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ECONOMIC ANALYSIS OF ALTERNATIVE CASSAVA PROCESSING TECHNOLOGIES:

A CASE STUDY OF DELTA NORTH AGRICULTURAL ZONE, DELTA STATE

APRIL, 1997

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A PROJECT REPORT IN THE DEPARTMENT
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IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE
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CERTIFICATION

Kaine, Anthony I. Nwanneamaka a Postgraduate Student in the Department of Agricultural Economics and with the Registration Number PG/MSc/92/13670 has satisfactorily completed the requirement for the course and research work for the degree of Master of Science (Msc) in Agricultural Economics. The work embodied in this Project Report is original and has not been submitted in part or full for any other diploma or degree of this or any other University.

Dr. E. C. Eboh
Supervisor
Date April 22, 1997

Dr. E. C. Nwagbo
Head of Department
Date April 22 1997

DEDICATION

This work is dedicated to Almighty God, and to my father Chief S.U. Kaine, my mother V.A. Chukwudi and J.U. Kaine (my step mother) for their encouragement and support in all my endeavours.

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ABSTRACT

This study on the economic analysis of alternative cassava processing technologies was conducted in Delta State with Particular emphasis on Delta North Agricultural zone, Delta State. The study covered 60 farmers/processors randomly selected from five Local Government Areas in the study area. Frequencies, means, percentages and partial budgeting technique were employed in analyzing the data.

Both traditional and modern processing technologies were used for processing cassava tubers through a number of operations. Gari, akpu, starch, abacha and cassava flour were the main products obtained from processing cassava in the study area. Cassava tubers used for processing were obtained from personal farms, spouses farm as well as purchased from the market. Paid and family labour services were employed for processing cassava tubers. Women and children (male and female) contributed in the various processing operations in the study area.

Net margin of cassava processing for the different products were estimated and discussed. The analysis showed that abacha is more profitable with a net revenue of =N=3,200.70/5,000kg. This is followed by akpu and gari/starch with a net revenue of =N=1,031.70/5,000kg and =N=748/5000kg respectively. To analyse the economics of the different processing technologies, partial budgeting technique was employed. The result shows that a labour cost of =N=200 was incurred by using the traditional processing technology while a total amount of =N=300 would be lost by using the modern processing. The net profit change of -=N=300 indicates that a total labour change of =N300 was incurred by using a machine (modern processing technology). Therefore, it would be more economical to use the traditional processing technology at their small processing capacity.

Several factors militating against increased cassava processing in the study area were identified and these include: tedious nature of peeling, lack of government support, poor storage of cassava/storage facilities, lack of sufficient capital to invest, market uncertainty and e.t.c. There is the urgent need therefore for the government and financial institutions to check these bottlenecks and hence support cassava farmers/processors by encouraging increased cassava production/processing through the provision of adequate storage facilities. Also loans and subsides should be given to cassava farmers/processors to enable them increase the output of processed cassava products. If this is done, it will go a long way to improve their income as well as their standard of living and hence accelerate economic development.

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CHAPTER ONE

INTRODUCTION

1.1 Background Information

Cassava, *Manihot esculenta* Crantz believed to have originated from Brazil and introduced into West Africa by the Portuguese is considered the most productive crop in the tropics. Apart from its high productivity and calorific content, cassava has other advantages such as being "season band" and the ability to store well in the soil for several months. This is why cassava has been called the "famine security crop" (Okuneye and Igben, 1981). These good qualities allow cassava farmers some flexibility.

Ijere (1977) and Food and Agricultural Organisation (1983) reported that next to Zaire, Nigeria is the second largest producer of cassava in the world and it is one of the food crops in which several parts of the world look up to Nigeria for leadership in research and production. The International Institutes for Tropical Agriculture (IITA) (1991) however, reported that Nigeria is the largest producer of cassava in 1989 and 1990, surpassing Brazil and Thailand. Cassava production in the country accounts for about 22% of the total output of Africa (Nweke *et al*, 1988 and Ijere, 1977).

The yearly fresh cassava roots production in Nigeria is about 10 to 12 million metric tonnes on a land area of 1.2 to 1.4 million hectares [National Root Crop Research Institute (NRCRI), 1983]. Onwueme (1987) and NRCRI (1986) reported cassava to have gained advantage over yam to some extent in the South due to its ease of cultivation, considerable resistance to drought, ability to grow in exhausted soils and generally its ability to adapt to a wide range of ecologies.

It is estimated that over 120 million people throughout Africa rely heavily upon cassava for their energy source (April *et al*, 1974; Hahn and Keyser, 1985; Dorosh, 1987; Sarma and Kunchai, 1990). Cassava possesses many merits as insurance crop, source of carbohydrate, energy food, etc. The processed forms can be sources of raw materials for some industries as well as animal feed (Iduosogie and Olayide, 1982; Hahn, 1988).

Okoigbo, (1971), Idusogie and Olayide, 1982 reported cassava to have been a major food crop in Nigeria for many decades. Its importance in providing the dietary needs of Nigerians grows over the years and with increases in population. Cassava is most important in the diets of the people in the Southern States where it is consumed in the processed form mainly as gari and akpu. In some parts of Northern Nigeria, cassava is consumed as a boiled or baked vegetable (dan Wake) (Ifediora, 1993; Okigbo, 1975; Idusogie and Olayide, 1982).

Processed forms of cassava include gari, starch, Cassava flour, akpu (foofoo), tapioca, abacha, kpo-kpo gari.
The form into which cassava is processed depends on such factors as cultural food habits, tastes and preference of the people as well as the variety of cassava and age at harvest of tubers (Hahn, 1988 and Okorji *et al.* 1989).

Cassava is also processed to make Syrup and Monosodium glutamate, the latter being very widely used to enhance the flavour of other processed foods (Susa and Anne, 1988). Furthermore, Truman and Phillips (1974) after elaborate research maintains that cassava whether fed as root or processed, promotes a rapid growth of pigs as cereals and it is as well used for milk production in dairy cattle.

Rural based processing offers opportunities in terms of employment, adds value to products, reduces waste due to spoilage, improves acceptability, extends storage life and encourages development of technical and marketing skills in villagers. Increased processing of agricultural products could result in substantial benefits for national economies (Ifediora, 1993).

Cassava processors are faced with numerous problems which limit their ability to improve their contribution in processing activities. Some of these problems are associated with socio-economic factors (such as culture, belief, capital and e.t.c.) poor infrastructure, inadequate processing equipment and lack of access to loan to enable them commercialize their processing operations.

Improvement of cassava processing and utilization techniques would greatly increase labour efficiency, productivity, incomes and life of cassava farmers and the urban poor as well as enhance the shelf-life of products, make transportation easier, raise marketing opportunities and upgrade nutrition (IITA, 1992).

1.2 Statement of the Problem

Agricultural production would be meaningless if what is produced is not processed into forms that consumers would prefer or cherish. The quantity and quality of agricultural products processed into food products affect the marketability and availability of food to consumers.

In Nigeria today, cassava has assumed a prominent and significant role as one of the major staple food not only among the rural people but also among a lot of urban dwellers. As a result of demand generated for the major product - gari; cassava now forms a major item in the crop combination of most farmers. Emphasis is now on intensifying cassava production to meet the demand of the general populace.

Ashiedu (1989) observed that after harvesting, cassava roots are susceptible to spoilage, and without any preservation measure can only be stored for about 48 hours before they begin in deteriorate. Hence Booth (1974), Etegere and Romakrishna (1985) recommended that cassava roots be processed within 24 hours after harvesting because of their toxicity and perishability.

Researches have shown that cassava contain substances known as cyanogenic glucodies, which breaks down into hydrocyanic acid (HCN) after the crop is harvested. This acid makes raw cassava very poisonous for (animal and human) consumption (Cook and coursey, 1981;

Rosling, 1987). Processing of cassava is a measure to remove this poison, reduce their toxicity, increase their palatability and storage life. This agricultural operation (processing) has not been given its appropriate place as it is mainly done by rural dwellers.

In line with this, Aboaba (1976) and Odeniyi (1985) remarked that efficient storage and processing of food including cassava which are obtained in developing countries as a solution to food shortage in the country has not been given adequate attention in Nigeria. Isirimah el al, (1989) and Hahn (1988) on the other hand reported that research on cassava has so far concentrated on production aspects with little or nothing done on the processing, storage and marketing aspects.

This study derives from the importance of cassava as one of the major staple food not only among the rural people but also among a lot of urban dwellers, the rising population, the resultant rise in food-stuff prices, the need to improve income and taste of rural and urban dwellers as well as the dearth of data on cassava processing in the study area. There is need therefore to look into the economic analysis of alternative cassava processing technologies, analyze the cost and return of the different technologies and the resulting products and the attendant problems of cassava processing so as to meet up with food requirements, reduce post-harvest losses and also form a bench mark for further research work.

1.3 Objective of the Study

The broad objective of this study is to undertake an economic analysis of alternative cassava processing technologies in Delta North Agricultural Zone, Delta State.

The specific objective are:

(1) To identify and describe the traditional and modern technologies used by farmers to process cassava into different products;

(2) To ascertain the conditions and factors that affect farmers'

choice of a particular cassava processing technologies;

(3) To assess the costs and returns associated with the existing traditional and modern technologies;

(4) To identify and describe factors militating against increased cassava processing in the study area; and

(5) to derive policy implications and directions for improved cassava processing among farmers.

1.4 Justification of the Study

Traditionally, cassava roots are processed by a variety of methods into many different products, and used in diverse ways according to local customs and preference, to provide the carbohydrate part of the diet.

Cassava is one of the most important food crops grown in the study area and in tropical Africa in general. Because of its efficient production of food energy, year-round availability, tolerance to extreme stress conditions and suitability for present farming and good systems in Africa, cassava is playing a major role in efforts to alleviate the African food crisis (hahn and Keyer, 1985; Hahn et al, 1987).

The increasing awareness of cassava potentialities have induced researchers into improving the productivity and quality of cassava produced. However, the ban on the importation of food products resulted in an increase in demand for food products in general and that of cassava products in particular, including being a source of raw materials for local industries.
Attention then was shifted to local processing of agricultural products including cassava.

Even though, theoretical explanations exist regarding cassava processing, little or no empirical studies are available regarding Economic analysis of alternative cassava processing technologies. Where empirical studies exist, attention is not given to Delta North

Agricultural Zone, Delta State. This therefore calls for urgent need to expand knowledge and statistical data on alternative cassava processing technologies.

This study on the economic analysis of alternative cassava processing technologies would help agricultural programs that would achieve greater agricultural productivity and national self-reliance in food production. It is expected that the study will unfold a variety of socio-economic constraints and infrastructural factors that limit the technological efficiency of cassava processing. Also, it would provide much of the data required for these and other result-oriented research studies.

1.5 Limitation of the Study

This study was limited to five Local Government Areas (Aniocha North, Anoicha South, Ika South, Ndokwa East and Ndokwa West) of Delta North Agricultural Zone. This is principally due to time and financial constraints. The sample size used was limited to 60 respondents, twelve from each local government area owing to the nature and the volume of data required for the study.

Most of the information provided by the farmers/processors were based on their ability to recall them as no record of any processing operation (s) performed were kept.

1.6 Plan of the Report

This study is presented in six chapters. Chapter one is the introduction while two is the literature review. In Chapter three, the methodology adopted in the study is described while Chapter four deals with different cassava processing technologies.

Economic analysis of the processing technology is presented in chapter five. Chapter six is summary, recommendation and conclusion.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The review of literature in this chapter is discussed under the following broad headings:-

- *Cassava production;*
- *Cassava processing technologies;*
- *Development in methods of cassava processing;*
- *Potential utilization of products from cassava processing;*
- *Constraints in cassava processing and*
- *Cassava marketing.*

2.2 Cassava Production

Cassava is produced in many parts of the tropics especially in the more humid regions. Numerous cassava cultivars exist in each locality where the crop is grown. The cultivars have been distinguished based on the morphology, shape of tuber, time of maturity, yield and the Cyanogenic glucoside (HCN) content of the roots. On the basis of the HCN content, Onwueme(1978), Oben and Menz (1980) classified cassava into two cultivars namely the sweet and bitter cassava. The cultivare with less than 70mm HCN per kilogram is referred to as the sweet cassava while the bitter cassava is described as that with about 200 to 300mm HCN per kilogram.

Cassava is adapted to diverse environmental conditions and systems of cultivation. It is not limited to well defined harvesting periods and does not require special skill in production (Obeta, 1990). Optimum production of cassava requires an average rainfall of 1000 - 2000mm, average annual temperature of 25 - 29oC and freely draining sandy loam soils dominated by oxisols, utisols and alfisols (Onwueme, 1978; Ezeilo et al, 1979).

Cassava could be planted either on ridges, mounds or on flat surfaces. Unamma et al (1985) reported that seed bed preparation for

cassava production is mainly by mounding and ridging. Minimum tillage or no tillage methods are hardly practiced, while beds are used only for vegetables. Okoigbe (1971) however pointed out that there is no effect of the various forms of preparation on root tubers' yield.
IITA (1984) reported that cassava cuttings taken from older, more matured parts of the stake give a better yield than those from the younger portions.
Hence, Onwueme (1978) recommended that cassava cuttings used for planting should be as matured as possible.
Krochmal (1969), Onwueme (1978) observed that irrespective of the length of cuttings each should have a minimum of three nodes while Weber et al (1980) reported that using cuttings longer than 30cm does not confer any yield advantage. The ideal time interval between severing the cassava stakes and actual planting into the soil is only two to three days (Onwueme, 1978).
Since keeping them longer would lead to deterioration arising from desiccation or rotting.

