

Upgrading of Indigenous Technology for Processing Shea Butter (*Vittelaria paradoxa*) In Nigeria.

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Abstract
Nigeria has a number of natural resources that can form the backbone of its economic development aspirations. Most of these resources are currently contributing to industrial and economic development, albeit at very low levels. This is due to the current level of their development. Some of them are, most especially, the agricultural resources are still growing in the wild and mostly processed using indigenous technologies which are laborious, low yielding with associated low quality products. This reduces their competitiveness both locally and in the international markets. Among the natural agricultural resources is the shea tree which produces shea butter. While shea butter has a muber of industrial uses globally, its development in Nigeria has not been very encouraging. The processing of sheaut to shea butter in Nigeria is constrained by the indigenous technology being used for its production while the underdevelopment of the shea tree limits is productivity. In view of these, a number of mandated research institutes and other stakeholders have being working to improve the shea butter output through the upgrading of the indigenous technology employed locally. A number of processing plants have been designed, fabricated and tested. Some of these have been deployed for industrial use. Productivity improvement programmes are being carried out on the shea tree to promote its development in plantations. These developments are leading to the overhauling of the shea nut value chain in Nigeria. Improved shea butter processing facilities are now being used by small scale industries in parts of the country. The sustainability of these efforts will assist in making shea butter production a virile industrial activity in Nigeria and in due course assist in foreign exchange generation.

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1.Introduction

Indigenous technology is the technology applied by native inhabitants for the purpose of developing or processing natural resources for a variety of purposes. It constitutes an important part of the inhabitants' cultural heritage. Indigenous technology refers to the technological knowledge; skills and resources transmitted or handed down from the past indigenous people to the present ones to meet their needs and wants by means of investigating, designing, developing, and evaluating products, processes, and systems (Oladiran, 2017). This should be encouraged as indigenous technology represent adaptive mechanism through which people survive in any ecological niche they find themselves. In spite of the low patronage indigenous technology has received from indigenous peoples and governments, it has several prospects for development of Nigeria. It has the potential to catalyze the economic growth of the nation along with providing employment opportunities to citizens. It promotes and facilitates attainment of self-reliance in the technological arena. It also provides ample opportunity for innovation, modernization and technological competitiveness, apart from stimulating industrial development and domestic capacity building. Furthermore, it creates awareness and demand for it in the global market. Indigenous technology has the tendency to impose checks on the imports from overseas and to provide opportunities for exportation of technology.

Most countries in Africa have a pool of indigenous technologies that have been used for centuries for survival (UNMP, 2005). However in today's globalized world, economic activities have shifted largely from domestic affairs to more complex international relationships (UNMP, 2005). While a number of counties in Africa have been reported to have enormous natural resources, they are classified as being poor as a result of inadequate appropriation of Science, Technology and Innovation to the development of their natural resources. As a result, the major problems the developing economies are facing today relate inability to attain competitive advantages in natural resource processing, quality improvement and development for industrial use. According to the United Nations Millennium Project, despite the increasing globalization of technology, the involvement of developing countries in new technologies and innovations development and application is almost negligible (UNMP, 2005). In addition, the Global Knowledge Conference in Toronto in 1997 emphasized the urgent need to learn, preserve, and exchange indigenous technology for a new inclusive approach to development of indigenous technology (Oladiran, 2017).

