TOWARDS A SUSTAINABLE VALUE CHAIN APPROACH TO AGRICULTURAL TRANSFORMATION IN NIGERIA: THE IMPERATIVE OF ENDOGENOUS AGRICULTURAL MACHINERY DEVELOPMENT

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ABSTRACT

Value addition is a vital component of the overall strategy for addressing global market competition, post-harvest losses and food security. The strategy of value addition on agricultural produce provides ample opportunity for wealth creation, revenue generation, employment generation and effective post harvest management to reduce losses. Value chains reside at the core of high-impact and sustainable initiatives focused on improving productivity, competitiveness, entrepreneurship, and Small and Medium Enterprises (SMEs). Agricultural value chain links the steps a product takes from the farmer to the consumer and includes input suppliers, production, processing, marketing and finance. Agricultural development in Nigeria has been pursued under various development plans launched and executed by succeeding governments, yet the sector is currently dominated by peasant farmers using little or no technologies. A national agriculture transformation agenda tagged Agricultural Transformation Action Plan (ATAP) is currently being implemented in the country. The initiative is aimed at an overall development of the agricultural sector with focus on value chain development as a strategy towards agriculture revival. The transformation agenda is aimed at making agriculture work for Nigerians, especially rural farmers such that it becomes not just a development programme but also an income generating commercial activity. However, the transformation agenda cannot be achieved without agricultural mechanization.

This paper identifies different agricultural development programmes in Nigeria to include Farm Settlement Centre/Scheme, River Basin Development Authority, Agricultural Development Programmes (ADPs), Tractor and Equipment Hiring Scheme, National Accelerated Food Production Programme, Operation Feed the Nation, etc. The current situation in Nigeria is that the operators of the various components of value chain operate without machines, making their operations to be uncompetitive, leading to weak links in the chain. Tractors, ploughs, planters, fertilizer spreaders, trucks, fork lift, conveyors, threshers, digesters, packaging machines, etc, are some of the agricultural machinery identified as requirements for agricultural transformation and agricultural value chain development in Nigeria. The paper, therefore, recommends the development of a robust machinery building programme in the country for the achievement of agricultural transformation. Strategies to achieve sustainable value chain approach to agricultural transformation through agricultural machinery development were identified to include increased patronage of local fabricators of agricultural machinery, establishment of a sustainable Loan Scheme for stakeholders in the value chain, upgrading of laboratories and workshops in agricultural research institutions, establishment of appropriate standards for machinery, encouragement of the development of processing and marketing clusters and the establishment of machinery hire and leasing services.

KEYWORDS: Value chain, agriculture, transformation, mechanization, agricultural machinery.

1. INTRODUCTION

There is a range of ecological belts which favours Nigeria to produce a wide variety of agricultural commodities such as cereals, legumes, roots, tubers, fruits, vegetables, tree crops, forestry and shrubs, livestock and fish. (Onwualu, 2009a). However, Nigerian agricultural production has failed to keep pace with trends in technological development. Mechanization of Nigerian agriculture has been the subject of discussion and analysis for some time now (Onwualu, 2009b; Onwualu, 2006; Onwualu, 2008; Iweriebor,

2004; Oyeyeni, 2002). Agricultural mechanization is the development, introduction and use of mechanized assistance of all forms and at any level of technological sophistication in agricultural production, processing, distribution and storage. It involves the design, development, operation and maintenance of prime movers and devices for agricultural land development, crop and animal production, processing and storage (Onwualu, 2010a). The benefits of agricultural mechanization are so apparent in developed countries of the world that one would have thought that the path to mechanization of agriculture in Nigeria would be smooth, but unfortunately, the average farmer in Nigeria still depends on hand tools for production (Onwualu, 2009c; Onwualu, 2010a). The objectives of this paper are, therefore, to x ray the challenges facing agricultural development in Nigeria and recommend strategies and policy options for effective agricultural mechanization in the country in order to use agricultural machinery to improve productivity and competitiveness of the industry.

2. AGRICULTURAL DEVELOPMENT IN NIGERIA

Agricultural development in Nigeria has been pursued under various development plans launched and executed by succeeding governments, yet the sector is currently dominated by peasant farmers using little or no technologies. The first National Development Plan was launched in 1962 and lasted till 1968, the plan was aimed at promoting export of agricultural produce. The Second National Development Plan (1970 – 1974) was designed to reconstruct areas ravaged by the civil war and to rehabilitate agricultural production. Farm Settlement Schemes and National Accelerated Food Production Programme were among some specialized development schemes initiated and implemented during this period. The Third National Development Plan was launched in 1975 and lasted till 1980. The plan supported many agricultural programmes such as the River Basin and Rural Development Authorities Programme (1976), Operation Feed the Nation (1976), the Green Revolution Programme and the World Bank assisted Agricultural Development Projects (ADPs).

While each of the above programmes sought to improve food production, the ADPs was the first major practical demonstration of the integrated approach to agricultural development in the country. Since 1980, several interventions, policies and programmes have been executed by different governments. These have resulted in a number of agricultural institutions including agricultural research institutes, extension research liaison services and several River Basin Authorities (Table 1), as well as universities of agriculture, Federal and State Colleges of Agriculture, and Faculties of Agriculture and Veterinary Medicine in over 50 Universities within the country.

Table 1. Some Agricultural Development Programmes in Nigeria

Name	Date Started	Status
Agricultural Transformation Action Plan (ATAP)	2011	Functional
Nigerian Incentive-Based Risk Sharing for Agricultural Lending (NIRSAL)	2010	Functional
Nigerian Agricultural Insurance Corporation	1993	Functional
Commercial Agricultural Development Programme (CADP)	2008	Functional
The National Agricultural Land Development Authority (NALDA)	1992	Defunct
National Agricultural Research Project (NARP)	1991	Defunct
National Centre for Agricultural Mechanization (NCAM)	1990	Functional
The Directorate of Foods, Roads and Rural Infrastructure (DFRRI)	1987	Defunct
FADAMA Programme	Various	Functional
Rural Agro-Industrial Development Scheme (RAIDS)	1981	Defunct
Agricultural Mechanics and Machinery Operations Training Centre (AMMOTRAC)	1980s	Functional
The Green Revolution	1980	Defunct

The Nigerian Agricultural and Co-operative Bank (NACB) (now Bank of Agriculture)	1977	Functional
The River Basin Development Authority (RBDA)	1976	Functional
Operation Feed the Nation (OFN)	1976	Defunct
National Grain Production Company (NGPC) and National Root Crops Production Company (NRPC)	1974	Defunct
The Agricultural Development Programmes (ADPs)	1974	Functional
National Accelerated Food Production Programme (NAFPP)	1973	Defunct
Farm Settlement Centre/Scheme	1960s	Defunct
Tractor and Equipment Hiring Scheme	1960s	Defunct
Co-operative Plantation Programme	1960s	Defunct
Nigerian Commodity Boards	1940s	Defunct
Agricultural Research Institutes	Various	Functional
Universities of Agriculture	Various	Functional
Colleges of Agriculture and Faculties of Agriculture	various	Functional

Source: Adapted from Onwualu, 2012a

All the programmes listed above were initiated by the Federal Government of Nigeria. It should be noted that various state governments also have agricultural programmes geared towards the development of agriculture in the states.

