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and Manufacture of Simple Food Processing and
Preserving Equipment

Lusaka, Zambia, 9-13 January 1989*

FOOD PROCESSING AND RELATED ACTIVITIES IN BOTSWANA**

Prepared by

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* Organized by UNIDO in co-operation with the Government of Zambia and the Village Industry Service.

** The views expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO. Mention of firm names and commercial products does not imply the endorsement of the United Nations Industrial Development (UNIDO). This document has not been edited.

*** Manager, Thusano Lefatsheng, Gaborone, Botswana

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PART ONE

Introduction

It is in the national interest of all developing countries to encourage rural development and rural income generation, thus enabling people to remain in the rural areas and avoid an urban drift. Agricultural development, other than subsistence farming, depends very much on the possibility of marketing the products. Since most agricultural products are perishable, preservation means must be provided before any significant increase in agricultural production can be expected.

Rural, small or cottage industries are some of the best mediums to preserve and conserve work. These industries need to be as efficient as possible and may have to overcome several problems, such as quality control, marketing, the need for technical and management skills and training before becoming successful. Appropriate technology plays an important role. The food processing industry of Botswana is still in its initial stage; the design, development and manufacture of processing and preservation equipment are, too, in an early stage. Significant achievements have been made in this field, some of which will be described below.

Background

In 1966, Botswana achieved independence and has an area of 582,000 square kilometers. Most of the country has a semi-arid, sub-tropical climate. The average rainfall varies from 200mm a year in the extreme south to 750mm a year in the far north. Rainfall is very erratic. The average summer temperatures vary between 23-30°C with a range of 10-15°C above and below the average. Daytime winter temperatures vary between 15-20°C, but at night may fall to -6°C. The surface water is very scarce except in the Okavango region of the northwest. Groundwater resources are also scarce. The water is often salty; boreholes are expensive to equip, expensive to run and frequently have a low yield.

The main agricultural products are livestock (over 80 per cent of all production by value), sorghum, maize and pulses. Although the country has a successful beef-export industry, it is dependent on imports of most other foodstuffs.

Botswana has a rich flora which includes many medicinal and aromatic plant species used in local traditional medicine. Some species are recognized by the international pharmacopoeia and have a very high value.

There is a growing concern in Botswana about the need to diversify the economy away from a reliance on diamonds. The sector that can absorb most people is the agricultural sector; however, much depends on the ability to process available raw material. One of the major problems is the lack of appropriate processing and preservation equipment. Botswana relies heavily on

imported equipment, most of which either originates from or enters via South Africa. This poses a serious problem, taking into consideration the fact that most of the equipment is designed for industrialized areas and is not suited for use in rural areas where different types of equipment are necessary.

Organizations in Botswana involved in food and related processing

A number of nongovernmental organizations in Botswana are involved in this kind of appropriate technology and food/plant processing.

The Botswana Technology Centre's Food Technology Research Service

This specifically concerns the design and testing of appropriate processing methods and equipment and small-scale training of such methods and equipment. One of its activities is the Biltong project. See appendix I.

The Rural Industries Innovation Centre

Its primary objective is to create rural employment and self-sufficiency through the research and development of appropriate technologies in the areas of renewable energy and food processing. Two of their technologies are the sorghum dehuller and the Kgoletso oven. See appendix II.

Thusano Lefatsheng

This rural organization is engaged in the identification, research and development of various aspects of agricultural production and processing of medicinal plants, industrial plants, fruit and nut trees and other food plants of potential commercial value.

Thusano Lefatsheng's work with veld products

Some of Botswana's wild plants have been and still are exported for processing and sale on the world market. As in many parts of the developing world, Botswana has lacked the capability to process indigenous plants on a commercial scale into products for domestic consumption and export. Instead, plants which are in great demand outside Botswana have been harvested by rural people and then sold to middle-men, who likewise export them at a good profit for processing in industrialized countries. Once they are processed, these substances are sold at still greater profits on lucrative foreign markets. In some cases, these substances are re-exported for sale to Botswana and are sold at prices as much as thirty times the price paid to the supplier of the raw plant material. Almost all the value has thus been added to the raw material outside the country of origin.

Grapple

One such plant with a high commercial value, which has been exported unprocessed for a long time and, which Thusano Lefatsheng is now processing,

is *Harpagophytum procumbens* DC (Pedaliaceae), which is commonly known as the grapple plant or devil's claw. Grapple is found only in the Kgalagadi sandveld, where it abundantly grows. For generations the dried secondary roots of the plant have been made into a bitter tasting tonic or tea and have been used by the indigenous peoples of southern Africa as a treatment for a variety of medical complaints. Today, the plant is gathered for sale by the residents of the Kgalagadi, who are among the poorest members of the country's population. Small amounts of grapple are still used by traditional healers, but the bulk of the harvest is sold for processing to companies based in western Europe. There the dried root is crushed and processed into teas, capsules and tablets. Thusano Lefatsheng is presently processing grapple for the local market.

There is a very high demand for grapple products in western Europe, particularly in France and Germany, where it is registered as a pharmaceutical. The popularity of the plant can be attributed to its invigorating effect. Grapple allegedly has a therapeutic effect on arthritis, rheumatism and hypertension. There is already evidence to support these claims and subjective evidence from the users who find it most effective. Thusano Lefatsheng recognizes the great commercial prospects of wild plant processing in Botswana and the possibilities of generating substantial employment. Consequently, it has started a simple grapple-processing project using simple technology, which could later be transferred to small industries.

