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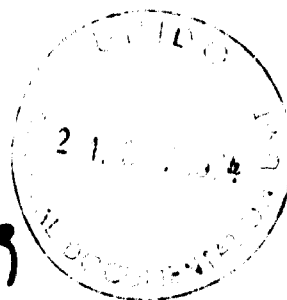
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SIS 71/1389 GAM-3

UNITED NATIONS INDUSTRIAL DEVELOPMENT
ORGANIZATION

(R) FEASIBILITY STUDY
ON
ASSEMBLY AND/OR MANUFACTURE OF
SMALL ANIMAL DRAWN
AGRICULTURAL IMPLEMENTS.



S/F AGRO-ENGINEERING

C/F

THE GAMBIA 1972

PP 36

This report has not been cleared with the UNIDO which do not, therefore, necessarily share the views expressed.

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Introduction

Already in the ILO - Report from January 1968 (Mission Order No. RM6 - RP 2(b)4 in paragraph 3.2.2.0 the idea of making agricultural implements and equipment in the frame of small enterprise and handicrafts has been mentioned. This has been proposed in order to increase employment opportunities.

Two years later, early 1971, the same idea rose from another point of view. This time the Department of Agriculture stated that the small agricultural implements imported from United Kingdom and from Senegal are not quite suitable for Gambian conditions.

In general they are too heavy.

The prices are high and constantly rising.

The designs are rather old and some factories have stopped the production.

Besides other reasons, foreign currency could be saved. Thus this idea gained ground. On request of the Government of The Gambia a project data sheet and the expert job description had been drafted by the Senior Industrial Development Field Adviser (UNIDO) North West Africa and approved by the Government. Preliminary discussions took place with the Secretary-General of the President's Office and with the Agricultural Engineering Section of the Department of Agriculture.

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For the project "Assembly and/or Manufacture of Small Animal Drawn Agricultural Implements" Nr. SIS 71/1389 G/M-3 an expert was appointed on the 1st of February 1972 in order to draw up a feasibility study. He arrived in The Gambia the 26th of February and left the 8th of May 1972. During his stay in Dakar he visited Siscoma Head Office and the factory at Pont.

This project is likely to greatly influence the agricultural structure and ought to be embedded in the plans of the Government of The Gambia. It must be closely linked to the present conditions and be geared towards the future development.

Part I. Present Conditions.

1. The Present Position of Agriculture

The problems of Agriculture of The Gambia are manifold and actually they are not the concern of this study. Some however might be mentioned because they will enlighten the difficulties this report has to deal with.

A. Structure of the Ministry of Agriculture and Natural Resources

The Ministry of Agriculture with its Head Office in Bathurst is divided up into four Departments.

The Department of Agriculture has its office at Bakau, the Veterinary Department at Abuko, the Department of Co-operation and the Fisheries Division both in Bathurst.

The Gambia as a whole has five administrative divisions. The Department of Agriculture has three stations or circles dealing with these five divisions. The Yundum Station 15 miles from Bathurst deals with the Western Division. The Janoi Station, 102 miles from Bathurst is situated in the Lower River Division and also incorporates the North Bank Division while the Sapu Station is situated in the MacCarthy Island Division (168 miles from Bathurst) deals also with the Upper River Division.

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The Yundum Station has a great number of sections of which the Agricultural Engineering section and the Extension Service are important for this study.

B. Activities of the Concerning Sections

a. Agricultural Engineering Section

A permanent Agricultural Engineering Section has started in 1971 to advise on farm mechanisation especially for the development of animal drawn machinery and implements. During 1971 in the wet as well as in the dry season a great number of tests have been carried out in order to find suitable implements for the Gambian conditions. The Agricultural Engineer also trains the departmental extension staff in the use of ox-drawn equipment and tests the implements improved and modified as well as any other agricultural machinery. Unfortunately the workshop equipment and the possibilities for field tests are not adequate to the task.

b. Extension Service Section

The Extension Service is guided and controlled by the Officer-in-Charge in the Department of Agriculture. The Agricultural Officers at the three stations are responsible for the extension work in the field. The field staff are based at 24 Mixed Farming Centres, spread evenly throughout the country. These Centres had originally been erected as the first "Ox-plough Schools" where working oxen were trained. With the tasks of the Centres the name was changed. Now-a-days at each Centre up to 25 pairs of oxen are broken in but also the young farmers coming with their oxen are taught in some general agricultural knowledge. The training period is from April to June. Besides the Agricultural Assistant who is in charge of the Centre, there is the Ox-Ploughing Instructor and two further assistants. During the rainy season some acres belonging to the Centre are cultivated. The remaining months of the year these extension workers visit the villages of their area covering 8-12 miles radius. They will follow-up the ex-trainees and advise the farmers, transmitting to them the new findings of the departmental research work. At the Centres implements and fertiliser are also
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sold to the farmers.

C. The Crops Cultivated

The main cash crop in The Gambia are groundnuts besides rice and cotton. For the self-subsistence of the families the farmers grow sorghum, millet, maize and vegetables.

The groundnut cultivation is common in The Gambia and it covers the vast majority of the cultivated acreage. In 1971 there were 200,000 to 250,000 acres sown with groundnuts and this figure is constantly increasing. Nearly the whole yield is sold to Gambia Produce Marketing Board in the outskirts of Bathurst. A confectionary groundnut variety has been introduced recently. The prices for groundnuts have risen since 1969 by 20% for farmers.

The acreage of the cereals and vegetables cultivated is about 25% of the groundnuts that is about 55,000 acres. They are grown in small plots next to the houses. The vegetable production next to Bathurst is increasing especially during the tourist season.

Rice is cultivated along the river banks where the water conditions are favourable mainly however in the MacCarthy Island Division. In 1971 about 60,000 to 70,000 acres of rice were cultivated, whilst some 160,000 acres are suitable. A great deal of rice is still imported.

The cultivation of cotton is still in his early stage. In 1971 only 200 acres were sown with cotton in the area of Basse, Upper River Division.

D. The Livestock

Besides sheep, goats, poultry and some pigs the main livestock are cattle. The N'Dama breed of cattle is dominant in The Gambia. These cattle are rather small with an average liveweight of only 550 lbs. The big advantage however being that they are very tolerant against Trypanosomiasis. Due to their size also the weight working oxen can pull is small. In 1970 to 1971 a Livestock Marketing Mission elaborated very interesting figures. The country is according to this report heavily over populated with a total of 220,000 cattle in 1971. That means the density is 9 acres to abeast instead of the usual 15 acres. Following this report the

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carrying capacity during the dry season is 79,500 on swamp grazing and another 72,600 on crop residues, stubbels and fallow grazing. Thus a decrease of cattle to a total number of 160,000 adult animals is recommended while the number of oxen, included in above figure, should increase from 17,585 in 1970 to 20,000 beasts.

E. Farming System

The Gambia covers a total area of 4,000 sq. miles. About 50% are estimated to be water, swamps, woodland, forest reserves, barren flats, roads, settlements etc. that leaves 2000 sq. miles equal to 1,080,000 acres of arable land at rough estimate.

