PRE-FEASIBILITY STUDY OF THE PROCESSING OF AFRICAN LOCUST BEANS INTO DAWADAWA

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Prepared under Improvement of Dawadawa Processing Project

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ABSTRACT

Dawadawa is a highly nutritious condiment popularly used in Northern Ghana. It is mainly produced by women. The traditional dawadawa processing technology involves drudgery, wastes water, time and fuel. Processing is also done under very deplorable hygienic conditions.

The above mentioned deficiencies in traditional dawadawa processing technology led to the development of an environmentally benign technology which reduces the drudgery, time and energy involved in processing dawadawa.

The improved technology enhances the storability and marketability of the product. It is envisaged that with adequate promotion on dawadawa consumption and utilisation, the improved technology will expand the activities of the small scale women entrepreneurs and strengthen their economic base.

The study seeks to determine the financial viability of both traditional and improved processing technologies for sound investment decision-making by would-be entrepreneurs. It will also serve as a guide for donors who wish to assist projects with real chance of success financially.

The study concluded that the traditional dawadawa processing activity is not financially viable. This could be attributed to failure on the part of the processors to capture all the cost elements in pricing. However, the improved processing activity is financially viable and more efficient. The Breakeven Analysis resulted in a positive gross margin of ¢5.50 on each cube of dawadawa produced (improved) and a Breakeven quantity of about 3000 cubes, with monthly production capacity of 75,000 cubes by a group of five processors.

It is recommended that the packaging activity under the improved dawadawa production technology should be mechanised to reduce labour cost and intensive promotion on consumption and utilisation of dawadawa embarked upon.

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PRE-FEASIBILITY STUDY ON DAWADAWA (PROCESSING OF THE AFRICAN LOCUST BEANS INTO DAWADAWA)

1.0 INTRODUCTION

1.1 Background

Dawadawa is the Hausa term for the Fermented African Locust Bean (*Parkia clappertoniana)* and in colloquial usage refers to the tree itself (Norton, 1987). The Fermented African Locust Bean is a highly nutritious condiment popularly used in Northern Ghana. It contains vitamins, minerals and serves as a principal source of dietary protein for people who cannot afford meat (Kordylas, 1991).

In Northern Ghana, dawadawa processing is an important economic activity of women. However, the traditional processing method is drudgerous and time consuming. This has necessitated the development of improved processing technology which employs the use of a dehuller instead of the manual pounding to remove the seed coat. In addition to the reduction in drudgery involved in production of dawadawa, the improved technology saves fuelwood, time and water. The dawadawa is also produced under more hygienic conditions, neatly packaged to enhance its storability and marketability.

It is therefore envisaged that with adequate promotion on consumption and utilisation of dawadawa the new technology would help strengthen the economic base of beneficiaries, improve upon their standard of living and attract more young people into the African locust beans processing industry.

1.2 Description of *Parkia clappertoniana*

The average height of the tree is above 2.1m with medium to dense spreading canopy. It is propagated by natural regeneration, tree cutting, seedling, stumps or smokers and direct sowing. Farmers in Northern Ghana mostly use direct sowing by spreading some of the seeds on their farms after harvesting. Management is by pollarding, lopping and coppicing. Naturally, maturity takes about 12 years but with improved management practices maturity is reduced to 7 years (Yidana, 1993).

The fruit of the tree occur in bunches with a yellow mealy substance enclosing the seeds. The seeds are black or dark brown in colour.

1.3 Environmental Conditions

Parkia clappertoniana thrives well under mean annual rainfall and temperature of 99.2mm and 32.8°C respectively. The tree is tolerant to shade, soil compaction and constant wind exposure. It is moderately drought resistant.

1.4 Uses of *Parkia clappertoniana*

I. Agricultural Uses

The leaves and fruit pods are used as fodder for animals. The leaves which are rich in nitrogen are also used as manure.

ii. Medicinal Purposes

The young flower buds are used to cure leprosy (Dalziel, 1937). In La Cote d'Ivoire, the bark is used to prepare tonic for diarrhoea.

iii. Industrial Uses

The wood is used for construction, furniture and fuel. The bark, richin tannin, is used to tan leather. The wood ash is useful in soap-making as a source of potash.

iv. Culinary Uses

The fruit pulp, rich in easily assimilated carbohydrate, is used in preparing drinks. The seeds are processed into "dawadawa" which is used as flavour in soups, stews and jollof rice.

