ECONOMICS OF SHEA NUT PROCESSING IN KWARA AND NIGER STATES, NIGERIA

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NIGERIA

NOVEMBER, 2022

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE NIGERIA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF TECHNOLOGY (M. TECH) IN AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

NOVEMBER, 2022

DECLARATION

I hereby declare that this thesis titled "Economics of Shea Nut Processing in Kwara and Niger States, Nigeria" is a collection of my original research and it has not been presented for other qualification anywhere. Information obtained from different sources (published and unpublished) here been duly acknowledged.

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CERTIFICATION

This thesis titled "Economics of Shea Nut Processing in Kwara and Niger States, Nigeria" by AYODELE George Charis (M. TECH/SAAT/2019/10001) meets the regulations governing the award of the Degree of Master of Technology (M. TECH) of the Federal University of Technology, Minna and it is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

This research work is dedicated to God Almighty who manifest miraculously in all facets of my life, including the completion of this research work and to my wife, Oluwakemi and children: Michelle, Mindy and Miles for their patience, endurance, love and support during the course of this work.

ACKNOWLEDGEMENTS

First and foremost, I am greatly indebted to my major supervisor, Prof. K.M. Baba for stimulating my interest in the topic and his guidance, professional advice and constructive criticisms which are the bedrock for the development of this thesis. My sincere appreciation goes to my cosupervisor, Dr. M.A. Ndanitsa for his contribution and encouragement during the development of this work. I also want to thank the Head of Department, Prof. A.J. Jirgi, as well as, Prof. J.N. Nmadu, Prof. L. Tanko, Prof. M.A. Ojo, Prof. F.D. Ibrahim, Dr. A.A.A Coker, Dr. C.O Adebayo, Dr. A.O Ojo, Dr. E.S Yisa, Dr. U.S. Mohammed, Dr. A.I. Oseghale, Dr. A. Ogaji, Malam M. Yakubu and all other Lecturers in the Department of Agricultural Economics and Farm Management for the unquantifiable knowledge imparted in me and their various contributions towards making this thesis a success.

Also, I am greatly indebted to my Mummy Mrs Ayodele Olufunmilayo for her love and care which has been a motivational factor in my academic journey. My sincere gratitude also goes to my siblings and family at large; Mr and Mrs.Saba, Mr. and Mrs. Babatunde, Mr. and Mrs Olayiwola, Mr. and Mrs. Akintade, Mr and Mrs Folusola and Mr. and Mrs. Olatunbosun.

Furthermore, I am grateful to Mr. Adebayo Raphael, who never question my absence from work for the completion of this work. Also I acknowledge my colleagues in the Masters class for their assistance on this work. Time and space constraints would not permit me to list all their names, I must specifically express gratitude to all those who participated in the seminar sessions held on this study. Their various observations, comments and suggestions have been helpful.

Above all, I acknowledge the Almighty God, the giver of life, sound health, and wisdom whose amazing grace has given me this great opportunity to complete this thesis.

ABSTRACT

This study investigated the economics of shea nut processing in Kwara and Niger States, Nigeria. Multi-stage sampling technique was employed in selecting the respondents and primary data were collected from 300 randomly selected respondents in Kwara and Niger States. The methods used in this research were descriptive analysis, budgetary analysis and stochastic profit frontier (SPF) model. Results from the analysis showed that the average age of the respondents in the study area was 43 years and on the average had spent 21 years in shea processing. It was also observed that 70.67% were female, majority of the respondents (56.67%) were married, and the average household size was seven persons. The result also showed that 76% of the respondents had shea nut processing as their primary occupation and majority (73%) were members of association. Also 37% had access to credit, 56% had access to training, and 61% of the labour were family labour. In the shea processing enterprise, 55% of the respondents sourced the shea fruits through picking and 33% of the processors picked and also bought some more for processing while 12% of them mainly bought from pickers. The methods of shea nuts processing were mainly traditional method (51.67%), semi-mechanized (26%) and mechanized (21.66%). The budgetary analysis showed that, in the processing of one kilogram of shea fruits to shea kernel, the total cost was ₦76.80, total revenue was ₦95.00 of shea kernel. The Gross Margin was ₦18.22, Net Processing Income was ₦18.20 and Return on Investment was 0.24. And also showed that in processing one kilogram of shea kernel to shea butter, the total cost was ₦466.04 and total revenue was ₦769.99. The Gross Margin was ₦309.96 and Net Processing Income was ₦303.95. Also, Return on Investment was 0.67 and Operating Ratio for the enterprise was 0.61. The profit function analysis indicated that the estimated gamma (γ) parameter was 0.68, statistically significant at 1% and also the estimated sigma square (δ^2) was 0.77 which was statistically significant at 1%. The estimated coefficients of average cost of manual labour, shea nut, daily water used, wages of machine operator were statistically significant at 1%. The results also showed that the estimated coefficients of average cost of manual labour, electricity, fuel wood, were negatively related to profit gained of shea nut processors. The determinants of profit efficiency of shea nut processors in the study area were found to be age, educational level, access to credit, extension contact, access to training and processing experience. The constraints in the study area were found to be inadequate credit facility, bad road network, inadequate government support, inadequate extension services and inadequate operational knowledge. Based on the findings, the study concludes that shea nut processing is profitable with returns on investment. The earnings from the enterprise is low due to lack of capital investment. It recommends that the processors make their cooperative societies and processors associations more viable in order to benefit from Federal Government interventions. Nigerian Export-Import Bank (NEXIM) and World Bank should ensure linkage of the processors to formal credit institutions in order to boost productivity. Federal and State Governments should provide support in the form of basic amenities in the rural areas, improve road network and repair of bad ones.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

The global demand for shea butter as a result of its use in food, cosmetics and pharmaceutical industries has increased in the recent years with an estimate of 3.8 million metric tons (MT) of dry shea kernel exported annually from Africa (Issahaku *et al.,* 2011). The European Union Commission has given the cottage industries the permission to use up to 5% of stearin – a shea product, in cocoa butter and margarines as improvers or cocoa butter equivalent. In the cosmetics and personal care industries, there is increase demand in the use of shea butter as ingredient in their products due to its anti-ageing characteristics (Rousseau, 2015).

Tiamiyu *et al*. (2014) posited that, in Nigeria, shea butter has been included in the list of export commodities in the bid to diversify the economy from oil. This is in recognition of the potentials of shea butter's contribution to the economy of the country and also on the basis of shea butter industrial use abroad. Shea production generates employment along the shea belt of the country, it generates income for stakeholders along the value chain which ranges from the women and youths that collect the fruit from the wild, the post-harvest processors of the fruit to kernel, the processor of the shea kernel to shea butter, middle men between the producers of shea kernel and exporters (Matanmi *et al*., 2011). Shea has long improved the livelihood of those living in the producing areas. It provides staple edible oil for cooking and lighting. It is used as fuel wood, building material as well as tools; also the roots and bark are used as medicine. Shea fruit (pulp) is an important energy giving diet as the harvesting period coincides with hunger period of early wet season in the production areas of shea (Adagba, 2014). Shea butter, which is the most important of all the shea derivatives, serves as edible oil and is also used in soap making. Shea tree is deciduous in nature which replenishes the soil by shedding its leaves yearly for fertility of the soil as well as carbon fixating agent in the soil.

West Africa Trade Hub (WATH) recorded that, the bulk of the shea nuts produced are for home consumption and local trading (WATH, 2010). Nigeria is the leading producer of shea nut: 355,000 tonnes produced in 1999, 58% of the African production, but 10,000 tonnes lower than in 1996 and 414,000 tonnes in 2005. West African countries are top producers of shea nuts. Exports of shea nuts have increased dramatically in recent years, from 50,000 tonnes in 1994 to 150,000 in 2004 and 350,000 in 2008. Until recently, about 90% of exported shea product was raw nuts. However, the figure has dropped to 65% as processing operations in West Africa have increased. It is estimated that about 30,000 to 35,000 tonnes of butter are processed in Africa for export to Europe and Asia for further refinement into value added shea butter to be used in food and cosmetics (WATH, 2010).

However, Nigeria being the highest producer of shea nut globally has not been in a vantage position to take the credit due to a number of factors such as: increased local consumption of shea products, lack of incentives to engage shea nut pickers in the activities, little remuneration accrue to pickers and local processors and smuggling activities to neighboring countries with efficient infrastructures to export agricultural commodities to European countries and others. Thus, Nigeria official shea export record is low compared to other countries like Ghana, Mali, and Burkina Faso. Thus, reduce foreign exchange earnings (Tiamiyu *et al*., 2014).

1.2 Statement of the Research Problem

Despite the potential of shea butter industry, it has not been given adequate recognition and support to its production, consumption and commercialization in Nigeria (Bolaji-Olutunji *et al.*, 2018). Women collect the shea nuts, extract the butter and sell the refined product using crude traditional method which is tedious, time-consuming and inefficient (Bulmuo, 2012).

Hee (2011) projected that the production of 1kg of Shea butter takes one person 20-30 hours, from collection to final product. It is also estimated that 8.5-10.0kg of fuel wood is required to produce 1kg of Shea butter. This is a drain of scarce resources in the shea belt zone. Shea products are currently in high demand, especially with the European Union permission to include shea butter (stearin) of up to 5% as cocoa butter improvers. Yet the production of shea butter in Nigeria is still far below demand in both quantity and quality. This is because of inadequate remuneration that accrues pickers and processors upstream, (Hee, 2011). The meager profit and inefficiency in shea industry in Nigeria could have effect on the sustainability of the industry which in turn affect rural industries and economic growth of a developing country like Nigeria.

It is imperative to provide information on the economics of shea nut processing to avail government and investors of the market share opportunities in the multi-billion dollar cosmetic and food industries. Based on the foregoing, this study therefore seeks to determine the Economics of Shea Nut Processing in Kwara and Niger States, Nigeria.

1.3 Aim and Objectives of the Study

The aim of the study was to analyze the economics of shea nut processing in Niger and Kwara States, Nigeria.

The specific objectives are to:

i. describe the socio-economic characteristics of the shea nut processors;

ii. identify and describe the methods of processing shea nut; iii.

estimate the costs and returns of shea nut processing enterprise; iv.

determine the profit efficiency of the shea nut processors;

v. ascertain the determinants of profit efficiency of shea nut processors; and vi.

identify and describe the constraints faced by the shea nut processors.

1.4 Justification of the Study

Over the years, trade in shea derivatives have been on the rise because of the increased demand by the European Union, Japan, India, Canada, and the United State (Bolaji-Olutunji *et al.*, 2018). Thus, shea tree has gained importance as an economic tree and this has prompted research studies both at home and abroad in the shea industry. Haruna *et al*. (2012) analyzed the viability of shea butter processing in Northern Region of Ghana on different processing methods; Godfred *et al*. (2015) also explores shea butter production and resource use by urban and rural processors in Northern Ghana while Mohammed (2017) examined the profit efficiency and its determining factors, the investment opportunity and the challenges of shea butter producers in Northern Ghana. Many more studies were reviewed; however, there is inadequate studies on profit efficiency of shea nut processing in the context of Nigeria. Therefore, there is need to carry out this study and the result is expected to provide valuable information to researchers, investors, policy makers, government, processors and other actors in the value chain to make informed decisions. Also, it will serve as a contribution to the existing knowledge of the subject matter and as a guide to other researchers for further studies.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 The Shea Tree

The shea tree is a food plant that is common in Africa. It is botanically called *Vitellaria paradoxa*, from Sapotacea family, famous for its soaping abilities. It was first described by Carl Gaertner (Nikiema *et al*., 2007). The West African shea tree and that of East African are classified as subspecies namely: *V. paradoxa* and *V. nilotica* respectively (Hee, 2011).

Shea tree is an agro-managed tree crop, which is found in the wild, growing in parklands across the semi-arid region of Africa where the shea occurrence zone lies in a region of 600–1500 mm of annual rainfall (Enaberue *et al*., 2011). Shea tree is considered to be semi-domesticated and propagated unconsciously by people, cattle, bats, birds and other animals that disseminate the seeds. However, the trees are not traditionally planted in a domesticated manner (Maranz and Wiseman, 2003; and Harlan and Madison, 1992), but rather the decision to keep or to cut naturally regenerating saplings as a component of an agroforestry system, means the trees are selectively managed. Across West Africa, it has been noted that this process has resulted in an increasing density of desirable traits in shea trees maintained in parklands as opposed to natural woodland formations, that is, fruit yield, sweetness and fat content (Lovett and Hagi, 2000; Maranz and Wiseman, 2003 and Lamien *et al.,* 2004). It has been observed that the shea trees start to produce fruits at about 15–20 years of age and they can live hundreds of years. The fruits are harvested around May until September, coinciding with the rainy season (Hall *et al*., 1996). The genetic variability of shea is noted to be high and there is no tradition of planting trees, as shea is highly effective in propagating itself in this environment. Recent works, however, show that with micropropagation, root cuttings and grafting may allow opportunities to formally domesticate and enrich parklands through selection and planting of more productive shea trees (Sanou *et al*., 2006; Sanou *et al*. 2004; Yeboah *et al*., 2011 and Chimsah, 2014). Such technological advances may ultimately reshape the economics of shea nuts produced; however, in the foreseeable future shea nut production will likely remain in the hands of local women who collect the fruits from the semidomesticated wild-managed parkland trees. Thus, it is critical to develop strategies to enable women to produce high quality shea nuts for storage at the upstream of the shea value chain. Shea has long improved the livelihood of those living in the shea belt, providing staple edible oil, fuelwood, building material, soil protection and honey from the bee pollinators. The fruits are directly consumed which in turn provide good quality vitamins and energy to rural dwellers. The shea seeds/kernels (nuts) from these fruits are sold raw as kernels or further processed into shea butter for cooking, skincare, medicine, and other benefits in many areas of human well-being and rural development. The trees provide regulation through carbon sequestration, wind breaks, and preventing erosion in addition to serving as a habitat for other organisms and direct provisioning of fruits (Lovett, 2004).

Shea play important socio-economic role in Nigeria in terms of employment and income generation to a significant proportion of rural population especially women who are, directly involved in shea nut collection and butter extraction (Matanmi *et al*., 2011). On the basis of its industrial use in the European Union and United States, shea has the potential to generate foreign exchange earnings to Nigeria.

