



Ensuring sustainable development in cassava value chain and value addition

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Abstract

Contemporary rural and urban agriculture in Nigeria and the World over is grappling with the critical challenges of climate change, rapid industrialization and urbanization that take over designated farmland with attendant waste problems, slum menace and youth banditry; armed conflict scenario and poor or lack of master plan for emerging agro- technologies to ensure sustainable development in our agricultural production. This paper in tackling these challenges explores the concept of sustainable development; cross-cutting issues of sustainable Development, Cassava value chain and value addition as the basis for increased competitiveness and profitability given the importance of the crop in Nigerian cropping system. Policy initiatives and interventions on Cassava were expatiated upon. Also, the concept of value chain and value addition was reviewed. The cassava belt zones in the country were highlighted. Cassava Production within the locally obtainable and global value chain and addition were x - rayed.

Keywords: sustainable development, cassava, value chain, value addition, competitiveness.

Introduction

The quest for nations to evolve an agricultural developmental strategies that would stand the test of time in this era of population explosion (especially in the third world), rapid urbanization and industrialization against the backdrop of declining natural resources and environmental degradation led to the resolution by the world leaders to evolve the theory of sustainable development. The concept is believed should permeate every facet of human endeavour because of its concern for the ecosystems and continuity of production at all time. Given this background, this paper therefore seeks to review sustainable development in Cassava value chain addition in Nigeria under the following framework: Concepts of sustainable development, Sustainable Development Goals, potentialities of Cassava crop, Policy initiatives on Cassava, Nigerian Cassava Belt-Potentials, Opportunities in Cassava value Addition, Concept of Value Chain and Value Addition, Production Process of Cassava Value Chain Addition and Institutional Infrastructure for Cassava Value Chain Addition.

Concept of Sustainable Development Sustainable Development

The World Commission on Environment and Development (WCED, 1987) through the Brundtland Report characterized sustainable development in terms of ‘pursuing those paths of the economic, social and political progress that meet ‘the needs of the present without compromising the ability of future generations to meet their own ‘needs’ within the carrying capacity of the supporting ecosystems’.

According to this report (WCED 1987), the above definition contains two key concepts:

- ‘the concept of ‘needs’, in particular the essential needs of the world’s poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the

environment’s ability to meet present and future needs”.

Other critical objectives of the report for environment and development policies include

- reviving growth and changing in quality;
- meeting essential needs for jobs, food, energy, water and sanitation;
- ensuring a sustainable level of populations;
- conserving and enhancing the resource base;
- Re-orientating technology and managing risk; and merging environment and economics in decision-making.

Sustainability must address social, environmental, and economic concerns (UNEP, 1995). The economic aspects addressed must take into account the value of the natural systems of the site (Stavins *et al.*, 2003) [14].

Sustainable Development Goals

Following the expiration of the implementation timeline of the Millennium Development Goals (MDGs), which came to end in 2015, the international community through the United Nations in collaboration with the Heads of States and Governments of the 193 Member Nations, launched the Sustainable Development Goals (SDGs) as a new development agenda. This agenda, also known as Agenda 2030, is framed into 17 Goals, 169 Targets and 230 Indicators. Nigeria, being one of the countries that ratified and adopted the Agenda for implementation in September 2015, proceeded immediately to domesticate it as a vehicle for freeing humanity from poverty, securing a healthy planet for future generations, and building a peaceful, inclusive society as a foundation for ensuring a life of dignity for all (United Nation General Assembly, 2015).

This global momentum has at its heart a promise to leave no one behind. In effect, the 2030 Agenda is both ambitious and transformational. Essentially, the Agenda is a shared

plan to transform the world by looking after the welfare of the people within a period of fifteen years.

The goals (United Nation General Assembly, 2015) are outlined as follows:

1. End poverty in all its forms everywhere.
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
3. Ensure healthy lives and promote well-being for all at all ages.
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. Achieve gender equality and empower all women and girls.
6. Ensure availability and sustainable management of water and sanitation for all.
7. Ensure access to affordable, reliable, sustainable and modern energy for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10. Reduce inequality within and among countries.
11. Make cities and human settlements inclusive, safe, resilient and sustainable.
12. Ensure sustainable consumption and production patterns.
13. Take urgent action to combat climate change and its impacts.
14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

With regards to sustainable agricultural production within the context of SDG, goals: 1, 2, 3, 5, 8, 9, 10, 12 and 17 are quite instructive to this end.