The yellowish mealy pulp around the seeds is dried, sifted and sold as additive for soups, cakes or eaten with meat and other food products (Irvine, 1961).

v. Ornamental Purposes

The tree is used as an avenue plant.

1.5 Objective

The study seeks to determine the financial viability of both traditional and improved dawadawa processing for prospective investors' considerations as well as to elicit socio-economic conditions underlying dawadawa production.

2.0 METHODOLOGY

2.1 Sources of Data

Both primary and secondary data were employed to achieve the objective of the study. Primary data were gathered through direct observations and semi-structured interviews with individual traditional processors as well as some officials of Ministry of Food and Agriculture in the Northern region. The test Kitchen Staff at Food Research Institute were also interviewed on the improved dawadawa production technology using a checklist.

The wholesale market at Tamale in the northern region was visited to observe the presentation and packaging of dawadawa for sale. Costs of processing equipment and prices of raw materials were obtained from the local market. An Informal Survey was also conducted at some Markets in Accra to compare the prices of dawadawa and other condiments.

Secondary information relevant to the study were obtained from Publications available at the Department of Agro-Forestry, Tamale.

2.2 Analysis of Data

Breakeven Analyses was done to determine the Financial viability of both traditional and improved dawadawa production activities. The efficiency of the improved processing technology over the traditional processing technology was analysed on the basis of the opportunity cost associated with the use of the improved processing technology developed.

3.0 SOCIO-ECONOMIC ASPECTS

3.1 Land Tenure

In most part of Northern Ghana, the subjects of a Chief have right to farm anywhere on the community's bush land as long as it has not been recently used or not required for grazing. However, ownership of land for compound farms around settlement is clearly delineated and partrillineally inherited, ie passing to a man's junior brothers or sons.

Settlers or strangers who need land for farming purpose would have to approach the chief of the area to give gifts of money or kola before land is allocated to him. After each harvesting, tributes are paid to the chiefs. In the case of commercial farmers, chiefs are allowed the use of a tractor rather than giving gifts or cash.

3.2 Ownership of *Parkia clappertoniana*

Ownership of *Parkia* trees whether through chieftaincy right or the presence of trees on farm land, is vested in the men. In most areas, the Parkin tree is usually regarded as the property of the chief of the area.

3.3 Supply Base

Parkia clappertoniana is a fruit tree mostly found in the savannah belt of West Africa (Abbiw, 1990). It belongs to the family leguminosae, and more specifically to the sub-family mimosoideae (Balogun & Fetuga, 1986).

In Ghana, it is found in colonies in places such as Ejura in the Ashanti region, the Shai plains and northern Abene in the Kwahu district of the Eastern region. However, the widest distribution is in the northern sector of Ghana ie the savannah zone (Irvine, 1961). The trees are harvested by men in the later part of the dry season (March/April) but processing is solely performed by women.

Unfortunately, there is no known document on the Parkia tree populations and yields from natural regeneration in Ghana. However, in line with government policies on export diversification and environmental protection, the rural agro forestry Department in the northern region has initiated an on-going programme which encourages the establishment of tree plantations including Parkia species by community members. Rural forestry project provides seedlings for the establishment of tree plantation and with proper management practices, about 52 trees of Parkia can be planted on an acre of land.

Research activities are undertaken to ensure the maximum exploitation of Parkia and forestall the erosion of their genetic base. Also efforts are being made to protect Parkia trees from wide spread annual bush fires and neglect.

From the fore going, there is satisfactory evidence that Parkia seeds would be adequately available for processing and rate of adoption of the new technology by small scale entrepreneurs is likely to be enhanced.

Presently, Parkia seeds are sold in the open market at prices ranging between ¢1,200 and ¢2,000 per bowl during the peak and lean season respectively. A bowl contains about 2.6kg of dawadawa seeds.

3.4 Product Market

Demand for dawadawa is high among the northern folks who use it as flavour in soups, stews and jollof rice. Apart from the northern Ghana which forms the largest market for dawadawa, some quantities of dawadawa are retailed in the South. The retailers get their consignment from traders who travel to the north to buy other grains like maize, millet and cowpeas.