2.2 Shea Nut Processing

Traditional manual processing, semi-mechanized and mechanized industrial methods are three major methods used in processing shea nuts into butter in West African countries. There are several stages of shea nuts processing after wild harvesting which include: curing, extraction, refining, fractionation and manufacturing to final products which may include chocolates, margarines or cosmetics products. The traditional and semi-industrial methods usually stop after extraction, while the industrial process covers the whole range of activities from extraction to fractionation. Medium to large-scale food and cosmetic industries complete the final stage of product manufacturing, using the derivatives of processing (Addaquay, 2004).

2.2.1 Traditional method

Traditional manual processing of shea nuts required the following equipment: pan for boiling water, drying mat, hammers, pestles, winnowing basket, and pot. It involves waiting for the wild shea fruit to ripen, collection of wild fruit, the pulps of the collected fruit are being crushed under foot after fermentation. This berry (almond) sticks to the shell wall, to separate them, the nuts are immersed in boiling water and sun dried for a few days. During the drying stage, the berries become detached. Nuts can now be stored for months without deterioration.

Shelling is carried out using stone, hammers and pestles. Winnowing is achieved by holding basket filled with nut at arm length and gradually employing them. If there is a strong wind, the piece of shell will be blown away, if not, then the operation is repeated many times (Fleury, 2000). The day prior to oil extraction, the shelled almonds are dried again from a moisture content of 40 to 50% to 6 to 7% (Godwin and Spensley, 1971).

The traditional process involves many time-consuming stages. After drying, the kernels are crushed by simultaneous strokes, in a mortal. The paste that is gradually formed needs to be kept at a temperature of about 40^{o}C because shea butter tend to solidify between 34^{o}C to 38^{o}C. Once the paste becomes a fluid, it is strained and heated in a pan. A kneading process using a polished stone takes place to break up oil cell and ease oil extraction. The paste is then mixed with water to separate the remaining oil.

Afterwards it is rapidly mixed by hand until it starts to cover itself with a white emulsion of fat, once this is achieved, the paste is left for some times. The oil that floats to the surface is scooped off, and poured into a container filled with lukewarm water for decantation. During decantation, a white film form over the top of the surface, this is shea butter. It is separated and heated in a cauldron to evaporate remaining water and allow heavy impurities to settle at the bottom. The butter is left overnight to cool. Traditionally, it is then divided and wrapped in leaves for selling or for storage. The butter will last for many years if kept away from light and heat as it is resistant to oxidative rancidity (Fleury, 2000). Although, the large demand for large quantities of water and fuel wood creates a significant drain on scarce resources in the semi-arid areas where shea grows.

2.2.2 Semi-mechanized method

Semi-mechanized extraction method involved the use of diesel or electrically-powered attrition mills, crushers and kneaders. The semi-mechanized method achieve higher extraction rates than strictly traditional methods of extraction, traditional processors have been slow to adopt the various introductions of appropriate small-scale technologies. Each of the aforementioned process activities, once mechanized improves efficiency to 35- 40%. Recently, small-scale machines, such as roasters, milling machines, kneaders and boilers, have been introduced in an attempt to minimize or eliminate the drudgery of traditional manual methods.

2.2.3 Industrial method

The industrial process uses state-of-the-art mechanical and chemical technology to obtain both the highest yields (42-50%) and the highest quality of butter, in terms of stability for extended shelflife and suitability for industrial and food processing. Such an industrial unit may combine an extraction plant with the refinery or may be a stand-alone refinery, using crude shea butter as raw material. The extraction process incorporates fully mechanical, as well as sometimes automated and computerized systems. For large-scale plants, producers add a refinery to the extraction plant. Figure 2.1 shows the flow in the industrial extraction plant combined with a refinery.

After the extraction of the crude shea butter, also known as "natural shea butter" or "bulk shea butter", various options exist for transforming or cleaning, which is loosely described as "refining". In fact, every stage of the refining process takes any natural ingredients deemed unfit for human consumption out of the butter. In the process, harmful refining chemicals are introduced as catalysts and must be removed at the end of the process by "re-refining". Many popular natural products go through such dissections, the same way traditional African shea butter, which has been modified into a myriad of marketable products. The variants may be classified as natural, refined, processed, industrialized, extra refined, ultra refined, etc. Producers use four major processes for modifying or cleaning crude shea butter: De-gumming, neutralization, bleaching and deodorization.

De-gumming (the continuous acid / water process): Gums in edible vegetable oil must be removed to avoid color and taste reversion during subsequent refining steps. The process involves a singlestage phosphoric acid treatment and a single-stage hot water treatment, followed by continuous removal of the hydrated gums in a de-gumming centrifuge.

Neutralization: All crude vegetable oils destined for human consumption (e.g., as ingredients in chocolate and margarine) are neutralized to remove free fatty acids and latex-like matter and then washed to reduce the soap content of neutral oil. This produces a more stable product. Effective

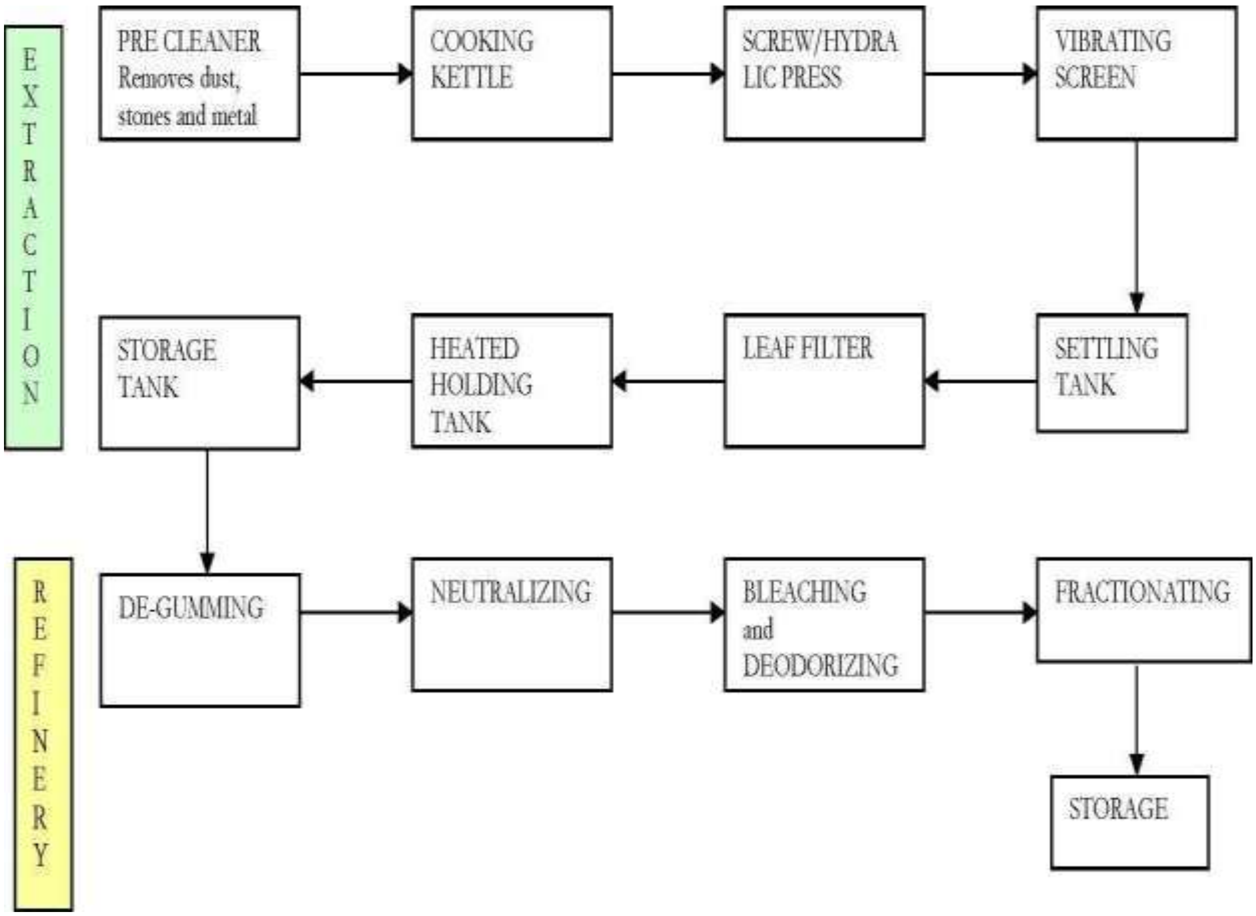


Figure 2.1 Industrial shea butter extraction plant and refinery
Source: Addaquay (2004)

Neutralization results in enhanced effectiveness of subsequent steps, such as bleaching, deodorizing and furthermore, results in high yields of a quality product. Neutralization also aides in the removal of phosphatides, removal of free fatty acids, mineral and color bodies. Neutralization (refining) occurs by the mixing crude butter/oil with a water solution of sodium hydroxide at about 66-77 degrees Celsius. Some plants use sodium carbonate or potassium hydroxide. The alkali reacts with the free fatty acids to form soap, which is an important byproduct of vegetable oil. After refining, processors remove the undesirable traces of soap and moisture through water washing and vacuum drying. In the refining and washing steps, centrifuges separate neutral oil from soap-stock and wash water.

Bleaching and Deodorizing: The neutral, washed and dried vegetable oil still contains some color bodies and small traces of soap (<50 ppm) that have to be removed. Bleaching, the process for removing these pigments from fats and oils occurs when 1% bleaching clay is added to oil under vacuum at approximately 107-110 degrees Celsius, which is later agitated and filtered to remove the clay. High temperature drives moisture from the clay (Fuller's Earth), so that it will absorb the pigments. Some systems also use activated carbon. A high-tech bleaching plant may be equipped with hermetic leaf filters and operates under vacuum to prevent oil oxidation. The oil is cold-mixed with metered quantities of bleaching earth and/or other bleaching agents and thereafter heated to the correct temperature and pumped to a bleaching chamber operating under vacuum where an adequate retention time is provided to ensure effective bleaching. The oil/earth slurry is further pumped through hermetic leaf filters operating in sequence to enable continuous bleached oil (filtrate) discharge. Deodorization represents the last major processing step in refining of edible oils and removes the compounds that cause undesirable odor, flavor and color. Deodorization separates out the impurities and creates three groups of compounds:

1. Saponifiable compounds: free fatty acids, partial glycerides, esters, gummy constituents,
2. Unsaponifiable compounds: paraffinic hydrocarbons, olefinic and polyolefinic materials, sterols, triterpenic alcohols,
3. Oxidative reaction products: aldehydes, ketones, peroxides.

This highly specialized process uses a type of steam distillation under high vacuum to remove objectionable volatile components, such as ketone, aldehydes and alcohols. The bleached oil pumps through a de-aerator where the pretreated oil is de-gassed. This de-aerated oil passes through a heat exchanger where the oil is heated by exchanging the heat of the deodorized oil.

Deodorization further heats the oil to the stripping temperature in a pre-heater. The oil then flows to a flash chamber and thereafter to an oil distributor inside falling film deodorizer. The oil descends countercurrent to the stripping steam in the form of a very thin film and becomes completely deodorized. The process condenses cools and stores the distilled fatty acids. The oil from the bottom flows to an intermediate vessel containing an arrangement for dosing citric acid. This deodorized oil pumps through a heat exchanger to the polishing filter and thereafter passes through a cooler. It is then discharged for collection. The resulting product lacks flavor, odor, minerals and vitamins.

Fractionation: Shea butter has two main components – the stearin (the creamy fat) and the olein (the runny oil). The production of cosmetics mainly uses olein, while the stearin goes into margarines and chocolates. The process which separates the two components is "fractionation". Two methods of fractionation exist – the chemical/mechanical method and physical method. The former requires the creation of a vacuum (airless condition) and applies a chemical reagent to separate the olein from the stearin at different temperatures. After separation, the oily part can then be poured out through decantation or siphoning. The physical process involves a process of sedimentation or a centrifugal method to cause the stearin to separate from the olein. This process, however, proves more difficult when working with the West African shea butter because of the higher ratio of stearin to olein.

2.3 Challenges of Traditional Method of Shea Nut Processing

There are challenges in the processing of shea nut to shea butter. Babatunde and Olaoye, (1997) noted that the inefficiency in extraction of shea butter oil constitute to its inability to compare well with other common vegetable oil. Alonge and Olaniyan, (2007) agreed that the inefficiency in the extraction of butter using traditional method is due to some factors which are: Mesocarp removal which is tedious and time consuming because the harvested berries are left for days for the pulp to decay and are crushed underfoot to remove the pulp; Drying of the shea nut depends on the availability of sun which is not specific in supply and may not be efficient for shea butter production; Shelling of the nut to kernel in traditional method still rely on pestle, hammer and stone which is arduous and inefficient; Winnowing also required the use of basket and wind to blow away of broken shell since the supply of wind is not specific, thus not efficient; Crushing is being achieved in traditional processing with mortar and pestles, which is slow, tedious, energy sapping, arduous and grossly inefficient; Mixing is carried out inside large pot, strong enough to withstand the effect of the mixing operation. The mixing is done by hand until it starts to cover itself with white emulsion of fat. This task is also arduous and time consuming; Temperature control shea butter solidification at room temperature and hence it should be extracted at a temperature above the melting point, which might be too hot for the traditional manual method of mixing using bare hand (Addaquay, 2004).

2.4 The Shea Value Chain

There are wide range of stakeholders in the shea value chain playing different roles at various stages, these include village pickers and post-harvest processors of dry kernel, local buying agents (LBAs), rural or urban traditional butter processors, large-scale exporters of shea kernel, largescale processors (mechanical extraction and export) of shea butter based ‘in-country’, small-scale entrepreneur formulating cosmetics based on shea butter in Africa, external (US, EU, India and Japan) large scale buyers and processors of kernel and butter, external entrepreneurs or companies formulating cosmetics based in shea butter, and external entrepreneurs or companies formulating edible products, including Cocoa Butter Equivalents (CBEs) or Cocoa Butter Improvers (CBIs) based in shea butter (Lovett, 2004).