A national agriculture transformation agenda tagged Agricultural Transformation Action Plan (ATAP) is currently being promoted by the Federal Government. The initiative is aimed at an overall development of the agricultural sector with focus on value chain development as a strategy towards reviving agriculture to its former glory. The transformation agenda is aimed at making agriculture work for Nigerians especially rural farmers such that it becomes not just a development programme but also an income generating commercial activity. The basic components of the transformation agenda include the development of value chain in some priority agricultural commodities namely – rice, cassava, sorghum, cocoa, cotton, maize, oil palm, dairy, beef, leather, poultry and fisheries (Onwualu, 2012a). If properly implemented, it will definitely work for Nigeria. Ultimately, the weak links in the chain for each of the crops or livestock will be developed to ensure that the entire value chain from production to consumption is simultaneously developed.

The programme also addresses reduction in post-harvest losses, improving linkages with industry with respect to backward integration, as well as access to financial services and markets. The Transformation Agenda targets rural communities particularly women, youth and farmers associations, as well as improving rural institutions and infrastructure. The programme announced in the last quarter of 2011 is expected to create 3.5 million jobs in four years and is also expected to inject about N300 billion ($2 billion) income into the hands of Nigerian farmers and about N350 billion ($2.2 billion) into the economy through sufficiency in rice production (www.fmard.gov.ng).

Also, to address the issue of financing the sector, the Central Bank of Nigeria (CBN) in 2010 engaged the Alliance for Green Revolution in Africa (AGRA) to develop the Nigeria Incentive-Based Risk Sharing for Agricultural Lending (NIRSAL) which was launched in 2011 (Sanusi, 2012). NIRSAL is a demand-driven credit scheme put in place given the need for an agricultural financing strategy that would boost output, increase farmers' income, create jobs and provide wealth opportunities across the value chain. The whole essence of the NIRSAL is to spark an agricultural industrialization process through increased production and processing of the greater part of the commodities produced in the country to boost wealth generation across the value chain. NIRSAL's primary goal is to increase agricultural lending by USD3 billion within 10 years (Sanusi, 2012).

In addition to all these, there are development partners and NGOs who have been involved in agricultural development in Nigeria. These include Food and Agricultural Organization (FAO), German Agency for

Technical Cooperation (GTZ), Economic Community of West African States (ECOWAS), European Union (EU), United States Agency for International Development (USAID), United Nations Industrial Development Organization (UNIDO), Canadian International Development Agency (CIDA), International Institute for Tropical Agriculture (IITA), Winrock International, etc.

Despite all these laudable policies and programmes, agriculture has suffered from years of poor management, inconsistent and poorly implemented government policies, and the lack of basic infrastructure. Nigeria agriculture is still characterized by subsistence farming, poor yields, low productivity, drudgery, poor quality produce, low technology, etc (Onwualu, 2011). Nigeria still spends about USD3.5 billion Naira importing food products annually. Imports are dominated by commodities such as rice, wheat, fish, poultry, milk, etc (Agriculture and Agri-food Canada, 2011).

3. VALUE CHAIN APPROACH TO AGRICULTURAL TRANSFORMATION

3.1 Concept of Value Chain

The concept of value addition is a vital component of the overall strategy for addressing global market competition, post-harvest losses and food security (Gibbon, 2001). The strategy of value addition on agricultural produce provides ample opportunity for revenue generation, employment generation and effective post harvest management. Majority of the Small and Medium Enterprises (SMEs) and indeed industries in Nigeria are agriculture related (Onwualu, 2009a; Onwualu, et al., 2010). The processing of agro raw materials into various innovative products promotes market acceptability and gives the products high economic value which consequently brings higher income to the producer (Onwualu, 2009a; Onwualu, 2010b; Olife, et al., 2013). Processing also expands the horizon of human participation in the production process and therefore creates awareness for employment generation in the downstream activities such as packaging, marketing, retail, exports, etc (Onwualu, 2009b). Value addition provides opportunities for developing countries to work out economic strategies for competing successfully in the global scene.

Value Chains reside at the core of high-impact and sustainable initiatives focused on improving productivity, competitiveness, entrepreneurship, and Small and Medium Enterprises (SMEs) growth (Figure 1). Value Chain thinking is revolutionizing the agriculture and the food industry. The Value Chain concept acknowledges that production must be linked to demand and the critical role of organizing the flow from farmer to consumer opportunities (FAO, 2012).

Agriculture is evolving towards a global system requiring high-quality, competitive products and organized in value chains. Value chain analysis was originally developed for manufacturing (Gereffi, 1994). Gibbon (2001) emphasized the relevance of value chain analysis for agricultural commodities as well. The relevance for agricultural commodities became particularly clear when the approach became applied to high-value produce within the so-called "buyer-driven" chains (Dolan and Humphrey, 2001; Dolan, et al., 1999; Ponte, 2002).

According to FAO (2012), agricultural value chain links the steps a product takes from the farmer to the consumer and includes input suppliers, producers, processors, marketers and financiers (Figures 1 and 2). Value addition can occur without high cost capital investment or physical transformation of the product. Value subtraction takes place when the end price does not compensate the investment cost. Therefore, it is important to focus on core business before diversifying into capital intensive value adding agro-processing technologies. Investments in agro-food technologies will fail without attention to management systems and capacities that reduce transaction costs (FAO, 2012).

The value chain approach has become an increasingly important framework for examining change in the global trade commodities and their implications for primary producers. Commodity value chain encompasses a whole lot of activities from production, processing distribution and marketing of specific

traded commodity and identifies the main stakeholders involved at each stage, including research and development, developing each group and making sure the links are strong (FAO, 2012; Onwualu, 2012a).

