart. The lateral positions are also 18M apart. A hydrant serves land on both sides of the sub main and at no time is a hydrant serving more than one lateral. A maximum of 12 laterals would be watering in each half of the unit at a time. Each lateral serves a unit area of 0.20Ha from each setting.

Each hydrant covers 6 lateral positions thus serving a net area of 1.68 ha.

4(b) Canal System

Irrigation water is proposed to be pumped from main pump station on the Juba river, sited on a straight stretch of the river 700 m. upstream of the Mogambo flood relief off-take. The main canal discharge is proposed to be held constant 24 hours a day. Surface irrigation is during day only and sprinkler irrigation by night. The difference in day and night requirment is proposed to be balanced by storage in a reservoir at the Head of the distributary canal, as the main canal flow remains constant.

The required discharge of 6.5 cumecs in the main canal is to be delivered by five inclined axial flow flood lifter type diesel driven pumps composed of three 36 inch pumps and two 24 inch pumps delivering 2.2 cumecs and 1.1 cumecs each, respectively. The mix of pumps is chosen to provide greater flexibility of operation. An inlet channel leading water to the pump station with a settling basin into which water is pumped are proposed. The inlet channel proposed is to safeguard against possible bank erosion that may endanger the station. The settling basin (S.B.) proposed is for trapping sediments which may otherwise clog the canal system. The size of the settling basin proposed is 400m X 36m X 2m. It is estimated that annually a total of 56,400 cubic meters of sediment will be deposited in the S.B. and 35,000 cubic meters in the storage reservoirs. A floating grab dredger of capacity 92,000 cubic meters per year is proposed for acquisition to maintain the S.B. and storage reservoirs. The design of the settling basin is said to allow for a sediment storage capacity of 12,000 cubic meters at a constant dredging rate of 4,700 cubic meters per month.

4(c) Main Canal

The proposed main canal of 16.25 Km length, divided into 4 reaches is designed to carry a maximum discharge of 6.5 cumecs in the first reach of 4 Km. dropping to 1.40 cumecs in the last reach. Canal slope varies from 8cms to 10cms per kilometer. The design allows for a peak of 90 1/s for irrigating (surface) a unit of 27ha. (net) and 77 1/s for a unit of sprinkler system irrigating 40.8ha net. Sprinkler irrigated areas occur interspersed with surface irrigated areas, except in 2 cases out of 9. The pumps of the sprinkler system draw water from the distributaries. In the other two cases they draw directly from the main canal. The design of the main canal allows for seepage losses. Canal regulators, siphons and crossings are allowed for.
Storage reservoirs at the Head of distributaries are proposed to be excavated with a provision for dead storage of 0.5 m depth equivalent to about 5 years deposit of silt at the estimated rate of deposit. Maintenance of the reservoirs by dredging is proposed to be done by a floating grab dredger that will also be used for dredging the settling basin at the head of the main canal.

4(d) Distributary Canals

All distributaries off-take from storage reservoirs. Often two distributaries share one storage reservoir. Some of the distributary canals serve only surface irrigation, some only sprinklers, some both. Those that serve surface system are designed to carry .90 1/s/ha served, those that serve sprinklers 70 1/s/ha and those that serve both will have a discharge in between depending on the relative extent of areas under the distributaries. The distributary canals are also provided with regulators, and culverts. A tail escape is provided to prevent accidental overtopping of the canal banks due to poor operation of the system, at any time. Unit channels distribute water to the surface

irrigated fields. A total of 250 Km. length of unit channels have to be constructed.

4(e) Sprinkler Irrigation

Hnad move lateral system has been chosen in preference to other systems such as roll line, rotating boom, travelling boom, etc. because of the greater simplicity in handling the system. Due to greater wind speeds during the day it is proposed to set the sprinkler system during the day and irrigate by night.

The system is designed to answer a peak requirement of 174 mm (net) and 232 mm (field). An irrigation interval of 12 days is proposed. This requires an application rate of 7.5 mm/hour considering 12 hours of irrigation. The proposed spinkler grid is 18M X 18M. The laterals proposed are 70mm dia. 6M long quick coupling type pipes. The discharge at the Head of the lateral would be 5.8 l/sec.