2.5 Theoretical Framework

2.5.1 Theory of the firm as it applies to rural household production behaviour

This study is based on the theory of the firm as it applies to rural household production behaviour. The theory of firm is microeconomic concept founded in profit maximization. This is to create much gap between revenue and costs. The firm's goal is to determine pricing and demand within the market and allocate resources to maximize net profits. In theory of the firm, the behavior of any company is said to be driven by profit maximization. The theory governs decision making in a variety of areas including resource allocation, production techniques, pricing adjustments and the volume of production.

The theory of rural household behaviour integrate in a single institution decisions regarding production, consumption and processing overtime. These households are partly subsistence and partly commercial in the sense that, even if all markets work, at least some of their production is kept for home consumption and some of their labour resources are used directly for home production. The household sell food produced in excess after consumption in the product market, and family labour supplied in excess of its requirement on the home plot is sold in the labour market. Hence, if production is less than consumption then the household is a net buyer of food vice-versa and if labour supplied is less than required in the home plot, the household is a net employer in the labour market. Thus, both goods produced and consumed by the same household is implicitly farm profit while consumption are both goods purchased and self-produced inclusive. In developing countries, the farm household behaviour is typically influenced by several natural, market and social uncertainties which has raised some complexities in terms of understanding their production decisions. Seeking to insure household members against hunger and hardship is of great importance to any rural family in a less developed setting (Joseph, 2016). Within the standard expected utility approach, the introduction of risk in peasant production choices has entailed including household preferences toward risk (e.g., risk aversion). However, the risk behaviour of agents is determined not only by preferences but also by the availability of institutions that facilitate risk bearing. In other words, where institutional arrangements provide imperfect insurance, households will self-protect by exercising caution in their production decisions. All these factors shape farm households' production choices and explain why vulnerable peasants are often observed to sacrifice expected profits for greater self-protection. This is because risk management is costly, and will differ across households at different points in the wealth distribution, with subsequent implications in terms of efficiency losses and poverty traps.

Alternative economic theories (profit maximization, utility maximization and risk-averse) of peasant household behaviour approaches assumes that peasant households have an objective function to maximize, with a set of constraints. Moreover, these theories are based on a set of assumptions about the workings of the wider economy within which peasant production takes place. First, consider the model of the "profit-maximizing" peasant, which has been criticized on the ground that it overlooks the aspect of consumption in peasant household decision processes. Subsequently, neoclassical agricultural household models, which incorporate both the production and consumption goals of farm households, have become popular. Mostly as a reaction to these models, other economists have crafted the risk aversion theory, which states that the objective function of peasant households is to secure the survival of the household by avoiding risk.

2.5.2 Profit-maximization

The farm households in developing countries are “poor but efficient” gave rise to a long debate among economists and a new wave of empirical work designed to test it (Schultz, 1964). Prior to Schultz’s work, development economics had been dominated by the notion that peasant farmers were poor because they were backward and inefficient.

Referring explicitly to allocative efficiency, and implicitly to technical efficiency, Schultz describes the peasant production mode as profit-maximization behaviour, where efficiency is defined in a context of perfect competition (that is, where producers all apply the same prices, workers are paid according to the value of their marginal product, inefficient firms go out of business, and entrepreneurs display non-diminishing marginal utility of money income) (Mendola, 2007).

Several studies have adopted the allocative efficiency criterion to test whether peasants were or were not efficient (that is, whether they were profit maximizers or not) with some contradictory results (Bliss and Stern, 1982). Conflicting evidence apart, the main caveat in this approach is that profit maximization has both a behavioral content (motivation of the household) and a technicaleconomic content (economic performance of the farm as a business enterprise). Most work in the area of efficiency infers the nature of the former by investigating on the latter. It is therefore concerned less with the way a farm household reaches its decisions than with the outcome of those decisions for the efficiency of the farm as a firm.

2.5.3 Utility maximization

Utility maximization approaches encompass the dual character of peasant households as both families and enterprises and thereby take account of the consumption side of peasant decision making. In expanding the scope of the Chayanovian model and assuming perfect markets, the neoclassical farm household model became popular in the 1960s to explain the behaviour of farm households in simultaneous decision making about consumption and production. This model typically incorporates the notion of full household income and conceives of the household as a production unit that converts purchased goods and services as well as its own resources into use values or utilities when consumed. Thus, the household maximizes utility through the consumption of all available commodities (that is, home-produced goods, market-purchased goods, and leisure), subject to full income constraints. The model shows that if all markets exist and all goods are tradable, prices are exogenous and production decisions are taken independently of consumption decision. In such conditions the decision making process could be regarded as recursive (or separable), because time spent on leisure and time used in production becomes independent; utilization of family labour will be directly linked to the market determined wage rate, and income is singled out as the only link between production and consumption (Mendola, 2007). In contrast to consumer theory in which the household budget is generally assumed to be fixed, in the farm household model, the budget constraint is endogenous and depends on production decisions that contribute to income through farm profits. Thus, to the standard Slutsky effects in the consumer model, the agricultural household models add an additional, “farm profit” effect, which may be positive (e.g., if the price of the home-produced staple increases) or negative (such as when the market wage increases, squeezing profits) (Taylor and Adelman, 2003).

In the absence of a labour market, as in the Chayanovian model, or any other missing market, the decision may not be recursive because the family will be left to decide about the percentage of its total available time to be devoted to production (the difference being assumed to be used for leisure). Therefore, there is no separability between consumption and production (Mendola, 2007).

The household's objective is still to maximize (a discounted future stream of expected) utility from a list of consumption goods (including home-produced goods, purchased goods, and leisure), but subject to what may be a large set of constraints, in which a missing market is yet another constraint on the household. At the same time, the task of empirical economics has shifted to providing evidence of market inefficiencies and their impact on (second-best) household production choices.

2.6 Conceptual Framework

The conceptual framework of this study as shown in Figure 2.1 represents how various factors inter-relate to influence the profitability and profit efficiency of shea nut processing. It is based on production theory with focus on productivity. Productivity measures how efficiently inputs for production are being utilized in production to produce a given level of output (Coelli *et al.,* 2005). Thus, shea nut processing is influenced by the use of processing technologies and other interrelated factors. The output from shea nut, shea butter, is determined by various practices, physical environment and research and development. Processors practices are influenced by the physical environment while research and development is influenced by the potential demand for shea butter. On the other hand, the output market can be influenced by the potential demand, transaction cost and size of the market to determine the output price. Hence, the quantity of shea butter sold to the market is multiplied by market selling price while the quantity consumed is multiplied by the retail price. The total revenue is equal to the revenue from market and revenue from own consumption and stock.

The cost of supply can be influenced by transaction cost, size of market, input production cost, import policies and socio-demographic, institutional and technological factors which in term determine the cost of production. The profit which is determined by subtracting cost of production from the revenue can be influenced by the socio-demographic, institutional and technological factors.

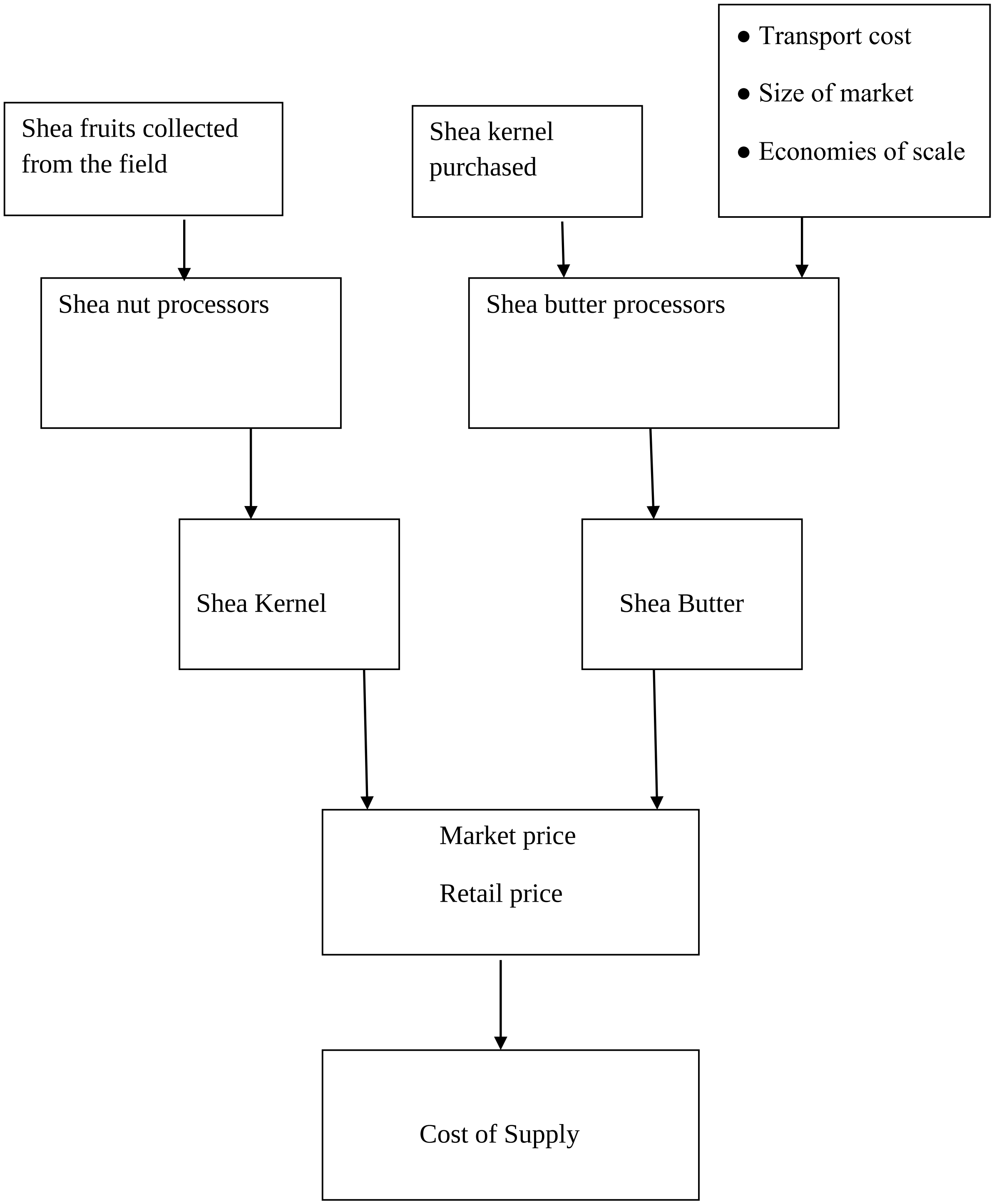


Figure 2.2: Conceptual framework of shea nut processing

Source: Modified from Joseph (2016).

2.7 Empirical Review of Previous Findings

2.7.1 Previous findings on the socio-economic characteristics of shea nut processors

Onikoyi *et al*. (2015) studied the factors associated with shea butter processing in Kwara State, Nigeria and found that majority of shea nut processors were females, elderly, married with large household size, little or no formal education and shea butter processing was their primary occupation. Also Godfred *et al.* (2015) studied shea (vitellaria paradoxa) butter production and resource use by urban and rural processors in Northern Ghana and found that all participants in the experiment were adult female with no formal education.

Jamala *et al*. (2013) studied the socio-economic contribution of shea tree (*Vitellaria paradoxa*) in support of rural livelihood in Ganye, Southeastern Adamawa State, Nigeria and stated that majority of the respondents engaged in Shea butter enterprise were women with no formal education and their primary occupation was shea butter processing even though they were also involved in other form of activities in order to diversify their economy.

Daudu *et al*. (2017) examined the comparative analysis of shea butter production techniques used among women processors in Baruten and Ilorin South, Kwara State, Nigeria and found that majority of the respondents in the study area were within their active age with mean age of 38years, had no formal education, married and had about 10years experience of shea nut processing.

Adagba (2014) in their study, socio-economic characterization of shea value chain in Nigeria, noted that the more the number of workers available in a household the less the requirement for hired labour. Average number of household member participating in farm activity was 7 persons. This was an indication that the need for hired labour would be minimal among the collectors thereby alleviating labour constraints. And again, the study also posited that about three-quarter did not attend formal education school, thus implied that majority of the pickers and processors may not find easy to access information on how to improve upon their various activities with modern technologies.

2.7.2 Previous findings on the methods of processing shea nut

According to Garba *et al.* (2015) in their study on profit potential of shea nut processing in Bosso and Borgu Local Government Areas of Niger State, Nigeria. They revealed that majority of the shea nut processors in the study area used traditional method of processing as indicated by over 80% of the respondents.

The study of Jamala *et al*. (2013) on the socio-economic contribution of shea tree (*Vitellaria paradoxa*) in support of rural livelihood in Ganye, Southeastern Adamawa State, Nigeria indicated that majority of the respondents use manual method for Shea butter processing while only a few used mechanized method of processing.

Dauda *et al*. (2017) asserted that majority of shea nut processors in Baruten and Ilorin South used traditional method of processing while only a few are into modern method of processing shea nut in the study area.

Sarkodie *et al*. (2016) assessed the impact of indigenous shea butter processing activities in Northern Ghana. Analysis of the results revealed that majority of the respondents used indigenous methods of shea nut processing while others used semi-mechanized and mechanized methods of shea nut processing.

Egbunonu *et al*. (2019) studied the assessment of rural women's knowledge on usage of improved shea butter processing technologies in Ilorin East Local Government Area, Kwara State, Nigeria and the findings revealed that majority of Shea butter processors uses parboiling to soften the fruit and to ease fermentation while others uses roasting method by heating the Shea nut with fire as well as the use of pestle and mortar in breaking the Shea nut.

2.7.3 Previous findings on the costs and returns of shea nut processors

Tiamiyu *et al.* (2014) studied the profitability analysis of shea nuts supply chain in selected states in Nigeria and the results indicated that the gross margins per ton for shea nuts collection and processing were ₦10,846.15 and ₦43,500.00 respectively, shea nuts marketing margin per ton within Nigeria was ₦7000.00 while export margins for nuts and for butter were ₦19,500.00 and ₦34,500 per ton, respectively. The returns per each naira invested in shea-based enterprise range from 0.16 to 0.46; thereby indicating the level of profitability.