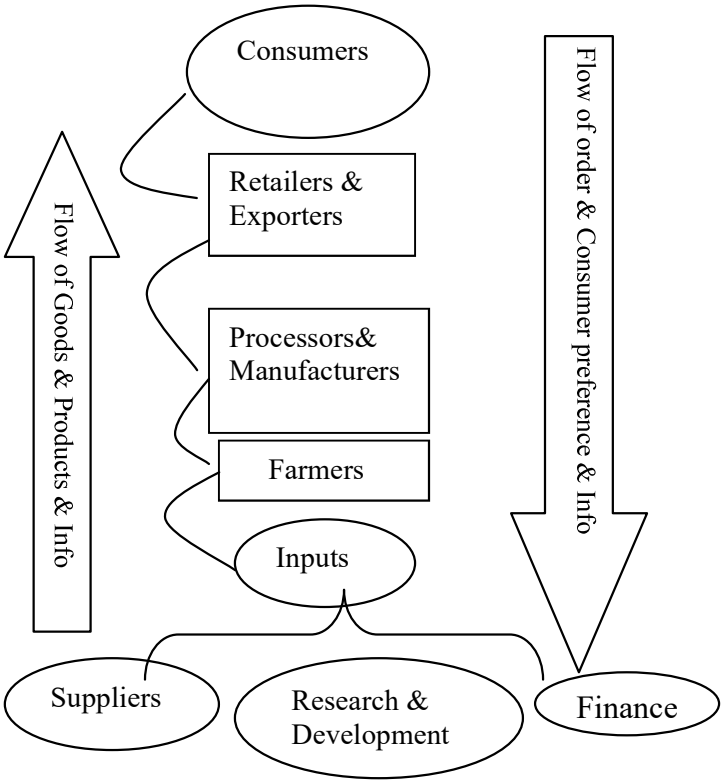

Figure 1: The Value Chain model
Source: FAO (2012)

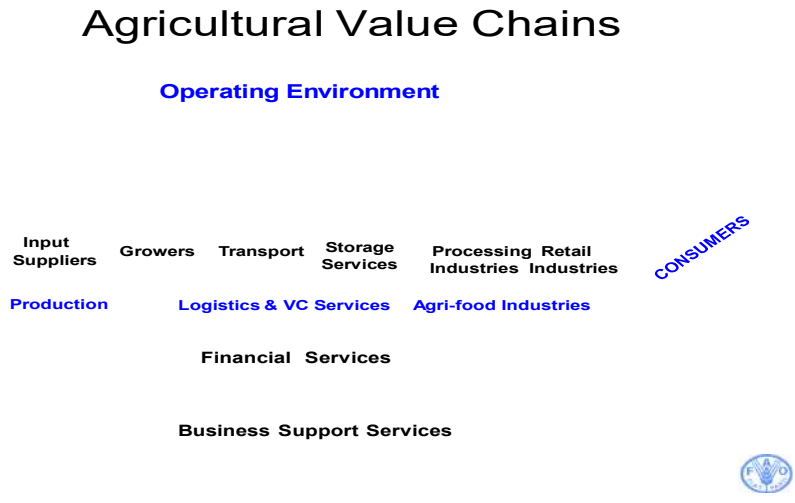

Figure 2: Agricultural Value Chains
Source: FAO, 2012

3.2 Cassava Value Chain

Cassava products can be classified into primary and secondary products. Primary products e.g. gari, fufu, starch, chips, pellets, and ethanol are obtained directly from raw cassava roots while secondary products are obtained from further processing of primary products (e.g. glucose syrup, dextrin, and adhesive are obtained from starch). Figure 3 shows cassava value chain.

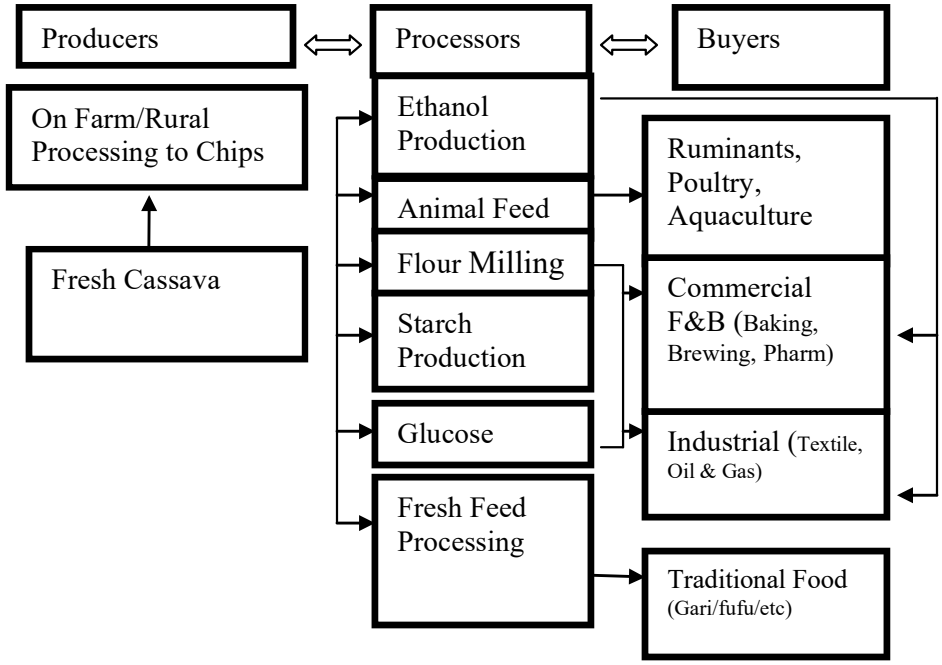

Figure 3: Cassava value chain
Source: USAID, 2009

Major actors in the cassava value chain include suppliers of farm inputs (fertilizers, and other inputs), small and medium scale farmers, buyers, processors and industries that engage in the production of animal feeds, high quality cassava flour for baking and pharmaceutical use, starch production for industrial use and glucose production and ethanol for brewing and biofuel. In Nigeria, 90% of cassava is used as human food and 5 – 10% as secondary industrial raw material (mostly as animal feed). Nigeria's industrial demand for cassava products is mainly for High Quality Cassava Flour used in bakery and confectioneries, dextrin, pre-gelled starch for adhesives, starch and hydrolysates for pharmaceutical products and seasonings. Chips/pellets, starch and ethanol are three basic cassava-based products traded internationally. Improving the competitiveness of the entire cassava value chain is critical to creating stable and growing markets for the commodities produced by farmers (Onwualu, 2009a; Onwualu, 2012a). Each of the components of value chain for cassava offers immense opportunity for endogenous development of machines by Agricultural Engineers in Nigeria.

3.3 Oil palm Value Chain

The value chain for oil palm is as shown in figure 4 (Onwualu, 2012a). Main actors in the oil palm value chain include providers of farm inputs (fertilizers, seeds and other inputs), small and medium scale farmers, owners of large scale plantations, oil millers (for palm oil and palm kernel oil), palm wine tapers, industries that engage in the production of vegetable oil, soap, animal feeds, margarine and oleochemicals. Other actors include particle board makers, broom, basket and rope makers.

In the food sub-sector, there is good potential for products such as trans-free margarine, shortening and specialty products. In the non-food sub-sector, oleochemicals and their value-added derivatives have great export potential due to growing world demand for natural based oleochemical products. Market prospects are favourable for the production of specialty products, including glycerin, fatty nitrogen derivatives and fatty acid esters (Onwualu, 2009a; Onwualu, 2012a). Major end users for specialty surfactants are manufacturers of personal care and cosmetics products as well as fabric softeners.

