EFFECTIVE AGRO-LOGISTICS: PATHWAY TO REDUCE POST HARVEST LOSSES AND IMPROVE HOUSEHOLD AND NATIONAL FOOD SECURITY IN NIGERIA

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ABSTRACT
Preservation of agricultural products has remained a serious challenge over the years, resulting in huge post-harvest losses annually. This position paper, examined various challenges associated with post-harvest losses, factors that contribute to post-harvest losses and its consequences on household and national food security. Using literature and pictures from authors' studies, this paper also identified agro-logistics bottlenecks and different stages at which losses are incurred along agricultural value chain. Lack of storage facilities (especially modern facilities), financial incapability, lack of access to modern drying technology, poor post-harvest handling across the value chain were among the factors that contribute to post-harvest losses. Poor post-harvest logistics and bad road networks most especially in rural areas also contribute to losses of food in the supply chain. Consequently, actors at different stages of agricultural value chain have a share of the losses. As concerted efforts are being directed at increasing food production in the country, adequate attention should be given to effective agro-logistics in the agricultural value chain as well. This will not only ensure getting agricultural products to the right market or consumers, at the right time, in the required quality or specifications, but also, reduce costs along the value chain and increase the revenue of actors in food supply chain, thereby contributing to sustainable food security at household and national levels in the country.
Keywords: Agro-Logistics, Post-Harvest losses, Pathway, Challenges, and Food security.

INTRODUCTION

Nigeria agricultural growth and competitiveness over the years has experienced various institutional and structural bottlenecks. This include poor infrastructure such as roads and electricity supplies, lack of inputs, lack of technical expertise, and inadequate policies and weak institutional support (Guritno, 2017). In the same vein, Bartecchi, (2011) stated that the low standard of living in rural communities depends not only upon the range of foods grown, the capacity to grow in quantity, but also upon the facilities for efficient handling, drying, storage and marketing of farm produce. Consequently, enormous quantities of agricultural produce especially in food supply are lost annually (FAO, 2011) at different stages of post-harvest handling. A major drain on food production and food security in Sub-Sahara Africa is post-harvest losses that occurred at different levels and stages of the value chain (Obayelu, 2014). In addition to the food losses, massive losses are also recorded in terms of wasted arable land and water resources, labour, fertiliser and other inputs as well as money that went into food production (Chen *et al.*, 2018; Kitinoja 2011; FAO, 2013).

Post-harvest loss which was defined as the degradation in both quantity and quality of a food production from harvest to consumption (Kiaya, 2014) has become a major obstacle in achieving sustainable food supply in Nigeria resulting in high cost across food supply chain and inaccessibility of average households to adequate quality and enough dietary intake. Lack of access to require quality and quantity household food supply leading to food insecurity is not just about insufficient food production, availability and intake, but also as a result of post-harvest, losses which cut across the entire food supply system (Obayelu, 2014; Kumar and Kalita, (2017; Aulakh and Regme. 2013). Food loss occurs during the stages in the post-harvest operations which include harvesting, transportation, drying, storage, processing, sales, and consumption (Atanda *et al.* 2011; Wu *et al.*, 2017).

Indirectly, post harvest losses can lead to reduction in employment opportunities within post harvest value chain and as well in the capital available for stakeholders to either expand their business activities in the value chain or invest in other business enterprises as a way of diversifying their livelihood activities. Studies revealed that as critical as the issue of post harvest losses is, enough attention has not been given to food losses that occur during post-harvest handling especially in developing economies as compared to the attention and concerted efforts directed at production (FAO 2011; Affognon *et al.* 2015; Adebayo *et al.* 2017). World Bank (2011) opine that persistent huge post-harvest losses are symptoms of poorly performing value chains, and it contributes to high food prices, have impact on environmental and climate change. Meanwhile, reduction of just one percent in post-harvest losses can lead to a gain of million US Dollars annually (World Bank, 2011; Kitinoja, *et al*., 2011; Mada, *et al.* 2014), with producers as key beneficiaries of the accrued gain (World Bank 2011). Provision of necessary post-harvest logistics across the value chain with appropriate complimentary infrastructures/facilities, could be a pathway to considerable reduction in food losses and increase in the income levels of actors across agricultural value chain.

Agro-logistics which is a sub-discipline of the general logistics sector is a concept that has been developed and put into use in some countries such as Netherlands, South Africa, Thailand and China, to bridge the gap between food production and consumption by which considerable losses are being recorded annually. In modern agricultural sector development, implementation of functional logistics in food supply chain is imperative, considering the increasing demand and competitiveness of agricultural food products in the world market. This study therefore, assessed agro-logistics bottlenecks in post-harvest value chain and the importance of effective agro-logistic system to improving household and national food security in Nigeria. Also, factors and challenges that contribute to post-harvest losses at different stages of agricultural value chain and its consequences on household and national food security were discussed, in a view to identify appropriate agro-logistic system to address challenges and ensure food security at household and national levels.

