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INDUSTRIAL CONSULTANCY SERVICES

DP/ML/88/018

REPUBLIC OF MALAWI

Technical report: Assistance to Nu Line Food Products Ltd*

Prepared for the Government of the Republic of Malawi
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of W. Novero, Agronomist

Backstopping Officer: M. Farah, Industrial Management and
Rehabilitation Branch

United Nations Industrial Development Organization
Vienna

* This document has not been edited.

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ABSTRACT

Project No DP/MLW/88/018/11-54/J.12206 titled "Cassava Production and Estate Development Project" came into being upon approval of the request of Nu Line Food Products Limited by UNIDO, through the Malawi Government, to finance the services of a short term Agronomist.

The project was to assist Nu Line Food Products established and manage a cassava estate in Liwonde and train its staff in the production of cassava and other agricultural technology related to its culture.

The duration was for 3 months; starting 14 October 1990.

It is strongly recommended that a feasibility study on irrigating cassava be made before any further land development is made by the company. Natural precipitation has to be supplemented if maximum cassava yield is to be expected and year-round harvesting (and planting) is desired.

Estate management has to be upgraded from its present level by hiring highly qualified staff. Providing them sufficient authorities to discharge assigned responsibilities is also imperative.

Closer co-operation with agricultural research stations and agricultural chemical firms is very essential in obtaining cassava varieties resistant to predominant pests and diseases. Likewise, better ways of controlling each pests and diseases must be sought to ensure optimum cassava yields.

Value of local currency: 1 \$ US = K2.55 (Kwacha)

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INTRODUCTION

The general aim of the project is to improve industrial productive capability and capacity through the development and application of appropriate industrial management systems and consultancy services, with a view to increasing income and employment.

More specifically, the project is to assist Nu Line Food Products Limited, a bubblegum and hard sweets manufacturer, develop an initial 412 hectare estate in Liwonde, leased by the Government of Malawi to the company. The immediate plan of Nu Line Food Products is to ensure a steady supply of cassava tubers as feedstock for the manufacture of starch and glucose, principal raw materials for the confectionary industry.

The project started on 19 October 1990 on the arrival of W P Novero, Agronomist, in Blantyre/Limbe and ended when his contract expired on 13 January 1991 (Please refer to Appendix 1).

1. SITUATION IN THE PROJECT AREA

1.1 Location of the Estate

The estate consists of 4 separate lots with a total area of 2424 hectares located in Machinga District, with 2 lots found in the township of Liwonde, Southern Malawi. Liwonde is about 57 kilometers north of Zomba and approximately 30 Kms west of Balaka. Two lots, A and C (consisting of 856 and 712 hectares respectively) are adjacent to, and separated by the Shire River. Lot D is opposite the Chombe School along the Liwonde-Mangochi road and measures 444 hectares. Lot B, which the company has partially developed, is located about 2 Kms. east of the township center along the Liwonde-Ntaja road. It measures 412 hectares. (Please refer to maps, Appendix 3 and 4).

1.2 Climatic conditions in the project area

Over the past 14-year period, Liwonde received an average annual rainfall of 748 mm. spread over 3 1/2 months. Generally, the rainy season starts in early December and ends in mid March. It was estimated that about 71% of the farmers plant between the period 15 November to 15 December. (Please refer to the Annual Rainfall Distribution Chart, Appendix 5).

While the temperature in Liwonde is suitable for the production of a wide range of crops including cassava, the mean daily winter temperature of 18 degrees centigrade from May to August may reduce cassava growth.

1.3 Soil in the project area

The general makeup of the soil in the 412 hectare lot is of the mopanosol type, a soil type unique to Central Africa. It is a type of Solod on the FAO classification.

A very recent analysis of soil sample taken from the estate indicated that the soil is dominantly sandy loam and acidic in reaction. Organic carbon is low to medium; phosphorus is very low, potassium is medium magnesium is low to very low, while calcium is very low to medium.

The site is part of the old alluvial terraces of the Shire River. Illuviation has led to the separation of a shallow sandy A horizon from an intradable clay B horizon at a depth of 3 to 15 cms. This duplex profile presents problems of drainage.

1.4 Estate Organization and Management

1.4.1 Organisation

The key personnel of the estate are:

Chief Executive of Nu Line Food Products

General Manager of Nu Line Food Products

Farm Assistant 1

Payroll Clerk 1

Surveyor 1

Tractor Mechanic 1

Security Chief 1

The work force is composed of general field labourers, tractor drivers, chainsaw operators, handtool handle makers and office area orderlies totally 220. Security on the estate is provided by 36 watchmen, 33% of which are illiterate.

No one in the labour force, including staff below the General Manager levels has a college degree. Five percent attained college level; 26% reached Standard 7 and 8, 27% reached Standard 4 and 6 and 42% are considered illiterate.