Morama

The potential of this plant (*Tylosema esculentum*), which grows in the Kalahari, has created a lot of interest among scientists. It is a perennial legume, which regenerates every year from an underground tuber that stores water, thereby enabling it to withstand prolonged droughts. The people of Botswana have long enjoyed the beans of the morama plant. When roasted, they have a very pleasant flavour, which has been likened to the cashew nut. Nutritionally, the bean is equal to, or better than, groundnuts. It contains between 30-35 percent high quality protein and 40 percent edible oil. The meal remaining after oil extraction has a protein content of 52 per cent. The young tubers of morama are also edible and can be used either as a fresh vegetable or boiled or roasted in a similar way to that of a potato. Research trials have shown that in six months, up to three tons of tubers per hectare can be produced. Bean yields of ten kilograms per plant have been obtained from wild plants.

The commercial possibilities of morama are roasted nuts, morama butter, morama oil, morama chips and vegetable and stock feeds.

Morula

This fruit tree (*Sclerocarya caffra*) has tremendous potential for development. The morula tree has always been a highly valued food source in southern Africa. In terms of fruit yields and taste, it compares well with the introduced fruit trees but has not yet been seriously exploited. It yields up to 1.5 tons per tree and the vitamin C content of the juice is up to

four times more than that of orange juice. The protein content of the nut is 24 per cent (cashews have only 19 per cent) and the nut is also very rich in oil, containing 56 per cent by the weight of an oil, which can be used either for cooking or in industry.

The commercial possibilities of morula are morula jam, fruit juice, beer or liquor, nuts, oil and fresh fruit.

Thusano Lefatsheng plans to exploit the commercial possibilities of morula and morama. Hand-(or possibly animal-)powered oil extraction machinery, hand-operated butter-making machinery, nut-cracking and fruit-juice extraction machinery will be used for these processing activities.

Conclusion

Although Botswana is still in the early stages of food processing, the potential for such processing is enormous. Through the work of such organizations as Thusano Lefatsheng and the Rural Industries Innovation Centre, not only will rural employment increase but also Botswana will become more self-sufficient in food production and processing.

PART TWO

Introduction

It is becoming more evident that the indigenous plant populations of Botswana constitute a resource with significant potential for commercial utilization, especially by the rural population. At the same time, it is important to bear in mind the ecological consequences of the exploitation of these indigenous plants. Overexploitation of grasses by cattle led to the degradation of the veld; the same can happen when people realize the commercial value of other plant species. To prevent the overexploitation of these other plant species, they should be utilized in a manner, which ensures continued use. In this respect Thusano Lefatsheng, which has taken the lead in the utilization of indigenous plants, especially medicinal, fruit and food plants, hopes to guarantee that the commercialization of these plants will not lead to their overexploitation in the wild. Thusano hopes to protect wild populations by developing successful cultivation techniques at its research centre.

Medicinal plants

A large majority of the world's population relies on traditional medicine as its primary health care. Many of the drugs and cures employed are obtained from medicinal plants. The world is becoming increasingly aware of the importance of medicinal plants. Although Botswana is certainly well endowed with its share of medicinal plants, Botswana has favoured imported drugs. Amongst medicinal plants are:

Sengaparile/Makakare/Lematla/Kalahari Devil's Claw/Grapple (Harpagophytum procumbens)

Devil's claw is a plant which grows widely in the Kalahari Sand Veld and occurs less frequently in other areas of Botswana. The plant had previously been exploited in the wild as had the people who were harvesting it. It was then often sent over the border to South Africa. Botswana received very little of the profit made on the sale of the plant.

Devil's claw is now a legally conserved plant in Botswana. Thusano Lefatsheng is training the workers to harvest the plant according to ecologically sound methods. If the storage tubers are harvested and the parent tuber remains intact, then the plant will regenerate. The plant is also able to survive drought conditions. The tubers are collected, dried and sliced by the harvesters and then purchased by Thusano Lefatsheng. The material is crushed and packed in the form of a tea. Part of Thusano Lefatsheng's extension programme is aimed at the local farmers who are harvesting, as well as at those who are cultivating the plant and who will then send it to Thusano. This provides some cash income for the farmers, many of whom have very little access to cash. In drought years, some of these people are not able to grow food crops to feed their families; therefore, it is important that they should have some way of making money to purchase food and other necessities.

Thusego work has so far indicated that it can be cultivated as a commercial crop. Since devil's claw is a perennial plant, it can survive drought periods by using moisture stored in tubers, unlike sorghum, which can die during the growing season when there is not enough rainfall.

The healing properties of the storage tubers are very well known in traditional medicine in Botswana. The plant has also been recommended by many natural health-care healers in Europe and elsewhere for a wide variety of illnesses. Among these illnesses are rheumatism; arthritis; hypertension; kidney, gall and liver disfunctions; stomach and intestinal disorders; and skin problems. A general cleansing effect on the body has been claimed. However, only reasonable scientific evidence exists for effects against rheumatism, arthritis, hypertension and effects on the heart rhythm. For the last 50 years, the plant has been taken from Botswana and Namibia as a raw material at very low prices and used in Europe. The Agricultural Resources Board 1982 Annual Report indicated that about 20 tons of devil's claw were exported into Namibia. As indicated from plants raised at Thusago, we believe that six plants are harvested to yield a kilogram, which totals a yearly harvest of about 120,000 plants. The demand on devil's claw has now increased; more and more hectares of wild populations are being harvested. Though the parent tuber regenerates if left intact, the chances of survival and reproduction are still questionable. This urges the cultivation of devil's claw to protect the wild populations. Thusano Lefatsheng is starting an extension programme on devil's claw cultivation with remote area dwellers in about five districts. The long-term aims are to reduce the harvesting from the wild and to rely more on cultivated devil's claw so as to conserve the wild populations.