The changing world economic order has necessitated that production and processing of natural resources meet international standards in order to stimulate industrial development and domestic capacity building, impose checks on imports so that local industries can grow and propel nations to attain technological self-reliance (Siyanbola *et. al*. 2012). Indigenous technological improvement can therefore be seen as a key element of industrialization and catch-up in emerging economies. In most cases, the upgrading of indigenous technology and knowledge have become imperative to the development sectors such as agriculture, preventive medicine, community development and poverty alleviation. This is very germane as most indigenous knowledge which forms the bedrock of effective indigenous technology development is facing extinction, occasioned largely by the absence of strong mechanism for ensuring that such knowledge is passed on from generation to generation (Warren et al, 2005). In view of this, it is important for developing countries to focus and give primacy to the deployment of Science, Technology and Innovation in areas where they have comparative advantages in their natural resources development order to promote development of small and medium enterprises. One of the natural resources that most West African Countries have in common and has been contributing to poverty alleviation in some of the countries is the shea nut tree. The major problem limiting the growth of the enterprise is that more than 98% of the processors are indigenous people using indigenous technology to process the nut to butter and other products. This limits the competitiveness of the product in both the local and international markets. As a result, the value chain has remained grossly underdeveloped. In view of this, assiduous efforts are being made to upgrade the technology of shea butter production in several parts of West Africa. This paper reviews the importance of the shea tree and the major industrial product, shea butter in ameliorating the incidence of poverty in Nigeria. It highlights the efforts being made to upgrade the indigenous technology of shea butter production and to overhaul the entire value chain. The initiatives of the Raw Materials Research and Development Council (RMRDC) to overhaul the chain are discussed.

2.0. Shea Nut and Butter Production.

Shea tree (*Vittellaria*) with sub species *paradoxa* and *nilotica* is indigenous to the Guinea and Sudan Savanna zones. It is a perennial and deciduous tree which grows naturally. Mature tree height vary considerably with some attaining heights of over 14m and girth of about 1.75m. The tree has profuse branches with a round or hemisphere crown. The bark of the stem is deeply fissured, thick, waxy, corky and fire resistant. In Nigeria, the Hausas call it mankade, while the Ibos call it Okwuma and the Yorubas Igi-emi (Adesiji *et al*., 2015, Issahaku *et al*. 2011). It has been reported in Senegal, Sudan, Western Ethiopia and Uganda, in a belt of about 5,000km long and 500 - 700km wide. Shea tree is found in the interior, separated from the Gulf of Guinea by the forest. In Ghana and Nigeria, it occurs within 50km from the coast. The shea tree grows naturally in about 21 of the 36 states in Nigeria. In view of its multifarious applications, shea butter has become a central commodity for a number of industries. The shea nut market in Nigeria is well established and it is sold in major markets in the country where it plays significant role in poverty alleviation.

Shea butter is the oleaginous material obtained from the kernel of the shea nut tree. Shea butter extracted from shea kernels is raw. It is used as table oil due to its nutritive value and low cholesterol levels. Locally it is used in soap making, cosmetics, lubricants and paints (Olaniyan and Oje, 2007b). The bark, roots, and leaves are used in traditional medicine preparation (Ogunwusi, 2012, 2013a, 2013b; Ogunwusi and Ibrahim, 2016). The roots of the shea tree are used by locals in Northern Nigeria as chewing sticks for cleaning the teeth. The roots are mixed with the bark to prepare traditional medicine for the treatment of jaundice, diarrhoea and stomach pain. The roots are mixed with tobacco to produce poison among the Jukun ethnic tribe in Northern Nigeria. The bark of the shea tree is also boiled and taken as a beverage. This beverage is claimed to be able cure diabetes in some communities in Ghana (Maanikuu and Peker 2017). It is also widely used locally for curing leprosy.

