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STRATEGIES TO REDUCING POST HARVEST LOSSES OF PERISHABLE CROPS: A WAY OF ENSURING FOOD SECURITY IN NIGERIA.

A.R. LAWAL, B.U. OLAYINKA, L. B. ABDULRA'UF & E.O. ETEJERE

Abstract

Nigeria is a country rich in a great supply of agricultural products, but post-harvest losses is a great concern. Majority of our farm produce are lost due to lack of proper post-harvest process and storage. By 2050, the world's population is expected to reach 10.5 Billion, 33% higher than what it is today. This increase is further adding to global food security concerns and will lead to increase in the demand for food. Availability and accessibility of food have therefore become critical issues confronting government and scientists. Reduction in food losses would increase amount of food available for human consumption and enhance food security. Thus, reduction of post-harvest food losses is a critical component of ensuring future global food security. The objective of this paper review is to provide background information on post harvest food losses. It highlights some concepts and problems of post harvest losses in perishable crops and critical factors governing them. The paper identifies and synthesizes some strategies and ways of preventing or reducing these losses as well as roles of government and individuals in combating these problems.

Keywords: *Postharvest loss, Strategies, Perishable crops, Food security*

Introduction

One of the main global challenges is how to ensure food security for a fast growing world population which is expected to hit about 10.5 billion by 2050. According to Alexandratos and Bruinama (2012), food production would need to grow by 60% (estimated at 2005 food production levels) so as to match the expected food demand in 2050. In order to ensure food availability and accessibility, there is need to increase food production, coupled with improved distribution and storage in addition to reducing the losses. In other words, reduction of post-harvest food losses is a critical prerequisite for ensuring future global food security.

With the proportion of global food unsecured population that keeps unacceptably rising annually (FAO, 2012; IFAD, 2012; WFP, 2012), associated with massive quantities of food being wasted owing to spoilage and infestations during transit to final consumers (FAO, 2002; 2012; Stuart, 2009). Minimizing if not outright eradication of these losses would be required to enhance food availability for human consumption. Consequently, this will ensure global food security which is a growing concern with rising food prices, due to increased consumer demand not merely for ingestion but also for biofuel and other industrial uses in addition to increasing weather variability (Mundial, 2008; Trostle, 2010). Food losses do not merely reduce food availability for human consumption but also cause negative impact on the society through costs required to manage the resulting wastes, greenhouse gas production and loss of scarce resources used in their production (Aulakh and Regmi, 2013; Aulakh, *et al.*, 2013). Food losses is estimated to account for about 6–10 percent of human-generated greenhouse gas emission (Gustavsson, *et al.*, 2011; Vermeulen, *et al.*, 2012). This is due to methane gas emitted from the landfills where such food waste decomposes anaerobically (Buzhy and Hyman, 2012).

Most published studies on post-harvest technology so far are predominantly on grains and other durable products (Basavaraja, *et al.*, 2007; World Bank, 2011; Abass, *et al.*, 2014;

Taiwo and Bart-Plange, 2016; Kumar and Kalita, 2017) which are stored dry but less work are reported on perishable food crops which are of great importance in many humid and sub-humid tropics and contribute to the stable carbohydrate portion of the diets of about 700 million people in the developing countries (Atanda, *et al.*, 2011). In perishable crop production, much attention is given to increasing production by research on breeding, improved varieties, optimizing fertilizer etc. However, much of the researches and energy devoted to production and marketing of these crops will be of little value if provision is not made for proper handling to stem postharvest losses.

Given the paramount role food loss reduction could have towards achieving and sustaining global food security, it is therefore important to have reliable measures of cubing these losses. Nowadays, postharvest losses reduction is seen as an important component of the efforts of any government or agency to reduce food insecurity. Postharvest losses is increasingly recognized as part of an integrated approach to realizing agricultural full potential to meet the world's increasing food and energy needs (Victor, 2014). Therefore, reducing postharvest losses along with making more effective use of today's crops will improve productivity on existing farmland and will help to contribute to food security and economic development of the country's population.

This paper highlights some concepts and problems of postharvest losses of perishable crops, the causes of loss along the entire food chain and possible ways of preventing these losses.