The total population in 1972 is about 375,000 people of which 85% are directly engaged in agriculture that is 320,000. If there are 7 people to a farmer's family then there are about 45,700 families to deal with 1,080,000 acres of arable land or 23.6 acres to a family including fallow and the areas not yet taken under cultivation.

The property system is still following the traditional laws. A certain area belongs to a village community and the chief of the village (the alkali) distributes the arable fields among the village families. There might be changes every year. Thus a farmer is never absolutely certain whether he will cultivate the same fields next year.

This tenancy system influences enormously the interest the farmers take in the fields. If they are likely to be cultivating their fields for one season only, then obviously they are going to be unwilling to spend either effort or money in preparing the land for future use e.g. stumping, fertilising, taking care of the fallows and improving the fertility of the soil in general.

..../B.

Real mixed farming is even now rather seldom and there are generally speaking two groups of farmers, the arable farmers and the stock farmers. The arable farmers may have only sheep and goats or a few cows, maybe a pair of working oxen, while the stock farmer often have a large herd, regarded as a "prestige herd". They cultivate only a few acres for self-support. No care what so ever is taken to feed the herds during the dry season. During the rainy season and some following eight weeks there is forage in abundance on the fallows and in the shrub savanna. During the dry season however a movement of the herds to the flood plains takes place and this interferes often with the rice growing farmers, who are spreading out. Thus the cattle depend more and more on the crop residues.

Those farmers who keeping working oxen have realised their benefit and take proper care of the fodder. The groundnut hay is stored and in addition the oxen are fed with bran.

2. The Present Position of Agricultural Tools and Implements

A. Hand tools

It is estimated that still 95% of the framework, cultivating, seeding, weeding, harvesting, transporting, is done by hand and with hand tools. Nearly all the required hand tools are locally made by the village blacksmith who makes them to the individual's wishes of the farmers. Many hoes are of timber and just the cutting edges are reinforced with iron. Long or short handles are used, and the shape depends on the tradition of the tribe the farmer belongs to. There are no statistics about the import of farming hand tools. Inquiries have been made and it was found that in 1970 and 1971 a number of hand tools were given as a gift from the United States. In 1970 there were cutters, ploughs and axes, 50 of each type and tined hoes and ordinary hoes, 100 of each type. In 1971 100 heavy hand hoes were handed over. It has been said that the farmers prefer their traditional ones.

B. Ox-drawn Implements

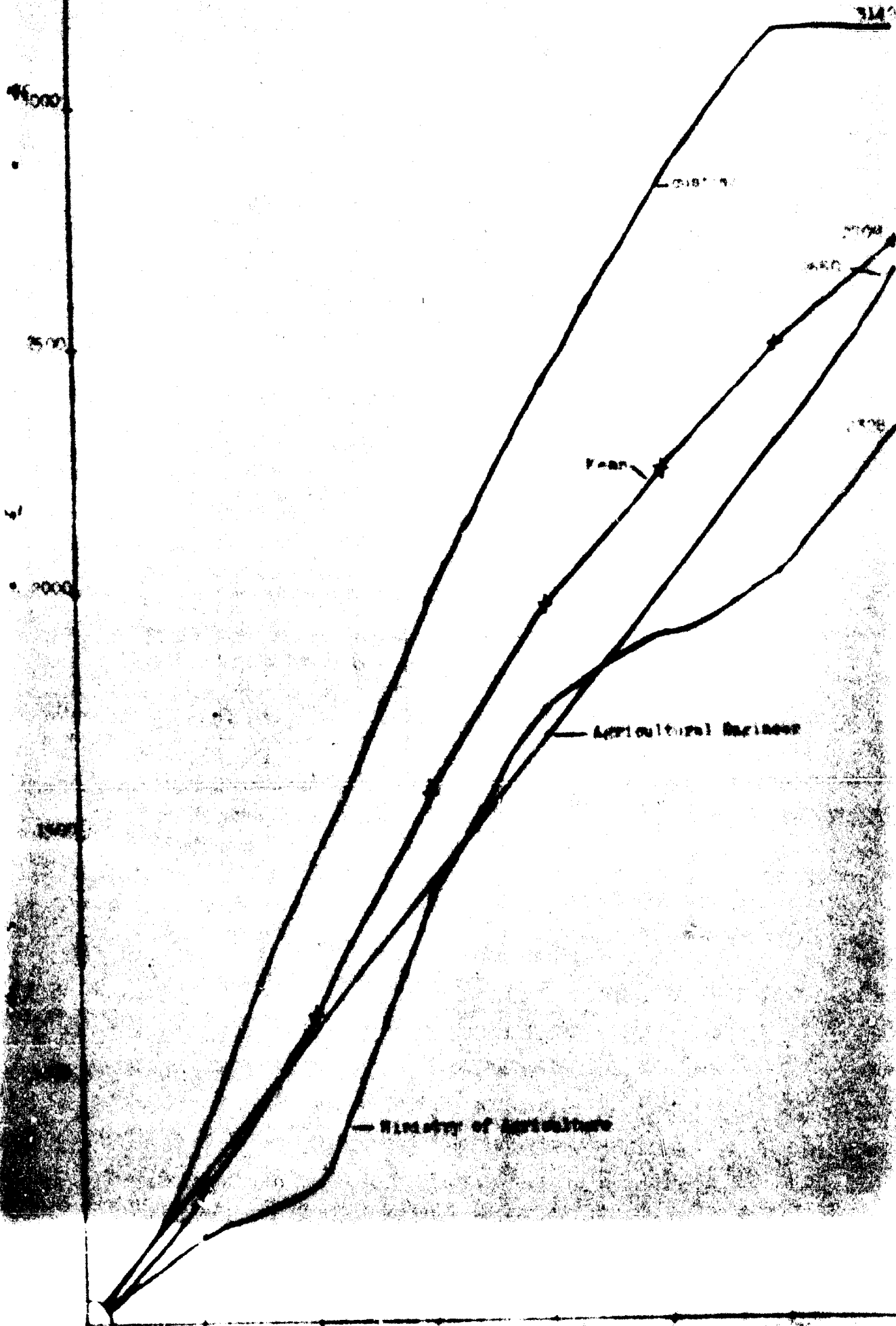
It is only a small percentage that is actually done by animal drawn implement, but nevertheless it is the beginning of the mechanisation of agriculture. The equipment considered are ploughs, ridgers, weeders, seeders, groundnut lifters and carts. About fifteen years ago a small number of ox-ploughs were introduced. These were the first in the country. With the rising activity of the Mixed Farming Centres the number of the ox-drawn implements also increased. The Ministry of Agriculture have some statistics about the sale to farmers beginning in 1969. For the same year onwards the Customs supplied figures on the import of "Ox-drawn agricultural machine and appliances for preparing and cultivating the soil (e.g. ploughs, cultivators, rollers etc.)" under item 712-110. The figures in 1966/67 and 1967/68 are obviously false. Most likely they include a great number of Spare Parts. Thus they have been corrected according to the existing trend. Moreover there is the estimate of the Agricultural Engineer on the total number in 1972. Assuming that before 1969 about 500 ploughs and ridger were in the country, the figures of the three sources have been laid down in the diagram I next page but only for ploughs and ridges together.