Shea butter is a vegetable fat (Hall et al., 1996; Pontillon, 1996; Kengue and Ndo, 2003; Elias and Carney, 2004; Schreckenberg, 2004). The kernels contain about 42 to 48% oil which has tremendous skin care, healing, and medicinal properties which makes its demand in various industries very high**.** Shea butter is ideal for use as raw materials in the food, pharmaceutical and cosmetic industries. It is used as cooking oil, in baking and production of chocolate, margarine, cosmetics, soap, detergents, paints, lubricants and candles due to the presence of solid fat (stearin) and liquid oil (olein) (Chevalier, 1943; Boffa et al., 1996; Russo and Ethrington, 2001). Due to the low fat content, it is popularly being used as a substitute for cocoa and palm oil. Its use as cocoa butter substitute derives from its melting point which is between 32 – 45°C and high amounts of distearin (30%) and stearo-palmitine (6.5%) which makes it blend with cocoa butter without altering the flow properties. As a result, there is high demand for shea butter in the international market as a substitute for cocoa butter in the production of chocolate. There is also increasing demand for it in the pharmaceutical and cosmetics industries. The American Shea Butter Institute (ASBI, 2004) reports that 100% pure natural shea butter is an all– natural vitamin A cream which makes it a good moisturizer, with exceptional skin healing properties. ASBI (2004) also asserted that shea butter has proved to be effective against skin and other skin related conditions such as dry skin, skin rash, skin peeling after tanning, blemishes and wrinkles, itching, sunburn, shaving cream for a smooth silky shave, small skin wounds, skin cracks and tough or rough skin, cold weather frost bites, stretch mark prevention during pregnancy, insect bites, healthy skin, muscle fatigue, aches and tension, skin allergies such as poison ivy or poison oaks, eczema, dermatitis and skin damage from heat. The high proportion of unsaponifiable matter which consists of about 60 – 70% triterpene alcohols, gives shea butter creams good penetrative properties that are particularly useful in cosmetics.

In view of its various industrial applications, the demand in cosmetics and personal care industry is rising daily. Today, commercial shea butter is available in the market on the basis of its purity and processing, as grades Grade A, B, C, D and E. A-Raw or unrefined, B-refined, C-highly refined or extracted with solvents, D-lowest uncontaminated grade shea butter and E-shea butter with contaminants. Grade A shea butter retain its most natural properties as compared to other grades, hence its demand from food and cosmetics segments is higher.

3.0 Demands for Shea Butter

According to Custom Market Insights (CMI, 2023), the Global Shea Butter Market was estimated at USD 2.5 billion in 2021 and is expected to reach USD 2.8 billion in 2022. It is anticipated to reach around USD 5.2 billion by 2030, growing at a Compound Annual Growth Rate (CAGR) of roughly 8% between 2022 and 2030. CMI (2023) reported the shea butter market to be segmented on basis of regions which includes North America and Latin America, Middle East & Africa, Japan, Eastern Europe, Western Europe and Asia Pacific excluding Japan. Western Europe and North America demand high quantities and quality of shea butter in the cosmetics and personal care industries. The cosmetics and soap industry in the U.S. is a most lucrative global market for shea butter extracts. Other factors driving market demand for the butter are continuous and rising demand for cocoa equivalent products due to rising chocolate consumption globally. In Japan, shea butter is highly sought after due to its high skin care, emollient and moisturizing properties (CMI, 2023). The Asia Pacific is also an important market for the product as its demand in food as well as natural cosmetics market in the region is increasing.

The demand for shea butter produced in West Africa has increased by over 1,200% over the last 10 years (Ibrahim, 2019). In 2017, an estimated 450,000 tonnes of kernels were exported from Africa, with a market value of approximately US$140 million. Nigeria has the largest shea belt in the world, and it is recognized as the world's leading producer of shea nut with a global production of about 45% (Ibrahim, 2019). The documented annual production is between 330,000mt – 350,000mt, while the potential production is estimated at 800,000mt as at 2016. However, out of the 800,000mt of Shea nuts produced in Nigeria, only 20,000mt is processed into butter while the rest are exported to neighboring West African countries. This is due to the inability of shea butter produced in Nigeria to meet international standards. This indicated that the shea tree has the potential to contribute to the economic development of Nigeria as a result of the wide range of its industrial applications. Activities along the value chain could provide employment and business opportunities to Nigerians, most especially in the shea tree belt. Presently, approximately, 16 million rural women in Africa obtain their livelihoods by collecting, processing, and selling shea kernels and butter for local consumption or export. These activities contribute on average, about 15% or more to their household income. In view of its poverty alleviation potential, the Global Shea Alliance (GSA) was established in 2011 to promote competitiveness and profitability of shea nut processing activities. It presently has over 350 members from around the world, including the world's largest buyers of shea nuts and butter, traders, processors, service providers, women's groups, international brands and retailers and non-profit organizations (Ibrahim, 2020). The GSA supports major initiatives in quality control, standards, and traceability. It works to improve the quality of West African shea products through developing training materials on best practices in post-harvest shea nut processing and handling. The GSA is developing industry-recognised quality standards for shea nuts and also facilitating direct purchases between collector groups and shea nut buyers to encourage faster processing which also promotes traceability (Ibrahim, 2019).