In recent times, more people are becoming aware of the nutritive value of dawadawa although there is still the need for intensive educational campaign to promote its utilisation. This coupled with the fact that supply of fish and other sources of dietary protein is inadequate (Gyasi, 1996), consumption of dawadawa is being encouraged to curb the incidence of malnutrition, especially among pregnant women and children in many parts of the country. It is envisaged that dawadawa produced under the improved technology could compete favourably with other condiments like jumbo, royco and maggie cubes available on the markets. This assertion was confirmed through personal interactions with some individuals who dislike the mode of preparation and presentation of traditionally produced dawadawa. An informal survey conducted at some markets in Accra, also revealed that dawadawa is more affordable than other condiments.

3.5 Traditional Processing

Pre-Fermentation Treatment of Seeds

The seeds are boiled or cooked for 12 - 16 hours or overnight. Afterwards, the cooked seeds are pounded in a wooden mortar with sand or ash to remove the seed coat. The pounded seeds are thoroughly washed in a sieve or basket with continuous rubbing until the fibrous coating is removed.

Fermentation

The dehulled beans are cooked again to soften for about 6-8 hours, partially cooled and poured into paper-lined baskets. Either ash, millet flour or a tenderizer (specific leaves) is added and tightly covered with a lid and allowed to ferment for a few days (2 - 3 days).

Post fermentation Process

After fermentation, the seeds could be moulded directly or pounded before moulding into balls, (See Figure 1). The balls are sundried on raised platforms or on the floors.

3.6 Improved Processing

Pre-fermentation Treatment of Seeds

The seeds are cleaned by removing foreign materials from the seeds. Afterwards, the cleaned seeds are dehulled by the use of a dehulling machine (a prototype designed by FRI). The dehulled seeds are winnowed and sorted before boiling for about 2 hours.

Fermentation

Fermentation process is similar to that of the traditional method. However, corn flour (tenderizer) and spices are spread on the partially cooled seeds in layers before fermentation.

Post-fermentation Process

After fermentation, the seeds are moulded or milled using the dehuller before moulding into cubes and sundried (See Figure 2).

3.7 Packaging and Storage

Traditional Method

Dawadawa is displayed in head pans and retailed in polythene bags on the open market. Unsold dawadawa is dried intermittently to keep the flavour and extend its shelf life. It is usually stored in ventilated boxes for a maximum of two months.

Improved Method

Dawadawa is well dried, wrapped with aluminium foil and either sold singlely or bulk packaged in polyethylene bags.