Seretlwana (Waltheria indica)

It is supposedly effective: against internal hemorrhages; as a mixture with others to treat sexually transmitted diseases, skin diseases and cleansing wounds. One can use it to treat infants at birth and to treat teething. This plant can increase the fever resistance in children. It can also be used as a purgative.

Lengana (Artemisia affra)

This is commonly taken as a tea and is effective for conditions such as bronchial troubles, coughs and colds, chills, indigestion, stomach ache, gastric derangements, colic croup, whooping cough and gout. It is also effective as a purgative. The infusion or decoction can also be used as a lotion to bathe hemorrhoids and as a hot bath to bring out the rash in measles. It can be used for earaches; to ease the pain of gumboils and hasten their bursting; it can be taken in fevers and in "blood poisoning". The vapor from boiled leaves can be inhaled for respiratory affections and can relieve neuralgia, swellings in mumps, throat inflammation and the sweating of the feet.

Seswagadi (Jathropha zeyheri)

It can be used as a decoction for purifying blood, as a purgative and as a remedy for headache and some coughs. The sap is applied to open sores and wounds.

Moretologa-wa-podi (Ximenia americana)

The root can be used as a remedy for fevers and diarrhoea. Pulverized bark and root is used at times as a dressing for ulcers and ringworms. Sometimes the bark is rubbed on the skin for fevers. The root has been used for sexually transmitted diseases. There are records in tropical Africa that the leaf, which contains tannin and resins, is used as a remedy for coughs, fevers and wounds.

Mosukubyane/Mosukujane (Lippia javanica)

This is a very nice tea to drink. It can be generally used for coughs, colds and bronchial troubles. The infusion is sometimes made by adding Lengana (*Artemisia affra*) and then also used for fevers, influenza, measles and as a prophylactic for lung inflammations. Records by Gelfard *et. al.* (1985) show the use of Mosukubyane/Mosukujane for coughs, asthma, fever headache, nose bleeding, convulsions, pneumonia, chest pains, abdominal pains and backache (uses in Zimbabwe and Malawi).

Since medicinal plants are essential in primary health care, both in self-medication and in national health services, we should all recognize the vital importance of medicinal plants and the significant economic value of the

medicinal plants used today and the great potential of our plant kingdom to provide new drugs. All of us should conserve our medicinal plants to ensure that adequate quantities are available for future generations. The best solution is the sustained utilization of plants: this will include improved methods of harvesting and increased cultivation.

Fruit trees

Botswana has an extremely diversified flora of indigenous, edible fruit trees. We must consider that all the popular fruits we know today were developed from wild fruits by selective breeding to upgrade fruit quality by improving propagation and cultivation methods. It is astounding that the vast potential of the indigenous fruit trees of Botswana has not yet been tapped. Some of the fruit trees are:

Morula (Sclerocarya caffra)

This is a fruit tree with tremendous development potential. The morula tree has always been a highly valued food source in southern Africa. In terms of fruit yields and taste, it compares very well with the introduced fruit trees, but has never yet been seriously exploited. Some facts about the morula fruit tree are:

- (a) it yields up to 1.5 tons per tree have been reported
- (b) it has a measure of vitamin C up to four times that found in orange juice
- (c) it has a protein content of 24 per cent (cashews have only 19 per cent)
- (d) contains 56 per cent weight in oil, which can be used for cooking or industrial uses
- (e) It has the following commercial possibilities:
 - (i) morula jam;
 - (ii) morula fruit juice;
 - (iii) morula beer or liquor;
 - (iv) morula nuts;
 - (v) morula oil;
 - (vi) fresh morula fruit.

The major advantage of the morula over the introduced fruit trees is its tolerance to drought and its ease to relatively establish itself. Why struggle to grow trees that are not suited to Botswana's dry climate when trees with the potential of morula thrive in such conditions?

In the same way that fruits, such as oranges and peaches, have been developed over the years, selective breeding of the morula will improve the size and quality of the fruits. Rather than simply being a popular wild fruit, this tree can be developed into a dependable income source for the rural people of Botswana.

Maupudu (Mimusops zeyheri)

It can be useful as a general-purpose timber, which is easily worked (Coates Palgrave, 1977). It produces a pleasant-tasting fruit, which is very popular in Botswana. The fruit is usually eaten fresh, but it can also be sun dried and stored for a long time. According to Grivetti (1975), the fruit can also be crushed; the fresh juice can be extracted and immediately taken or it can be fermented. Swart (1982) reports that the fruit makes an excellent jelly or jam. An other possibility is making fruit rolls with the fruits. The fruit has a high content of nicotinic acid and vitamin C (C. Moss, 1988). According to documents by Watt and Breyer-Brandwijk (1962), the vitamin C content of the fruit has been recorded to be 50-80mg per 100 grams.

Mulo (Vangueria infausta)

The fruit, which is popular and pleasant tasting, is the only edible part of the tree. The fruits can be eaten fresh or sundried and then stored for later use. The fruit can also be used to make fruit rolls.

