



**'NEW MARKETS FOR CASSAVA' PROJECT
REPORT ON PROJECT OUTPUT 1.6**

**FOOD RESEARCH
INSTITUTE**

**ECONOMIC FEASIBILITY OF MALTOSE
PRODUCTION IN GHANA**

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Executive Summary

The present study is an activity under “New Market for Cassava” project, which is being funded by DFID and implemented by NRI in collaboration with various institutions in Ghana. The study analyzes the economic feasibility of cassava based sugar syrup (Maltose) production and examines the effect of industrial use of cassava on its availability for food and on farmer livelihood as well as the long-term and medium term sustainability of maltose markets in Ghana. The purpose of the study is to provide information that would serve as an investment decision tool for rural processors, potential investors and researchers interested in cassava based sugar syrup production in Ghana.

Cash flow analysis of the alternative options of sugar syrup production revealed that cassava flour based sugar syrup production is financially and economically viable with estimated **NPV of ₵3,023,264** and **₵85,755,097** at 30% discount rate; and **IRR of 44% and 137%** for small-scale and large scale production respectively. However, sugar syrup production from starch is not financially viable due to the high cost of starch. Economically, sugar syrup cannot be substituted for sugar as a sweetener. The immediate market envisaged for centralized/commercial production option is industrial use of sugar syrup. Considering the effect of the proposed project on cassava availability, the study established a surplus-cassava- supply case in Ghana that underscores the importance of developing ‘New market for Cassava’ especially in narrow utilization based production areas. Other economic and social benefits derived from such a project include foreign exchange savings, improvement in income levels of target groups and employment creation opportunity for women to engage in mainstream income generating activities.

It is recommended that work done on industrial market survey (sugar syrup) should be updated and coverage expanded in order to analyze the expected market growth for sugar syrup. In addition, product level competitive analysis (imported sugar syrup vis -a -vis domestic sugar syrup) in terms of quality, value and volume requirements need to be researched into and appropriate market linkages created for rural processors, as a key-determining factor to adoption of such an innovative technology.

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1.0 INTRODUCTION

This study forms part of activities being undertaken on the 'New Markets for Cassava Project'. The main project, which is funded by DFID and implemented by NRI in collaboration with various institutions in Ghana, aims at expansion of the utilization and market base for cassava. Among the value added cassava products developed so far under the project is cassava based sugar syrup. This study was therefore commissioned with a general objective of analyzing the economic feasibility of cassava based sugar syrup (Maltose) production in Ghana. The current study considers alternative options of cassava-based sugar syrup production with the view of presenting a high-yielding alternative that makes the most effective contributions to the national economy in terms of income distribution, foreign exchange savings, job creation and improvement to other social indicators. Thus, as a background to the study, the usefulness of the proposed project is considered in the context of government of Ghana's social and economic development objectives as well as the current agricultural policy framework in Ghana. Economic analysis, which is a build-up on financial analysis, gives accurate reflection of a project's income generating capacity. Results and findings from the study would therefore assist both researchers and potential investors in making informed decisions on the viability or otherwise of sugar syrup production in Ghana.

Objectives

Primarily, the scope of this study covers the following specific objectives;

- to determine the economic viability of maltose production from cassava
- to conduct comparative analysis of economic feasibility of village based and commercial/large scale options for maltose production
- to determine the effect of industrial use of cassava on cassava availability for food and on farmer livelihood
- to analyze the long-term and medium term sustainability of maltose markets

Sources of Data

Primary and Secondary data were used to achieve the objectives set. Some data and information on the socio-economic implications of the proposed project were collected at a

participatory field-testing of the technology conducted at Kokofu- a selected cassava-growing village in the Atebubu district. Secondary sources of data included MOFA, FAO, ISSER, FRI and grey literature from some key informants.

Analysis

The Economic evaluation of the costs and benefits of the project is made using cashflow analysis, Net Present Value (NPV) and Internal Rate of Return (IRR). Sensitivity analyses were made to show the effect of some variations in the level of costs and revenues. Current market prices and exchange rates (exchange rate ϕ : US\$ 7600) were used in the analysis.

The Net Present Value (NPV) is given as;

$$NPV = \sum_{t=0}^{t=T} S_t / (1+R)^t = 0$$

where NPV denotes the net present value,

S denotes net benefit

$1 / (1+R)^t$ is the discount factor in year t

t is the project year

R is the internal rate of return (the interest rate that makes NPV zero)

The above computations are generated from Excel Financial Analysis

The basic food balance sheet approach (also adopted by MOFA in estimating national supply and demand for agricultural commodities) is used to assess supply - demand gaps for cassava in Ghana. The following relations are considered:

Net food production = Total Production - Non-food use

Total food supply = Net food production - net imports - change in stocks

Food Balance = Total Food Supply - Total Consumption requirement

Where, Total consumption requirement = Per capita consumption * Total Population

2.0 BACKGROUND INFORMATION

2.1 The proposed project in the Context of GOG's Social and Economic Development objectives

The overriding aim of GOG's social and economic development program is the reduction of poverty and general improvement in the welfare of Ghanaians. The strategy for poverty alleviation focuses on fast economic growth particularly, in the rural sector, to generate increased employment opportunities, and improved access by the rural and urban poor to basic public services. The primary objective is achieved through

- Acceleration of economic growth by implementing sound fiscal, monetary, and other macroeconomic policies;
- Strengthening growth in the agricultural sector through opening access to market;
- Broadening and deepening the manufacturing services in order to create new business and employment opportunities;
- Investing in human resources development by improving access to nutrition, education, health, water and sanitation services;
- Encouraging the development of an indigenous entrepreneurial class through improving access to training, financial services, credit and local and foreign markets;
- Reducing the isolation of the poor communities through strengthening economic infrastructure such as roads and communications networks.

In Ghana, about 60% of the total population and employment is rural, and poverty is highly concentrated in the rural areas and among small farmers. The incidence of poverty is 36% among the rural population and rural poverty accounts for 84% of total poverty. Other social indicators are also very low for the rural population (See Table 1).

The Ghana Living Standards Survey of the Statistical service indicated that incidence of consumption poverty and extreme poverty reduced from 51.7 percent to 39.6 percent and 36.5 percent to 26.8 percent respectively, between 1991/92 and 1998/99. It notes that reduction in poverty occurred in Western, Greater Accra, Volta, Ashanti and Brong-Ahafo regions, while in Central, Northern and Upper East regions it increased. However, export

farmers and waged workers in private employment, enjoyed the most gains and crop farmers gained the least.

The proposed project aimed at rural poverty reduction with special focus on rural-urban linkages in terms of raw material supply and agricultural growth, based on technologically driven factor productivity increases that could provide the effective engine for employment creation in the farm and non-farm sectors.

Table 1. Social Indicators -Ghana

<i>Core Indicators</i>	<i>National</i>	<i>Rural</i>	<i>Urban</i>
Poverty incidence	29	36	14
Poverty (pop. Below national poverty line)	31		
Child malnutrition	27	33	21
Infant mortality rate (per 1000 live births)	69		
Access to safe water	56		
Net primary enrollment rate	88	87	90

Source: GLSS (1999)

Social and economic benefits will accrue to the rural people through increased productivity and income resulting from agro processing (sugar syrup production) and enhanced access to markets. In addition, employment opportunities will be created for rural and town folks engaged in input supply, transport and financial activities.

2.2 General Overview of the Agricultural Sector

The Agricultural sector remains the mainstay of the Ghanaian economy. It contributed about 36% of total GDP in 2000 (ISSER), 37.4% of foreign exchange earnings and employs about 60% of the Ghanaian labor force. Following the cobweb nature of its growth performance, the sector grew at 3.9% in 1999 as compared with 5.1% in 1998; 2.1% and 4.0% in 2000 and 2001 respectively. However, the sector is crippled by unfavorable Macro-economic conditions. These conditions include, large increase in government deficits, crowding out of private investment and high interest rate, which discourages private investment in the Agricultural sector. Others are high cost of non-wage farm inputs (especially, importable)

due to depreciation of the cedi (exchange rate ¢: US\$ 7300) and removal of agricultural subsidies, low levels of public investment in agricultural sector, poor infrastructure and lack of incentives to encourage production of non-traditional export crops (reasonable tax rebate on Agric products).

Another important factor that is adversely affecting the sector is high prices of fuel. This is contributing to high transportation and irrigation services costs. Transportation cost alone contributes to about 70% of marketing cost. In order to solve the numerous problems facing the sector, a number of measures have been put in place by the ministry of Agriculture. These include;

- Shifting resources to non-traditional export commodities.
- Provision of irrigation systems to ensure all year round production and reverse erratic nature of price trends.
- Provision of processing and storage facilities to stabilize prices. Completion of the agricultural sector Investment project in 1999 (ASIP), which provided assistance to agro-processing industry, development of market infrastructure, rehabilitation and maintenance of rural feeder roads and provision of water.
- Shifting extension services from over reliance on government's thin resources to one of shared responsibility and financing with farmers' associations and the private sector. Government policy is to support decentralization of front-line extension activities to district assemblies. Thus empowering beneficiaries to participate in priority setting and decision making of extension and adaptive research programs
- Strengthening weak farmer based organization. There is the need for farmers to organize themselves and consolidate their effort to solve teething problems in production and marketing. Farmer based organizations are also seen as pillars of social and economic development in rural communities. Weak farmer based organization contributes to invisibility of farmers, voice of farmers not heard at the national decision making process. With low factor productivity and poor resource base of small holders who dominate the sector, farmers cannot explore the opportunities of fast growing domestic and regional markets.

