

## **Effect of Post-Harvest Losses on Food Security: A Review**

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**Abstract:** Food loss study in developing countries that fulfills the food demand of an increasing population remains a major global concern. More than one third of food is lost in postharvest operations. Household food security depends on a regular, sufficient and sustainable supply of food throughout the year. Food loss tends to reverse the gains made in producing enough food to achieve food security. Postharvest food losses are among the leading causes of food insecurity, thus an adequate food system is needed, together with efficient food distribution system from farm to consumer to reduce losses and improve income. In developing countries like Nigeria, post-harvest losses have been highlighted as one of the determinants of food shortage. Proper post-harvest storage, packaging, transport and handling technologies are practically insufficient for perishable crops like vegetables, thereby allowing considerable loss of produce.

**Key words:** Food Security, Handling, Loss, and Post-Harvest

### **Introduction**

According to Food and Agriculture Organization (FAO, 2014), food loss reduction complements effort to enhance food security. Reducing the incidence of postharvest losses along the marketing chain will contribute to improving food availability among farming households by making more income available, resulting in an increased economic access to food through job creation and income generation. The Democratic People Republic of Korea (DPRK) has implemented a mitigating postharvest losses control method to enhance food security (FAO, 2014). Food security and insecurity are terms used to describe whether or not households have access to sufficient quality and quantity of food. Food security is perceived at global, national, household and individual levels. One definition says that food security is a condition in which all people have access at all times to enough food of an adequate nutritional quality for healthy and active life (Adebayo, 2010). Household food security exists when all members of a household at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life (Abafita and Kim, 2014).

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insecurity (FAO, 2006), thus an adequate food system is needed, together with efficient food distribution system from farm to consumer to reduce losses and improve income.

### **Concepts of Food Security**

Food security is defined as a situation that 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. Four dimensions of food security have been identified. These are food availability, accessibility, utilization and stability. All four of these dimensions must be achieved to have full food security (Babatunde *et al.*, 2007). More recent development in food security studies emphasize the importance of food sustainability which may be considered as the long-term (fifth) dimension to food security.

Peng and Benny (2019) are of the opinion that food security is best considered as a causal, linked pathway from production to consumption, through distribution to processing recognised in a number domain, rather than as four “pillars” or dimensions. Food security and food insecurity are dynamic, reciprocal and time dependent and the resultant status depends on the interaction between stresses of food insecurity and the coping strategies to deal with them. Measuring food security at the household level involves five categories of indicators including dietary diversity and food frequency, spending on food, consumption behaviours, experiential indicators and self-assessment measurements (Peng and Berry, 2019). This study adopts the food accessibility pillar as its concept of food security. It looks at the ability of households to purchase available food in sufficient quantities to meet household’s food needs. This is related to the food spending of food category of Peng and Berry (2019).

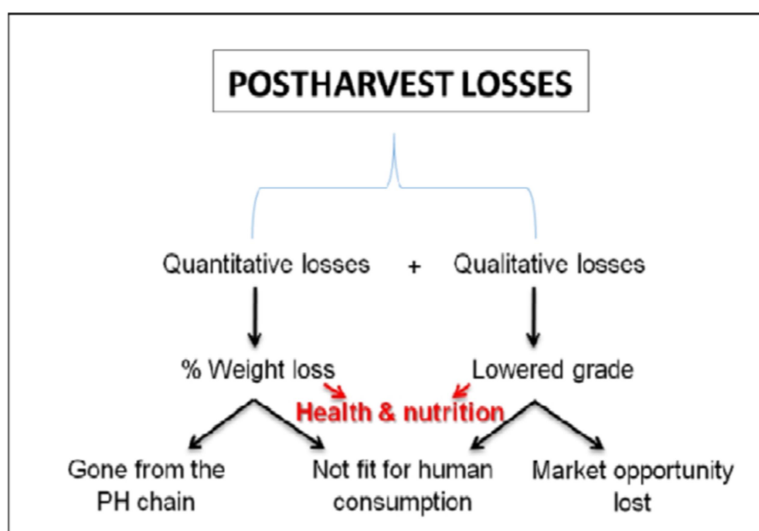
### **Concept of Postharvest Food Losses**

Postharvest loss can be defined as the degradation in both quantity and quality of a food produced from immediately after harvest to consumption. Quality losses include those that affect the nutrient/caloric composition, the acceptability and the edibility of a given product. These losses are generally considered in developed countries (Kader, 2002). Quantity losses refers to those that result in the loss of a portion of the amount of a given food product. Loss of quantity is more common in developing countries (Kitinoja, 2010).