Some of the potential fruit trees that can be developed and utilized are:

<u>Name</u>	<u>Potential use</u>
Mongono (<i>Ricardendron rautanelii</i>)	oil, nuts
Motlhatswa (<i>dequaertiendendron magalismontanum</i>)	vinegar, jams, jelly, wine
Motlhoojewa (<i>Bauhinia petersiana</i>)	brandy and syrup soup

Morama (Tylosema esculentum)

Morama is an example of a food plant. This plant grows in the Kalahari and has a potential that has created a strong interest among scientists. It is a perennial legume, which regenerates every year from an underground tuber that stores water, thereby enabling it to withstand prolonged droughts. The beans of the morama plant have long been enjoyed by the people of Botswana. When roasted, they have a very pleasant nutty flavour, which has been likened to cashews.

Nutritionally, the bean is equal to, or better than, groundnuts. It contains between 30-35 percent high quality protein and forty percent edible oil. The meal remaining after oil extraction has a protein content of 52 percent. The young tubers of morama are also edible and can be used either as a fresh vegetable or boiled or roasted in a similar way to that of a potato. Research trials have shown that in six months, up to three tons of tubers per hectare can be produced. Bean yields of ten kilograms per plant have been obtained from wild plants. The commercial possibilities for morama are:

- (a) roasted morama nuts;
- (b) morama butter (just like peanut butter);
- (c) morama oil (for cooking, cosmetic and industrial uses);
- (d) morama chips;
- (e) a nutritious vegetable for the dinner table;
- (f) a high-quality stockfeed (from the residue left after oil extraction).

It is up to Botswana to face the challenge of developing the full potential of the morama plant. It will be a long process, but it is worth remembering that all of our present crops once originated from wild plants. Thusano Lefatsheng has taken the first steps in cultivating morama and will shortly begin processing morama products.

Structural changes in our agriculture

Approximately half of the world's land surface is arid or semi-arid; most of which is characteristic in the developing countries. Many of these countries are now facing chronic food shortages as crops repeatedly fail due to drought and increasing populations. A contributing factor to this decrease in food self-sufficiency is the fact that most of the major food crops have been developed in regions of higher rainfall. Without irrigation, these crops generally have a poor yield in arid areas.

As a result, researchers from all over the world are currently searching for new sources of food from wild plants that are well adapted to drought-prone environments such as those experienced in Botswana. As Botswana is endowed with traditional food plants, which have considerable potential for development, perhaps this is the time that Botswana should exploit the relative advantages of each region in respect of the availability of veld products of potential economic value, and developing them as crops. Since they are already adapted to the environment of Botswana, it should be relatively easy to develop the local plant species in comparison to introducing new crops from overseas. As indicated in Moss (1988), the inability of the existing agricultural system to meet subsistence needs is commonly and mistakenly accredited to drought. However, droughts are catalytic rather than causal. Droughts are to be expected in Botswana, and in the past, were coped with by traditional tribal, social and agricultural practices, which had an innate resilience to this harsh and unpredictable environment. In the future, local plants, which have this built-in resilience to dry conditions, need to be better utilized.

Conclusion

There is a high economic potential in the many plant species in this country. It is up to Botswana to challenge the development and utilization of these plants. In respect of rural development, the present National Development Plan (NDP VI) Strategy for development calls for the creation of employment and economic opportunities in rural areas: We should plan our income-generating activities in rural areas to utilize the raw materials available per area. With respect to the National Food Strategy, village

co-operatives should use some of the veld products in their income-generating activities to make jellies, jams, juices, soups, soaps, oils, etc. Since the raw material is next to them, it could boost the cash economy of the rural population. To diversify and distribute the economic opportunities, it is advisable to allow the rural population to use the veld products as small businesses and co-operatives. Some sort of law must be enacted to protect the small businesses and co-operatives from larger ones.