- Land administration and utilization in Ghana is being looked into in order to make large tracts of land available for commercial farming.

GOG is also working towards provision of credit facilities in the Agric sector; facilitate technology transfer, quality assurance and control. Farmers will be assisted to access marketing information and irrigation services, develop niche market for non-traditional export commodities and to put together a scheme to facilitate supply and distribution of Agric inputs. Current projects being implemented in the Agricultural sector include the Food Crops Development Project (FCDP), village infrastructure project (VIP), the Root and Tuber Improvement Programme (RTIP) and the Presidential Initiative on starch production from cassava.

Food Crops Development Project (FCDP), which is being supported by the African Development Bank, was started in 2000 and will be implemented over five years. The primary objective of the project is to improve household food security, nutrition and farmer incomes. The project is to help alleviate poverty of smallholder farmers in the transition and Guinea Savanna zones via increased production and village level processing of cereals and legumes. FCDP is being implemented in eight districts, viz Nkwanta and Krachi districts in the Volta Region, Ejura-Sekyedumasi and Sekyere East districts in the Ashanti Region, Wenchi and Nkoranza in the Brong-Ahafo Region and East Dagomba and West Gonja in the Northern Region.

The village infrastructure project (VIP), which succeeded ASIP in 1999, focused on enhancing the quality of life of the rural poor through increased transfer of technology and the provision of financial resources to develop and sustain basic village infrastructure. The targeted areas include rural water, rural transport, rural post harvest activities and rural institutions.

The Root and Tuber Improvement Programme (RTIP) is being run in conjunction with International Fund for Agricultural Development (IFAD). This project is to help improve food security and incomes of resource-poor farmers on a sustainable basis thorough the provision of improved and locally adapted technologies of root and tuber crops. Basically, more emphasis is placed on enhancing production capacity and efficiency of root and tuber

crops. Under the RTIP programme planting materials of high yielding cassava varieties have been supplied to farmers for farm expansion. Unfortunately, data on production targets is yet to be put in the public domain by the Ministry of Food and Agriculture. However it is proposed that more than one million farmers could have access to cassava planting materials to cover a total of 222608 ha by 2004 (assuming 0.2 ha cultivated per farmer) through the current multiplication and distribution strategies.

The Presidential Starch Initiative (PSI) is an integrated action programme for cassava starch production and Export. This is a special initiative of the President of the Republic of Ghana designed to develop the cassava starch industry in Ghana, as a major vehicle for job creation and poverty reduction in rural communities. The programme is based on the premise that it is easy to expand cassava production if market is guaranteed. Under this initiative very high quality-starch is to be produced from cassava for the export market.

There is also a high focus on rice development in the country with the view of increasing production as well as improving quality in order to reduce rice imports. The maltose production project, under review, seeks to take advantage of development strategies mentioned above. It provides opportunity for making use of the proposed starch project as well as providing market avenues for cassava expansion program under RTIP.

3.0 THE PROJECT

3.1 Project description

This project seeks to enhance income levels of rural farmers through the production of sugar syrup (maltose) from cassava starch and cassava flour. It also aims at creating employment opportunities in the urban and /or peri-urban areas of Ghana through production of sugar syrup from cassava starch or cassava flour. Additionally, the project seeks to save foreign exchange for the country through import substitution.

The project has two designs, a small-scale village level enterprise and a large scale centralized enterprise. The village level production targets a daily capacity of fifty kilograms (50kg). Here, indigenous alternatives of equipment and raw material are employed when

available. The large-scale centralised production targets a capacity of four hundred kilograms (400kg) daily and employs more sophisticated equipment alternatives.

3.2 Detailed Features

The project entails construction of factory building, procurement and installation of equipment, production of enzyme (a raw material) needed in the production process. This is done either by the same enterprise carrying out sugar production, or by a specialised enzyme production enterprise. Enzymes will be produced from paddy rice in accordance with a procedure employed in Vietnam (see Quynh, Thanh-tri and Cecil, 1996). The production processes and technical coefficients are presented below (See also Figures 1&2):

3.2.1 Technical coefficients

Enzyme (seedling) production

Five kilograms (5kg) of rice grain produces 16 kg of fresh seedlings

Ninety percent or more germination rate

2 kg dried seedlings is equivalent 4kg of fresh seedlings

1.0 m square of floor space for 10 kg of seed

Maltose production, estimated inputs per 100 kg of product

<i>Input</i>	<i>Number</i>	<i>Units</i>
Wet starch	145	kg or 95 kg dry starch
Labour	1.5	md
Wood	200	kg
Chopped seedlings	40	kg
Chemicals	0.15	kg
Electricity	1	kwh

3.2.2 Building and Equipment

Building

The project will include the construction of a factory building. This will require 20 -25 square metres of land. This will house equipment and provide storage space for raw materials and product (output), see Quynh, Thanh-tri and Cecil, 1996).

Equipment

- **Furnace**

This will be a single or two pan furnace depending on scarcity of fuel. A single pan furnace is used when output will be small and fuel is abundant.

- **Heating vessel**

The number of vessels used is equivalent to the number of pans in the furnace.

Vessels should have capacities of between 150 - 250 litres. An ideal vessel will have a diameter of 90 - 110 cm at the rim and 35cm deep. The vessels should weigh between 10 and 15 kg.

- **Foam chimney**

The foam chimney will be made of basket-work or metal sheet. This will be about three-quarters of the diameter of the heating vessel and 50 cm high.

- **Drums**

Oil drums will be used. Between six and ten will be used. Two of these will be 40 cm deep and have handles.

- **Filtering equipment**

This comprises a basin (aluminum or stainless steel) to collect drained liquid, jute sack to hold material to be pressed and a tripod to hold sack into position

- **Robust screw press**

This is made of screws and strong boards

Minor equipment

A number of minor equipment and tools are also needed (**See Schedule B** under Equipment and Machinery).