Sprinkler pump stations have capacities ranging from 0.285m^3/sec. to 0.360m^3/sec. Each pump station is proposed to be provied with 5 pumps (including one standby). Asbestos cement buried pipes ranging in diameter from 100mm to 700mm are proposed for the distribution net work set with a minimum ground cover of 1 meter. The distribution system includes valves and hydrants for effective control.

5. Drainage System

Drainage is needed to evacuate excess water in the fields due to rains or irrigation and to control build up of water table that may affect the roots of crops. The irrigation water should contain a proportion in excess of crop need to flush the salts below root zone. All these have been considered in the study.

For overhead irrigation of saline soils where deep percolation is limited, by the limited application of water, salt tolerant cotton is proposes to be grown, to enable subsequent less tolerant crops to be grown.

It is considered that the salinity of irrigation water is such that salinity build up is not a problem even with lower rates of deep percolation in the basin areas, and in areas of higher ground water sprinkler irrigation will help to avoid early water logging problems.

It is therefore concluded that sub-surface drainage is not needed in the initial years, and unlikely to be needed during the project's life. However, a monitoring system will be required to record the movement of water table and of moisture movement down the profile. If a sub-surface drainage system is needed in future vertical tube wells or horizontal buried field drains are recommended, depending on detailed studies to be made.

5(a) Surface Drains

It is proposed to provide the surface irrigated unit area with unit drains that will be connected to collector drains which in turn will join the eastern or western out fall drains. In the over head irrigated areas natural drainage channels will be used in addition to unit drains where necessary. In the east, Mogambo out fall drain will be used and in the west, the western out fall drain has to be reorganised by connecting low laying areas and to allow a flood flow of 100 cumecs.

Structures will be built at the junction of drains for the safe transfer of flow, and where an out fall or main collector drain crosses a flood protection bank a flap gate will be constructed to prevent water entering the project area.

Five drainage pump stations will be provided to lift water from lower main collector to the outfall drains. The operation of these pumps would be limited to rainy seasons.

Eventually the eastern outfall drain will discharage into the Farta system in the southwest of the project area. Western outfall also joins

this system. The farta system connects to Dhesheeg Waamo. Peak discharge of the eastern outfall is expected to be in Gu when Mogambo relief channel will not normally be operating, which is a welcome feature that will reduce heavy flows in the farta system.

Effect of Bardhere dam would be to ease the drainage problems of the project, though some modifications may be required to the western outfall drain.

6. Infrastructure

Roads, buildings and services such as water and power, are the infrastructural facilities proposed to be provided.

Road network will consist of a 6.0m wide surfaced primary road linking the project HQs and the Kismayo/Gelib road. Rest of the primary road through the project area linking the HQs and the villages will be a raised but unsurfaced road. Embanked secondary roads (6.0m wide) will be provided, and will generally follow the main drains. Inspection roads (6 to 4m. wide) on canal embankments are proposed. With in field units, ground level graded earth roads (4.5m) are proposed.

A centrally located project HQs covering an area of 65 HQs and containing staff quarters, offices, stores workshop and training centre is proposed. Nine senior staff houses and 22 junior staff houses are proposed. Project HQs will also contain a generator house, grain dryer and rice mill, meteorological station and vehicle park. Water supply drawn from the canal and treated is proposed if no borehole supply is found.

A project HQs village containing 4 wards of 56 houses is proposed in the southern part of the HQs. Four other villages suitably located in proximity to the primary road, and containing traditional houses for 200 people and six people in project constructed housing are proposed.

The villages will house farm manager, junior executive staff, pump station and regulator operators. Villages will be provided with power and water supply.

Layout of project HQs, villages, houses, stores, workshop power station etc. are included in the report.