Fig. 1 TRADITIONAL PRODUCTION OF DAWADAWA

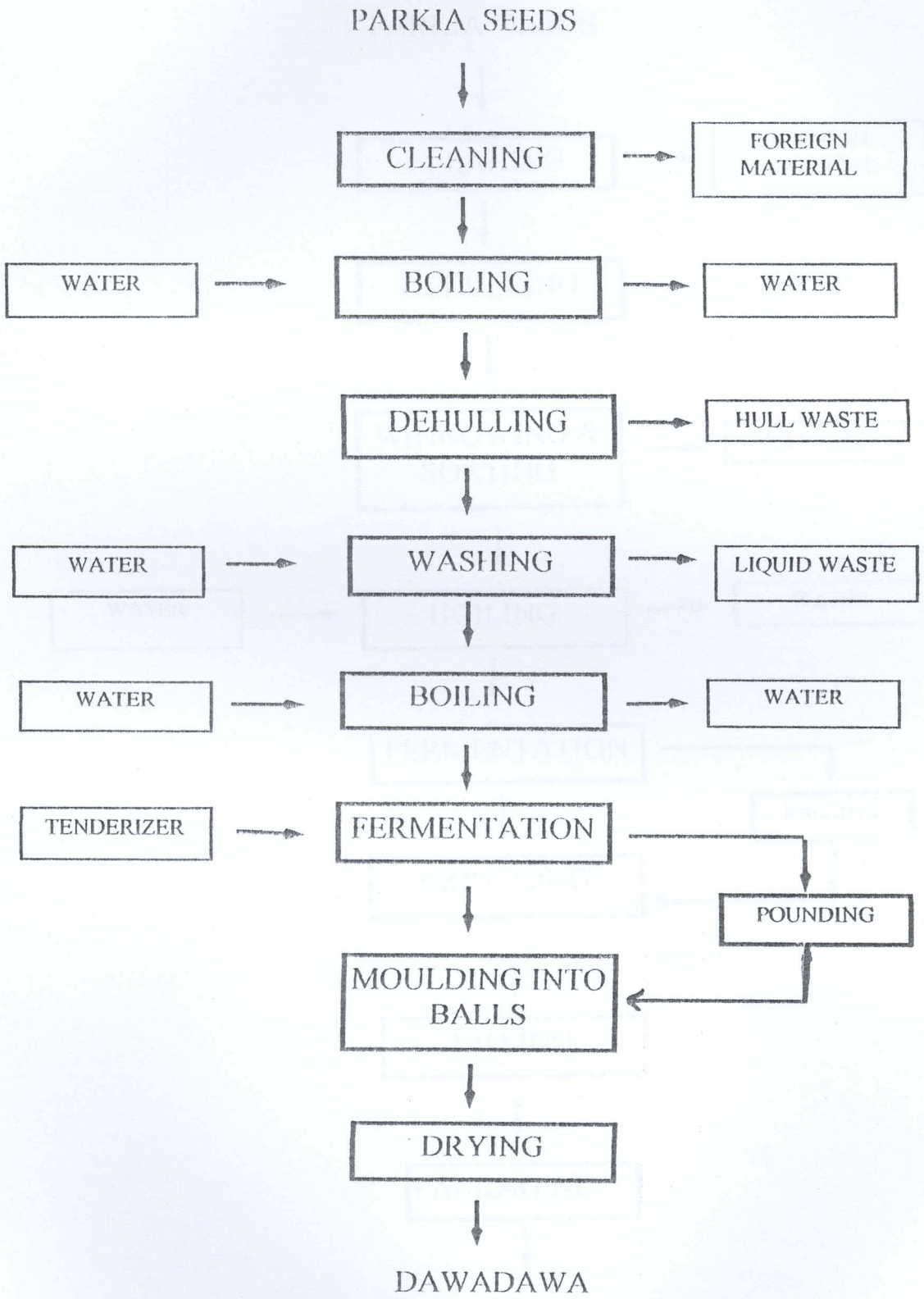
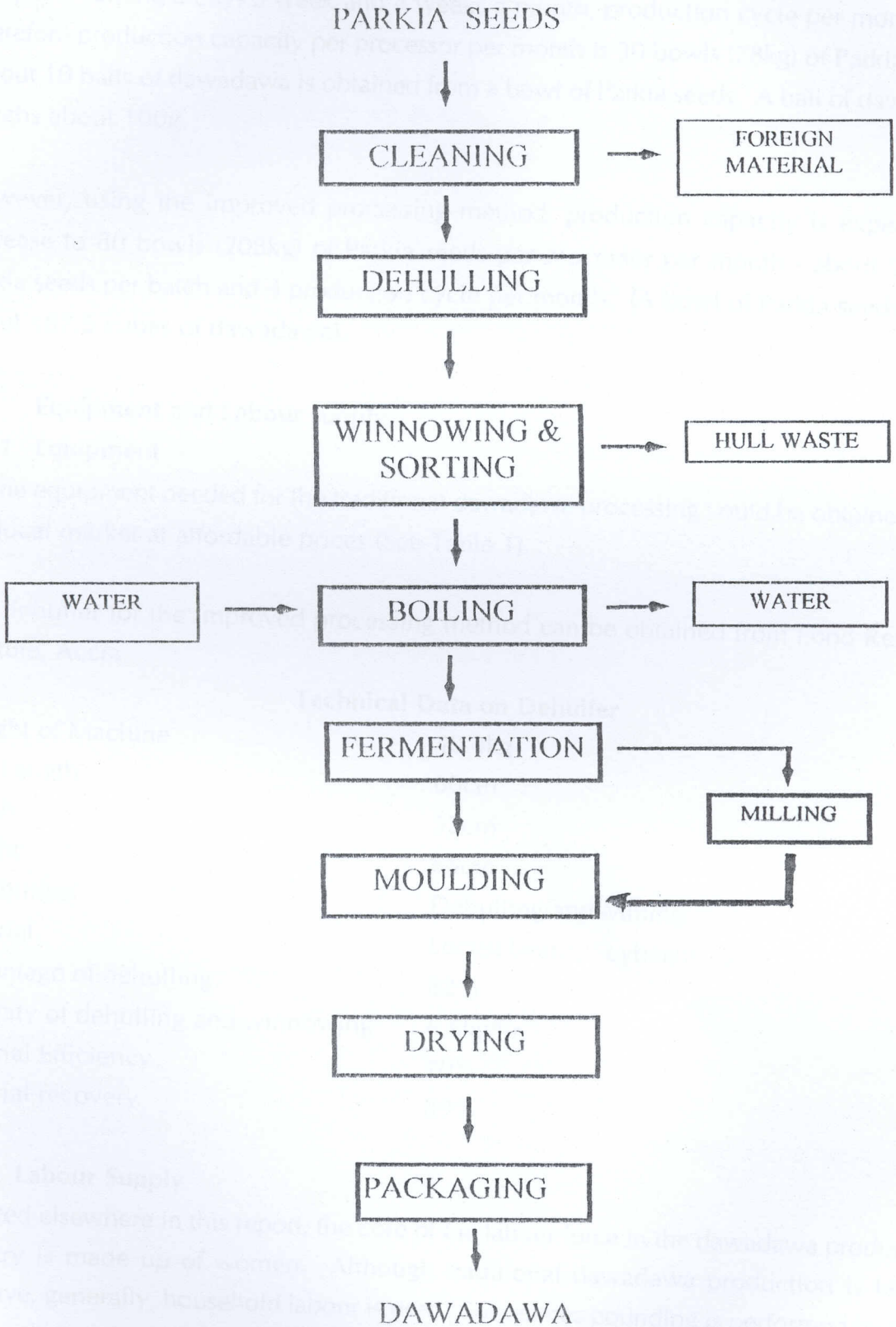