Figure 1. Flow Chart - Enzyme Production

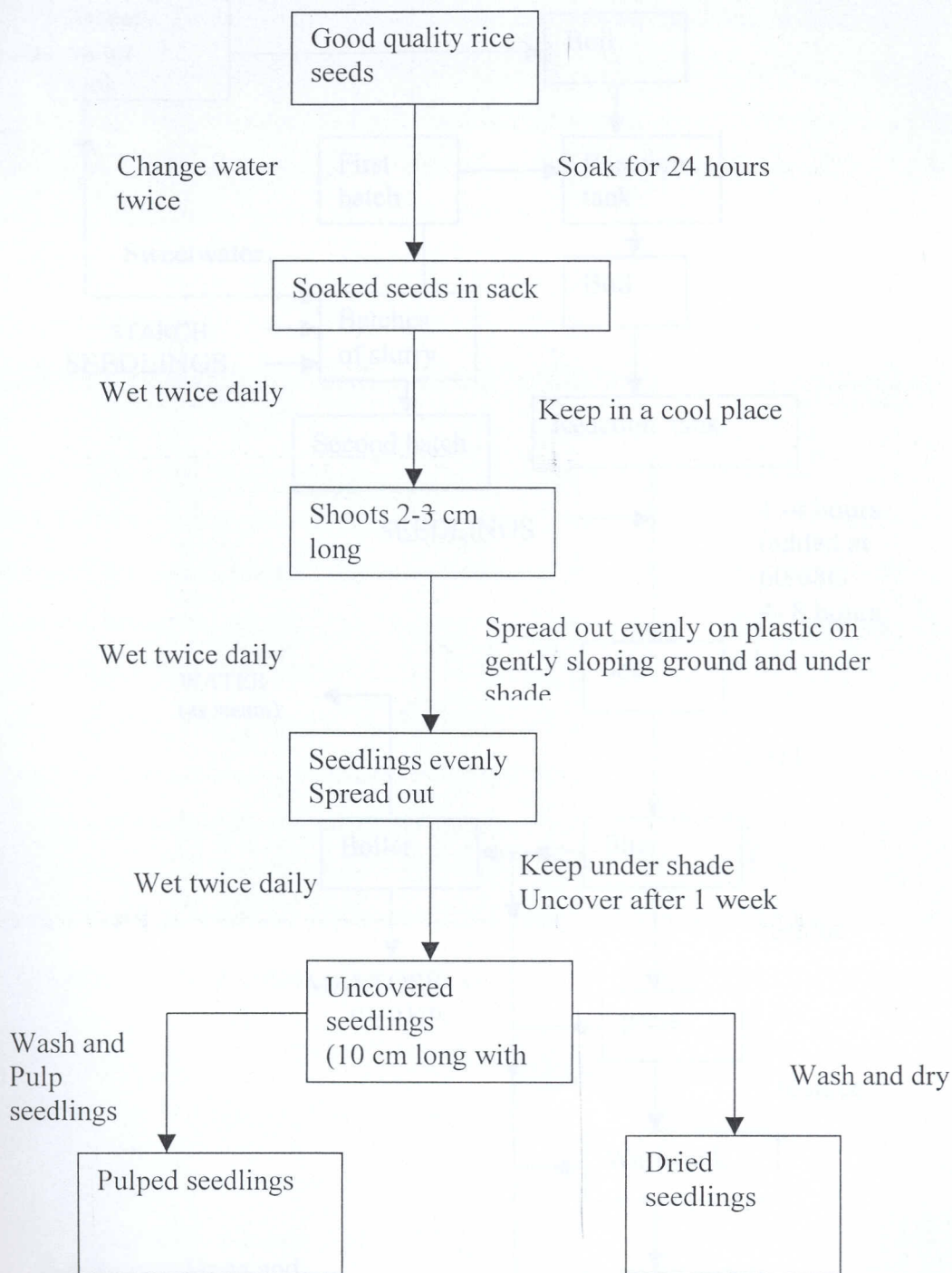
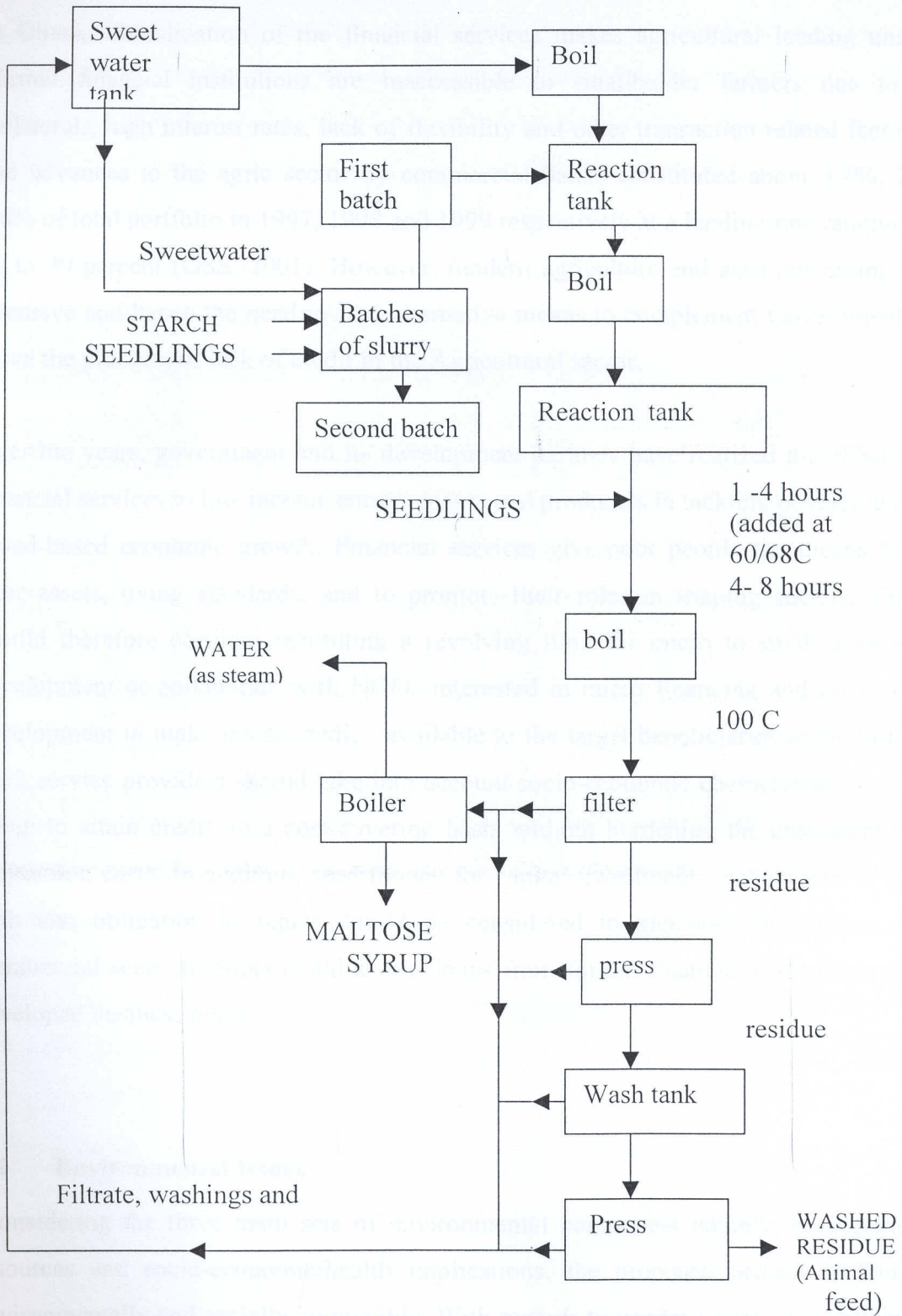


Figure 2 Maltose Production Process



3.3 Financing

In Ghana, liberalization of the financial services makes agricultural lending unattractive. Formal financial institutions are inaccessible to smallholder farmers due to lack of collaterals, high interest rates, lack of flexibility and other transaction related factors. Loans and advances to the agric sector by commercial banks constituted about 3.2%, 2.2% and 1.6% of total portfolio in 1997, 1998 and 1999 respectively at a lending rate ranging between 30 to 49 percent (GSS, 2001). However, modern agriculture and agro-processing is capital intensive and hence the need to find alternative means to complement Government effort to solve the problem of lack of credit in the Agricultural sector.

Over the years, government and its development partners have realized the effectiveness of financial services to low income entrepreneurs and producers in tackling poverty and creating broad-based economic growth. Financial services give poor people the means to increase their assets, living standards, and to promote their roles in shaping society. The project should therefore consider instituting a revolving fund for micro to small-scale enterprise development or collaborate with NGOs interested in micro financing and micro enterprise development to make micro credit available to the target beneficiaries at the village level. Such service providers should take into account socio-economic characteristics of the target group to attain credit on a cost-covering basis without burdening the customers with high transaction costs. In addition, seed money for capital investment / acquisition of equipment with less obligation to repay should be considered to kick-start the project. Potential commercial scale investors could access loans from formal financial institutions with well-developed business plans.

3.4 Environmental Issues

Considering the three main sets of environmental parameters namely; ecological, natural resources and socio-economic/health implications, the proposed project is found to be environmentally and socially compatible. With regards to gender issues, it is anticipated that to a large extent women will benefit from the project since they play a vital role in the production of sugar syrup especially, at the cottage level. It is however, worth noting, that construction of the building should have in-built environmental protection measures to compact any potential negative impact in terms of solid and liquid waste disposal.

Sustainable land use system will be employed by cassava farmers to ensure continuous supply of cassava. Target groups should also be trained on personal cleanliness and maintenance of hygienic conditions in the processing compound. For large scale processing, an Environmental Impact Assessment Study by EPA should form a basic requirement for site selection.

3.5 Organization and Management

It is suggested that the project employs community based resource management approach at the cottage level. This will involve the use of group concept (grassroots independent body that is led and run by the target group) in the technology transfer process. A committee should be set up to oversee the day-to-day activities, keep track of progress and effectively manage project resources. Extension agent in the operational area should be trained on techniques and dynamics of group formation and facilitation. It is envisaged that the target group will fully understand and accept the challenges and responsibilities they are likely to face as stakeholders and collectively exercise authority over their resource management, bargaining power at the market place and taking decisions that affect their own livelihood in order to ensure sustainability of the project.

3.6 Project Location

The following parameters are to be considered in the selection of project location:

- Availability of raw material
- Availability of Water
- Accessibility to market
- Road Net work
- Other Input supply
- Availability of fuel
- Electricity supply
- Availability of Labour

3.6.1 Availability of Water

Availability and high quality of water is very crucial for commercial scale production of starch and sugar. Potential investors should therefore take this into consideration when locating their plant.

In respect of cottage scale production at Kokofu, it was observed that water supply is a major problem in the area. The village has no source of portable drinking water. Sources of water include rivers and wells, which dry up in the dry season. Effort to construct boreholes in the community has not yet been successful. Currently, water is sourced from Atebubu-20miles from Kokofu, at ₦5,000.00 per drum, excluding transportation cost.

It is recommended that cassava flour should be used as the raw material base instead of starch, which requires high volumes of quality water to produce. Water tanks should also be obtained to hold adequate water for production activities.

3.6.2 Availability of Fuel

Fuel-wood is readily available and accessible in the area. At Kokofu, fuel is sourced without any cost from their farms. However, for the purpose of this study, fuel prices at Atebubu are used as basis for costing. Maxi-bag of Charcoal used for demonstration cost ten thousand cedis (₦10,000.00). For centralized option, gas stoves are recommended.

3.6.3 Availability of Labour

At the cottage level processing, people in the community will provide labour input. Currently, labour is readily available and accessible. The going wage/labour rate at the time of the survey (March 2002) was ₦10,000.00 and ₦4,000.00 per manday for farm work and off- farm work respectively. Though unskilled labour will be used for cottage scale level production, these should be should be given a considerable amount of training for the maximum performance and high quality production. For commercial scale production, both skilled and Semi-skilled labour is recommended.

3.6.4 Background of the target groups -Kokofu

Predominantly farmers cultivate, cassava, yam, rice, sorghum, groundnut, etc. Yam and cassava cultivation is their main source of income. Cassava is produced largely for cash with

less than 10 percent consumed in the home. It was observed that off-farm income generating opportunities in the village is limited though the village is easily accessible and close to a major market centre (Atebubu). Therefore, the women particularly, see sugar syrup production as an opportunity to participate in mainstream income generating activity likely to improve their livelihood. Though target groups are interested in sugar syrup production, interactions with them indicate that farmers would concentrate more on their farming activities for financial and food security reasons. It is therefore necessary to gradually promote their interest by constantly encouraging them and creating appropriate marketing linkages for them. Questions asked by the target group suggest the importance of market source as a key-determining factor to adoption of such an innovative technology. **Guiding principle is thinking big but starting small.**

Below is a calendar of activities of the target group, which depict labour resource use and time availability for off-farm income generating activities.