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APPENDIX I

BILTONG MEAT DRIER DIAGRAM

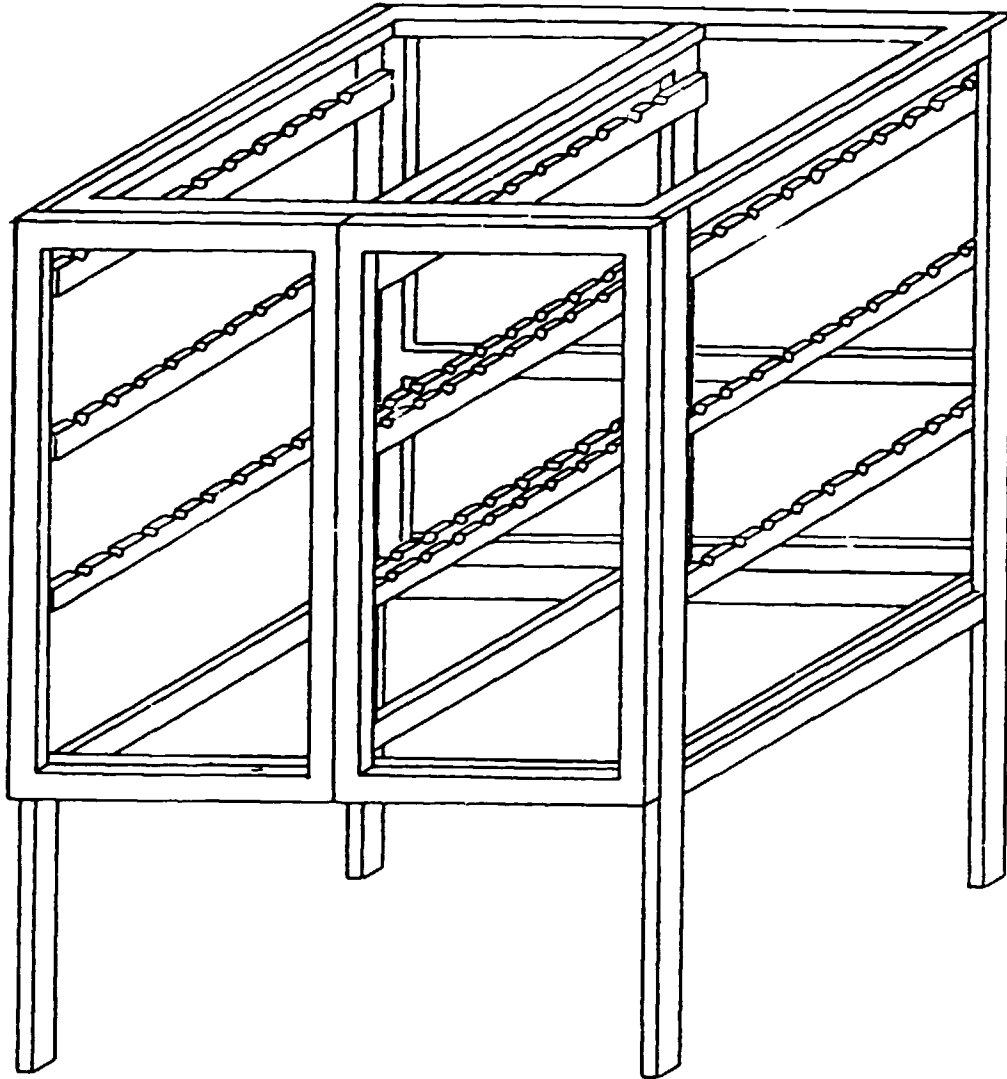


Figure 1

APPENDIX I

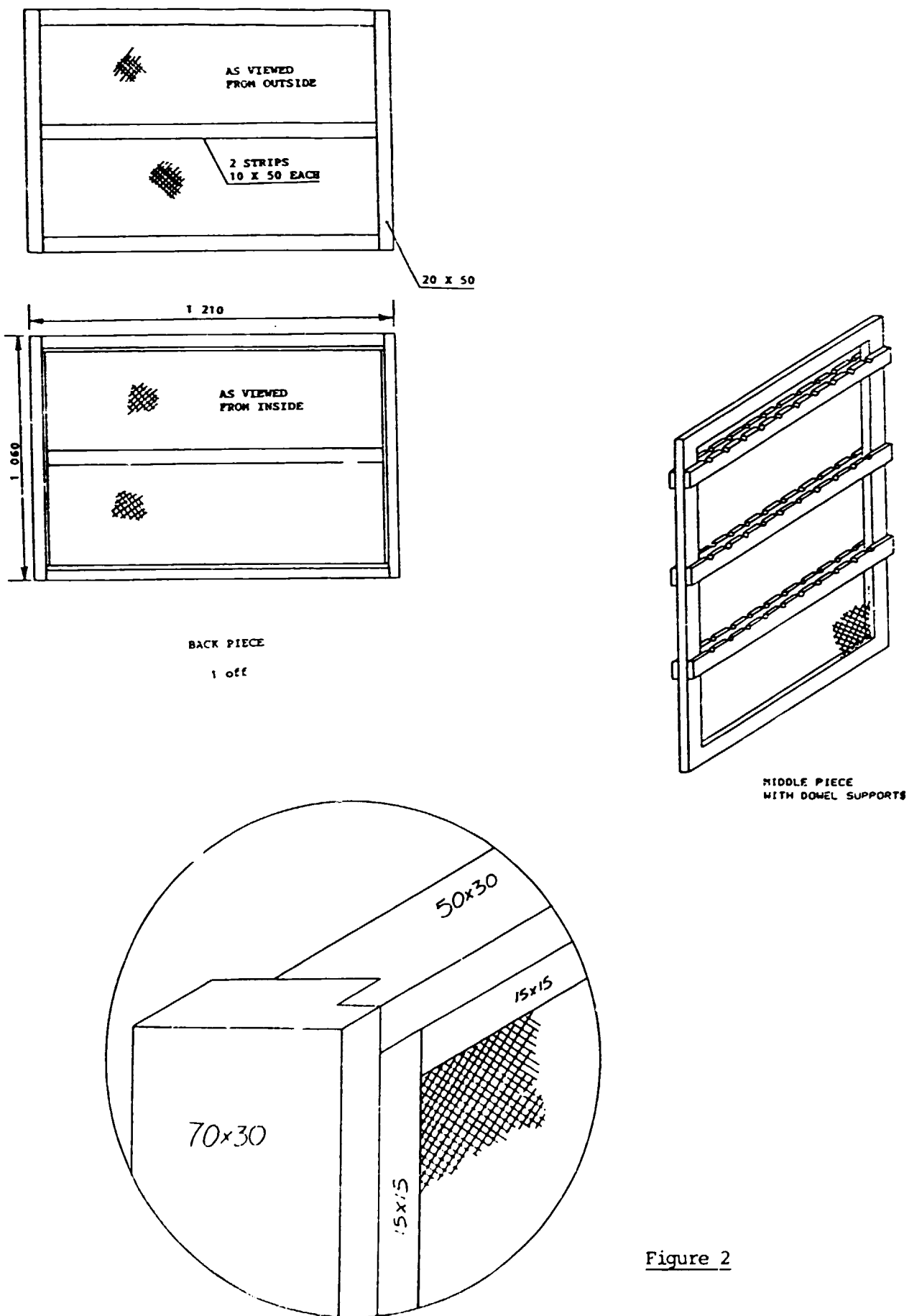
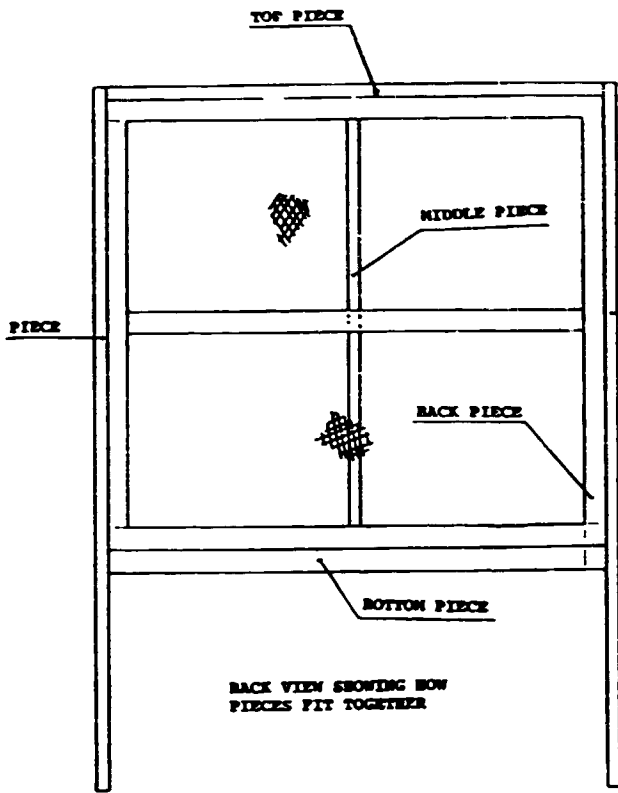