4.0 The Shea Butter Industry in Nigeria

In Nigeria, raw shea butter is obtained primarily by the traditional method of extraction (Abdul–Mumeen et al., 2013) although, few large scale plants also operate in the country. R&D in Nigeria and lsewhere have shown that shea butter can be extracted through mechanical (Olaniyan and Oje, 2007a), enzymatic (Didia et al., 2018) and chemical methods (Apea and Larbi, 2013). The fruiting and gathering of the nuts occur between the months of May to August every year (Moore, 2008), during which the shea nuts are processed into kernel (Owoo and Lambon– Quayefio, 2017). The raw and ripe fruits are green but the ripe fruit is occasionally yellowish (Moore, 2008) and soft when felt. The fruit primarily undergoes several processes. The most important ones are de-pulping, boiling, drying, deshelling, winnowing and sorting to obtain the kernel from which the shea butter is extracted.

The Nigerian Shea industry has the potentials to contribute significantly to the economic and industrial development of the nation. Nigeria can generate up to 2 billion dollars annually from the use of Shea butter by the cosmetics industry alone. Despite these, the potential of shea butter and its industrial applications have not been fully exploited. Also, while the shea tree has potential for poverty alleviation and employment generation for both rural women and youths, shea tree is not planted or cultivated as other domesticated crops but occurs naturally in the wild with adaptation to survive bushfire and other harsh conditions. The shea occurring in the wild could take up to a decade to mature into fruit bearing trees. They are usually maintained and managed on farms till maturity. On uncultivated reserves, shea trees in particular are consciously not cut down for fuel wood. A major disadvantage of the underdevelopment of the shea tree is that the trees do not usually yield fruit until they are 20 years old, and do not reach full maturity until they are 45 years old. However, once productive, they will continue to bear fruits up until their 200th year. An average of 15 - 20kg of berries can be expected each year from one tree, and one in three trees will be productive each year. However, the long period taken to reach maturity has discouraged its planting in organized plantations. Till date, many actors along the value chain still export the raw nuts which yield very low - dividends to the pickers and processors at the community level as they use indigenous technology for processing the nuts.

5.0 Indigenous Technology for Shea Butter Production

The processing methods employed for shea butter production can be categorized into three. These are the traditional, semi mechanized and fully mechanized methods. Several studies indicated that in various parts of Nigeria where shea trees occur, rural women process the nuts into butter using indigenous methods that were passed down from generation to generation with minor improvements overtime. The traditional or indigenous method involve a series of operations which include shelling or cracking of the shell using stone or by gently pounding the nuts in a mortar with pestle. In Nigeria, most shea nuts shelling and cleaning are done manually by rural women and children, which is time consuming and tedious. This is attributed to the fact that the cost of mechanization is beyond the reach of small scle processors. The process produces 100% raw and unrefined shea butter with attributed low prices both locally and in the international market. The traditional method is fully manual and accounts for 60% of all crude butter produced. The extraction rate is approximately 20% (Addequay, 2004).