Table 2. Calendar of Activities of Target Group-Kokofu

<i>Month</i>	<i>Activity</i>
January	Harvesting of yam, cassava, agushie, vegetables clearing of new fields
February	Less work, felling of trees
March	Planting, felling of trees (Busy month, visit monthly, everyday except taboo days)
April	Planting yam, felling of trees, first weeding of farm- groundnut, maize, cowpea
May	Planting agushie, staking yam, weeding
June	Secondary weeding of yam (both family and hired labour used)
July/August	Minor season farming, June activities continue
September	Clearing for next season's farming
October	Fourth weeding of yam farm
November/December	Less work, off-season

Source: Authors' Compilation

3.6.5 Availability of rice

In Ghana, Demand for rice outstrips supply. Though Ministry of Food and Agriculture (MOFA) statistics show an upward trend in production of rice over the years (*see Table 1) only about 40% of rice consumed in Ghana is produced locally. Out of this, over sixty-five percent 65% is grown in northern Ghana (Day *et al.*, 1997). Rice is cultivated in four main ecological zones namely, rainfed lowland and uplands in northern Ghana, inland valley and irrigated fields in northern and southern Ghana. The Government of Ghana has initiated rice improvement programmes geared towards up scaling of production and other post harvest operations in order to cut down on rice imports. Rice is one of the major food staples in the Brong Ahafo region. However, the region ranks ninth in terms of production and output (SRID, 1996-2000) It is planted once a year but could be planted twice a year under irrigation. Quantity produced in any particular year is highly dependent on rainfall pattern. Swampy and upland varieties **largely the red type** is cultivated in the Brong Ahafo region. It is planted in the months of April and May and harvested in October to December, but is available on the local markets throughout the year.

At Kokofu, rice availability is seasonal and highly dependent on the climatic conditions and period of harvesting. Unlike the regional outlook, rice may not be available in the locality at certain times of the year and farmers may have to depend on the Atebubu market for rice supply. At the time of this survey, local rice was scarce in the community but available on the Atebubu market, which is easily accessible to the people in Kokofu.

Table 3. Rice Production

<i>Years</i>	<i>Output(000MT)- National</i>	<i>Output (000MT)- Brong Ahafo Region</i>
1995	221	8.10
1996	216	4.90
1997	197	5.27
1998	281	5.74
1999	210	2.72
2000	249	2.85
2001	295	2.91

Source MOFA-PPMED, Accra

For the commercial production option, rice can be sourced from any of the rice growing areas in Greater Accra region.

Considering the quantities of rice seedlings required for syrup production and the sensitivity of the production process, it is suggested that enzyme production should be integrated into sugar syrup production as one unity initially. However, enzyme production as a separate production unity can be later considered when an active market has been developed (see appendix 1).

3.6.6 Availability of Cassava

Cassava is cultivated throughout Ghana and contributes about 22% of agricultural GDP. Its production is prevalent in the Brong Ahafo, Ashanti and Eastern regions, which constituted about 65% (Al-Hassan 1991) of total national production. Over 90% of Ghanaian farmers cultivate cassava either as main crop or mixed with other crops. Cassava cultivation is predominantly on smallholder basis. Main system of farming is traditional with the use of hoe and cutlass, and tractor to a limited extent.

As shown in Table 4a, the average annual cassava production estimates is about 7 million tons (covered area of about 640000 ha). This figure could be doubled if expanded market is guaranteed since land is available (see SRID/MOFA 2001 publication on arable lands). As mentioned elsewhere, through the current multiplication and distribution strategies adopted under RTIP, more than one million farmers could have access to cassava planting materials to cover a total of 222608 ha by 2004 (assuming 0.2 ha cultivated per farmer). Also under PSI, about 1.9 million tons of cassava will be produced over the next 4 years, yielding 380,000 tons of starch for export¹. Selected districts based on incidence of poverty, production levels, market access, etc, for PSI program implementation are

- Awutu –Efutu –Senya district in the Central region
- Upper Denkyira district in the Central region
- Asuogyaman district in Eastern region
- Fantakwa district in Eastern region

¹ At this level of operation, only 6.7% of total cassava production in Ghana is processed into starch

Table 4a. Cassava Production –National Output (000MT)

<i>Years</i>	<i>Output (000MT)- National</i>	<i>Output (000MT)- BrongAhafo region</i>
1995	6612	1347.00
1996	7111	1468.46
1997	7150	1425.62
1998	7172	1168.62
1999	7845	1621.41
2000	8107	1702.48
2001	8966	1872.73

Source MOFA-PPMED, Accra

Current starch exports figures are presented in table 4b. Using 2000 export figures, the FOB price of starch per kilo in cedi equivalent is eight thousand four hundred cedis (8,400.00).

Table 4b. Cassava Starch Exports

<i>Year</i>	<i>Quantity (MT)</i>	<i>Value (1000\$)</i>
1998	7	8
1999	21	19
2000	21	19

Source: FAO website (fao.org)

It is suggested that starch requirement for centralized sugar syrup could be integrated into commercial starch production initiated by the government since development of domestic market for cassava starch forms part of the program

3.7 Cassava Use Patterns And Possible Effect of Sugar Production on Cassava Availability For Food and Farmer Livelihood

Cassava is an important food staple in the tropics, accounting for a third of all staple food produced in Sub-Sahara Africa (Akorada and Arene, 1992). Estimated levels of per capita consumption² of cassava in Ghana, for 1995 and 2000 are 149.7 Kg /head / year and 151.4 Kg / head / year respectively (SRID/MOFA 2001). Generally, there is ethnic and cultural

diversity in cassava use patterns in Ghana. Cassava is less expensive in areas where its consumption is limited. Cassava is commonly processed into agbelima (cassava dough), *kokonte* (dried chips milled into flour), gari (which is the most widely consumed cassava product) and to a limited extent, starch. Cassava is also used for *fufu* (boiled and pounded roots), ampesi (boiled roots), *able kakro*, *ayigbe biscuit*, *tapioca* and *yakayaka* (steamed cake). Cassava leaves and roots are also used in livestock feed (Al-Hassan 1991). Currently, new markets are developing and high-quality cassava flour is being used in the bakery industries (Ferris. 1998)

In the Brong Ahafo region and specifically, Kokofu, a rapid appraisal of the cassava use patterns revealed that cassava is largely processed into kokonte/cassava chips for sale, constituting about 90 percent of the cassava market share in the area. The rest is used for gari, agbelima, cassava flour and fufu. Cassava for kokonte therefore seems to be the major competitive use in terms of economic importance in the area. The monetary gain from kokonte production is therefore used as yardstick of competitiveness for other cassava uses. For example, the financial viability of village based sugar syrup production will be judged against that of Kokonte production.

Currently a maxi-bag of cassava costs between ₵90,000-₵110,000 depending on the season and a maxi-bag of kokonte (the major cassava use competitor) is ₵120,000. Market for kokonte is quite seasonal and pricing system is similar to that of cassava.

As already mentioned, insignificant proportion of cassava produced in the target area for village-based sugar production is consumed at the household level. Other staples like yams and rice form a major part of the eating habit of the people in the Kokofu area. Hence, the proposed project will not impact negatively on food availability. Key informants in the village also emphasized on the need to develop new markets for cassava and the availability of land for farm expansion, if scaling up of cassava production becomes necessary in future.

Using the basic Food Balance Sheet framework detailed under data analysis, supply and demand gaps for cassava in Ghana is shown in Table 5. As indicated in the table, there is surplus supply of cassava in Ghana and therefore the need to expand market base for cassava.

² Estimates based on food available for human consumption from domestic sources divided by population

Table 5. Cassava Supply/Demand in “000 MT” (1995-2001)

<i>Year</i>	<i>Total Production</i>	<i>Total Non Food Use³</i>	<i>Net Domestic Food Production/Total domestic Supply</i>	<i>Total Consumption Requirements</i>	<i>Food balance (deficit/Surplus)</i>
1995	6611	1983.6	4628.4	2609.271	2019.129
1996	6939	2133.3	4977.7	2669.151	2308.549
1997	7150	2145	5005	2745.498	2259.502
1998	7172	2151.6	5020.4	2748.492	2271.908
1999	7845	2353.5	5491.5	2751.486	2740.014
2000	8107	2432.1	5674.9	2785.76	2889.14
2001	8966	2689.8	6276.2	2816.04	3460.16

Source: Authors' Compilation 2002

4.0 PRODUCT MARKET

The market for sugar syrup is yet to be developed and it is worth noting that development of a new market is a time consuming process. There is the need to explore potential for niche markets considering the varied uses of sugar syrup. The success of such a market development process depends largely on helping prospective entrepreneurs build a strong relationship with customers through direct contact so they can understand first hand, what customers want and need in the way of products. Such feedback from customers helps inspire producers to improve or modify their products to meet the demands of the market place.

Due to difficulties to meet minimum commercial orders in the short term, the ability to market sugar syrup in the immediate future will likely hinge on the identification of buyers who are willing to purchase smaller volumes initially and develop the market with the producers. Most importantly, such niche markets should be developed along the lines of ' fair

³ MOFA allowances for Non-Food Use (Seed, Feed and Waste) for Cassava is 30% and per capita consumption of cassava used for the analysis are 149.7 Kg /head / year and 151.4 Kg / head / year for 1995 and 2000 respectively (SRID/MOFA 2001).

trade' whereby small-scale sugar syrup producers receive a reasonable percentage of the profits and also ensuring that producer's inefficiencies are not passed on to buyers. To this end realistic demand projections are very necessary, in order to clear the market and ensure positive market signals to encourage producers.