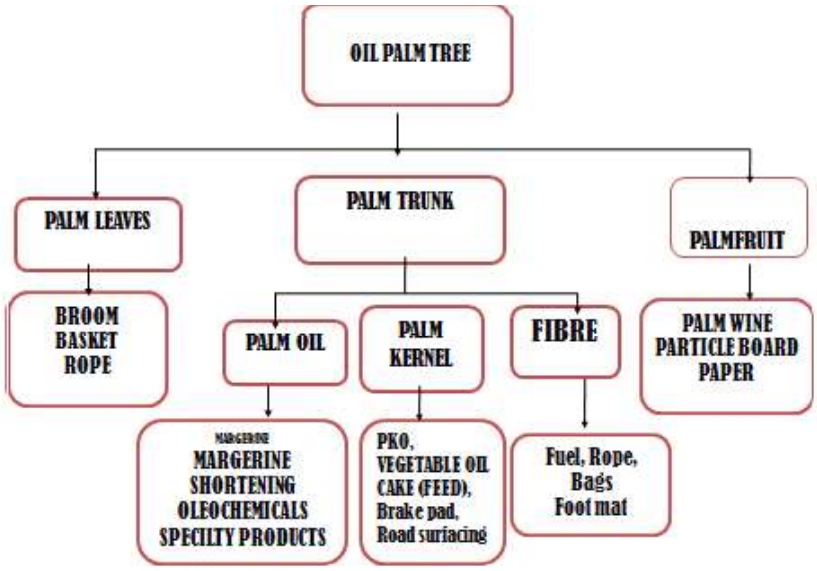

Figure 4: Oil Palm Value Chain
Source: Onwualu, 2012a

3.4 Cashew Value Chain

The value chain for cashew is shown in figure 5 (Carr, 2001; Olife, et al, 2013). Cashew has medicinal, industrial, investment, and export potentials. Products from cashew fruits include: liquor, vinegar, juice, juice concentrate, jam, beverages, pickle, chutney and candied products. Cashew nut shell contains inedible Cashew Nut Shell Liquid (CNSL), while the nut/kernel contains Cashew Nut Kernel Oil (CNKO), which is sweet edible oil. The pressed kernel cake from CNKO extraction process is suitable for use in human and animal feeds (FAO, 1992).

Cashew nuts have high medicinal and pharmaceutical potency (Streets, 1962). The CNSL contains high proportions of phenolic compounds which are used in industries as raw materials for making vehicle brake lining compounds, water proofing agents, preservatives, manufacture of paints and plastics; type-writer rollers, oil and acid-proof cements and for making industrial floor tiles (FAO, 1992). Also, cashew apple residue left after juice extraction, which is about 30 – 40% of apple weight can be used to recover low methoxyl pectin or as cattle feed after drying. Major actors in the value chain include providers of farm inputs, small and medium scale farmers, owners of orchards, collectors of cashew nuts and apple, traders, processors of cashew nuts and apples, marketers, etc.