Iddrisu *et. al.* (2019) has done extensive reviews on the challenges of the indigenous technology for shea butter production. Some of these are presented as reviewed by the authors. According to the review, the processing of shea butter is seasonal. The fruiting and gathering of the nuts occur between the months of May to August every year (Moore, 2008). The fresh mature fruit of the shea tree is covered externally by the pulp which consist of an epicarp (greenish) and a mesocarp (yellowish). De–pulping is the removal of the pulp (the epicarp and the mesocarp) when the shea fruit is ripe. The pulp which is mostly green becomes soft when the fruit ripens (Gyedu-Akoto et al., 2017). The fruits are collected from the ground and the pulp is removed by fermentation or manual peeling (Chaffin, 2004; Moharram et al., 2006). Fruit storage before de pulping, especially after three days, negatively affects the quality (Aculey et al, 2012) and quantity of the resulting butter because the sugar rich pulp assists fungal growth and thereby reduces oil content of the kernel (Carette et al., 2009). Ojo and Adebayo (2013) confirmed this when, during the bio–deterioration study of the shea nut fruit pulp, they isolated eight fungi species (*Aspergillus flavus, Aspergillus niger, Botrydiplodia theombromae, Botryosphaeria spp., Colletotrichum gleosphoriedes, Lisidiplodia spp., Pseudofasicocum spp. and Trichoderma viridae*) from the fruit natural environment and from parboiled kernels (Aculey et al., 2012). The shea nut comprising the shell and the kernel, is obtained after the pulp has been removed. The shea kernel sticks to the shell wall and to separate them, the nuts are immersed in boiling water or on rare occasions smoked (Honfo et al., 2013). The nuts are usually boiled for about 30 – 45 min (Honfo et al., 2013) to temperatures ranging between 100 and 105ºC to deactivate all biological and enzymatic activities in the nut (Abdul–Mumeen, 2013). Boiling increases the fat output of the kernel and a possible explanation is that boiling softens the nuts leading to cell disruption and a better release of the oil (Honfo *et al*., 2013; Moore, 2008). Thus, to allow efficient extraction of the fat (Womeni *et al*., 2006; Lovette, 2004) stressed that boiling of shea nuts was necessary. Boiling also clean the surface of the nut of any remaining pulp (Moore, 2008) that has the tendency to promote microbial growth. After boiling, shea nuts are allowed to dry either via sunlight for 5-10 days or by using oven for 2-3 days (Moore, 2008).

When the sunlight drying method is used during the rainy season it can lead to mold contamination. This may affect the quality of the shea butter and shea butter products (Moharram et al., 2006; Senyo, 2014). Both parboiling duration and drying method significantly affect shea butter yield and quality and the free fatty acids levels (Aculey et al., 2012). During the drying period, the kernels become detached from the shell wall. De-shelling is carried out using stone, hammers and pistles (Alonge and Olaniyan, 2007). Winnowing is achieved by holding basket filled with a mixture of the shells and kernel at arm's length and allowing a gradual pour–out (Alonge and

Olaniyan, 2007). After this the remains of the shell pieces from the shea kernels are removed in a process generally referred to as sorting. At this stage, shea kernels that are broken, infected by mould or are black in colour are removed to obtain clean unbroken shea kernels. The shea kernels can now be stored for several months without deterioration or processed into shea butter. The pre–treatment and storage of the shea kernels before the butter extraction process is a critical stage that affect the quality of shea butter produced. The first adverse effects are seen in the decrease in oil phenols and in the reduction of volatile compounds responsible for the various properties of shea butter (Hee, 2011). Angerosa *et al.* (2004), noted that long–term storage of seeds when the high relative humidity is high leads to mould contamination. This increases the free acidity due to the production of lipase which results in moulding. This affect the fatty acid (arachidic, linoleic oleic, palmitic, and stearic) composition and the free fatty acid content in particular, thereby dictating the quality parameters of the butter and hence the international standards as set by the West African Regional Standards in 2006.