The General Manager was appointed to the post after the inception of the estate in 1988 but do not have technical agriculture

background. He is a retired Under Secretary from the Ministry of Finance.

The farm assistant is a holder of a Certificate in Agriculture, acted as manager for a time in a small tobacco farm growing barley and worked in another tobacco estate for 7 years as field assistant. He attended a 2-week course on rootcrops conducted by the International Institute of Tropical Agriculture (IITA) held in May 1990.

The surveyor has been a surveyor assistant for Dwangwa Sugar Company for 2 years and was employed by the Agricultural Development and Marketing Corporation (ADMARC) doing clerical work for 7 years before being taken in by Nu Line Food Products in December 1989.

The tractor mechanic obtained his skills in repairing tractors when he was with the Farm and Engineering Sales for 14 years. The company sells Massey-Ferguson tractors and parts, and also irrigation equipment.

The appointed security chief is by profession a carpenter/house building contractor and never had experience in running a security force.

1.4.2 Estate Management

The farm assistant supervises the day-to-day activities in the estate. He receives instruction and orders from the Chief Executive and/or General Manager who are both based in Limbe. They make periodic one-day visits to the estate, either together or singly, to give directions and at the same time receive verbal accounts of events in the estate.

All decisions are made by the Chief Executive from hiring to firing personnel, purchase of tools and equipment, fuel and maintenance supplies and disbursement of wages.

There are no written or specific job responsibilities, authorities and accountabilities for the position occupied by the estate staff.

1.5 Land, Infrastructure and Machinery

There are still 46 families living in 52 houses occupying about 8 hectares on the 412-hectare lot. Most houses are pole huts while 8 are built with bricks. Actual survey showed that the area which could be effectively put under cultivation is 150 hectares. The bigger portion of the estate still has to be cleared of forest trees, while the 48 families have to be compensated before they will vacate the land.

On the estate are an office building, a storehouse for hand tools, seeds and fertilizers and a garage for tractors. Dirt roads were also laid out for access to most parts of the estate. Existing drainage ditches were improved and contour ridges constructed to check erosion caused by heavy down pour.

The farm machinery and equipment present in the estate are:

| | |
|-------------------------------|---------|
| 1 Ford 5000 | - 65 hp |
| 1 Massey Ferguson 375 | - 75 hp |
| 2 Massey Ferguson 1134 | -150 hp |
| 2 Heavy duty plow-harrow | |
| 1 Three-bottom disc plow | |
| 1 Disc harrow | |
| 1 Three-bottom moldboard plow | |
| 1 Ridger | |
| 3 Chainsaws | |

A single tap on a 1/2 inch line provides water for drinking and watering the vegetable nursesey on the estate.

There is no electricity on the farm.

1.6 Crops on the estate

Cassava is the only crop standing in the estate on an area of about 10 hectares located close to the office building and the Liwonde-Ntaja road. Some are two years old and the majority are one year old planted January-February 1990.

Practically all the cassava plants are infested in varying degrees of mealy bugs and scale insects while

all are infected with the African Cassava Mosaic virus.

2. ACTIVITIES AND ACCOMPLISHMENTS

2.1 Estate Management

2.1.1 Provided overall leadership and supervision in running the estate. With the concurrence of the Chief Executive, the consultant acted as the farm manager with the intension of showing, thus training the farm assistant in managing the the estate. Farming, being a dynamic business, requires fast, on-the-spot decisions/actions based on current conditions. The consultant has tried to involve the staff in scrutinizing each and every major activities, guided them to identify problems and coached them to arrive at a solution/decision aimed at improving work efficiency.

2.1.2 Instituted periodic staff meetings. As observed, the estate staff worked individually with the aim of satisfying orders issued by the higher officials. In a project which has already spent millions of kwachas on materials labour and equipment, the need for team management approach is very essential so that each member is updated on the current situations and problems. By instituting staff meetings, the

2.1.2 (continued)

consultant hoped that camaraderie, better understanding of their job and rational personal commitments will result, all towards a similar objective of making the project a success, thus longer tenure on their jobs.

2.1.3 Trained staff members on how to plan and organize weekly/daily work programmes. Supplementary to 2.1.2, the staff were made to go through forecasting what are to be done weeks ahead and to prepare for these activities, keeping in mind the available resources, which are money, manpower, materials and methods to go about it.

2.1.4 Introduce the concept of job responsibility, authority and accountability for each work position in the estate. The consultant feels very strongly that overlapping of responsibilities should be avoided, not only to give credit where it is due but also for better work harmony amongst them.

2.1.5 Introduced a control system in disbursing fortnightly wages to labourers. The only evidence that a worker received his pay was a simple pencil check tick made by the payroll clerk across the payee's name. This was done because no sufficient

space in the payroll book is enough for a thumbprint (42% cannot sign their names). The consultant, together with the farm assistant, devised a simple form on a separate paper, bound in a folder, to provide such space for thumbprints and signatures. As the worker's number was called, he affixed his signature or thumbprint before receiving his pay.

