



### Full Length Research Paper

## Cassava: A Potential Crop for Industrial Raw Material in Nigeria

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### Abstract

Nigeria is currently the largest cassava producer in the world with an estimated annual production of about 40 million metric tonnes but the country is yet to fully harness the economic potentials of cassava root that would translate to higher ranking of cassava next to petroleum as major contributor to the gross domestic product (GDP). Its production is currently put at about 34 million metric tonnes a year (FAO, 2002). Total area harvested of the crop in 2001 was 3.125 million ha with an average yield of 10.83 tonnes per ha. Presently, cassava is primarily produced for food especially in the form of gari, lafun and fufu with little or no use in the agribusiness sector as an industrial raw material although the crop can be processed into several secondary products of industrial market value. These products include chips, pellets, HQCF, fermented and un-fermented flour, adhesives, alcohol, and starch, which are vital raw materials in the livestock, feed, alcohol/ethanol, textile, confectionery, wood, food and soft drinks industries and are also tradable in the international market. This study assesses the potentials of cassava as an industrial raw material in Nigeria.

**Key words:** Cassava, Potential, Industrial crop, Raw material

### Introduction

Cassava (*Manihot esculenta* Crantz) is a major food and industrial crop in tropical and subtropical Africa, Asia and Latin America. In Africa and most of Latin America cassava is mainly used for human consumption. According to Opara, L.U (1999) the root goes by different names in Nigeria it is known as Rogo in Hausa, Ege in Yoruba and Akpu in Igbo.



**Figure1** Picture of Cassava Root

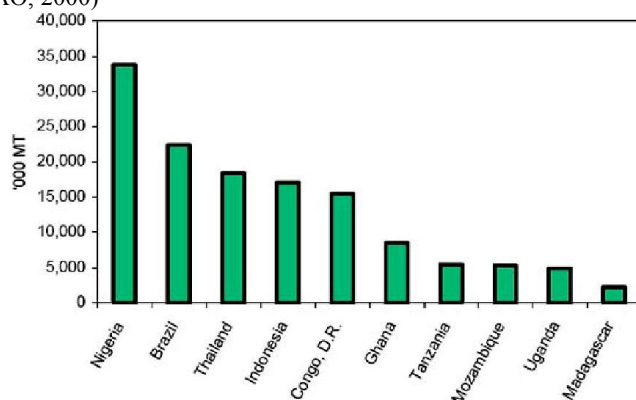
Cassava belongs to the family *euphorbiaceae* and it is claimed to have originated from the Latin Americas and cultivated in almost all parts of the world with Nigeria as the highest cultivator of the root. The FAO reported that world production of cassava root is estimated to be 184 million tonnes in 2002; it rose to 230 million tonnes in 2008 while Nigeria is the world's largest producers of the root cassava with an annual production of over 34 million tonnes.

In all places, cassava has become very popular as a food and cash crop and is fast replacing yam and other traditional staples of the area. Cassava is important not just as food crop but even more so as a major source of income for rural households, foreign exchange earner for the country, raw material for industries such as the alcohol and pharmaceutical industries. FAO (2007) revealed that about 42% of harvested cassava roots in west and east Africa are processed into dried chip and flour while Ajibola (2000) reported that Nigeria as the world's largest exporting country of dried cassava with a total of 77% of world's export in 2005. Thus, many Nigerians derive much of their food and employment from cassava production, processing, marketing and cassava based agro-industrial schemes.

IFAD and the FAO (2000), have found cassava to be used to alleviate food insecurity, especially in times of war or social unrest, as the crop is easy to grow, can be stored for long periods of time in the ground and also can be harvested at any period of the year. Surplus production can be fed to farm animals or sold as fresh roots or dry chips for human consumption or animal feed. The economic potential of cassava cannot be matched by any other known crop, however the potential of cassava as an industrial raw material for various industries in Nigeria has not been exploited.

**Status of Cassava Root**

In Nigerian cassava production is by far the largest in the world; it is a third more than the production in Brazil and almost double the production of Indonesia and Thailand. Cassava production in other African countries appears small in comparison to Nigeria’s substantial output. (IFAD and FAO, 2000)



**Figure 2** Leading World Producers of Cassava

**Source:** FAOSTAT

Cassava is a very versatile commodity with numerous uses and by products. Each component of the plant is valuable to its cultivator. The leaves are consumed as a vegetable, cooked as soup ingredient or dried and fed to livestock as a protein feed supplement, the stem is used for plant propagation and grafting while the roots are typically processed for human, livestock and industrial consumption. In Nigeria, the consumption pattern varies according to ecological zones.