According to Iddrisu Abdul-Mumeen *et. al.*(2019) the shelled kernel is broken into small pieces for roasting. This is done using either two stones or pestle and mortal. Crushed shea nut pieces are roasted using cylindrical container made of mild steel with handle on open fire. This is where the slight smoky smell of traditional shea butter originates (Iddrisu Abdul-Mumeen *et. al*.(2019). Most of the existing equipment for processing of shea butter especially the roasters are made of mild steel materials. The mild steel can easily become rusted and cause contamination of the product. Metal particles form as a result of the rusting settlement at the bottom of the equipment, thus causing contamination of the product. Smoke from open fire can also result in contamination of the Polycyclic Aromatic Hydrocarbon (PAHS), some of which are said to be highly carcinogenic (Ajai, 2011). In addition, open fire roasting has the disadvantage of producing burnt crushed kernels which in turn leads to black shea oil formation and loss of vital and essential nutrients (Orhevba et. al. 2013). After the roasting, the roasted shea kernels can be allowed to cool down for at least 30min or at most 1 hour, before milling in a machine into a fine paste. The next stage is the mixing or oil extraction. This is the most complex operation in the production process (Iddrisu Abdul-Mumeen et. al. 2019). It involves the following stages; mixing the paste with water, beating the paste with a palm of the hand, adding further small quantities of water, and gathering the floating fat. The mixing process serve two main purposes. It releases the fat from the ground mass and remove as much of the brown colour as possible from the brown mass and produce a clean fat. Moreover, the manual method of mixing used by women in Nigeria is very tedious. Most often the container holding the paste is placed on the ground; women stand over the bucket and bend at the waist. Not only is mixing by hand tedious and time consuming, but the bending can cause strain on the back, making the process only suitable for younger women and exposes product to further contamination (Gana *et. al.* 2019). These developments necessitate the need for upgrading of the indigenous technology through mechanization of the operations in order to make it less laborious, more productive and profitable and to increase the quality of the products. This will increase acceptability of the products industrial use and in the international market.

5.1 Upgrading of the Indigenous Technology for Shea Butter Production

To address the shortcomings of the indigenous processing methods, a number of initiatives have been introduced by some mandated research institutes and private sector operatives. According to Gana *et. al.* (2019) a shea nut processing plant was developed at the Federal Polytechnic, Bida. The plant has five main sections: a) Shea nut shelling and separation areas where the shelling of the shea nut and separation of the broken shell from the kernel takes place. b) Shea kernel crushing area where the shelled kernels are crushed into smaller sizes for further processing. c) Steam roasting area where the roasting of the crushed kernel takes place. Here, a boiler generates steam and delivered it to the roasting chamber where the roasting takes place. d) Milling unit where the size reduction of the roasted kernel takes place. The size reduction is achieved by using a hammer mill powered by a 15hp electric motor, and, e) Mixing or oil extraction area where the fine kernel is mixed with water to form a paste. The paste is fed into the mixer where the oil is extracted.

The beauty of the plant is that the process is mechanized. After cleaning and shelling, the kernel is reduced to smaller sizes with the aid of a crusher. The crushed nuts are roasted with steam inside in the steam roaster. The kernel roaster is a cylindrically shaped vessel made of stainless-steel plate with three separate compartments that include the roasting chamber, steam chamber, and insulator chamber. Crushed kernel is poured into the roasting chamber through the hopper or inlet (Gana *et al*, 2019). The steam chamber receives the heat from incoming steam and heat up the outer wall surface of the roasting chamber. After a few minutes, when the chamber has heated up, stirring of the crushed kernels begins by rotating the paddle carrying shaft through the rotating handle with the aid of gear arrangement. This constant stirring and heat application bring about uniform roasting of kernels. The roasted crushed kernels are then discharged into the collection pan through the roasters outlet. The roasted shea kernel is reduced into finer sizes by milling using the developed milling machine. The milled shea kernel is then mixed with water to form shea paste (Ghana *et. al*. 2019).