Figure 2

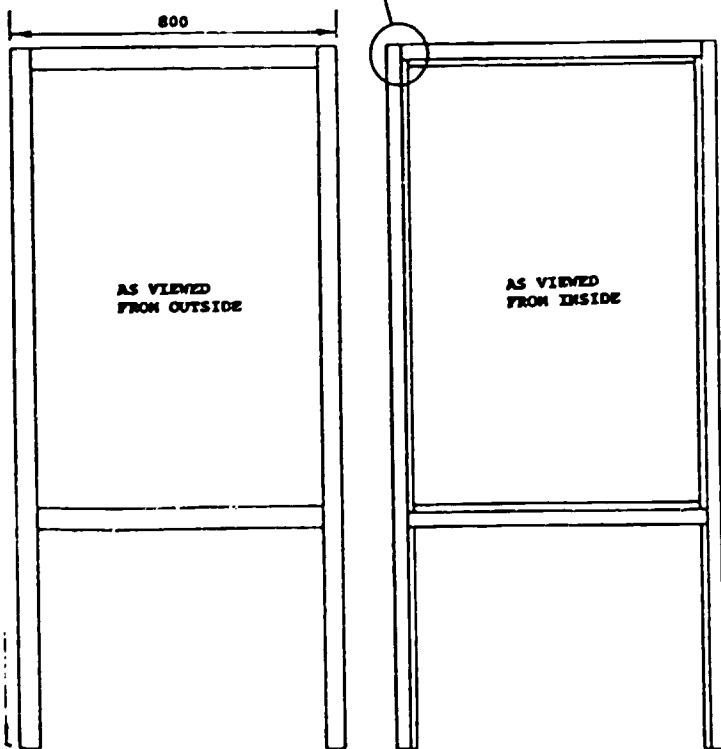
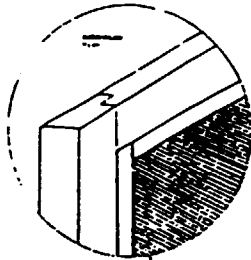
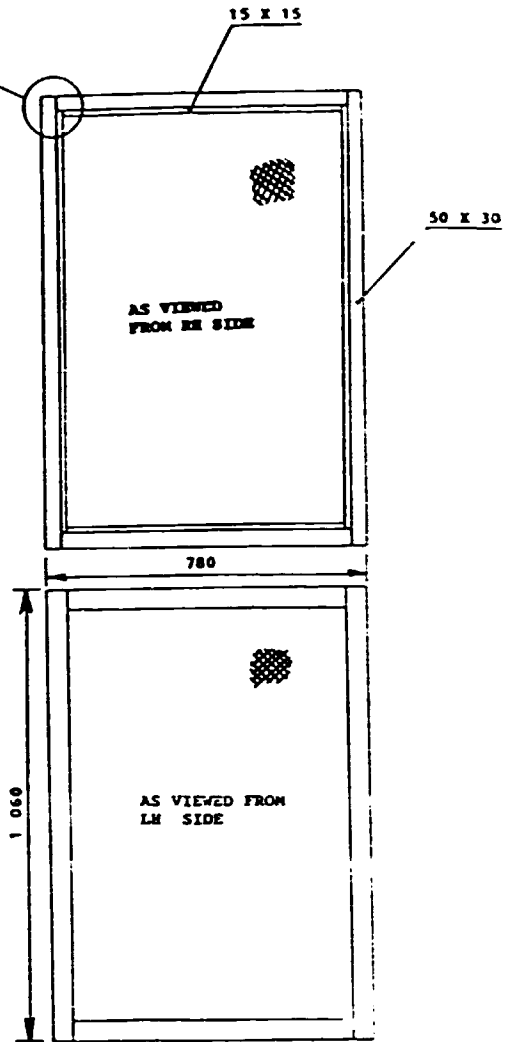