Cassava: Untapped Goldmine

Cassava has played and continues to play a remarkable role in the crop sub-sector of agriculture in Nigeria. Since its debut in the late 1600s on Portuguese trade ships from Brazil into Nigeria, it has gone from minor crop to a major crop that accounts for between 40-50% of all calories consumed in Southern and Central Nigeria (Adebayo, 2005); Western and Central African sub - region. Nigeria is the world's largest producer of cassava. Its current production was estimated in 2009 to be 36.8 million metric tons (FAOSTAT, 2010). Total area harvested in 2009 was 3.13 million ha, with an average yield of 11.7 t ha⁻¹ (FAOSTAT 2010). It is produced predominantly (99%) by small farmers with 1-5 ha of land intercropped with yams, maize, or legumes in the rainforest and savannah agro-ecologies of Southern, Central, and lately Northern Nigeria. Nigeria is said to be losing about \$10bn worth of export in agriculture annually due to the absence of value addition to

our agricultural produce.

Policy initiatives and Interventions on Cassava

Cassava has been cultivated for centuries in the Americas, initially for human consumption and more recently cultivated for the production of dry chips (used as animal feed), ethanol and starch. With cassava viewed as a food security crop and therefore poorly commercialized, the changes along the Cassava Value Chain have been minimal. Systematic interventions in the cassava sector began in the early 1980s with the introduction of high yielding, early bulking varieties resistant to the cassava mosaic disease (CMD) and cassava bacterial blight (CBB), produced at the International Institute for Tropical Agriculture (IITA) in the 70s', and the establishment of small-scale processing facilities. These two key interventions increased profit margin for producers and processors alike and drove down prices of cassava food products for the rural and urban consumer. "The cassava transformation", as the rapid increase in production and marketing has been termed, spun an entire food industry and transformed the crop from a rural subsistence crop to a cash crop and urban food staple (Nweke *et al.*, 2001)^[9].

The second wave of cassava transformation began with the Presidential Initiative on Cassava, started in 2003. The initiative sought to position cassava as a commodity crop and foreign exchange earner, beyond its traditional role as a food crop. A number of projects were embarked upon to build flour and sweetener processing factories in the country. Increased productivity of cassava by small scale farmers in Nigeria was addressed via the production and dissemination of over 100 million bundles of certified stock of improved cassava varieties over a period of three years, and a fast-track farmer participatory selection of new varieties (Nweke *et al.*, 2001)^[9].

Multiplication centres were established across the country to facilitate farmer access to improved cassava varieties. Local fabricators were trained by the National Centre for Agricultural Mechanization (NCAM) and other relevant agencies to build and sell thousands of grating, dewatering, and drying machines. Six farm-gate primary processing Centers for training extension and farmers in production of cassava flour, chips and pellets were established. State extension personnel were also trained in improved production technologies.

Nigerian Cassava Belt

The Nigerian cassava system, characterized by small-scale farmers/holdings cultivating less than 2 hectares of cassava (average of 0.5 ha), is subsistent in nature, primarily cultivated for the traditional food market, and not oriented to the industrial market. Any surplus cassava is either processed on the farm, or sold to local processors.

The IITA data as captured by Azogu *et al.*, (2005)^[2] shows that the north central zone (Benue, Nasarawa, Plateau, Niger, Kogi, Taraba, and Kwara States) produces the largest quantity (about 29%) of cassava in Nigeria. Thanks to their longer sunshine months and a mono-modal rainfall pattern (better than the southern States), making the north-central zone the best area to source cassava used for livestock feed and to locate pilot plants for cassava chips or pellets. The southern area of Kaduna State and the northern parts of Oyo, Ekiti, Ondo, Enugu, Ebonyi, Edo, and Cross Rivers States are also conducive for cassava chips production.