After this, the paste is fed into the mixing container where cold water is added intermittently. As the machine blade rotates, it mixes the paste with water. Mixing continued with addition of small amounts of cold water from time to time to get a smoother texture. This process is continued until the fat begins to break away from the cake (this is indicated by the colour of the mixture from chocolate to milk chocolate). At this stage cold or warm water is added depending on the temperature of the environment. A more quantity of cold-water is then poured into the mixture and stirred continuously to cause a grey, oily scum to rise. The water draining tap will subsequently be opened and water with lesser density than the oil would be drained out of the mixer through the tap. Fat will be collected into the boiling/heating container. Fat collected is immediately boiled in the boiling/heating container to complete the separation of fat from the cake. Boiling is continued until separation occurs and then oil is drained through the tap into a container and allowed to settle down for 30min. Heat supply from the combustion unit is temporarily cut off to allow for clean-up of the cake residues that settled under the oil in the bottom of the heating tank in the form of a thick brown paste. The oil will be retrieved into the clean heating tank where it will be boiled to dehydrate the fat completely on a gentle heat and monitored closely to remove floating particles and dirty foam with ladle. The warm liquid fat or oil will then be filtered through the tap using the ordinary thick cotton materials and finally collected on a plastic container and allowed to cool down and solidify (Gana et al, 2019).

This is one of the equipment produced through R&D to improve the indigenous technology used locally. In the subsequent section, the efforts of RMRDC at promoting the development of the value chain in Nigeria.

5.2 Development of Indigenous Technology for Shea butter Production; RMRDC Initiatives

The Raw Materials Research and Development Council (RMRDC) is a Federal Government parastatal under the Federal Ministry of Science and Technology. The mandate of RMRDC is to promote sustainable development of locally available raw materials for industrial use. In line with this, the Council initiated a number of programmes and projects that runs concurrently for the achievement of this mandate (RMRDC, 2020). Among these is the identification of all the raw materials required in all the ten industrial sectors of Nigeria's economy, determine the extent of their local availability and supply to the nation's industries, identify gaps in demand and supply status and initiate programmes and projects to develop the raw materials to fill the gaps and produce surplus for export (RMRDC, 2018).

RMRDC collaborated with mandated ogranizations and private sector operatives to overhaul the shea nut value chain in Nigeria. Among these are upgrading the indigenous technology used in shea butter production and promotion of increased production of shea nut trees locally. Through the collaboration, the Council has developed and fabricated the equipment for shea nut processing, which was installed at Agbaku-eji, Kwara State for Araromi Women Cooperative Society and Amanawa Shea Butter Women Cooperative Society, Kebbi state (RMRDC, 2020). The plant has a crushing capacity of 0.5 tons/hour and kneading capacity of 100Kg/hour. The technology has been adopted by private sector operators in the neighboring villages. The Council has conducted laboratory analysis of the Shea butter samples produced through these initiatives to classify the butter either as grade A, B, C or D in accordance with international grading of shea butter for different uses. Two samples of shea butter, one produced using the upgraded equipment from Agbaku-eji and the other produced using an imported equipment from Korea were analyzed in the USA in 2015 by the American Shea Butter Institute (ASBI). The result from the locally fabricated machine was graded and compared with Standards (RMRDC, 2018).

The Agbaku-eji shea butter was not graded as belonging to the premium quality. However, the result indicated that it can be utilized by glue manufacturers, soap manufacturers, industrial lubricants producers, biodiesel manufacturers, paint manufacturers, European chocolate and confectionary manufacturers, livestock feed manufacturers, pet food manufacturers, biomass manufacturers, candle makers, Asian textile manufacturers, Asian chocolate and confectionary manufacturers (RMRDC, 2020).