To check daily attendance, the consultant required that headcount be made at exactly 0600 hours, the required reporting time. A grace period of 10 minutes after six o'clock was provided, but those reporting after this time were considered absent and recorded in the book. Another headcount was made by the payroll clerk in the field at anytime of the day to check on their presence.

2.1.6 To serve as basis for realistic estimation of the estate's financial and material needs, the area under cultivation this year was determined. Before, estimates were all based on the total area of 412 hectares, resulting in the over-procurement of maize seeds to be inter-cropped with cassava. The survey of the estate also provided a map detailing boundaries, roads, drainage ditches and buildings.

2.1.6 (continued)

The map also served as a tool for the farm assistant to point out to the labour team leaders where to plant what crop in the plantation.

2.2 TRAINING

2.2.1 A group of 10 labourers, selected based on educational attainment and ability to receive instructions, were trained on the more critical aspects of cassava production - selection of planting stems/stakes, handling and treatment of stakes, method of planting, spacing, weed control and integrated control of pests and diseases. This group served as the core in teaching other workers on the above mentioned activities.

2.2.2 Four tractor drivers were taught the most efficient methods of sub-soiling, plowing and harrowing, thus saving on time and fuel in these operations.

2.2.3 Trained the surveyor's group in getting soil samples for laboratory analysis to determine pH, available nitrogen, phosphorus, potash and water-holding capacity.

2.2.4 Provided the staff written guidelines in cassava

production, multiple cropping and crop rotation.

(Appendix 6)

2.2.5 Prepared a sample of an Annual Budget for the estate (Appendix 7)

2.3 EXPERIMENTAL WORK

Established a 2-ha irrigation experiment in Lot A located 200 meters from the western bank of Shire River and has an elevation of a little less than 4 meters. The experiment aims to prove that watering at critical stages of cassava growth would dramatically increase tuber yield and be harvestable within 12-18 months.

RECOMMENDATIONS

1. The amount of rainfall received by the estate in Liwonde will definitely not support maximum cassava tuber production. Cassava requires about 9 months of optimum growing condition and irrigation is the only alternative to modify the natural environment. With irrigation, it also becomes technically feasible to produce cassava throughout most of the year.

It is then strongly recommended that a study to determine the feasibility of irrigating cassava as the main crop be made immediately. The cost of infrastructure needed has to be looked into as well as the profitability for the company in putting up such project.

2. The area partially developed by Nu Line Food Products (Lot B) has an elevation of about 27 meters from Shire River and about 5,700 meters away. It will be relatively expensive to put this site under irrigation as compared to Lot A and C (536 and 856 hectares respectively) which are adjacent to the river and only 5 meters and 7 meters at their highest point above Shire River. It is then recommended that Nu Line Food Products start its cassava production under irrigation in either of these two areas.
3. Nu Line Food Products Limited should also diversify to

other crops and not concentrate on cassava alone. Short duration crops that could be supported by natural precipitation such as pigeon peas, soya beans, groundnuts, maize and sunflower should also be planted. Produce from these crops could be processed in its factory or be marketed locally. Either way, these will provide additional revenues for the company.

It is also advised that perennial fruit trees be established in the estate, particularly in areas where irrigation is not economically feasible. Trees like coconut, cashew and exportable mango varieties should be considered.

4. Cassava is a long duration crop - 12 to 18 months, and is subject to a lot of negative production factors such as adverse weather conditions, weeds, pests and diseases, etc. Multiple cropping cassava with short duration crops is recommended, not only to generate additional income from the estate but also to improve the soil condition especially when leguminous crops are used.

Cassava will readily exhaust plant nutrients in the soil if planted successively so that crop rotation with short term crop is essential.

Recommendations (continued)

5. Nu Line Food Products should hire immediately a full-time person to manage the estate. The man must be an agronomist with a full knowledge of Malawi agriculture and must have experience in managing at least a medium-size plantation. He must be given not only the full responsibility to manage the estate but also authorities to plan, organize, supervise and control activities required in running the estate. He should be fully accountable to the Board of Directors of the company.

At a later time when estate income could support additional hirings and farm activities warrant it, an assistant farm manager, another junior agronomist, an entomologist/pathologist and an irrigation engineer should be appointed. Corresponding specific responsibilities and authorities must also be provided.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

TERMS OF REFERENCE

JOB DESCRIPTION
DP/MLW/88/11-54/J.12206

- POST TITLE: Cassava Agronomist
- DURATION: Three months
- DUTY STATION: Liwonde, Malawi with travel within the country
- PURPOSE OF PROJECT: The purpose of the project is to improve industrial productive capability and capacity through the development and application of appropriate industrial management systems and consultancy services, with a view to increasing national income and employment.
- DUTIES:
1. To assist the company in establishing a cassava estate comprising initially 500 hectares.
 2. To advise on the most suitable methods of growing cassava, considering Malawi conditions.
 3. To train Malawian personnel in all aspects of growing cassava.
 4. To advise on inter-cropping of cassava with cereals, legumes, fruits and accounts.
 5. To advise on establishing systems for control and managing the estate.
 6. To advise on land husbandry, i.e. design contours and water drainage systems to overcome water loggings etc.