**Table 1:** Cassava product Consumption pattern in Nigeria

Zone	Order of importance
South West	Gari, Lafun, Fufu/Akpu
South South	Gari, Akpu
South East	Gari, Fufu/Akpu
North Central	Gari, Fufu/Akpu, Starch
North East	Fufu/Akpu, Gari,
North West	Boiled sweet root

Estimates of industrial cassava use suggest that only approximately 16 percent of cassava root produced was utilized as an industrial raw material in 2001 in Nigeria. Ten percent was used as chips in animal feed, 5 percent was processed into a syrup concentrate for soft drinks and less than one percent was processed into high quality cassava flour used in biscuits and confectionary, dextrin pre-gelled starch for adhesives, starch and hydrolysates for pharmaceuticals, and seasonings (Kormawa and Akoroda, 2003). This estimate leaves 84 percent or 28.9 million tonnes of production for food consumption, a portion of this of course being lost in post harvest and waste.

**Cassava products**

Cassava can be processed into different products that can be grouped as five (5) different types, these are: fresh root, dried roots, pasty products, granulated products and cassava leaves.

*Fresh root:* These are the roots of the different cassava varieties. The fresh root of the sweet variety are often eaten raw, roasted in an open fire, or boiled in water or oil, while that of the bitter variety has to undergo various processing to remove the cyanide. According to Grace (1997), the cyanogens in the roots are destroyed by slowly cooking the roots.

*Dried roots:* the dried cassava roots are often stored or marketed as chips, balls or flour. The Chips and balls are milled into flour in preparation for a meal. There are two broad types of dried cassava roots: fermented and unfermented.

*Pasty products:* Two forms of pasty cassava products are common in Nigeria: these are the uncooked paste (Fufu) and steamed pastes. The most popular is the uncooked paste because it is stored or marketed without cooking. Steamed cassava pasty products have been recently introduced into the Nigerian urban markets and it has proved to be a promising food for busy urban consumers. The steamed cassava pasty is a product that can be stored for a long time due to the double fermentation of the product as well as the steaming.

*Granulated products:* In Africa, there are three common types of granulated cassava products: these are: *gari*, *attieke* and *tapioca*.

*Cassava leaves:* Cassava leaves have a nutritive value similar to other dark green leaves and are an extremely valuable source of vitamins A (carotene) and C, iron, calcium and protein (Latham, 1979). The consumption of cassava leaves helps many Africans compensate for the lack of protein and some vitamins and minerals in the root.

#### **Utilization of cassava products in Nigeria**

Cassava products are used in various forms mostly for human consumption, livestock and manufacture of industrial products. In Nigeria cassava is processed into different forms utilizable by man, usable forms of cassava products in Nigeria include:

- High Quality Cassava Flour which is simply unfermented cassava flour.
- Gari: Creamy white, granular flour with a slightly fermented flavour that is slightly sour made from fermented, gelatinize fresh cassava tubers.
- Cassava starch: It is mainly used as food but it is also readily converted chemically, physically and biologically into many useful products.
- Lafun: The fibrous powdery form of cassava similar to fufu in Nigeria.
- Fufu: A fermented wet paste made from cassava. It is ranked next to gari as an indigenous food of most Nigerians in the south.
- Tapioca: Meal made from partly gelatinize cassava starch
- Cassava chips- the most common form in which cassava roots is marketed.
- Cassava Pellets- Cassava roots are made into pellets which are used in compounding animal feeds for cattle, sheep, goats, pigs, poultry, and farmed fish.

#### **Processing of cassava**

Cassava roots are highly perishable with a post harvest life of less than 72 hours but they can be stored underground for longer periods if they are not detached from the plant (Lincoln and John, 2005). According to Oyewole and Asagbara, (2003); Ashaye *et al*, (2005), once harvested, the root undergoes rapid deterioration. One way of postharvest preservation is by processing to a number of dry food and exportable products which store longer (Hahn and Keyer, 1985). This minimizes quantitative and qualitative losses, ensures steady production and availability of other products. One of the greatest advantages that cassava has over other tropical starchy root crops is that the roots can be put to many uses (Onyekwere *et al*, 1994). Almost all the cassava produced in Nigeria is used for human consumption with less than 5% being used in industry (Taiwo, 2006).