Cassava is generally intercropped with the major staples such as yam, cocoyam, maize and subsidiary crops like melon, okro, vegetables, groundnut and sugar cane (Ezeilo et al, 1979; Nweke et al, 1988). The number of cuttings planted per mound varies with location, tradition, number of crops per, mound, size of mound, crop combination etc. The time of planting of cassava in the study area and Delta State in general is at the beginning of the rainy season (April or between April and September). Cassava is also planted in the study area in November and is referred to as "early farm." Okigbo (1971) and Ezedinma et al (1980) however reported that cassava planted later than June produced higher yields than those from early plantings. Furthermore, investigation on June to October planting and harvesting at 12 months showed that the yields of fresh root tuber did not differ significantly from any of the planting dates. (Ezedinma et al, 1980)

In traditional agriculture, cassava production is usually carried out without fertilizer (Onwueme, 1978). He however, pointed out that high potassium requirement of cassava makes it well suited to traditional agriculture where bush burning is the rule. The ash left after bush burning is naturally rich in potassium and cassava planted immediately on such land will benefit immensely. Unfortunately many small-holder farmers do not plant cassava soon after bush burning, it is commonly planted last in a sequence of crops (Okigbo, 1971). Cassava does not require fertilizer as much as other crops in rich soils especially newly cleared land. However, studies conducted by IITA (1982) showed that cassava can respond to nitrogen, lime and potassium application in poor soils. Njoku (1981), Odurukwe and Igbokwe (1981) remarked that cassava tuber yield is increased by nitrogen and potassium dressing rather than phosphorus.

Weeding is a very essential operation in cassava production. According to Onwueme (1978) weed control is a task that requires most attention in cassava production during the first two to three months after planting (MAP). After this time, the crop produces enough canopy to suppress the weeds. Weed control in cassava is therefore most critical during the first two to three months. Weed control in the study area is achieved by hoeing, using an Indian hoe, an African hoe, matchet or bent cutlass (referred to as agor).
Two to three times weeding is required during the growing period of cassava. First weeding is done 25 to 30 days after planting (DAP), the second weeding at about 60 DAP, and the third, if necessary, at about 90 DAP. Beyond the second and third weeding, no further weeding is needed on the plot until harvest.

Harvesting is continuous throughout the year but peaks between November and March. The harvesting of cassava as need arises allows for greater flexibility in the use of labour and lands as a security crop for small-holder farmers (Levis and Havinden, 1982) although there could be inherent opportunity cost. According to Odurukwe (1980) different cassava varieties have different maturity periods which vary from 8 - 24 months depending on the maturity grouping of the variety, ecological and nutritional conditions. The cassava roots may be stored by leaving them in the ground for upwards of six months. Delayed harvesting could lead to progressive weight and starch losses, increased hydrogen cyanide (HCN) content and increased woodiness (Grace, 1971; Booth et at, 1976; Odurukwe, 1980; IITA, 1986; Karunwi and Ezumah, 1988). These affect the quality of the processed end products especially tapioca as reported by Hones (1974).

Karunwi and Ezumah (1988) reported an average cassava crop yield of 18.7 tons/ha determined at 14 months from on-farm adaptive research cassava farm land. Bachmann (1981) reported 9.5 tons/ha in upland fields for cassava in Ntege, Enugu State. Nweke (1987) showed that the improved varieties harvested at 12 months yielded 75 percent higher root weight than local varieties. Okoli (1987) also reported a high yield from improved cassava varieties in Imo State.

Diseases and pests constitute the major biological set-back to cassava production in Africa. The main diseases of cassava include: Cassava bacteria blight (CBB), Cassava Mosaic disease (CMD) or Cassava Mosaic virus (CMV) and Cassava anthracnose disease (CAD). CMD is capable of causing yield reductions of up to 90 percent in severely infected crops (Hahn, 1978).

The main pests of cassava include: Cassava Mealybug, Phenococcus manihoti and the green spider mite, Mononychellus tanajoa

2.3 Cassava Processing

Processing is concerned with the addition of Value which results from changing the form of raw product (Kohl and Uhl, 1972). Booth (1974) and Aboaba (1976) noted that processing in particular is essential to put some crops in a state where they can easily be stored hence making them available for a longer period of time and over a wide area. They also mentioned that processing reduces the cost of transportation and increases the farmers earning as it affects the marketability of produce to the consumers.

Processing of cassava roots prior to consumption is essential because of its cyanide content and generally, they do not store for a very long time after harvest.

Booth (1974) and Etegere and Ramakrishna (1985) reported that there is need to process cassava roots within 24 to 48 hours after harvesting due to its toxicity and perishability. Hahn and Onaholu (1988) on the other hand remarked that it is only Sweet cassava with low HCN content that can be consumed without processing.

Chinsman and Fiagan (1987) however added that proper processing and preservation of harvested produce, minimize post-harvest losses and thus help to offset shortage in food supply.

Hahn and Keyser (1985) and Dorash (1987) reported that 88% out of 55 to 60 million tonnes of fresh cassava roots produced every year in Africa is utilized as human food. In Nigeria over 90% of cassava produced is consumed by humans and as such requires one kind of processing or the other)Oben and Menz, 1980); Chinsman and Fiagan, 1987; Rosling, 1987; Hahn, 1988).

Cassava processing comprise a combination of activities such as peeling, soaking, grating, fermenting (which removes the toxic substances through the use of hydrolysing enzymes), frying, slicing, sieving, dewatering, drying, boiling, steaming (which eliminates HCN) etc., (Ekpere et al, 1986; Kwatia, 1986; Karunwi and Ezumah, 1988; Okorji and Okereke, 1990; IITA, 1992).

The end products desired determines the number of processing operations. Based on these operations kwatia (1986) identified three broad classes of cassava processing technologies in Nigeria. They include:

(i) Technology based on drying and dry products with or without fermentation;

(ii) Technology based on fermented cassava dough; and

(iii) Minor processing technologies:

The processing technologies are associated with the following main food forms: Lafun (fermented cassava flour), Abacha (cassava noodles), cassava flour (unfermented) and pupuru with the first technique while the product developed from fermented cassava dough are gari and foo foo (akpu). The product under the third technique include starch.

Cassava has greater number of variety of food forms than any other roots and tuber crops such as yam and cocoyam. Over ten from of processed cassava have been reported, they include gari, cassava flour, starch, chips, tapioca, foo foo (akpu), pellets etc. (Etegere and Ramakrishna, 1985; Ekpere et al, 1986; Karunwi and Ezumah, 1988; Kwatia, 1986; Hahn, 1989; Okorji and Okereke, 1990). The form into which cassava is processed in an area has been shown to depend on such factors as cultural food habit, preferences of the people and taste, variety of cassava as well as age of cassava tubers at harvest (Hahn, 1989; Okorji et al, 1989).

Karunwi and Ezumah (1988) reported that high cyanide (bitter) cassava tubers require between 3 to 14 days of processing but most of the cassava produced in Nigeria requires a minimum of three days processing as majority of the cassava tubers consumed are in form of gari and foo foo.

IITA (1992) reported that cassava processing activities are usually carried out by children, women and men (depending on the stage of operation).

Karunwi and Ezumah (1988) however observed that 84 percent of the processors are women and that gari is in many cases the major end product.

2.4 Development in Methods of Cassava Processing

Cassava roots are processed by a variety of methods into many different products and used in diverse ways according to local custom and preference, to provide the carbohydrate part of the diet. The various range of operations involved in cassava processing reduces the toxicity, post harvest losses of fresh tubers, improve their palatability, covert the perishable fresh roots into stable products and provide raw materials for small-scale cassava-based rural industries (IITA, 1990).

Processing of cassava roots has been done mostly by traditional method. Traditional cassava processing does not require sophisticated equipment. Processing cassava into gari requires equipment such as grater, presser and fryer, but for production of other cassava food products, not much equipment is needed. Traditionally, cassava processing requires that the roots be peeled with knife, washed, then followed by the application of different operations to arrive at the desired end product. For example, in the processing of cassava tubers to produce gari, the fresh cassava roots are peeled, washed, then grated. Grating is usually done manually. The traditional cassava grater is made of a flattened kerosine tin or sheet perforated with nails and fastened onto a wooden board with handles. Grating is achieved by rubbing the peeled roots against the rough perforated surface of the iron sheet which tears off the peeled cassava root flesh into a mash (IITA, 1992). The marshy product obtained after grating is then put in sacks (jute or polyproplene) and the sacks are placed under heavy stones or tied wooden frames for 3 - 4 days to express excess liquid from the pulp while it is fermenting. Fermentation impacts an acidic taste to the final product. The dewatered and fermented lump of pulp are crumbled by hand. Thereafter, the semi-dried mash is sieved to separate the fibre from the granulated pulp. The latter is fried in an open iron cast frying pan or in an earthenware pot to produce gari.

The traditional methods have been criticized as grossly inadequate, inefficient, laborious, time consuming and can only be done on a very small scale (Odigbo, 1979; Okanigbe, 1979; Ekpere et al, 1986; Ikpi et al, 1986).

Despite the fact that traditional processing method and techniques give end products that meet the organoleptic quality demand of the consumers, research on alternative processing technologies have been (and are still being) developed with the aim of increasing labour efficiency, productivity, incomes, and life of cassava farmers and urban poor as well as enhance the shelf life of products, make transportation easier, raise marketing opportunities and upgrade nutrition (Odigbo, 1979; Nwokedi, 1983; Ikpi et al; 1986; Chinsman and Fiagan, 1987; IITA, 1992).

Alternative (Mechanical) technologies for cassava processing have been developed for the most arduous and laborious operations such as peeling, grating or grinding the dry chips with a view to reducing labour cost to a minimum. Mechanical peeling techniques have been studied and tested in Nigeria. A batch processing abrasion peeling machine has been developed by Odigbo (1979) at National Root Crops Research Institute (NRCRI) umudike.

Nwokedi (1983) reported mechanical cassava root peeling efficiency of 80% and further observed that the operation of such machines requires manual labour for cutting and trimming cassava roots.

IITA (1988) reported that a power grater can reduce the time needed to grate 140kg of tubers from 6 hours to about seven times more to process a tonne of cassava by manual method into gari than by mechanical method.

Ikpi et al (1986) further reported that a machine saves women 21 hours' work each week and given the average amount of cassava processed by a household in a year in Oyo State area surveyed with appropriate cassava processing equipment, each family would save an average of 441 hours of work.

Kwatia (1986), IITA (1988), Chinsman and Fiagan (1987) however observed that mechanical graters are probably the most significant development in cassava processing operations. They also reported that the mechanical grater involves an electric motor that is usually

imported and a grater screen unit manufactured locally. Mechanical cassava graters mounted on wheels are now available even in some remotest villages.
Dewatering machines are also available in the market, however, its use is not yet wide spread, probably because not many cassava farmers can afford its cost (Okanigbe, 1979). A mechanical garification ovens, equipped with chimneys and mechanical stirring systems has also been developed.

In a study in Nigeria, comparing two techniques for processing gari, it was found that a locally produced "intermediate" technique was far superior to a fully mechanized foreign machine (Kaplinsky, 1974). Kwatia (1986) observed that garification is still carried out in the traditional method by many gari producers, despite the improved technology.

In Nigeria today, cassava processing is being carried out using both traditional and mechanised methods.
However, research is on to provide better processing alternative technologies with the sole aim of minimizing postharvest losses, improve utilization conditions of most agricultural products including cassava and improve output and income of cassava producers and processors (IITA, 1988) as well as eliminate labour costs particularly for women (CHinsman and Fiagan, 1987).

2.5 Potential Utilization of Cassava and its Products

Cassava is an important food in the tropical areas of africa, Asia, and Latin America. It is estimated that the crop provides about 40% of all calories consumed in Africa. Evidence has shown that over 120 million people throughout Africa rely heavily upon cassava for their energy source (April et al, 1974; Hahn and Keyser, 1985; Sarma and Kunchai, 1991).

Cassava has wide potential uses for human and animal consumption as well as for the industrial uses.

The cassava tuber is utilized in many food preparations in Africa. It provides most of the calories in a meal, while the vegetables, legumes and meat/fish provide the necessary protein, minerals and vitamins. Processed cassava products such as foo foo, tapioca, kpo kpo gari are low-cost food products that provide options and greater food security for rural and urban household.

Such products as cassava chips and pellets provide a source of easily stored and low-cost feed for cattle, pig, poultry and prawns. Research carried out by IITA in Nigeria has shown that substituting up to 44% of the maize in pig feed with cassava does not lead to any reduction in the performance of pigs (IITA, 1990).
They further reported that with addition of 0.1 to 0.2% DL methionine, the performance of pigs fed on diets which contain more than 50% cassava meal is improved.
It has also been reported that the use of cassava in the diet of white Fulani herds in Nigeria has increased milk production by 22%, this has been accompanied by an increase in percentage of butter fat, protein, and non-fat solids (IITA, 1990).

Processed cassava products are used in the baking and confectionery industry as thickening and mounding agents. IITA (1984) and Kwatia (1986) reported that cassava flour can substitute for 10-30 percent of wheat flour for baking bread and biscuits. Processed cassava products are also used in the pharmaceutical industry as fillers and for the production of alcohol (NRCRI, 1986; Uzo, 1986; Al-Hassan, 1992).

Starch is used in the textile industry for sizing or strengthening yarns during weaving and for printing, in paper industry for sizing and binding. Starch can also be used in food industries in the production of ice cream wafers, glucose and monosodium glutamate-high fructose syrup (a sugar substitute) used to enhance flavour and increase palatability in other processed food.

2.6 Cassava Marketing

Cassava marketing like in the case of any other product can be considered under the forms in which cassava is sold, the categories of buyers, sellers, and markets used etc. Cassava in the study area is mainly marketed as fresh raw tubers or such processed forms as gari, akpu, and starch. Fresh cassava tubers are usually sold in heaps or baskets; the prices however, depends on the variety as well as the season.

Karunwi and Ezumah (1988), observed that despite the various uses to which cassava can be put, more than 90 percent of all the cassava produced in the country is consumed as food by humans indicating the fact that most cassava grown enter the market in the processed form.

According to Ikpi et al (1986), and Karunwi (1988) gari which is the main form in which processed cassava roots is consumed accounts for about 70 percent of cassava consumed in Nigeria. Processing of cassava into gari has been reported to be profitable (Ekpere et al, 1986; Karunwi and Ezumah, 1988). Gari in the study area is sold in small quantity with cup measurement, in basins and bags depending on the prevailing market condition and the quantity demanded by the consumer.