7. Operation and Maintenance

The study describes the methods of operating the main canal, distributary and unit field channel flows. One operator is proposed for each group of off-takes on the main canals suitably housed nearby. An operator is needed for each distribuatary canal. Labour requirement for field irrigation is computed would be some 66,000 labourers/days and 10,000 foremen/days per year (for both surface and sprinkler irrigation).

Operation and maintenance of the various pump stations, main pump station, sprinkler pump stations and drainage pump stations have been provided for. Maintenance of settling basin, storage reservoirs and canal is also covered. Irrigation operation staff will consist of one irrigation engineer, four irrigation supervisors, 16 block supervisors, and some 17 foremen. Vehicles and machinery needed for operation and maintenance are listed. List includes earthmoving, transport and miscellaneous equipment needed for operation and maintenance of the system.

8. Costs

Total cost of construction is estimated at 234.981 m. So.Sh. of which 109.624 m. So.Sh. is foreign exchange component. The investment is proposed to be spread over 3 years, as follows.

1st year	67.467 m. So.Shs.
2nd year	122.182 m. So.Shs.
3rd year	95.282 m. So.Shs.
Total	284.931 m. So.Shs.

The estimate includes provision for engineering design and supervision. Detailed break ups are provided for each main head of work. Replacement costs of items of equipment that will need to be replaced within the life of the project, and list of operation and maintenance of equipment has been provided. Capital cost of surface irrigation is about 29,583 So.Sh./ha. and sprinkler irrigation 37,323 So.Sh./ha... (Exclusive of customs tariffs).

9. OBSERVATIONS AND COMMENTS

1. Gross and net areas to be irrigated and to be brought under each system of irrigation (surface and spinkler) has not been stated. This essential information should be provided in the annex, even if this has been stated in another annex.

2. Only one pump station near Mogambo has been considered. As the Farm is fairly adjacent to the river along its length the possibility of having more than one pump station could have been considered. This would provide the advantage of flexibility in farm operations, by keeping the operation of the southern part of the farm independent of the northern part.

3. With surface and sprinkler irrigation occuring interwined, the rather small differences on the map in delineating surface and sprinkler irrigated areas, disturb the clarity of the maps. It would be preferable if more distinctive differentiation could be made such as by shading or other means.

4. A set of maps to scale that would reduce the size by half would make for convenience in handling. Lay out maps are to scale 1:20,000

and 1:10,000 and 1:1,000 specified in the Terms of Reference. However, this may be accepted.

5. In land levelling though levee soils may have top soils of low salinity it would be preferable if the saline termite soils are disposed off elsewhere (than on crop growing land) such as in farm roads.

6. One of the disadvantages of the sprinkler system is that it is heavy in first cost and will need equipment that will require to be imported to keep the system in good operational order. As sprinkler system may have to be depended on elsewhere in the Juba Valley in particular and the country in general it is advisable at an early stage to standarise as far as possible sprinkler irrigation layout, equipment and operations and to examine to what extent some of the equipment and spares could be produced with in the country.

7. The engineering report does not clearly state what crops sprinklers will irrigate though cotton and maize are mentioned in passing.

8. It is not clear why all sprinkler pump stations should have five pumps (Ref. Section 4.13, page 4-52) though required discharges vary widely from 0.285 cumecs to 0.860 cumecs.

9. Reference page 3.4 of Annex 5, table numbers in the text should read 3.2 (a) and 3.2 (b) instead of 3.1 and 3.2.

10. A hand book of instructions in Somali will eventually need to be prepared for reference and instruction of staff and foremen operating and maintaining the irrigation system and pump stations. The hand book should also include design principles.

11. Construction schedule should provide for preparatory phase of 6 months in which to organise work and place purchase orders for equipment.

ANNEX 6 - IMPLEMENTATION OF THE MOGAMBO IRRIGATION PROJECT

The Consultants suggest that the implementation of a complete project such as the Mogambo Irrigation Project normally involves three separate parties:

The Employer (Project Authority);

The Project Consultant;

The Contractor Executing the Works.

The implementation encompasses three basic activities:

a) Setting-up the Employer's organisation which will ultimately operate and maintain the project;

b) The engineering construction;

c) The agricultural planning and execution.