Postharvest food loss (PHL) is the measurable qualitative and quantitative food loss along the supply chain, starting at the time of harvest till its consumption or other uses (Hodges, 2014). Postharvest loss can occur either due to 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 wilted produce, not consuming available food before its expiry date, or taking serving sizes beyond one’s ability to consume. Food loss on the other hand is the inadvertent loss in food quantity because of infrastructure and management limitations of a given food value chain. Food losses can either be the result of a direct quantitative loss or arise indirectly due to qualitative loss. Food loss and food waste contributed to postharvest food losses. Food loss can be quantitative as measured by decreased weight or volume or can be qualitative, such as reduction in nutrient value and unwanted changes in taste, colour, cosmetic features and texture of food (Buzby and Hyman, 2012). Quantitative food loss refers to the reduction in weight of food available for human consumption. The qualitative

food loss can occur due to incidence of insect pest, mites, rodents and birds or from handling, physical changes or chemical changes in fat, carbohydrate and protein and by contamination of mycotoxins, pesticide residues, insects, fragments of excreta of rodents and birds and their dead bodies. When this qualitative deterioration makes food unfit for human consumption and is rejected, it contributes to food loss (Bada, 2016).

Postharvest losses (PHLs) consist of qualitative and quantitative losses (see Fig. 1). Qualitative losses occur as a result of either altered physical condition, perceived substandard value, deterioration in texture, flavor and or nutritional value whereas quantitative losses refer to physical losses of food as unfit for human consumption and hence readily discarded. Another aspect of postharvest loss is economic losses which apply when products of higher quality are restricted to lower markets. Only quantitative loss would be considered in the present study.



**Source:** Adapted from Morris and Kamarulzaman (2014)

Figure 1: Schematic diagram showing types of postharvest losses

Postharvest tomato loss refers to the degradation in both quantity and quality of tomato from harvest to consumption. Quality losses include those that lower the grade of the tomato quality and may affect the nutrient/caloric composition, the acceptability and the edibility of the given product (Kader, 2002). Quantity losses refer to tomato losses that result in the loss of weight/quantity of a product. Postharvest losses could also result in reduced nutrition and edibility. Loss of quantity is more common in developing countries while loss of quality is more common in developed countries (Kitinoja, 2011).

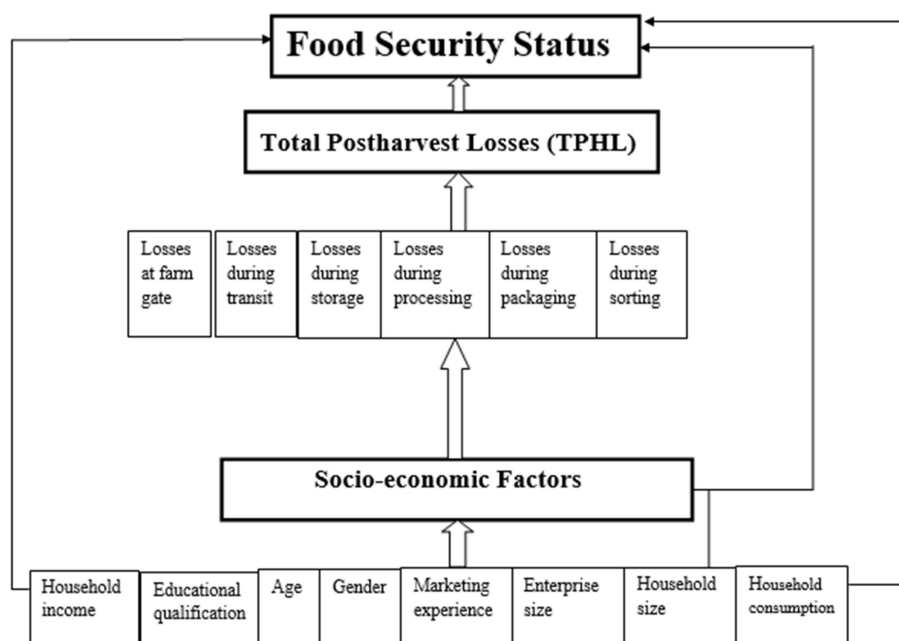


Figure 2: **Conceptual Framework for Postharvest Food Loss and its effect on food security**

Food security status is influenced by socio-economic factors such as household income, educational qualification, gender, age, marketing experience, enterprise size, household size and household consumption. Also, losses at various stages such as losses at farm gate, losses during transit, storage, processing, sorting and packaging are influence by the socio-economic factors of marketers. The state of socio-economic characteristics of marketers will eventually give rise to the total postharvest losses the greater the total postharvest losses the more the negative impact on the food security status of marketing households.