The situation of the ox-drawn implements is rather confusing. Years ago different types of ploughs were imported from different countries. These ploughs were single purpose. For the main crop, the groundnuts, the farmer also did the ridging with it. Later a single purpose ridger was imported. An imported multipurpose implement was not successful and is now-a-days used as an ox-cart only. The total number of ox-carts has been estimated to be 1400 to 1500, and weeders, seeders and lifters to be 200 each type.

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TABLE OF VARIOUS BANKS AND ...

1969/70 to 1970/71



a. Recent Achievement of the Agricultural Engineering Section

As already mentioned before, the N'Dama cattle race is lighter than the Zebu race and accordingly the pull of one N'Dama oxen is only 120-130 lbs max 160 lbs. Due to this fact the implements offered on the market are not suitable. During 1971 the Agricultural Engineer made a great number of tests with single purpose and multipurpose implements imported. After some alterations a prototype was made. It also has been kept in mind that this implement should be easy to be manufactured by the elimination of cast iron pieces etc. Unfortunately these implements could not be tested properly during the season 1971. For the season 1972 however enough units are available. They will be tested on the 24 Mixed Farming Centres as well as with 24 individual farmers. The multipurpose implement will be equipped with ploughing body, lifter, weeder and ridger, while the single purpose one is for ridging only with a bigger body. The ox-cart has also been modified. For the time being the axle with the wheels, the chassis and the other iron parts are imported while the wooden parts will be made in the Yundum Workshop. By modifying the ox-cart it is hoped to make it cheaper.

b. Recent Development of the Mixed Farming Centres

As previously mentioned there are 24 Mixed Farming Centres which are equipped by the Agricultural Engineering Section with ridgers. There are for the season 1972 450 ridgers but they are not sold and not added to the sale figures of the Ministry in the diagram. The young farmers and the oxen are trained with these implements and they take them along to their own farms for one season only. The other implements are also available and the farmers are instructed how to handle and to set them. As said before the newly developed implements will be tested on the Mixed Farming Centres and they are also shown and explained to the young farmers. Thus these Centres are a very important link in the further mechanisation of agriculture.

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The National Repair Week is a combined effort of the Agricultural Engineering Section and the Extension Service. Once a year a certain week well before the rains is published by Gambian Broadcasting. A fitter from the Agricultural Stations, equipped with spare parts and tools will be at the Centres and the farmers of that area will bring their implements to be repaired. Of course they have to pay. However if something goes wrong during the season, the farmer may have to travel long distances to get it repaired thereby losing several days during the very busy season, because the Mixed Farming Centres are not supposed to do any repairs. The National Repair Week was started in 1967.

c. Tractors and Implements

In a previous chapter the Tractor Ploughing Scheme has been mentioned. The farmers are supposed to pay in advance 30 Dalasis per acre. However they are well behind with the payment and the tractors are standing idle and valuable time is lost. In 1971 only 6,000 acres were done by the tractors. Thus the actual costs per acre are very high and the scheme must be substituted by Government. There are 28 tractors in the scheme. The Department of Agriculture has on the whole about 50 tractors, the Public Works Department another 20 and about 20 are privately owned.

The repair and maintenance is done in the workshops of the Agricultural Stations.

Part II. Future Aspects

1. Plans of the Government

Early 1971 the "Third Development Programme 1971/72 to 1973/74" has been elaborated by the Government of The Gambia. This programme shows clearly its endeavour in further development of the country. Those topics concerning agriculture in the near future shall be mentioned here as they are essential for this study.

The growth rate of the population has been estimated in 1970 at 2.1% in general, while it is estimated at 1.9% outside the Bathurst - Kombo St. Mary area. Thus the population of The Gambia will be mid 1972 about 375,000 on 4,000 sq. miles. That means that the density of the population is one of the highest in Africa.

Due to the very violent land pressure the urban drift is constantly increasing the number of job-seekers. It is the aim of the Government to stem this drift by making the rural life more attractive. But some drastic changes in agriculture must take place.

The areas most suitable for farming have been cultivated for many generations by shifting cultivation. The fallow period used to be 8 to 15 years whilst now-a-days due to the land pressure it is 2 to 3 years only. It is evident that this method cannot continue, even by using fertiliser. Soon the fertility of the soil will be ruined and the economy of The Gambia will be threatened as agriculture contributes over 50% of the Gambian product.

The only answer is a complete change in the traditional system.

Intensive cultivation of the fields to raise the yield per acre and to produce a better quality crop.

Intensive cattle rearing and to regard the herds as cash crops. Using the fallows to grow special fodder crops, conserving crop residues and making silage.

The Mixed Farming Centres will find it very difficult convincing local farmers to change their traditions. The Centres will need to be constant examples to them. Whenever possible ox-drawn implements will be used to do the work in the fields and also ox-drawn machines will be used in the farm yard.

The Agricultural Engineering Section will develop and introduce further ox-drawn implements, tools and farm yard machine to be tested and demonstrated at the Mixed Farming Centres. They will be designed to be produced as far as possible in the country, using local material whenever it is applicable, and for a reasonable price.

It is the purpose of this feasibility study to evaluate the possibilities for this local production.

2. Future Demand of Ox-drawn Implements

Before discussing the possibilities of local production the demand of ox-drawn implements should be known. In a previous chapter the probable development of these implements is given in the diagram I with a total of 2709 in 1970/71. Because the ridger is the most important implement the following as well as the previous calculations are made on the ridger though they do include some ploughs as well. The demand for at least the next five years must be found as it is decisive for the way of production. Different possibilities offer themselves (see diagram II).

- i) We may simply continue the development of the previous years. Every body knows that the demand of a product decreases slowly until the market is saturated. This however will not take place for many years to come.
- ii) The cultivated area of 335,000 acres of which 5,000 acres are done by tractors may give an idea. Assuming that up till 1979/80 30% of the area might be cultivated by oxen, the total number of implements must be some 5325 should each pair of oxen work 20 acres per season.
- iii) Both these previous considerations are rather vague. A new implement will be bought if an additional pair of oxen has been trained. The training in the Mixed Farming Centres amounts to 350 per year plus 5% privately trained gives 365 per year. These figures are valid from 1967 only. Before this year 150 pairs might have been trained. The oxen however will not be really powerful for work when older than 8 years. Thus a

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total of trained pairs including the training in 1972 adds up to 2490. The mortality rate of the N'Dama cattle is said to be 3 to 5%. Considering that the working oxen are well looked after 3% has to be subtracted leaving a final total of 2415 pairs of trained oxen. As this figure is fairly closed to the number of implements, this calculation seems to be rather realistic.