Duties:

7. To advise on suitable application of fertilizers and other biological controls on pests etc.
8. To advise on design of irrigation.
9. To prepare a final report setting out the findings of the mission and recommendations on future action which might be taken by the Government.

OFFICIALS MET IN MALAWI

Bvumbwe Research Station, Thyolo

R F M Sauti, Senior Agricultural Research Officer
A D C Chilimba, Soil Chemist
J W Nkhalamba, Soil Chemist
P O Panje, Soil Chemist

Makoka Research Station, Thondwe

Dr Nyirenda, Scientist
J E Dzuunde, Researcher

Kasinthula Research Station, Chikwawa

Mr Chinto, Officer-in-Charge
Mr Lloyd Mumba, Research Officer

Agricultural Development Division, Liwonde

J A Mhango, Programme Manager
Gerhard Schweizer, Research Officer Advisor
Mr Longwe, Agronomist

Liwonde Town Council

Mr Kandodo, Chairman Liwonde Town Council
Peter Chisasa, Town Clerk

Agricultural Development & Marketing Corporation

Absalum Kasia, Factory Manager
Mr Mitengo, Assistant Factory Manager
Mr Nyambalo, Depot Supervisor

Physical Planning Office, Blantyre

Mr Don E Chalira, Regional Planning Officer

United Nations Industrial Development Organisation (UNIDO)

Olu Omosaiye, Agro Industrial Advisor
Olafa Cau, Financial Management & Marketing Adviser

Ministry of Trade, Industry and Tourism

Mr C C Kachiza
Mr R A P Matsuka

Private Companies

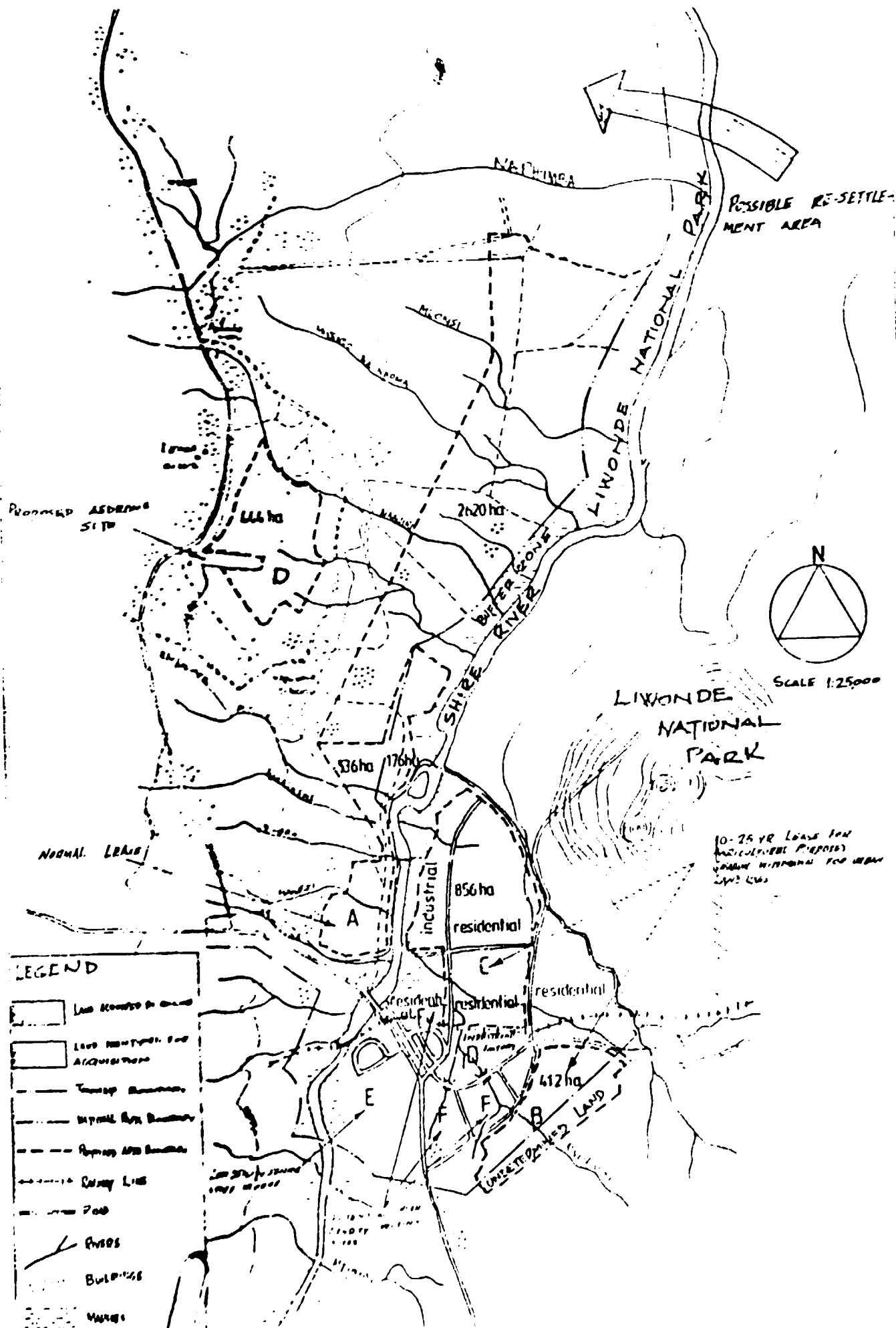
A E Hicks, Managing Director, ICI (Malawi) Limited