As a project objective the Consultants put forward a fully operational state farm.

It is believed that a second thought should have been given to this organisational form.

A number of projects of similar character as Mogambo are in various stages of development (preliminary design, design phase, construction phase, etc) as for example: Homboy, Genale and Saakow. They are already overtaxing the absorptive capacity of the ministries and the respective parastatal agencies. It should be explored whether for such projects as Mogambo, a type of Company similar to existing parastatal agencies could be set up.

The Company of this kind would have a large autonomy of operation and would be able to procure all equipment and other inputs of the project dispasing of an adequate allocation of the necessary foreign exchange. It would hire employees and labour at such salary rates, which complemented by incentives, would induce a higher production

The Company would also dispose of a working capital in local and foreign currency which would enable it to finance smoothly its operation.

The Company might have a form of a joint-venture similar to that one of LIBSOMA agricultural project. The Consultants should have offered an analysis of possitive and negative experiences made by this joint-venture and suggest an improved set-up for the future (especially with regard to basic earth-moving machinery). [illegible]

ANNEX 7 - E C O N O M I C S

The Annex 7 - ECONOMICS contains three main aspects: market prospects and prices, economic and financial analyses of alternative cases and of recommended option. In the Chapter 9 it was given comparison with the TAMS/FINTECS Report.

The Annex 7 which concerns economics of the project was elaborated in accordance with the international standards.

1. ECONOMIC AND AGRICULTURAL BACKGROUND

This is an introductory part of the Annex 7 - Economics. It elaborated general economic background (population, central government finance, balance of payments, government planning strategy) and agricultural background (agricultural production, livestock production and implications for the Project).

1) The number of human population was estimated at 3.7 million and the breakdown of this population by region is given in the table 2.1 as the provisional results of 1975 census.

It is known that the estimate of the 1975 census was 3.5 million people.

2. MARKET PROSPECTS AND PRICES

1) This part of the Annex 7 comprises considerations on official bodies (i.e. institutions involved in marketing Agricultural Development Corporation, National Trading Agency and National Banana Board, while livestock Development Agency was described in the Annex 4); production, imports, prospects for supply and demand and prices (financial, economic and byproducts) for rice, maize and sorghum, sesame, cotton and bananas. In other words detailed analyses for each crop which was accepted in the cropping pattern of the project is given including its marketing and price determination, taking into account supply and demand in the domestic market and in the respective international markets.

Market prospects and prices were approached and elaborated well as far as the chosen cropping pattern is concerned. The main factors were taken into account and resulted into well established pricing of all crops envisaged in the Project.

2) The main-short coming of this Annex is lack of analysis of input supply, especially those from imports. There were some indications of difficulties in ensuring supply of fertilizers, chemicals, spare parts and similar, but there was no attempt to make sure from which country they will come , at what prices, by which transport, etc.

So far, the major problems in implementation of projects were supplies of machinery, equipment and material inputs. Therefore, an appropriate analysis should give more idea how to solve these problems institution-wise, where to address for purchases, how to solve the shortage of foreign currency, possibility of the direct involvement of the farm in purchases abroad, etc.

3. FINANCIAL ANALYSIS

1) The first basic approach in determining the cropping pattern applied by the Consultant was budget for each crop which could be grown on the Mogambo areas. The budgets have been prepared in order to compare the return to each crop on equivalent bases, rather than to include every possible attributable cost. The following crops were taken into account; paddy rice, upland rice, maize, sesame, cotton and banana. This led to rejection of two crops: upland rice and sesame.

The crop budget did not comprise machinery depreciation, operators and the cost of water. On the other hand, the concept of the project, due to shortage of labour force, was mechanisation as much as possible.

Some crops require more water (like bananas, paddy rice, and partly maize) other less (sesame, upland rice, sorghum). Cost of irrigation scheme can be calculated and added to the crop budget.

The level of mechanisation of agricultural operations may influence very much cost of production. Depreciation charges and cost of operators and other related costs, must be also added to the crop budget.

