ECONOMICS OF HIGH QUALITY CASSAVA FLOUR PRODUCTION: IMPLICATIONS FOR RESEARCH AND DEVELOPMENT, AND PROMOTION OF CASSAVA-BASED INDUSTRIES IN NIGERIA.

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ABSTRACT
This study was carried at the National Root Crops Research Institute Umudike, in 2007 to evaluate the cost effectiveness of the production of high quality cassava flour from (*Manihot Esculenta Crantz*), NR8082 developed by the institute. The processing method, resource inputs and problems encountered are described. Results show that an estimated gross margin per tone of N29, 473 and a net processing margin (profit) of N 29,329.73 are realizable from the venture. The findings reveal that the project is profitable and viable. On research and development, it is suggested that for a continuous flour production during rainy season, a suitable mini cabinet dryer should be obtained by the processor. This will prevent further fermentation of the flour and possibly prevent change of colour caused by microorganisms.

Keywords: High quality cassava flour, processing, input, economics.

INTRODUCTION
In many developing countries, agricultural production represents a high percentage of the total GDP, and rural house hold incomes depend almost entirely on agriculture (Camara, 2000). The range of agricultural products is often limited due to climatic conditions, marginal soils and water scarcity. Cassava (*Manihot esculenta Crantz*) is a perennial root crop that grows in non-ideal conditions and represents a major staple crop in Africa, South America and Asia. The relative importance of cassava arises from its adaptability to a wide range of agro-ecologies, including marginal lands and erratic rainfall conditions (Nweke., 1994).

Nigeria is the largest producer of cassava in the world, with a total production of 34 million metric tons a year (FAO, 2004). Cassava is a cheap and reliable source of food for more than 700 million people in the developing world (FAO 2003). It is estimated that 250 million people in sub Saharan Africa derive half of their daily calories from cassava (FAO, 2005). In Nigeria cassava supplies about 75 percent of daily calorie intake to over 50 million Nigerians in cassava growing zones (Ugwu *et al;* 1993). Data from the collaborative study on cassava in Africa (COSCA) showed that 80 percent of Nigerians in the rural areas eat cassava meal at least once weekly (Ezedinma *et al.,* 2003). Generally cassava is the second most important food staple, after maize in terms of calories consumed (Nweke, 2004) It is the sixth major staple in the world after rice, wheat, maize, potato and sweet potato with an annual production of 185 million tons (FAO, 2003). All parts of the cassava plant can be consumed, including the starchy roots and foliage. It provides very efficient carbohydrate production and it can be used as food, animal feed, starch and alcohol (FAO and IFAD, 2000). It also contributes substantial amount of protein, minerals (iron and calcium) and vitamins (A and C) through leaf consumption, although to a much smaller population in the present time (Dixon, *et al.,* 2003).

Post-harvest physiological deterioration (PPD) is an endogenous root disorder affecting the storage roots of cassava. Within one to three days of harvest, cassava roots exhibit a blue-black discolouration and other unpleasant changes (Reily., 2007). This rapid deterioration is a major constraint on the development of cassava, reducing the marketability of fresh unprocessed cassava. Total losses from post harvest physiological deterioration (PPD), pests and diseases have been estimated at 48 million tons yearly or more than 30 percent of the total world production valued at US 1.4 billion (GCP,2000).

Finding an economic way to deal with some of these rapid post harvest deterioration is the key to opening the potential of cassava in fighting poverty. One of such methods of reducing losses in cassava is through processing. Processing reduces the bulkiness, transportation costs and extends the shelf life as well as adding value to the product. The fact that cassava roots have to be processed before marketing may seem to make it less tradable than grains. But the vast majority of cassava roots are processed at the village level by a variety of small-scale methods into many different products that cater for the local preferences and for industrial use. Small-scale processing machines namely graters mills and press are available in the processing areas of Nigeria. (Ezedinma and Oti, 2001) Cassava can be processed into chips pellets, flour, ethanol and starch. High Quality cassava flour is a valuable product from processed cassava. The flour is used in substituting wheat flour in bakeries and confectionery industries and recently its demand has increased (Okoruwa and Sanni 2005)

The objectives of this are:

1. Describe the High quality cassava flour production process.
ii. Identify and cost the required inputs used for its production
iii. Estimate the return, processing margin and profitability.
iv. Discuss the implication of the study for research and development.

