

Economic Implications of Food Grain Losses on Farming Households in Developing Countries: A Review

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Abstract: *The study reviewed the analysis of economic implications of food grain losses on farming households in developing countries. The data for the study was obtained from secondary sources such as journals, conferences, dissertations and thesis. The review indicates that reduction in food loss will increase the amount of food availability for human consumption and enhance food security. Food loss is occurring at a time of increasing food prices and worsening food insecurity. The issue of food loss is of high importance in the effort to convert hunger, food insecurity, malnutrition and poverty. Food loss reduction complements efforts to improve food availability through improved farm level productivity, thus tending to benefits producers and more specifically the poor. Grain loss in sub-Saharan Africa was estimated to be 20% of the total production. The annual value of the loss was estimated at US \$4billion. This amount exceeds the value of total food and sub-Saharan Africa received over the last decade, equates annual value of cereal imports of sub-Saharan Africa which had an annual range of US \$3-7billion over 2000-07 period and equivalent to annual calorie requirement of at least 48million people at 2,500 kilo calorie per person per day. Millions of tons of food grains end up in trash cans or spoil on the way to market and has induced poverty in farming households which creates unequal income distribution in the households.*

Keywords: *Economic, Implication, Food, Grain, Farming, Households, Developing, Countries*

INTRODUCTION

Food is any substance, whether processed, semi-processed or raw, which is intended for human consumption and includes drinks, chewing gum and any substance which has been used in the manufacture, preparation or treatment of “food” but does not include cosmetics or tobacco or substance used only as drugs. Food loss refers to edible parts of plants and animals that are produced or harvested for human consumption but not ultimately consumed by people. In particular, food loss refers to food that spills, spoils, incurs an abnormal reduction in quality such as bruising or wilting or gets lost before reaching the consumer. Food loss is the unintended result of an agricultural process or technical limitation in storage, infrastructure, packaging or marketing. Although food waste is a component of food loss, it is important to distinguish food waste from food lost. Food waste refers to the food that is of

good quality and fit for human consumption but does not get consumed because it is discarded either before or after it spoils. Food waste is the result of negligence or conscious decision to throw food away (Lipinski *et al.*, 2013). Lowering food loss is one of the potential measures for overcoming hunger (Morisaki, 2011).

The Food and Agriculture Organization of the United Nations (FAO) estimates that 32% of all food produced in the world was lost in 2009. In 2013 about 1.3 billion tons of food were globally lost. The estimate was based on weight, when converted into calories, global food loss amounted to approximately 24% of all food produced (FAO, 2013). Food loss has many negative economic implications. These include negative implications on rural income, food security and poverty among others. Grains are very important food staples in Sub-Saharan Africa where grain losses amount to about 20% of total production.

Current world population is expected to reach 10.5 billion by 2050 (UN, 2013). This development will further add to global food concerns. This increase will translate into 33% more human mouths to feed with the greatest demand growth in the poor communities of the world. Alexandratou and Bruinsma (2012) reported that there is the need to increase food supplies by 60% (estimated at 2005 food production levels) in order to meet the food demand in 2050. Food availability and accessibility can be increased by increasing production, improving distribution and market infrastructure as well as reducing prices of inputs. Reducing household food losses is a critical component of ensuring future global food security. One percent reduction in annual losses could amount to about US \$4billion, with producers as key beneficiaries (Segre *et al.*, 2014). Viewed from a different perspective, the annual value of the loss (estimated at US \$4billion): Reduction or elimination of these losses will increase the amounts of food available for human consumption and enhance food security (Gustavasson *et al.*, 2011).