Table 1

MT/ha in State	Annual HA planted (x1000)	Annual MT produced (x1000)	Mean yield (MT/HA)	Rank
1	2 3			
Benue	261.1	3551	13.6	1
Kogi	184	2605	14.2	2
Enugu	186.5	2085	11.2	3
Imo	156.5	2052	13.1	4
Cross River	177.5	1958	11	5
Kaduna	206	1835	8.9	6
Rivers	167.5	1735	10.4	7
Ondo	73.2	1267	17.3	8
Ogun	75.7	1178	15.6	9
Oyo	121	1019	8.4	10
Osun	66	915	13.9	11
Akwa-Ibom	117.8	893	7.6	12
Delta	70	811	11.6	13
Ekiti	41.2	651	15.8	14
Anambra	53	627	11.8	15
Edo	45	545	12.1	16
Niger	73.5	535	7.3	17
Bayelsa	30	459	15.3	18
Ebonyi	29	435	15	19
Kwara	30	425	14.2	20
Plateau	26.9	345	12.8	21
Lagos	25.1	300	12	22
Abia	15.7	265	16.9	23
Nasarawa	25	248	9.9	24
Taraba	12	111	9.3	25

Source: Azogu *et al.*, (2005) [2].

Opportunities in Cassava value Addition

Cassava, in its processed form, is a reliable and convenient source of food for tens of millions of rural and urban dwellers in Nigeria. It is estimated that more than 90% of cassava production is processed into food (Nweke *et al.*, 2002; Philip *et al.*, 2004) [9]. But a significant industrial demand exists for cassava, primarily as substitution for imported raw materials and semi-finished products. There is a potential demand of 250,000 ton/year in the High Quality Cassava Flour (HQCF), primarily from 10% replacement in bread flour and for use in bouillon, noodles, and the adhesive industry (dextrins); a demand equivalent of 1.15 million tons of fresh roots. Similarly, demand for native and modified starches exceeds 230,000 tons/year in the food, paint, and pharmaceutical industries, another million tons of fresh roots. In the sweetener industry, an annual demand of 150,000 tons exists for high fructose syrup, as part replacement for imported sugar, and 40,000 tons/year for glucose (40,000ton/year); this requires an additional 950,000 tons of fresh roots.

The dried cassava chips value-chain has a potential demand of 900,000 tons per annum with 300,000 tons going to the regional food market, an estimated 80,000 tons/year to the local animal feed market, and 520,000 tons destined for the China export market. The dried chips market requires 3.4 million tons of fresh roots. Lastly, Nigeria has adopted the policy of blending gasoline with 10% ethanol, the E-10 policy. These represent a potential one billion liter per year market for fuel ethanol and, a potential demand of 2.3 million tons of fresh roots, assuming 50% of feedstock of E-10 comes from cassava. Cassava, Sugarcane, and sweet sorghum are currently the most economic feedstock for fuel ethanol production in Nigeria but cassava is by far the most

widely grown. Garri, fufu and lafun (Cassafufu) is a widely consumed Nigerian food. An estimated 4.2 million tons were produced in 2009 (IITA, 1990).

However, poor packaging and inconsistent quality limits Nigeria's participation in lucrative export markets in North America and Europe targeted at West Africans in the diaspora, and from large supermarkets. Where garri has been packaged well and is of good quality, it finds a ready market in large supermarkets patronized by middle class Nigerians and beyond the shores of the country. The size of the high quality garri market is estimated conservatively to be 455,000 tons/ per year, 65,000 tons from export to the diaspora and 390,000 demand from super markets, equivalent to 2.73 million tons of fresh roots per year. Combined, opportunities for cassava in the industrial, export, and retail industries come to 12.7 million tons of fresh roots from 510,337 ha of land; creating over a million jobs.