Patrick Khonje, Sales Rep., ICI (Malawi) Limited

Fletcher M Chipeta, Agrochem Manager, Shell Malawi Ltd

R J Ling, General Manager, Farming & Engineering Sales, Blantyre

Francois Denis, Chairman, Societe Francaise de Coordination pour le Développement, Paris



RAINFALL ANALYSIS

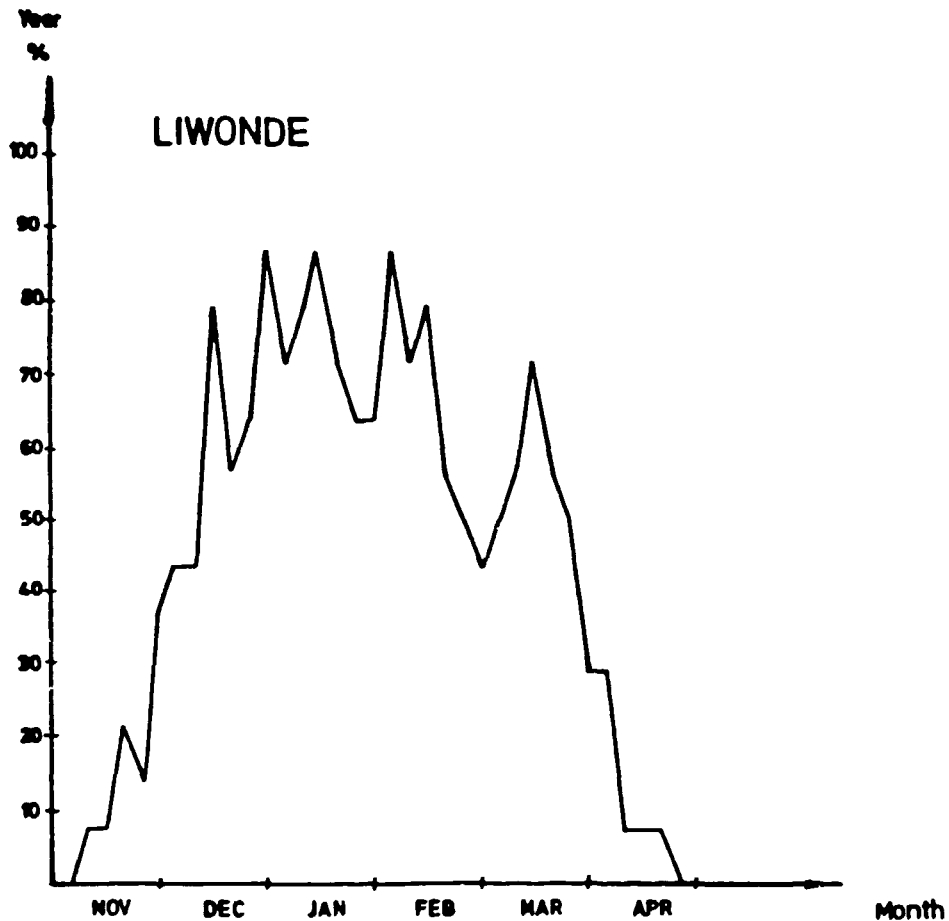
STATION: LIWONDE

NO. OF YEARS: 14

PROJECT: KAWINGA II

1. Total Average (mm/year) :748.....

2. Rainy Pentade Analysis



| | |
|---|-----------------|
| 3. Start of Season : | .06 December.. |
| End of Season : | .14 March..... |
| 4. Percentage of years People planting between 15.11. and 15.12. : | .71.. |
| 5. Net Season Length (days) : | .98.. |
| Shortest reported Season days; year) : | .16;..1965/66.. |
| 6. Season Quality (%) : | .79.. |
| Percentage of dry Pentades during Jan/Feb: | .33.. |
| 7. Dry Spell Analysis : | |
| Periods of 20 days 40 mm: | .33.. |
| Periods of 20 days 30 mm: | .21.. |
| Periods of 15 days 20 mm: | .50.. |
| Periods of 15 days 10 mm: | .43.. |
| 8. Percentage of Years without dry spell Jan/Feb.: | .21.. |

CASSAVA PRODUCTION +

Agriculture is the main industry in Malawi, providing 85-90% of foreign exchange earnings and employing about 85% of the labour force. The primary food crop is maize but cassava is also of great significance for small farm holders and has great industrial potential.