Ani *et al*. (2012) conducted a study on economic analysis of shea butter plant in Ukum Local Government Area, Benue State, Nigeria and found that the processing of shea butter products was profitable with a mean value of gross returns of ₦823.75.

The results Kodua *et al*. (2018) on the profitability of small scale local shea butter processing: empirical evidence from Kaleo in the Upper West region of Ghana showed that shea butter making in the study area was profitable with positive average values of gross margins, net incomes and net returns on investments.

Adagba (2014) observed that the gross margin per season for shea nut processors was N14, 100.00 and the net income was N12, 283 which is an indication that shea nut processing can be considered profitable in the study area. The gross margin per variable costs, representing the returns per each invested Naira was 0.46. The net cash per variable cost was 0.40 revealing that the shea nut processing was cost-effective.

The total revenue and net revenue accrued to the processing business of shea nut according to Garba *et al.* (2015) were found to be N9, 879, 480.00 and N2, 754, 197.22 respectively for all the respondents per month. The net return was calculated to be N18, 001.29 per respondents per month, which is an indication of profitability of the enterprise in the study area.

2.7.4 Previous findings on the profit efficiency of shea nut processors

The study on the profit efficiency and constraints analysis of shea butter industry in Northern region of Ghana by Mohammed (2017) revealed that profit efficiency was positively influenced by sex, household size, marital status, educational level, transportation cost, store rent, and price of shea nut with a gain in profit efficiency of 58.5%. There are limited studies of profit efficiency on shea trees/ nuts, however, studies of profit efficiency on other crops are reviewed as follow:

Hyuha *et al*. (2007) studied the analysis of profit inefficiency in rice production in Eastern and Northern Uganda. The results show that rice farmers are not operating on the profit frontier. The main causes of inefficiency are firm-specific which include low education and limited access to extension services. These two factors have hampered the attainment of reasonable technical and allocative efficiency.

Stochastic profit frontier function was employed by Kolawole (2006) to determine profit efficiency among small scale rice farmers in Nigeria. He found that rice farmers were fairly efficient in their resources allocation. Kolawole further revealed that profit efficiency where positively influenced by age, educational level, farming experiences and household size.

In their study on economic efficiency of cassava based farmers in Nigeria, Akpan *et al*. (2013), use translog stochastic profit frontier function to estimate efficiency. They found low average profit efficiency of 58% for the farmers in their study area.

2.7.5 Previous findings on the determinants of profit efficiency of shea nut processors Kodua *et al*. (2018) assessed the profitability of small scale local shea butter processing: empirical evidence from Kaleo in the Upper West region of Ghana and found that access to market information, access to credit, length of production cycle (time), savings, experience and household size were found to be significant determinants of profit efficiency in the study area.

Also, Mohammed (2017) in profit efficiency and constraints analysis of shea butter industry: Northern region of Ghana, found that the determinants of profit efficiency of the shea butter seller were sex, household size, marital status, educational level, transportation cost, store rent and price of shea nut which are negatively significant while, age, experience and shea butter quantity produce are positively significant to the profit efficiency of shea butter sellers in the study area.

Abu *et al*. (2012) also used Cobb-Douglas stochastic profit function to determine the technical, allocative and economic efficiency among sesame farmers in Nigeria. They found that farming experience, educational status and access to credit are factors that influence efficiency. Access and availability to credit enhance efficiency.

Sadiq and Singh (2015) on maize farmers in Nigeria found that farmers with experience perform better than those without. They argued that maize farmers with more years of experience tend to operate at significantly higher level of profit efficiency.

In a study by Islam *et al*. (2011) to measure profit efficiency among small scale rice farmers in Bangladesh. They found mean profit efficiency of the microfinance borrowers and non-borrowers were estimated at 68% and 52% respectively, hence suggesting that a considerable share of profits were lost due to profit inefficiency in rice production.

2.7.6 Previous findings on the constraints faced by shea nut processors

In a study conducted by Onikoyi *et al*. (2015), on the factors associated with shea butter processing in Kwara state, Nigeria; the major constraints identified were insufficient water, bad road networks, lack of credit facilities, uncoordinated marketing system for the products, high cost of modern processing equipment and inadequate extension services as the major constraints faced by shea butter processors in Kwara state, Nigeria.

Koloche *et al*. (2016) studied the quantity of shea nut assessed, collected and processed using improved shea nut processing technologies in Niger State, Nigeria and indicated that majority of the processors had the problem of insufficient shea nut during the peak of the dry season for processing sufficient quantity of shea butter for commercial purposes, lack of credit facilities, seasonality in supply of shea nut, risk associated with picking/collection of shea nut, price fluctuation of shea butter, poor processing equipment, poor quality of the shea butter produced, poor capacity building support as well as lack of viability commercial practicing technologies.

The major challenges encountered by shea nut processors in Ganye, Southeastern Adamawa State, Nigeria as identified by Jamala *et al*. (2013) were lack of processing equipment, technical skills, low inputs and capital as well as lack of assistant from government or non-governmental organization.

According to Alonge *et al*. (2007), the problem of shea butter processing starts with harvesting which is usually collected after dropping from the tree to the ground; other problems include postharvest storage because of lack of facilities for immediate parboiling after harvest. Washing, drying and cracking of the nut to recover the kernel also constitute a menace because of inadequate facilities. The milling and roasting of the kernel prior to butter extraction is also laborious and tedious.

Garba *et al.* (2015) identified some of the major problems faced by shea nut processors in their study area to include lack of mechanized processing equipment, drudgery associated with processing, poor access to credit and storage facilities among others.

The constraints faced by shea nut processors as ranked by Egbunonu *et al*. (2019) were high cost of machine, inadequate credit facilities, inadequate knowledge on operational skill, high maintenance cost, inadequate extension support, consumers' preference as well as unavailability of market.

Jamala *et al*. (2013) in their study, showed that majority of the respondents (90%) pointed out that they do not receive any kind of assistance from government or nongovernmental organization in order to enhance shea butter processing enterprise. 60% of the respondents explained that the major challenges mostly encountered in shea butter enterprise was that of lack of processing equipment, others (20%) said that they also faced some technical and low inputs challenges. Majority of the respondents (90%) were of the opinion that government should provide them with support and also training to enhance their productivity. 10% of them added that processing equipment when provided can highly enhance their livelihoods.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 The Study Area

The study was conducted in Kwara and Niger States in the North central part of Nigeria. Niger State lies within latitudes 8° 20'N – 11° 30'N and longitudes 38° 30'E – 7° 20'E. It shares a foreign border with the Republic of Benin in the North West, Kaduna State in the East, Abuja FCT in the South-East, while in the North it shares boundaries with Kebbi and Zamfara States, also with Kwara and Kogi in the South. The state has an estimated population of 5,718,176 people at a growth rate of 3.2% according to the projection of National Population Commission (NPC, 2018). The state covers an estimated land mass of 86,000 square kilometres, taking about 10% of Nigeria's total land mass, of which 85% is arable land (Afolayan *et al*.,2012).

Niger State experiences distinct dry and wet seasons with annual rainfall varying from 1,100mm in the Northern part of the State to 1,600 mm in the southern parts. The duration of the rainy season ranges from 150-210 days or more from the north to the south. Generally, the climate soil and hydrology of the State permit the cultivation of most of Nigeria's staple crops and still allows sufficient opportunities for grazing, fresh water fishing and forestry development. The wet season starts late April to October with the peak being in July and the dry season from October to March which is dominated by the North-east trade winds, popularly called the harmattan. The harmattan is cool, dry dusty wind, which blows across from the Sahara.

The people of Niger state comprises of three principal ethnic groups namely: Nupe, Gwari and Hausa and they engage in farming mainly on subsistence level. Prominent among the crops grown are maize, rice, groundnut, soya-bean, sorghum, millet, cowpea, cassava, sugarcane, yam and assortments of fruits and vegetables. A part from crop farming, livestock are also reared such as cattle, sheep, goat, pigs, chickens, guinea fowl, and duck etc. The state is currently made up of 25 Local Government Areas (LGAs) which are grouped into three administrative zones: I, II and III. Though shea trees are cultivated in almost all parts of the state, it is predominantly produced in zone I.

Kwara State is situated in the North central geopolitical zone of Nigeria. The coordinates of the state is within latitudes $8^{0}30'$N -$5^{0}0'$Eand longitudes 8.500^{0}N – $5^{0}0'$E of the equator. The state is bordered in the west by Benin Republic, in the north by Niger state, in the south by Oyo, Osun and Ekiti States and in the east by Kogi State. The state has an estimated population of 3,493,422 at a growth rate of 3.05% people according to the projection of National Population Commission (NPC, 2018). The State covers an estimated land mass of 36,825 square kilometres, ranked 9^{th} of 36 States of Nigeria. Kwara State lies exclusively within a tropical hinterland and experiences both the wet and dry seasons each lasting for about six months. The raining season starts from March and end in October while the dry season begins in November and ends in early March. The total annual rainfall in the state ranges from 800mm to 1,200mm in the northwest and 1,000mm to 1,500mm in the southeast. The state has a mean annual temperature ranging between 30^{0}- 35^{0}C and a relative humidity of 60% on the average.

The major ethnic groups of the state are Yoruba, Nupe, Bariba and Fulani with Islam and Christianity being the predominant religion in the State. The main stay of the economy of the State is agriculture with principal cash crops like cotton, cocoa, coffee, kolanut, tobacco, beneseed, palm produce, while other crops include: maize, rice, groundnut, soya-bean, sorghum, millet, cowpea, cassava, sugarcane and yam. A part from crop farming, livestock are also reared such as cattle, sheep, goat, pigs, chickens, guinea fowl, and duck etc. The state is currently made up of 16 Local

Government Areas (LGAs) which is further classified into four Agricultural zones. Shea trees are found in all the four agricultural zones of the state but predominant in zone A and C (Onikoyi *et al*., 2015).

3.2 Sampling Technique and Sample Size

A multi – stage sampling procedure was adopted in this study to select adequate number of shea nut processors that were representatives of the population for this study. In Niger State, the first stage involved purposive selection of zone I due to the predominance of shea nut trees. The second stage involved purposive selection of three LGAs (Gbako, Katcha and Agaie) from the zone because of the predominant involvement in shea nut processing while the third stage involved random selection of three villages each from the selected LGAs to make up nine villages in total: Ndakama, Ndagbachi, Fembo, Gbakogi, Assanyi, Babagi, Koriyagi, Kpotun Waoro and Wadata. The sampling frame was obtained based on identification and random selection of shea nut processors duly registered by the Niger State Agricultural and Mechanization Development Authority (NAMDA) and shea nut Processors Association in the study area.

In Kwara State, agricultural zones A and C were purposively selected in the first stage because of the predominance of shea trees. The second stage involved random selection of two LGA's from each of the zone to make up a total of four LGAs while the third stage involved random selection of three villages from each of the selected LGAs to make up a total of twelve villages: Kemanji, Tenebo, Kukugi, Igbogi, Magaji, Sinawu, Budo-Aribi, Alagbede, Budo-Ogbin, Agbaku-Eji, Okete and Adanduro. The sampling frame was obtained based on identification and random selection of shea nut processors duly registered by the Kwara State Agricultural Development Agency and shea nut Processors Association in the study area.

The sample size for this study was obtained from the sampling frame using Taro Yamane's formula (equation 1) as adopted by Coker and Audu (2014) and a proportionate sampling formula (equation 2) was used to distribute each sampling frame to the sample size for each of the selected villages.

The summary of sampling procedures to be used for this study is presented in Table 3.1.

The Yamane formula is given as:

$$n = \frac{N}{1 + N(e)^2} \qquad (1)$$

Where:

n = sample size N = finite population e =

level of significance (5% precision level)

1 = unity

The proportionate sampling formula is given as:

$$nn = \frac{n \times nh}{N} \qquad (2)$$

Where:

nn = Sample size n = Sampling

frame nh = Predetermined

sample size

N = Total sample frame

Table 3.1 Summary of sampling procedures for the study

Agricultural Zones	LGA's	Villages	Sampling Frame	Sample Size
NIGER				
Zone A	Agaie	Koriyagi	110	27
		Wadata	70	17
		Kpotun waoro	50	12
	Katcha	Babagi	55	13
		Assanyi	123	30
		Gbakogi	48	12
	Gbako	Ndakama	50	12
		Ndagbachi	50	12
		Fembo	35	9
Sub-total	**3**	**9**	**591**	**144**
KWARA				
Zone A	Kaiama	Kemanji	53	13
		Tenebo	45	11
		Kukugi	60	15
	Baruten	Igbogi	59	14
		Magaji	48	12
		Sinawu	55	13
Zone C	Asa	Budo Aribi	60	15
		Alagbede	50	12
		Budo Ogbin	45	11
	Moro	Agbaku Eji	61	15
		Okete	55	13
		Adanduro	50	12
Sub-total	**4**	**12**	**641**	**156**
Total	**7**	**21**	**1,232**	**300**

Source: Adopted and modified from Niger State Agricultural and Mechanization Development Authority (NAMDA) and Kwara State Agricultural Development Project (2019).

3.3 Method of Data Collection

The study was based on primary data. The relevant data were obtained with the aid of structured questionnaires administered to the shea nut processors in the study area. The questionnaires were administered to the respondents by the researcher and well-trained enumerators in each of the locations. Information collected includes shea nut processors' socio-economic characteristics such as literacy level, age, gender; resource characteristics such as household size, scale of production; information on inputs and output.

3.4 Analytical Techniques

Both descriptive and inferential statistics were used for this study. The descriptive statistics includes mean, frequency distribution, percentages and graphical illustrations while the inferential statistics were farm budgetary techniques and stochastic profit frontier.

Objectives i, ii and vi were achieved using frequency distribution and percentages, objective iii was achieved using budgetary technique while objectives iv and v were achieved using stochastic profit frontier model.