Processed cassava products are sold to wholesalers, retailers and consumers. They can also be marketed at farm gate, village or local market as well as urban markets. The market choice of processor depends on the processor's need, transfer cost, the marketing days, quantity and form of product(s) to be marketed as well as price. On the other hand, prices of processed cassava products can be affected by the availability of the processed products, quantity and quality of products, locality and relative prices of other foods.

2.7 Constraints to Cassava Processing

Cassava/farmers/processors are confronted with many constraints in carrying out their processing activities. They may not have access to large efficient processing equipment or obtain loan to commercialize their processing activities. Hence they remained a low processor and a low-income earner.

There has always been the side effect of inhaling cyanide fumes in the final stages of frying in gari production. There has also been no monetization of value given to women labour for all stages of cassava processing (Hahn and Onabolu, 1988).

Large-scale mechanized cassava processing in Nigeria (mostly gari) has not been successful because the household techniques is more efficient. This is largely because of differences in capital investment as well as under utilization of capital because of inadequate supply of raw material to large-scale processors. Another possible factor, however, could be that "cassava roots are processed by a variety of methods into many different products and used in diverse ways, according to local custom and preference" (Hahn, 1989). Numfor and Ay (1987) identified at least nine intermediate products and 20 end-products transformed from cassava roots for human consumption in Cameroon. Gebremeskol et al (1989) identified at least 23 traditional cassava processing in Africa. Hahn (1989) identified 17 major utilization products also for Africa. There are usually small differences in taste, texture, appearance and ease of preparation into a meal which are appreciated by local groups. For instance, in Nigeria, gari is different in flavour and appearance when it is aimed at the Eastern rather than the Western Nigeria markets. Large-scale processing will be unable to meet the demands of the restricted markets differentiated by local customs and preferences in taste and appearance. This means that economy of scale is not taken advantage of in cassava processing (Nweke, 1992).

Ekpere et al (1986) and Karunwi and Ezumah (1988) identified major barriers to increasing cassava processing (especially in gari production) in the humid forest part of Nigeria to include lack of capital, high cost of frying pans, transportation of cassava roots, shortage of cassava roots and market uncertainty as well as the tedious operation of frying. Okanigbo (1979) saw irregularity of shapes of cassava roots as a challenge or problem to all interested in cassava processing as it reduces both speed and efficiency of peeling.

CHAPTER THREE

METHODOLOGY

3.1 THE STUDY AREA

Delta-North Agricultural zone is one of the three Agricultural zones in Delta State. It is comprised of seven Local Government Areas which include: Aniocha North, Aniocha South, Ika North-east, Ika South, Ndokwa East, Ndokwa West and Oshimili Local Government Areas. Delta North Agricultural zone has a total population of 786,778 which is comprised of 384, 730 males and 402,045 females out of the Delta State's total population of 2,570,181 (National Population Commission, 1991).

The study area lies roughly between longitude 5^0 00" and $6^0$30" North and latitudes 5^0 00" and $6^0$45" East. It is bounded in the East by Anambra, North by Edo State, South by Rivers State, West by Isoko North and Isoko South, South by Ughelli North and Ethiope East (Fig 1) (Delta State Directorate of Lands and Survey, Asaba, 1994).

Delta North Agricultural zone is on tropical climate marked by two distinctive seasons. These are the dry season and rainy season. The dry season occurs between November and April while the rainy season begins in April and last till October. There is a brief dry spell in August. This is commonly referred to as "August Break". From December to February, the dry harmattan wind blows over the area. The annual rainfall range is between 2000mm to 2500mm. Rainfall is heaviest in July. It has a high temperature ranging between 39°C and 44°C with an average temperature of 30°C (80°F) (Delta State Diary, 1993). The vegetation varies from mangrove swamps to evergreen forest.
The zone is richly endowed with fertile agricultural land suitable for the growth of various tropical crops and good feeders for domestic animals. Major crops grown by the inhabitants include: oil palm, yam, pepper, maize, cassava, melon groundnut and vegetables. Pig, goat, sheep and poultry constitute the important livestock enterprises.

Delta North was purposively selected for this study because the

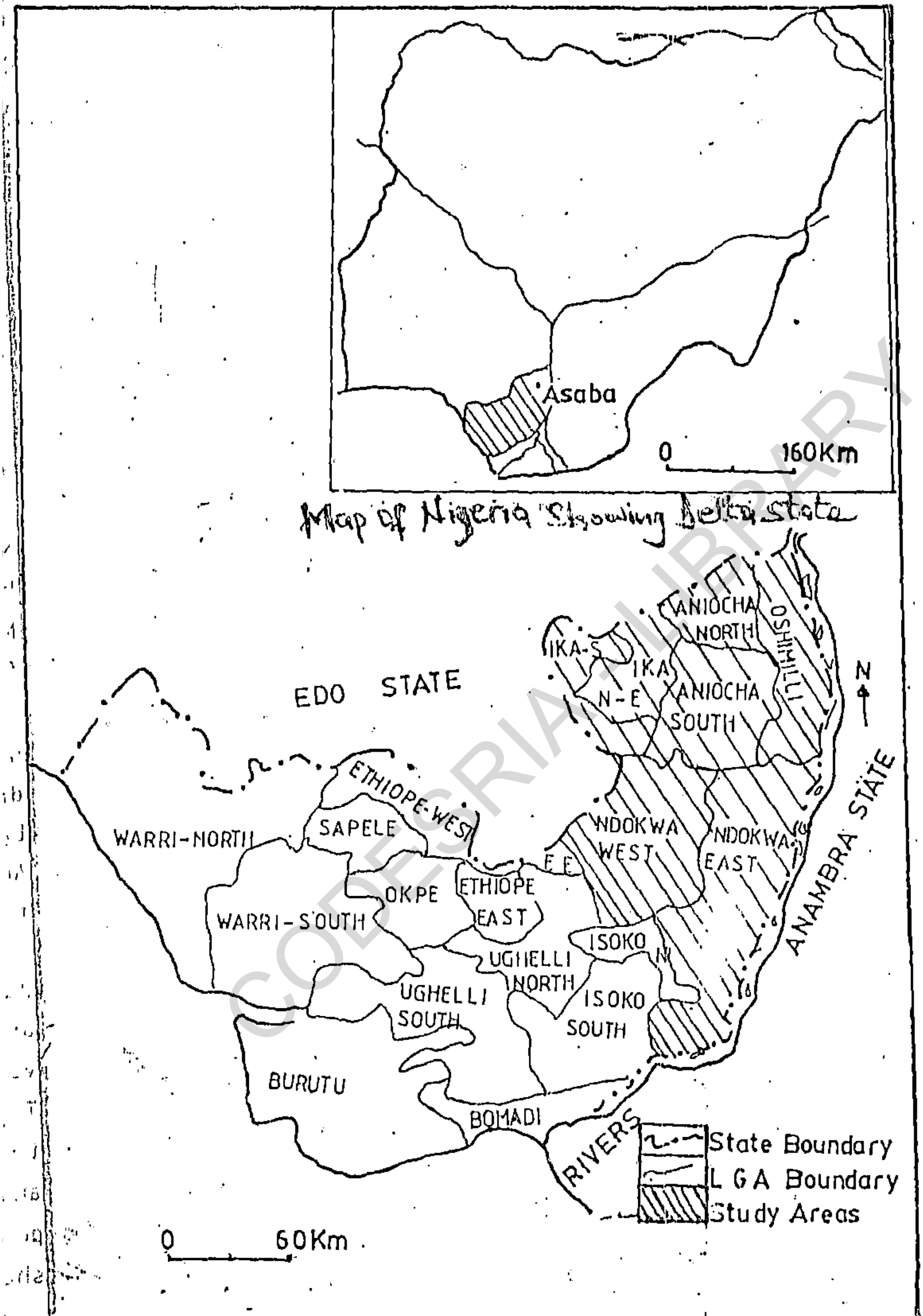

Fig 1: Map of Delta State Showing the Study Area
(Source: Ministry of Lands & Survey, Asaba)

inhabitants are small-holder farmers with majority producing cassava and hence engage in cassava processing. Above all, the zone ranks the largest producer of garri in the state and it is the main source of gari supply to the state and the country in general.

3.2 Sampling Procedure

Five out of the seven Local Government Areas in the zone were randomly selected for this study. These include: Aniocha North, Aniocha South, Ika South, Ndokwa East and Ndokwa West (Fig. 1). Generally, cassava farmers/processors formed the sampling frame.

A list of cassava farmers/processors in each of these Local Government Areas was drawn up at community level. From the list twelve farmers/processors were randomly selected from each of the five Local Government Areas giving a total sample size of sixty (60) respondents for the study.

3.3 Data Collection

Data for this study were obtained from primary sources only. The data were obtained through the use of questionnaire which was administered to the respondents. Two well-trained and resident enumerators from each of the sampled Local Government Areas of the selected agricultural zone assisted in the administration of the questionnaire. The enumerators were, however, closely supervised by the researcher. In addition to the use of questionnaire, physical measurements of cassava tubers and processed products as well as personal observations of cassava processing activities were done. Oral interview was also used to augment data collected with the questionnaire.

The questionnaire provided information on the processors' characteristics including age, household size, composition, educational level, reasons for processing cassava, years of experience, sources of labour/processing materials, methods, stages, and products obtained, task performed, cost of labour, transportation and processing materials, revenue from processed products as well as factors militating against increased cassava processing in the study area. Data collection exercise and field work lasted for a period of 3 months.

3.4 Data Analysis

Objectives one, two and four were analysed using descriptive statistics such as frequencies, percentages and means.

Objective three was analysed using Net Margin analysis for all the cassava processed products obtained and marketed in the study area. Net Margin is estimated for a single unit of each enterprise and it is defined as the difference between total income and total variable cost (Kay, 1986). Abbott and Makehan (1980), defined Gross Margin as the difference between gross income earned and variable cost incurred.

CHAPTER FOUR

CASSAVA PROCESSING, PATTERNS, TECHNOLOGIES AND METHODS

4.1 Social-economic characteristics of Cassava Processors

The results of this study are presented in this Chapter and they are discussed under: age, marital status, educational level, household size, occupation, years of processing experience of the farmers/processors. The other aspects discussed in this chapter include: farmers'/processors' objectives, conditions and factors that affect the farmers'/processors' choice of a particular technology, items used in cassava processing, methods, stages and products obtained from processing cassava tubers.

4.1.1 Age and Marital Status

The age structure of the respondents is important in this study as age to a great extent influences individual's decision, ambition, attitude and aspiration. Table 4.1 shows the distribution of the respondents according to age.

Table 4.1: Distribution of Respondents According to Age

AGE OF RESPONDENTS	FREQUENCY OF RESPONDENTS	PERCENTAGE
Less than 20		
21-30	6	10
31-40	18	30
41-50	24	40
Above 50	12	20
Total	60	100

Source: Field Survey, 1995.

Out of 60 cassava farmers/processors interviewed, 40% were in 41-50 age bracket, 30% in the 31-40 age bracket and 10% were within 21-30 age bracket while the remaining 20% were above 50 years.

The marital status of the respondents showed that 10% of them were not married, 85% were married while 5% were widows. An analysis of the sex/gender of the respondents also shows that 37% of the respondents were males while 23% were females.

4.1.2 Educational Level

An analysis of the level of formal education attained by the respondents is very essential because it helps to determine to what extent the processor could imbibe new ideas and methods of processing. The level of education attained can also affect the behavioural pattern of an individual towards the selection of a particular processing technology, it helps an individual to analyses any issue critically and finally helps to remove fear and suspicion. Table 4.2 shows the number of years spent in school by the respondents.

Table 4.2: Distribution of Respondents According to Number of Years Spent at School.

NO. OF YEAR SPENT IN SCHOOL.	FREQUENCY OF RESPONDENTS	PERCENTAGE
Zero		
1 - 6	6	10
7 - 12	18	30
13 and above	24	40
Total	60	100

Source: Field Survey, 1995.

From the analysis of the number of years spent in school, is clear that 8% of the respondents had no formal education, while the rest spent between 1 and 13 years in the school. Thus the level of literacy of the respondents was relatively high and this might be helpful in their awareness and positive reactions to government programs and supports.

4.1.3 Household Size

The household include: household heads (male or female), wife or wives, children, extended family members - nephews, nieces, brothers and sisters to the household head or his wife/wives, servants or house help feeding from the same pot at a particular time (National Population Commission, 1991). The survey of the household size was essential as it influences the supply and availability of unpaid labour services especially where cassava processing is labour intensive. Table 4.3 shows the percentage distribution of respondents according to household size.

Table 4.3: Percentage Distribution of Respondents According to Household Size.

AGE OF RESPONDENTS	FREQUENCY OF RESPONDENTS	PERCENTAGE
Less than 6	18	30
6-10	29	48
11-15	9	15
16-20	4	7
Total	60	100

Source: Field Survey, 1995.

The number of children in each household ranged from zero to sixteen with a mean of six per household. On the average, the household size ranged from two to twenty-four with a mean of seven persons per household. The number of persons per household can have influence on the household expenditure on food, clothing and shelter. This means that the respondents would have the need for external financing outside personal savings to cater for their processing activity and other purposes. On the other hand a large household is of great advantage in the provision of cheap labour force for cassava processing.

4.1.4 Occupation

Table 4.4 shows the distribution of respondents according to their occupation.

Table 4.4: Distribution of Respondents According to Occupation.

OCCUPATION	FREQUENCY OF RESPONDENTS	PERCENTAGE
Farming/Fishing	17	24
Trading	12	17
Teaching/Civil service	16	23
Cassava farming/procesing	24	40
Palm tapping/dealer	2	3
Bricklaying	2	3
Total	*	*

** Multiple responses were obtained.*

Source: Field Survey, 1995.

The data in Table 4.4 shows that 30% of the respondents had no other occupation except cassava production/processing and hence depended solely on cassava processing. The rest engaged in other occupations (such as farming/fishing, trading, teaching/civil service, palm wine tapping/dealer, and bricklaying) in addition to processing to augment for the food provided for the family and then realize money to meet up with other financial commitments.