Cassava, Manihot esculenta, is second to maize in quantity of food produced in Malawi. In Liwonde, it is grown entirely on small plots by smallholder farmers for subsistence purposes and for sale in local market.

Nu Line Food Products has embarked on producing cassava on a wide scale, initially on a 412 hectares leased by the Government to the company, later on expanding to about 2.424 hectares. The company's primary aim is to use cassava to produce glucose, a major raw material in the manufacture of bubble gums and sweets, which it is presently making. Cassava will also be used as raw material in the production of starch, flour and synthetic cassava rice.

Growing cassava on a large scale has never been done in Malawi and hopefully, this paper will provide the guideline on cassava production in the estate.

MAJOR FIELD ACTIVITIES IN CASSAVA PRODUCTION

- I CLEARING THE FOREST AREAS
 - A. Felling of trees
 - B. Removal of undergrowth and stumps

- II LAND PREPARATION
 - A. Subsoiling (Ripping)
 - B. Plowing
 - C. Harrowing
 - D. Ridging

- III PREPARATION OF PLANTING MATERIALS
 - A. Selection of cassava stems
 - B. Storing
 - C. Cutting the stakes
 - D. Treating cassava stakes
 - E. Hauling the stakes to the field

This paper was prepared by W P Novero, Agronomist Consultant for the cultivation of cassava in Liwonde, Malawi: UNIDO Project Code No DP/MLW/88/018/11-54/J.12206. This paper served as a guide for training the estate personnel and in the actual crop production activities.

IV PLANTING AND REPLANTING

- A. Time of weeding
- B. Method and distance of planting
- C. Replanting schedule

V CULTIVATION AND WEEDING

- A. Time of weeding
- B. How cultivation and weeding are done

VI FERTILIZATION

- A. Fertilizer recommendation for cassava
- B. Time of application

VII IRRIGATION

- A. Systems of irrigation
- B. Time to irrigate

VIII CONTROLLING PESTS AND DISEASES

- A. Major pests and their control
- B. Major diseases and their control
- C. Biological control

IX HARVESTING

X POST HARVEST CARE

DETAILED DISCUSSION ON MAJOR FIELD ACTIVITIES

I CLEARING THE FOREST AREAS

Felling of trees and clearing of undergrowth must be done immediately after the rainy period, or during the months of April and May when the soil is still moist and soft. Be sure that all stumps, large or small are dug out and removed. Trunks and stems of felled trees must be cut one meter in length, removed from the field and hauled to a designated area accessible to lorries or tractors for easy disposal later on.

II LAND PREPARATION

Subsoiling or ripping up to a depth of 2 feet must be done immediately after the land is cleared of stumps and undergrowths. For better water penetration, ripping crosswise is advisable.

On light soils, ripping is followed immediately by a harrow-plow drawn by a 150 hp tractor. Heavier soils must be plowed once, followed by two harrowings.

Ridging 20-30 cm high and 90 cm apart may be done soon after the second harrowing. Ridging must be across, not along the slope of the land.

III PREPARATION OF PLANTING MATERIALS

The production and availability of good cassava propagation materials are important for successful cassava production and improved yield. Great stress must be placed on the importance of utilizing healthy planting material that is properly treated and handled.

The establishment of cassava multiplication plots for the production of planting stakes is essential. It must be located on the best soils available close to the production area and must receive special attention in terms of disease and pest control, good weed control and heavily fertilized to increase top growth.

In case the planting materials will be taken from production areas, select the best part of the field for special attention and care to insure good healthy plants. Harvesting must be done shortly before planting to avoid extended storage of the stakes.

Selection of cassava stems and stakes

Planting stakes should come from cassava stems 12-18 months old which are free from such pests as scale insects or wealybug and disease like African cassava mosaic virus.

To determine if the cutting is mature enough for planting, cut across section on the stake. If the diameter of the pith is less than 50% of the total stem diameter, then the stake is at the proper maturity stage. If the pith diameter is more than 50%, it is still immature. Basal parts of the stems are usually too old and woody, while those near the tip are too tender or succulent. Generally, stakes taken from the middle portion of the cassava stem give better yield than those taken from the top or basal portion. Suitable cassava stakes, therefore, should be taken from the middle portion of the stem with a diameter of not less than 40 mm.