Concept of Value Chain and Value Addition

Value Chain

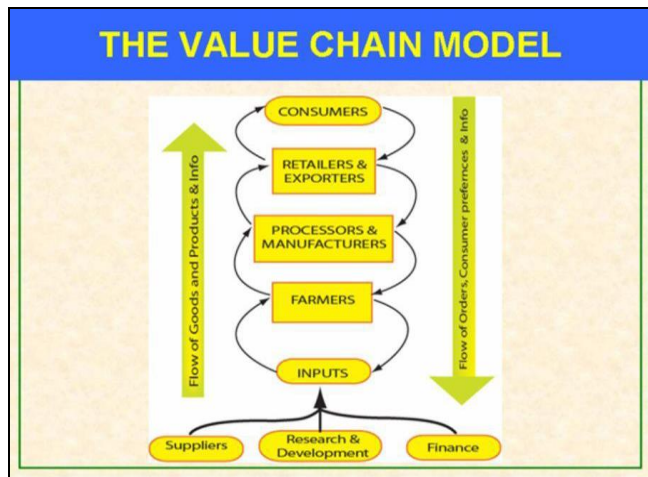
Value Chain can be defined as an organized system of exchange from production to consumption, aimed at increasing value and competitiveness. It is also an alliance of enterprises, working vertically to achieve greater market access. Value Chains encompass the full range of activities and services required to bring a product and/or service from its production/conception to its end use. These include the final markets into which a product or service is sold; local, national, regional or global. Actors in the value chain are driven by incentives namely, profit, prices, commissions or some other extrinsic factors. It is the incentive in the value chain that encourages private sector investments and oils the wheel of progress for any industry. For the success in global markets, Value Chains must move a product from production to the consumer more efficiently, with better quality and/or in a unique variation different to Value Chains in competing countries. The competitiveness of the Nigerian cassava industry therefore depends on its ability to develop, and to maintain an edge over market rivals (EFDI-Technoserve, 2005, Sanni, 2005) [5].

Value Addition

Value addition is competitiveness created at different stages and by different actors throughout the value chain in terms of derivatives produced at the end of the value chain. Value added may be related to quality, costs, delivery times, delivery flexibility, innovativeness etc. The size of value added is decided by the end-customer's willingness to pay (EFDI-Technoserve, 2005, Sanni, 2005) [5].

Opportunities for a company to add value depend on a number of factors, such as market characteristics (size and diversity of markets) and technological capabilities of the actors. Moreover, market information on product and process requirements is key to being able to produce the right value for the right market. In this respect, finding value adding opportunities is not only related to the relaxation of market access constraints in existing markets but also to finding opportunities in new markets and in setting up new market channels to address these markets (EFDI-Technoserve, 2005, Sanni, 2005) [5].

Below are examples of value chain models for proper understanding of the concept:



Source: FAO (2012)

Fig 7: Value chain model

Production Process of Cassava Value Chain Addition

Cassava in Nigeria is currently used for two main purposes: 90% as human food and only 5-10% as secondary industrial material (used mostly as animal feed). About 10% of Nigeria's industrial demand consists of HQCF used in biscuits and confectioneries, dextrin pre-gelled starch for adhesives, starch and hydrolysates for pharmaceuticals produces and as seasonings. 70% of cassava processed as human food is *gari*. Other common cassava products human foods are *lafun* and *fufu/Akpu*. Processed products can be classified into primary and secondary products. The former, e.g., *gari*, *fufu*, starch, chips, pellets are primary products which are obtained directly from raw cassava roots, while the latter are obtained from the further processing of primary products (e.g. glucose syrup, dextrin, and adhesive are obtained from starch).

- Largest Cassava producer but account for 0% of global trade in value added cassava products
- Cassava Bread Flour Substitution (Nigeria could save about N254bn to cassava flour substitution policy)
- Cassava subsector expected to reach a net worth of \$8.5b before 2020
- Improved variety (pro Vitamin A Cassava) from Cassava Resource & Tech Transfer Centre, Ilorin; NRCRI, Umudike/IITA collaboration.

Primary Products from Cassava

Four primary industrial products from cassava stand out as important for Nigeria. These are (a) cassava flour, (b) crude ethanol, (c) native starch, and (d) animal feed/cassava chips and pellets and are discussed below. These products are commonly traded and show the highest potential for growth in demand, and are associated with medium and large scale processing. The Enterprise Analysis for the development of processing plants for each of these sub-sectors is presented in Annex I. In the domestic market, industrial cassava products compete with traditional cassava products, mainly *gari*. Furthermore, each of the main industrial products (cassava flour, chips for animal feed, chips for food grade ethanol, and cassava starch) faces competition from (a) identical imported products, and (b) substitute products that are either being imported or locally grown. For domestic cassava flour the main competitive product is wheat flour. For cassava chips/pellets it is feed grains. For ethanol it is ethanol from other sources, and for starch it is corn/maize

starch. Based on the enterprise analysis, the cost of raw materials (fresh cassava) in Nigeria for the various cassava products are indicated below:

- Flour: 65%
- Starch: 63%
- Pellets: 58%
- Ethanol: 59%

Quite clearly, significantly lowering the cost of raw materials (ex-factory price) would greatly reduce the cost of the final product, making them more competitive. One strategy to achieve this is the vertical integration of commercial farms to each processing plant. This strategy is discussed extensively in a later section as one of the action plans for the development of the cassava industry in Nigeria.