The policy on the use of 10% cassava flour in bread and confectionery has automatically put the farmers and cassava processors into the supply chain of bakers and flour millers in Nigeria. This has created an opportunity for farmers and cassava processors to work together with the flour millers and master bakers with the technicalities and investment opportunities in the cassava flour industry (IITA, 2005).

METHODOLOGY

Processing method and data collection:

Two samples (94kg and 78kg) of cassava roots *(M. esculenta cranz)* varieties (NR8082) were used for the study. The processing was carried out by a food Technologist at the processing unit of National Root Crops Research Institute, Umudike.

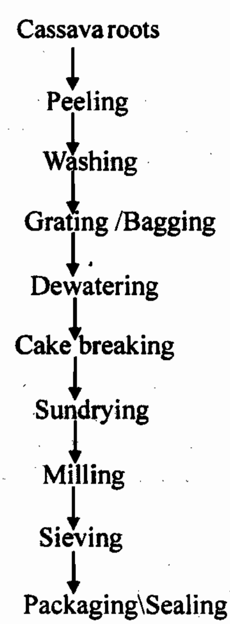

Figure 1: High Quality Cassava Flour Production Process, NRCRI Umudike, 2007

Cost effectiveness of Cassava flour production

The processing method used was that described by (Okoruwa and Sanni 2005). The processing stages or sequences are illustrated in figure 1. These include manual peeling of cassava roots, washing to remove particles of dirt, grating into pulp using a grating machine and dewatering using a hydraulic press to remove water. Others are cake breaking, sundrying, milling into flour, sieving into fine particles and packaging\sealing.

Close observations of all the processing operations were made and recorded. Data taken include labour, time utilized, cost of raw material (cassava), and cost of finished product (flour), machine-hours used as well as the number of days the equipments and house were used for the processing operations. The data was used in calculating the depreciation cost attributed to the use of these fixed resources.

Limitation of study

As the data analyzed in this report are generated, some discrepancies are bound to occur. Mistakes might have occurred in the weighings and timing of the operations.

Apart from the possibility of such mistakes and the consequent error in data, there are other measurement problems. One such problem is valuing of certain inputs, for instance the estimation of depreciation charges incurred in using the machines and building. There are weather disturbances. In one of the occasions of drying the samples there was rain; the samples were sent in and brought out when it was sunny. This caused the drying time to be prolonged; in extreme cases it does affect the colour of the product/flour. There could also be some processing losses associated with peeling, grating and milling.

The empirical model

The analytical frame work incorporates the concepts of gross margin analysis and complete costing as described by Reddy *et al.* (2004).There is a direct relationship between cost, method of production and that between inputs and outputs. All the accounting cost elements such as direct labour, material and expenses are embodied in the product. The gross margin analysis deducts the variable cost of production (e.g, cost of labour and material) from the gross revenue generated per tone

$$GM = TR - TVC$$

.where;

GM =Gross margin

TVC =Total Variable Cost.

TR =Total Revenue

Complete costing evaluates the profitability of the processing technology. The method involves, deducting the variable cost and fixed cost of production from the gross revenue generated. The economic analysis assumes that an individual small processor adopting the technology seeks to maximize profits and operates in a competitive market. His total cost of production is made of Total fixed and variable cost components. The fixed cost item consists of labour and raw materials. The depreciation charges on the equipment and building were calculated using the straight line method. The calculation was based on 4 days use of processing equipments, their acquisition and construction costs of the building, namely (I). Grating machine (N70, 000) (ii). Presser N 46,000(.iii).Milling machine N 120,000(iv).Sealing machine N 5,000 and (v) construction of the building N 20,000 respectively. Their assume economic life of 20 years was also used to calculate the depreciation value. Equally, interest on funds (assumed borrowed) was estimated. Based on these assumptions and information the gross margin over fixed costs and the net processing margin (profit) of high quality cassava flour (output) were estimated using the going market prices of inputs and output (product).The model for complete costing is implicitly stated as follows:

π=TR-TC
TC=TFC+TVC
Where
π =Net processing margin or profit.
TR= Total Revenue TFC= Total Fixed Cost
TC= Total Cost TVC= Total Variable Cost.