Therefore all direct costs should be calculated and added to the crop budget in order to get a very precise net margin which can contribute in determining the cropping pattern of the project.

2) A set of alternatives has been elaborated to get the most appropriate alternative. This elaboration started with analysis of the base case with no Bardhere Dam at any time. The base casesshowed very low economic internal rate of retrun, (3.22 per cent), Financial Internal Rater of Return (3.33 per cent) and higher Foreign Exchange Internal Rate of Return (when only items generating and paid in for, are included). The inherent economic weakness of the base case led to elaboration of additional five alternative cases. The case numbered as 6 has the same characteristics as the Base Case, but after Bardhere Dam is constructed bananas will replace maize on levee soils. Actually, all the alternatives have no outstanding results so that choice cannot be made simply on economic grounds.

3) Analysis of the Recommended Option, i.e. case 6 showed that the Internal Financial Rate of Return will be 4.15 per cent taking into account 30 years of financial cash flow, and projected prices of output for 1985.

However, taking into account the existing prices which the ADC pay for grain and NBB for bananas, the Financial Internal Rate of Return is "0" and the Net present worth becomes negative amounting to So.Sh. -162.4 million at 2 per cent discount rate.

4) The main failure of the financial analysis was in omitting calculation of increases in cost of inputs due to normal increase of prices on the supply markets. If this was calculated the Financial

Internal Rate of Return would decrease to zero, as well as the other financial parameters would go down to zero or to negative values.

5) Loan repayment and interest charges were not included in the Financial cash-flow. It was not given any account how the project will be financed. The envisaged loan repayments and interest charges may have shown to which extent the project is able to finance and viable from the point of view of financing sources and their costs.

6) It appears that some financial calculations were not precise as it was expected. Namely, the Table 8.1, case 6 - Cash Flow at inancial prices gives an Internal Rate of Return 4.72 (4.15) per cent. The net present worth calculated at 6 per cent DR amounts to negative So.Sh. 47.5 million

4. ECONOMIC ANALYSIS

For the purpose of economic analysis the consultant assumed an opportunity cost of unskilled labour at 67 per cent and a shadow rate of foreign exchange of So.Sh. 9.5 = 1 US$ applied to output and inputs, but not to capital investment. Taxes and duties on purchased inputs were ignored, correctly being transfer payments. No charge for irrigation water was considered in the analysis of the Project. The opportunity cost of capital was assumed at 6 per cent.

1) The calculated net margin on the bases of economic prices appeared to be higher than on the basis of financial prices in the case of maize, sesame, cotton and bananas, but lower in the case of rice (both paddy and upland).

2) At 30 years cash-flow and at 6 per cent discounting rate the benefit-cost ratio was estimated at 0.936, the Net Prest Worth negative at -576,000 So.Sh., the value added at So.Sh. 419 million.

The Economic Internal Rate of Return was estimated at 5.72 per cent, while the economic break-even point will occur in year 18.

The consultant introduced the Foreign Exchange Internal Rate of Return which amounted to 16.49 per cent (taking into account only those items generating or paid in for by foreign exchange).

3) The consultant carried out the sensitivity analyses which showed that the project is more sensitive to changes in output than to changes in either capital or operating costs, while advanced or retarding implementation has little effect, as well as the date when Bardhere Dam becomes operational.

4) It appears that the economic parameters also were not calculated precisely. Firstly, it is not clear at all which table was used for the calculation of IRR and some other economic parameters. If one assumes that the table 7.5 was used then the results are following:

- The economic Internal Rate of Return 5.20 per cent (not 5.72 per cent)
- The Net Present Worth at 6 per cent DR -23.7 million So.Sh. (not -576.000 So.Sh.)
- On the page 9.1 at the beginning of the Chapter 9 it is said that the Economic Internal Rate of Return amounts to 6 per cent.
- The Benefit-Cost Ratio 0.974 (not 0.936).