Food and Agriculture Organization of the United Nations, FAO (2011) reported that food loss is occurring at a time of increasing food prices and worsening food insecurity. The issue of food loss is of high importance in the effort to combat hunger, food insecurity, malnutrition and poverty. Food loss reduction complements efforts to enhance food security through improved farm level productivity, thus tending to benefit producers and more specifically the poor. Grain food loss in sub-Saharan Africa which amounts to 20% of total production. The annual value of the loss (estimated at US \$4billion):

- exceeds the value of total food aid Sub-Saharan Africa (SSA) received over the last decade,
- equates the annual value of cereal imports of Sub-Saharan Africa (SSA) which had an annual range of between US \$3-7 billion over 2000-07 period.
- equivalent to the annual calorie requirement of at least 48 million people (at 2,500 kcal per person per day) (Segre, *et al.*, 2014). This implies reduction in foreign exchange spending, thus, improving the economy and per capita income.
- Millions of tons of food grains end up in trash cans or spoil on the way to market and has induced poverty in farming households.
- Creates unequal income distribution in the households.

The food problem may become more serious in the coming years if the food supply does not meet the rate of population growth. However, an efficient household food conservation will help to bridge the food deficit gap. This is particularly important with regard to food grains which are important food staples in many developing countries. Therefore, there is the need to review food grain losses to establish its economic implications. This review will therefore cover concept of food losses, food losses among farming households, economic implications of food losses, grain storage technologies and factors responsible for food losses.

Concept of food losses

Food loss refers to a decrease in quantity or quality of food. Food loss in the production and distribution segments of the food supply chain is mainly caused by the functioning of the food production and supply system or its institutional and legal frame work. An important part of food loss is called food waste, which refers to the removal of food which is fit for consumption or which has spoiled or expired from the food supply chain. Food wastage is mainly caused by economic behaviour, poor stock management or neglect (FAO, 2014).

In recent years the topic of Food Loss and Waste (FLW) has been gaining importance, both in the public and private sectors of the global food systems. Many initiatives are being undertaken world-wide to reduce food loss and waste (FLW). Many definitions and terminologies are being used by various actors and stakeholders in the global food systems. Therefore, FAO's Global Initiative on Food Loss and Waste Reduction' has taken a coordinating role, to enhance information exchange, collaboration, synergy and harmonization of strategies and methodologies. In this respect, it is important to agree on, and accept, a common definition of food loss and waste. It will provide an opportunity for achieving a globally harmonized approach to improving data collection, data comparability, and evidence-based regulatory and policy decisions for food loss prevention and reduction (FAO, 2014).

Food loss has an impact on food security, on local and national economies, on the natural resource base, as well as on waste streams and the environment. One thing became very apparent in the process: a definition on FLW is not a mathematical or physical law. It has many different logics which are equally good, and therefore it is just a matter of choice on what to accept as the definition. FAO offers this definition as a global reference for any stakeholder dealing with FLW, and to use it within the context of their operations.

Essential terms and concepts in this definition are:

- Food is any substance intended for human consumption.
- Food waste is a part of food loss, however not sharply distinguished; the term “food loss and waste” is nevertheless maintained in regular communication.
- ‘Intended for human consumption’ (already embedded in the Codex definition of ‘Food’).
- Plants and animals produced for food contain ‘non-food parts’ which are not included in FLW.
- Food redirected to non-food chains (including animal feed) is food loss or waste.
- Quantitative FLW = the mass (kg) reduction.

- Qualitative FLW = reduction of nutritional value, economic value, food safety and/or consumer appreciation (FAO, 2014).

It has to be noted that the supplementary notes are an integral part of the definition and are as important as the actual definition points.