4.1.5 Years of Processing Experience

Table 4.5: Percentage Distribution of Respondents According to Years of Processing Experience

YEAR	FREQUENCY OF RESPONDENTS	PERCENTAGE
1 - 5	8	13
6 - 10	22	37
11 - 15	16	27
16 - 20	8	13
21 - 25	3	5
26 and above	3	5
Total	60	100

Source: Field Survey, 1995.

The number of years of processing experience is considered of a great importance because most often it gives an idea of farmers/processors managerial ability. Many years of processing experience might lead to more stability in the processing business. The number of years of processing experience of the respondents is shown in Table 4.5

Although most of the respondents (farmers/processors) could not say precisely the year they started processing cassava, 50% of them indicated processing cassava for over ten years. Those that started processing below ten years were able to say precisely the actual year they started and they constitute about 50% of the respondents. The average number of years of processing experience of the respondents was 13 years. This experience was however acquired through the farmers'/processors' involvement in household processing activities.

4.2 Cassava Farmers'/Processors' Processing Objective

Cassava farmers/processors in the study area had so many reasons for engaging in cassava processing. These reasons are shown in Table 4.6

Table 4.6: Percentage Distribution of Respondents According to the Factors that Induce them to Engage in Cassava Processing.

	REASONS	FREQUENCY OF RESPONDENTS	PERCENTAGE
i.	To produce for household consumption	30	40
ii	For sale to earn income	27	36
iii	To put in a more durable form	2	3
iv	Food security/storage	7	10
v	To make cassava tubers edible	2	3
vi	To produce other cassava products		
TOTAL		*	*

* Multiple responses were obtained.

Source: Field Survey, 1995.

From Table 4.6, it is observed that the major reasons for cassava processing was to satisfy the household need for food as was indicated by 40% of the respondents. Cassava farmers/processors in the study area were also engaged in cassava processing with a view of selling their products and earning more income to better their living condition(s) and hence increased standard of living. Also for the fact that raw cassava tubers are toxic for both human and animal consumption and does not last long after harvest, respondents found it necessary to involve in processing in order to make it more edible than the harvested tubers.

4.3 Choice of Processing Technology

Cassava farmers/processors in the study area used both the traditional and modern processing technologies in processing cassava tubers. Table 4.7 shows the distribution of the respondents according to the processing technology used.

Table 4.7:Percentage Distribution of Respondents According to Choice of Processing Technology.

TECHNOLOGY	FREQUENCY OF RESPONDENTS	PERCENTAGE
Traditional	41	68
Modern	19	32
Total	60	100

Source: Field Survey, 1995

Table 4.7 shows that 68% of the respondents used the traditional processing technology in processing cassava to gari and starch. Most of the respondents that used the traditional processing technology however indicated using the mechanical methods in such operations like grinding and dewatering. Only 32% of the respondents indicated using basically the modern processing technology in processing operations like grinding and dewatering in processing cassava tubers to gari and starch. They also indicated that they complemented the modern processing technology with human labour. In processing cassava tubers to Akpu and Abaca, it was observed that all the respondents indicated using the traditional processing technology in the processing operations. The use of such processing technology was attributed to the unavailability of modern processing technology for processing cassava tubers to akpu and abaca.

4.4 Conditions that Affect Farmers'/Processors' Choice of Technology

Cassava farmers/processors in the study area had so many reasons or factors that determine their choice of a particular processing technology. These factors are shown in Tables 4.8 and 4.9

Table 4.8:Percentage Distribution of Respondents According to the factors that influence their choice of Traditional Technology.

	FACTORS	FREQUENCY OF RESPONDENTS	PERCENTAGE
i	Lack of capital	12	17
ii	Technical know-how	23	33
iii	Cheap family labour	26	37
iv	Un-availiabity of modern processing technology for most of the processing operations	3	4
v	Low cost of maintenance	6	9
TOT		*	*

* Multiple responses were obtained.

Source: Field Survey, 1995.

Table 4.8 shows the responses obtained from respondents on factors affecting their choice of traditional processing technology in the study area. Multiple responses were obtained from those respondents that used the traditional processing technology. From the survey, 37% of the factors that induced the respondents to employ the use of traditional processing technology was attributed to cheap family labour which according to the respondents can be source for without costing (paying) for such labour. Technical know-how accounted for about 33% of the factors that induced the respondents to use the traditional processing technology. The respondents indicated that the use of the traditional processing technology does not require much or any skill and hence can easily be manipulated and source for locally. Lack of capital accounted for about 17% of the factors that influenced the respondents to employ traditional processing technology in cassava processing operations while 4% and 9% of the factors affecting the use of traditional processing technology were attributed to unavailability of modern processing technology for most of the processing operations and low cost of maintenance respectively. The traditional processing technology was used in all the processing operations in the study area except in grinding. Both traditional and modern processing technologies were used in dewatering operations by the respondents.

Table 4.9 shows the responses obtained from respondents on factors that influenced their use of modern processing technology in processing cassava tubers.

Table 4.9: Percentage Distribution of Respondents According to the factors that influence Choice of modern processing technology

	FACTORS	FREQUENCY OF RESPONDENTS	PERCENT AGE
i	Reduction in human labour	11	27
ii	Efficiency of production	7	17
iii	Faster/saves time	19	46
iv	Higher level of output	4	10
TOTAL		*	*

* Multiple responses were obtained.

Source: Field Survey, 1995.

A mean of two determinants for employing the modern processing technology in processing cassava tubers were however indicated by the respondents. The modern technology was only employed in grinding and dewartering. Other operations (such as peeling, washing soaking, parboiling, slicing, breaking of cake, sieving, frying, pounding and decanting) were carried out using the traditional processing technology. The respondents further reported that there were no modern processing technology for such operations in the study area and where they existed is not known to them. The respondents indicated using the modern processing technology as a result of shorter time being spent for using the modern processing technology. This accounts for about 46% of the determining factors for using the modern processing technology. Reduction in human labour and efficiency of production accounted for about 27% and 17% (respectively) of the factors that induced the respondents to apply the modern processing technology in cassava processing operations while 10% of the factors affecting the use of the modern processing technology was attributed to the quantity of output produced. The use of the modern processing technology according to the respondents leads to a greater output and hence increases their net revenue.

4.5 Items Used in Cassava Processing

The items used for processing include:

(a) Cassava tubers: Although Hahn and Onabolu (1988) reported that is only sweet cassava with low HCN content that can be consumed without processing, however, both the sweet and bitter cassava varieties are processed in the study area before consumption. To the respondents, the best variety to be processed depends on the desired end product(s) to be obtained and also the purpose for which the product(s) is produced.

The bitter cassava is mostly used in the study area for the production of such products as gari, Akpu, starch and where the product is for commercial purpose. According to the respondents, the main reason(s) for using the bitter cassava were that it is relatively more available than sweet cassava, it high yielding and disease resistant. The sweet variety is preferred for such products as tapioca, abacha (referred to as iwuakpu, or borborzie, or ibibio in the study area) and cassava flour. The use of the sweet variety for the production of these products according to the respondents was because it requires less number of processing operations to reduce the cyanide content to edible level.

In Nigeria, the IITA, Ibadan and NRCRI, Umudike have developed improved cassava clones which include:

Tropical Manihot Selection (TMS) 30001 (Sweet cassava), 30211, 30395, 30555,30572, 4(2) 1425, 63397, 91934 and 50395. Others are U/41044, NR8082 and U/7706.

In the study area, local varieties existed but they have names that differed from place to place. Some of these local varieties include: Opotopo, Nneifanyi, Onyeanusi, Odeyeye and etc.

The cost of cassava tubers ranges from =N=3.00/kg to =N=4.00/kg. The cost fluctuates and this depends on the variety, size of the individual tuber, the season, locality, and quantity of cassava tubers available in the market at that particular time.

The cassava tubers were either sold in heaps, baskets, wheelbarrow or trucks.

(b) *Matchets:* Used for trimming the edges and cutting the cassava tubers before peeling. The matchet cost from =N=350 to =N=450 with life span of about five years.

(c) *Knives:* They are used for peeling the cassava tubers. They are also used for slicing parboiled cassava tubers. The cost ranges from =N=80 to =N=150. They have a life span of about three years.

(d) *Basins*: These are mainly made out of enamel and are of three main sizes - small, medium and large. They are used for various purposes which include putting cassava tubers prior to washing, putting the sliced parboiled cassava as well as collecting the dried or semi-dried pulp, fermented or ground cassava while sieving; soaking the cassava tubers prior to fermentation and putting the processed products. The cost of the basins ranged from =N=150 to =N=750 depending on the size. They have a life span of five years.

(e) *Bags:* These are of different types - The fertilizer, poultry and salt bags. They are used for putting grated pulp or akpu prior to dewatering or draining. They are also used for packaging processed products such as gari and akpu for easy conveyance to place of sale or need. Their cost ranged from =N=15 to =N=30 with a life span of about six months.

(f) *Pots:* These are of two types - earthenware (clay) and aluminum. The clay one are used mainly for soaking of cassava tubers and for preservation of akpu for some couple of days. The aluminum pots occasionally serve the same purpose as clay. They are also used for washing and boiling of cassava tubers. They can as well be used for measuring water into the clay pots for soaking cassava tubers. The clay pot costs about =N=250 to =N=350 with a life span of about one year, while the aluminum type costs about =N=350 to =N650 and has a life span of about five years.

(g) *Stakes:* They are wooden materials used in place of hydraulic press to hold the bag(s) containing the grated cassava pulp during dewatering. An average of four to five stakes are needed for this operation. The unit cost is about =N=5 to =N=20 with a life span of about six months.

(h) *Pressing ropes:* These are used to tie firmly the stakes sandwiches with the bag(s) containing cassava pulp being dewatered. The ropes are of different lengths with an average of five meters per piece. The unit cost per piece (meter) is about =N=30 to =N=70 with a life span of about one year.

(i) *Sieve or Sifter* These are of different tpyes. A traditional sieve is made by weaving pieces of split cane or iron or polyethylene mesh that is now in common use. These type are without frame and are used to sieve the semi-dried pulp to remove the coarse fibre from the soft mass. There are also the framed fine cloth sieves, which are used mainly for sieving cassava flour and during starch extraction. The cost of the sieve without frame ranges from =N=70 to =N=150 and has a life span of about one year while those with frame cost about =N=50 to =N=100 with a life span of about one year.

(j) *Tripod Stands:* These are three-legged iron stand used for placing the pot or frying pan over the fire. The unit cost is about =N=100 to =N250 with a life span of about ten years.

(k) *Firewood:* The firewood used for processing in the study area are either purchased from the firewood sellers' homes or market or they are got from their personal farms. The prices of the firewood purchased varied depending on the quantity, the market condition, and the season. Firewood were usually sold in logs or in bundles. A sizeable log of firewood cost about =N=30 to =N=70 while the bundles cost about =N=20 to =N=50 depending on the season. During the rainy season, people find it difficult fetching firewood from the farms and forest and also, they are faced with the problem of drying the firewood.

(l) *Piece of Calabash:* This is derived by dividing a matured calabash fruit into two or three parts. Each part is broad enough to be handled with hand/palm and is used while frying gari for turning the semi-dried pulp in the frying pan over the fire until a dried granular mass is obtained. The cost per unit ranged from =N=10 to =N=20 with a life span of about six months.

(m) *Wooden stirrers:* These are stirrers constructed in the form of a paddle with wood. The handle is narrow and elongated while the other end or part is broad and lowered into the semi-dried pulp in the frying pan. They are used for turning or stirring the pulp for even distribution of heat during frying of gari. The unit cost is about =N=15 to =N=25 with a life span of about one year.

(n) *Palm Oil*: This is added to gari to improve the flavour, taste, give it a bright yellow colour and hence increase the nutritional value. Palm oil is usually added to gari after grinding the cassava and hence mixed properly with the marshy product. It can also be added while frying. The unit cost is =N=80 per 0.7 litre. Use of palm oil in gari production is optional, however, though the yellow gari costs more in the market.

(o) *Frying Pans*: The frying pans are of two types - the open iron cast pan popularly known as "Ovini" in the study area and the black coated type (pot) also called "Ugbugbe" in the study area. Both are used for frying gari. The "Ovini" is capable of holding about three to four kilograms of semi-dried pulp during gari frying while the "Ugbugbe" takes about half to one and half kilograms. The cost of the "Ovini" ranges from =N=1500 to =N=2000 while the cost of the "Ugbugbe" ranges between =N=500 to =N=1000 with a life span of about five years and three years respectively.

(p) *Graters*: These are of two types - the round type, with roundish perforations all over the body with smooth inner surface and a rough outer surface. This is used for sieving the soaked fermented cassava tubers to produce akpu. The cost ranges from =N=50 to =N=70 with a life span of about two years. The second type is mostly oblong-shape, constructed in form of an open box. It is perforated on the broad side with pattern that is somewhat oval. This type is specially made for slicing parboiled cassava tubers, thus processing them into noodles or long slender tapioca. It has a unit cost of about =N=50 and a life span of about three years.

(q) *Spreading nylons:* These are used for spreading out gari to allow time for cooling off before bagging. A yard cost about =N=50 and has a life span of about one year.

4.6 Methods, Stage and Products of Cassava Processing

Cassava processing consists of all the measures used to eliminate or reduce the level of cyanide in cassava, increase their palatability and storage life.

It is regarded as a transformation stage (physical and chemical changes) which harvested cassava tubers pass through before arriving at product(s) that is/are fit for consumption or use. It s therefore necessary to examine the methods use to enable such ransformation to take place. It was observed that both the raditional and modern methods of cassava processing were employed n cassava processing in the study area. The traditional method equires that the cassava tubers be processed using manual labour while the modern method requires processing cassava tubers using mostly mechanized means.