Currently, alcohol distillers and the bakery industries in Atebubu and Yeji Districts have been identified as the major potential buyers of sugar syrup. A meeting was held with bakers (executives of the bakers association in the area) and executive members of distillers co-operative association to establish contact for possible market linkages with producers of sugar syrups, estimate demand and also to bring their perceptions and preferences to bear on the research activities. Thus, plans are far advanced to develop a product, which meets buyer's specific requirements in terms of sugar concentration, packaging material, colour, etc. Unfortunately, feasibility analysis indicates that it is uneconomical to substitute sugar syrup for sugar as a sweetener. Other factors that will be captured in the product market development process include customers purchasing behaviour and attitudes, frequency of use as well as quantities needed and time and place of delivery.

It is recommended that other potential buyers in the confectionaries and pharmaceutical industries in the urban centers should be explored after developing the identified local market. Estimates of sugar import-substitutes market are shown in Table 6.

4.1 Distillers

Estimated sugar requirement was based on actual local gin sold through the district distillers co-operative various outlets which mainly comprises retailers and distillers. However, the figure was adjusted for sales through other channels. Actual figure recorded for July 2000-June 2001 is 3831.5 tins; four (4) gallons is equivalent to 1 tin. (i.e Atebubu and Sene districts). Cassava based sugar syrup will certainly be a better alternative source of sugar to distillers because of the ever rising cost of sugar in Ghana. It is more likely to have an advantage over the use of palm wine, which is becoming scarce. Distillers are however, of the view that the use of cassava based syrups for distilling will be better enhanced if consumers are not made aware of the type of raw material used due to attitudes of Ghanaian consumers.

4.2 Bakery Industry – Village based

Table 6. Industrial Sugar Demand in the Target Area – Cottage level

<i>Town</i>	<i>Estimated Number of bakers</i>	<i>Monthly sugar requirement (Kg)</i>	<i>Total Monthly sugar requirement</i>	<i>Total Annual sugar requirement (Kg)</i>
Atebubu	50	10	500	6000
Yeiji	70	10	700	8400
Kwame Danso	10	10	100	1200
Amanteng	10	10	100	1200
Ejura	60	10	600	7200
Prang	8	10	80	960
Total				23760

Note: Processing capacity per baker is about 1bag/day.
Processor works 5 days a week

Using conversion rate of 1.35kg of sugar syrup: 76kg of sugar (provided by Technical expert) the estimated sugar syrup market for the bakery industry in the area is about 42205.26kgper annum.

4.3 Sugar Syrup Import Substitution

The immediate market envisaged for centralized/commercial production option is industrial use of sugar syrup. It is estimated that about 116000kg of sugar syrup was imported in 1999. However, current figures are unavailable (see Table 7). It is suggested more detailed work on industrial survey should be conducted.

Table 7. Sugar Imports

<i>Year</i>	<i>Sugar, total (raw Equiv.)</i>		<i>Sugar (centrifugal, raw)</i>	
	<i>Quantity (Mt)</i>	<i>Value (1000\$)</i>	<i>Quantity (Mt)</i>	<i>Value (1000\$)</i>
1995	136,440	58,100	6,000	2,100
1996	84,508	37,448	46,401	21,368
1997	38,259	27,318	24,106	16,187
1998	77,008	31,680	69,231	26,929
1999	108,955	31,725	68,212	24,769
2000				
2001				

Source: FAO website (fao.org)

Table 7 (contd.)

Year	Sugar and sugar syrup		Sugar Confectionary		Sugar Refined	
	Quantity (Mt)	Value (1000\$)	Quantity (Mt)	Value (1000\$)	Quantity (Mt)	Value (1000\$)
1995			400	700	120,000	56,000
1996	49	70	351	505	35,057	16,080
1997	83	111	732	1,015	13,019	11,131
1998	56	56	2,611	2,238	7,155	4,751
1999	116	115	1,989	1,457	19,083	6,957
2000						
2001						

Source: FAO website (fao.org)

It is recommended that detailed industrial market study on sugar syrup users need to be conducted in order to analyze the expected market growth. Product level competitive analysis (imported sugar syrup vis-a-vis domestic sugar syrup) in terms of quality, value and volume requirements need to be researched into.

5.0. FINANCIAL AND ECONOMIC JUSTIFICATION

The financial analysis of sugar syrup production quantifies the cost of investment and returns in terms of market prices and presents estimates of the enterprise's financial profitability based on assumed cost of capital. The economic value of the enterprise is then estimated by adjusting the financial prices to reflect the real value of the enterprise (with regards to both inputs and outputs) to the nation.³ Three measures of project worth are used in the economic analysis namely, Net Present Value (NPV), Internal Rate of Returns (IRR) and Benefit-Cost ratio (B-C). In addition, Sensitivity analysis is incorporated to reflect the extent of effect on profitability by variations in the level of costs and revenues. The assumptions below are made in the analysis:

Assumptions

- Costs estimates are based on current prices in Ghana in March 2002
- Current Foreign Exchange conversion used is US\$1.00: ₵7600
- The analysis is restricted to first five years of the project implementation
- No residual values are assumed after 5 years for Equipment

³ Instead of market prices used for financial analysis, shadow/efficiency prices are used in the economic analysis. In addition, exchange rates distortions caused by trade policies are corrected and direct transfer payments also adjusted in economic analysis.

- Exchange rates and market prices are assumed to be efficiently determined. No price distortions in traded items.
- There are no subsidies and tax exemptions are assumed. Therefore financial and economic analysis are similar
- Rice seedlings (enzyme) preparation is integrated into sugar syrup production since there is no active market for seedlings immediately.
- Cassava flour and cassava starch give the same quality of sugar syrup
- No byproduct sales are assumed
- Costs and benefits estimations are based on constant prices. Thus general inflation will exert the same relative effect on both costs and benefits
- 30% lending rate/ cost of capital is used (April, 2002)
- Cash flows in future years are assumed to occur in one lump sum at the end of the year.

5.1 Cost estimates

Capital costs

Table 8. Costs of Assets

Item	Year1 Village-based	Year1 Commercial Scale
Building		
Major Equipment	5,650,000	11,850,000
Minor Equipment	360,000	1,400,000
Total	6,100,000	13,250,000

Schedule A: Land & Building

Item	Village -based	Commercial/Medium Scale
Land	-	-
Building	6,000,000	20,000,000
Total	6,000,000	20,000,000

Schedule B: Equipment and Machinery

Item	Number Needed	Unit Cost	Total
Major			
Furnace	1	1,000,000	1,000,000
Heating Vessel	1	3,200,000	3,200,000
Foam Chimney	1	250,000	250,000
Filter Unit	1	2,900,000	2,900,000
Robust Screw Press	1	2,800,000	2,800,000
Opened top drums/Aluminum Pans	6	150,000	900,000
Water holding containers	2	200,000	400,000
Gas Stove and Accessories	1	400,000	400,000
Sub-Total			11,850,000
Minor			
Steel Buckets	2	50,000	100,000
Circular Basket work Covers	8	10,000	80,000
Weighing Scale (Small)	1	60,000	60,000
Weighing Scale (Medium)	1	100,000	100,000
Ladle	1	10,000	10,000
Paddles	2	10,000	20,000
Metal Bowls	4	50,000	200,000
Sticks (Lifter)	2	20,000	40,000
Small Shovel	1	30,000	30,000
Sample Sticks	1	10,000	10,000
Glass tumblers	2	20,000	40,000
Graduated Cylinder	1	20,000	20,000
Thermometer	2	100,000	200,000
Brix Hydrometer	2	100,000	200,000
Cloth Sacks (filter)	10	10,000	100,000
Fine Screen	1	20,000	20,000
Coarse Screen	1	10,000	10,000
Pestle	2	10,000	20,000
Mortar	2	10,000	20,000
Steel Doors	2	50,000	100,000
Pokers	2	10,000	20,000
Sub-Total			1,400,000
Total			

Highlighted items applicable to small-scale

Schedule C. Indirect Labour

Category	Number	Monthly Salary
Technical Supervisor/Manager	1	700,000
Marketing Officer	1	700,000
Security Officer	1	300,000
Subtotal	-	1,700,000
Social Security Fund (12.5%)	-	212,500
Perquisites (12.5%)	-	212,500
Total		2,125,000

5.2 Revenue

Revenue projections for alternative options of Sugar syrup production over a five-year period are presented in Tables 9 & 10

Table 9. Small-Scale /Village based Sugar Syrup Production

<i>Year</i>	<i>Capacity (Kg/year)</i>	<i>Projected Revenue (¢'000)</i>
1	12000	51600
2	12000	51600
3	18000	77400
4	24000	103200
5	24000	103200
Total	-	387000

Source: Authors' Compilation 2002

Table 10. Large-Scale Sugar Syrup Production Using Cassava Flour

<i>Year</i>	<i>Capacity (Kg/year)</i>	<i>Projected Revenue (¢'000)</i>
1	72000	416,232
2	84000	485,604
3	96000	554,976
4	96000	554,976
5	96000	554,976
Total	-	2,566,764

Source: Authors Compilation 2002

Note that different selling prices reflect the differences in cost of production.

5.3 Financial and Economic Feasibility

The financial results of the various options are summarized into a projected cash flow presented in appendices 1-5. Debit service is calculated using equal annual installments with interest paid on outstanding balance. It is considered that loan acquisition, investment items will be made before project year one, and therefore 1-year grace period is allowed for debit financing. Inflow is subtracted from the cash outflow to obtain the incremental net benefit – investment ratio to all resources engaged.