Fig. 2 IMPROVED PRODUCTION OF DAWADAWA



3.8 Capacities and Yield

Capacity of a traditional processor is about 5 bowls (13kg) of Parkia seeds per batch over 4 days. Working 6 days a week and 4 weeks a month, production cycle per month is 6. Therefore production capacity per processor per month is 30 bowls (78kg) of Parkia seeds. About 10 balls of dawadawa is obtained from a bowl of Parkia seeds. A ball of dawadawa weighs about 100g.

However, using the improved processing method, production capacity is expected to increase to 80 bowls (208kg) of Parkia seeds per processor per month - about 52kg of Parkia seeds per batch and 4 production cycle per month. (A bowl of Parkia seeds yields about 187.5 cubes of dawadawa).

3.9 Equipment and Labour supply

3.9.1 Equipment

All the equipment needed for the traditional dawadawa processing could be obtained from the local market at affordable prices (See Table 1).

The dehuller for the improved processing method can be obtained from Food Research Institute, Accra.

Technical Data on Dehuller

Weight of Machine	40.4kg
Size Length	60cm
Width	52cm
Height	65cm
Capabilities	Dehulling/and Milling
Material	Locust beans, Soybeans etc.
Percentage of dehulling	82%
Capacity of dehulling and winnowing	6.6kg/hr
Material Efficiency	70%
Material recovery	89%

3.9.2 Labour Supply

As stated elsewhere in this report, the core of the labour force in the dawadawa production industry is made up of women. Although traditional dawadawa production is labour intensive, generally, household labour is used. Sometimes pounding is performed by more than one person at a time in order to hasten the process.

Labour cost per manday in northern Ghana is about ¢1000, which is relatively cheaper than labour charges in Southern Ghana.

3.10 Water Use

Generally, dawadawa processors use river water for washing dehulled seeds. Most households also have dugout wells which serve as a source of water for domestic purposes as well as for dawadawa processing. However, during dry season, water supply is adversely affected and processors have to travel far distances in search of water. About 220 litres of water is used for processing a batch of 5 bowls (13 kg) of Parkia seeds traditionally whilst about 176 litres of water is used per batch of 20 bowls (52 kg) using the improved method.

3.11 Environmental Impact

The need to protect our environmental resources to ensure sustainability of life has become more urgent with increasing population and its attendant high demand for regular water supply as well as forest resources. In the light of the above concern, the environmentally benign processing technology developed is deemed opportune and appropriate. It has a positive impact on the environment particularly, in protecting our water bodies from a pollution emanating from repeated washing of Parkia seeds during traditional production of dawadawa. Also fuelwood which would otherwise be utilised in long hours of boiling Parkia seeds as described under the traditional method is conserved.