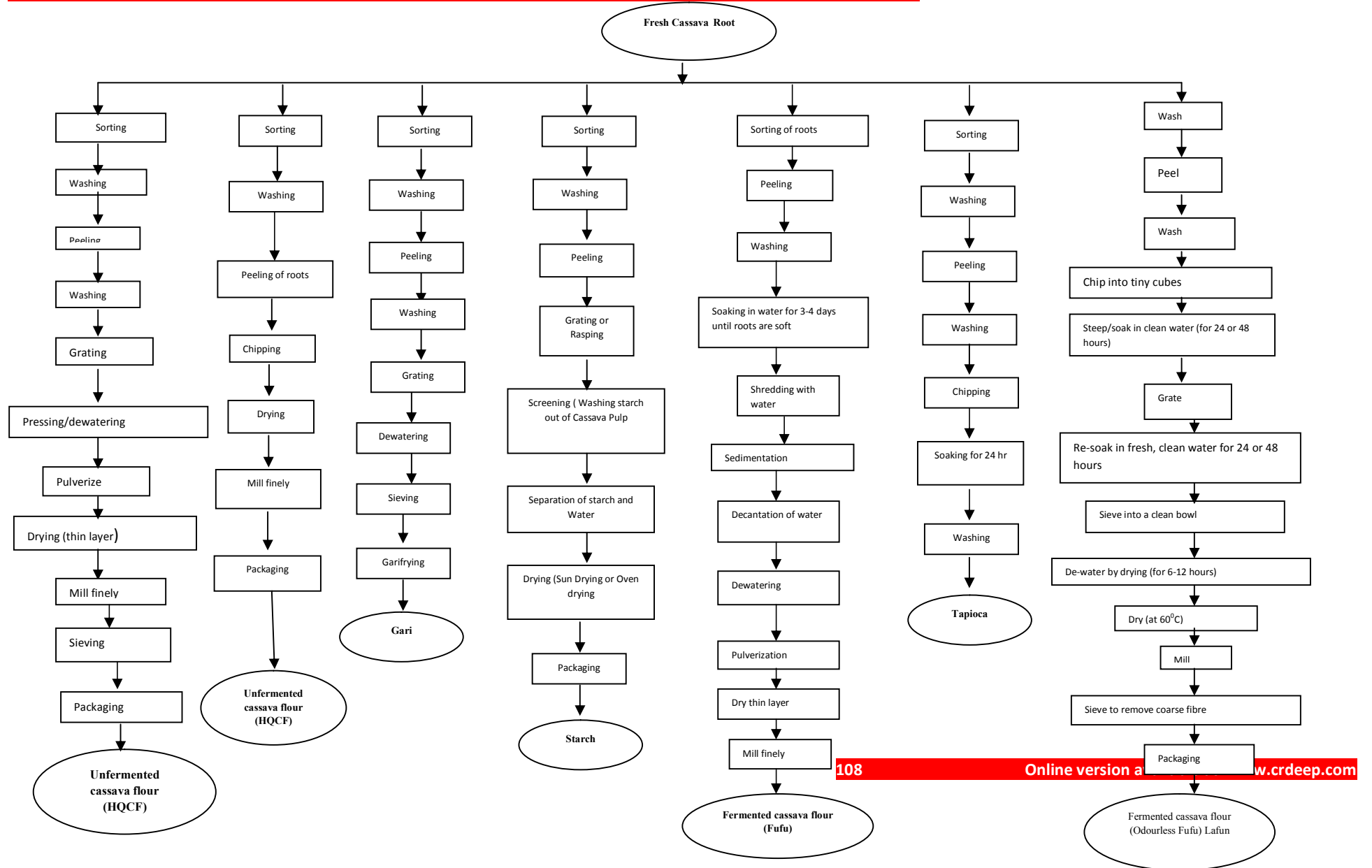


Figure 3: Flow chart for the processing of some cassava Products

**Potential of Cassava as an Industrial Raw Material**

Cassava finds relevance as an industrial raw material as cassava starch which can be used in confectioneries for different purpose such as thickening and glazing. It is a very important raw material in making of glue. Cassava starch based dextrose is an excellent adhesive and are used in many applications including pre-gummed papers, tapes, labels, stamps and envelopes