Factors and challenges of post-harvest losses

In the wake of Nigeria growing population, ensuring household and national food security in a sustainable manner has become a serious developmental challenge that calls for concerted efforts of respective organisations. Food losses in post-harvest handling have been detrimental to achieving the expected increase in food supply. A significant amount of produce is lost in post-harvest operations due to many factors including; inadequate technology, lack of adequate knowledge in post-harvest handling, bad road network lack of storage system, and poor rural infrastructures. Other factors include improper financial management and technical limitation in harvesting and processing techniques. The effect of post-harvest losses is not limited to mere reduction in food available for household consumption, but also result in other negative consequences to the society in terms of waste management, greenhouse gas emission and loss of scarce resources invested in the production (Aulakh, *et al*. 2013; FAO, 2011).

In Nigeria, losses in post-harvest chain result in high cost of food prices, reduction in income of stakeholders in the value chain especially the farmers and profitability of harvested produce (Obayelu, 2014). While qualitative losses in terms of nutrient, caloric and edibility of food product is said to be common in developed countries (Kader, 2013), both qualitative and quantitative losses in respect of loss in the amount of food produce before consumption are common in Nigeria (Obayelu, 2014) and developing countries (FAO, 2013). In addition, inadequate market information and facilities contribute to high post-harvest losses in Nigeria. Food loss cut across all agricultural production value chain, though the losses varies from commodity to commodity, season to season and by other circumstances in which food produce are harvested, transported, processed, stored and marketed (World Bank, 2011).

Harvest and Transportation stages: Losses occur as a result of inappropriate method of harvest and/or use of harvesting tools, lack of appropriate technology and/or skill for harvesting particular crop. Also, timeliness in harvesting of food crops and bad weather such as heavy rain fall during the time of harvest could be a reason for incurring losses at this stage (Kiaya, 2014) and delay in moving produce from the point of production to either market or processing centre could result in losses. Plate 1 for example, shows that bad road is one of the major factors causing delay in moving agricultural produce from farm to market.

Plate 1: Bad road network at Ijaye in Oyo state, Nigeria; a challenge to transportation of farm produce, which could result in post harvest losses.
Source: Oyegbile (2019)

Agricultural products are highly perishable, thus delay in conveying harvested crops to the point of sale or consumption will result in losses. Delay in transportation of harvested produce could be as a result of unavailability of vehicle at appropriate times, damage to vehicle due to bad roads or lack of financial capability of producers to hire vehicle as at when needed and inappropriate means of transportation, (see Plate 2 for example).

As stated by Kiaya (2014), in most developing countries, transport vehicles and other modes of transport, especially those suitable for perishable crops, are not widely available, while appropriate transport systems and refrigerated transport are lacking. Lack of appropriate harvesting containers (Dandago, *et al.* (2016) and handling during the process of harvesting also contribute to losses at the harvesting stage.

Plate 2: Means of transportation of farm produce at Buruku LGA Benue State.
Source: Oyegbile (2016)

Processing and Storage stage: Poor processing systems, technologies, skill/knowledge as well as traditional processing and marketing practices can be responsible for high losses (Atanda, *et al.*, 2011; Kiaya, 2014). Losses are recorded at both primary and secondary processing activities, which mostly involved the use of traditional practices and tools rather than improved technologies that could enhance efficiency and effectiveness in the processing of agricultural produce. For example the use of traditional tools such as knife as shown on Plate 3, could reduce the quantity and perhaps the quality of cassava processing in a given period of time.

Also, lack of appropriate means of drying agricultural produce contribute to qualitative and quantitative losses as shown on Plates 4, 5 and 6.

Storage system of agricultural food produce in Nigeria market has become problematic in the sense that not many purpose-built agricultural food storage facilities are available.

Plate 3: Use of traditional tools for peeling cassava at Osanetu, Iseyin, Oyo State.
Source: Oyegbile (2019)

Plate 4: Yam flour being dried on bare ground at Aba Oba village, Iseyin Oyo State, Nigeria. This could lead to quality and quantity losses
Source: Oyegbile (2019)

Plate 5: Cassava flour spread by the roadside along Ibadan - Eruwa road, Oyo State Nigeria; Qualitative and quantitative losses
Source: Oyegbile (2018)