The Concepts of Post-Harvest

Postharvest loss can be defined as the degradation in quantity and quality of a food production along the supply chain, beginning from the time of harvest till its consumption or other end uses (Hodges *et al.*, 2011). Postharvest losses can either be a consequence of food waste or due to inadvertent losses along the way. Thus, food waste is the loss of edible food due to human action or inaction such as throwing away wasted products, not consuming available food before it is spoiled or taking serving sizes beyond one's ability to consume (Aulakh, *et al.*, 2013). Food loss on the other hand, is the inadvertent loss in food quantity because of infrastructure or management limitations of a given food value chain. This can either be the result of direct quantitative loss or arise indirectly due to qualitative loss. Food loss and food waste combine to contribute to post harvest food losses.

Food Losses

Food losses refer to the decrease in edible food mass (dry matter) or nutritional value (quality) of food that was originally intended for human consumption (Food and Agricultural Organization (FAO), 2013). Food losses take place at the production, postharvest and processing stages in the food supply chain (Parfitt, *et al.*, 2010). Food losses are mainly due to poor infrastructure and logistics, lack of technology, insufficient skills, knowledge and managing capacity of supply chain actors (Victor, 2014).

Food Waste

Food waste according to Buzby and Hyman (2012), occurs when an edible item goes unutilized as a result of human action and inaction such as keeping food beyond its expiry date, left to spoil or poor preservation methods. Food waste occurs at the food chain (retail and final consumption) and relates to retailers and consumers behavior (Parfitt, 2010).

Food Security

Food security is the availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and price. Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Programme, 1996).

Perishable Crop

Perishable crops are agricultural food produce which have short life-span and must be consumed or processed within a short time after harvest (Camille, 2014).

Importance of Perishable Crops

Horticultural crops are essential for a nutritionally balanced diet. Fruits and vegetables are the major sources of vitamins A and C, a good source of calcium and iron; and they supply part of the requirements for a number of other minor nutrients. In addition, horticultural crops add varieties, enjoyment and a sense of satisfaction to the diet because of their appealing colours, flavours and textures. For example, it has been said that although onions and garlic are not rich in nutrients, they make a vegetarian diet acceptable because of the savoury flavour they impart to the monotonous starchy diet in a developing country like Nigeria. On all of these counts- economics and nutrition acceptability, horticultural crops play a major role in developing countries. Consequently, justifying the advocacy that something should be done to reduce the high losses that presently associated with these highly valuable commodities (Food and Agricultural Organization, 2015).

Causes of Losses

The factors responsible for postharvest food losses can be broadly classified into two, internal factors and external factors. (Food and Agricultural Organization, 2015)

Internal factors

a. Microbiological

Micro-organisms (fungi and bacteria) usually directly consumes small amount of the food and in the process, causing destruction of the food crop to the extent that it becomes unacceptable because of rotting, malodorous or other defects (Victor, 2014). They also produce toxic substances which have been proven to be carcinogenic causing some food to be condemned and hence lost. An example, is a mycotoxin called aflatoxin produced by the mold *Aspergillus flavus* which has been proven to be a liver carcinogen (Atanda, *et al.*, 2011).

b. Chemical

Many of the chemical constituents naturally present in stored foods spontaneously react causing loss of colour, flavour, texture and nutritional value. There may also be accidental or deliberate contamination of food with harmful chemicals such as pesticides or obnoxious chemicals such as lubricating oil (Atanda, *et al.*, 2011).

c. Mechanical

Bruising, cutting excessive pooling or trimming of horticultural products are also possible causes of their loss (Kader, 2005)

d. Physical

Excessive or insufficient exposure of these crops to heat or cold is another factor that can spoilage. In line with this is adverse atmospheric condition such as in a closely confined storage may also result in destruction and hence losses (Food and Agricultural Organization, 2015).

e. **Physiological**

Natural respiratory losses which occur in all living organisms account for a significant level of weight loss as the process generates heat. Changes which occur during ripening, senescence, including wilting, and termination of dormancy (e.g., sprouting) may increase the susceptibility of the commodity to mechanical damage or infection by pathogens (Atanda, *et al.*, 2011). A reduction in nutritional level and consumer acceptance may also arise with these changes. Production of ethylene has been reported to result in premature ripening of certain crops.