RESULTS AND DISCUSSION

Labour input into processing operations: Table 1 presents the labour demand by processing stages of the two samples of cassava roots (94kg and 78kg) and shows that a total of 691 man-minutes of labour were employed in processing an average of 86kg of cassava roots.

Table 1. Labour demand (man-minutes) by processing stages of cassava roots.

	Sample 1 94 kg	Sample 2 78 kg	Mean 86 kg
Processing Stage			
Peeling	120	116	118
Washing	4	3	3.5
Grating/Bagging	5	3	4
Dewatering	25	25	25
Cake breaking	5	5	5
Sundrying	420	420	420
Milling	11	10	10.5
Sieving	112	90	101
Packaging /Sealing	4	3	3.5
Total	**706**	**675**	**690.5**

Source: NRCRI, Umudike, 2007.

Table 2 gives the labour demand for processing 86kg and 1 tonne of cassava roots respectively. The relative labour demands per tonne of cassava roots by processing stage are presented in Table 3 and Table 4 ranks the processing stages by labour demand. It was found that the sundrying stage ranks first followed by peeling, sieving, milling, cake breaking Grating/bagging, washing and packaging/sealing in that order. The dewatering stage demands the least labour. Sundrying is labour intensive because the HQCF needs to dry to such a level that the moisture content will not encourage the growth of microorganisms and also to ensure that the shelf life of the product is prolonged.

Table 5 presents the estimated costs and gross margin per tonne of raw material over variable cost. The gross margin of raw material over variable cost is N 1279.00 while that of flour is N 29,473. The gross margin analysis measures the margin between the gross output and variable costs for an enterprise. Fixed overhead costs are not considered as in complete costing. In this sense, therefore, the gross margin of any enterprise in the firm is its contribution towards offsetting the fixed costs.

Economic theory holds that for a business to survive in the short run there is need to set the price of its product to cover the average variable costs. (Ezeh, 1992). Results of our gross margin analysis have shown that the average variable cost (N 6721.00t^{-1}) is less than the average price (N 8,000t^{-1} t^{-1}) for raw material and also the average variable cost of N 170,527.00t^{-1} is less than the average price of N 200,000t^{-1} for flour (product). Thus, this finding suggests that the project could be viable; on the short run.

Table 2: Labour demand (Man-days) per tonne of cassava roots by processing stage.

Processing Stage	Labour Time Used	
	Per 86 kg	Per tonne
Peeling	0.250	2.907
Washing	0.007	0.081
Grating/Bagging	0.008	0.093
Dewatering	0.005	0.058
Cake breaking	0.010	10.116
Sundrying	0.875	10.174
Milling	0.022	0.256
Sieving	0.210	2.442
Packaging /Sealing	0.007	0.081
Total	1.769	16.208

Source: NRCRI, Umudike, 2007.

Table 3: Relative labour demands (man-days) per tonne of cassava roots by processing stage.

	Labour Time Used	
	Per 86 kg	**Per tonne**
Processing stage		
Peeling	2.907	17.94
Washing	0.081	0.50
Grating/Bagging	0.093	0.57
Dewatering	0.058	0.36
Cake breaking	0.116	0.72
Sundrying	10.174	62.76
Milling	0.253	1.58
Sieving	2.442	15.07
Packaging /Sealing	0.081	0.50
Total	**16.208**	**100.00**

Source: NRCRI, Umudike, 2007.

Table 4: Ranking of processing stages of cassava roots by labour demand

Rank	Processing stage	Score (%)
1st	Sun drying	62.76
2nd	Peeling	17.04
3rd	Sieving	15.07
4th	Milling	1.58
5th	Cake breaking	0.72
6th	Grating/Bagging	0.57
7th	Washing	0.50
8th	Packaging/sealing	0.50
9th	Dewatering	0.36

Source: NRCRI, Umudike, 2007.