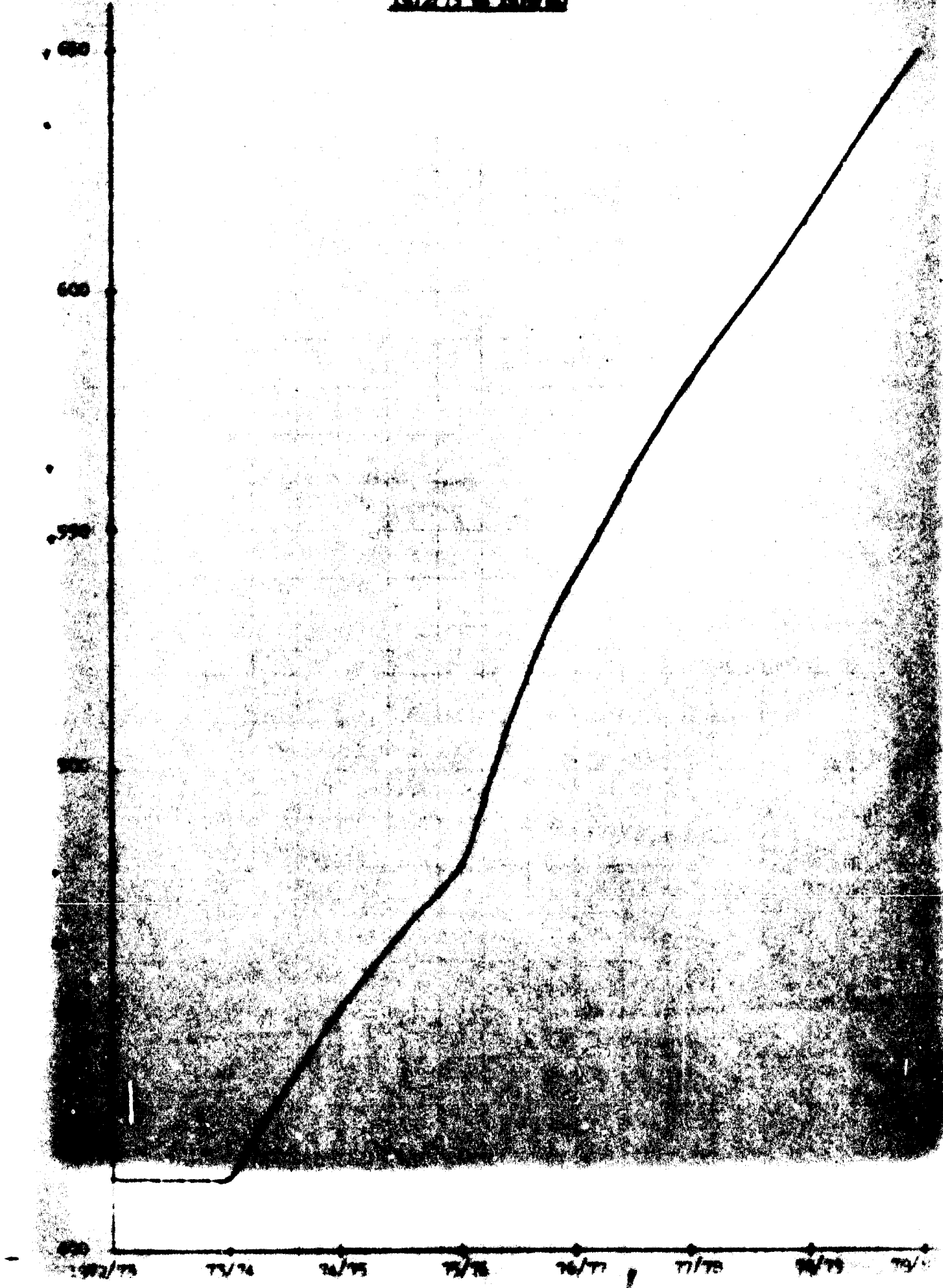
Thus we will have a demand of 365 new ridgers per year a figure which may slightly increase. As the supply has not been sufficient during 1970/71 and 1971/72 for the year 1972/73 the demand will be higher by an extra 150 units.

- iv) Under Gambian conditions the lifetime of the ridgers and ploughs can be calculated to be 10 years. Actually some implements 10 years of age have been seen. So in 1973/74 the demand for replacement is likely to start. For the year 1963/64 a total of 500 implements has been estimated. In 1973/74 the replacement may begin with 10%, increasing with the years.
- v) In the graph III the presumable demand of ridgers and ploughs is shown and on these figures the considerations for the possibilities for production in The Gambia will be based. The demand for ox-carts and other implements will most likely be a little less.

PLATE II

INDEX OF QUANTUM FLUXES AND FLOW

1972/73 to 1978/79



Part III. Possibilities for Local Production of Ox-drawn Implements

Again mainly the production of ridger and ploughs will be considered as the existing arrangement for the ox-carts is quite satisfactory.

The material required for the production must be imported. It consists mainly of raw material in standard length, of given cross-sections, of screws, bolts and nuts and of the special wearing parts like mould-board, share, points etc. The job is a combined one for mechanics, blacksmiths and welders.

The demand in 1972/73 will be about 515 units in 1973/74 about 415 and from this figure gradually increasing during the following years.

1. In a Factory

Some may have in mind a factory like the Siscoma plant in general. The demand however is the decisive factor the production of Siscoma is said to be 60,000 implements per year. The Gambian factory would of course be much smaller, producing an average 1.2 units, or including ox-carts 2 units per day, in which easily the Gambian demand for a year would be produced in a few months only. Also at any rate the costs for depreciation costs and other overhead costs will be too high. A profitable enterprise cannot be seen.

Moreover a factory whatever its size is not flexible enough to meet a number of smaller other requirements of the farmers.

Nevertheless the personnel and equipment requirements shall be listed as well as the costs in comparison with the following proposals.

A Manager who is also the Chief Engineer will be in charge of the fabrication. He will be the only expert, the job description is found in Annex Ia. An Accountant and a Storekeeper, both Gambians are needed. In the workshop there should be five men, a workshop foreman, two mechanics and two apprentices from the Vocational Training Centre.

At the moment it is not possible to give exact prices for the requirements as no price-list is available only a lump sum can be mentioned.

2. In the Workshop of the Agricultural Engineer

It has already been mentioned, that the workshop of the Agricultural Engineer at Yundum must be improved to be suitable for the development of further agricultural equipment. This workshop should also be equipped with a basic set of blacksmith tools and jigs described in the next chapter.

If the Agricultural Engineer would employ 2 or 3 young men from the Vocational Training Centre as apprentices he would be able to have several hundred implements produced in one year in order to meet the demand. Besides the apprentices, there should be a trained mechanic for supervision and to take care of the store at the same time.

A workshop building is necessary any way and in this case of production it must be a little bigger. The other additional requirement is only the set of blacksmith tools.

The costs are given in a following chapter.

3. With Village Blacksmith

A third possibility to decentralise the production and have it carried out by the village blacksmith. By his traditional profession the blacksmith combines to a certain degree the basic knowledge and ability of the three above mentioned artisans. He knows how to handle nuts and bolts and how to operate a hacksaw. Some blacksmiths are familiar with electric welding and of course all of them how to handle and to treat iron.