External Factors

Factors outside of the food supply chain also cause significant postharvest loss. These factors can be grouped into two primary categories: environmental factors and socio-economic factors.

Environmental factors

Climatic conditions such as rainfall, temperature, wind and humidity influence both the quantity and quality of a harvest (Grolleaud, 2002).

a **Temperature**

Temperature is one of the factors that affect/influence postharvest losses. The higher the storage temperature the shorter the storage life of products and the greater the amount of loss within a given time, as most factors that destroy the produce or lower its quality occur at a faster rate as the temperature increases (Atanda *et al.*, 2011).

b **Humidity**

Fresh horticultural products have high moisture content and need to be stored under conditions of high relative humidity to prevent wilting (except for onions and garlic). Dried or dehydrated products need to be stored under conditions of low relative humidity in order to avoid adsorbing moisture to the point where mold growth occurs (Atanda, *et al.*, 2011). This is simply because there is movement of water vapour between stored food and its surrounding atmosphere until equilibrium of water activity in the food and the atmosphere is attained. A moist food will give up moisture to the air while a dry food will absorb moisture from the air.

c **Altitude**

Within a given latitude, the prevailing temperature is dependent upon the elevation when other factors are equal. There is on the average a drop in temperature of 6.5°C (Atanda, *et al.*, 2011) for each kilometre increase in elevation above sea level. Storing food at high altitudes will therefore tend to increase the storage life and decrease the losses in food provided it is kept out of direct rays of the sun.

d **Time**

Storage time is a critical factor in loss of foods especially for horticultural products with a short natural shelf life. The longer the time the food is stored the greater is the deterioration in quality and the greater is the chance of damage and loss (Atanda, *et al.*, 2011)

2.2.2 Socio-economic factors

The biological and environmental factors that contribute to postharvest losses are well understood and many technologies have been developed to reduce these losses, but they have not been implemented due to one or more of the following socioeconomic factors (Kader, 2005)

a. Urbanization

Social trend such as urbanization has driven more and more people from rural areas to large cities, resulting in a high demand for food products at urban centres, increasing the need for more efficient and extended food supply chains (Parfitt *et al.*, 2010).

b. Inadequate Marketing Systems

Growers can produce large quantities of good-quality fruits, ornamentals, and vegetables, but, if they do not have a dependable, fast, and efficient means of getting such commodities to the consumer, losses will be extensive. This problem exists in many locations within developing countries like Nigeria. This is due to lack of communication between producers and receivers and lack of market information (Bolarin and Bosa, 2015)

c. Inadequate Transportation Facilities.

Losses directly attributed to transport can be high, particularly in Nigeria. Damage occurs as a result of careless handling of packed produce during loading and unloading; vibration (shaking) of the vehicle, especially on bad roads. Overheating leads to decay and increases the rate of water loss which can result from using closed vehicles with no ventilation and using vehicles that provide no protection from the sun. Breakdowns of vehicles can be a significant cause of losses, as perishable produce can be left exposed to the sun for a day or more while repairs are carried out (Atanda, *et al.*, 2011).

d. Poor Maintenance and Storage handling Facilities

In Nigeria some good storage facilities that were built a few years ago are currently "out of order" or not functioning properly because of lack of maintenance (Bolarin and Bosa, 2015). This problem is especially true of public-sector facilities. Some fruits and vegetables are also susceptible to contaminants introduced after harvest by use of contaminated field boxes/baskets; dirty water used for washing produce before packing and unhealthy produce contaminating healthy produce in the same packages (Victor, 2014)

e. Lack of Information

The human element in postharvest handling of horticultural commodities is extremely important. Most handlers involved directly in harvesting, packaging, transporting and marketing in Nigeria have limited or no appreciation for the need for, or how, to maintain quality (Kader, 2005). An effective and far-reaching educational (extension) program on these aspects is needed critically now and will continue to be essential in the future.

f. Unavailability of Needed Tools and Equipment

Even if growers and handlers of fresh horticultural crops were convinced of the merits of using some special tools and/or equipment in harvesting and postharvest handling, they most likely will not be able to find them in the domestic market (Bolarin and Bosa, 2015). This is true of harvesting aids, containers, equipment for cleaning, waxing, and packing as well as cooling facilities. This is one of the major factors that affect postharvest losses.