Cash flow analysis of the various options showed that small-scale and large scale sugar syrup production using cassava flour are financially and economically viable with estimated **NPV of ₦3,023,264 and ₦85,755,097 at 30% discount rate; and IRR of 44% and 137%** respectively. Thus, large-scale sugar syrup production yields financial returns that far exceed the current market interest rate or opportunity cost of capital. However, sugar syrup production from starch is not financially viable. As shown on the cash flow analysis, the cost of starch is even higher than the selling price of sugar syrup. It was also realized that sugar syrup is more expensive than ordinary sugar and cannot be substituted for sugar as a sweetener.

Sensitivity tests done by changing some sensitive parameters; 10% total cost overrun and 10% decrease in selling price levels are presented in appendices 6-9. **For 10% total cost overrun**, the sensitivity results showed **NPV of 11,532,165 at 30% discount rate and IRR of 42%** while 10% reduction in selling price showed **NPV of ₦6,864,623 at 30% discount rate and IRR of 20%** for large scale sugar syrup production. However, changes in both parameters gave negative NPV for small-scale sugar production. As already mentioned, different selling prices reflect the differences in cost of production. Selling prices are sticky downwards.

5.4 Economic and Social Benefits

Some of the economic and social benefits derived from the project are mentioned below:

- Foreign Exchange earnings (Gross Foreign Exchange Savings⁴ to be made, based on current world market, prices is estimated at approximately, \$ 100,000
- Improvement in income levels of target groups
- Employment creation
- Opportunity for women to engage in mainstream activities
- Efficient use of natural resources
- Reduction in the use of palms in local gin preparation

⁴ This is based on 1996 -1999 annual sugar syrup imports figures. Total expenditure involved in local production not considered.

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Appendices

Appendix 1: Technical Coefficients (enzyme production)

Conversion rates

<i>Qty of maltose(50Kg)</i>		<i>Qty of seedling</i>	<i>Quantity of grain</i>
50	kg	16 kg	5 kg
		40 kg	12.5 kg

Floor space for drying rice seedlings

1	msq	10 kg seed
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Covering for seedlings production

	Qty/ 5 kg rice
sack	0.125
plastic sheets	0.125

water use for

22 gallons	50 kg rice
0.44 gallons	1 kg rice

Prices

<i>Item</i>	<i>unit price</i>	<i>unit</i>
paddy rice	1,200.00	kg
sack	2,000.00	sack
plastic sheets	5,000.00	
water	4,000.00/ 22 gals	
	181.82/ gallon	
labour	5,000.00	manday

Enzyme production cost

50 kg

<i>Item</i>	<i>Quantity</i>	<i>Unit cost</i>	<i>total cost</i>
paddy rice	15.625	1200	18750
sacks	0.390625	2000	781.25
plastic sheets	0.390625	5000	1953.125
water	6.875	181.8181818	1250
labour	3	5000	15000

Enzyme production cost per 40kg of chopped seedlings

<i>Item</i>	<i>Quantity</i>	<i>Unit cost</i>	<i>total cost</i>
paddy rice	12.5	1,200.00	15,000.00
sacks	0.3125	2,000.00	625.00
plastic sheets	0.3125	5,000.00	1,562.50

<i>Item</i>	<i>Quantity</i>	<i>Unit cost</i>	<i>total cost</i>
water	5.5	181.82	1,000.00
labour	3	5,000.00	15,000.00
Subtotal			33,187.50

<i>Equipment</i>	<i>Quantity</i>	<i>Unit cost</i>	<i>total cost</i>	<i>useful life</i>	<i>Annual dep</i>	<i>monthly dep</i>
motar	2	10,000.00	20,000.00	5	4,000.00	333.33
pestle	2	2,000.00	4,000.00	2	2,000.00	166.67
basin	2	40,000.00	80,000.00	2	40,000.00	3,333.33
drum	2	90,000.00	180,000.00	2	90,000.00	7,500.00
Total			284,000.00			

Other expendables

Sacks

Plastic sheets

Appendix 2. Cashflow analysis for maltose production- Small Scale (sugar price as yardstick)

Item	Project year					
	0	1	2	3	4	5
<i>Inflow</i>						
Total inflows		22,800,000.00	22,800,000.00	34,200,000.00	45,600,000.00	45,600,000.00
<i>Outflow</i>						
Investment						
Building						
Equipment	6,000,000.00	-	-	-	-	-
heating pan	700,000.00	-	-	-	-	-
water containers	200,000.00	-	-	-	-	-
aluminium pans	300,000.00	-	-	-	-	-
filter press	550,000.00	-	-	-	-	-
press unit	2,800,000.00	-	-	-	-	-
furnance	1,000,000.00	-	-	-	-	-
chimney	100,000.00	-	-	-	-	-
Minor	360,000.00	-	-	-	-	-
enz prod unit	284,000.00	-	-	-	-	-
<i>sub-total</i>	12,294,000.00	-	-	-	-	-
Production cost						
flour		34,200,000.00	51,300,000.00	68,400,000.00	68,400,000.00	68,400,000.00

Item	Project year					
	0	1	2	3	4	5
labour		900,000.00	900,000.00	1,350,000.00	1,800,000.00	1,800,000.00
fuelwood		1,200,000.00	1,200,000.00	1,800,000.00	2,400,000.00	2,400,000.00
chopped seedlings		3,982,500.00	3,982,500.00	5,973,750.00	7,965,000.00	7,965,000.00
chemicals		105,480.00	105,480.00	158,220.00	210,960.00	210,960.00
sub-total		40,387,980.00	40,387,980.00	60,581,970.00	80,775,960.00	80,775,960.00
Total Outflows		12,294,000.00	40,387,980.00	40,387,980.00	60,581,970.00	80,775,960.00
Net benefit before financing		(12,294,000.00)	(17,587,980.00)	(26,381,970.00)	(35,175,960.00)	(35,175,960.00)
Financing						
Loan						
Debt service						
Net benefit after financing						
Basis:						
Selling Price using sugar price		φ1900/Kg				
Production Capacity						
	1-2 years	50Kg per day five times a week	Total quantity	42,429,980.00		
	3-year	75kg per day five times a week	Break-Even Price	12000		
	4-5 years	100kg per day five times a week	Mark-up(20%)	3,535.83		
			Selling Price	707.17		
				4,243.00		

Pricing System(with no debt service commitment)

Appendix 3: Cashflow analysis maltose production -Small Scale (Competitive Price)

Item	Project year					
	0	1	2	3	4	5
<i>Inflow</i>						
Total inflows	51,600,000.00	51,600,000.00	77,400,000.00	103,200,000.00	103,200,000.00	103,200,000.00
<i>Outflow</i>						
Investment						
Building Equipment	6,000,000.00	-	-	-	-	-
heating pan	700,000.00	-	-	-	-	-
water containers	200,000.00	-	-	-	-	-
aluminium pans	300,000.00	-	-	-	-	-
filter press	550,000.00	-	-	-	-	-
press unit	2,800,000.00	-	-	-	-	-
furnance	1,000,000.00	-	-	-	-	-
chimney	100,000.00	-	-	-	-	-
Minor	260,000.00	-	-	-	-	-
enz prod unit	284,000.00	-	-	-	-	-
<i>Sub-total</i>	12,194,000.00	-	-	-	-	-
Production cost						

Item	Project year					
	0	1	2	3	4	5
Flour	39,900,000.00	39,900,000.00	39,900,000.00	59,850,000.00	79,800,000.00	79,800,000.00
Labour	900,000.00	900,000.00	900,000.00	1,350,000.00	1,800,000.00	1,800,000.00
fuelwood	1,200,000.00	1,200,000.00	1,200,000.00	1,800,000.00	2,400,000.00	2,400,000.00
chopped seedlings	3,982,500.00	3,982,500.00	3,982,500.00	5,973,750.00	7,965,000.00	7,965,000.00
chemicals	105,480.00	105,480.00	105,480.00	158,220.00	210,960.00	210,960.00
Water	600,000.00	600,000.00	600,000.00	900,000.00	1,200,000.00	1,200,000.00
Sub-total	- 46,687,980.00	46,687,980.00	46,687,980.00	70,031,970.00	93,375,960.00	93,375,960.00
Total Outflows	12,194,000.00	46,687,980.00	46,687,980.00	70,031,970.00	93,375,960.00	93,375,960.00
Net benefit before financing	(12,194,000.00)	4,912,020.00	4,912,020.00	7,368,030.00	9,824,040.00	9,824,040.00
Financing Loan	12,194,000.00					
Debt service(Principal)		2,438,800.00	2,438,800.00	2,438,800.00	2,438,800.00	2,438,800.00
Interest		3,658,200.00	2,926,560.00	2,194,920.00	1,463,280.00	731,640.00
Net benefit after financing	- (1,184,980.00)	(453,340.00)	(453,340.00)	2,734,310.00	5,921,960.00	6,653,600.00
\$ Component	-	(155.92)	(59.65)	359.78	779.21	875.47
Selling Price	4300					
Production Capacity	years 1-2; 50Kg per day five times a week	NPV	€3,023,264.96			
	year 3 ; 75kg per day five times a week	IRR	44%			
	year 4-5 ; 100kg per day five times a week	Conversion Rate	7600			
		\$:¢				

Interest rate of 30% is used

Appendix 4 Cashflow analysis -Commercial Scale Production Using Starch

Item	Project year					
	0	1	2	3	4	5
<i>Inflow</i>						
Total inflows		504,000,000.00	588,000,000.00	672,000,000.00	672,000,000.00	84,000,000.00
<i>Outflow</i>						
Investment						
Building Equipment	20,000,000.00					
heating pan	3,200,000.00					
water containers	400,000.00					
aluminium pans	900,000.00					
filter press	2,900,000.00					
press unit	4,050,000.00					
enz prod unit	284,000.00					
Office equipment	800,000.00					
minor Equipment	1,400,000.00					
Stove and accessories	400,000.00					
Sub-total	34,334,000.00					
Contingencies(10%)	3,433,400.00					
Maintenance (10%)	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00
Total	37,767,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00