- ❖ Food loss (FL) in the production and distribution segments of the Food Supply Chain (FSC) is mainly caused by the functioning of the food production and supply system or its institutional and legal framework.
- ❖ An important part of food loss is called food waste (FW), which refers to the removal from the FSC of food which is fit for consumption, or which has spoiled or expired, mainly caused by economic behaviour, poor stock management or neglect.
- ❖ Food waste is not sharply defined. However, it is still recognized as a distinct part of food loss, because the underlying reasons, economic framework and motivation of the FSC actors for wasting food are very different from the unintended food loss, and subsequently the strategies on how to reduce food waste are conceived in a different, targeted manner. Although the term ‘food loss’ encompasses “food waste”, the term ‘food loss and waste’ (FLW) will continue to be used to emphasize the importance and uniqueness of the waste part of food loss.
- ❖ Quantitative food loss can also be referred to as physical food loss. It does not include the reduction of mass resulting from food processing operations such as drying, heating, ripening, and fermentation. It does however include the removal of food for cosmetic or other market reasons by food processing operations such as grading and sorting.
- ❖ The decrease of quality attributes results in the reduction of nutritional value, economic value, food safety and/or consumers’ appreciation:
 - Economic value refers to the price that any supplier in the FSC receives from its buyer, in a way that it affects the revenue of the supplier.
 - Food safety refers to the absence, or presence in acceptable levels, of microbiological, chemical or physical hazards in food to prevent risks to the health of the final consumer.
 - Consumers’ appreciation refers to the perception of the food by the consumer, with regard to sensorial attributes such as appearance, texture, smell, taste.
- ❖ Consumption’ refers to the ingestion of food by the final consumer.
- ❖ ‘Intended’ refers to the original purpose for the product in the food supply chain, even if certain actors in the FSC may intentionally discard a wholesome part of the product or divert it to a non-food supply chain. Example: the whole potato is food, even if a french-fry manufacturer disposes of a fraction when slicing the product into uniform sizes.

If at the early stages of the supply chain it is not determined, or not yet known, whether a product will be destined for food or not, absolute food losses can be assessed from percentage losses and statistical information on the fraction of that product which in a specific region and year finally enters a human food market.

- ❖ Whether plants, animals and their parts or products are intended for food depends on the FSC, the food system, and its geographical and cultural context.

- ❖ Fish discards are the portion of total catch which is thrown away or slipped. It comprises the following components:
 - Species which are intended to be caught, but get spoilt and rendered unfit for consumption by the act of catching; these discards are food loss.
 - Species which are intended to be caught, but do not meet the regulatory or quality standards, such as size; these discards are food loss.
 - Species which are not intended to be caught, but which are fit for entering the FSC; these discards are food loss.
 - Species which are not intended to be caught, and which are not considered food; these discards are not food loss. Fish includes fish, shellfish and cephalopods.
- ❖ Non-food parts of FPA are parts which are inedible, or could be edible but in the specific FSC are not destined to be consumed.
 - The FSC starts from the moment that:
 - crops are harvest-mature or suitable for their purpose;
 - animals are ready for slaughter;
 - milk has been drawn from the udder;
 - eggs are laid by the bird;
 - aquaculture fish is mature in the pond;
 - wild fish have been caught by the fishing gear.

The end point of the food supply chain is defined by when food is a) consumed; or b) removed from the food supply chain.

Food losses among farming households

Food loss can be qualitative and quantitative loss along the supply chain starting at the time of the harvest till its consumption or other end uses (Hodges *et al.*, 2011). Food loss is the inadvertent loss in food quality because of infrastructure and management limitations of a given food value chain. Food loss can either be the result of a direct quantitative loss or arise indirectly due to qualitative loss. 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 to taste, colour, texture or cosmetic features of food (Buzby and Hyman, 2012).

Quantitative loss can also occur as a result of drying (a necessary post-harvest process for all grains) (FAO, 2012). Although this process involves considerable reduction in weight, there is no loss of food value and therefore, should not be counted as loss.

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

- Food loss can occur upstream of the food chain, mainly during sowing, cultivation, collection, treatment and conservation. There are four major sources of loss:
- Food loss occur at the level of production and harvest due to bad weather, diseases or infestations, defect in the system of cultivation and defect in transportation system.
- It can occur during processing of the products.

- It can also take place during the wholesale distribution, where food remain unsold, because it does not correspond to the aesthetic and quality of buyers.
- At last, food loss occurs at the catering and domestic consumption. They create food waste before the expiry date and difficult to interpret the label and the information relating to the consumption.