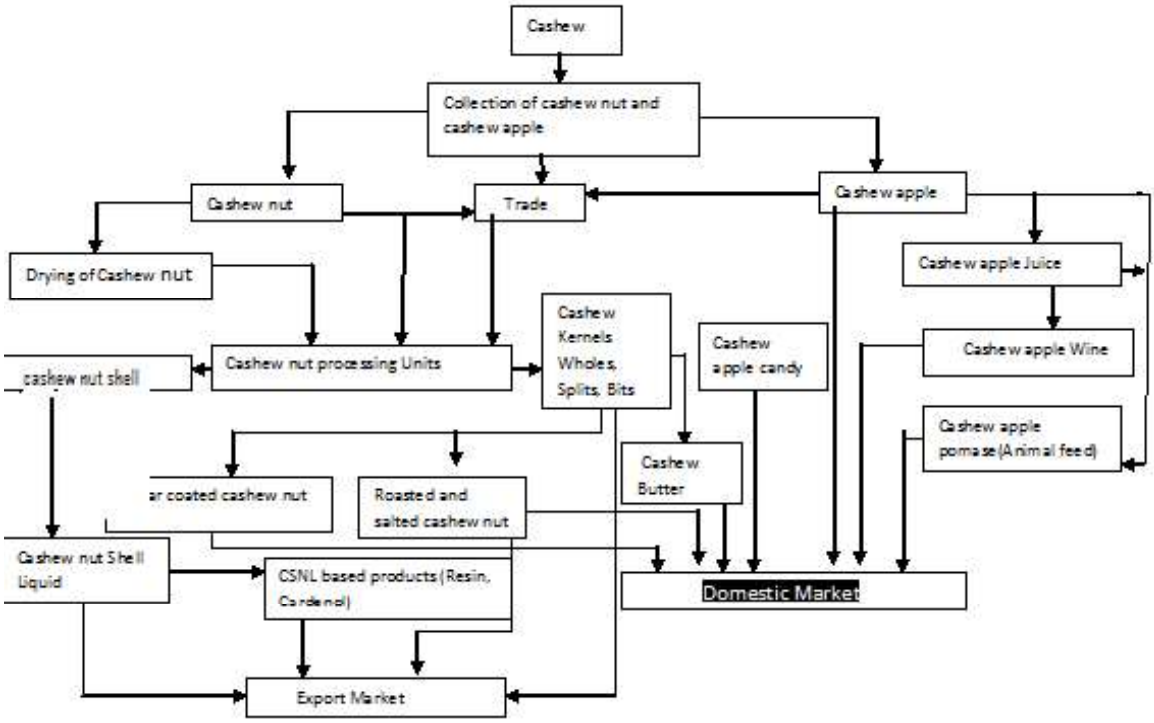

Figure 5: Cashew Value Chain
Source: Carr, 2001

3.5 Rice Value Chain

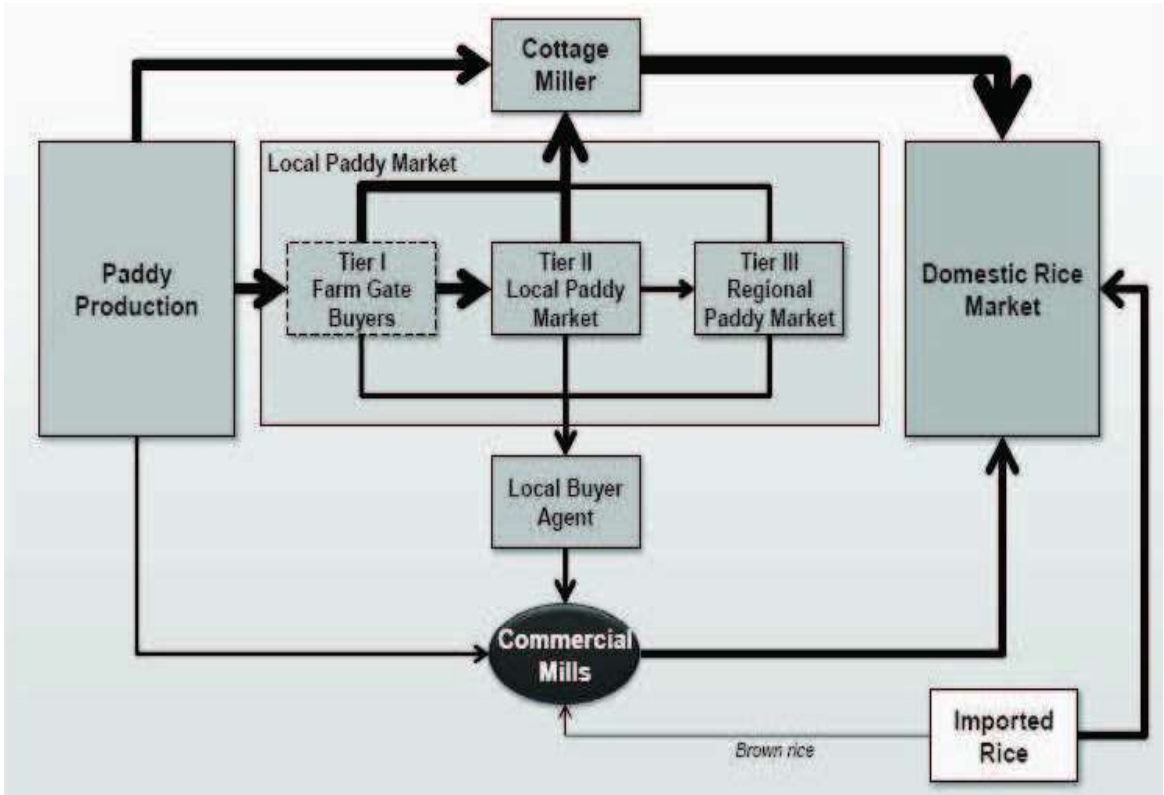

Figure 6: Rice value chain
Source: USAID, 2009

Rice is a major staple food and the fourth major cereal in Nigeria after sorghum, millet and maize. The demand for rice has assumed consistent rise in the last three decades. Rice importation consumes about the largest chunk of Nigeria's foreign exchange (Onwualu, 2012a). Rice value chain is shown in Figure 6. Value chain actors include farm input suppliers, farmers, threshers, transporters, millers, polishers and marketers. Farmers could be regarded as the most important actors in the value chain because they produce the cereal, handle both threshing and drying before other actors come into play.

3.6 Shea Nut Value Chain

Rural women are at the bottom of the Shea value chain with end points in multi-national food companies and the local domestic market (Fig. 7). Major actors in the value chain include shea nut collectors, local butter processors, local nut traders/bulkers, butter exporting companies, butter processing factories, industries that engage in cosmetics manufacturing and confectioneries.

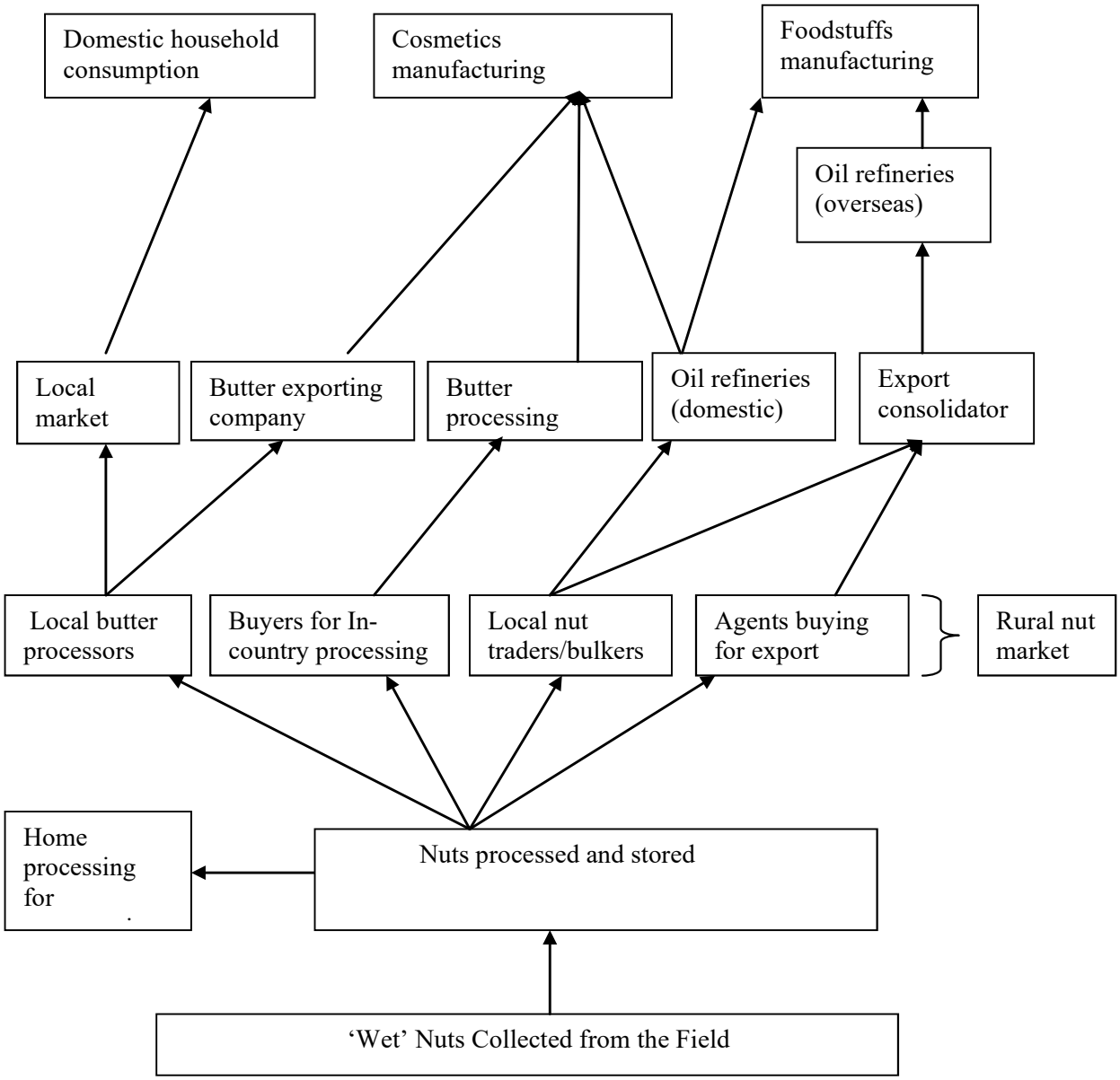

Figure 7: Shea value chain
Source: Kent and Bakaweri, 2010

Shea nuts are picked and processed mainly by the rural women. The nuts are also sold in the local market where they are bought by a range of actors including local butter processors, local nut traders and nut exporters. There are no Shea butter extraction facilities and Shea butter oil refineries in Nigeria. All processing are done by the rural people using traditional methods (Olife, et al, 2013).