Secondary Products from Cassava

Cassava can be processed into various secondary products, including modified cassava starch, glucose syrup, extra neutral alcohol, noodle, bakery and confectionery industries, meat and textile processing. It is also industrially processed as a raw material in the coating of pharmaceutical products, the manufacture of glues and adhesives and oil drilling starch. (EFDI-Techno Serve, 2005). Glucose syrup is a concentrated aqueous solution of glucose maltose and other nutritive saccharine made from edible starch. Glucose or dextrose sugar is found naturally in sweet fruits such as grapes or honey. It is less sweet than sucrose (cane sugar) and is used in large quantities in fruits, liquors, crystallized fruits, bakery products, pharmaceuticals, and breweries. Noodles are a long thin extruded food product made from a mixture of flour, water, and eggs usually cooked in soup or boiling water (Sanni *et al.*, 2004). At 12.5%, cassava starch/flour forms an integral part of the final product.

Cassava based adhesives, like the cereal starch adhesives, are of three main types:

- Liquid starch adhesives are supplied by the adhesives manufacturer in liquid form usually in plastic or lined metal drums, cans and bottles.
- Pre-gel starch adhesives are produced in dry flakes and milled to specific particles sizes. They are packed in waterproof lined multi-wall paper bags/sacks and are very suitable for export.
- Dextrin based adhesives are delivered to consumers in liquid and dry forms depending on specification and requirement. The liquid dextrin adhesives are packed as the liquid starch adhesives, while the dry dextrin adhesives are packed as the milled pre-gel adhesives. Dry dextrin adhesives are very suitable for export as intermediate raw materials used especially in Europe and America by the food and industrial companies.

Cassava By-Products

Cassava by-products are widely used in most tropical areas for feeding pigs, cattle, sheep and poultry. Dried peel of cassava roots are fed to sheep and goats. Raw or boiled roots are mashed with protein concentrates such as maize, sorghum, groundnut, oil palm kernel meal and mineral salts and used for livestock feeding. Cassava leaves and stems of the cassava plant are considered a waste product. However, analytical tests have shown that cassava leaves have a protein content equivalent to that of alfalfa (17-20%) (Onabolu. *et al.*, 1998)^[10] and can be used at 100 percent

substitution to replace alfa alfa as a protein rich source for animal feed. Cassava meal is the powdered residue of the chips and roots after processing is done to extract edible starch. It is generally inferior in quality to chips, pellets, and broken roots, has lower starch content and usually contains more sand. Its demand by the European Economic Community (EEC) has declined following a shift to the other cassava products. However, small-scale farmers who produce their own feedstuffs ensure its continued use by blending it with other ingredients. The above list of cassava products indicates the large variety of intermediate and end products within the cassava industry.

Cassava Flour Industry

High Quality Cassava Flour (HQCF)

Nigeria imports over one million tonnes of wheat annually. At 10% substitution of cassava flour in wheat flour and with the current national demand, 300,120,000 metric tonnes of HQCF (assuming the national demand for wheat flour is 1.2 million tonnes), is required. IITA has confirmed that 30% of the total wheat can be replaced by cassava flour in bread making, and 100% cassava flour is currently being used in pastries and confectioneries (Onabolu *et al* 1998) [10]. However, with poor regulation and standardization, some bakeries have complained about problems, including:

- Presence of impurities such as sand;
- Odour;
- Shorter product shelf life (e.g. biscuits);
- Brittleness;
- Gradual change of colour (biscuits turning pale);
- Unreliable supply;
- Poor final product quality in cases where the cassava flour had partially fermented.

The Ethanol Industry

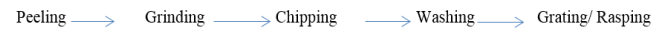
Most of the ethanol consumed in Nigeria is imported. Her current annual demand for the industrial, pharmaceutical and beverage industries is estimated at 160 million liters, a figure however expected to rise exponentially to 900 million liters once the E10 policy on ethanol in fuel is fully implemented.