3.5 Model Specification

3.5.1 Enterprise budgetary analysis

Budgetary analysis was used to determine the costs and returns of shea nut processors in the study area as stated in objective ii. The profit function is given as:

$$\pi = TR - (TFC + TVC) \quad (2)$$

Where:

Π = Profit;

TR = Total Revenue (amount derived by selling units of product from the enterprise);
TFC = Total Fixed Cost (spending on fixed assets used in processing e.g. calabash, cooking pot) and

TVC = Total Variable Cost e. g. cost of raw materials, fuel, water, wood, oil, transportation).

Gross Margin (GM) = TR-TVC

Net Processing Income (NI) = TR- (TFC+TVC)

Return on Investment (RoI) = GM/TVC

Operating Ratio (OP) = TVC/TR

3.5.2 Stochastic profit frontier model

The stochastic profit frontier model was used to determine the profit efficiency of shea nut processors and the determinants of shea nut processor's profit efficiency as stated in objectives iii and iv respectively.

The models are specified in explicit form as follows:

$$LnY=ln\beta_o+ln\beta_1X_1ij+ln\beta_2X_2ij+ln\beta_3X_3ij+ln\beta_4X_4ij+ln\beta_5X_5ij+ln\beta_6X_6ij\ldots..+ln\beta_nX_nij+V-U \quad (3)$$

Where:

Y_i = normalized profit ($\frac{\text{profit}}{\text{unit price}}$) (₦)

X_1 = average cost of labour (₦)

X_2 = average cost of shea nut per bag (₦)

X_3 = average cost of daily use of water (₦)

X_4 = average cost of electricity (₦)

X_5 = average cost of diesel/petrol (₦)

X_6 = average cost of lubricant/oil (₦)

X_7 = average cost of fuel wood (₦)

X_8 = average cost of milling (₦)

X_9= average packaging cost (₦)
X_{10}= average cost of drying (₦)

X_{11}= average transportation cost (₦)

X_{12}= average wages of machine operator (₦)

X_{13} = depreciation of fixed asset (₦)

Straight line depreciation = (cost of an asset - salvage value)/useful life of the asset β_0= constant β_1– β_{13} = estimated parameters; i = 1, 2, 3, …………..n, (processors) j = 1, 2, 3, …………….m, (inputs)

V_i = random variable assumed to be independently and identically distributed.

U_i = one sided error ($U_i \geq 0$) efficiency component that represent profit inefficiency in production which is assumed to be independently and identically distributed at truncation (at zero) of the normal distribution with mean, $Z_i\sigma$ and variance σ^2 (U $Z_i\sigma$, σ^2).

The inefficiency model (U_i) is given as:

$$U_i = \delta_0+\delta_1 lnZ_1ij+\delta_2 lnZ_2ij+\delta_3 lnZ_3ij+\delta_4 lnZ_4ij+\delta_5 lnZ_5ij+\delta_6 lnZ_6ij+\delta_7 lnZ_7ij+\delta_8 lnZ_8i+\delta_9 lnZ_9i+\delta_{10} lnZ_{10} + ij+W_i \quad (4)$$

Where:

Z_1 = age (years)

Z_2 = sex (male = 1, female = 0)

Z_3 = marital status (married = 1, otherwise = 0)

Z_4 = level of education (years)

Z_5= level of processors' experience (years)

Z_6= household size (number of people)

Z_7= amount of credit accessed (₦)
Z_8= membership of cooperative (yes= 1, otherwise = 0)

Z_9= extension visit (number)

Z_{10} = access to training (yes =1, no = 0) δ_o

= constant.

$\Delta_1 - \delta_{10}$ = Vector of unknown parameters to be estimated.

W_i = random variable defined by the truncation of the normal distribution with zero mean and variance σ^2

3.6 Measurement of Variables

Age: This is the age of a processor and was measured in years.

Sex: This is the gender of respondent and it was categorized into male and female. This is a dummy variable (1 if male, 0 if female)

Household size: These are the people living together under the same roof (measured in number)

Marital status: This is the marital status of respondent. This is a dummy variable (1 if married, 0 if otherwise)

Education: This is the years of formal education acquired by a processor; this was measured as total number of years in formal schooling.

Experience: This is the level of experience of processor in shea butter industry; this was measured in years

Quantity of shea: This is the quantity of shea butter extracted after processing and was measured in kilogram (kg)

Transportation cost: This is the money spent in transferring shea butter from production centre to the point of sale; this was measured in Naira (₦)

Distance to market: This is the distance of the processing unit to the market; it was measured in kilometer (km)

Store rent: This is the amount spent in renting store annually; it was measured in Naira (₦)

Input price (shea nut): This is the market value of shea nut and was measured in Naira (₦)

Amount saved: This is the money saved to be invested or had been invested in business of shea nut processing, was measured in Naira (₦)

Membership of cooperative/ association: This is an organized social group. Respondents' membership in cooperative or association was measured in number of years of cooperative/ association membership.

Extension visit: This is the number of times the extension agents visit the respondent.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Shea Nut Processors

The socio-economic characteristics of shea nut processors in Kwara and Niger States, Nigeria are presented in Table 4.1.

The results in Table 4.1 reveals that the mean age of the shea nut processors in the study area was 43 years and this implies that the shea nut processors were in their active and productive age, which could positively influence on the increasing shea nut processing. This also shows that shea nut processing is a serious business that cannot be left in the hands of teenagers. It further shows that shea nut processing is a laborious work which required lots of energy. This corroborates the findings of Adagba (2014) who carried out study on the socio-economic characterization of shea value chain in Nigeria and revealed that processors in the study area were dominated by youth, which was capable of supplying labour required for shea gathering and processing activities.

The study also shows that majority (70.67%) of the shea nut processors were female and 29.33% were male, implying that women dominated shea nut processing in the sampled communities. This is because shea nut collection and processing season overlaps the main cultivation season which keeps the male engaged in farming activities. This further lends credence to the findings of Becker and Held, (2001) that in Nigeria, at least 75% of the actors are women as compare to 25% men. Also agrees with the findings of Julius (2007) that across the African Shea Zone, women are the traditional custodians of the shea resource, with responsibility and control over all the stages of processing from collection of the fruits to transformation and marketing of shea butter.

Table 4.1: Socio-economic characteristics of shea nut processors

Variables	Frequency	Percentage	Mean

Age (years) ≤40			
	109	36.33	
41 – 50	170	56.67	
51 – 60	15	5.00	43 years
> 60	6	2.00	
Gender			
Male	88	29.33	
Female	212	70.67	
Marital Status			
Single	90	30.00	
Married	170	56.67	
Divorced	12	4.00	
Widowed	19	6.33	
Experience (years) ≤			
10	23	7.67	
11 – 15	17	5.67	
16 – 20	21	7.00	21 years
> 20	239	79.67	
Educational Level			
No Formal	110	36.67	
Primary	130	43.33	
Secondary	38	12.67	
Tertiary	22	7.33	
Household Size			
≤ 5	70	23.33	
6 – 10	165	55.00	
11 – 15	40	13.33	7 persons
> 15	25	8.33	

Source: Field Survey Data (2019).

Also, the result indicates that majority (56.67%) of the shea nut processors were married while 30% were single, hence married shea nut processors were more because they are saddled with responsibility of catering for the families, which will directly or indirectly influence their participation in income generating activities for improving the economic status of their families. Shea nut processing experience was expressed in number of years the processors have been in shea nut processing. This reveals an average years of experience of 21, indicating that processors with long period of processing experience will be able to make sound decisions as regards management of risk and other decision as that could improve the productive capacities. 36.67% had no formal education and 43.33% with only primary education implies their reluctance to adopt mechanized technology in the shea nut processing. Increased level of education increases the ability of processors to cope with the complexities of the new technologies. This results agrees with the findings of Rahman and Umar, (2009) which indicates that formal education has a positive influence on the adoption of innovations as well as improvement in technical efficiency of the farmers.

The household size ranging from 6 – 10 as indicated by 55% of the respondents indicating a mean of 7 persons per household which implies a relatively large family size in the study area. It shows a minimal requirement for hired labour since the family labour increased with larger family size. The implication of these results is that even though the shea nut processors in the study area had very little or no formal education, they had a great wealth of experience. Also, is in line with the findings of Koloche *et al*. (2016) who found that shea nut processors in their study area were mostly female who were married, in the age range of 41-60 with household size between 6-10 and with processing experience of over 20 years.

4.2 Occupation and Access to Rural Services

The results of the primary, secondary occupation and access to rural services of the respondents in the study area were analyzed and presented in Table 4.2. The result showed that 76.4% of the respondents had shea nut processing as their main occupation while 23.6% of the respondents had it as the secondary occupation in the study area. This indicates that shea nut processing is a major occupation in the study area and main support of livelihood in the study area. This was corroborated by Jamala *et al.* (2013) in their study on socio-economic contribution of shea tree (*vitellaria paradoxa*) in support of rural livelihood in Nigeria. Their findings revealed that 53% of the respondents had shea butter processing as major occupation. 69% of the respondents have extension contact while 31% had no extension contact, this indicates the presence of extension agents in the study area as a major source of information on new innovation, technology and modern practices in the shea nut processing in the study area.

73% belonged to processors association, while only 27% were not members of any association. This indicates that information can easily be disseminated to the members of the association through the association head. This also implies that the respondents are organized and can be supported easily through government interventions and non-government organization. About 37% of the respondents had access to credit, while 63% had no access to credit in the study area. This shows that majority have no access to credit which could influence the scale of production of shea nut processing in the study area. This also could negatively influence the adoption of mechanized and modern methods of shea nut processing in the study area. As evident in the Table 4.2, majority (56%) of the respondents had access to training, while 37% have no access to training. This further implies that the respondents were organized and may easily benefit from training support from government, Non-governmental organization and development organization.

Again, it could enhance the adoption of modern technology, innovations and practices this corroborates the findings of Tsado (2013), who pointed out that training positively and significantly influenced adoption.

Table 4.2 Occupation and access to rural services

Variables	Frequency	Percentage
Shea Nuts Processing		
Primary Occupation	229	76.4
Secondary Occupation	71	23.6
Extension Contact		
Yes	207	69
No	93	31
Membership of Association		
Yes	219	73
No	81	27
Access to Credit		
Yes	111	37
No	189	63
Access to Training		
Yes	168	56
No	132	44
Labour		
Hired	27	9
Family	183	61
Friends	60	20
Communal	30	10

Source: Field Survey Data (2019).

The family labour was higher compared (61%) to hired labour (9%), friends (20%) and communal (10%). In the study area, the household size was relatively large (7 persons per household), thus have more hands to carry out the shea nut processing activities from the family. Consequentially, minimize the requirement of hired and communal labour in the study area. This is in line with Adagba (2014), who reported that the more the number of workers available in a household the less the requirement for hired labour.

4.3 Sources of Shea Nuts/ Kernels and Methods of Shea Nut Processing

The result of the sources of shea nuts and shea kernels and methods of shea nut processing was analyzed as presented in Table 4.3. The result indicates that 55% of the respondents picked shea fruits, 33% picked and bought more fruits/kernel from sellers while, 12% indicated that they bought fruits/kernels. This findings lends credence to Hall *et al*. (1996), in their findings, shea nuts remained a picking products in shea butter processing.

Also, majority of the shea nut processor used traditional method of processing while a very few used mechanized method of processing as indicated by 51.67% and 21.66% of the respondents respectively. This low level of adoption of mechanized method of processing by the shea nut processors could be attributed to the high cost of the equipment and as such processing of shea nut is mostly done with crude processing materials such as mortar and pestle, baskets, sacks, clay pot, buckets, jerry cans, cups, sticks, stones, calabash and mats. This result corroborates the findings of Jamala *et al*. (2013) in their study that 73% of the respondents employed manual method of processing, 23.3% used mechanized while 3.3% used semi-mechanized.

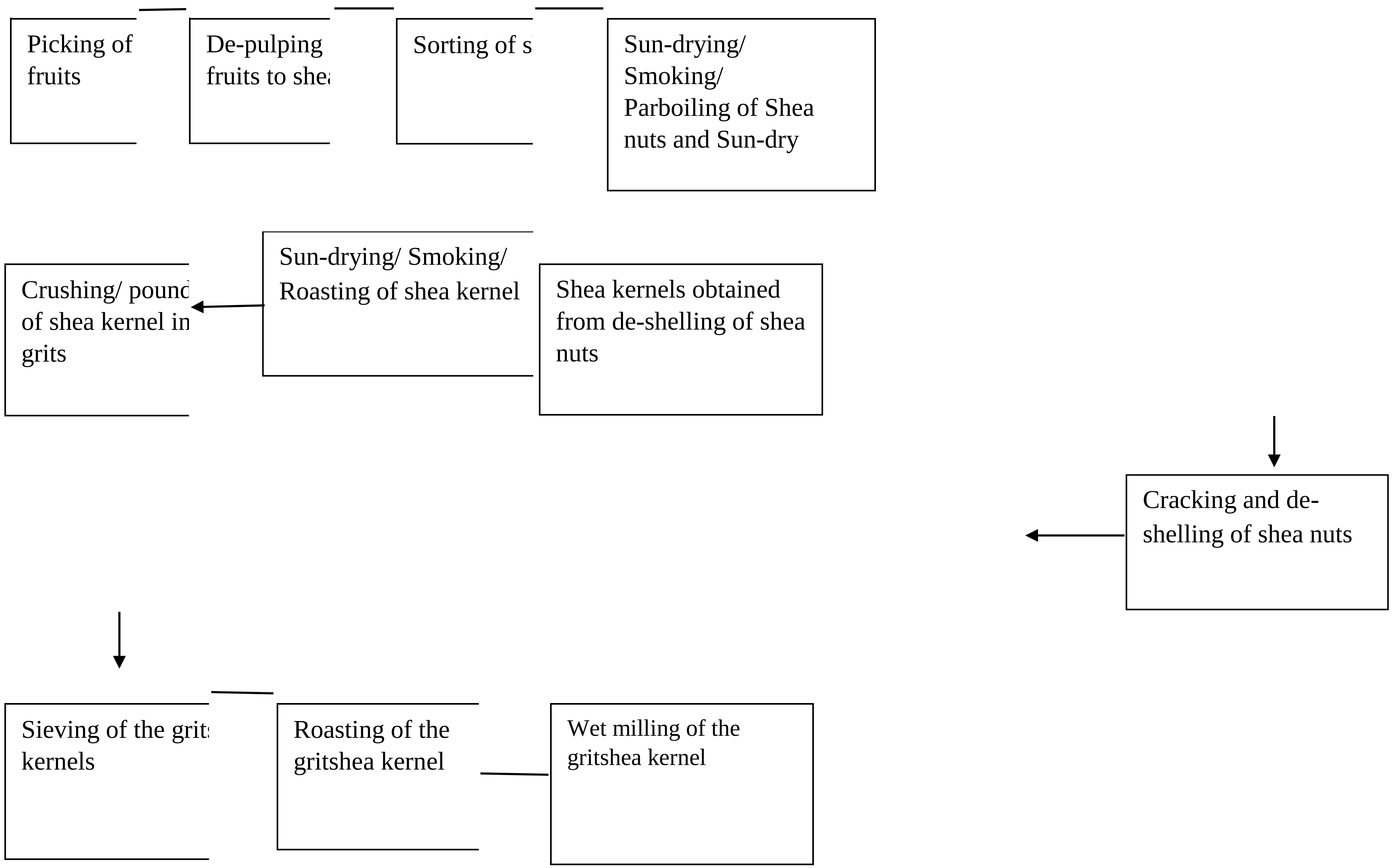
Figure 4.1 shows the flow chart of the shea nut processing stages and activities obtainable in the study area.