3.7 Tomato Value Chain

Nigeria produces large quantities of tomato annually, especially in the Northern part of the country. There are estimations that about 30% of total tomatoes produced in Nigeria annually are wasted because of lack of processing facilities and preservation mechanisms (UNIDO, CBN, BOI, 2010). Tomato value chain is shown in figure 8. Major actors in the value chain include input suppliers (fertilizer, seeds, pesticides, irrigation systems, etc), producers (farmers), traders, processors and industries that engage in the production of tomato pastes and purees. Other participants in the chain include transporters, suppliers of processing and packaging equipment. There is high demand for processed tomato products in the country. Presently, there are too many imported brands of tomato pastes and purees in Nigerian markets.

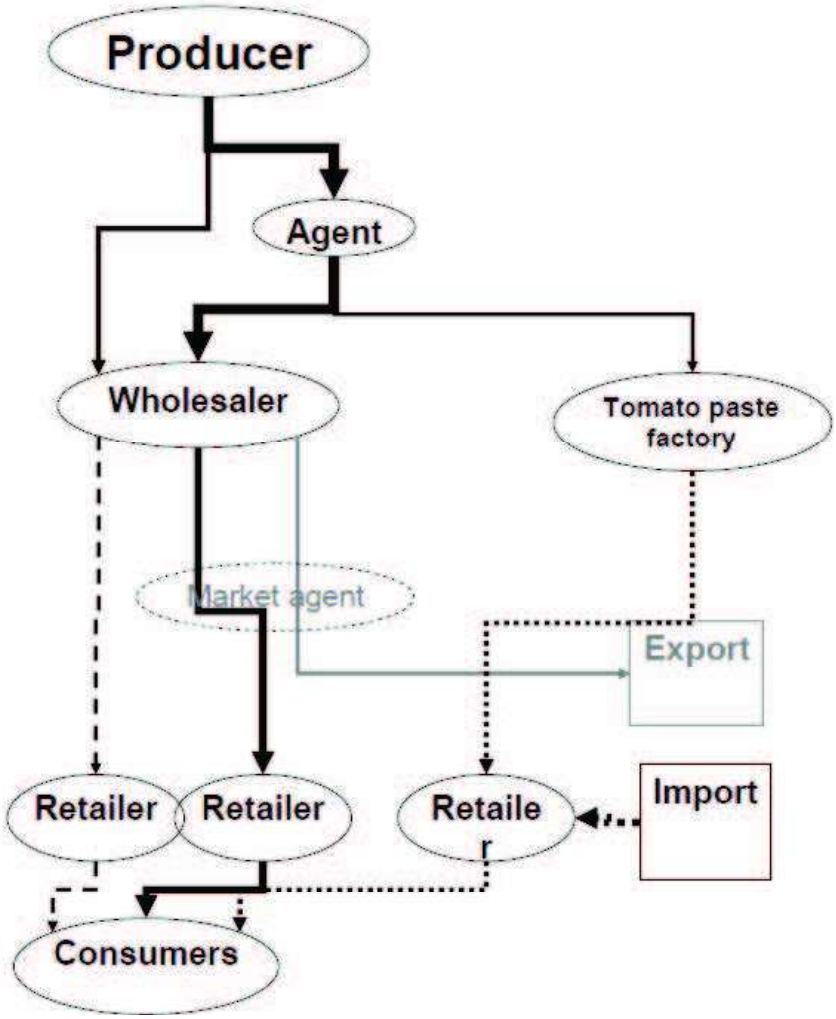

Figure 8. Tomato value chain in Nigeria
Source: UNIDO, CBN, BOI, 2010

3.8 Cocoa Value Chain

Nigeria is the fifth largest producer of cocoa beans in the world, behind Côte d'Ivoire, Ghana, Indonesia and Cameroon. After petroleum, cocoa is the country's most important export – before independence,

cocoa generated 90% of Nigeria's foreign exchange earnings. Nigeria produces 300'000-350'000 tonnes of cocoa annually (www.agriexchange.apeda.gov.in). The production quantity demands effective cocoa processing factories or value addition, employment generation and foreign exchange earnings. Cocoa value chain is shown in figure 9. Major actors in the value chain include input suppliers (seeds, fertilizer, pesticides, etc), producers (small and large scale farmers), bulk traders, local processors, exporters of cocoa beans, manufacturing industries that engage in the production of chocolate/confectioneries, cosmetics, etc. Other players in the chain include transporters (truck and ship) and warehouse operators.