The scope for increasing the use of cassava starch in Nigeria's industries is to a large extent, limited by the ready availability of high quality imported corn starch and Nigeria's meagre research and development investment in preparing cassava starch for industrial uses. An Illustration of the potential industrial uses for cassava and research priorities for developing cassava starch and dried cassava roots as industrial raw materials in six different industries in Nigeria: textile, petroleum drilling, pharmaceutical, soft drink, beer malt and ethanol/alcohol industries was elucidated by Nweke et. al (2001). The potential was discovered to be high in three industries.

**Table 2:** Nigeria: Industrial potential for cassava and research and development priorities

Industry	Cassava-based Raw Material	Potential for Increasing Cassava Utilization	Required research and development activity
Textile	Cassava starch in direct form	Medium	Improve the quality of cassava starch by improving the method of drying cassava roots
Petroleum drilling	Cassava starch in direct form	Medium	Make cassava starch gelatinize in cold water
Pharmaceutical	Cassava starch hydrolysates including glucose, maltose, sucrose, fructose and syrup	Medium	Set up industries to make glucose, maltose, sucrose, fructose and syrup from cassava starch
Soft drinks	Syrup concentrate	High	Prepare syrup concentrate from cassava starch and test it for suitability for making soft drinks
Beer	Dried cassava roots	High	Develop a method of making beer malt using dried cassava roots
Ethanol	Dried cassava roots	High	Set up cassava-based small-scale alcohol units; and carry out feasibility study of producing ethanol from cassava in Nigeria and ethanol from cassava in Ghana.

*Source: Nweke et al 2001*

Cassava starch can also be used as a biodegradable polymer to replace plastics in packaging materials. Glucose and fructose made from cassava plant are used as substitutes in jams and canned fruits while cassava based sweeteners are preferred in beverage formulation for their improved processing characteristics and product enhancing properties.

Cassava chips are an alternative source of raw materials for producing liquors as well as medical and industrial alcohol.

Cassava based adhesives (glue) are of three main types;

- liquid starch adhesives
- pre-gel starch adhesive
- dextrin based adhesive

Glue made from cassava starch is a key material in plywood manufacturing. The quality of plywood depends heavily on the glue that is used. Modified cassava starch is used in the wet stage of paper making to flocculate the pulp, improve run rate and reduce pulp loss. Native and modified cassava starches are also used in the coding and sizing of paper, improving the strength, and controlling ink consumption to improve print quality. Cassava starch is used in three stages of textile processing to size the yarn, to stiffen and protect it during weaving, to improve colour consistency during printing and to make the fabric durable and shinning at finishing. Cassava Ethanol generally produced by fermentation of sugar, cellulose or converted starch is used in the pharmaceutical industry and can serve as an alternative uses from bio fuel in most developed world.

**Cassava uses in Pharmaceutical:**

In the pharmaceutical industry native and modified cassava starch are used as binders, fillers, and disintegrating agents for tablet production. Glucose syrup is a concentrated aqueous of glucose, maltose, and other nutritive saccharides from edible starch. Glucose syrup is used in large quantity in fruits, liquors, crystallized fruits, bakery products, pharmaceuticals and brewery products. In Nigeria, Syrup concentrate has been successfully made from cassava starch while beer has been brewed in Nigeria with imported barley malt for many decades. According to RMRDC (1996) the Nigerian beer industry uses about 200 000 tonnes of sorghum each year to make beer malt. However no attempt has yet been made to prepare beer malt from dried cassava roots, though, biochemists at the National Root Crops Research Institute (NRCRI) believe that given the right enzyme, it is possible to prepare beer malt from dried cassava roots. Research is needed to develop the technology for making beer malt from dried cassava

roots. Another potential for cassava as an industrial raw material is a cassava-based alcohol industry. Currently, Nigeria imports about 90 million litres of alcohol annually with about 80 million litres being used by the liquor industry. If the 80 million litres were produced from cassava, it would require 500 000 tonnes of dried cassava roots which would increase the demand for cassava, raise farm income, generate on-farm and off-farm jobs and save foreign exchange.