Ethanol is produced by the fermentation of sugar related materials such as molasses and sugar juice, or starchy materials. Cassava stands as one of the richest fermentable substances for the production of crude alcohol/ethanol, with dry chips containing up to 80% of fermentable substances (starch and sugars). The process of cassava based ethanol production is described below.

Starch

The Nigerian demand for starch is estimated at 230,000 tonnes per year. Out of the 5 modern large-scale cassava starch factories existing in Nigeria, only two are in operation. Cassava starch is an important domestic and industrial raw material used in the manufacture of various products including food, adhesives, thickening agents, paper, and pharmaceuticals (IITA, 1990). It has many remarkable characteristics including high paste viscosity, high paste clarity and high freeze-thaw stability, which are advantageous to many industries. To make cassava starch, its roots being highly perishable, with enzymatic processing accelerate their deterioration within 1-2 days, it needs to be processed almost immediately after harvest. The process flow chart is described below. Starch has a lot more uses

than most cassava products.

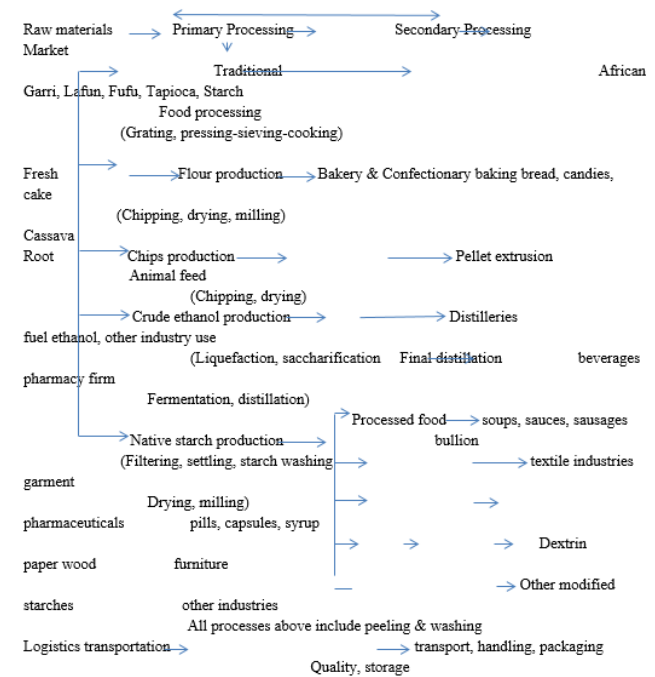


Animal Feed/Chips/Pellets

Cassava chips are dried irregular slices of roots, which vary in size but should not exceed 5cm in length (CIAT, 2004). The tuberous roots, either peeled or unpeeled, are cut up into chips (*cossettes*) and dried. Chips from peeled roots are used for human consumption and in animal feed industry and generally store better than flour (IITA, 1990). Chips are the most common form in which dried cassava roots are marketed and most exporting countries produce them. The standard method of processing chips consists of peeling, washing, chipping the cassava roots, and then sun drying the slices. The recovery rate of chips from roots is 20-40% depending on the initial dry-matter content of the cassava roots and the final moisture of the chips. In Nigeria, cassava chips were processed into animal feed and some animal feed millers continued the practice until the late 90s when the price of cassava became too expensive vis-à-vis the price of maize.

Cassava Value Chain Addition

Processing



Institutional Infrastructure

The Nigerian Support Institutions needed for the development of the cassava sector include (Oyewole *et al.*, 2003):

- Research and Development (R&D) Institutions.
- Finance Institutions.
- International organizations.
- Regulatory Institutions.
- Private Associations and NGO's.
- Ministries Government and Parastatals.
- Universities, Colleges and Polytechnics.

Conclusion

The concept of sustainable development; cross-cutting issues of Sustainable Development and Sustainable

Development Goals (SDG) were reviewed. The importance of cassava in Nigeria agricultural mix was explored with consideration for Value chain addition as a modern concept. Ranking of cassava according to their productive capacity on state basis was highlighted. The various derivative of cassava by-product was tabled so as to showcase the important of cassava as export earning crop within the context of sustainable development paradigm.

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