The village blacksmith already has his workshop, no matter how primitive it may be and he will also have some equipment. All the blacksmiths have a forge either with a fan or with bellows. Some of them have a normal anvil and some hand tools like hammer, tongs, files etc. They may have hand-driven drills and grinding stones. Even an electric welding set has been found.

A welding set is absolutely necessary for the production of the implement in mind. An electric one is cheaper and easier to operate. Therefore the selection of the first blacksmiths is restricted to those places where there is electricity available. If the first attempts turn out well there is no reason for blacksmith from other places to take up the production with gas welding sets. However the replacement of the oxygen and acetylene cylinders must be secured.

The village blacksmith has always produced the hand tools for the farmers, so he has already close connection with the customers for ox-drawn implements. He has always been able to make his living, the production of implements is a possibility to earn more money and to widen his business considerably.

With regard to the repairs and Spare Parts supply, another advantage offers itself. The blacksmith will be encouraged to keep a small stock of Spare Parts adequate for the implements he sells. It goes without saying that he will carry out all repairs. After some year it is hoped, the number of blacksmiths making implements, will widely exceed the number of Mixed Farming Centres. Then the Department of Agriculture will not have to organise the "National Repair Week" any more. As this burden will be shouldered by the blacksmiths who will have taken over. They are on the spot and the farmers don't have to loose any more valuable days during the busy season.

In many countries in Europe the village blacksmiths have been the pioneers for the mechanisation of agriculture in any form and it will be the same in The Gambia.

4. Training of Village Blacksmith Linked to Agricultural Engineering Workshop

The proposals 2 and 3 could well be linked together, the training workshop and the Agricultural Engineer's workshop. Whenever the instructor has a group of blacksmith for training, he will not be producing any other implements other than those he constructs as examples to the trainees. When he is not instructing the group of blacksmith, or when he is not on past training inspection tour. He may have one or two other men from the Vocational Training Centre. In case the instructor is on tour, the Agricultural Engineer will take over the supervision of the production in the training workshop.

With this arrangement these two workshops together could well produce the demand. However it should not be forgotten that it is the aim that gradually the village blacksmith will take over the production. But the workshops will not be unoccupied. As soon as the blacksmiths relieve them of one product they will go ahead with the next implement the blacksmith might not yet have been trained for.

For the selection at the Vocational Training Centre the sons of a blacksmith where there is electricity should have priority. In 1975 the first trainees from Miseric at Lamin will have finished and the apprentices might be recruited from there as they will have some training in forging too.

The personal requirement is just the same as with the two separate proposals 2 and 3. For all of them a full time job is guaranteed.

Regarding the future of these two workshops which will have an important task for many years to come, it should be made sure that the same line will be followed even when the contract of the two expatriates has finished. A scholarship for two able Gambians is proposed. These young men are E. Sonko at Yundum and B.M. Cham at Sapu. Both of them did the City and Guilds Part I 193 and they should be sent to U.K. in order to make the City and Guilds Part II 193, Mechanical Engineering. Both are working in about the same line now and they are felt to be able to work in this scheme later on to the benefit of their country.

The physical requirements are slightly different but only regarding the workshop building. For the sake of easy supervision the workshop should be in one or two adjoining buildings. The workshops themselves must however be strictly separated as well as the stores. The equipment for the workshops is the same as stated previously for the blacksmiths.

Part IV. The Practical Performance

The present background and the conclusive reasons for a local production of simple ox-drawn implement at a reasonable price, have been shown in the previous chapters. Also the probable demand for years up to 1979/80 has been elaborated. Different possibilities for the production have been shown. What the village blacksmith will be producing will be discussed in particular and how to contrive the practical performance will be shown in this chapter.

1. Technical Preliminaries

It has been said already that the Agricultural Engineering Section has developed suitable implements based on English designs. During the season 1972/73 they will be thoroughly tested. When they have been accepted the Agricultural Engineer will make proper technical drawings of each implement, the attachments and all single parts.

As the basic design is taken from an English company. They must be approached to negotiate on two subjects. The permission to produce the implements in The Gambia and at the same time this firm should guarantee the supply of the wearing parts for the future. (Project Equipment, Newton Toney, Salisbury, Wiltshire).

A list of material, parts and raw material, down to the last split pin will be drawn up by the Agricultural Engineer. As soon as the negotiations with the company have reached a favourable result the material for the implements must be ordered at once. A real 100% complete supply has to be ensured.

2. Physical and Personal Preliminaries

At the same time when the supposition to order the material is given the tools and equipment for the blacksmith workshops should be ordered. A list of these tools etc. you will find in Annex II. A complete set should be ordered for each blacksmith of the first group to be trained, one for the training workshop, one for the workshop of the Agricultural Engineering Section and a spare set.

The selection of the blacksmiths is of course important to find the right ones. It has already been mentioned, that due to the electric welding set the choice is bounded to the places where there is electricity. There are now 4 places equipt with electricity, these are Brikama, Kerevan, Georgetown and Basse, these towns are well distributed over the country. The towns and the blacksmiths there must be visited by a technically well informed person together with another person who must be competent in the financial and administrative questions. The blacksmith should be middle aged with a good reputation and it is hoped they will except the offer made. He should be literate in their own language.

With regard to the interchangeability of all parts especially of the imported wearing parts, one implement must be exactly like another one. For this reason jigs and forms have to be made very correct in order to guarantee uniformity. These jigs should be made in accordance with the technical drawings of the Agricultural Engineer with the advice of the blacksmith instructor, who will be specified later.

The building required for the training must have water and electricity and comprise of a small lecture room, a room for changing clothes and to wash, a workshop of about 20 x 25 m, one corner separated for welding and a store for parts. Outside the building there might be a shed for the forge and anvil and another one for the long raw materials. For the blacksmith instructor a house would be required.

3. Training and Post Training

The blacksmith instructor must be a really good practitioner about 40 years of age from an English speaking country. For the proposed Job-Description see Annex II. He should be assigned to The Gambia for a period of two to three years. He will train the small group of blacksmiths mainly in electric welding. The training workshop will be equipped with just the same basic tool set, the blacksmiths are expected to have thereafter in their own workshops. During the training the blacksmith will make some implements by using the mentioned jigs and appliances. What further technical abilities will be trained depends entirely on the knowledge and experience of the individual artisan, and will be left to the decision of the instructor. It is however essential that during the training some very primitive and basic ideas about calculation and book-keeping will be brought forward to the blacksmiths. Due to an officially made proper calculation the selling price of the implements produced by the blacksmith later on will be controlled to an upper limit. The same group might be called in for training for others, in the meanwhile developed and tested implements e.g. a seeder and ox-cart.

.../24.

An English speaking basidly trained mechanic should be attached to the instructor as an assistant and if necessary as an interpreter.

The length of the training period will have to be discussed with the blacksmith instructor. As a general point of view it might be said that the training should not take more than a month or two. The age of the blacksmiths should be between 30 and 40 years. People of this age are not used to continually absorbing new methods for a longer period than this. On the other hand they do not like to leave their homes, their business and their family for long time. The past training is as important as the initial training.