#### Expanded use of Cassava in Animal Feed

In Nigeria, the 5 percent of total cassava production that is used as feed is significantly lower than in Brazil (50 percent) because in Nigeria, cattle, sheep and goats are free grazed and pigs rummage on household waste. (FAOSTAT). In order to increase the use of cassava as animal feed, the logical step is to examine the global outlook for Nigerian cassava exports for livestock feed. Poultry feed trial has shown that if cassava roots and leaves were combined in a ratio of four to one, the mixture could replace maize in poultry feed and reduce feed cost without a loss in weight gain or egg production (Tewe and Bokanga, 2001). If this important research finding is diffused and adopted by farmers and livestock feed producers, the amount of cassava used in livestock feed in Africa would increase. At present, cassava leaves have no market value except in countries such as the Congo and Tanzania where the leaves are consumed as a vegetable.

#### Expanded use of Cassava in Food Manufacturing

Technologies exist for the use of cassava as a partial substitute for wheat in bread-making and biscuits, pastries and snack foods manufacture (Satin, 1988, Eggleston and Omoaka, 1994, Defloor, 1995 and Onabolu *et al.*, 1998). In Africa, the amount of cassava used for food manufacture by the food industries is insignificant. For example, in Nigeria in the late 1990s, an insignificant 3 tonnes of cassava was used per year for food manufacture compared with maize, 133 000 tonnes (FAOSTAT). Use of cassava as a partial substitute for wheat in food manufacture will increase if the practice can result in a reduction in the prices of the manufactured composite cassava and wheat flour food products compared with the prices of the same products made with 100 percent wheat flour.

Sustained investment in research and development on industrial manufacture of African cassava food products such as *gari*, *attieke* and *chickwangue* which have snack values can lead to the increased use of cassava in food manufacturing industries. The volume of cassava used in manufacture would increase dramatically if the production of these products is transformed from a small-scale home-made to a large-scale factory-manufactured product by replacing most of the production stages with mechanical or chemical processes as was the case in Brazil.

#### Cassava as a Source of Foreign Exchange

Virtually all cassava produced in Nigeria is used domestically, so cassava has not played any role as a foreign exchange earner, or in import substitution. However, there now appears to be a window of opportunity opening up for export of cassava products, as the traditional Asian exporters appear to be having difficulties in satisfying demand particularly on the European Union market due to changes in the relative costs of production and comparative advantage. Some sub-Saharan African countries are already taking advantage of this trend. For example exports of cassava chips from Ghana which commenced with 500 tonnes in 1993, reached 29 000 tonnes in 1996.

There are also some import substitution possibilities for cassava flour and industrial starch. Results of economic analysis by Djoussou and Bokanga (1995) show that with a 15 percent substitution rate of wheat flour with cassava, Nigeria could save up to US\$14.8 million in foreign exchange annually, with US\$12.7 million going to cassava processors and US\$4.2 million to cassava farmers. The potential of cassava as a foreign exchange earner in Nigeria needs to be carefully assessed.

#### Cassava policies

Cassava policies were designed to mobilize Nigerians to fully and profitably tap the potentials of cassava which previously had remained unharnessed. The policy was also designed to encourage foreign earning through the export of cassava end product such as cassava pellet, cassava chips and cassava starch; to develop the domestic industries that were involve in production of value added products such as ethanol, glucose syrup and adhesives to encourage rural industrialization and rural job creation that would create enhanced rural income and reduce rural urban migration. The cassava policies include;

- a) 40% inclusion of cassava into bread and other confectioneries
- b) New tax incentives for cassava millers and processors
- c) Zero% duties on all agricultural equipment and processing equipment for cassava processing.