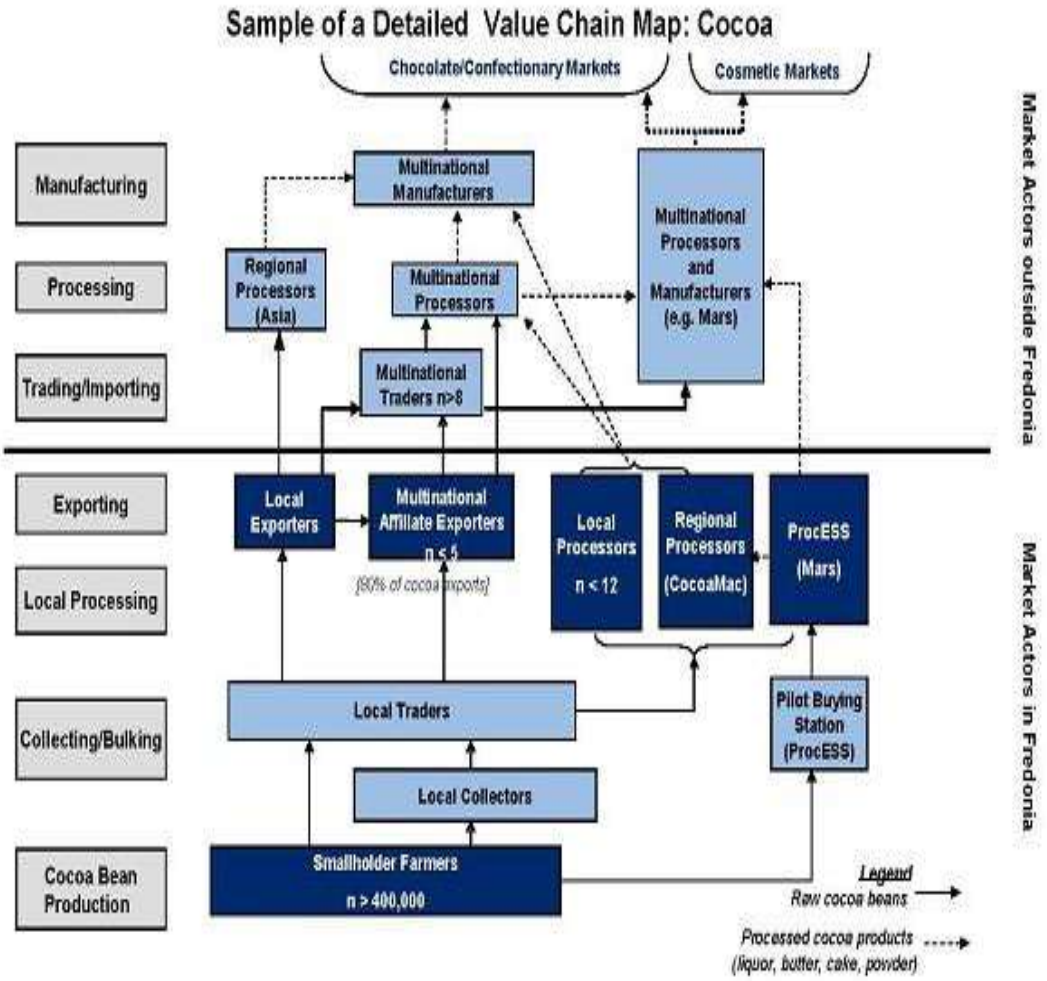

Figure 9. Cocoa value chain
Source: www.microlinks.kdid.org

3.9 Poultry Value Chain

Major actors in the poultry value chain are the poultry feed industry, producers of day old chicks, commercial farms, backyard producers/ traditional free range, egg producers, meat producers, and organic manure producers. The poultry value chain in Nigeria is shown in figure 10.

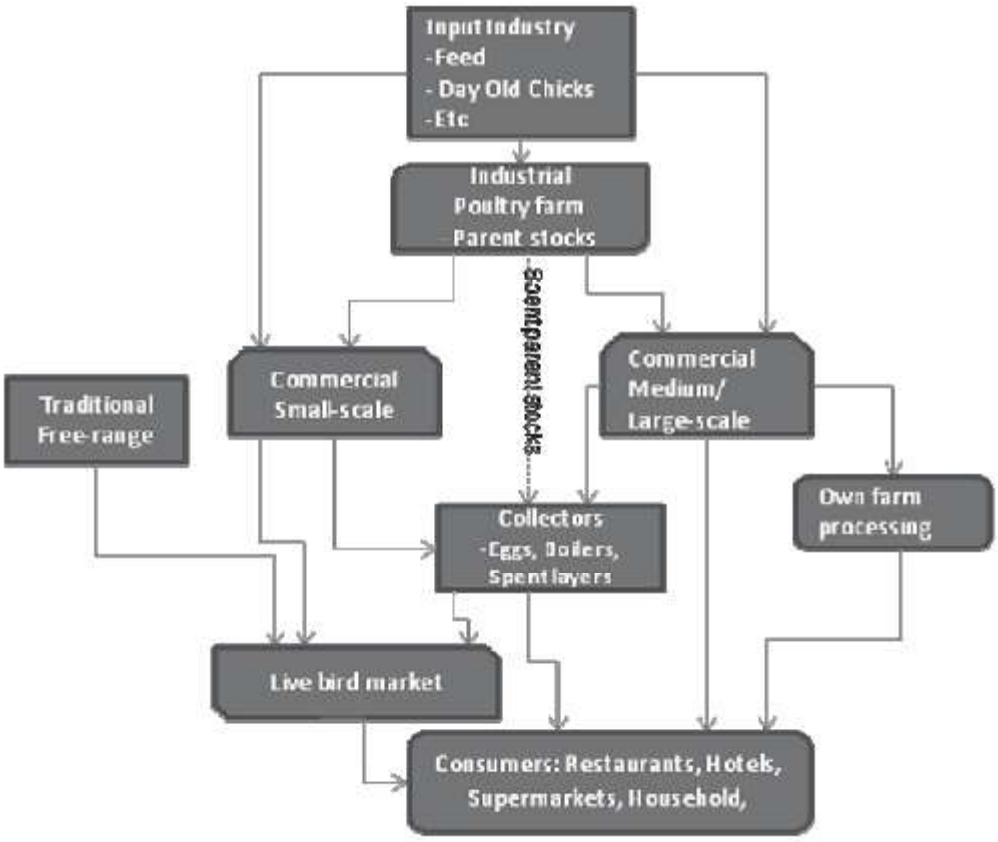

Figure 10. Mapping of poultry value chain in Nigeria
Source: UNIDO, CBN, BOI, 2010

3.10 Value chain for other Agricultural Products

Every agricultural product has a value chain. The challenge Nigeria has currently is that the machinery building industry in the country is too weak to provide the needed machinery to develop the value chains. As noted earlier, this challenge should be converted to opportunities for agricultural engineers.

4. AGRICULTURAL MACHINERY REQUIREMENTS OF VALUE CHAIN DEVELOPMENT

4.1 Machinery Requirement

In modern crop production, machines are used for different operations, from land clearing to harvesting. There are different techniques and machines used for different operations such as land clearing, tillage, planting, fertilizer application, spraying, weeding, harvesting, processing and packaging. The benefits of agricultural mechanization include: extension of the cultivated areas made possible by the capacity to do more work in the time available, precision of operations, improvement of the working environment, reduction of drudgery of farm work, improved dignity of farm worker and increased agro-business activity (Anazodo, et al., 1986).

In Nigeria, equipment manufacturers have exhibited tremendous capability not only for the manufacture of machinery/equipment locally, but also for the replication of the imported ones. However, most manufacturing is concentrated on a few simple machinery such as planters, ploughs, harvesters, silos, mills/grinding machine, manually operated press, crackers for palm kernels, grater/gari fryer, etc. Even at that production is only by fabrication of small units and not manufacture of large numbers (Onwualu, 2010c).

To achieve agricultural transformation in Nigeria, the government has to partner with the private sector through a Public-Private Partnership (PPP). Existing and new private sector operators should be identified to provide farm machinery leasing, hiring and rentals to farmers. Also, agricultural extension services should be revitalized and modernized to empower farmers on the adoption and application of research results, technologies and techniques for agricultural production. It is important that government should enhance and empower institutions like National Centre for Agricultural Mechanization (NCAM).

The transformation action plan is focused on key aspects of value chain. They include the provision and availability of improved inputs (seeds and fertilizer), increased productivity and production, as well as the establishment of staple crop processing zones. The transformation agenda will be achieved through the promotion of agricultural mechanization through the use of farm machinery, implements and processing machines for the production of crops, livestock and fish. Mechanization reduces drudgery, creates small effective workforce, leads to food security, and helps to produce surplus that can be used for industrial raw materials and enhance farmers income.