The flow chart depicts that in the study area respondents wait for the wild fruits to ripen and are collected. Afterwards, de-pulp the fruits by crushing under foot after fermentation. These are sorted from dirty and shaft and then mostly either sun-dried, smoked or parboiled. De-shelling of the shea nuts involve the use of stones/ pestles. The shea kernel is further sun-dried to achieve lower moisture contents which in turn crushed/ pound into grits. This is sieved, roasted and milled.
The milled paste is knead continuously with pestle to break the oil cell and ease oil extraction. Subsequently, this process is engaged by hand consistently to ensure white emulsion of fat, and heat in a large cauldron. This lead to separation of oil and water with which the oil is skimmed off from the water, cured and allowed to cool at lower temperature. This whole process result to shea butter commonly available in Nigerian market.

Table 4.3: Sources of shea nuts/kernels and methods of shea nut processing

Processing method	Frequency	Percentage
Sources of Shea Nuts/Kernels:		
Picking of shea fruits	165	55
Picking and buying more fruits/kernels	99	33
Buying of kernels	36	12
Methods:		
Traditional	155	51.67
Semi-mechanized	80	26.67
Mechanized	65	21.66

Source: Field Survey Data (2019).



Picking of fruits
De-pulping fruits to shea
Sorting of s
Sun-drying/ Smoking/ Parboiling of Shea nuts and Sun-dry
Crushing/ pound of shea kernel in grits
Sun-drying/ Smoking/ Roasting of shea kernel
Shea kernels obtained from de-shelling of shea nuts
Cracking and de-shelling of shea nuts
Sieving of the grits kernels
Roasting of the gritshea kernel
Wet milling of the gritshea kernel

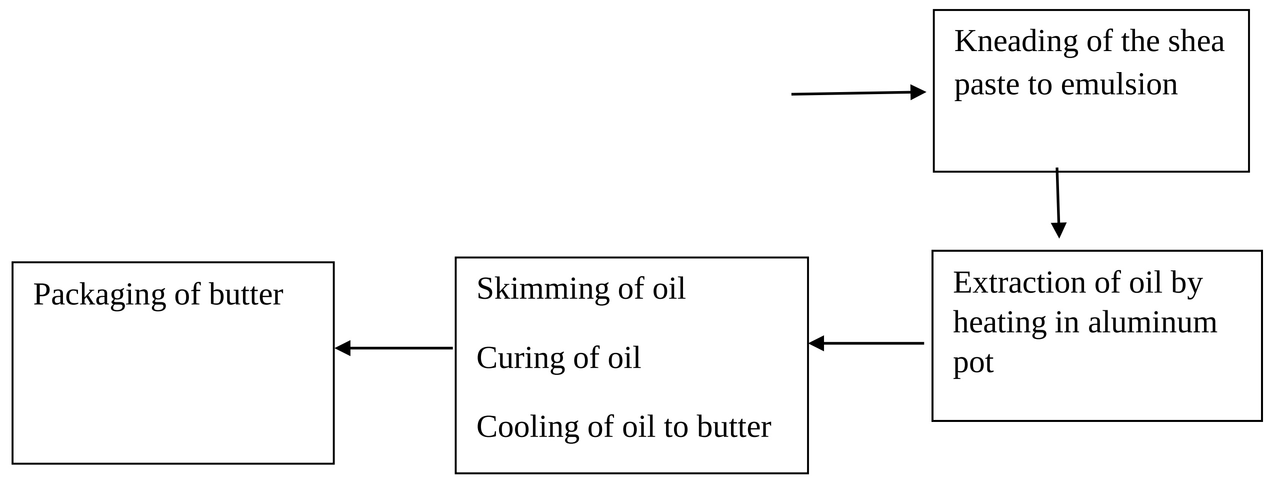


Figure 4.1: Flow chart of shea nut processing in Kwara and Niger States, Nigeria.
Source: Field survey (2019).

4.4 Costs and Returns of Shea Fruit to Shea Kernels Processing Enterprise

The shea fruit to shea kernel processors' profitability was analyzed using cost and return analysis and the result is as presented in Table 4.4. From the result of the analysis, the variable costs incurred by processing shea nut to kernel were costs of shea nut, firewood, water, transportation and labour while the fixed costs items were depreciation costs on capital items as indicated by the respondents in the study area.

The result revealed that the major variable costs incurred were cost of shea fruits which constituted about 73.03% of the total cost of processing, followed by cost of labour which was 15.63% while the major variable costs incurred in the processing of shea nut were depreciation cost on capital items with which constituted about 0.03%. Also, the Total Variable Cost (TVC) constituted about 99.97% of the Total Cost (TC) while the Total Fixed Cost (TFC) constituted only about 0.03% of the Total Cost (TC) as indicated in Table 4.4.

The Total Revenue (TR) generated from the sales of processed shea nut in the study was ₦95.00 per one kg of shea fruit processed; the Gross Margin (GM) for shea nut processors was ₦18.22 while a confirmation of the profitability for shea nut processors in the study area was indicated by the Net Processing Income (NI) of about ₦18.20. Also, the Return on Investment of 0.24 for processing one kilogram of shea fruits to kernel indicates that the enterprise is profitable. And the operating ratio of 0.81 means that 81% of the shea enterprise's net sales is operating expenses, thus, confirms the efficient performance of the enterprise. This is an indication that shea nut processing in the study area was a profitable venture. This finding corroborates that of Tiamiyu *et al*. (2014) who studied profitability analysis of shea nuts supply chain in selected states in Nigeria confirmed that shea nut processing in the study area was a profitable venture.

Table 4.4: Costs and returns of shea nut to shea kernel processing enterprise (n=12)

Items of Costs and Returns	Quantity	Amount (₦)	Percentage of Total Cost (%)
Variable Cost:			
*Shea fruits (Kg)	1.00	56.09	73.03
Fuelwood (Kg)	0.29	6.38	8.31
Water (L)		0.62	0.81
Transportation (₦)		1.29	1.68
Labour(Man-day)	0.10	12.00	15.63
Bagging (₦)		0.40	0.52
Total Variable Cost (TVC)		76.78	99.97
Fixed Cost (FC):			
Depreciation on Capital Items		0.02	0.03
Total Cost		76.80	
Total Revenue (TR):			
Sales of **Shea Kernel (Kg)	0.40	95.00	
Gross Margin (GM)		18.22	
Net Processing Income (NI)		18.20	
Return on Investment (RoI)		0.24	
Operating Ratio		0.81	

Source: Field Survey Data (2019).
*Shea fruit is fresh shea nut with pulp
**Shea kernel is dried shea kernel without shell

4.5 Costs and Returns of Shea Kernel to Shea Butter Processing Enterprise

The shea nut processors' profitability was analyzed using cost and return analysis and the result is as presented in Table 4.5. From the result of the analysis, the variable costs incurred by shea nut processors were costs of shea nut, fuelwood, water, fuel, transportation, labour and milling while the fixed costs was depreciation cost on capital items by the respondents in the study area. The result reveals that the major variable costs incurred were cost of shea kernel which constituted about 50.96% of the total cost of processing, followed by cost of labour and cost of milling which are 22.91% and 12.86% respectively while the major fixed cost incurred in the processing of shea nut was depreciation cost on capital items.

Table 4.5: Costs and returns of shea kernel to shea butter processing enterprise (n=288)

Items of Costs and Returns	Quantity	Amount (₦)	Percentage of Total Cost (%)
Variable Cost (VC):			
*Shea kernel (Kg)	1.00	237.50	50.96
Fuel wood (Kg)	1.50	33.24	7.13
Water (L)	4.09	3.63	0.78
Transportation (₦)		7.50	1.61
Labour (Man-day)	1	106.77	22.91
Milling (Kg)		59.93	12.86
Packaging (₦)		7.13	1.53
Storage (₦)		4.33	0.93
Total Variable Cost (TVC)		460.03	98.71
Fixed Cost (FC):			
Depreciation on Capital Items		6.01	1.29
Total Fixed Cost (TFC)		6.01	
Total Cost (TC)		466.04	

Returns:		
Total Revenue (TR)		
Sales of Shea Butter (Kg)	0.45	769.99
Gross Margin (GM)		309.96
Net Processing Income		303.95
Return on Investment (RoI)		0.67
Operating ratio		0.61

Source: Field Survey Data (2019).
* Shea kernel is dried shea kernel without shell

Also, the Total Variable Cost (TVC) constituted about 98.71% of the Total Cost (TC) while the Total Fixed Cost (TFC) constituted only about 1.29% of the Total Cost (TC) as indicated in Table 4.5.

The Total Revenue (TR) generated from the sales of shea butter by the respondent in the study was ₦769.99 per kilogram of shea kernel processed. The Gross Margin (GM) was ₦309.96 while a confirmation of the profitability for shea nut processors in the study area was indicated by the Net Processing Income (NI) of ₦303.95. Also, Return on Investment is 0.67, which is a measure of profitability in shea nut processing enterprise. The implication is that, for every ₦1.00 invested in shea nut enterprise, a gain of ₦0.67 is obtained in return. Thus, shea nut processing in the study area was a profitable venture. And the operating ratio of 0.61 means that 61% of the shea enterprise's net sales is operating expenses, thus, confirms the efficient performance of the enterprise. This substantiate the findings of Kodua *et* al. (2018), in their study, assessing the profitability of small scale local shea butter processing: empirical evidence from Kaleo in the Upper West region of Ghana and further agrees with the findings of Mohammed (2017) who studied Profit efficiency and constraints analysis of shea butter Industry in the Northern region of Ghana and confirmed that shea nut processing in the study area was a profitable venture.

4.6 Profit Efficiency of Shea Nut Processors

The profit efficiency of shea nut processors in the study area was analyzed using the profit efficiency model and the result is as presented in Table 4.6. It reveals that, the estimates of sigma square (δ^2) is 0.77, which is relatively large and statistically significant at 1%, this indicates a relatively good fit of the specified distributional assumptions of the composite error term for the efficiency model.

Table 4.6: Profit efficiency of shea nut processors

Variable	Parameters	Estimated Coefficients	Standard Error	T – ratio
Constant	β_0	0.8732	0.4410	1.98*
Avg. cost of manual labour	β_1	-0.5940	0.2628	-2.26**
Avg. cost of shea nut per bag	β_2	-2.6256	0.3136	-8.37***
Avg. cost of daily use of water	β_3	-1.9528	0.1758	-11.11***
Avg. cost of electricity	β_5	-0.1477	0.0665	-2.29**
Avg. cost of diesel/petrol	β_6	-0.0047	0.0036	-1.29
Avg. cost of lubricant/oil	β_7	0.3450	0.3594	0.96
Avg. cost of fuel wood	β_8	-3.8373	1.3371	-2.87**
Avg. cost of milling	β_9	-0.0012	0.0017	-0.69
Avg. packaging cost	β_{10}	-0.39043	0.2122	1.84*
Avg. cost of drying	β_{11}	-0.8557	1.0310	0.83
Avg. transportation cost	β_{12}	0.5915	0.4349	1.36

Avg. wages of machine operator	β_{13}	-1.2647	0.2549	-4.96***
Depreciation of fixed asset	β_{14}	0.1989	0.5525	0.36
Gamma	γ	0.68***		
Sigma	δ_2	0.77***		
Log likelihood		-145.18		

Source: Field Survey Data (2019).
***, ** and * denote 1%, 5% and 10% significant levels respectively.

Also, the gamma parameter (γ) of the model of 0.68 is statistically significant at 1%, this suggested that the shea nut processors were able to obtain 68% potential profit variation from the actual profit in the profit frontier mainly arose from the difference in the practices of the processors rather than random disturbances.

The result further shows that the estimated coefficients of average cost of manual labour, average cost of shea nut, average cost of water, average cost of electricity, average cost of fuel wood, average packaging cost and average wage of machine operator were all negatively related to the profit gained by shea nut processors in the study area, this shows that there exist an inverse relationship between these variables and profit. The table shows that average cost of shea nut per bag, daily use of water and wages of machine operator are statistically significant at 1%, average cost of manual labour, electricity, fuel wood were all statistically significant at 5% and the average packaging cost was statistically significant at 10%. Thus, 10% increase in these variables: average cost of manual labour, shea nut per bag, daily use of water and wages of machine operator will led to corresponding decrease in the profit of shea nut processors by 5.94%, 26.26%, 19.53% and12.65% respectively in the study area and vice versa. This does not conform to the *a priori* expectations, which could be due to the intrinsic traditional tools and state of technological progress in processing shea in the study area. Thus, have influence on the total factors of production and account for any efficiencies not related to the factors of production.

4.7 Determinants of Profit Efficiency of Shea Nut Processors

The determinants of profit efficiency were analyzed and the result is as presented in Table 4.7. This indicates that the sources of inefficiency using the estimated (ð) coefficients associated with the inefficiency model. Since the independent variables of inefficiency function represents the model of inefficiency, a positive sign of estimated parameters implies that the associated variable had a negative effect on the profit efficiency while a negative sign implies that the associated variable have a positive effect on the profit efficiency.