Storing the stems

Prepare the planting materials only when the field is ready for planting to prevent dessication or drying up. However, if necessary, this can be stored for sometime. When storing stems, tie the stems in bundles of 50 to 100 and place these vertically in cool, shady places. The stem should stand on loose humid soil covered with grasses. Do not store stems for more than two weeks because shoot development will be adversely affected.

Cutting and treating the stakes

Cassava stakes should be cut into length of 20-25 cms with at least 5 nodes. Seven nodes to a stake is desirable because there are more potential buds for ample development. Cut the stakes crosswise and not slanted using a very sharp machete, if no circular saw is available.

After the stakes are cut, dip them in a fungicide-insecticide solution to prevent organisms from attacking the buds and sprouts, thus increasing the percentage of bud development.

Hauling stakes to the field

Transporting stakes to the field where they are going to be planted is done by tractor or manually. Stake bundles must be carefully arranged so that the buds are not damaged.

When using stored stems for planting, get only those with enough moisture. A stem has enough moisture if, upon cutting, white latex appears on the wood within 5 seconds. Discard the end portions of the stem because these are no longer suitable for planting.

IV PLANTING

Time of Planting

In Liwonde where the average rainfall for the past 14 years is only 748 mm per year over a period of 4 months, the best time to plant cassava is on the onset of the first heavy rain, which should come about December.

Method and distance of planting

Plant the cassava stakes vertically on the ridge with about two-third of the stake buried in the soil. There should be about 2 to 3 nodes above the ground. Ridges are spaced 90 centimeters apart and the distance between stations should be 90 centimeters also, giving a plant population of about 12,300.

Replanting schedule

Cassava stakes that did not develop in about 2-3 weeks after planting must be replaced.

V CULTIVATION AND WEEDING

Weeds, when allowed to compete with cassava from planting to harvest, can reduce yield by 50% or more.

Manual weeding using hoe should be done 2-3 weeks after planting or as soon as weeds start to compete with the cassava. Weed the area again 5-6 weeks after planting. A third weeding may be done to control excessive weed growth but do this not later than 9 weeks after planting so as not to disturb the developing tubers.

VI FERTILIZATION

Nu Line Food Products estate is a newly opened area. There may be no need to apply fertilizer during the first two years. After this period, it is essential that soils be analyzed to determine the amount of available nitrogen, phosphorus and potassium in the soil as a basis for chemical fertilizer recommendation.

The amount of chemical fertilizer depends on the available plant nutrient in the soil, attention must

however, be given to the importance of potassium as a nutrient in cassava production. Potassium levels are critical if starch content of tubers is to be maintained, and adequate fertilization with potassium fertilizers is usually required to achieve high yields. Nitrogen and phosphorus, together with a wide range of minor elements is also required for proper development of cassava.

To appreciate the need for fertilizer cassava, following are figures to illustrate the amount of nutrient removed from the soil given a certain yield of cassava tubers:

Crop yield - 30 Tons/ha :

Nutrients removed:

| | | |
|----------|----------|---------|
| Nitrogen | - 114 to | 209 Kg. |
| P2O5 | - 25 to | 37 Kg. |
| K2O | - 240 to | 335 Kg. |

VII IRRIGATION

Cassava requires some 9-10 months of growing conditions before root yields are maximized, as such, sufficient water is required. While it grows under a wide range of climatic conditions, cassava is best suited to areas with a warm, humid climate with a well distributed annual rainfall of 1000 to 1500 mm.

In Liwonde where the total average rainfall for the past 14 years is only 748 mm and distributed in 4 months from December to March, water from natural means is definitely inadequate. Therefore, irrigation is essential to attain optimum yields.

Systems of irrigation

Two systems of irrigation is possible for the cassava estate where topography is relatively flat. The first is surface flooding. This will not involve heavy infrastructure cost, and would compose basically of water cost (if any) and the cost of providing earth channels to direct the water on to the crop.

The other system is the sprinkler irrigation, which simulate natural rain. However, this would require the construction of elevated water reservoir to provide the required pressure, miles of aluminum pipes distribution and hundreds of nozzles to effectively irrigate the proposed 412 hectares.

Time to irrigate

Cassava will require moisture at certain critical periods, these are:

1. During bud development and establishment of stand.
2. 4 to 6 months after planting and
3. Just prior to harvesting.

Since planting is done at the start of the rainy season, no irrigation is required. However, if drought occur 2 months after planting. It is best to irrigate to field capacity.

During periods of little or no rain (April to November), it is recommended to apply about 35 mm of water every 18 days.

CAUTION: Too frequent irrigation leads to excessive top growth and will reduce tuber yield.

VIII CONTROLLING PEST AND DISEASES

Mealybug, green spider mites and scale insects appear to be the major pest of cassava in the estate, while African cassava mosaic virus is the predominant disease.