After this first training the blacksmith will receive from the storekeeper the basic equipment and the material for a certain number of implements which he will produce in the following months to sell to the farmers. The number of implements he is going to produce is fairly accurately known by the number of pairs of oxen which have been trained in the one or two Mixed Farming Centres in the neighbourhood.

Soon after the blacksmiths went home the instructor will tour around to visit them in their own villages and workshops. He will advise them how to install the new equipment in the best position and help them in the work they are about to perform. He should also construct another implement with the blacksmith in the blacksmith's workshop. These past training visits should be repeated several times. While on tour the instructor may also be looking out for other onepable blacksmiths to join the next group. While working with the artisans in their own workshops the instructor will also show them how to make additional tools for their own use. For this purpose the instructor should take along some material from the scrap yard at Yundum and Sapu. A blacksmith is in the lucky position of being able to produce in his own occupation a great deal of the tools he is in need of.

The training workshop should be in the neighbourhood of the workshop of the Agricultural Engineer. Here the trainees can watch an even better workshop than their own in operation and observe the development of new implements which they will in time be producing. The trained blacksmith will be encouraged to keep a small stock of wearing parts he will sell to farmers, even for their older implements.

4. Personal and Equipment Requirements

The persons to be engaged in the pilot scheme have already been mentioned.

First of all there is the blacksmith instructor for job description see Annex Ib. He must be a good practitioner, flexible and able to improvise. It is more than likely that he will never have been in Africa before, so as the work will be completely new to him, he will require some guidance during the first few months. This guidance should be given by an experienced expert in a senior position to him, so that he might not be delayed unnecessarily through inexperience. The latter, familiar with Gambian conditions and necessities, should follow up the development of the pilot scheme, suggesting alterations and improvements. He should also discuss with the authorities concerned, the Agricultural Engineer, and with the instructor the further development of the program. In order to follow the same line, the same expert should be available from time to time.

The above mentioned assistant to the instructor should be an intelligent Gambian with some mechanical background. If possible he should speak English plus two local languages. After working for two years with the instructor he may be able to take over from him. The training of the blacksmith will go on for years.

The next person in this scheme is the storekeeper. During the first year this will not be a full time job, so he should also work with the instructor, who will also supervise him in the store. This storekeeper as well as the assistant should be from the Vocational Training Centre.

The equipment requirements have already been mentioned. These are the building for the workshop, the house for the instructor and the equipment for the workshops.

Part V. Financial Requirements and Comparisons

It is rather difficult to give at this stage exact figures of the financial requirements. As no price lists were available and the costs for the equipment as well as for the buildings could only be estimated. These figures however are given after intensive discussion with experienced officials.

Four proposals were made as to where to produce the ox-drawn implements.

<u>1. In a factory</u>	Investment £	Overhead costs £
Building with 2 offices, store, workshop, washing room, toilet etc.	5000	250
Workshop and office equipment	2500	250
Salary Manager, Chief Engineer (Expert)		6500
" Accountant		350
" Storekeeper		200
" Workshop Foreman 300	} including in selling price	-
" 2 Mechanics 400		-
" 2 Apprentices 200		-
		<hr/>
Total overhead cost per year		<u>£7550</u>

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2. In the Agricultural Engineer's Workshop

	Investment £	Overhead Costs £
Building with workshop, store and equipment is required in any case	2000	-
Set of basic blacksmith tools	400	40
Salary Mechanic & Storekeeper	300	-
" 2 Apprentices	200	-
		} including in selling price
Additional overhead costs per year		<u>£40</u>

3. With Village Blacksmiths

	Investment £	Overhead Costs £
Building with Workshop, Store, Lecture room changing and washing room	2500	125
House for instructor	2500	125
Set of basic blacksmith tools	400	40
Salary Blacksmith instructor		5300
" Assistant Mechanic & Storekeeper	200	-
" 2 Apprentices	200	-
		} including in selling price
Total overhead costs per year		<u>£590</u>

4. Blacksmith Training Workshop with Agricultural Engineer's Workshop

In general the costs are the same	£40
Plus	<u>5590</u>
	£5630
The building is less when both are in one	<u>500</u>
Total overhead costs per year	<u>£5130</u>

.../28.

It is doubtful whether the salary of the experts should be inserted in this calculation. The proposal 1 however has to be regarded as a commercial enterprise and the position of the expert will be filled sometime by a Gambian, so at least his salary should be taken in consideration.

The Agricultural Engineer's Workshop has least overhead costs. But that is quite natural as it is an existing section of the Department of Agriculture. This workshop however has to fulfil other tasks e.g. developing and testing other implements. For this reason it will not be possible to produce the whole demand of ridgers and ploughs, maybe $\frac{1}{2}$ only.

Also proposal 3 has other tasks namely the training of the village blacksmith, but as the Agricultural Engineer will supervise this workshop when the instructor is on tour, this place will be in the position to produce $\frac{2}{3}$ of the demand.

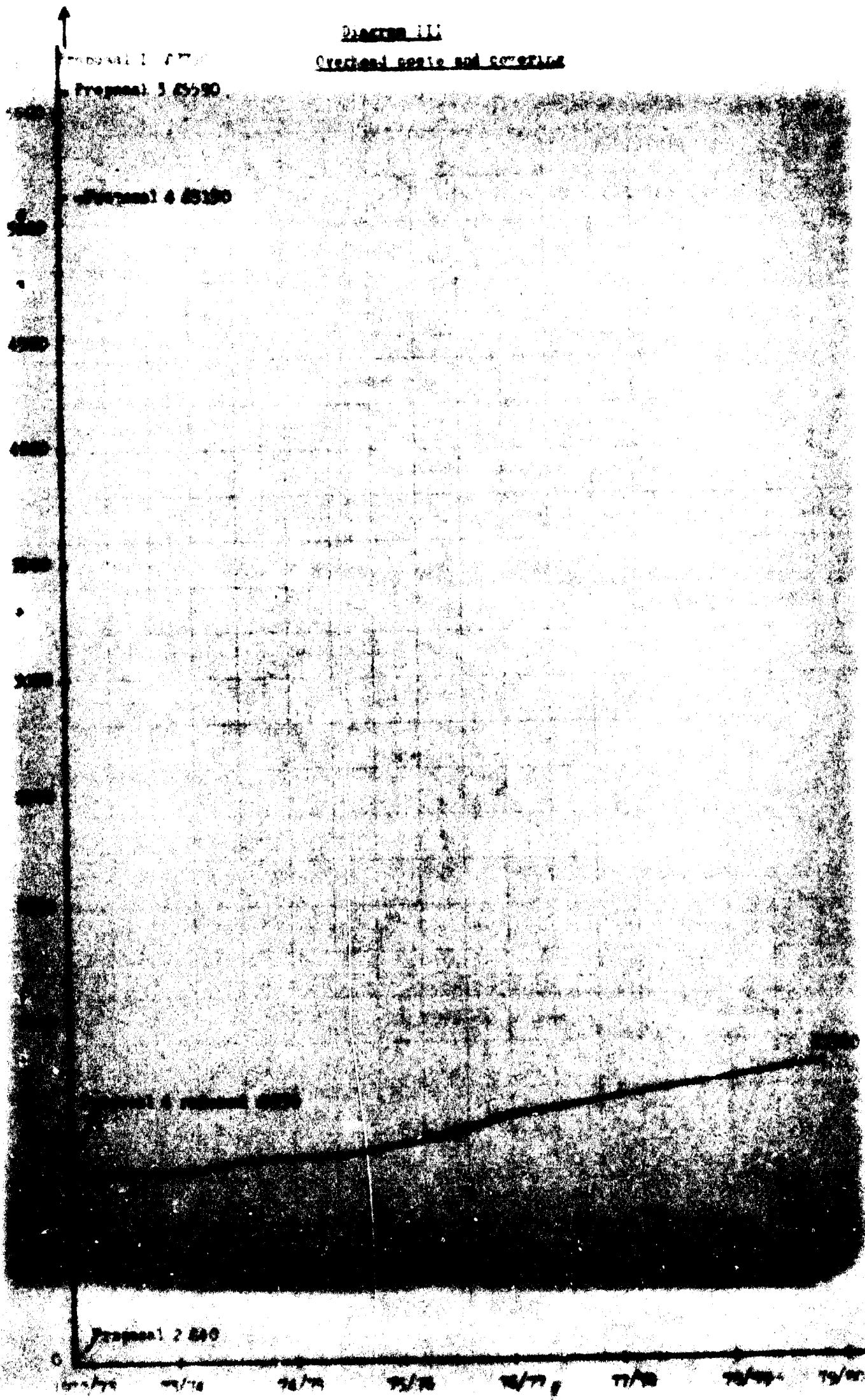
This leads already to proposal 4. By this arrangement the whole demand of ridgers and ploughs will be covered and as soon as some blacksmiths may take over a part, this workshop will go ahead with the production of other equipment, say ox-carts.