Begum *et al.* (2012) in their post-harvest study in Northern Region of Bangladesh, reported that post-harvest grain losses were estimated at household level in two major food grains, viz; rice and wheat in Rangpur and Dinazpur districts of Bangladesh. The result of the study revealed that household grain losses were high due to late harvesting of the crops (1.95kg/quintal in wheat). The household size and food losses of the farmers in both districts had negative and significance relationships in their probability of food security which implies that the household are food secured in both areas.

Basappa *et al.* (2007) reported that post-harvest losses of rice and wheat in India at different stages of post-harvest operations and the household post-harvest losses were estimated. Descriptive analysis was used to estimate the postharvest household food losses. The result of the study indicated that 3.82kg/quintal of rice and 3.28kg/quintal of wheat were lost. The losses have been highest during storage in both crops. Bala *et al.*, (2010) observed that the postharvest losses of grains at farm level for rice in Bangladesh were 9.16 percent, 10.10 percent and 10.17 percent for Aman, Boro and Aus respectively. The study further revealed that household losses were 33.92 to 40.99 percent of total losses at farm level. The storage loss of rice was 3.45-4.14 percent and it is followed by drying (2.19-2.37 percent), harvesting (1.60-1.19 percent) and threshing (1.10-1.79 percent). The estimated total losses of rice during household processing in Bangladesh were 1.30 percent, and 1.13 percent for Aman, Boro and Aus respectively.

Food loss is problematic for a number of reasons, including the loss of potentially valuable food source or resource for use in other processes (e.g. energy generation or composition). Nohman *et al.* (2012) reported that 1.4 million tons of food is wasted by South African Household each year. This equates to 15 percent of the total household waste generated. The cost of total household food loss and disposal was R 21.7 billion per annum. This equates to 0.8 percent of GDP or 10 percent of annual sales by food retailers in South Africa.

FAO (2012) estimated that approximately 1.3 billion tons of food were lost or wasted globally in 2007 which was equivalent to approximately one-third of the food produced for household consumption at that time. The result of the study further revealed that food losses and waste not only deprived the poor from accessing food but also caused significant depletion of households on resources such as land, water and fossil fuel, and increase the greenhouse gas emissions show quantitatively that reduction in household food losses in developed regions will decrease the number of undernourished people in rural areas by up to 63 million leading to decrease in the harvested area, water utilization and greenhouse gas emissions associated with food production efforts to feed households.

It was observed that close to one third of the edible food produced for household consumption was lost or wasted globally, equivalent to 1.3 billion tons per year (Rutten 2013). This study disclosed that the amount of household food losses and waste were estimated to be around 30 percent for cereals, 40 to 50 percent for root crop, fruits and

vegetables, 20 percent for oil seeds, meat and dairy and 30 percent for fish. Food losses and waste in industrials and developing countries were roughly the same in terms of quantity (670 and 630 million tons respectively) but greatly vary in terms of value (US \$680 and US 310 billion respectively).

Lipinski *et al.* (2013) observed that if the current rate of food loss were cut by half from 24 percent to 12 percent by the year 2050, the world would need about 1.314 trillion Kilocalories (Kcal) less food per year. The savings of 1.314 trillion kcal is roughly 22 percent of the 6,000 trillion Kcal per year between food available today and that needed in 2050. Access to household food storage remains one of the most problematic issues throughout the post-harvest chain, because devastating pests such as the Large Grain Borer (LGB) can cause up to 30 percent Dry Weight Losses (DWL) in six month of household grain storage (Boxall, 2002 and Golab, 2002). In Benin, major threat to household food security is post-harvest food losses. Household losses was estimated to be 15 to 30 percent depending on the region (ADA, 2010). The drier Sudan Savanna in the North records 2.5 percent while in the Guinea savanna average household food losses reached 10 percent (Ada *et al.*, 2002). In contrast, higher average losses were observed over a cropping year in the more humid southern Benin where high insect pressure existed due to favourable environmental conditions of high air moisture and temperature. Household food losses in the south reached 20 to 50 percent after six month of household food storage with traditional structures (Maboudou *et al.* 2004).