The level of noise produced by the dehuller during its operation is also relatively low and socially acceptable.

3.12 Financing

Traditional processors finance their activities from their own resources. However, in the case of the improved technology, the high cost of the dehuller would make individual ownership difficult. It is therefore anticipated that about five processors could pool their resources together to enable them own a dehuller. This will also encourage group formation among processors and become essential partners in research technology transfer.

3.13 Socio-Economic Benefits

Some of the socio-economic benefits associated with the adoption of the improved technology are presented below:

1. Increased income generating opportunities for women
2. Improvement in the standard of health of women processors
3. Improvement in the nutritional level of people through consumption of dawadawa
4. Encouragement of co-operative relationship among processors
5. Expansion of market outlets for dawadawa

4.0 FINANCIAL JUSTIFICATION AND CONCLUSION

4.1 Financial Justification

Breakeven Analysis on both traditional and improved dawadawa processing activities are presented in Table 1 - 6:

TABLE 1 EQUIPMENT COST AND DEPRECIATION SCHEDULE FOR TRADITIONAL PRODUCTION OF DAWADAWA

Item	Quantity	Unit Cost (¢)	Total Cost (¢)	Useful Life (Yrs)	Annual Cost (¢)
Aluminium Pot	2	20,000	40,000	10	4,000
Aluminium Bowls	2	18,000	36,000	6	6,000
Mortar	1	8,000	8,000	5	1,600
Pestle	3	1,000	3,000	4	750
Bucket (Aluminium)	1	8,000	8,000	5	1,600
Calabash	1	600	600	1	600
Sieve	1	1,000	1,000	2	500
Enamel Headpan	1	8,000	8,000	4	2,000
Baskets	2	500	1,000	0.5	2,000
Stools	2	1,500	3,000	2	1,500
			108,600		20,550

Assumptions Underlying Break-even Analysis for Traditional Dawadawa Production

1. Capacity per processor is 30 bowls (78kg) of locust beans per month.
2. Direct labour costs are assumed: 3 persons are required to pound a batch of raw material @ ¢1,000 per person; labour cost for removal of seeds, washing and rolling of final product will amount to ¢1,000/batch. Labour for fermentation and boiling is not significant.
3. Raw material is estimated @ ¢1,200/bowl.
4. About ¢4,000 worth of fuelwood is used for cooking a batch (5 bowls) of raw material.
5. About 220 litres of water is used per batch of 5 bowls.
6. About 10 balls (1000g) of the final product is obtained from a bowl of Parkia seeds and A ball of dawadawa sells @ ¢200 (a ball weighs about 100g).
7. Traditional hearth and working space do not attract any cost

TABLE 2 MONTHLY TOTAL VARIABLE COST - TRADITIONAL METHOD

Variable Input	Cost (¢)
Raw Material	36,000
Labour	24,000
Water	1,800
Firewood	24,000
Cement Paper	3,000
Sub Total	88,800
Selling expenses (5% sub total)	4,440
Total	93,240

Break-even Analysis

Break-even Quantity (BEQ)	=	Fixed Cost/(Price - Variable Cost)
Monthly Fixed Cost		1712.5
Price (¢/ball)		200
Variable Cost (¢/ball)		310.8
Gross Margin (Price - Variable Cost)		-110.8
BEQ (balls/month)		-15.46

TABLE 3 EQUIPMENT COST AND DEPRECIATION SCHEDULE FOR IMPROVED DAWADAWA PRODUCTION TECHNOLOGY

Item	Quantity	Unit Cost (¢)	Total Cost (¢)	Useful life (Yrs)	Annual Cost (¢)
Dehuller	1	200,000	200,000	10	20,000
Steamer	5	25,000	125,000	10	12,500
Aluminium Bowls	5	18,000	90,000	6	15,000
Bucket	5	8,000	40,000	5	8,000
Calabash	5	600	3,000	1	3,000
Sieve	5	1,000	5,000	2	2,500
Enamel Head-pan	5	8,000	40,000	4	10,000
Baskets	20	500	10,000	0.5	20,000
Stools	6	1,500	9,000	2	25,000
Gas Stove	3	42,000	126,000	10	12,600
Cylinder	3	90,000	270,000	30	9,000
Raised Platform (Drying Tray)	5	35,000	175,000	5	35,000
Sub-total			1,093,000		172,600
Ancillaries (10% of subtotal)			109,300		17,260
Total			1,202,300		189,860

Assumptions Underlying Break-even Analysis for Improved Dawadawa Production

1. Group of 5 processors use a dehuller at full capacity based on 1 shift - 8 hours per day, 5 days per week and 4 weeks per month working regime. About 400 bowls (1040kg) of locust beans are processed per month.
2. About 75,000 cubes of dawadawa are produced per month. A cube weighs 4g and sells @ ¢30.
3. There are no resource constraints to processing.
4. It is expected that with the potable size of equipment, working space does not attract any cost.

