Postharvest Loss in Rice: Causes, Stages, Estimates and Policy Implications

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Introduction
Rice is the most cultivated crop in the world. It is a major constituent of the diets consumed in many developing countries, and also a stable food in many countries in Africa. In 2006, paddy rice production in sub-Saharan Africa was estimated at 14.2 million tonnes and rice production in this zone grew at 3.23% per annum from 1961 to 2005 [1]. Studies conducted in Nigeria revealed that rice constitutes over 20% of total food expenditure among urban and rural households. The demand for rice has grown significantly over the last 40 years due to changing consumer dietary patterns and population growth. In 2014, the annual rice demand in Nigeria was estimated at 5.9 million MT. However, only an estimated 2.7 million MT of milled rice was produced locally, leading to a demand supply deficit that was filled by imports [2].

Postharvest losses represent more than just losses of food. When 20 percent of a harvest is lost, the actual crop loss is just part of the problem. Also wasted are 20 percent of all the factors that contributed to producing the crop, 20 percent of the land used to grow the food and 20 percent of the water used to irrigate it, along with the human labor, seeds, fertilizer, and everything else. In other words, post-harvest food loss translates not just into human hunger and financial loss to farmers but into tremendous environmental waste as well [3].

This review will therefore focus on the following issues:

a. Describe PHL and highlight the stages of Postharvest loss in rice production in Nigeria
b. Describe the causes of Postharvest losses in rice production in Nigeria
c. Review the estimates of postharvest losses in rice production in Nigeria

Postharvest losses explained
Postharvest loss can be defined as the degradation in both quantity and quality of food produced from time of harvest to the point it is consumed. Quality losses include those that affect the nutrient/caloric composition, the acceptability, and the edibility of a given product. These losses are generally more common in developed countries. Quantity losses refer to those that result in the loss of the amount of a product. Loss of quantity is more common in developing countries as cited by Kiaya [4]. Global estimates of postharvest losses and wastages are presented in Figure 1.

Figure 1: Global estimate of Post harvest losses [4].
The term post harvest losses in rice production means any reduction in the amount of edible rice grain due to reduction of availability, edibility, wholesomeness or quality that prevents the rice grains from being consumed by people. Rice grain is lost at every step from harvesting operations to consumption. Post harvest or post production losses of rice occur both on farm and off farm levels. The reduction in the moisture content of rice grain and the removal of inedible portions such as husk and bran in the process of milling are not considered as post harvest losses as cited by Guisse [5]. Loss is a concept which is difficult to define. If losses are determined on the basis of the original weight of the crop, it can lead to an overestimation of losses. On the other hand, there are other losses, which are difficult to determine, and these losses include time, manual labour, agricultural inputs, opportunity cost, illusion and hopes. (FAO 1992) as cited by Folayan [6].

Forms and stages of Postharvest loss in rice

**Table 1**: Generic food supply chain and examples of food waste

| Stage                                                                 | Examples of Waste                                                                 |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| 1. Harvesting, handling at harvesting                                 | Edible crops left in field, ploughed into soil, eaten by pests; timing of harvest not optimal; crop damaged during harvesting |
| 2. Threshing                                                          | Loss due to poor technique                                                         |
| 3. Drying, transport and distribution                                | Quality and quantity loss of during drying, poor transport infrastructure; loss owning to spoiling/bruising |
| 4. Storage                                                            | Pests and disease attacks, spillage, contamination; natural drying out of food     |
| 5. Primary processing, cleaning, classification, hulling, pounding, grinding, packaging, soaking, winnowing, drying, sieving, milling | Process losses; contamination in process causing loss of quality.                 |
| 6. Secondary processing, mixing, cooking, frying, moulding, cutting, extrusion | Process losses; contamination in process causing loss of quality.                 |
| 7. Product evaluation and quality control                            | Product disregarded /out-grades in supply chain                                     |
| 8. Packaging                                                          | Inappropriate packaging damages produces; grain spillage from sacks; attack by pests |
| 9. Marketing, selling, distribution                                   | Damage during transport; spoilage; poor handling; losses caused by poor storage    |
| 10. Post-consumer                                                     | Poor storage/stock management; discarded before serving; poor food preparation; expiration |
| 11. End of life disposal of food waste/loss at different stages in supply chain. | Food waste discarded may be separately treated, fed to animals, mixed with other wastes/land filled |

Source: Parfitt et al. (2010) as cited by Kiaya [4].

Some stages in the rice postharvest system are more critical than others, particularly in tropical and subtropical areas where rice is more vulnerable to damage and more likely to suffer qualitative and quantitative losses. Among these critical stages, drying and storage are especially important. Between 10-40% of the food that is grown never reaches the market or a consumer’s plate because of insects and rodents that get into storage containers, losses during harvesting and processing, market demand for “perfect” unblemished produce, and other factors. Postharvest losses can occur during any of the various stages of post-production system. (FAO 1997) as cited by Taiwo & Bart-Plange [7]. The various stages of PHL are further described in Table 1.

According to a study by the Swiss Agency for Development and Cooperation (SDC), postharvest losses occur at different stages such as harvesting, threshing, winnowing, transporting and storage, with storage being the stage at which the biggest loss occurs. Loss also occurs at every stage of the supply chain. Following harvest, about 60-70 percent of food grain is stored on farms for variable periods, normally in traditional structures and at dangerously high moisture levels. This makes them particularly vulnerable to infestations of pests and micro-organisms. Significant losses also occur during processing, where the number of mills is insufficient to meet demand, and most processing units are small and use outdated technologies (U.S. Department of State, 2013).

The U.S. Department of State, (2013) also added that the principal PHLs in rice occur during harvesting and handling due to grain shattering and due to spoilage during transport. They also arise from bio-deterioration in all steps in the postharvest chain, including storage. Quality of rice is often low because rice is not dried properly and the resulting high moisture content can accelerate spoilage.

**Causes of Postharvest losses**

The causes of Postharvest losses, which some estimates suggest could range from 15 to as high as 50 percent of what is produced, are manifold. These include harvesting at an incorrect stage of produce maturity, excessive exposure to rain, drought or extremes of temperature, contamination by micro-organisms.
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A study by the International Rice Research Institute (IRRI), (2007) in the Philippines has estimated that between 5 to 16 percent of rice is lost in the harvest process, which includes harvesting, threshing, drying, processing, storage, transportation, etc. have been estimated to claim between 30 and 40% of all food crops in developing countries [13].

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and 40 to 80 percent under more extreme conditions (Phan and Nguyen, 1995) as cited by Chukwunta [3]. According to the Africa Rice Center [1], Postharvest losses account for 15 to 50% of the market value of the initial production which equates to a value of $30 to $75 per ton. In 2004, Postharvest losses were estimated to be about 38,000 tons of milled rice equivalent, a value of $20 million per annum. This is not a profitable or sustainable way to farm. In developing countries, Postharvest losses destroy about 15 to 16 percent of the rice crop (FAO, 2004). However, there is insufficient data on postharvest losses of rice with regards to what, where and why the losses occur in the production system [14].

Conclusion and Policy Implications

With the ban on rice importation in Nigeria, domestic rice production is expected to rise. However, a huge supply and demand gap already exists in domestic rice production. Consequently, if PHL is left unchecked, household food and nutrition security will be affected as evident in the magnitude of the menace. Relevant policies to check post harvest losses are a matter of great urgent necessity if this emerging threat is to be curtailed. Similarly, further studies and research on PHL in food grains especially rice at different handling stages would help assess the extent and magnitude of losses and identify the factors responsible for such losses. This will in turn help develop proper measures to reduce these losses and ultimately prevent food insecurity.

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