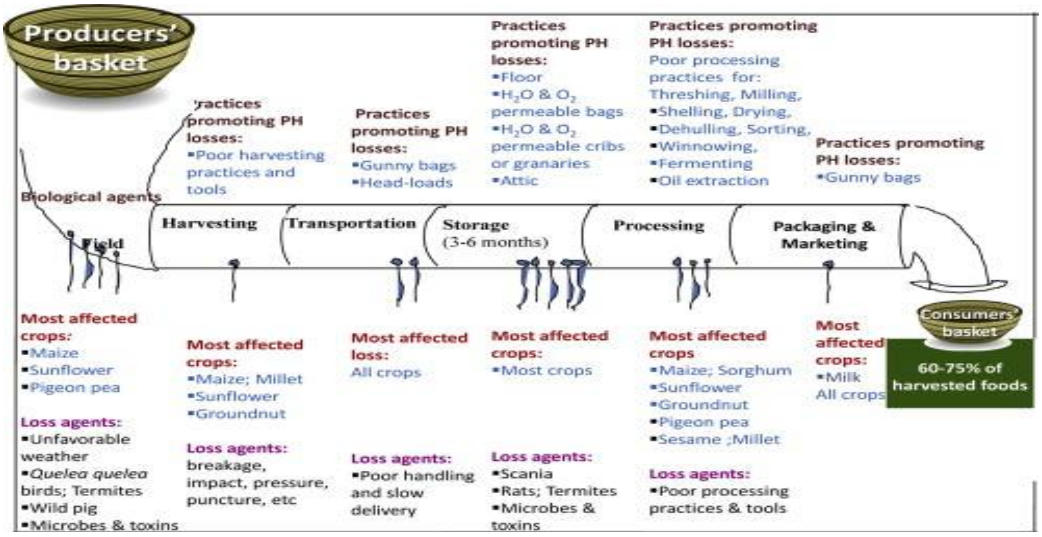
Plate 6: Drying of cassava flour by the roadside at Ido LGA Oyo State, Nigeria.
Source: Oyegbile (2018)

High technology based processing practices such as canning and freezing require a high capital, high energy costs and expensive packaging (Atanda, *et al*., 2011) that are not readily available. In other words, technical limitations in processing techniques contribute to post harvest losses. For instance, Plate 7 shows local means of rice processing which invariably result in poor quality of the processed rice, and loss of reasonable quantity of the rice being processed.

Virtually, in all farm produce collection points across the country, referring to local markets in rural areas where agricultural food produce from different farms and settlements are assembled for marketing and/or processing, also known as farmers market, good storage facilities are either completely lacking or the available ones are in poor condition.

Plate 7: Local rice processing centre at Shabaoshi Katcha LGA, Niger state Nigeria
Source: Authors File (2017)

The figure below shows stages of post-harvest value chain and losses that occur at each of the stages. Agro-logistics is needed along the value chain to reduce losses often recorded in the process of adding value to agricultural produce.



Adapted from; Adebayo Abass *et al* (2014)

Agro-logistics concept and bottlenecks to reducing postharvest losses

In general terms, logistics has been considered an issue deserving modest priority in nations' economy. According to Lukinykh and Lukinykh, (2016) effective logistics system is a significant competitive advantage in the marketing world. In a publication by the Department of Agriculture, Republic of South Africa in 2006 on the status of agro-logistics in the country, it was expressed that logistics is a part of the supply chain process which deals with the transportation, warehousing, as well as inventory administration and management of physical products between the point of production and delivery to the final consumer. In the same vein, Slavkova and Solovey, (2016) stated that logistics is a tool for the rational utilisation of resources, reduction of time expenditures and financial resources on the way of bringing products to consumers. In a World Bank position note on agro-logistics, Vorst van der and Snels, (2014) stated that, as part of supply chain, logistic management plans, implements and controls the effectiveness and efficiency of forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption so as to meet the requirement of customers. Relating this to agro-logistics, Wang (2012) states that agricultural products logistics is a branch of the logistics industry which refers to flows of physical entities and related information from producer to consumer that satisfy consumer's demand, including agricultural production, acquisition, transportation, storage, loading and unloading, handling, packaging, processing, distribution, and information activities.

According to Kramar *et al.* (2014) objectives of agricultural products logistics are to increase value-addition of agricultural products, save distribution costs, improve circulation efficiency and reduce unnecessary losses, as well as avoid market risks. Xu (2011) defined agro-logistic as an integrated industrial activity of integrated operation and management relying on advanced computer networks and information technology, integrating the use of modern transport and storage facilities, through a large number of business information instructions, engaged in agricultural transportation, storage, processing, handling, packaging and processing, distribution and information processing. From the definition, it can be inferred that optimizing the distribution channels of agricultural products, reducing operating costs of agriculture-related enterprises as well as providing faster and better service to consumers of agricultural products are the aims of integrating logistics system into agricultural food supply chain (Kramar, *et al.* 2014).