Item	Project year					
	0	1	2	3	4	5
Production cost						
starch	840,000,000.00	960,000,000.00	1,080,000,000.00	1,200,000,000.00	1,200,000,000.00	1,200,000,000.00
labour (semi-skilled)	6,300,000.00	7,200,000.00	8,100,000.00	9,000,000.00	9,000,000.00	9,000,000.00
gas	5,040,000.00	5,760,000.00	6,480,000.00	7,200,000.00	7,200,000.00	7,200,000.00
chopped seedlings	27,877,500.00	31,860,000.00	35,842,500.00	39,825,000.00	39,825,000.00	39,825,000.00
chemicals	738,360.00	843,840.00	949,320.00	1,054,800.00	1,054,800.00	1,054,800.00
water	42,000,000.00	48,000,000.00	54,000,000.00	60,000,000.00	60,000,000.00	60,000,000.00
Sub-total	921,955,860.00	1,053,663,840.00	1,185,371,820.00	1,317,079,800.00	1,317,079,800.00	1,317,079,800.00
Selling and general admin expenses						
Indirect labour	25500000	25500000	25500000	25500000	25500000	25500000
General admin	2,000,000.00	2,000,000.00	2,000,000.00	2,000,000.00	2,000,000.00	2,000,000.00
selling expenses	6,000,000.00	6,000,000.00	6,000,000.00	6,000,000.00	6,000,000.00	6,000,000.00
Subtotal	33,500,000.00	33,500,000.00	33,500,000.00	33,500,000.00	33,500,000.00	33,500,000.00
Total	955,455,860.00	1,087,163,840.00	1,218,871,820.00	1,350,579,800.00	1,350,579,800.00	1,350,579,800.00
Contingencies(10%)	95,545,586.00	108,716,384.00	121,887,182.00	135,057,980.00	135,057,980.00	135,057,980.00
Grand total	1,051,001,446.00	1,195,880,224.00	1,340,759,002.00	1,485,637,780.00	1,485,637,780.00	1,485,637,780.00
Total Outflows	37,767,400.00	1,976,390,706.00	2,252,977,464.00	2,529,564,222.00	2,806,150,980.00	2,806,150,980.00
Net benefit before financing	(37,767,400.00)	(1,472,390,706.00)	(1,664,977,464.00)	(1,857,564,222.00)	(2,134,150,980.00)	(2,722,150,980.00)
Selling Price of sugar syrup ₺7000/kg						

Appendix 5 Cashflow analysis -Commercial Scale Production Using Cassava Flour

Item	Project year					
	0	1	2	3	4	5
<i>Inflow</i>						
Total inflows	416,283,268.13	485,663,812.82	555,044,357.51	555,044,357.51	555,044,357.51	555,044,357.51
<i>Outflow</i>						
Investment						
Building Equipment	20,000,000.00					
heating pan	3,200,000.00					
water containers	400,000.00					
aluminium pans	900,000.00					
filter press	2,900,000.00					
press unit	4,050,000.00					
enz prod unit	284,000.00					
Office equipment minor Equipment	800,000.00					
Stove and accessories	1,400,000.00					
Sub-total	400,000.00					
Contingencies(10%)	34,334,000.00					
	3,433,400.00					
Maintenance (10%)		3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00
Total	37,767,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00

Item	Project year					
	0	1	2	3	4	5
Production cost						
Cassava Flour	252,000,000.00	294,000,000.00	336,000,000.00	336,000,000.00	336,000,000.00	336,000,000.00
labour (semi-skilled)	5,400,000.00	6,300,000.00	7,200,000.00	7,200,000.00	7,200,000.00	7,200,000.00
gas	4,320,000.00	5,040,000.00	5,760,000.00	5,760,000.00	5,760,000.00	5,760,000.00
chopped seedlings	23,895,000.00	27,877,500.00	31,860,000.00	31,860,000.00	31,860,000.00	39,825,000.00
chemicals	632,880.00	738,360.00	843,840.00	843,840.00	843,840.00	843,840.00
water	3,600,000.00	4,200,000.00	4,800,000.00	4,800,000.00	4,800,000.00	4,800,000.00
Packaging	-	-	-	-	-	-
Sub-total	289,847,880.00	338,155,860.00	386,463,840.00	386,463,840.00	386,463,840.00	386,463,840.00
Selling and general admin expenses						
indirect labour	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00
general admin	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00
selling expenses	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00
Sub-total	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00
Total	339,347,880.00	387,655,860.00	435,963,840.00	435,963,840.00	435,963,840.00	435,963,840.00
Contingencies(10%)	33,934,788.00	38,765,586.00	43,596,384.00	43,596,384.00	43,596,384.00	43,596,384.00
Grand total	373,282,668.00	426,421,446.00	479,560,224.00	479,560,224.00	479,560,224.00	479,560,224.00
Total Outflows	37,767,400.00	373,282,668.00	426,421,446.00	479,560,224.00	479,560,224.00	479,560,224.00
Net benefit before financing	(37,767,400.00)	43,000,600.13	59,242,366.82	75,484,133.51	75,484,133.51	75,484,133.51

Item	Project year					
	0	1	2	3	4	5
Equity	40%					
Loan	60%	22,660,440.00				
Debt service(principal)		4,532,088.00	4,532,088.00	4,532,088.00	4,532,088.00	4,532,088.00
Interest rate		6,798,132.00	5,438,505.60	4,078,879.20	2,719,252.80	1,359,626.40
Net benefit after financing ¢		(15,106,960.00)	31,670,380.13	49,271,773.22	66,873,166.31	68,232,792.71
\$component		(1,987.76)	4,167.16	6,483.13	8,799.10	8,978.00
Selling Price/ kg of sugar syrup		5,781.71		Break -Even Price/kg	5256.10187	
Production capacity/day				Mark-up (10%)	525.610187	
1year	300	interest rate 30%		Selling Price	5781.712057	
2year	350	NPV ¢85,755,097.04		Conversion Rate(\$:¢)	7600	
3-5year	400	IRR 137%				

Appendix 6 Cashflow analysis -Commercial Scale Production : 10% Price Reduction

Item	Project year					
	0	1	2	3	4	5
<i>Inflow</i>						
Total inflows		374,654,941.32	437,097,431.54	499,539,921.76	499,539,921.76	499,539,921.76
<i>Outflow</i>						
Investment						
Building Equipment	20,000,000.00					
heating pan	3,200,000.00					
water containers	400,000.00					
aluminium pans	900,000.00					
filter press	2,900,000.00					
press unit	4,050,000.00					
enz prod unit	284,000.00					
Office equipment	800,000.00					
Minor Equipment	1,400,000.00					
Stove and accessories	400,000.00					
sub-total	34,334,000.00					
Contingencies (10%)	3,433,400.00					
Maintenance (10%)		3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00
Total	37,767,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00

Item	Project year					
	0	1	2	3	4	5
Production cost						
Cassava Flour labour (semi-skilled)	252,000,000.00	294,000,000.00	336,000,000.00	336,000,000.00	336,000,000.00	336,000,000.00
gas	5,400,000.00	6,300,000.00	7,200,000.00	7,200,000.00	7,200,000.00	7,200,000.00
chopped seedlings chemicals	4,320,000.00	5,040,000.00	5,760,000.00	5,760,000.00	5,760,000.00	5,760,000.00
water	23,895,000.00	27,877,500.00	31,860,000.00	31,860,000.00	31,860,000.00	39,825,000.00
Packaging	632,880.00	738,360.00	843,840.00	843,840.00	843,840.00	843,840.00
	3,600,000.00	4,200,000.00	4,800,000.00	4,800,000.00	4,800,000.00	4,800,000.00
	-	-	-	-	-	-
Sub-total Selling and general admin expenses	289,847,880.00	338,155,860.00	386,463,840.00	386,463,840.00	386,463,840.00	386,463,840.00
indirect labour	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00
general admin selling expenses	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00
Sub-total	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00
Total	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00
Contingencies (10%)	339,347,880.00	387,655,860.00	435,963,840.00	435,963,840.00	435,963,840.00	435,963,840.00
Grand total	33,934,788.00	38,765,586.00	43,596,384.00	43,596,384.00	43,596,384.00	43,596,384.00
Total Outflows	373,282,668.00	426,421,446.00	479,560,224.00	479,560,224.00	479,560,224.00	479,560,224.00
	37,767,400.00	373,282,668.00	426,421,446.00	479,560,224.00	479,560,224.00	479,560,224.00
Net benefit before financing	(37,767,400.00)	1,372,273.32	10,675,985.54	19,979,697.76	19,979,697.76	19,979,697.76

Item	Project year						
	0	1	2	3	4	5	
Equity	40%						
Loan	60%	22,660,440.00					
Debt service(principal)		4,532,088.00	4,532,088.00	4,532,088.00	4,532,088.00	4,532,088.00	
Interest rate		6,798,132.00	5,438,505.60	4,078,879.20	2,719,252.80	1,359,626.40	
Net benefit after financing ¢		(15,106,960.00)	(9,957,946.68)	705,391.94	11,368,730.56	12,728,356.96	14,087,983.36
\$ Component		(1,987.76)	(1,310.26)	92.81	1,495.89	1,674.78	1,853.68
Selling Price/ kg of sugar syrup		5,203.54	Break -Even Price/kg	5256.10187			
Initial Production capacity; 1year annual increment of 50kg		300kg daily; anticipated interest rate	Mark-up (10%)	525.610187			
		30%	Selling Price Conversion	5781.712057			
IRR		20%	Rate(\$:¢)	7600			
NPV		¢6,864,623.89					