Economic implication of food losses

Current world population is expected to reach 10.5 billion by 2050 (UN 2013). This increase translates into 33% more human mouths to feed with the greatest demand growth in the poor communities of the world. Alexanda and Briunsmas (2012), food supply would need to increase by 60% (estimated at 2005 food production levels) in order to meet the food demand in 2050. Food availability and accessibility can be increased by increasing production, improving distribution and reducing losses. Thus, reduction of food losses is a critical component of ensuring future global food security.

Food and Agriculture Organization of the United Nations predicts that about 1.3 billion tons of foods are globally lost per year (Gustavasson *et al.*, 2011). Reduction in these losses will increase the amount of food available for human consumption and enhance global food security. A reduction in food loss improves food security by increasing the real income for all the consumers (World Bank, 2011). In addition, crop production contributes significant proportion of typical incomes in certain regions of the world (70% in Sub-Saharan Africa) and reducing food loss can directly increase the real incomes of the producers (World Bank, 2011).

Reducing food losses could potentially prevent global poverty. Basavaraja *et al.*, (2007) reported that total food loss is 1.3 billion tons of food per year, and this amount results in 3.3 billion tons of greenhouse gasses entering the atmosphere. This amount of food loss cost the World \$750 billion dollars annually. The United States of America losses \$161 billion a year, while it is estimated that \$265 billion per year is enough to put an end to poverty and hunger by 2030 all over the world. Food loss reduction improves the economy and reduces poverty in individuals, households and the nation at large and the result is a positive impact

(Basavaraja et al., 2007). Poverty and food security are intricately interlinked. Without an income or resources to grow food and prevent its losses people are likely to become ill and unable to work to produce food or earn an income.

The magnitude and pattern of food losses vary across countries based on their stage of economic development. In high and middle income countries, significant losses occur in the early stages of food supply chain. Field losses at early stages may reflect economic decisions by the farmer to forgo harvesting due to market conditions or grading perfections demanded by the consumers. Minor losses occur at the other stages of the supply chain (Hodges *et al.*, 2011). Food losses in the developed countries is generally low in the middle stages of the food supply chain. This can be attributed to more efficient farming systems, better transport, better management, storage and processing facilities which ensure that a larger proportion of harvested output is delivered to the market. The extensive and effective cold chain systems prevalent in these countries also help to prolong the shelf-life of food products (Hodges *et al.*, 2011).

In contrast, food losses in the low income countries mainly occur in the early and middle stages of the food supply chains with proportionately less amount at the consumer level. Food losses in these countries are the results of inadvertent losses due to poor state of the supply chains. Premature harvesting, poor storage facilities, lack of infrastructure, lack of processing facilities and inadequate market facilities are the main reasons for high food losses along the entire food supply chain. Food loss among different countries, or groups can be attributed to the changing food demand patterns at different income levels. Increase in per capita income levels of households across the world are contributing to major changes in food demand patterns (Regimi *et al.*, 2001). As consumers become wealthier, they tend to demand special quality attributes in the food they consume. In response to these demands, food suppliers have implemented stringent quality standard and certification programs. Products unable to satisfy these standards even if nutritious and safe for human consumption become discarded-contributing to food losses. Furthermore, as food comprises a small share of the budget for consumers in developed countries do not have strong incentive to avoid wasting food. In contrast, as food is a large share of the household budget for consumers in low income countries, purchase behaviors tend to be more frugal, contributing to less food loss (Regimi *et al.*, 2011).