Taking agricultural products as the core, Li *et al*. (2013) stated that agricultural products logistics refers to the organic combination of the entity flowing from producer to receiver and the involving technology, organisation, management and other basic functions. According to Li, *et al.* (2013), agricultural products logistics consists of a series of links, including agricultural production, purchase, transport, storage, loading and unloading, handling, packaging, distribution, circulation processing and, information activities, while realizing agricultural product appreciation and organisation objectives in the process.

Analysing the underlying principle critically, it implies that if the entities comprised in agro-logistics system is provided, and efficiently managed, the system could be seen as a value-adding process that can directly address the problem of losses in food supply across post-harvest value chain. It will significantly enhance the competitiveness of food supply chain in terms of related services, information requirements, profitability (as it accrued to producers) and adherent to rules and regulations concerning quality food supply across Nigeria in particular and the global community at large. Logistics in agricultural value chain allows for flexibility in responding to market demands (Lukinykh and Lukinykh, 2016) and covers all activities that are required to convey agricultural produce from farm where it is being produced to market and/or final consumers. The need to improve the competitiveness of agricultural food sector by developing strategies that will lead to massive investment in logistic systems to efficiently support agricultural sector is imperative. This will create an opportunity for the sector to establish a logistic strategy will ensure that unique demands for global food supply are met in a sustainable manner.

According to Shufeng *et al.* (2010) modern agro-logistics should consist of 12 functional elements of procurement, supply, storage, transportation, loading and unloading, sorting, packaging, distribution, distribution processing, marketing, recycling, and information control. As suggested by Shufeng, *et al*. (2010) responsibility of modern agro-logistics system management should not only be directed at solving the problem of high cost of logistics process in agricultural sector and reducing losses in the post-harvest chain, but also to find sustainable ways through research to promote the functional elements of the system to comprehensively play the integrated effects in lowering production cost, raising economic benefits for agriculture, raising the income of peasant producers and pushing forward modern agricultural economic development.

The fundamental principle of agro-logistics system according to Vorst van der and

Snels, (2014) is to ensure that the right agro-product gets to the right place, at the right time in the right specification; in quality and quantity at the lowest cost. Meanwhile, bottlenecks in agro-logistics contribute to rural poverty and food wastage (Vorst van der and Snels, 2014), resulting in threat to household and national food security. The bottlenecks are caused by lack of required entities to carry out the aforementioned functional elements of agro-logistics. In addition, lack of adequate knowledge and skill in modern technologies for value-adding logistics process and services by larger proportion of Nigerian farmers especially the peasant farmers also constitute bottleneck in agro-logistics. Modern advanced technologies for post-harvest value chain practices are either not available in Nigeria or out of the reach of majority of actors in the food supply chain. Another agro-logistic bottleneck is information constraint in terms of insufficient access to and/or use of ICT that are necessary to easily access related information in the global food supply chain to meet up with the competitiveness and profitability of agricultural produce.

As concerted efforts are being directed at increasing food production in the country, adequate attention should as well be given to effective agro-logistics in the agricultural value chain. This will not only ensure getting agricultural products to the right market or consumers, at the right time, in the required quality or specifications, but also, reduce costs along the value chain and increase the revenue of actors in food supply chain, thereby contributing to sustainable food security at household and national levels.

CONCLUSION AND RECOMMENDATIONS

This paper revealed that agro-logistic limitations in post-harvest value chain has limited agricultural sector in achieving its full potentials in Nigeria, despite the efforts and resources invested in the sector. Agro-logistic limitations have contributed to post harvest losses in the country. Consequently, exploring profitability and entering into the global competitive market in food supply has becomes very difficult milestone to attain. Losses are incurred at every stage of post-harvest handling; harvesting, processing, storage, transportation and marketing. Apparently, there have been reductions in the quality and quantity of food supply that get to the final consumer. A continuous, interlinked chain in logistics practices that will cut across all the components of food supply value chain is of great importance. Rural enterprises which play a significant role in household and national food supply should have sufficient access to the mainstream of logistics system that will ensure timeliness in agricultural value chain processes, with marginal loss of food in the process. Therefore, it is recommended that actors in food supply chain should be armed with knowledge and skill of sustainable techniques at each stage of the post harvest value chain, while effective agro-logistic practices should be ensured through the provision of the entities in logistic system. Also, agro-logistic hubs with well equipped modern technologies and other complimentary infrastructures should be established at strategic agricultural produce collection points i.e. rural 'farmers' markets' across the country. This will invariably reduce food loss along the value chain; enable the country to meet up with the global competitive trend in food supply demands and the profitability potentials of agricultural food production sector while the actors within the value chain make reasonable profit from their respective activities within the chain.

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