5. CONCLUSIONS

The supplementary feasibility study on Mogambo Irrigation Project submitted by Sir M. Macdonald and Partners Ltd represents much more improved project proposals compared to that one submitted by TAMS/FINTECS in 1977. The cropping pattern, engineering works, prices, costs, alternative approach, etc. give more detials in depth than the previous study.

However, even the results of this study are not fully aceptable. The Financial and Economic Internal Rate of Returns are very low so that the project viability seems to be somewhere on the boundary of the profitability. It seems that the consultant was to a certain ee

extent pesimistic in approaching the Mogambo Irrigation Project. Otherwise, it might be very contraversial that the Mogambo area is the best or among the best in the Juba River Valley if that area gives such low results of economic parameters. It is suggested herewith that new reconsideration and analysis should take place in order to find better solution.

The consultant put to much emphasis on the Foreign Exchangle Flows, making even the Internal Rate of Return (16.49 per cent). It is important to have positive total value of the annual foreign exchange flows. But, this cannot be taken as only one valid parameter when the other, more important, parameters are close to zero or negative.

6) SOME PARTICULAR REMARKS

Page 2-1 : The following sentence in the last paragraph is not clear. The low overall population density of 6 persons per square kilometre reflects the considerable size of Somalia - 637,000 square kilometres:

Page 2-2 : 1975 census estimates of population was 3.5 million people.

Page 3-13: Prospects for increasing course grain production in Somalia are not more restricted than for rice. In all projects with irrigation scheme course grain is taken into account equally as rice and other crops. This statement relates more to sorghum than to maize.

TABLE 13.1

Project Staffing

LOCATION	DESIGNATION	GRADE	YEAR 1	2	3	4	5	6	7	NOTES
HQ	General Manager	SE	1	1	1	1	1	1	1	
HQ	Secretary to G.M.	PA	1	1	1	1	1	1	1	
HQ	Internal auditor	JE	-	1	1	1	1	1	1	
HQ	Audit clerks	C	-	1	1	1	2	2	2	
HQ	Chief accountant	SE*	-	1	1	1	1	-	-	
HQ	" "	JE	-	-	-	-	-	1	1	(1)
HQ	Secretary	PA	-	1	1	1	1	1	1	
HQ	Assistant accountants	JE	-	1	1	2	3	3	3	
HQ	Accounts clerks	C	-	1	2	4	6	6	6	
HQ	Administrative manager	SE*	½	1	1	1	1	-	-	
HQ	Administrative manager	JE	-	-	-	-	-	1	1	(1)
HQ	Secretary	PA	-	1	1	1	1	1	1	
HQ	Clerks	C	-	1	1	2	2	2	2	
HQ	Training manager	JE	-	1	1	1	1	1	1	
F	Training officer	JE	-	1	2	3	4	4	4	
HQ	Personnel manager	JE	½	1	1	1	1	1	1	
HQ	Secretary	PA	-	1	1	1	1	1	1	
HQ	Clerks	C	-	1	1	2	2	2	2	
HQ	Community services manager	JE	-	1	1	1	1	1	1	
F	Community officers	JE	-	1	2	3	4	4	4	
HQ	Agricultural extension officer	T	-	1	1	1	1	1	1	
HQ	Livestock extension officer	T	-	1	1	1	1	1	1	
F	Village extension workers	T	-	-	1	2	3	4	4	
HQ	Office manager	JE	-	1	1	1	1	1	1	
HQ	Clerks	C	1	1	3	5	6	6	6	
HQ	Watchmen	L	2	12	20	20	20	20	20	
HQ	Messengers	L	2	5	10	10	10	10	10	
HQ	Drivers	SL	5	10	15	15	15	15	15	
HQ	Rest house staff	SL	2	3	4	4	4	4	4	
HQ	Building maintenance	SL	-	2	4	6	6	6	6	
				60						
	TOTAL IDEAL	=		56		man years				
	ACTUAL ALLOWED	=		38		man years				

(excludes construction supervision)

Consider also need for a 13-11 Procurement Officer

TABLE 13.1

Project Staffing (continued)