4.6.1 Traditional Method

Traditional cassava processing is labour intensive. The various traditional cassava processing methods used in Africa according to Jones (1969) probably originated in Tropical America, particularly northeastern Brazil, and/or have been adapted from indigenous techniques for processing yams. This processing method comprises a combination of operations which include:

(a) *Peeling:* This serves to remove the bark of cassava tubers from the tuber to obtain a white inner part of the tuber. Odigbo (1979) reported that abrasion peeling machine can be used to carry out this processing (peeling) operation. In the study area such machines however are not in existence.
Nevertheless, Okanigbe (1979) reported that the peeling machine is not efficient as most of the supposedly peeled cassava tubers will come out remaining wholly or partially unpeeled as a result of irregular shapes of the tubers.
In the study area peeling was done manually with using matchets and/or knives.

(b) *Washing*: Washing of peeled cassava tubers was done to remove dirts, sand particles and adhering mucilage (for parboiled/sliced cassava tubers). Washing was done manually with the aid of water and sponge. Where there are no regular water supply, this operation proved difficult and expensive and could be omitted.

(c) *Soaking*: Was done by putting cut cassava tubers or sliced parboiled cassava tubers in a container (basin, pot) with water. The water covers the quantity of cassava put and the set up is allowed to stand for upwards of ten hours to four days as the case may be.

(d) *Parboiling*: This involves the treating of the cut cassava tubers in a pot with water over fire for few minutes but not allowing the cassava to cook fully.

(e) *Slicing:* Parboiled cassava tubers are cut into thin, wide or slender, flat pieces using knife or grater designed for such purpose.

(f) *Dewatering/Pressing:* This refers to the removal of considerable quantity of water from the pulp (grated cassava tuber, akpu and or starch). This was done manually by putting the pulp in a porous bag and allowed to drain gradually or pressed manually by squeezing the bag containing the pulp at intervals (as in processing stage of starch and akpu). Dewatering was also achieved by putting the grated cassava pulp in sacks which were placed between wooden plates and excess water expressed by tightening ropes around the platforms. The bag(s) was/were pressed harder at intervals by untying and retying the rope, pressing the bag and changing the stakes' positions.

(g) *Breaking of cake*: This was achieved in the study area by using hand. It involves the crushing or reduction of the compact dewatered pulp into small bits or pieces. The bits or pieces are then rubbed in between the palm until they are reduced to smaller pieces or granules to ease sieving.

(h) *Sieving:* This refers to the separation of fibrous materials or coarse particles (chaff) from the fine or soft particles. In the study area, sieving was done manually using the sieve or sifter.

(i) *Frying:* It was observed that in the study area, about 100% of the respondents engaged in processing cassava tuber into gari adopted the manual method of frying gari. This involves the gentle heating of the sieved fairly wet pulp put into "Ovini" or "Ugbugbe" (as it is called in the study area) over fire and with constant stirring of the pulp with a stirrer and/or piece of calabash till a toasted granular particles (gari) is produced. Although Oti et al (1992) reported that a gari frying machine was manufactured by fabrico, Issele-Uku further investigation into the output of the machine showed that the machine had a higher output compared with manual tray fryer produced by the Rural Agro-Industrial Development Scheme (RAIDS), Ibadan, and manual frying using the traditional frying pot. However, the use of the gari frying machine is not in existence in the study area. Hence frying was carried out manually.

(j) *Pounding:* Here, the cut, dried cassava or semi-dried pulp are manually reduced to granular form by pounding using mortar and pestle.

(k) *Decanting:* This involves the gentle pouring out of top water separated from filtrate (during cassava processing into starch), leaving the sedimented filtrate.

4.6.2 Modern (Mechanical) Method

Modern (Mechanical) method of cassava processing is essentially capital intensive, though it intermittently requires the use of human labour. The modern method of processing cassava increases productivity and improves the quality and storeability of cassava products. Modern method considerably reduced the human cost of labour, time spent on those operations that can be mechanized, results in higher extraction rate and generally produced cheaper product(s) by reducing the cost of production.

IITA (1990) identified the objectives of improved (mechanical) method of processing to include: reduction of the drudgery and labour intensiveness of traditional cassava processing methods, and thus increased productivity, producing an end product of better and more uniform quality. Others include ensuring the reduction or total elimination of undesirable toxic constituents in cassava so that it is suitable for human consumption, reduce the amount of fuel used for drying cassava and to promote export potential of cassava products. In the study area, modern method was employed for such processing operations as grating and dewatering.

(a) *Grating:* Here the cassava tubers are crushed into pulp using grating machine mounted on wheels or concrete slab, with the assistance of human labour to feed in the tubers into machine through an elevated end while the grated tuber (pulp) comes out through the lowered end. This operation was done by men in the study area. An average of three machines were available in each community.

(b) *Dewatering:* Mechanical method of dewatering cassava pulp involves the use of iron instrument constructed with or without compartments where the bags containing the wet pulp are put for press-drying and they are press-dried with the aid of hydraulic press or screw press. Human labour (two persons) were required to load, adjust the pulp bags as well as press the hydraulic press or screw the screw press. An average of two dewatering machines were available in each community studied.

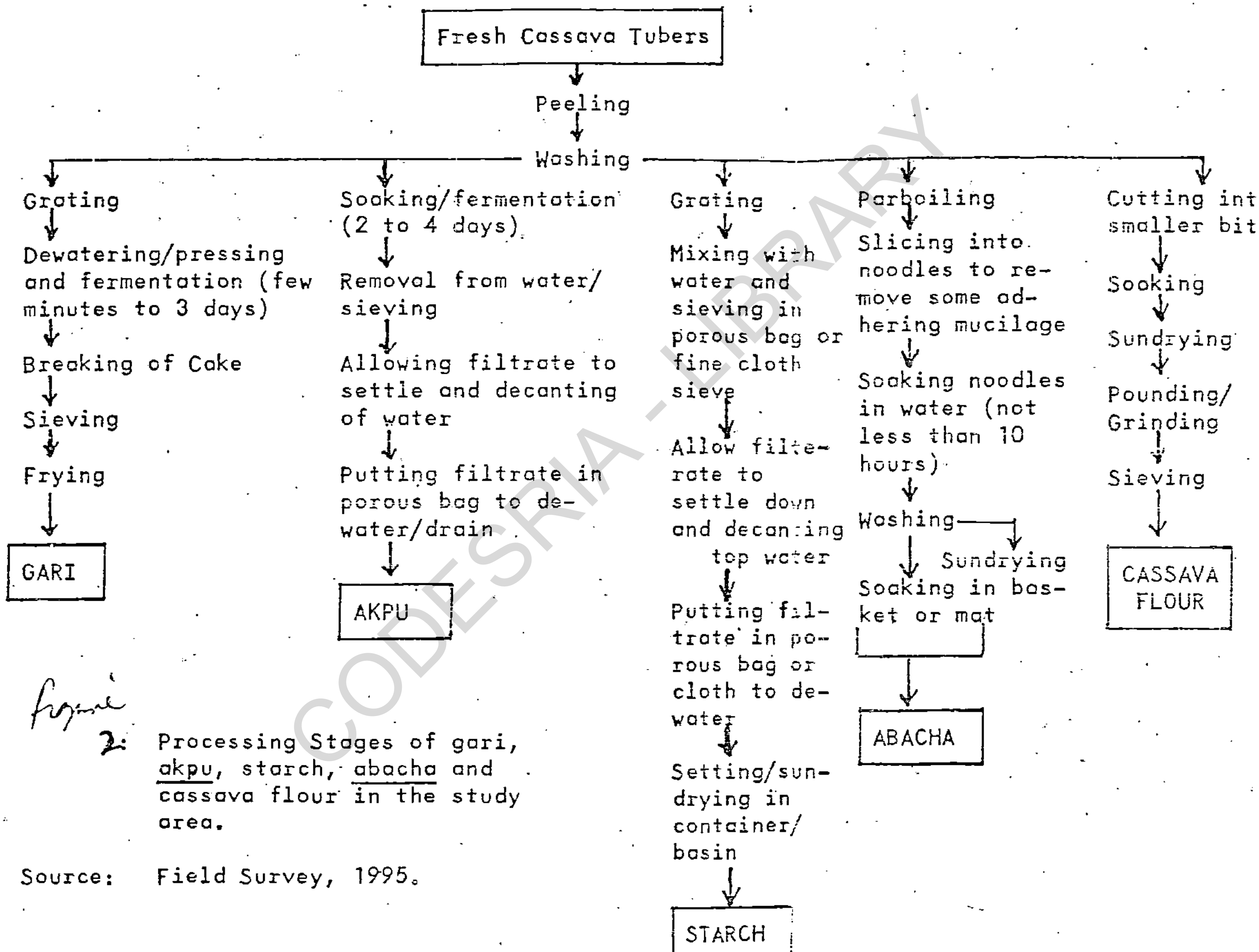

Figure 2: Processing Stages of gari, akpu, starch, abacha and cassava flour in the study area.

Source: Field Survey, 1995.

4.7 Stages and Products of Cassava Processing

A complete flow chart of stages of cassava processing generally involves a number of traditional and mechanical methods and the combination of a number of processes or operations Fig.2)

In the study area, the following cassava processing operations were identified; peeling, washing, soaking, grating, fermenting, boiling, slicing, sieving, dewatering, drying and frying. The number of processing operations required were however determined by the end product(s) desired.

Five end products were identified in the study area. The stages for processing them are shown in figure 2 while the products and their processing stages are discussed below.

4.7.1 Gari Production

To prepare gari, the fresh tubers are peeled, cut and washed. Peeling was usually done by women and children. Peeled tubers were loaded into big basins, wheel-barrows and/or any other available means and taken to the grating machine where they are grated into pulp. All the respondents producing gari indicated using grating machine for grating cassava tubers to produce gari. The grated tubers were packed or loaded into sacks (polyproplene) ready for dewatering - which took ten minutes to one day and allowed to ferment. Both traditional and modern (hydraulic press) methods were employed by the processors. However, most of the respondents used the traditional method. The dewatered cake pulp were usually broken and sieved manually. Thereafter the sieved pulp was fried. Frying was done manually (using traditional) method as mechanical frying machines were not available. Small amounts of oil, usually palm oil were added by some respondents to prevent burning and to give a pleasant yellow colour: thus two types of gari - white and yellow were produced in the study area. IITA (1992) has observed that palm oil contains a substantial quantity of Vitamin A and is expensive. Therefore yellow gari is more nutritious and costs 10 to 30% more than white gari. The product (gari) obtained after frying, is allowed to cool before bagging by spreading on a nylon material on the floor. Well dried gari is capable of storing for up to six months without appreciable deterioration.

4.7.2 Starch Production

The traditional method of processing cassava to produce starch consists essentially of peeling, washing, grating, and drying. Freshly harvested tubers are peeled, washed and then grated into a pulp. The pulp is put into a basket over a pan (basin) or bucket covered with a piece of clean cloth. Water is poured over the basket, the starch is washed out and is filtered through the cloth into a pan. Care is taken not to totally destarch the pulp as they are further processed into gari. The aqueous starch suspension in the basin is allowed to settle and the top water decanted at intervals during the settling process. When decanting is completed, the end product results to starch, which can be allowed to dry in the basin. For preservation the starch can be sundried by spreading out in a basin or flat surface under the sun or put in a pot with a little quantity of water over it.

Another traditional method is to put the grated tubers in bags and to pour enough water over them to soak the contents. The bags are then squeezed and a white liquid is expressed, which is poured into baskets. More water is added to the grated cassava, and the process is repeated until the liquid is left for several hours so that the starch can settle and the supernatant can be poured off. The remaining starch is washed three to four times until the liquid is clear. It is finally pored off and the starch is sundried. Respondents that produced starch reported that the sundried starch preserves better than that left with water over it.

4.7.3 Akpu Production

Cassava tubers are peeled, cut, washed and soaked in a pot, basin or bucket containing water. The soaked cassava is allowed to stand for about three to five days; thus allowing a period of softening and fermentation. Some of the respondents indicated that the duration depends on the sizes of the cut tubers, the time lapse between harvesting and soaking and the maturity of the tubers. Softening of the soaked tubers is accomplished with foam which forms a thick layer of scum above the tubers in the pot, basin or bucket. The softened cassava tubers are removed from the water in which they were soaked, washed for about two times, and then sieved with a framed sieve. Washing helps to reduce the odour (the process is usually omitted where there is water scarcity). The sieve is usually submerged in a basin of water and the soft cassava is put into the sieve in the water in bits. This process is to allow for easy separation of the fibrous parts from the fine part. The fibrous parts are gathered in the sieve while the fine part settles in the basin containing water as the filtrate which is the akpu.

The filtrate is then allowed to settle and the top water is decanted. The semi-liquid filtrate is put in white bags or salt bags and the water is allowed to drain off. This is the last stage of akpu production.

The resultant semi-dried dough (akpu) is ready for sale or prepared as foo foo for human consumption.

The akpu can also be preserved for some couple of days by submerging the salt bag containing akpu in a basin containing water or by putting in its semi-dried form in a pot (clay or aluminum) or in a small basin.

4.7.4 Abacha (Ibibio, Bobozie, Iwuakpu) Production

Abacha as it is called in the Eastern part of Nigerian is commonly known and referred to as Ibibio, Bobozie and Iwuakpu in the study area. It is peeled and washed cassava tubers are cut into bits, parboiled and subsequently sliced into shape as desired either as noodles or a flat thin shape. The slicing could be done with a knife or grater designed for such purpose. The sliced cassava is washed with water to remove some adhering mucilage and then soaked in a basin containing water for some time. Thereafter, the sliced cassava is thoroughly washed over and over until it loses its sticky nature. The resultant product (Ibibio, Bobozie, Iwuakpu) is then ready for consumption. This can be preserved for few days by soaking in water or for a longer period if sundries.

4.7.5 Cassava Flour Production

Cassava tubers are peeled, washed, cut into small bits then soaked for about 24 hours after which they are sundried. Thereafter, the dried cassava is ground with a machine or pounded using mortar and pestle. The ground mass is sieved using a framed fine cloth sieve to remove the coarse particles; thus the fine powdery particles are left which is the cassava flour. Cassava flour can be preserved for up to two months during the rainy season and over two months during the dry season. This difference in preservation periods is mainly because rainy season mostly encourages the growth of moubls on the cassava flour surface.