But with all 4 proposals how will the overhead costs be covered? Of course by the sale of the produced implements. The selling price of a Unibar frame with ridger and lifter as recommended by the Agricultural Engineer is now a little less than £18. One reason for having carried out the production in The Gambia is to lower the price. It will be possible to cut down the price by $\frac{1}{3}$, that is £12. On this production price a margin of 15% must be added to get a selling price of £14, that is a margin of £2 to cover the overhead costs and then it is still 22% cheaper than the imported implement. This margin of £2 per implement is inserted in diagram III in relation to the calculated demand or sale (see diagram II) in the following years. The abnormally high demand in 1972/73 has been neglected.

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Diagram III

Overhead costs and coverage



In diagram III it is easy to see that with proposal 2 only the overhead costs will be covered. But as said before in this case the demand will not be supplied without neglecting the other tasks of the Agricultural Engineer.

The next is proposal 4. In this case especially because the expert has to train the village blacksmiths it is felt to be justified to deduct his salary and have it replaced by a Gambian successor with a salary of £1100. Then we will have for proposal 4 total overhead costs of £930. This amount will be covered in 1975/76. At this time the contract of the blacksmith instructor should be terminated anyway. Thus proposal 4 seems to be the most promising.

Part VI. Further Development

If the production of the ox-drawn implements and the other demands of the farmers is gradually handed over to the village blacksmiths, it is strongly believed that it will fit very neatly into the 3 years plan of the Government.

The village craftsmen, the blacksmith, the carpenter, the artisan in leather, they all are in a desperate position as many things e.g. weapons are not asked for any more and very many utensils are imported. Moreover it is often impossible for them to get proper tools and the proper material they are in need of, even when they are prepared to pay cash.

New ideas about things for a somewhat higher standard of life for the rural population must be put forward to the village craftsmen. Besides the ox-drawn implements the blacksmith will inevitable be required to produce other equipment e.g. ox-carts, groundnut hullers, water lifting devices, capstan to drive mills and threshers etc. The carpenter will complete the ox-carts, he will make harrows, marking rakes, hey rakes, maybe even transmission gears etc. Also the craftsman in leather will play his share in this development by making better harnesses and so on.

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When the rural artisans are trained to produce more modern equipment and have widened their knowledge and ability they will recognise their chance to earn more and they will be prepared to improve their workshop equipment to widen their possibilities. And when young men from the Vocational Training Centre or from the Misorio handicraft school are trained in the same line at the same place, the settled craftsmen it is hoped, will be willing to co-operate with them. Moreover the village youths will have a chance to see, to learn and to carry out really modern productive work. This fact will help to stem the drift to the towns. A new generation of rural handicraftmen will grow up.

The farmers also will gladly consent to this development. They are not forced any more to undertake sometimes long and tiresome tours to one of the Agricultural Stations in order to get a spare part or to have small things put right. Sometimes by this he is losing 3 days or more during the busiest time of the year. With other equipment on the fields and on the farmyard the rural life will become more attractive, reducing the trend of the youths to go to the towns.

Of course such a development will take its time. It has been mentioned before that the beginning of farm mechanisation took place some fifteen years ago. The Gambia is now making a remarkable step ahead in this line. It is hoped that within three years after the start of this pilot production scheme some noticeable steps will have been achieved towards the target for development of the villages.

SUMMARY

The reasons have been stated in Part I why ox-drawn implements should be produced in The Gambia. The offer on the World Market does not suit the Gambian conditions, they are too big for the strength of the N'Dama oxen and the prices are continually rising. Moreover less and less factories are producing these implements as the small companies are being taken over by bigger concerns who are not interested in small series. The demand of The Gambia has been shown not to be

of any interest.

The only solution for the further development of mechanised farming and to introduce modern techniques by using ox-drawn implements and other higher standard equipment is to produce the demand locally. In this feasibility study a way has been lined out as to how this could be done. The proposal has been made to engage the village craftsmen in this problem as it is very likely that this will be the most effective method for the development of the villages of The Gambia. This program will aid the endeavour of the Government to make the rural life more attractive and will help to lessen the drift to the towns.

In order to have, as a start, a small number of blacksmiths trained and equipped, to enable them to produce a part of the demand for the season 1972/73 the arrangements should be started at once. The recruiting of the experts, the abroad training of counterparts, the order of the material and equipment and the selection or construction of the required buildings should be started without any delay.

It is hoped that the right decisions will be made in that it will contribute not only to the modernisation of agriculture but also benefit the rest of the country.

Appendix Ia.

Job Description

Post Title: Expert in manufacturing small agricultural machinery.
Duration: Three years.
Date Required: As soon as possible.
Duty Station: Bathurst.
Purpose of: To manufacture and assemble small multi-purpose
Project: Implements and ploughs according to drawings.
To train a counterpart and mechanics for this work.
To manage this small factory.

.../33.

Duties: This small factory shall be established in Bathurst or in its neighbourhood to meet the demand of Gambian farmers in this kind of implements. The number of the output is limited to 400 to 700 units.

The export will be expected to:

1. Manage and supervise this small factory in any respect including book-keeping.
2. Manufacture the implement according to prototypes and drawings as cheap as possible.
3. To train a local counterpart so that he may take over after 3 years.
4. To train the local mechanics and apprentices in proper accurate work.
5. To keep the stock up to the requirements. The wearing parts will be imported.