With significant food grain loss across all food grains, per capita food loss in Europe and North America was reported to be high at about 95-115kg/year, whereas in sub-Saharan and South East Asia is much lower at about 6- 11kg/year (Jaspreet and Regimi 2013). It is estimated that about 1.6 million tons of food grains are lost in the United Kingdom because they do not meet the retailer standards (Jaspreet and Regimi 2013). In addition, UK households estimated to lose another 6.7 million tons of food grains each year. Similarly, food losses are high in other developed countries with estimates indicating that about 30 percent of all food produced in the United States is lost (Buzby and Hyman 2012). Although food waste accounts for a very small portion of the total loss, food loss is significant in the developing countries. Total food loss in the Sub-Saharan Africa are estimated to be worth \$4 billion per year, an amount which can feed 48 million people (FAO, 2013). Losses on cereals are estimated to be as high as account for about 25% of the total crop harvested, (Voices Newsletter, 2006).

Millions of tons of food end up in trash cans or spoil on the way to market. This must be avoided so as to end poverty. Poverty is the principal cause of hunger. The causes of poverty include lack of resources, and extremely unequal income distribution in the households and within specific country. World Hunger News (2017) revealed that 233 million people in sub-Saharan Africa were hungry in 2014-2016 (its most recent estimate), 795 million people were hungry worldwide. Sub-Saharan Africa was the area with second largest number of hungry people as Asia had 512 million, principally due to the much larger population of Asia when compared to sub-Saharan Africa. There has been the least progress towards reducing hunger in sub-Saharan region, where more than one in four remain poor and undernourished. The highest prevalence of poverty varies among regions of the world. In 2012, 501 million people or 47 percent of the world's population are poor. The principal factor in causing widespread hunger is poverty, (WHES,2015).

International Food Policy Research Institute (2015) estimates the economics of food grain losses in Malawi. It was estimated that 12 percent of maize produced each year was lost due to flooding in the southern region. Average crop loss due to droughts are 28 percent for small and medium scale farmers compared to 1.3 percent for large scale farmers. Out of 12.1 million Malawians, 52.4 percent or 6.3 million people are considered poor. Drought cause poverty increases directly through its impact on household incomes and indirectly through its consumer prices. At the national level drought causes 0.7 percent increase in poverty rate. This rises to as much as 16.9 percent during a severe drought (IFPRI, 2014). On the average, poverty is 1.3 percent higher due to drought affecting 154,000 people.

Poverty rates are twice as high in rural than in urban areas. Given the importance of agriculture in rural economy, it is not surprising that the rural poor are found to be more sensitive to food loss. Small and medium scale farming households are particularly vulnerable.

Factors Responsible for Household Food Losses

Zakari *et al.* (2014) observed in a study on factors influencing household food losses in southern Niger, that drought, high food prices, poverty, soil infertility, diseases and insect attacks were the main causes of household food losses. Morisaki (2011) in his study pattern of food losses in households in Japan reported that Japanese households generated approximately 11 million tons of edible as food loss. Food loss happens in both developed and developing countries despite food shortage in the later. He opined that educational attainment does not affect food waste behavior. Seventy-five percent of the respondent's impulse buying, while housewives' who were working or employed as well as others who were impulse buyers tended to waste more food. Households in the study area generate about 115g per person a day of food wastes higher than japons national average. Morisaki (2011) further disclosed that the total amount of food waste was 19 million tons and the food loss is estimated at 5-9 million tons which is 30 percent to 50 percent of the total food waste. This amount of loss is more than what is required to feed the worlds hungry which is about 7.5 million tons. In 2005 alone, households in Japan produced almost 11,000,000 tons of food waste and among them the food loss was about 2,000,000 – 4,000,000 tons. The portion of the household food loss was 40 percent of the whole food loss when both industrial and household food waste are considered.