The number of processed cassava products obtained by respondents ranged between one to five with an average of two products obtained per respondent.

Distribution of respondents according to products obtained is shown is Table 11 below.

Table 4.10 Distribution of Respondents according to types of Cassava Processed Products Obtained.

PRODUCTS	FREQUENCY OF RESPONDENTS	PERCENTAGE
Gari	49	53
Akpu	26	30
Starch	10	11
Abacha	4	4
Cassava flour	2	2
TOTAL	*	*

* Some respondents indicated more than one product.
Source: Field Survey, 1995

From Table 4.10 cassava processing into gari seems to be on the increase with 53% of the respondents producing it. This was followed by akpu 30% starch 11% "Abacha" 4% and finally cassava flour produced by 2% of the respondents. Majority of the respondents produced gari probably due to its position in their food habit, market value, taste and preference of the people as well as its storage quality. Ninety-eight percent of the respondents did not process cassava into flour.
This could be attributed to their cultural affinity, low demand of the product, unawareness of its technique for production and use as food.

The study also showed that respondents put their cassava processed products into various uses (Table 4.11).

Table 4.11 Distribution of Respondents According to the Various uses they put their Cassava processed products.

Uses	Processed Product				
	Gari	Akpu	Starch	Abacha	Cassava Flour
	Frequency of Respondents				
Consumption/Home use	51	30	5	4	1
Sale	43	11	5	4	1
Gift	20	7	1	2	-

Source: Field Survey, 1995.

Table 4.11 shows the various uses of cassava processed products. These include mainly consumption/home use, sale and gift. The highest proportion of the respondents consumed cassava products as gari followed by akpu. The processed akpu and cassava flour were cooked and prepared as foo foo before consuming with soup or stew mixed with vegetable and meat/fish.

Over 50% of the respondents producing each of the product sold part of their processed products to realize money in order to meet other financial commitments. This implies that cassava products were of great economic importance in the study area.

Processors who processed cassava into flour were very few in number and they used it mainly for personal consumption and for sale. Those who indicated gift however did not process just for the purpose of gift but occasionally they gave out from the quantity processed.

CHAPTER FIVE

COSTS AND RETURNS OF CASSAVA PROCESSING

5.1 This Chapter is concerned with the resource inputs and costs, output and value of products, of the various cassava products and profitability of the different processed technologies. Partial budgeting (used to estimate the effect of using the modern processing technology) was also undertaken in addition to analyzing factors militating against increased cassava processing in the study area.

5.2 Resource Use and Costs

5.2.1. Capital

Out of the sixty respondents interviewed, 88% of them source most of their capital from personal savings, 8% borrowed from friends/relatives and 4% borrowed from banks.

Capital for cassava processing varied according to the product(s). On the average the respondents capital is small, usually less than =N=6400.00.

The study showed that the respondents who borrowed from banks and Natural Resources (MANR) were few. Probably the difficulties of obtaining loan from the banks and MANR prevented them from sourcing their capital from such institutions. On the other hand, the banks and MANR must have not recognized cassava processing as one of the lucrative agricultural enterprises. There is the urgent need therefore for the banks as well as the government to show interest and/or pay attention in and/or to this area.

5.2.2 Labour

The different processing operation required one form of labour or the other. Women labour was used for most of the operations though in some operations such as peeling, grating, and dewatering the assistance of children (male and female) was secured.

Sixty percent of the respondents reported that labour used for processing was provided by household and hired labour (Table 5.1) thirty two percent by the household and eight percent hired labour.

Table 5.1 Percentage Distribution of Respondents According to the Source of Labour.

SOURCE OF LABOUR	FREQUENCY OF RESPONDENTS	PERCENTAGE
Hired labour	5	8
Household	19	32
Household and Hired Labour	36	60
TOTAL	60	100

Source: Field Survey, 1995.

Hired labour was used in such operations as peeling, washing, grating and sometime for conveying peeled cassava tubers to the grating centre. Also for sieving and gari frying, hired labour was employed by some respondents. The remaining operations were carried out with the household labour.

Four the purpose of this study, the cost of labour provided by household members was also valued at the prevailing wage rate which the farmers/processors would have paid if such labour were to be hired. This was equivalent to about =N=100.00 per day of about eight working hours. This method of valuation is necessary because there is an opportunity cost for family and other source of labour outside the hired labour.

Estimates of labour cost by operations for the different cassava products may not be accurate as a result of the fact that the method of paying hired labour =N=100.00 per day of about eight working hours did not distinguish between some processing operations performed. Also, some of the operations were done in fewer minutes, and the number of operations differ among processing products as such, it would not be appropriate to assign values for labour equally among the operations.

5.2.3 Cassava Tubers

Cassava tubers processed by each respondent per week ranged from 200kg to 4800kg with an average of about 1600kg of processed cassava tubers per week per respondent producing gari and akpu. Respondents who produced "abacha" processed an average of 400kg per respondent in a week.

An average of 260kg of cassava tubers were processed by respondents who produced cassava flour per week.

The study showed that all the processors or respondents processing cassava to produce starch extracted starch in the course of producing gari.

The study further showed that cassava tubers used for processing were obtained from various sources such as own farms, spouse's farm and/or purchased from the local market. Sixty eight percent of the respondents source their cassava tubers from their own farms. Four percent source their cassava tubers from their spouse's farm. The remaining twenty-eight percent purchased their cassava tubers from the market where an average of =N=160 was paid for every 50kg of cassava tubers purchased. The respondents reported that the cost of purchasing cassava tubers varied greatly with the season. Hence, the cost of cassava tubers was higher during the dry season and planting period than during rainy season.

Other cost incurred by the processors in obtaining the cassava tubers and distributing processed products include:

(a) Cost of bagging the cassava roots at =N=4.00 per 70kg;
(b) Cost of loading the bag(s) into a truck or vehicle at =N=5.00 per bag;

(c) Cost of conveying the cassava tubers in the bags to the processor's home which is on the average of =N=10 per bag;
(d) Cost of off-loading the bags of cassava tubers at processor's home is about =N=4.00 per bag;
(e) Cost of conveying 30kg bag or gari to the market is about =N=60.00 per bag;
(f) Cost of conveying about 12kg bag of akpu to the market i s about =N=4.00 per bag;
(g) Cost of conveying "Abacha" to the market is about =N=2.00 per bag.

5.2.4 Firewood

Majority of the respondents source their firewood from either the forest or personal farms.
The respondents during the dry season would prefer to fetch their won firewood and occasionally bought from the firewood sellers. In the study area, firewood was also sold at the sellers; home. The firewood was either tied up in bundles weighing between 30kg to 50kg or were sold in logs. About 40kg of firewood was used to fry about 155kg of cassava tubers to produce gari while about 20kg of firewood was used to parboil cassava tubers of about 100kg. The average cost of firewood per kg was =N=5.00

5.2.5 Palm oil

Eighty-five percent of the respondents producing gari in the study area added oil in the process of processing cassava tubers to produce gari. Hence yellow gari dominates in the area. The cost of palm oil was about =N=80 per 1.0 litre in the survey year. About 1.0 litres of palm oil was used to produce about 54kg of yellow gari in the survey conducted.

5.2.6 Equipment

The equipment use in processing cassava tubers to obtain the desired product(s) in the study area include: matchets, knives, basin (small, medium and large), bags (fertilizer, poultry and salt), tripod stand, frying pans (black coated and iron cast), pots (aluminum and clay), stakes pressing ropes, sieve and/or stirrers, piece of calabash, graters and the spreading nylon. The straight line method of calculating depreciation was employed in calculating the depreciated values of the equipment used in cassava processing. The salvage was assumed to be zero at the end of useful life. These are shown in Table 5.2.

Table 5.2 Depreciated Values of Equipment Used In Processing Cassava Tubers Into Various Products.

Equipment	Number	Unit Price (=N=)	Total Value (=N=)	Life Span (yrs)	depreciated Value (=N=)
Matchets	2	375	750	5	150.00
Knives	3	115	345	3	115.00
Large basins	2	450	900	5	180.00
Medium basins	3	350	700	5	140.00
Small basins	3	300	600	5	120.00
"White" bags	6	25	150	0.5	300.00
Tripod stands	2	175	350	10	35.00
Wooden Sieves	1	75	75	1	75.00
Metal sieve	1	110	110	1	110.00
Framed cloth sieves	2	50	110	1	100.00
Sieving graters	3	60	180	3	60.00
Slicing graters	3	50	150	3	50.00
Clay pots	3	300	900	1	900.00
Aluminum pots	3	500	1500	5	300.00
Salt bags	6	35	210	0.5	420.00
Pressing rope	1	50	50	1	50.00

Spreading nylons	3	50	150	1	150.00
Stakes	5	15	75	0.5	150.00
Wooden Stirrers	2	20	40	1	40.00
Iron Pans	1	1750	1750	5	350.00
Frying pans	1	650	650	3	216.00

Source: Field Survey, 1995.

5.3 Output and Value of Products

Conversion ratios of unpeeled cassava tubers used to obtain the various processed products was determined based on the field survey carried out. This was based on the average weekly quantities of cassava tubers processed into each product. The conversion ratios for one kilogram of cassava tubers used to produce gari and starch were 0.27 and 0.07 respectively. The conversion ratio for one kilogram of akpu was 0.28 while that of abacha was 2.34. The conversion ratio of fresh cassava tubers used to produce starch was very low just because starch production is carried out in a single process with gari.

The quantities (kg) of processed products were calculated on yearly basis by using estimates for output per year for different products which were determined by taking a year's extrapolated quantities of fresh unpeeled cassava tubers processed into each product per respondent per week and the results obtained from the estimates were: 76800kg of cassava tubers processed, 20736kg of gari and 537.6kg of starch were produced and 21504kg akpu while about 3744kg of abacha was produced.

The values of the processed products were obtained by multiplying the price of each product by the particular quantity of processed product (Table 5.3).

Table 5.3: Total output and value of products by quantities of cassava tubers processed per year to various products.

Processed Product	Qty of Upeeled Cassava Tubers(kg)	Conversion Ratio	Qty of Output (kg)	Unit Price (=N=)	Total Value (=N=)
Garri	76,800	0.27	20,736	18.32	379,883.52
Starch	76,800	0.07	5,376	13.00	69,888.00
Akpu	76,800	0.28	21,504	17.32	372,449.28
Abacha	1,600	2.34	3,744	9.80	3,669.72

Source: Field Survey, 1995.

From the study conducted, it was observed that more than fifty percent of the quantity of the processed products were kept aside for sale. These were sold mostly in the local market and at the processor's home. Most of the processors sold directly to the wholesalers while others sold to retailers and consumers. Unlike gari and <u>akpu</u>, they have standard measurement of cigarette cups and 30kg or 50kg basin measurement for gari and 12kg salt bag measurement for <u>akpu</u> sales. The other products were sold without any standard measurement. Processors however, used their initiatives to measure out the quantity equivalent to the amount desired by the customers putting into consideration the cost of production.

5.4 <u>NET MARGIN ANALYSIS FOR THE DIFFERENT CASSAVA PRODUCTS</u>

Kay (1986) referred to budgeting as a tool used to select the most profitable plan from a number of alternatives and to test the profitability of any proposed change in a plan.

In this study the profitability of cassava processing in the study area was evaluated by computing net margin for each for the processed cassava products that were produced and marketed by the respondents.

5.4.1 Gari and Starch Production

To estimate the net revenue for the production of gari and starch using 5000kg of cassava tubers, net margin analysis was conducted.

The result showed that after processing 5000kg of cassava tubers, using the conversion ratio of 0.27 and 0.07 for gari and starch respectively, 1350kg and 350kg of gari and starch were produced respectively. Thirty kilograms of gari was sold at =N=550 while 7kg of starch was sold at =N=91. This gave the estimate of returns from gari as =N=24,732 and that of starch as =N=4,550. The total revenue from sale of both gari and starch amounted to =N=29,282.

The total cost is made of total variable cost and total fixed cost. The total variable cost includes the cost of inputs, labour for various processing operations, and transportation cost while the total fixed cost which is the depreciated values of the equipment used for gari and starch production.

Table 5.4 Cost and Returns of processing 5000kg per annum of Cassava Tubers to Gari and Starch.

Item	Unit	Price/Unit #	Quantity	Value
REVENUE				
Gari	Kg	18.32	1,350	24,732
Starch	Kg	13.00	350	4,550
Total Revenue				29,282
VARIABLE COST				
Inputs				
Cassava tubers	Kg			16,000
Firewood				951
Palm Oil				1,496
Sub - Total				18,447
LABOUR				
Gari & Starch				1,280
Transportation				5,745
Tot. Variable cost				28,534
FIXED COST				
Depreciation				3,062
Total fixed Cost				3,062
Total Cost				28,534
Net Return				#748

Source: Field Survey, 1995.

The total cost of processing 5000kg of cassava tubers to produce 1350kg of gari and 350kg of starch was =N=28,534.00. The cost of inputs was =N=18,447 which represents about 65% of the total cost, labour cost was =N=1,280.00 which is equivalent to 4% of the total cost, transportation cost was =N=5,745.00 which is about 20% of the total cost while the total fixed cost was about =N=3,062.00 and about 11% of the total cost.

Net returns per 5000kg of cassava tubers processed to gari and starch, defined as the difference between total revenue and total cost per 5000kg tubers processed was estimated at =N=748.00 in the survey year.

5.4.2 Production of Akpu

Table 5.5 shows the Costs and Returns of processing 5000kg of cassava tubers to produce akpu in the study area. The conversion ratio for akpu was 0.28. 5000kg of cassava tubers produced 1400kg of akpu after processing. The return of 5000kg of akpu was estimated at =N=24,248.00.

Table 5.5: Costs and Returns of processing 5000kg of Cassava Tubers to akpu.

Item	Unit	Price/Unit (#)	Quantity	Value
Revenue	Kg	17.32	1,400	24,248
Total Revenue				24,248
Variables Cost				
Inputs				
Cassava tubers		3.20	5,000	16,000
Sub Total				16,000
Labour for the various processing operations for akpu production				3,170
Transport Costs				1,946
Total Variable Cost				21,116
Fixed Cost				
Depreciation				2,100.30
Total fixed Costs				2,100.30
Total Cost				23,216.30
Net Returns				1,031.70

Source: Field Survey, 1995.