The variables with estimated coefficients of the inefficiency model that were negatively related to profit efficiency were age, level of education, access to credit, extension contact, access to training and processing experience. Age, educational level, access to credit, extension contact and access to training were all statistically significant at 1%, while processing experience was found to be statistically significant at 10%.

Table 4.7: Determinants of profit efficiency (inefficiency model) of shea nut processors

Variables	Parameters	Estimated Coefficients	Standard Error	T – ratio
Constant	$ð_0$	-0.4551	0.3447	-1.32
Age	$ð_1$	-0.6691	0.059	11.29***
Gender	$ð_2$	-0.1038	0.1059	-0.98
Marital status	$ð_3$	1.0206	0.9278	1.10
Level of education	$ð_4$	-3.2896	0.9508	-3.46***

Level of processors' experience	ð$_5$	-0.0014	0.0008	-1.70*
Household size	ð$_6$	-0.3450	0.3594	-0.96
Amount of credit accessed	ð$_7$	-0.1477	0.0645	-2.29***
Membership of cooperative	ð$_8$	0.0746	0.1821	0.41
Extension visit	ð$_9$	-0.3351	0.1250	-2.68***
Access to training	ð$_{10}$	-0.4981	0.1491	-3.34***

Source: Field Survey Data (2019)
***, ** and * denote 1%, 5% and 10% significant levels respectively.

This implies that age, gender, level of education, processors experience, household size, amount of credit accessed, extension visit and access to training with negative coefficients increase the profit efficiency of the processors, hence increase in profit. This is in conformity with Mohammed (2017) who indicated that profit efficiency was directly influenced by age, gender, level of education, processors experience, household size, amount of credit accessed, extension visit and access to training. These findings have policy implications in improving production efficiency among processors of shea nuts in the study area.

4.8 Profit Efficiency Distribution of the Shea Nut Processors

The shea nut processors exhibited varied profit efficiency ranging from 30.4% to 93.8% as presented in the Table 4.8. The least profit efficient processor needs an efficiency gain of 74.20% of processing if such processor is to attain the profit efficiency of the best processor in the study area. While, for an average profit efficient processor will need an efficiency gain of 29.4% to attain the most efficient level of shea butter processing. And the most profit efficient processor in the study area need 0.063% gains in profit efficiency to be on the frontier efficiency.

Table4.8: Frequency distribution of profit efficiency

Efficiency scores	Frequency	Percentage
1.00	0	0.00

>0.90<1	3.9	1.30
>0.80≤90	78.6	26.20
>0.70≤0.80	104.4	34.80
>0.60≤0.70	74.7	24.90
>0.50≤0.60	21	7.00
>0.40≤0.50	11.7	3.90
>0.30≤0.40	5.7	1.90
Total	300	100
Mean	0.724	
Minimum	0.304	
Maximum	0.938	
Std Dev.	0.118	

Source: Field Survey Data (2019)

4.9 Constraints Faced by the Shea Nut Processors in Kwara State

The result of the constraints faced by shea nut processors in the study area in Kwara State is presented in Table 4.9. It showed that the major constraints faced by the processors were inadequate credit facilities (93.11%), this could hamper the economies of scale of the enterprise and could reduce the adoption level of modern techniques of shea nut processing and innovations. Also, bad road network (100%) was a major constraint identified by respondents in the study area, the processors walk several kilometers of distance to fetch shea fruits, to the market, to buy shea nuts or kernels as most of their roads are not motorable.

Table 4.9: Constraints faced by shea nut processors in Kwara State

Constraints	Frequency n=156	Percentage	Rank
Bad road network	156	100	1st
Inadequate water supply	149	95.63	2nd
High cost of processing equipment	148	94.58	3rd
Inadequate credit facilities	145	93.11	4th
Lack of storage facilities	139	89.20	5th

Lack of government support	125	80.24	6th
Inadequate transport facilities	120	76.95	7th
Inadequate extension support	117	75.31	8th
Uncoordinated market system	73	46.94	9th
Inadequate operational knowledge	60	38.6	10th

Source: Field Survey Data (2019).

This lends credence to the findings of Lovett (2004), in the study on research and development of premium quality shea butter for promotion in Northern Ghana, opined that transportation issues are widespread with high cost, limited reliability, poor roads network within the country and outside the country.

Inadequate support from the government (80.24%) was ranked high among the respondents, this could reduce the interest of the respondents in shea processing. The respondents rely on the government for the provision of basic amenities such as provision of pipe-borne water, infrastructure such as road, electricity, schools to make the rural area habitable for the respondents and prevent rural – urban drift common in these communities. Inadequate extension support (75.31%), in the area of shea production and processing, the extension agents could be lacking in the knowledge of modern practices in shea processing. High cost of processing equipment (94.58%) as well as lack of storage facilities (89.20%). This has hampered the adoption of mechanized method of shea processing in the study area. This could be the reason for the small scale production predominance in the study area. Thereby, restricting the shea processors to traditional method of processing shea nuts. This result corroborates the findings of Garba *et al*. (2011), in their work, potentials of shea nut tree to the Nigerian economy, reported that the traditional extraction technique of shea butter is time consuming, physically exhausting and require large quantities of fuel wood and water, resources that are scarce in the regions where butter is produced. Also in the findings of Jamala *et al*. (2013) who studied socio-economic contribution of shea tree in support of rural livelihood in Ganye, Southeastern Adamawa State, Nigeria and asserted that the major constraints faced by shea nut processor in the study area were lack of government support, inadequate storage facilities and inadequate processing equipment.

4.10 Constraints Faced by the Shea Nut Processors in Niger State

The result of the constraints faced by shea nut processors in the study area presented in Table 4.10 shows that the major constraints faced by the processors as indicated by the respondents were inadequate credit facilities (76.27%), this could hamper the economies of scale of the enterprise and could reduce the adoption level of modern techniques of shea nut processing and innovations. Also bad road network (89.45%) is also a major constraint identified by respondents in the study area, the processors walk several kilometers of distance to fetch shea fruits, to the market, to buy shea nuts or kernels as most of their roads are not motor-able. This lends credence to the findings of Lovett (2004), in the study on research and development of premium quality shea butter for promotion in Northern Ghana, opined that transportation issues are widespread with high cost, limited reliability, poor roads network within the country and outside the country.

Inadequate support from the government (73.24%) was ranked high among the respondents, this could reduce the interest of the respondents in shea processing. The respondents rely on the Government for the provision of basic amenities such as provision of pipe-borne water, infrastructure such as road, electricity, schools to make the rural area habitable for the respondents and prevent rural – urban drift common in these communities. Inadequate extension support (68.91%), in the area of shea production and processing, the extension agents could be lacking in the knowledge of modern practices in shea processing. High cost of processing equipment (75.73%) as well as lack of storage facilities (40.59%). This has hampered the adoption of mechanized method of shea processing in the study area. This could be the reason for the small scale production predominance in the study area. Thereby, restricting the shea processors to traditional method of processing shea nuts.

This result corroborates the findings of Garba *et al*. (2011), in their work, potentials of shea nut tree to the Nigerian economy, reported that the traditional extraction technique of shea butter is time consuming, physically exhausting and require large quantities of fuel wood and water resources that are scarce in the regions where butter is produced. Also in the findings of Jamala *et al*. (2013) on socio-economic contribution of shea tree in support of rural livelihood in Ganye, Southeastern Adamawa State, Nigeria asserted that the major constraints faced by shea nut processor in the study area were lack of government support, inadequate storage facilities and inadequate processing equipment.

Table 4.10: Constraints faced by shea nut processor in Niger State

Constraints	Frequency n=144	Percentage	Rank
Inadequate transport facilities	138	95.90	1st
Bad road network	129	89.45	2nd
Inadequate credit facilities	110	76.27	3rd
High cost of processing equipment	109	75.73	4th
Lack of government support	105	73.24	5th
Inadequate water supply	105	72.63	6th
Inadequate extension support	99	68.91	7th

Uncoordinated market system	82	56.94	8th
Lack of storage facilities	58	40.59	9th
Inadequate operational knowledge	48	33.34	10th

Source: Field Survey Data (2019)

Majority of the respondents (90%) pointed out that they do not receive any kind of assistance from government or nongovernmental organization in order to enhance shea butter processing enterprise. 60% of the respondents explained that the major challenges mostly encountered in shea butter enterprise was that of lack of processing equipment, others (20%) said that they also faced some technical and low inputs challenges. Majority of the respondents (90%) were of the opinion that government should provide them with support and also training to enhance their productivity. 10% of them added that processing equipment when provided can highly enhance their livelihoods. In Kwara and Niger states, the respondents are faced with similar constraints hampering the processing of shea nuts. Table 4.9 and 4.10 show that bad road ranked number one and two in Kwara and Niger states respectively. This shows that processors are faced with difficulties of transporting their products to market. Also, inadequate credit facility ranked third and fourth in Niger and Kwara states respectively. This implies that the processors in both states face the challenges of increasing the scale of production of their processing business. High cost of processing equipment is also considered critical in the study area. It ranked third and fourth in Kwara and Niger states respectively. This shows that processors in both states still largely depend on traditional method of processing shea nuts which is considered inefficient, labour intensive and required a lot of their scarce resources, water and fuel wood, in the study area.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study was carried out to analyze the economics of shea nut processing in Kwara and Niger States of Nigeria.

The socio-economic characteristics of shea nut processors in the study area indicates that the respondents were in their active age, dominated by adult females, majority were married, they have little or no formal education and relatively long years of experience. The household size was relatively large and shea nut processing was one of the means of livelihood in the study area. Majority of the respondents have shea nut processing as their primary occupation. A good number of processors are pickers of shea fruits themselves and still relied on the natural vegetation of shea trees in the wild with little or no control on the production, thus result into low yield and production output. They are members of association with little access to credit, extension services and with access to training. Majority accessed labour within the family. Processors greatly relied on traditional methods and implements to process shea nuts to butter, this consequently reduce the quality and quantity of shea butter produced.

The results indicate that stochastic profit frontier analysis implied that the inefficiency associated with controllable decision is about 0.68, hence the processors need to reduce controllable inefficiency in their activitiess. The coefficient of average cost of shea nut, average cost of water and average wage of machine operator were all negatively related to profit gained. The determinants of profit efficiency of shea nut processors in the study area were age, educational level, access to credit, extension contact, access to training and processing experience.

The major constraints in the study area were inadequate access to credit facilities, bad road network, inadequate government supports, inadequate extension services, high cost of processing equipment and inadequate water supply. These have hampered the development of shea industry in the study area.

The business of shea nut processing is a profitable venture with a higher returns on investment in the processing of shea fruit to shea kernel than processing of shea fruit to shea butter. Although, the earning from the enterprise is low due to low capital investment which in turn brings about low earnings.

5.2 Recommendations

Based on the findings of this research, the following recommendations were therefore made:

i. The processors should make their cooperative societies and associations more viable to harness their resource for higher productivity. Also reposition themselves for intervention programmes of Federal Government of Nigeria, particularly the Shea Value Chain of Federal Ministry of Agriculture and Rural Development.

ii. Nigerian Export-Import Bank (NEXIM) and World Bank intervention programmes should ensure linking the Shea nut processors with formal credit institutions to increase the scale of production and alleviate rural poverty.

iii. Nigerian Institute for Oil Palm Research (NIFOR) and other relevant agencies should provide shea nut processors with supports in terms of improvising simple, affordable, mechanized and adoptable processing equipment to enhance their productivity in quantity and quality of shea products. The extension agents be trained on modern practices in shea nut processors for onward training (train of trainer) of the processors in the rural area.

iv. State Governments and private investors such as cosmetics, cottage companies and others that use shea butter and shea products should provide processing equipment at subsidized rate to increase the rate of adoption of mechanized method of processing. This will boost processing efficiency of shea butter processors, therefore improve the livelihood of shea nut processors and other stakeholders along the shea value chain.

v. Federal and State Government institutions with the mandate of rural development should ensure basic amenities in the rural areas and provide good rural road networks and repair bad ones.

5.3 Contribution to Knowledge

The study analyzed the economics of shea nut processing in Niger and Kwara States of Nigeria. The researcher established the following:

i. Ascertain that the business of shea nut processing is traditionally women business and mostly relied on traditional tools for processing.

ii. Shea nut processing is profitable in the study area despite the usage of traditional method of processing.

iii. The findings in the study showed that Shea Value Chain has the potential of contributing to the Gross Domestic Product (GDP) of the Country. In this way, the Federal, State and Local Governments should increase capital investment in shea industry.

iv. The findings in the study have presented shea nut enterprises as an investment opportunity to both Federal, State, Local Governments and Private investors.

v. The findings in the study are valuable information and guide for researchers, investors and policy makers to make informed decisions.

vi. The study will serve as a reference for further study in the immediate and future time.

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APPENDIX

Questionnaire No:………………………
Latitudes:………………………
Longitudes:………………………

DEPARTMENT OF AGRICULTURAL ECONOMICS AND FARM MANAGEMENT, SCHOOL OFAGRICULTURE AND AGRICULTURAL TECHNOLOGY, FEDERAL

UNIVERSITYOF TECHNOLOGY, MINNA, NIGER STATE TITLE: ECONOMICS OF SHEA NUT PROCESSING IN KWARA AND NIGER STATES, NIGERIA

RESEARCH QUESTIONNAIRE

Dear Ma/Sir,

I am a student of the above named institution who is currently undertaking research on '**Economics of Shea Nut Processing in Kwara and Niger States' Nigeria** for the award of M. Tech Degree in Agricultural Economics. This questionnaire is designed to be used strictly for academic purposes only. Any information provided will be treated confidentially. Please kindly tick / fill as appropriate. Thank You.

AYODELE George Charis

08066726644.

RESPONDENT IDENTIFICATION

Name of respondent (optional): ………………………………………………………………

Phone number: ……………………………………………………………………………..

Name of Village: …………………………………………………………………………..

Local Government Area: …………………………………………………………………..

State: ……………………………………………………………………………………….