Samuel *et al.* (2011) observed in a study post-harvest food losses reduction in maize production in Nigeria that the field where the crop was grown among others were identified as sources of insect infestation of the stored maize grains. This resulted in poor quality and loss of market grains. In a similar study on post-harvest losses of maize in Akure North Local Government area of Ondo state, Nigeria Folayan (2013) observed that major factors affecting household's food losses in the study area were inadequate finance, insect pest attack, high cost of transportation and price instability among others.

Banwat *et al.* (2012) in their study on factors affecting household food loss in rural community in north central Nigeria, the result showed that 66.2% of the household grew most of their consumed food on their farm land, 43.8% of the households spent between 25-50% of their monthly income on feeding their household members. Majority of the households (72.9%) dry and bag their farm produce after harvest.

Traditional household food storage technologies remain the prevailing storage methods in many rural communities in Nigeria. These technologies vary in shape and structure, and from one place to another depending on the agroclimatic conditions, ethnic and some socioeconomic factors (Adegbola, 2007). Wooden granaries are found in southern Nigeria and they are categorized into two types called the Ago and the Ava. The conical roofing of Ago is made up of straws and the body is made up of palm tree branches, while the Ava granaries have only a clinical body and straw roofing (Adegbola, 2007).

Adegbola (2010) observed that farmers used several traditional methods to preserve grains from insect attacks. These methods included exposition of maize cobs to the sun and use of products such as ash and leaves and placing of maize cobs over the fire place, where the smoke will dry the cobs and repel insects. Beside, some households spray pesticides on stored grains.

Kadjo *et al.* (2013) reported that several projects and technologies were designed to reduce food losses among which are the Danish project called programme of Appui au Development du secteur Agricole (PADSA). These projects disseminated projection measures such as chemical and integrated control methods of pest. The introduction of the improved storage structures had brought about significant reduction in household food losses to 5 percent and 1 percent respectively for improved wooden and hay made granaries.

Maboudou *et al.* (2004) in a post-harvest study in Benin, Nigeria opined that quality of the road, access to rural areas throughout the year and membership of association are some of the factors responsible for grain losses. Likewise, membership of an association may ease the transfer of information about household grain handling innovations and play a vital role in social safety for food security.

Adegbola (2010) also reported that storage protectant is presumed endogenous because studies and field observations revealed that many farmers face severe access constraints in obtaining improved technologies. He pointed out that protectant access constrained the adoption of new technology of grain handling practice. The most recommended chemical in protecting grains at household level is sofragrain, but in practice many farmers have access to farm pesticides and other uncertified chemicals to preserve grains at household levels which could endanger the health and lives of consumers.

Kadjo *et al.* (2013) observed that nearly 10 percent of the chemicals used were cotton pesticide applied on maize and there is statistical significance difference depending on the region and the type of grains handling technology used. Farmers who used chemicals have a lower expected losses ratio (P value 5%). In the south, the mean expected losses was close to 11 percent and can reach more than 50 percent.

Household food losses depend on farmer's storage technology. The rate of household food losses were eight percent on the average and approximates 11.5 percent in the southern part of Benin. Food losses increases from the south to the north. Farmers who apply chemical report a lower average rate of loss (around 6 percent) than the other farmers (8.5%). This difference was statistically significant at less than 1 percent (P value and T test) (Kadjo, *et al.* 2013).

Fulgie (2014) reported that only one variable among the household grain storage technology covariates is highly significant. The coefficient for plastic bags was negative and significant at P value less than 5 percent. Farmers who used polypropylene bags preserved less grain as they are used for multi-purpose such as transporting grain to market rather than storing for later use in household during the year. Chemicals used on the grains have the expected positive sign on food losses and the result are marginally significant (P values less than 13 percent). The Coefficient indicates that farmers who use storage protectant increase quality of maize preserved by nearly 196 Kilograms on average. The average amount kept at household by a respondent is about 2000 kilograms. The use of chemicals will therefore increase quantity kept by about 10 percent.