Strategies for Reducing Postharvest Losses

According to Bell *et al.*, 1999; Kitinoja and Gorny, 1999, a systematic analysis of each commodity production and handling system is the logical first step in identifying an appropriate strategy for reducing postharvest losses. Also essential is the cost-benefit analysis to determine the return on investment in the recommended postharvest technologies. Selection of technologies that are appropriate for the size of each postharvest enterprise is another important area of consideration. (Kitinoja and Gorny, 1999; Kitinoja, *et al.*, 2011). There is a wide range of post-harvest technologies that can be adopted to improve losses throughout the process of pre-harvest, harvest, cooling, temporary storage, transport, handling and market distribution which will reduce loss substantially and also cost-effective.

Especially for small scale farmers, whose utmost desire is to reduce losses but could not afford the expensive technologies. Losses can be avoided by adopting good practices as indicated above.

Value of Postharvest Research and Development

Food is the basic means of sustenance and adequate food intake in terms of quality and quantity is a key for health and productive life (Omonona *et al.*, 2007). Over 80% of food consumed by poor-households in rural and urban settings in Nigeria is obtained from farm. The unavailability of food at all seasons is affected by post-harvest food losses and causes food insecurity (Bolarin and Bosa, 2015).

Postharvest losses have been the subject of considerable debate and speculation in recent years. Several authors have presented a strong argument in favour of devoting more resources to postharvest research and development efforts in developing countries (Okezie, 1998). In Nigeria, efforts made to improve food production include the establishment of river basin authorities, agricultural development programmes, operation feed the Nation, establishment of research institutions, agricultural input supplies and bulk purchase companies among others. However, increased food production is not the final solution to food security. It has been complemented by good harvest and postharvest practices to reduce the amount of food loss. Although minimizing postharvest losses of already produced food is more sustainable than increasing production to compensate for these losses. A 50% reduction in postharvest food loss in Nigeria will also reduce the need for food importation.

Goletti and Wolff (1999), stated that "while research on the improvement of agricultural production has received considerable attention and funding, until recently postharvest activities have not attracted much attention from international research organizations, such as Consultative Group for International Agricultural Research (CGIAR), Food and Agricultural Organization (FAO), Australian Centre for International Agricultural research (ACIAR), International Display Research Conference (IDRC), German Agency for technical Cooperation (GTZ), Centre de Cooperation International en Recherche Agronomique pour le Developpment (French Agricultural Research Centre for International Development (CIRAD), National Research Institute (NRI), United States Agency for International Development (USAID). Less than 5% of the funding for agricultural research is allocated to postharvest research areas (Kader, 2003). They identified the following as reasons to justify an increased commitment to postharvest research by the international agricultural system: high internal rates of return, effect on poverty, effect on food security and good health, and effect on sustainable use of resources.

Therefore, with these great significant contributions of postharvest research to agricultural development and food security, an awesome allocation of fund to postharvest research will post a potential for large impacts as constraints and bottlenecks are removed. And all efforts will be geared toward reduction of postharvest food losses from field to the consumers. To achieve this, the farmers, government, non-governmental organization, extension officers, research institutions must be involved.

The Way Forward

To address the above issues properly, a system must be implemented that brings public and private sectors together for active interaction. Therefore, Government, Farmers, Research institutes, Agricultural Engineers, Food Scientists and Non-Governmental Organizations (NGO's) have important roles to play in order to reduce of postharvest food losses and ensure food security and sustainability in Nigeria.

The Roles of Government

The following suggestions will go a long way to reduce postharvest food losses and enhance attainment of food security in Nigeria if properly implemented.