Agricultural machinery required for the transformation agenda include engine powered machines such as tractors that can be used with implements (disc ploughs, mould board ploughs, harrows, seed drills, row crop planters, grain pickers, mowers, combine harvesters), and trailers/trucks for transportation. Others include post harvest handling and processing machines (threshers, cleaners, shellers, hullers and polishers, mills, graters, dehuskers, bailers and dryers), crop storage equipment (silos, conveyors, unloaders, coldrooms, electric motors), water supply and irrigation equipment (water pumps, sprinklers etc).

Every component of the value chain for agricultural production shown earlier requires one machine or the other. Table 2 is a listing of the various machines required to mechanize the value chain for different agricultural production processes. Nigeria being a large country, each of these machines is required in their thousands at affordable prices.

Table 2. Machines required for agricultural value chain

SN	Component of value chain	Machinery required	Status
1	Input suppliers and producers	Growth chambers, nurseries, production factory machines, handling equipment	Mostly imported
2	Growers/producers	Land clearing equipment, tractors, planter, ploughs, weeders, fertilizer spreaders, harvesters, irrigation pumps	Mostly imported
3	Transporters	Trucks, tricycles, forklift, motorcycles	Mostly imported
4	Storage services	Silos, warehouses, conveyors, moisture meters, humidity and temperature control equipment	Mostly imported
5	Processing industries	Threshers, cleaners, digesters, sorters, graders, grinders, heating and cooling systems, graters, pressers, packaging machines, pumps, mills, extruders, crackers	Some imported
6	Wholesale/Retail industries	Packaging machines, warehouses, loading and offloading equipment, packaging boxes	Mostly imported
7	Machinery manufacturers/ fabricators	Drills, furnace, metal cutters, lathe machines, welding machines, foundries, machine parts	All imported
8	R&D institutions	Workshops, laboratories, with relevant equipment and facilities, ICT equipment	All imported

The agricultural sector in Nigeria cannot experience appreciable development without mechanization (Onwualu, 2009c; Onwualu and Obassi, E, 2013). Mechanization should be the vehicle for the agricultural transformation agenda of the government. The transformation agenda has received a boost with the decision of AGCO, one of the world's largest tractor manufacturers, to set up two tractor assembly plants in Rivers and Kaduna States (www.fmard.gov.ng). About 300,000 tractors would be required for the implementation of the agricultural transformation agenda.

4.2 Strategies for Providing the Machines

The process of mechanizing agriculture in Nigeria has been limited by the low levels and inadequate allocation of resources to agricultural development, science and technology. The factors that limit the development of agricultural mechanization in Nigeria include fragmented holdings, prevailing agronomic practices, inadequate repair and maintenance facilities, lack of trained machinery operators, poor credit facilities, inadequate research programmes, inadequate agricultural extension services, absence of incentives for indigenous design and manufacture of equipment and inadequate infrastructural facilities (Anazodo, et al., 1989; Onwualu, 2011). Other challenges include non availability of fund, lack of workshop/factory machinery and spare-parts, non-availability of raw materials and ancillary products required for fabrication and lack of manpower required for machine design and fabrication. While there is poor upgrading of existing skills, the private sector and specifically the steel and machine tool industries are not vibrant enough to absorb the few qualified graduates of technical disciplines.

The primary goals of agricultural mechanization are: to increase labour productivity, to increase land productivity and to decrease the cost of production. However, for mechanization to be achieved, there is need to consider the following points: (i) agricultural mechanization policy should be an integral part of the general economic development policy of the country; (ii) existing technology should be adapted for the production of various crops; (iii) home grown power units, machines and processes suitable for the country's cropping environment should developed; (iv) emphasis should be more on the encouragement of indigenous development of machinery rather than importation; (v) rural infrastructural (electrification, irrigation and drainage) development should be intensified; and (vi) in service training programmes for the development and improvement of the technical competence of agricultural engineers and technologists should be promoted.
In order to remove these challenges and ensure that machines are available for the transformation agenda we propose the following strategy:

i. Systematic upgrading of local or traditional systems of machinery production. These include a systematic study of blacksmithing technology all over the country and upgrading the facilities used by the blacksmiths as well as improving their skills. It is common knowledge that these blacksmiths produce most of the farm tools in use in Nigeria. With a little upgrading, such enterprises can produce other simple machines. This is the time to reactivate and expand the Federal Department of Agriculture Blacksmith Programme based in Ilorin.
ii. Massive importation of agricultural machinery, from those for primary production to those for processing, transportation and preservation. This can be done through a network of importers and distributors that can be supported to sell the machines under special schemes (hire purchase, machinery loan scheme, machinery leasing, etc). These have to be supported by a network of demonstration, training and maintenance centre all over the country.
iii. Commercialization of Prototypes of Machines: In many of the higher institutions in Nigeria (Universities, Polytechnics and Research Institutes) many agricultural machines prototypes have been developed. A special scheme should be instituted to identify the viable ones and empower machine producers to manufacture as many of them as possible. This can be distributed through any of the schemes mentioned above.
iv. Empowerment of local Fabricators: There are a number of good local machinery fabricators but they are handicapped by low demand and poor equipment. One way to empower these set of

manufacturers is to engage them in fabricating large quantities of some of the machines required. This will enable them to expand and hence improve their operations.

v. Reverse Engineering: A special scheme aimed at using reverse engineering to produce some of the imported machines should be established.

5. POLICY IMPLICATIONS AND CONCLUSIONS

The current situation in Nigeria is that the operators of the various components of value chain operate without machines, making their operations to be uncompetitive, leading to weak links in the chain. The approach being used currently is to import most of the machines. But this approach is not sustainable in a country with high unemployment rate. Thus, it is important that even as imported machines are used, a robust machinery building programme should be pursued locally (Onwualu, 2011; Onwualu, 2012a; Onwualu, 2012b; Onwualu and Obasi, 2013; Ajoku and Onwualu, 2012). This will include:

i. Increased patronage of local fabricators of agricultural machinery by government and its agencies.
ii. Establishment of a sustainable loans scheme for farmers, fabricators, processors, marketers and all components of agricultural value chain towards the purchase of relevant needed machines.
iii. Upgrading of workshops and factories of R&D institutions involved in developing local technologies including NCAM, NASENI, RMRDC, FIIRO, and other Agricultural Research Institutes in Nigeria.
iv. Establishment of appropriate standards for machinery including imported and local ones.
v. Encouragement of the development of clusters of processors and specialized markets for products of the clusters. This is where the current Ward Based Cluster Programme of the Federal Ministry of Science and Technology is very relevant (Onwualu and Obasi, 2008).
vi. Agricultural Engineers should take up the challenge of local design, fabrication and manufacture of needed agricultural machines, with support from government.
vii. Establishment of machinery hire and leasing services to provide services to the various components of the value chain by Agricultural Engineers with support from development banks such as Bank of Agriculture (BOA), Bank of Industry (BOI) and Nigerian Export Import Bank (NEXIM).

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