Consequently, future intervention strategies should include the following:

- development, rapid multiplication and dissemination of improved varieties to enhance the availability and diversity of improved planting materials;
- development and extension of improved agronomic practices for cassava production;
- Deliberate efforts to support the development of cassava processing prototypes and identification of applicable and useful technologies and incentives for local entrepreneurs to fabricate them. This will save labour and improve the efficiency of



processing, raise the quality and enhance marketability of products. The design of such machines should be gender-sensitive, bearing in mind the cardinal role of women in processing;

- Strengthening of extension-farmer linkage with research to facilitate the ongoing spread of cultivars, management practice and processing techniques. This should lead to the mobilization of farmers through emphasis on a participatory development approach, family- or group-based extension and seed multiplication activities involving due recognition of the role of women in production, processing and marketing and assistance that would enable all farmers to take advantage of development programmes as far as possible; adequate and sustained research funding which must be timely released;
- development of new cassava products and packaging techniques for existing and new products;
- promotion of industrial uses of cassava and diversification of processing options to encourage increased cassava production and enhance rural household income;
- establishment of a sound macroeconomic policy that would promote sustained cassava development;
- investment in rural infrastructure (especially feeder roads and water supply) to promote cassava production, processing and marketing; and
- Greater involvement of the private sector and non-governmental organizations in the use of research and technology in cassava production, processing and marketing and in the development of infrastructural facilities.

### The way forward

Unfortunately, no supply chain structures exist for the commercialization of secondary cassava products as primary source of raw material for agro industries. (Ezedinma et al, 2002). Production of cassava is not oriented towards commercialization but instead farmers produce and process cassava as a substance crop. (Dixon, 2002). The way forward in actualization commercialization of cassava products are as follows:

- The current status and potential demand for cassava and its secondary products as industrial raw material in Nigeria is neither unknown nor documented. To guide the commercialization of cassava such documents are important and should be made available.
- Identification of market opportunities organizing and training clients, including farmers, processors and traders to respond to the demand of existing and potential market opportunities to enhance farm agribusiness linkages and cassava trade.
- Evaluate the economics of cassava production and processing costs structures (and profitability) of value adding cassava enterprises and suggest reduction strategy.
- Value addition to cassava will lead to export oriented industrialization through chain upgrading.
- Improved post-harvest systems with strong linkages between crop producers and end users not only to generate added value but also create employment opportunities in rural areas, thereby contributing to economic growth and poverty reduction.
- Mechanization of the pre and post harvest systems of cassava production and processing will not only create employment but increase the yield of cassava making it more available for industrial use.
- Extension service will have an important function in increasing the *rate of adoption* which enhances productivity and producer welfare by being directly involved in increasing awareness, in facilitating skill acquisition and in assisting in understanding of technology and its relevance to farmer circumstances. It will also have an important role in *feeding back* information on farmer constraints, potentials and farmers experiences with new technology to the research system, as well as in working with farmers and researchers in developing and spreading *indigenous solutions* to problems.

To address the new bottlenecks that emerge with the cassava transformation, research and diffusion should be broadened beyond plant breeding and plant protection to include the following:

- the development and diffusion of labour-saving technologies for harvesting cassava;
- the development and diffusion of labour-saving methods for peeling cassava;
- development of the market pulls for cassava by improving roads;
- development of industrial uses for cassava;
- the diffusion of labour-saving cassava grating technologies to regions where such technologies do not exist;
- the diffusion of *gari* preparation methods to regions where such methods do not exist;
- the diffusion of methods to prepare cassava leaves in regions where such methods do not exist;
- an in-depth study of industrial uses for cassava in the major cassava producing areas in Nigeria.

### Conclusion

The high perishability of harvested cassava and the presence of cyanogenic glucosides call for immediate processing of the storage roots into more stable and safer products. The extent to which the potential market for cassava may be expanded depends largely on the degree to which the quality of various processed products can be improved to make them attractive to various markets, local and foreign, without significant increases in processing costs.

In recent years, Nigeria has been consistently ranked as the world's greatest producer of cassava. Unfortunately, most of our farmers, businessmen, investors and industrialists are unaware of the investment opportunities which cassava industry offers. Many European and America countries, including Germany, UK, France, and the Netherland among others demand huge quantities of processed cassava products annually; in addition, the use of cassava for compounding livestock feeds which has gained wide acceptance in Latin America and Asia. Recently, Asia led by China has emerged as a major buyer of cassava products. Presently, cassava is primarily produced for food especially in the form of gari, lafun, and fufu with little or no use in the agribusiness sector as an industrial raw material. But the crop can be processed into several secondary products of industrial market value. These products include chips, pellets, flour, adhesives, alcohol and starch, which are vital raw materials in the livestock feed, alcohol/ethanol, textile, confectioneries, wood, food and soft industries. These cassava products are tradable in the international market.

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