Appendix 7: Maltose Production (Small-Scale)-10% Price Reduction

Item	Project year					
	0	1	2	3	4	5
<i>Inflow</i>						
Total inflows						
<i>Outflow</i>						
Investment						
Building Equipment	6,000,000.00	-	-	-	-	-
heating pan	700,000.00	-	-	-	-	-
water containers	200,000.00	-	-	-	-	-
aluminium pans	300,000.00	-	-	-	-	-
filter press	550,000.00	-	-	-	-	-
press unit	2,800,000.00	-	-	-	-	-
furnance	1,000,000.00	-	-	-	-	-
chimney	100,000.00	-	-	-	-	-
Minor	260,000.00	-	-	-	-	-
enz prod unit	284,000.00	-	-	-	-	-
<i>sub-total</i>	12,194,000.00	-	-	-	-	-
Production cost						

Item	Project year					
	0	1	2	3	4	5
flour		39,900,000.00	39,900,000.00	59,850,000.00	79,800,000.00	79,800,000.00
labour		900,000.00	900,000.00	1,350,000.00	1,800,000.00	1,800,000.00
fuelwood		1,200,000.00	1,200,000.00	1,800,000.00	2,400,000.00	2,400,000.00
chopped seedlings		3,982,500.00	3,982,500.00	5,973,750.00	7,965,000.00	7,965,000.00
chemicals		105,480.00	105,480.00	158,220.00	210,960.00	210,960.00
Water		600,000.00	600,000.00	900,000.00	1,200,000.00	1,200,000.00
sub-total		- 46,687,980.00	46,687,980.00	70,031,970.00	93,375,960.00	93,375,960.00
Total Outflows	12,194,000.00	46,687,980.00	46,687,980.00	70,031,970.00	93,375,960.00	93,375,960.00
Net benefit before financing	(12,194,000.00)	(46,687,980.00)	(46,687,980.00)	(70,031,970.00)	(93,375,960.00)	(93,375,960.00)
Financing						
Loan	12,194,000.00					
Debt service(Principal)		2,438,800.00	2,438,800.00	2,438,800.00	2,438,800.00	2,438,800.00
Interest		3,658,200.00	2,926,560.00	2,194,920.00	1,463,280.00	731,640.00
Net benefit after financing	-	(52,784,980.00)	(52,053,340.00)	(74,665,690.00)	(97,278,040.00)	(96,546,400.00)
\$ Component						
Selling kg Price		(6,945.39)	(6,849.12)	(9,824.43)	(12,799.74)	(12,703.47)
Production Capacity						
		NPV	(ϕ 10,006,170.42)			
		years1-2; 50Kg per day five times a week				
		year 3 ; 75kg per day five times a week				
		year 4-5 ; 100kg per day five times a week				
\$:ϕ		7600				
		Interest rate of 30% is used				

Appendix 8 Cashflow analysis -Commercial Scale Production : 10% Total Cost Overrun

Item	Project year					
	0	1	2	3	4	5
<i>Inflow</i>						
Total inflows		416,232,000.00	485,604,000.00	554,976,000.00	554,976,000.00	554,976,000.00
<i>Outflow</i>						
Investment						
Building Equipment	20,000,000.00					
heating pan	3,200,000.00					
water containers	400,000.00					
aluminium pans	900,000.00					
filter press	2,900,000.00					
press unit	4,050,000.00					
enz prod unit	284,000.00					
Office equipment	800,000.00					
minor Equipment	1,400,000.00					
Stove and accessories	400,000.00					
Sub-total contingencies(10%)	34,334,000.00					
	3,433,400.00					
Maintenance (10%)		3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00
Total	37,767,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00	3,433,400.00

Item	Project year					
	0	1	2	3	4	5
Production cost						
Cassava Flour	252,000,000.00	294,000,000.00	336,000,000.00	336,000,000.00	336,000,000.00	336,000,000.00
labour (semi-skilled)	5,400,000.00	6,300,000.00	7,200,000.00	7,200,000.00	7,200,000.00	7,200,000.00
gas	4,320,000.00	5,040,000.00	5,760,000.00	5,760,000.00	5,760,000.00	5,760,000.00
chopped seedlings	23,895,000.00	27,877,500.00	31,860,000.00	31,860,000.00	31,860,000.00	39,825,000.00
chemicals	632,880.00	738,360.00	843,840.00	843,840.00	843,840.00	843,840.00
water	3,600,000.00	4,200,000.00	4,800,000.00	4,800,000.00	4,800,000.00	4,800,000.00
Packaging	-	-	-	-	-	-
Sub-total	289,847,880.00	338,155,860.00	386,463,840.00	386,463,840.00	386,463,840.00	386,463,840.00
Selling and general admin expenses						
indirect labour	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00	25,500,000.00
General admin	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00
selling expenses	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00	12,000,000.00
Sub-total	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00	49,500,000.00
Total	339,347,880.00	387,655,860.00	435,963,840.00	435,963,840.00	435,963,840.00	435,963,840.00
Contingencies (10%)	33,934,788.00	38,765,586.00	43,596,384.00	43,596,384.00	43,596,384.00	43,596,384.00
Grand total	373,282,668.00	426,421,446.00	479,560,224.00	479,560,224.00	479,560,224.00	479,560,224.00
Total Outflows	41,544,140.00	410,610,934.80	469,063,590.60	527,516,246.40	527,516,246.40	479,560,224.00
Net benefit before financing	(41,544,140.00)	5,621,065.20	16,540,409.40	27,459,753.60	27,459,753.60	75,415,776.00

Item	Project year					
	0	1	2	3	4	5
Equity	40%					
Loan	60%	24,926,484.00				
Debt service(principal)		4,985,296.80	4,985,296.80	4,985,296.80	4,985,296.80	4,985,296.80
Interest rate		7,477,945.20	5,982,356.16	4,486,767.12	2,991,178.08	1,495,589.04
Net benefit after financing ¢		(16,617,656.00)	(6,842,176.80)	5,572,756.44	17,987,689.68	19,483,278.72
\$component		(2,186.53)	(900.29)	733.26	2,366.80	2,563.59

Selling Price ¢/ kg of sugar syrup 5,781.00

Initial Production capacity; 1year 300kg daily; anticipated annual increment of 50kg

interest rate 30%

NPV ¢11,532,165.31

IRR 42%

\$:¢ 7600

1.1

Appendix 9: Maltose Production -Small-Scale : 10% Cost Overrun

Item	Project year					
	0	1	2	3	4	5
<i>Inflow</i>						
Total inflows	51,600,000.00	51,600,000.00	77,400,000.00	103,200,000.00	103,200,000.00	103,200,000.00
<i>Outflow</i>						
Investment						
Building Equipment	6,600,000.00	-	-	-	-	-
heating pan	770,000.00	-	-	-	-	-
water containers	220,000.00	-	-	-	-	-
aluminium pans	330,000.00	-	-	-	-	-
filter press	605,000.00	-	-	-	-	-
press unit	3,080,000.00	-	-	-	-	-
furnance	1,100,000.00	-	-	-	-	-
Chimney	110,000.00	-	-	-	-	-
Minor	260,000.00	-	-	-	-	-
enz prod unit	284,000.00	-	-	-	-	-
<i>sub-total</i>	13,359,000.00	-	-	-	-	-
Production cost						
flour	43,890,000.00	43,890,000.00	65,835,000.00	87,780,000.00	87,780,000.00	87,780,000.00

Item	Project year					
	0	1	2	3	4	5
labour		990,000.00	990,000.00	1,485,000.00	1,980,000.00	1,980,000.00
fuelwood		1,320,000.00	1,320,000.00	1,980,000.00	2,640,000.00	2,640,000.00
chopped seedlings		4,380,750.00	4,380,750.00	6,571,125.00	8,761,500.00	8,761,500.00
chemicals		116,028.00	116,028.00	174,042.00	232,056.00	232,056.00
Water		660,000.00	660,000.00	990,000.00	1,320,000.00	1,320,000.00
Sub-total	-	51,356,778.00	51,356,778.00	77,035,167.00	102,713,556.00	102,713,556.00
Total Outflows	13,359,000.00	51,356,778.00	51,356,778.00	77,035,167.00	102,713,556.00	102,713,556.00
Net benefit before financing	(13,359,000.00)	243,222.00	243,222.00	364,833.00	486,444.00	486,444.00
Financing Loan	12,194,000.00					
Debt service(Principal)		2,438,800.00	2,438,800.00	2,438,800.00	2,438,800.00	2,438,800.00
Interest		3,658,200.00	2,926,560.00	2,194,920.00	1,463,280.00	731,640.00
Net benefit after financing	(1,165,000.00)	(5,853,778.00)	(5,122,138.00)	(4,268,887.00)	(3,415,636.00)	(2,683,996.00)
\$ Component Selling kg Price	(153.29)	(770.23)	(673.97)	(561.70)	(449.43)	(353.16)
Production Capacity	4300		Before Financing			
	years 1-2; 50Kg per day five times a week	NPV	(¢9,661,997.77)			
	year 3 ; 75kg per day five times a week	\$:¢	7600			
	year 4-5 ; 100kg per day five times a week					
Interest rate of 30% is used						