- a. Government at all levels needs to invest more in postharvest research.
- b. There is need for the federal government to encourage and promote local manufactures in design and fabrication of postharvest equipment.
- c. All the programmes implemented by local, state and federal governments to facilitate attainment of food security should be properly maintained and improved.
- d. Good road network should be provided and repair of dilapidated roads for easy transportation of agricultural products.
- e. Good agricultural policies should be put in place as this will ensure viable national farm factors which will provide food for the people and raw materials for agro-industries.
- f. An integrated approach must be adopted in shaping policies, plans, determining strategies, formulating programmes and managing their implementation.
- g. Establishment of processing unit and storage systems is the likely option that can put the postharvest losses under control.

The Roles of Farmers

Farmers have important roles to play in reducing postharvest food losses which include:

- a. Farmers should adopt/apply the indigenous technologies/low input technologies for harvesting and postharvest handling.
- b. The farmers should endeavour to be informed in the recent postharvest technologies developed.
- c. The farmers should instruct or train his/her workers on how their harvesting practices and methods can reduce or completely eliminate the fast deterioration of fruits and vegetables.
- d. Farmers should know the source for market and demand for his agricultural produce.

The Roles of Research Institutes/Universities

The function of research institutes is to provide postharvest technologies for harvesting, processing and storage of agricultural produce. Therefore, to reduce postharvest losses of food in Nigeria and attainment of food security, the research institutes has paramount roles to play by carrying out the following suggestions:

- a. There is need for research institutes to fabricate and develop appropriate postharvest equipment.
- b. The technology developed by research institutes should be made available for local users at avoidable prices.
- c. All research institutes and universities should be involved in local processing and storage to serve their immediate environment.
- d. The research institutes/universities should also carryout extension programmes/training to educate farmers on postharvest technologies and agro-processing at the rural areas.
- e. Interdisciplinary team research by research institutes/universities to develop potential solutions to postharvest food losses should be encouraged. The likely

disciplines for prevention/control of postharvest losses of horticultural products are: agro-climatology, entomology, plant pathology, agronomy, food science and technology, agricultural engineering, agricultural economics and extension.

- f. The research institutes/universities should make their achievement known nationally and internationally to all those that can use the findings.
- g. The research institutes/universities should also carryout farmer evaluation and adaptation of technology and monitoring of its adaption.

The Role of Non-Governmental Organizations (Private Sectors)

- a. NGOs should help with rural broadcast with agricultural information/techniques which are culturally acceptable to the people in the language they understand.
- b. The problem of postharvest losses could be solved if farmers participate on the development process of the postharvest loss prevention techniques through documentary programmes, cassette-tape, cinema and video films on appropriate harvesting, handling, packaging, transportation, storage and marketing techniques.
- c. Co-operative societies could also help the farmers in obtaining postharvest techniques at reduced price.
- d. The banking sectors should be involved in giving out loan to farmers, agro processors to purchase postharvest technologies at low interest rate.

Conclusion and Recommendations

Minimizing postharvest losses of horticultural perishables is a very effective way of reducing food losses and boosting food availability and security in Nigeria. Integration of postharvest strategies in to agricultural programmes is a better way to provide technical advice and affordable solution to farmers. To solve the problem of postharvest food losses of perishable crops in Nigeria, there is need for cooperation and effective communication among all researchers, extension officers and industry personnel. Postharvest horticulturists need to coordinate their efforts with those of production horticulturists, agricultural marketing economists, engineers, food technologies and others who are involved in various aspects of production and marketing system. The use of available information and application of available technologies at the appropriate scale will also go a long way in providing solutions to existing problems. Also, overcoming the socio-economic constraints is essential to achieve the goal of reducing postharvest food losses and this could only be achieved/work effectively if the efforts of government, groups, non-governmental organizations (NGOs), private organization and individuals are combined to provide:

- I. Electricity to rural areas.
- II. All season motorable feeder roads.
- III. Broadcasting centres e.g T.V and radio centres for rural farmers.
- IV. Cottage industries that provide fruits and vegetables into finished products.
- V. Storage and marketing facilities.

Relatively less research has been conducted on postharvest losses in relation to food security and nutrition. Considering the greatest impact of postharvest losses on food security and availability, this paper recommends that more researches should be conducted on the relationship of postharvest losses to food security and nutrition.

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