SIDE PIECE

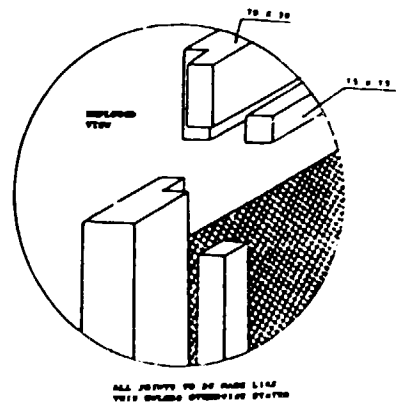
MIDDLE PIECE

1 off

BACK VIEW SHOWING HOW
PIECES FIT TOGETHER

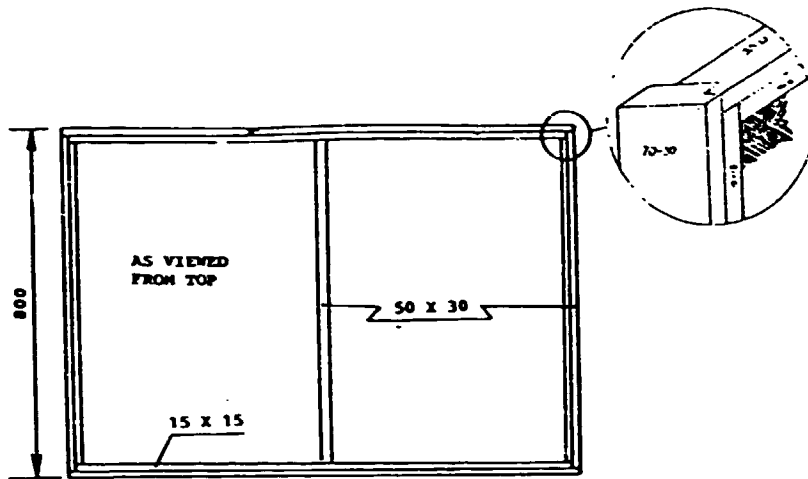


SIDE PIECE

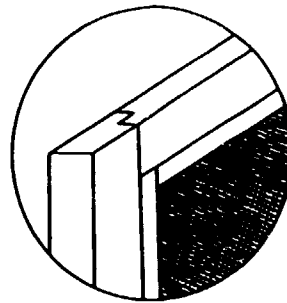
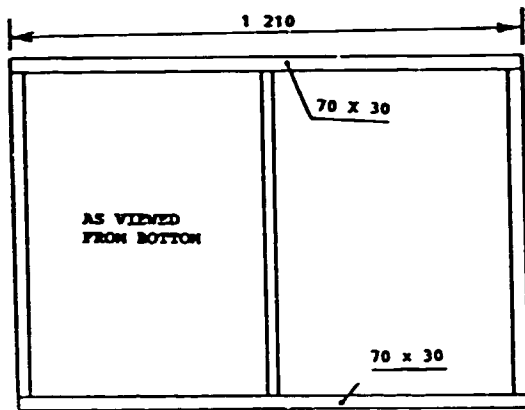


APPENDIX I

Figure 3.

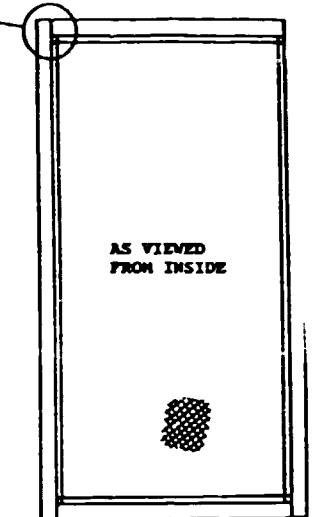


APPENDIX I
Figure 4

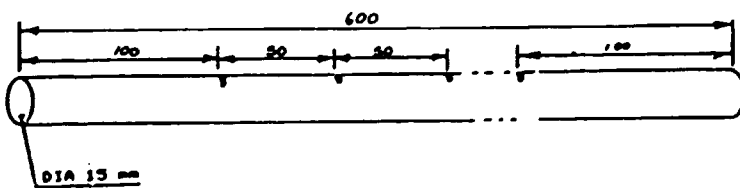


BOTTOM PIECE

1 off



630

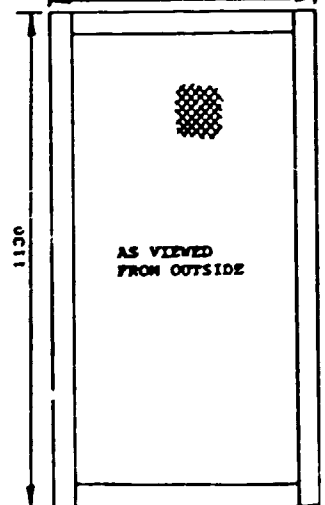


DOWELS

600 OFF

DOORS

2 off



APPENDIX II

Figure 1



TSHILO DEHULLER MK II

(The compact versatile, high performance machine that removes husks and grinds cereals.)