To further boost the quality of shea butter produced locally, the Council has established a Model Shea nut processing Centre in Gawu village, Abaji Area Council of the FCT. The centre is being used for training shea nut processors in the Federal Capital Territory (FCT) and surrounding states. Since the beginning of the exercise, over 350 women and youths have been trained on best practices for shea kernel production and processing, butter production and production of shea-based cosmetics and cosmeceuticals in the North West and North East geopolitical zones of the country and the FCT. The aim was to improve the quality of locally produced shea butter and allied products as well as to promote products diversification. To facilitate the trainings, English version of the poster on best practices for production of quality Shea nuts was translated into Hausa language and distributed to National Shea Products Association of Nigeria (NASPAN) members in the North East zone of the Country. The impact assessment of the exercise indicated that the 350 entrepreneurs trained initially have been able to train 2,472 other entrepreneurs (RMRDC, 2020). This has resulted in improvement in the quality of all the products and increase in the income of the processors by about 25%. As a result of the capacity building workshops somecompanies in Nigeria, most especially, Vic-Coe Great Nigeria Limited has started exporting shea butter products (cream) in since July, 2018 to Houston, United States(RMRDC, 2022).

One of the major problems constraining the optimal development of the shea nut value chain in West Africa is the absence of plantations of shea tree as most gatherers of shea nut and its processors depend on shea trees from the wild (Ogunwusi and Ibrahim 2016; RMRDC, 2017, 2018). To encourage plantation establishment of shea trees and consequently reduce the long gestation period associated with sheanut trees, RMRDC in collaboration with the National Centre for Genetic Resources and Biotechnology (NACGRAB), Ibadan embarked on the exploration and collection of shea tree germplasm from five selected states of Oyo, Kwara, Kogi, Niger and Benue. The exercise was carried out to aid the domestication and improvement of seed handling techniques of shea tree. In addition seed handling training workshops were held for shea nut farmers and processors Associations in the five states.

In a related development, improved Shea nut seedlings with 5 - 7 years gestation period have been developed by the National Institute for Oil palm Research (NIFOR), Benin. A pilot shea tree plantation had been established by the Council using the seedlings developed at NIFOR. This is being used to demonstrate to possibility of domesticating the Shea tree. To further the optimal development of the shea industry in Nigeria the Council in collaboration with the National Shea Products Association collaboration and other stakeholders has developed a roadmap for the sector. This had been adopted as a working document for all operators in the sector.

6.0 Conclusion

The need to move Nigeria's economy forward has become very important. Since the 1960's, the economy has depended mostly on crude oil export despite availability of more than 20 indigenous with plants high economic potential and highly productive arable land in most parts of the country. Most of the indigenous plants such as shea nut are using traditional indigenous technology that is passed down from one generation to another. The process is not only tedious; it is laborious with low quality products. The globalization of the world economy has made competitiveness very germane. This necessitated that drastic steps must be taken if developing countries are to rise from excruciating poverty and to industrialize their economies. A major way towards the achievement of this goal is the intensification of Science, Technology and Innovation (STI) in research and development activities.

This has made research outfits to embark on upgrading of the indigenous technology being used for development of local natural resources. Shea nut processing is one of the indigenous activities that is providing means of livelihood for a number of people in West Africa, most especially in Nigeria. The upgrading of the indigenous technology is capable of making shea butter production a major foreign exchange earner in countries where it grows well in West Africa.

The efforts of stakeholders towards improving and upgrading the indigenous technology are gradually improving the quality of shea butter produced in the country. While these concerted efforts may not have led to production of grade A products, sustenance of the tempo through R&D and application of the principles of STI will lead to improved and diversify products with enhanced qualities. The efforts to produce high yielding shea tree with high quality nuts and low gestation periods must also be maintained and sustained to enable the value chain development efforts work optimally. This can be actualized through improved funding for research and development and the commitment of stakeholders. The overall goal of the RMRDC shea butter value chain development programme is to increase production and processing of both the nut and the butter, produce high quality nut and butter for the industrial sector, secure better market share for the processors so as to enjoy higher premium price for their products, generate more employment and income for the rural women and youths, reduce poverty and generate revenue for the country. Within the next few years the intention is to increase Nigeria's share in the export market and to generate for foreign exchange earnings in the country.

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