Qualifications: Degree or equivalent in Mechanical Engineering.
Extension experience in the manufacturing sector, in establishing manufacturing units, machine tools' sections, process planning, production techniques, jigs, project scheduling and organisation.
Experience in book-keeping and management.

Languages: English.

Appendix Ib.

Job Description

Post Title: Blacksmith Instructor.
Duration: Three years.
Date Required: As soon as possible.
Duty Station: Yundum, 15 miles outside Bathurst and touring the country.
Purpose of Project: To train village blacksmiths in short courses in producing ox-drawn implement according to prototype and drawings. To train young men from the Vocational Training Centre in the same abilities.

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- Duties:** The Instructor will be expected to:
1. Help in the selection of village blacksmiths for the course.
 2. Train the blacksmiths during a short course to produce the implements in demand.
 3. Tour the country visiting the trained blacksmiths, advise them in their own workshop in any respect.
 4. Train the young men from the Vocational Training Centre in the same line and produce with them some 200 implements per year.
 5. Make full proof jigs for the implements.
 6. Watch carefully the stock and order new material. Raw material, wearing parts and small parts will be imported.

Qualifications: Must be firm in his profession if possible mainly for rural demand. Must be firm in electric and gas welding, hardening, soft and hard soldering and in normal mechanical work. Must have some knowledge in wood work. Must be flexible and able to improvise and to do a good job with a primitive set of tools. Must be ready to take hardship while touring the country, accompanied by an interpreter, counterpart.

Age: 35 to 45 years of age.

Languages: English.

Appendix II

List of Basic Blacksmith Tools.

Anvil 200 lbs.
Tong, open mouth 20"
" , bolt 20"
Smiths' hand hammer 5 lbs.
" sledge " 10 lbs.
Hot sets 1/10 lb.
Hacksaw, adjustable

.../3.

Hacksaw blades 6
Vice, Leg 100 lbs.
Spanner, single ended $\frac{1}{2}$ ", $\frac{3}{4}$ ", $\frac{1}{2}$ " WW
Files flat bastard 10"
" " smooth 8"
" halfround second cut 10"
" round " 6"
Bench grinding stone 12" x 2" Yorkshire grit
Steel rule 12" long (inches into 16ths, Centimeters into millimeters)
Electric Welding Set with handscreen complete 3 or single face 180 Amp Volt 240/990
Drilling machine, bench type hand-driven up to $17/32$ "
Twist drills $\frac{1}{2}$ ", $13/32$ ", $17/32$ "
Forge, hand-driven fan
Wire brushes 2
Brushes for painting 4

References

- 1) Third Development Programme 1971/72 to 1973/74 Sessional Paper No. 2 of 1971.
- 2) Report of The Gambian Livestock Marketing Mission 1971.
- 3) ILO - Geneva 1970. Memorandum to the Government of The Gambia on Manpower Assessment and Planning.

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The Staff of the Customs and the Statistics.

The Staff of the UNDP Co-ordinating Office and their colleagues.

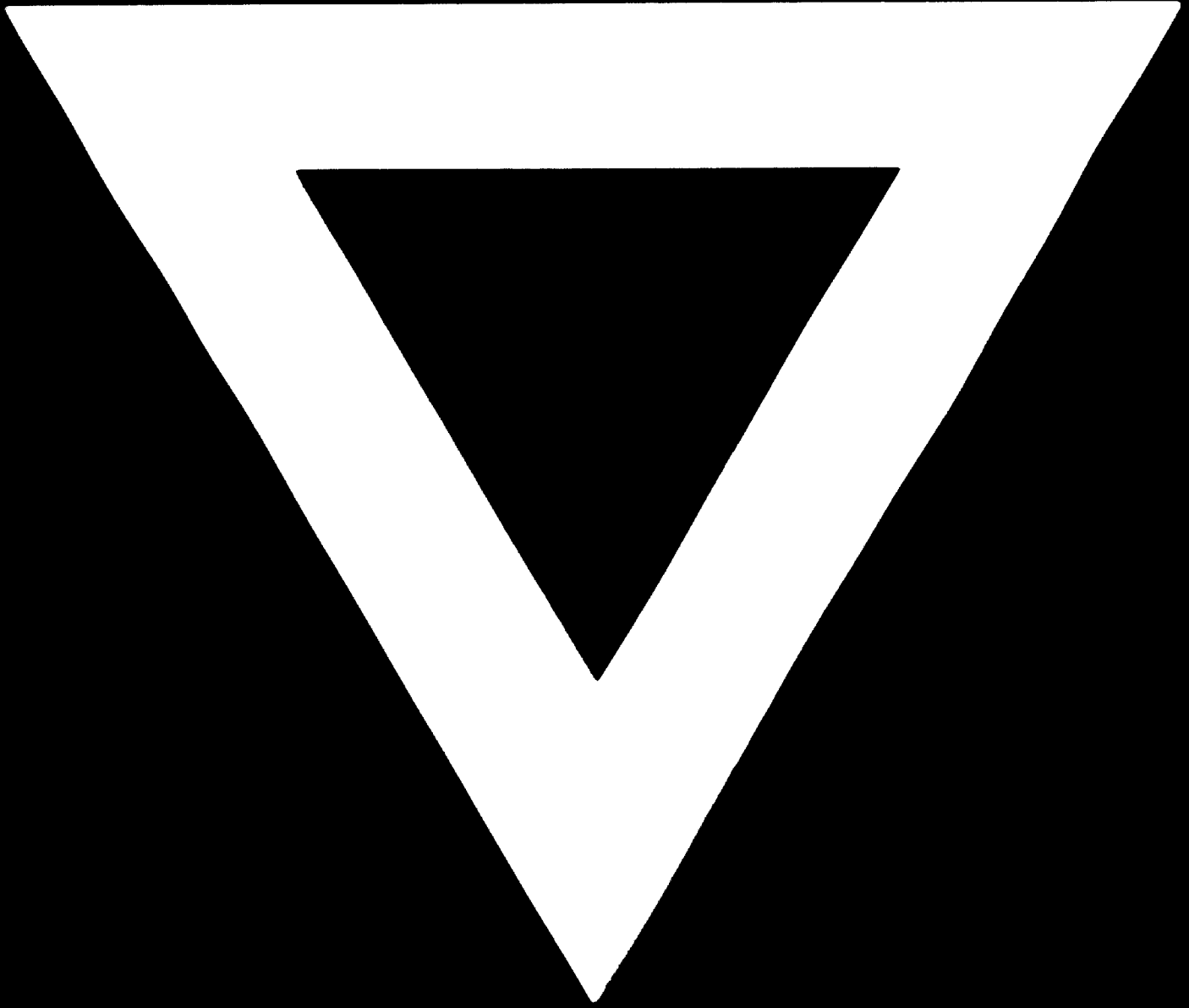
The Staff of the Vocational Training Centre.

Lamin Technical And Agricultural Centre (Misereor) .

Some Local Companies.



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