LOCATION	DESIGNATION	GRADE	YEAR							NOTES
			1	2	3	4	5	6	7	
HQ	Deputy general manager	SE*	½	1	1	1	1	½	-	
HQ	" " "	JE	-	-	-	-	-	1	1	(i)
HQ	Secretary	PA	-	1	1	1	1	1	1	
HQ	Agronomist	SE*	-	1	1	1	1	1	-	5
HQ	"	JE	-	-	-	-	-	1	1	(i)
HQ	Seed processing manager	JE	-	-	1	1	1	1	1	
HQ	Crop " "	SE*	-	-	1	1	1	-	-	(ii)
HQ	Rice mill manager	JE	-	½	1	1	1	1	1	
HQ	HQ agriculturalist	JE	-	1	1	1	1	1	1	
F	Field agriculturalists	JE	-	1	2	3	4	4	4	
HQ	Secretary	PA	-	1	1	1	1	1	1	
HQ	Clerks	C	-	1	1	2	2	2	2	
HQ	Mechanics	T	-	1	3	6	6	6	6	
HQ	Labour	L	-	5	10	15	20	20	20	
HQ	Stores	T	-	-	1	1	1	1	1	
HQ	Mechanisation specialist	SE*	-	1	1	1	1	-	-	4 (iii)
HQ	Workshop manager	T*	-	1	1	1	1	-	-	(iv)
HQ	Workshop mechanics/ tradesmen	T	-	10	20	30	30	30	30	
HQ	Mobile workshop mechanics	T	-	-	2	4	4	4	4	
HQ	Workshop labour	SL	-	12	22	34	40	40	40	
HQ	Storekeeper	T	-	1	1	2	2	2	2	
HQ	Fuel pump attendant	T	-	1	2	2	2	2	2	
HQ	Truck drivers	SL	-	2	4	4	4	4	4	
HQ	Clerks	C	-	1	1	2	2	2	2	
HQ	Irrigation engineer	SE*	-	1	1	1	1	-	-	4
HQ	" "	JE	-	-	-	-	-	1	1	(i)
HQ	Surveyor	JE	-	1	1	1	1	1	1	
HQ	Assistant surveyor	JE	-	1	2	2	2	2	2	
F	Pump operators	T	-	5	15	30	43	43	43	
F	Pump mechanics	T	-	2	4	6	8	8	8	
F	Canal maintenance foreman	S	-	1	2	3	4	4	4	
F	Canal maintenance labour	L	-	3	6	18	24	24	24	
HQ	Plant operators	T	-	2	4	6	8	10	10	
HQ	Assistant operators	T	-	2	4	6	8	10	10	
HQ	Drivers	SL	-	6	12	24	30	30	30	
HQ	Clerks	C	-	1	1	2	4	4	4	
HQ	Power station attendants	T	-	2	2	4	4	4	4	
HQ	Power station mechanics	T	-	2	2	4	4	4	4	
HQ	Water treatment works attendant	SL	-	1	1	1	1	1	1	
F	Water treatment works attendant	SL	-	1	2	3	4	4	4	
HQ	HQ farm manager	JE	-	-	1	1	1	1	1	
HQ	HQ farm storekeeper	T	-	-	1	1	1	1	1	
HQ	HQ farm labour	L	-	-	1	3	6	10	10	
F	Field inspectors	JE	-	1	2	3	4	4	4	

TABLE 13.1

Project Staffing (continued)