TABLE 4 MONTHLY VARIABLE LABOUR COST - IMPROVED TECHNOLOGY

Production Step	Man days	Cost/Man day	Total Cost (¢)
Dehulling and	40	2,000	80,000
Winnowing	30	2,000	60,000
Moulding into Cubes	30	2,000	60,000
Drying and Packaging			200,000
Total			

TABLE 5 MONTHLY TOTAL VARIABLE COST - IMPROVED TECHNOLOGY

Variable Input	Cost (¢)
Raw Material	480,000
Labour	200,000
Fuel	65,000
Water	4,800
Corn flour & Spices	20,000
Packaging Material	900,000
Sub-total	1,669,800
Selling expenses (5% of sub-total)	83,490
Contingencies (5% of sub-total)	83,490
Total	1,836,780

Break-even Analysis

Break even Quantity (BEQ)	=	Fixed Cost/(Price - Variable Cost)
Monthly fixed cost	=	15821.67
Price (¢ cube)	=	30.00
Variable cost (cube)	=	24.50
Gross Margin		5.5
BEQ (Cubes/Month)		2876.7

TABLE 6 SUMMARY OF PREFEASIBILITY STUDIES

	Traditional Method	Improved Technology	Remarks
Minimum Investment Capital Capital Outlay Working Capital (25% annual variable cost)	¢383,320 ¢108,600 ¢279,720	¢6,712,640 ¢1,202,300 ¢5,510,340	Improved technology could be jointly owned by 2 - 5 women. Packaging material is expensive
Capacity/Month	78kg of locust beans	1040kg of locust beans	The capacity of the improved technology is about 13 times that of the traditional
Output/Month	30kg	300kg	Improved technology has about 10 times output per month over that of the traditional method. (Improved produced dawadawa has less water content).
Labour Requirement/kg	¢800	¢670	More labour is required for moulding improved dawadawa into cubes and wrapping with aluminium foil. This activity needs to be mechanised to reduce labour costs.
Water Requirement/kg	¢60	¢16	In monetary terms about 73% of water cost is saved using the improved technology
Financial Viability	Traditional dawadawa production is not financially viable. Break-even analysis showed a negative gross margin of ¢110.8 on each ball of dawadawa weighing 100g	Is financially viable. Breakeven analysis showed positive gross margin of ¢5.50 on each cube of dawadawa weighing 4g	Traditional processors do not capture all the costs elements such as family labour in pricing. The products are therefore under priced.

4.2 CONCLUSIONS AND RECOMMENDATIONS

The study revealed that traditional dawadawa production activity is not financially viable. The Breakeven analysis showed a negative gross margin of ¢110.8 on each ball of dawadawa produced. The traditional processors do not capture all the cost elements such as family labour in pricing.

The minimum investment capital (working capital and cost of equipment) needed to start traditional dawadawa production activity is approximately Four Hundred Thousand Cedis.

Improved dawadawa processing activity is a viable venture with a positive gross margin of about ¢5.50 on each cube of dawadawa produced. With a group of five women processing about 75,000 cubes of dawadawa per month, the breakeven quantity is approximately 3000 cubes of dawadawa.

The minimum investment capital needed to undertake an improved dawadawa production business is approximately 6.8 million cedis.

It was observed that using the improved technology, the capacity of improved technology is about 13 folds over that of the traditional. About 73% and 16% of water and labour, fuelwood costs per kilo of dawadawa produced respectively are saved (See Table 6). However, the labour cost associated with moulding of dawadawa into cubes and wrapping with aluminium foil is rather on the high side. It is therefore recommended that the packaging activity should be mechanised in order to reduce the cost of labour (See Table 6). Promotion on consumption and utilisation of dawadawa needs to be strengthened to increase demand.

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