Table 5. Estimated Costs and gross margins per tonne of raw material and flour

Item	Unit	Quantity	Prices ₦	Value (₦)
Gross output (a)				
(Revenue)	Tonne	0.04	200,000	8,000
Variable costs (VC)			6,000	
Cassava roots	Tonne	0.172	200	1032
Labour (Internal)	Monday	90	200	1800
50kg polythene	Number	4	16427.1	800
Milling (External)	Tonne	0.0487	120	800
Transport/Fuelling	Litre	10		1200
Interest charge (17%)				1089
Total Variable Costs (TVC) (b)				6721.00
Gross margin t^{-1} raw material (a-b)				1279.00
Gross margin t^{-1} (Flour)**				29,473.00

TVC/tonne of flour = N 170,527.
Source: NRCRI, Umudike, 2007.

Table 6 shows the estimated costs and net processing margins (profits) per tonne of raw material and flour. The net processing margin per tonne of raw material and product (flour) are N 1135.30 and N 29,329.73 respectively. These net margins represent profits since they are differences between estimated revenues and total costs (total variable costs plus total fixed costs) of the project. The result shows that the project is profitable and viable. However, the use of these Profit estimates for feasibility appraisal calls for caution since their computation is liable to error. It should also be noted that other conditions for entrepreneurial success would need to be met by a "typical" small processor. These conditions include an optimal scale of operation, demand for the product and stable input and product prices

Table 6: Estimated cost and net Processing Margins of Raw Cassava Material and High Quality Cassava Flour (HQCF)

Item	Unit	Quantity	Prices ₦	Value (₦)
Gross output (a)				
(Revenue)	Tonne	0.04	200,000	8,000
Variable costs (VC)			6,000	
Cassava roots	Tonne	0.172	200	1032.00
Labour (Internal)	Monday	90	200	1800.00
50kg polythene	Number	4	1642.1	800.00
Milling (External)	Tonne	0.0487	120	800.00
Transport/Fuelling	Litre	10		1200.00
Interest charge (17%)				1089.00
Total Variable Costs TVC (b)				6721.00
Fixed costs (FC)				
Depreciation charge for 4 days' usage**				
Machines				132.42
Building				10.85
Total fixed cost (TFC) (C)				143.27
Total cost (TC) = TVC+TFC (d)				6,864.27
Net Processing Margin t^{-1} for raw material (TR-TC)				1135.73
*Net Processing Margin t^{-1} (Flour) (TR-TC)				29,329.73

** The acquisition and construction costs of machines and building are N241000 and N20, 000 respectively and their economic life is assumed 20years (1 year = 52 weeks, 1 week = 7days,4 days' usage.). *Net processing margin for flour is based on the computed figure (TR-TC=N200000-N170670.27)
Source: NRCRI, Umudike 2007.

CONCLUSION AND POLICY IMPLICATIONS.

The economic analysis has shown that the technology for production of high quality cassava flour is labour intensive, requiring about 16 man days in processing one tonne of cassava roots. The technology is evidently small Scale. An estimated gross margin N29, 473 t^{-1} over variable cost and a net processing margin (profit) per tonne of flour of N29, 329.73 are realizable from the project. The results of this study have important implication for research and development (R&D) and promoting of small- scale cassava-based industries in Nigeria. On R&D, it is suggested that for a continuous flour production during rainy season, a suitable mini dryer should be obtained to prevent further fermentation of the cassava flour and possibly prevent change in colour caused by microorganisms, experienced during prolonged sun-drying. According to Abass *et al;* 1998, influence of weather on the production capacity revealed that production capacity of small-scale processors during dry season reduces to 10-50% in the rainy season, as a result of difficulty in drying. Processor can also form cooperatives to partnership and attract establishment of flash dryers from IITA. This will also help to improve quality and quantity of high quality cassava flour production.

On the promotion of cassava based industries it is worth maintaining that any developed technology (innovation) can be adopted by an entrepreneur if and only if it has been proved viable, given that the entrepreneur can finance it. A continual measure of project's viability is its potential to yield an acceptable level of profit to the entrepreneur. Our results have shown that high quality cassava flour using the IITA technique is cost effective, what seem to be urgently needed are positive policies aimed at promoting this technology making it acceptable to and adoptable by small investors. Government should also provide intending cassava processors with soft loans to enable them procure the necessary equipments needed for the production of high quality cassava flour.

Further, the peel from the processed cassava roots could be utilized by other rural industries to produce livestock feed and organic fertilizers. If well integrated, horizontally and vertically, these small scale cassava industries could generate employment and income for rural dwellers and provide raw materials for other industries.

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