LOCATION	DESIGNATION	GRADE	YEAR							NOTES
			1	2	3	4	5	6	7	
F	Farm managers	SE*	-	1	2	3 2	3 2	2 1	1 -	
F	" "	JE	-	-	-	1	2	3	4	(i)
F	Mechanisation supervisors	JE	-	1	2	3	4	4	4	
F	Irrigation supervisors	JE	-	1	2	3	4	4	4	
F	Block supervisors	S	-	2	6	10	16	16	16	
F	Gate operators	SL	-	2	4	6	8	8	8	
F	Storekeepers	T	-	1	2	3	4	4	4	
F	Assistant storekeepers	T	-	1	2	3	4	4	4	
F	Clerks	C	-	2	4	6	8	8	8	
F	Watchmen	L	-	4	8	12	16	16	16	
F	Drivers	SL	-	1	2	3	4	4	4	
F	Foremen irrigators	S	-	12	25	40	50	50	50	
F	Ditch riders	T	-	8	14	20	26	26	26	
F	Agricultural and irrigation labour	L	-	60	300	700	900	900	900	
F	Machinery operators	T	-	23	63	125	165	165	165	
	Construction									
HQ	Resident engineer	SE*	1	1	1	1	-	-	-	
HQ	Assistant engineer	SE*	3	3	3	2	-	-	-	
HQ	Engineer/Inspector	SE*	1	1	1	-	-	-	-	
HQ	Secretary	PA	1	1	1	1	-	-	-	
HQ	Clerks	C	1	1	1	1	-	-	-	

Notes:

* Indicates expatriate

(i) Somali replacement for expatriate

(ii) Crop processing manager replaced by rice mill manager

(iii) Mechanisation specialist not replaced

(iv) Workshop manager replaced by Somali mechanic

SE - Senior Executive

JE - Junior "

PA - Personal Assistant

C - Clerk

T - Technician

S - Supervisor

SL - Skilled Labourer

HQ - Project Headquarters

F - Farm Village

PARTNERS DESIGN SHEET

Code No: _____ File No: _____ Drawing Ref: _____

Project	Designed By	Checked By: Theory	Checked By: Arithmetic	Date	Sheet No. of Sheets
HOMBOY					
Structure PRELIMINARY COSTS	PGW.				

Members Ref. | CALCULATIONS | OUTPUT

	ITEM	MOGAMBO (6400 ha NET) (£x10⁶)	MOGAMBO (6400 ha NET) (S.Sx10⁶)	BURA (6500 ha NET) (£x10⁶)	BURA (6500 ha NET) (SSx10⁶)	HOMBOY (8600 ha NET) (£x10⁶)	HOMBOY (8600 ha NET) (SSx10⁶)	GENALE (4000 ha NET) (£x10⁶)	GENALE (4000 ha NET) (SSx10⁶)
1.	Irrigation & Drainage Works	15·2	205·2	14·0	189·0	24·0	324·0	• 4·2	56·7
2.	Roads	0·3	4·1	1·0	13·5	3·9	57·2	• 0·2	2·7
3.	Settlers Housing	4·1	55·4	2·6	35·1	12·8	172·8	• 1·5	20·3
4.	Project Buildings			7·2	97·2	9·5	128·3		
5.	Buildings Infrastructure	1·0	13·5	7·2	97·2	9·5	124·2	• 0·4	5·4
6.	Public Health	–		0·4	5·4	0·5	6·8	–	–
7.	Vehicles & Equipment	2·0	27·0	2·2	29·7	2·9	39·2	1·0	13·5
8.	Cotton Ginning	–		2·9	39·2	–	–	–	–
9.	Operation & Maintenance	8·1	109·4	5·5	74·3	7·3	98·6	3·4	45·9
10.	Farm Inputs	1·8	24·3	2·4	32·4	3·2	43·2	–	–
11.	Engineering Costs	1·5	20·3	4·0	54·0	5·3	71·6	0·6	8·1
12.	Management Costs	–		1·1	14·9	1·5	20·3	–	
13.	Training Costs	–		0·3	4·1	0·4	5·4	–	
	TOTALS	34·0	459·2	50·8	686·0	80·8	1091·6	11·3	152·6

Notes

1. Prices in millions of pound sterling
2. Homboy estimates based on Bura estimates increased on a pro-rata basis except for roads and I & D works (see W.P. estimate) and settlers housing taken as £1500 per house.
3. Estimates based on 1979 prices including physical contingencies but not including price contingencies
4. Genale costs at July 1978.

Figure 7.1 Fanoole - Kamsuuma area Supply and drainage works