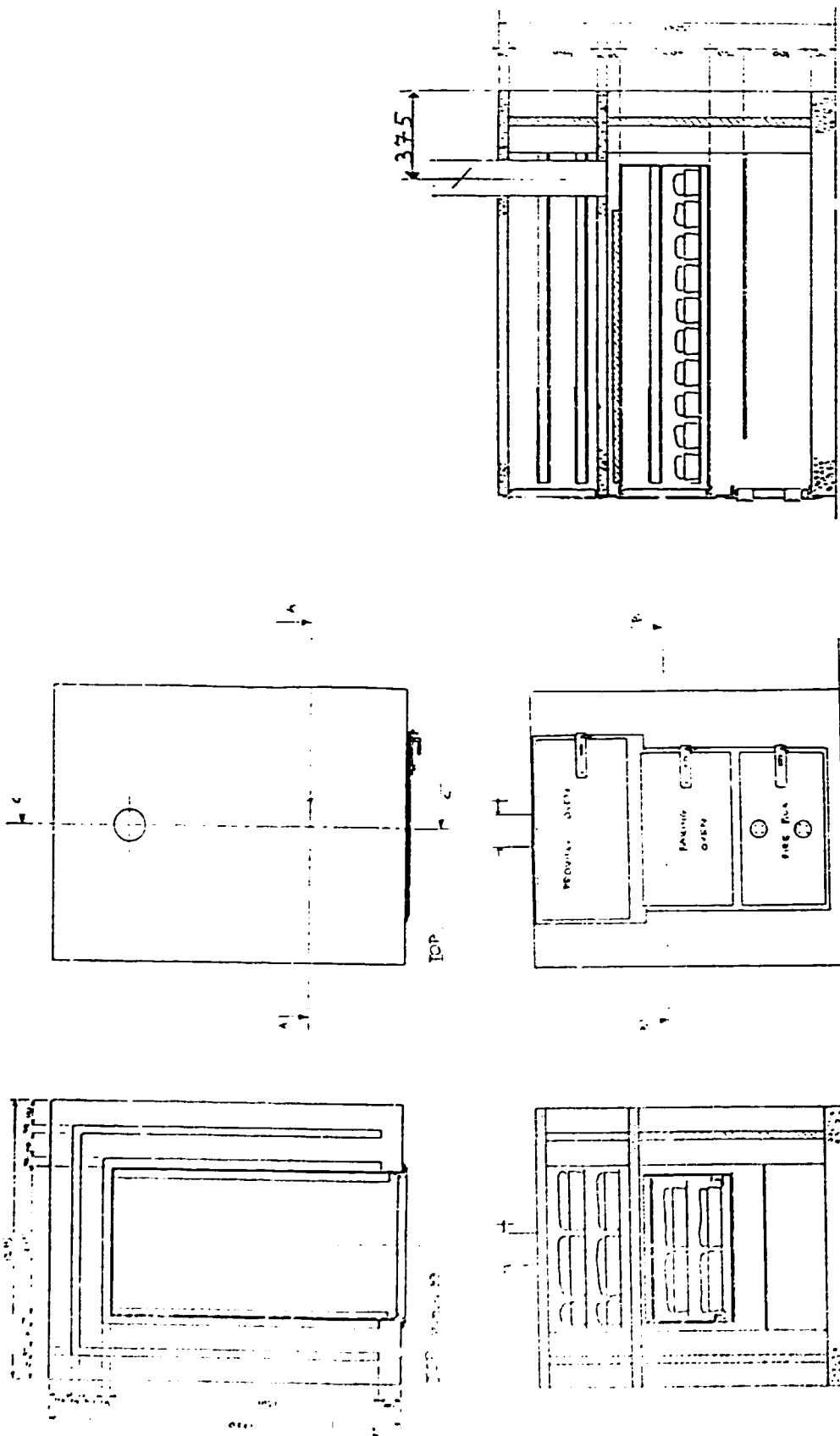
TECHNICAL DATA

Power requirement	· 5.5 Kw. 3 phase electric motor or a 10 HP engine
Main shaft rpm	: 2000
Fan shaft rpm	: 2000
Throughput speed	: 10 Yp/min
Approximate net weight	: 200 Yp.
Hopper capacity	· 25 Yp of grain
Barrel capacity	· 20 Kp of grain
Fan capacity	· max. velocity 2000m/min.
Grinding stones	· carborandum vitrified bonding wheels with K face size 250 x 20 x 38

Tshilo dehuller, a product of the Rural Industrial Innovation Centre in Kanye has been designed to blend in harmony into its African environment. About 50 sorghum dehulling machines are in operation in Botswana. Some of these machines are being exported to 10 other African countries.

APPENDIX II

Figure 2



SIDE SECTION, C.C.

FRONT

FRONT VIEW

APPROXIMATE	GENERAL APPROPRIATION	DATE
1950	BRICK OVEN - 40 LBS.	10-1-50
1951		
1952		
1953		
1954		
1955		
1956		
1957		
1958		
1959		
1960		

/// MASONRY, VENEER-LIKE MASONRY
 --- CONCRETE SLAB