The total cost of processing 5000kg tubers of cassava tubers to produce 1400kg of akpu was estimated at =N=23,216.30. From this, =N=16,000 was spent for purchasing cassava tubers. This represents 69%

of the total cost. Labour cost accounted for =N=3,170.00 or 14%. Transport cost was =N=1,946 or 8%. Fixed (depreciated amount of equipment used for akpu production) amounted to =N=2,100.30 and was about 9% of the total cost. The cassava tubers accounted for the highest proportion of the total cost.

The net revenue accruing to the akpu processors (which is total revenue less the total cost) was therefore estimated to be =N=1,031.70.

5.4.3 Production of Abacha

In estimating the net revenue for using 5000kg of cassava tubers to produce abacha, the Net Margin analysis was conducted. The result of the analysis showed that after processing 5000kg of cassava tubers and using the conversion ratio of abacha was sold for =N=9.80 per measure (kg) in the study area during the survey year. The total revenue accruing from the sale of abacha was =N=38,220 per 5000kg of cassava tubers processed. The variable cost items include costs of cassava tubers, firewood, labour for the various processing operations for "abacha" and transportation costs while the fixed cost is the depreciated values of equipment used for "abacha" production (Table 5.6).

able 5.6: Cost and Returns for processing 5000kg Tubers of ssava to "abacha".

Item	Unit (Kg)	Price/Unit (#)	Quantity	Value
Revenue				
Abacha				
Variable Cost	Kg	9.80	3,900	38,220
Cassava tubers	Kg	3.20	5,000	16,000
Firewood				3,925
Sub Total				19,925
<u>Labour</u>				
Labour for various processing operations for the production of <u>abacha</u>				6,170
Transportation Cost				6,324
Total Variable Cost				32,419
Fixed Cost				
Depreciation				2,600.30
Total Fixed Cost				2,600.30
Total Cost				35,019.30
Net Revenue				3,200.70

Source: Field Survey, 1995.

From the survey, the total cost for processing cassava tubers to abacha was =N=35,019.30 and this constitute the total variable cost (=N=32,419) and total fixed cost (=N=2,600). Out of the total cost, input cost constitute =N=19,925 or 57%, labour cost =N=6,170 or 18%, transport cost, =N=6,324 or 18%. The fixed cost on the other hand, constitutes =N=2,600.30 or 7% of the total cost. The fixed cost constituted the least percentage of the cost of abacha production. The estimated net revenue for abacha production was =N=3,200.70.

5.5 PROFITABILITY OF THE VARIOUS CASSAVA PRODUCTS

In trying to determine the profitability of the various cassava products during the survey year, cost items of the different products were compared (Table 5.7) as well as their net revenues (Table 5.8).

Comparing the inputs and labour costs for the various products, it will be seen that all the products are input intensive compared to the labour cost even though labour is comparatively high for such products as gari/starch and abacha, where labour cost make up 4% and 18% of the total cost, due to the various operations performed to obtain the products, however, they are still higher than the cost of input which contributed about 65% and 57% for gari/starch and abacha respectively.

Table 5.7 Cost of Processing Various Cassava Products

Cost items	Garri and Starch		Akpu		Abacha	
	Amount (₦)	Percentage of Total Cost	Amount (₦)	Percentage of Total Cost	Amount (₦)	Percentage of Total Cost
Inputs	18,447	65	16,000	69	19,925	57
Labour	1,280	4	3,170	14	6,170	18
Transportation	5,745	20	1,946	8	6,324	18
Variable Cost	25,472	89	21,116	91	32,419	93
Fixed Cost	3,062	11	2,100.3	9	2,600.3	7
Total Cost	28,534	100	23,216.3	100	35,019.3	100

Source: Survey data, 1995.

The transfer cost (transportation) was comparatively small. This suggests that cassava farmers/ processors did not travel very far to source their cassava tubers and other inputs as well as the distribution of products.

Comparing the fixed cost used for the various products, that of abacha is very small (7%) of the total cost against 11% and 9% for gari/starch and akpu respectively. On the other hand, the proportion of the variable costs for the products is higher in abacha This is followed by akpu and gari.

Table 5.8 shows the summary of Net returns for the cassava products.

Table 5.8: Summary of Net Returns for processing 5000kg of cassava tubers to different product.

Items	Gari & Starch	Akpu	Abacha
Total Revenue	29,282	24,248	38,220
Total Variable Cost	25,472	21,116	32,419
Total Fixed Cost	3,062	2,100.30	2,600:30
Total Cost	28,534	23,216.30	35,019.30
Net Return	748	1,031.70	3,200.70
Total Return/Total Cost	1.03	1.04	1.09
Net Return/Total	0.03	0.04	0.09

Source: Survey data, 1995.

The net-returns for processing 5000kg of cassava tubers to different products gave values of 1.03 for gari/starch production, 1.04 for akpu, and 1.09 for abacha. This means that for every one naira invested in gari/starch production and akpu production yields the sum of three kobo and four kobo respectively. Similarly, for every one naira invested on abacha production yields the sum of nine kobo. The result of the net return to the total cost ratios shows that abacha production is more profitable followed by akpu while gari and starch production appears the least profitable venture.

The net revenue estimates shows that cassava processing is a profitable venture. Although gari\starch and akpu produced, gave a low net revenue, it could be attributed to the low or small capacity of cassava tubers processed. This implies that with an increase in their production capacity, the products will equally attract a higher net revenue. The implication of this is that at the present level of production, their profit level are comparatively low. This tends to discourage most farmers\processors from venturing into cassava processing. The emphasis on increased food production (self reliance), the increase in demand for cassava and its products as a source of local raw materials for the indigenous industries as well as a source of staple food (carbohydrate) and food security, should have led to an increase in the returns of the large numbers of cassava products. But, the introduction of the structural adjustment programme and the accompanied implications has resulted to an increase in the cost of production in many sectors of the economy. Consequently, it affected the returns as profit to cassava products.

The product abacha gave a high net-revenue than gari\starch and akpu. This means that the present level of production for the product (abacha) has almost reached the actual capacity processed in year.. Thus the processors of abacha can increase the production capacity to be able to make more profits.

Unfortunately, this increase would be proportionately less than their gains. Unlike gari and akpu, abacha in the study area and most areas is regarded as inferior product and food for low income earners.

This tends to limit its market potential. Inspite of this, the market potentials for all the cassava products can as well be expanded. The extent to which this can be done will to a great extent depend on the degree of processing so as to improve the quality of the processed products. Although abacha seemed to be more profitable in this analysis, it is worthy to note that most of the respondents engaged in gari production. This probably may be because of its role in the local diet, its general acceptance in the study area as well as its ability to store longer than any other cassava product(s).

5.6 PARTIAL BUDGET

Kay (1986) referred to partial budget as a tool used to calculate the expected change in profit for a proposed change in farm business. In this study, partial budgeting is used to estimate the cost of the different processing technologies for processing cassava tubers (Table 5.9).

Table 5.9: Partial Budget to Estimate the effect of using modern processing technology (Hydraulic Press).

Additional Cost (=N=)		Additional Income (=N=)
Cost of using hydraulic Press	500	None
Reduced Income (=N=)		**Reduced Cost (=N=)**
None		200
Total Cost 500		
(A) Total annual additional costs and reduced income	500	(B) Total annual additional income and reduced costs 200
Net change in profit		200
Net change in profit (B-A)		500
		====
	=	-300
		====

From Table 5.9 on partial budgeting to analyse the profitability of the different processing technologies, it was observed that in using traditional processing technology to dewater cassava pulp, a labour cost of =N=200 was incurred. Similarly, in using a machine (modern processing technology), a total amount of =N=300 would be lost. The net profit change of -=N=300 indicates that a total labour charge of =N=300 was incurred by using a machine.

This therefore implies that it is more economical to use the traditional processing technology than the modern technology at that stage of processing cassava. Farmers/processors may be advised to use the traditional processing technology, since with such method they are better off with small processing capacity. However, should they increase their processing capacity, it is most likely that using the modern processing technology may offer them the economies of large scale processing.

5.7 FACTORS MILITATING AGAINST INCREASED CASSAVA PROCESSING IN THE STUDY AREA

Cassava processors were confronted with a number of problems which tended to limit their ability to improve their processing activities, reduce their level of participation and consequently retard expansion on investment in processing business.

the major factors which militate against increased cassava processing are shown in Table 5.10

Table 5.10: Percentage distribution of respondents according to factors militating against increased cassava processing in the study area.

Major Factors	Frequency of Respondents	Percentage
i Tedious nature of peeling	5	3
ii Lack of government support	23	12
iii Poor storage quality of cassava tubers/storage facilities	28	14
iv Inadequate capital for invest	40	20
v Market uncertainty	26	13
vi High cost of processing equipment	8	4
vii Poor network of road/inadequate transport facilities	13	7
viii Inadequate labour supply/high cost of labour	32	16
ix Agronomic factors such as size, shape of tubers e.t.c	23	13
TOTAL	*	*

* Multiple Response by respondents.
Source: Field Survey, 1995.

The factors militating against increased cassava processing as was identified by the respondents include: tedious nature of peeling which was considered to be tedious by 3% of the respondents. Peeling operation(s) is/are laborious and consumes much time. The problem of peeling may be aggravated when the tubers are of small size. Also roots with irregular shapes are difficult to harvest and peel by hand. This leads to great losses of usable root material. Similarly, the problem of inhaling the smoke from the firewood used and Cyanogenic substance (HCN) from the gari being fried by the processor also has an adverse effect on the processors' health.

Twelve percent of the respondents reported that they never had any assistance from the government. Thus lack of government support is a major factor militating against increased cassava processing the study area. Poor storage of cassava tubers/storage facilities was considered as a problem by 14% of the respondents.

Lack of sufficient capital was reported as a militating factor by about 20% of the respondents. Capital is of great importance in the running of any business. Capital is very essential when one considers the cost of items used in processing, transportation and labour.

Market uncertainty was reported as a major bottle-neck in cassava processing by 13% of the respondents. The increased demand for various food products has led to increased involvement in processing, hence processed products (including cassava products) flood the market such that processors can hardly dispose of all that they kept aside to be sold before the products deteriorate.

High cost of processing equipment was identified by 4% of the respondents to militate against cassava processing. This may be attributed to the effect of the structural adjustment programme (SAP) with consequent devaluation of currency which resulted to price increase of most of the industrial equipment (especially processing machines) and foreign exchange which are valued at high rates. Where the equipment is locally source, they end up to be too expensive due to high prices of the spare parts. Aslo, since most of these farmers/processors process in small quantities, their personal savings are not enough to invest in such expensive equipment.. There is therefore the need for external assistance.

About 7% of the respondents reported poor network of roads/inadequate transport facilities as a factor inhibiting increased cassava processing. The bad condition of the rural roads makes transportation of fresh cassava and the products to market difficult. Most of the rural areas in the study area are often not motorable during the rainy season, thus making it almost impossible for cassava and its products to be transported. The effect of poor network of roads/inadequate transport facilities is an increase in cost of production resulting from increased transfer cost even though most of the processors do not travel far to source their cassava tubers.

Inadequate labour supply/high cost of labour was considered as a limiting factor. About 16% of the respondents reported this. This problem is obvious considering the high rate of rural-urban migration.

Agrnonomic factors was identified by 13% of the respondents as an inhibiting factor against increased cassava processing in the study area. Cassava requires some months after planting before yielding. Time of planting and harvesting, and age of plant (from planting to harvesting) affect size and shape of tubers, starch content, yield and quality of processed products (IITA, 1992). Other agronomic practices such as fertilizer application, spacing, etc., can also affect them.

CHAPTER SIX

SUMMARY, RECOMMENDATION AND CONCLUSION

6.1 SUMMARY

This study was conducted to analyse the economics of alternative cassava processing technologies in Delta State with particular reference to Delta North Agricultural Zone. The need to generate data on the traditional and modern methods of cassava processing as well as analyse the costs and returns of the various cassava products also necessitated this study. The study analysed the traditional and modern technologies used by farmers for processing cassava into different products, conditions and factors that affect farmers' choice of a particular processing technology, profitability of cassava processing and factors militating against increased cassava processing in the study area.

Five Local Government Areas (Aniocha North, Aniocha South, Ika South, Ndokwa East and Ndokwa West Local Government Areas) were randomly selected for the study. In each of the Local Government Areas twelve cassava farmers/processors were randomly selected and interviewed. Personal observations and oral interviews were also used. A total of sixty cassava farmers/processors were interviewed.

Data used for the study were generated through primary sources. Primary data were collected using questionnaire adminstered to the sixty respondents. Statistical tools such as frequencies, means, percentages and Net Margin analysis were employed in analysing the data obtained.

The result shows that 40% of the respondents were within the age bracket of 41-50 years, 30% were within 31-40 years, and 10% were within 21-30 years while 20% of the respondents were above 50 years. About 85% of the respondents were married, 10% were single and 5% were widows. Literacy level was relatively high as 41% of the repondents has between zero and six years of formal education. The mean household size was seven persons. This constituted the main source of unpaid labour for processing. Thirty percent of the respondents depended entirely on cassava processing as a means of livelihood. The rest engaged in other occupations such as farming/fishing, trading, teaching/civil service, palmwine tapping etc. The average number of years of processing experience by respondents was 13 years.

Cassava processoros in the study area were engaged in processing cassava mainly to produce food for household consumption. This was indicated by 40% of the respondents. They also engaged in cassava processing with a view to selling their products and earning more income to better their living condition(s). They also found it necessary to process cassava so as to put it into a more durable form, increase the shelf life, reduce the toxicity level and hence make it more edible and palatable.

Both traditional and modern (mechanical) methods were employed for processing cassava in the study area. The processing operations included peeling, washing, grating, dewatering, slicing, soaking, sieving, drying and frying. The main products obtained from cassava processing in the study area include gari, akpu, starch, abacha and cassava flour. With the exception of cassava flour all the other products were marketed in the study area.