PART I: FOR ALL PROCESSORS

Section A: Socio-Economics Characteristics

1. Age…………. (years)
2. Gender………… (a) Male [ ] (b) Female [ ]
3. Marital status: (a) Single [ ] (b) Married [ ] (c) Divorced [ ] (d) Widow [ ]
4. Religion: (a) Christian [ ] (b) Muslim [ ] (c) Others [ ], Specify: ……………..
5. Education attainment: (a) No formal education [ ] (b) Quranic [ ]
(c) Primary education [ ] (d) Secondary education [ ] (e) Tertiary education [ ]
6. Number of years spent in school………………
7. What is your household size……………………. (number)
8. Household Size: Adult male [ ] Adult female [ ] Children below 18 [ ]
9. What is your primary occupation (a) Processing [ ] (b) Farming [ ]
(c)Trading [ ] (d) Civil Servant [ ] (e) Artisan [ ] (f) Others [ ] specify:………………………
10. How long have you been engaged in the shea butter processing? ………Years

11. What is your secondary occupation (a) Processing [ ] (b) Farming [ ] (c) Trading [ ] (d) Civil Servant [ ] (e) Artisan [ ] (f) Others [ ] specify: ………

12. Estimated income per month from other sources

Occupation	**Estimated income per month (₦)**
Farming	
Trading	
Artisan	
Civil service	
Others specify	

Access to Rural Services

13. Do you have access to extension services? (a) Yes[ ] (b) No[ ]

14. If yes, how many times in a year? (a) Weekly [ ] (b) Fortnightly [ ] (c) Monthly [ ] (d)

Quarterly [ ] (e) Annually [ ] (f) Others [ ] specify:…………………

15. How do you contact extension agents (a) Phone [ ] (b) Face to face [ ](c) Group meeting [ ]

16. Do you have access to credit? (a) Yes [ ] (b) No [ ]

17. If yes, from which source(s)? (Tick as many as appropriate)

Credit sources	**Amount (N)**	**Interest (N)**	**Year**
Processors' organisation			
Family and friends			
Microfinance bank			
Bank of Agriculture (BOA)			
Bank of Industry(BOI)			
Commercial bank			
Cooperatives			
Others (specify)			

18. Do you have access to training? (a) Yes [ ] (b) No [ ]

19. Do you belong to any cooperative organization? (a) Yes [ ] (b) No [ ] 20. If yes, kindly indicate the cooperative you belong to in the table below:

Cooperatives/ Association	Member	Exco	For how long? (years)	Frequency of participation		
				Whenever conducted	Sometimes	Never
Processors cooperative						
Marketing cooperative						
Consumer cooperative						

Credit and thrift						
Others (specify)						

PART II: FOR PROCESSORS OF SHEA FRUITS TO SHEA KERNEL

Section B: Inputs and Methods of Processing Shea Nut to Shea Kernel

21. What is the source of shea fruits used for shea kernel processing? (a) Pick shea fruits and process them to shea nuts myself [ ] (b) Pick shea fruits myself, buy some more fruits and process into shea nuts myself [ ] (c) Buy shea fruits myself and process them into nuts myself [ ] (d) Buy the shea nuts from producer [ ] (e) Others [ ], specify:…………………………
22. What method of processing do you use? (a) Traditional method [ ] (b) Semi-mechanized method [ ] (d) industrial method [ ] (e) others [ ], specify;…………………….
23. What equipment do you use for shea fruits processing? (a) Traditional equipment-pan, pot, drying-mat, hammers/stones, e.t.c [ ] (b) Semi-mechanized equipment-diesel/ electrically powered attrition for: Roaster [ ], Crusher [ ], Mixer [ ]
24. At what stage do you stop processing? (a) shea fruit – shea nut [ ] (b) shea nut – shea kernel (c) others [ ] specify ……………
25. What is the average processing time for a cycle of shea fruit to shea kernel you produce?(a)5hours [ ] (b) 7hours[ ] (c) 10hours [ ] (d)12hours [ ] (e) 15hours [ ]

(f) 2days [ ] Others [ ], Specify:………………

26. Identify the processing period of shea fruits to shea kernel in the table below:

Period	Time (Month)	No of Batch(s) Processed
Peak	Jan - April	
	May - Aug	
	Sept – Dec	
Low	Jan - April	
	May -Aug	
	Sept - Dec	

27. Have you changed your production technology over the last five years? Yes [ ] No [ ] 28. If Yes please indicate the type of technological change and reason in the table below:

Time Period	Type of Technology formerly used	Type of Technology used now	Reason for change in Technology	Effect of Technological Change on Productivity

Section C: Costs and Returns of Processing Shea Fruits to Shea Kernel

29. Kindly fill in the table below?

Items	Specific unit of measurement	Quantity used	Cost per unit (N)	Total cost (N)
Shea fruit				
Shea nut				
Shea kernel				

30. Transportation- Kindly fill the table below:

Items	Method of transportation	Distance to market	Cost of transportation **(₦)**
Shea fruit			
Shea nut			
Shea kernel			

31. Do you employ other people to help you with the Shea kernel Processing? Yes [ ] No [ ]
32. If yes, how many employee do you have? ……………………….
33. Kindly fill in the table below:

Types of labour	No of labour used	No of Hours/day(s) work	No of days work	Cost per labour/day (₦)	Wage/ salary (₦)
Hired labour					
Family labour					
Friends					
Communal					

34. Kindly fill the processing activities you engage in the table below:

Processing activities	Method	Quantity	Unit of measurement	Cost/unit **(₦)**	Total cost **(₦)**
Harvesting					
Storage					
Fermentation/ depulping					
Parboiling					
Drying					
Decorticating (remove shell)					
Beating (crushing)					
Roasting					
Wet milling					
Mixing					
Extraction of oil					

35. Kindly fill the table below:

Specifications	Source	Unit of measurement	Quantity used/ day	Total quantity used	Cost/day (₦)	Total cost (₦)
Electricity						
Diesel						
Petrol						
Kerosene						
Lubricant/oil						
Fuel wood (firewood)						
Water						
Packaging						

36. Storage: Kindly fill the table below?

Items	Method of storage	For how long	Cost of storage **(₦)**
Shea fruit			
Shea nut			
Shea kernel			

37. What kind of fixed capital items do you use?

Equipment	Number	Cost of purchase(₦)	Life span (years)	Salvage value (₦)
Sickle (Go-to-hell) for harvesting				
Harvester				
Basket for carrying/ heaping fruits				
Tarpaulin for fermentation				
Fermentation box				
Crusher for depulping				
Drying mat				
Drier for drying shea nut				
Raise platform for drying				
Oven for drying shea nut				
Stove				
Charcoal pot for frying shea nut				
Stone				
Hammer				
Mortar				
Pestle				
Cracker				
Basket for winnowing				
Sieve				
Blower				

Pneumatic separator				
Grinding stone				
Oil expeller				
Milling machine				
Mixer				
Pot/ cauldron				
Roaster				

38. What is the price, as in the table below :

Specifications	Specific unit of measurement	Quantity produced/ day	Total quantity produced/season	Price per unit (N)	Total price (N)
Shea nut					
Shea kernel					

Section D: Constraints Faced by the Shea Nut Processors

39. Kindly indicate some of the constraints faced:
    (a) Lack of storage facility (a) Yes [ ] (b) No [ ]
    (b) Bad road networks (a) Yes [ ] (b) No [ ]
    (c) Inadequate transport facility (a) Yes [ ] (b) No [ ]
    (d) Lack of water (a) Yes [ ] (b) No [ ]
    (e) Inadequate credit facilities (a) Yes [ ] (b) No [ ]
    (f) Inadequate extension support (a) Yes [ ] (b) No [ ]
    (g) Consumers' Preference (a) Yes [ ] (b) No [ ]
    (h) Uncoordinated market system for the products (a) Yes [ ] (b) No [ ]
    (i) Lack of government support (a) Yes [ ] (b) No [ ]
    (j) High cost of modern processing equipment/machine (a) Yes [ ] (b) No [ ]
    (k) High maintenance cost (a) Yes [ ] (b) No [ ]
    (l) Inadequate knowledge on operational skill (a) Yes [ ] (b) No [ ]

PART III: FOR PROCESSORS OF SHEA NUT, SHEA KERNEL TO SHEA BUTTER

S**ection E: Inputs and Methods of Processing Shea Nut, Shea kernel to Shea butter**

40. What is the source of shea nuts used for shea butter processing? (a) Pick shea fruits and process them to shea nuts myself [ ] (b) Pick shea fruits myself, buy some more fruits and process into shea nuts myself [ ] (c) Buy shea fruits myself and process them into nuts myself [ ] (d) Buy the shea nuts from producer [ ] (e) Buy shea kernel from producers [ ] (f) Others [ ], specify:…………………………
41. What method of processing do you use? (a) Traditional method [ ] (b) Semi-mechanized method [ ] (d) industrial method [ ] (e) Others [ ], specify :……………………..
42. What equipment do you use for shea butter processing? (a) Traditional equipment- pan, pot, drying-mat, hammers/stones, e.t.c [ ] (b) Semi-mechanized equipment- diesel/ electrically powered attrition for:Roaster [ ] Crusher [ ] Milling [ ] Kneader [ ]
43. At what stage do you start processing? (a)shea fruit [ ] (b) shea nut [ ] (c) shea kernel [ ]
44. At what stage do you stop processing? (a) shea fruit [ ] (b) shea nut [ ] (c) shea kernel [ ] (d) shea butter [ ] (e) others [ ] specify………….
45. What is the average processing time for a cycle of shea fruit to shea kernel you produce?

(a)5hours [ ] (b) 7hours[ ] (c) 10hours [ ] (d)12hours [ ] (e) 15hours [ ] (f) 2days [ ] Others [ ] Specify:…………….

46. Identify the processing period of shea nuts to shea butter in the table below:

Period	Time (Month)	No of Shea fruit/kernel processed in (kg)	No of Shea butter processed (kg)	No of shea butter processed (buckets)
Peak	Jan - April			
	May - Aug			
	Sept – Dec			
Low	Jan - April			
	May -Aug			
	Sept - Dec			

47. Have you changed your production technology over the last five years? Yes [ ] No [ ] 48. If Yes please indicate the type of technological change and reason in the table below:

Time Period	Type of Technology formerly used	Type of Technology used now	Reason for change in Technology	Effect of Technological Change on Productivity

Section F: Costs and Returns of Processing of Shea Nut, Shea Kernel to Shea butter

49. Kindly fill in the table below:

Specifications	Unit of measurement	Quantity used	Cost per unit (N)	Total cost (N)
Shea fruit				
Shea kernel				
Shea butter				

50. Transportation- kindly fill the table below:

Items	Method of transportation	Distance to market	Cost of transportation **(₦)**
Shea fruit			
Shea nut			
Shea kernel			
Shea butter			
Shea oil			

51. Do you employ other people to help you with the Shea kernel Processing? Yes [ ] No [ ]
52. If yes, how many employee do you have? ……………………….
53. Kindly fill in the table below:

Types of labour	No of labour used	No of Hours/day(s) work	No of days work	Cost per labour/day (₦)	Wage/ salary (₦)
Hired labour					
Family labour					
Friends					
Communal					

54. Kindly fill the processing activities you engage in the table below:

Processing activities	Method	Quantity	Unit of measurement	Cost/unit **(₦)**	Total cost **(₦)**
Harvesting					
Storage					
Fermentation/ depulping					
Parboiling					
Drying					
Decorticating (remove shell)					
Beating (Crushing)					
Roasting					
Wet milling					
Mixing					
Extraction of shea butter/oil					

55. Kindly fill the table below:

Specifications	Source	Unit of measurement	Quantity used/ day	Total quantity used	Cost/day(₦)	Total cost (₦)
Electricity						
Diesel						
Petrol						
Kerosene						
Lubricant/oil						
Fuel wood (firewood)						
Water						

56. Packaging-kindly fill the table below:

Types of packaging/Container	Source	Unit of measurement	Cost/ unit	No of packaging/ container	Price/ unit
Leaf(ves)					

Nylon					
Rubber (Take-away)					
Bucket					
Drum					
Cauldron					
Tank					

57. Storage- kindly fill the table below:

Items	Method of storage	For how long (month)	Cost of storage **(₦)**
Shea fruit			
Shea nut			
Shea kernel			
Shea butter			
Shea oil			

58. What kind of fixed capital items do you use?

Equipment	Number	Cost of purchase(₦)	Life span (years)	Salvage value (₦)
Sickle (Go to hell) for harvesting				
Harvester				
Basket for carrying/ heaping fruits				
Tarpaulin for fermentation				
Fermentation box				
Crusher for depulping				
Drying mat				
Drier for drying shea nut				
Raise platform for drying				
Oven for drying shea nut				
Stove				
Charcoal pot for frying shea nut				
Stone				
Hammer				
Mortar				
Pestle				
Cracker				
Basket for winnowing				
Seive				
Blower				
Pneumatic separator				
Grinding stone				

Oil expeller				
Milling machine				
Mixer				
Pot/ cauldron				
Roaster				
Others				

59. What is the price as in the table below:

Specifications	Unit of measurement	Quantity produced/ day	Total quantity produced	Price per unit (N)
Shea butter				
Shea oil				

Section G Constraints Faced by the Shea Nut/Kernel Processors

60. Kindly indicate some of the constraints faced:

(a) Lack of storage facility (a) Yes [ ] (b) No [ ]
(b) Bad road networks (a) Yes [ ] (b) No [ ]
(c) Inadequate transport facility (a) Yes [ ] (b) No [ ]
(d) Lack of water (a) Yes [ ] (b) No [ ]
(e) Inadequate credit facilities (a) Yes [ ] (b) No [ ]
(f) Inadequate extension support (a) Yes [ ] (b) No [ ]
(g) Consumers' Preference (a) Yes [ ] (b) No [ ]
(h) Uncoordinated market system for the products (a) Yes [ ] (b) No [ ]
(i) Lack of government support (a) Yes [ ] (b) No [ ]
(j) High cost of modern processing equipment/machine (a) Yes [ ] (b) No [ ]
(k) High maintenance cost (a) Yes [ ] (b) No [ ]
(l) Inadequate knowledge on operational skill (a) Yes [ ] (b) No [ ]