Morris (2014), de-categorize all activities in the postharvest system (postharvest handling and marketing) of the commodity in question into their tiniest bits and then directly measured their contribution to the overall losses. This study also described a similar framework for such assessment of postharvest losses in the supply chain where losses are broken down to losses at farm gate, transit storages, process packaging of salting as in Fig 2.2. A fact for typical agri-food marketing is that fresh produce quantity and quality reduce as products travels down the marketing chain. Heavily deteriorated products end up being discarded as food waste while partially deteriorated produce may end up at reduced price values. The discarded produce and those provoking price reduction due to perceived reduced quality represents the quantitative and qualitative losses respectively. Both kinds of losses (qualitative and quantitative) when added, give the total amount of losses along the marketing chain. This total loss is the PHLs for that particular marketing chain and can be expressed as:

$$\text{Total Postharvest losses (PHLs)} = (\sum \text{Quantitative} + \sum \text{Qualitative}) \text{ losses}$$

$$\% \text{ PHLs} = \frac{\text{Postharvest Losses}}{\text{Total Production}} \times 100 \dots\dots\dots \text{Equation 2.1 ((Moris, 2014)}$$

It is noteworthy that every horticultural produce has a shelf life (postharvest life) following harvest. The shelf life of a product expires when the product is no longer useable and therefore discarded. Nevertheless, the quality at harvest may influence the level of effectiveness of the postharvest handling and marketing towards shelf life. This is because agricultural produce could be manipulated to prolong its shelf life; however, its quality cannot be improved after harvest but only maintained (Hodges, 2012).

### **Effect of Postharvest Losses on Food Security Status**

Global Food Security Index GFSI (2014) reported in its special report that cereals comprise the largest share of global food loss by caloric content (53%) when considering calories; the USA is particularly losing an estimated 1,520 calories per person per day. Europe and Asia loose less than half of that amount, or fewer than 750 calories per person per day. FAO (2013) reports that the world produces enough food to feed everyone, yet at the same time an estimated one in eight people or 870 million people suffer from chronic undernourishment. The many consequences of food loss on food security, the economy or the environment and its causes vary significantly among regions, stages of the food supply chain and type of food product that are lost (FAO, 2013).

GFSI (2014) reported that food loss has strong relationship with overall food security. Lower levels of food loss were correlated (correlation = -0.59) with a higher overall score given the negative impact of food loss on food availability. Among all the indicators, food loss shared the strongest relationship (correlation = -0.49) with agricultural infrastructure. The findings confirm the role that infrastructure plays in determining food loss and linking it to food security (GFSI, 2014).

Some 815 million people have insufficient food to meet their nutritional needs today, which means that one in eight of the current world population is chronically undernourished (UN, 2014). Access to food is an important determinant of good health and studies have emphasized that food insecurity is associated with compromised individual and population health (Seligman, *et al.* 2010). Under-nutrition is estimated to be the underlying cause in 45% of all deaths among children under five years of age (FAO, 2014). The world population is projected to grow by another two billion by 2050. Thus, global food demand in 2050 will have to increase by at least 60% above 2006 levels to feed this population (Rosen, *et al.* 2016). Paradoxically, at a time of projected severe food shortages, it is estimated that roughly one third of food produced for human consumption is lost globally, amounting to about 1.3 billion tons per year (FAO, 2016). Consequently, if food loss can be minimized, this would make a very significant contribution to meeting the demands of the food insecure (Cribb, 2010 and Campbell, *et al.* 2012).

FAO (2014) stated that if food losses could be halved, the required increase of available food to feed the world population by 2050 would only need to be 25% and not 60% as currently projected, thus, reducing food loss can be part of broader systematic changes towards more sustainable food systems and global food security.

Kumar & Kalita (2017) reported in a food loss study in developing countries that fulfilling the food demand of an increasing population remains a major global concern. More than one third of food is lost in postharvest operations. Reducing the postharvest losses especially in developing countries, could be a sustainable solution to the problem of food availability, elimination of hunger and improving livelihoods and in general providing food security.

Kader (2015) observed in his postharvest study that qualitative losses such as loss of caloric and nutritive value, loss of acceptability by consumer and loss of edibility are more difficult to measure than quantitative losses of fresh fruits and vegetables. Reduction of quantitative losses is a higher priority than qualitative losses in developing countries like Nigeria. The opposite is the case in developed countries where consumers' dissatisfaction with product quality result in a greater percentage of the total postharvest losses, providing consumers with fruits and vegetables that taste good can greatly increase their consumption of the recommended minimum of five servings per day for better health (Kader, 2015).

### **Conclusion**

Postharvest loss is a major challenge hampering food availability in most developing countries. Postharvest loss is a large and serious problem which needs to be addressed urgently and is particularly acute in developing countries where food loss reduces income by at least 15% for over 470 million smallholder downstream value chain actors, exposing them to inadequate expenditure on food leading to food insecurity.

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