Biological control studies against mealybug were initiated by Government scientist right on the farm in Liwonde but produced limited success. No extensive research using chemicals in controlling mealybugs on cassava has also been done in Malawi.

It is then recommended that an intergrated approach be done to control pests and diseases in the estate.

1. Plant high yielding varieties resistant to most pest and diseases.
2. Only quality stakes be planted in the estate. This means stakes coming from healthy, mature stems and free from pests and diseases. Stakes may be dipped in a fungicide/pesticide mixture for disinifestation, disinfection and protection.
3. Plant stakes in a vertical position for better root development.
4. Good weed control is a must in cassava production, this could reduce both pathogens and pest population on other host species.

5. Plant debris left on the ground after harvest can set a propagation media for pathogens and pests. These should be removed, especially of stems and roots.
6. Periodic inspection of the plantation is highly recommended. Remove plants or plant parts with initial infection and infestation symptom, placed in plastic bags and burned to prevent the dissemination of this problems. A full-time trained worker must be hired to carry out control of agrophytosanitary problems.

IX HARVESTING

Depending on the variety and climatic conditions, cassava is ready for harvest 12 to 18 months after planting.

In the absence of a mechanical harvester, harvesting by hand is done, involving two stages, pruning the aerial part of the plant about 30 cm from the ground, and harvesting the tubers with the help of mechanical tools.

Pruning the aerial part is done using a machete or any cutting tool. Tubers are harvested by hand oscillation with the help of a hoe. Tubers remaining in the soil are extracted with the help of a mattock or heavy hoe.

X POST HARVEST CARE

Harvested whole fresh tubers are very perishable and may be stored for a very short time (1 day). If stored for a week or less the tubers turn grayish or develop numerous bluish veins. For cassava to be stored longer, the tubers could be washed, then peeled and sliced in cross section about 3-5 mm thick and dried for several days. The chips are thoroughly dried if these are crisp, brittle and crumble easily into powder with slight finger pressure. The dried chips may then be stored in cans or sealed plastic bags.

NU LINE FOOD PRODUCTS LIMITED

LIWONDE CASSAVA ESTATE

SAMPLE OF AN ANNUAL BUDGET
(1990 - 1991)

Total area: 12 ha
Area under cultivation: 150 ha
Crops to be planted: Cassava, Maize and pigeon peas

Fixed cost:

Salaries and wages:

| | <u>Rate/Mo.(K)</u> | <u>Rate/Annum (K) (1)</u> |
|------------------------------|--------------------|---------------------------|
| Farm Manager | 1,000 | 12,000 |
| Assistant Farm Manager | 600 | 7,200 |
| Field Assistants: | | |
| Agronomist | 200 | 2,400 |
| Pest/Disease Control Officer | 200 | 2,400 |
| Agric'l Engineer | 200 | 2,400 |
| Accountant | 200 | 2,400 |
| 2 Clerk/Storekeeper | 60 per | 1,440 |
| Mechanic | 200 | 2,400 |
| 2 Assistant Mechanics | 60 per | 1,440 |
| 5 Tractor Drivers | 100 per | 6,000 |
| 3 Field Supervisors | 100 per | 3,600 |
| Chief Security | 200 | 2,400 |
| 20 Watchmen | 60 per | 14,400 |
| 50 Labourers | 55 per | 33,000 |
| | | ----- |
| TOTAL SALARIES & WAGES: | | K93,480 ===== |

Operating Cost:

| | |
|--|----------|
| Maintenance and repair of tractors and equipment: | |
| Diesel fuel (2) | K 46,740 |
| Oil and grease | 3,000 |
| Repair, parts | 5,000 |
| Planting materials: (3) | |
| Cassava stakes | K 90,000 |
| Maize seeds | 4,500 |
| Fertilizers/Pesticides (4) | 43,616 |
| Additional labour (5) | 54,600 |
| Office supplies | 2,000 |
| Insurance (6) | 1,000 |
| Depreciation (7) | 4,000 |
| | ----- |
| TOTAL OPERATING COST: | K254,456 |
| Contingencies (10% of total fixed and operating cost) | K 34,794 |
| | ----- |
| Grand Total Budget for 1990-1991 | K382,730 |
| | ===== |

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- (1) One US\$ = 2.55 Kwacha (K)
- (2) Based on 4 tractors working 235 days (10 hrs/day) consuming 24,600 litres diesel at K1.90/litre
- (3) Cassava needs 12,000 stakes and K0.05 on an area of 150 ha.

Maize, on 100 has and 25 Kg/ha at K1.80/kg
- (4) Based on fertilizer recommendation of 100-40-0 (NPK)/ha., fertilizer requirements are: urea - 490 bags/50 kg and K51.99/bag and DAP - 224 bags at K67.64/bag; various agricultural chemicals at K3,000.
- (5) Additional labour is required during planting, weeding, fertilizer application and harvesting, total months - 7 months on and average of 150 workers at K52/month.
- (6) Estimated only