Mechanical method was employed for such processing operations as grating, and dewatering while traditional method was used for all the operations except grating of cassava tubers.

Cassava processors in the study area obtained their fund for processing through personal savings, friends and relations. Women labour was used for most of the processing operations though in some operations such as peeling, grating, and dewatering assistance from children (male and female) was secured. Both paid and unpaid labour services were used. Sixty percent of the respondents used household and hired labour during processing operations, 30% used mainly household labour while 8% of the respondents source their labour mainly through hired labour. Hired labour was used mainly for such operations as peeling, grating, sieving and gari frying. Processors obtained their cassava tubers from their own farm cooperative farmers as well as the market. An average of about 1600kg of cassava tubers were processed per week per respondent processing cassava into gari, starch, and akpu, about 400kg of cassava tubers were processed per week per respondent producing abacha and about 260kg of cassava tubers were processed per week per respondent producing cassava flour.

Five thousand kilograms of cassava tubers was used as computing quantity for estimating the costs and returns for one year's production of each product. The results of the costs and returns showed a decreasing order of net return of =N=3,200.70, =N=1,031.70 and =N=748 for abacha, akpu and gari/starch production respectively.

Using the net revenue and total cost ratio, it is observed that it is more profitable to produce abacha followed by akpu and then gari and starch.

The relatively low profit obtained from gari and starch as well as akpu could be attributed to their small capacity of processing cassava tubers. Inspite of the fact that most cassava tubers used for processing were not purchased, all the cassava tubers were valued at their average market prices in the survey year.

Similarly, all labour supplied including household labour was valued at the average wage rate for similar labour in the study area.

To estimate the economics of the different processing technologies, partial budget technique was employed. The analysis shows that a labor cost of =N=200 was incurred by using the traditional processing technology while a total amount of =N=300 would be lost by using the modern processing technology. The net profit change of -=N=300 indicates that a total labour change of =N=300 was incurred by using a machine. Thus it becomes relatively economical at small capacity of processing to use the traditional processing technology which is probably the most technically efficient method. However, it is likely that if the farmers/processors change (increase) their capacity of processing, they may obtain the benefit(s) of large scale processing by using the modern processing technology.

Factors militating against increased cassava processing in the study area were identified to include: tedious nature of peeling, lack of government support, poor storage of cassava tubers/storage facilities, lack of sufficient capital to invest, market uncertainty, high cost of processing equipment, poor network of road/inadequate transport facilities, inadequate labour supply/high cost of labour, and agronomic factors such as the nature of the tubers - size, shape and e.t.c.

6.2 RECOMMENDATIONS

Cassava processing may not essentially be for monetary benefits. Cassava farmers/processors are motivated to process cassava into different products owing to social norms, the need to satisfy the food requirements of the teaming population, making provision for household food security and to put cassava into more durable form and thus making them more edible.

This could be achieved by reducing the cost of production or processing. Gari for instance is a generally accepted food in the study area, yet the net return (revenue) compared to akpu and abacha is very low. This could be attributed not only to the degree of processing operation but also to the cost of producing gari. Thus by reducing the cost of production or cost of input (especially cost of cassava tubers) gari producers or processors will be better off. Similarly, the government should gear up efforts to encourage farmers to form Cooperative societies and make more land available for production of cassava. This will enable processing to be more regular and a relatively large quantity of cassava tubers will be produced. Also the government should try to direct efforts towards subsidizing most or some of the inputs used for the processing operations.

Government and banks should also make provision for farmers/processors to have access to loans to enable them increase their ventures in cassava processing especially in the areas that involve increasing capital allocated to cassava processing, acquiring low-cost processing equipment and other items used in cassava processing to increase quantities of processed products. A reduction in the cost of production and increased output of processed product, all things being equal, will no doubt greatly increase the net revenue accruing to the cassava processors.

Modern techniques of harvesting cassava tubers (especially during the dry season), storing of cassava tubers and products as well as the entire processing operation should be developed and made available to cassava farmers/processors. This will go a long way to increase productivity and improve the quality and storability of cassava products. It will also help to reduce the cost of cassava tubers and processing operations, cassava wastage and make products available throughout the season. Cassava farmers/processors on the other hand, should try to embrace the formation of viable Cooperative societies to enable them benefit from banks and the government in terms of loan and input purchased at reduced costs.

The extension agents should also endeavour to make the improved cassava varieties available to farmers and processors. Similarly the cassava processors should be informed about the existence of the improved production and processing technique and be enlightened on the use and benefits of such technologies as well as on the production of cassava flour and its uses as an alternative to akpu. The improved fryers with chimneys that direct smoke away from the processors should be introduced to them to ease frying, which is one of the most tedious operation in gari processing.

Given the wherewithal and attention, it is hoped that cassava farmers/processors will not only improve their productivity but will also raise their standard of living.

6.3 CONCLUSION

Despite the fact that cassava processing seems not to be too profitable (especially gari production), people are still increasingly involved in its processing operations. This, no doubt confirms the role of cassava in the dietary need of the growing population.

In conclusion, therefore, it is likely that the cassava processors might have been operating at a loss unknowingly and for the fact that they stayed in the business for long and had no other occupation(s) to support the processing business, they cannot help but tend to continue in the business. Nevertheless, it is more profitable at small scale processing to use the traditional processing technology which is probably the most technically efficient method compared with the modern processing technology. However, should farmers increase their processing capacity, they may enjoy the benefit(s) of large scale processing and be better off by using the modern processing technology.

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APPENDIX

DEPARTMENT OF AGRICULTURAL ECONOMICS
UNIVERSITY OF NIGERIA, NSUKKA

RESEARCH QUESTIONNAIRE

Dear Farmer/Processors,

I am carrying out a research study on the Economic Analysis of Alternative Cassava Processing Technology, a Case Study of Delta North Agricultural Zone, Delta State.

I therefore wish you to kindly answer the questions that will be put to you as best as you can.

I sincerely wish to assure you that the information supplied by you will be regarded and hence treated as confidential and has nothing to do with tax. I anticipate your co-operation.

Thank you.

Kaine, A.I. Nwanneamaka
(Researcher)

INSTRUCTION: Please tick( ) or complete the appropriate space(s)..

GENERAL INFORMATION

1. Name of Cassava farmer/processor ----------------------------
2. Village/town --
3. Local Government Area ----------------------------------
4. Age (less than 20 years); (21-30 years); (31-40 years); (41-50 years); (above 50 years).
5. Marital status. Single ( ), Married ( ), Divorced ( ) Widow ( ).
6. Number of years spent at school ( ).
7. Level of education. No formal education ( ) Primary school level ( ), Vocational education ( ), Secondary school level ( ) Others (specify)________
8. How many children do you have? ( ).
9. Number of household (dependent/relatives)( ) Children( )Adults( ).
10. How long have you been a cassava farmer/processor? ( )
11. Do you have any other occupation outside cassava farming/processing? Yes ( ) No ( ).
12. If yes to no. 11 above, state these other occupations?
    (a) --------------- (b) --------------- (c) -------------
    (d) --------------- (e) ---------------

13. CASSAVA PROCESSORS' OBJECTIVE/IMPORTANCE OF CASSAVA PROCESSING

1. Why do you process cassava? (a) --------------
   (b) --------------- (c) --------------- (d) ---------------
   (e) ---------------

2. Why can fresh roots not be stored? (a) -------------------
   (b) --------------- (c) --------------- (d) ---------------
   (e) ---------------

3. Which months of the year do you process cassava? -----------
4. When is your peak period of processing? -------------------5. Wha is your lean (lowest or minimum) period of processing?
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6. What are the major forms or products you obtain from processing cassava? ---------------------------------------
7. what are the minor forms or products you obtain from processing cassava? ---------------------------------------

Products obtained	A	B	C	D	E
Main Products					
Minor or by-products					
Uses Product	a	b	c	d	e
Consumption					
Sales					
Gift					
Others (Specify)					

9. Do you process any other primary agricultural products?
10. If yes, to No.9, list these agricultural products
(a) --------------- (b) --------------- (c) --------------
(d) --------------- (e) ---------------

C TECHNOLOGIES USED, STAGES AND TIME SPENT.

1. What are the stages involved in cassava processing to obtain each of the processed products? --------------------------
2. What are the technologies used to obtain each of the products? Describe the technoligies used.

Products	Technologies Used
Gari	
Starch	
Akpu	
Cassava Flour	
Abacha	
Others (Specify)	

3. What is the time spent (in hours) in each of the processing operations?

Product a	Product b	Product c	Product f	Product e

D. CONDITIONS THAT AFFECT FARMERS'/PROCESSORS' CHOICE.

1. What are the processed forms of cassava in your area? List them

(a) --------------- (b) ---------------

(c) --------------- (d) ---------------

(e) ---------------

2. which of these forms do you process your cassava? Give reason(s) for processing your cassava into such form(s)

----

3. Does your environment have any impact on your choice of a particular processing technology? Yes ( ), No ( ).

4. If yes to No.3 above, state the impact or effect?

5. What equipment do you require for the particular processing technology you have chosen?

----

6. What are the factors that affect your choice of a particular technology? List them (a)-----(b)---- (c)---------- (d) --------- (e)---------

E. RESOURCE INPUTS AND COSTS.

1. What are the capital assets you own and use for cassava processing?

Assets	NO	Unit Price (=N=)	Total Value (=N=)	Life Span (Years)	Dep. Value (=N)	Cost (=N=)
Grinding Machine						
Frying Pan						
Basin						
Sieve/Sifter						
Bag						
Pot/Oven						
Matchet						
Knife						
Frying Spoon						
Others (Specify)						

2. What are the other items used in cassava processing and their costs. (These exclude cassava tubers and those mentioned in No.1 above).

Items	Qty. (With unit of measure e.g. kg,tin,tonne etc	Cost (=N=)
a. Firewood		
b. Palm Oil		
c. Others (Specify)		

4. What are the source(s) of fund for your cassava processing? (a) Personal savings ( ), (b) borrowed from friends/relatives/co-operative society ( ) (c) Bank ( ) Ministry of Agriculture ( ).

5. If the fund was from external source (outside personal savings how much was received? ----------------------

6. How much was allocated to cassava processing this processng season?-------------------------------------

7. How did you source the labour for cassava processing?
(a) Household ( ), Hired labour ( ),
(c) Household and hired labour ( ), (d) Others (specify) --------------------

8. Which processing operation did you required hired labour and how much was spent? (a)-------- (b)------- (c)--------
(d) -------------- (e) --------------

9. What categories of labour did you use for cassava processing and at what rate(s)? -----------------

Category	Male (=N=)	Female rate (=N=)
Children		
Adult		

10. What are the various technologies, inputs used and cost o f processing each of the cassava products in your area?

Processing Technologies	Prodcut									
	Gari		Starch		Akpu		Cassaflour		Abacha	
	Inputs used	Cost (=N=)	Inputused	Cost (=N=)	Inputs used	Cost (=N=)	Inputused	Cost (=N=)	Inputs used	Cost(=N=)
Peeling										
Washing/cutting of tuber										
Grating										
Fermenting										
Sieving										
Grinding										
Dewatering										
Pounding/frying										
Others (specify)										

11. Did you use machine for some of these operations?
Yes ( ), No. ( ).

12. If yes to No.11 above, what quantity of cassava were processed and how much did you spend as cost for using machine to process them.

Operations	Quantity of cassava Processed (kg)	Cost of using machine (=N=)
(a)		
(b)		
(c)		
(d)		
(e)		
(f)		

13. What is/are the source(s) of your fresh cassava tubers used for processing: (a) Personal farm (a) ( ), (b) Spouse farm ( ), (c) Market and ( ), (d) Others (specify) ---------------

14. If cassava tubers were purchased, at how much --------, at what quantity was purchased ----------, for what period of time ---------- and for how long ----------.

	Quantity (kg)	Cost (=N=)
Bagging of cassava tubers		
Loading of cassava tubers from source to processors' home		
Off-loading at processors' home		
Conveying processed products to place of sale (specity product(s)		

F. OUTPUT AND VALUE OF PRODUCT

1. What quantities of fresh cassava tubers were obtained for processing into various products this processing season and what quantities of products were obtained in each case?

	a	b	c	d	e
Quantity of fresh casses tuber (kg)					
Quantity of fresh product obtained (kg)					
Quantity of by - product (kg) i					
ii					
iii					

2. What quantity of processed product(s) did you sale and how much was realized at different points of sale?

Processed	Processor Home	Rural Market	Urban Market	Others	Total

Product							(Spe		
	Qty Kg	Price per Unit (=N)	Qty Kg	Price per Unit (=N)	Qty Kg	Price per Unit (=N)	Qty Kg	Price per Unit (=N)	Total Amt realised (=N=)

3. Do you sell any of the by-product(s)? Yes ( ) No ( ).

4. If yes to No.3, which by-product(s) was/were sold, what quantity (kg) and how much was realised from the sales?

By Product	Quantity (kg)	Price/Unit =N=	Amount (=N=) Realised
i)			
ii)			
iii)			
iv)			
v)			
vi)			

5. Which of the distribution channels did you use this processing period? (a) consumers ( ), (b) relatives ( ), and (c) wholesalers ( ).

G. MILITATING FACTORS

1. Do you encounter problem(s) in cassava processing? Yes( ) No ( ).

2. What are the five major problems encountered in cassava processing your area?

a)____________________
b)____________________
c)____________________
d)____________________
e)____________________

3. I your own suggestions, what can be done to solve these problems militating against increased cassava processing in your area? ____________________

4. In your own suggestions, what can be done to improve cassava processing in your area? ____________________

____

5. Do you think government can help to solve the problem(s) militating against increased cassava processing in your area? Yes ( ) or No ( )

6. If yes to No.5 above, state the way(s) the government can help to solve these problems.

____

7. Have you ever obtained any assistance from the government? Yes ( ) or No ( ).

8. If yes to No.7, in which area or farms have they assisted you?

a)___

b)___

c)___

d)___

e)___

9. If no to No.8, in what way(s) would you like the government to assist you?

a)___

b)___

c)___