Barago (2013) observed in his study on factors affecting household food security in Miwara region of Tanzania, that 56.8 percent of all food was sold immediately after harvest. The study revealed that 75 percent of household storage structure were kitchen ceiling and 24.2 percent polythene bags. About 79.1 percent did not treat food before storage. About 33.5 percent of all food stored was destroyed during storage. About 61.5 percent of the households lost between 100-200kg, 27.2 percent lost between 201-400kg, 5.2 percent lost between 401-600kg while 6.1 percent lost more than 601kg. The study concluded that poor farming technology, excessive selling and poor storage facilities contributed to the household food losses in the study area. In their study reasons for household food waste, observed that packaging affects food waste in households. The study examined reasons of food waste in households and to what extent packaging influenced the amount of food waste. The result of the study revealed that about 20-25 percent of household food waste could be attributed to packaging. Three packaging dominate the packaging related waste; Packages that the consumer noted as being too long; packages that were difficult to empty and wastage because of passed "best before date" (Williams *et al.* 2012).

CONCLUSION

This Paper reviewed literature on economic implication of food grain losses on farming households in developing countries. Reduction in these losses will increase the amount of food availability for human consumption and enhance food security. This paper has highlighted the importance of reducing postharvest food losses as a necessary step in ensuring future global food security in a sustainable manner. Given the challenges posted by climate change and limited use of land and water resources, attention needs to be given to

measures to reduce losses along the farm to consumer chain. Reduced losses not only reflect an increase in food available for human consumption but they also reflect more judicious use of our limited natural resources. This implies reduction in foreign exchange spending, thus, improving the economy and per capita income. The annual value of food loss (estimated at US \$4billion) exceeds the value of total food aid Sub-Saharan Africa (SSA) received from 2000-2007 (estimated at US \$3-7billion), equivalent to annual value of cereal imports in Sub-Saharan Africa. It also equates to caloric requirement of 48million people at 2500 Kcal per person per day.

REFERENCES

- Adda, C., Borgemeister, C., Biliwa, A., and Markham, H. M. (2002) Integrated Pest Management in Post-Harvest, a case study from republic of Togo (West Africa). *Journal of Agriculture, Ecosystem and Environment*, vol.93 pp. 305-321.
- Adebayo, A.A. (2010) Food Security Status in Nigeria: Pre and Post Economic Deregulation Review: Department of Economics, Michael Otedola, College of Primary Education, Naforija, Epe, Lagos State, Nigeria. *International Journal of Economic Developmental, Research and Investment*, vol.1 (1) pp.135-140.
- Adegbola, G.C. (2010) Analysis of Maize Storage Innovations in Southern Benin, Dissertation for the Degree of Doctor, Wageningen University (Wageningen, Germany)
- Adegbola, A.C. (2007) The Effect of Information Sources on Technology Adoption and Modification Decisions. *Journal of Agricultural Economics*, vol. (37), pp55-65,
- Alexandratos, N. and Bruinsma, J. (2012) World agriculture towards 2030/2050, the saving water, From Field to Fork Curbing Losses and Wastage in the Food Chain, 2012 revision, Working Paper: FAO: ESA No.12.03 pp.4
- Barago, D.K. (2013) Factors Affecting Household Food Security: A case study of Miwara Rural District. Dissertation submitted to the Department of social work, University of Tanzania.
- Basappa, G., Geshmanya, J.B. and Patil, B.L. (2007): Post-Harvest Losses of Maize crop in Karnataka-An Economic analysis. *Karnataka Journal of Agricultural Science* 20(1), 69-71
- Basavaraja, H., Mahajanashetti, S. B. and Udagatti, N. C. (2007): Economic Analysis of Post-Harvest Losses in Food Grains in India: A Case Study of Karnataka. *Journal of Agricultural Economics Research Review*, 20 (1).
- Begum, M.E.A., Hossain, M.I. and Papanagiotou (2012): Economic Analysis of Post-Harvest Losses in Food Grains for Strengthening Food Security in Northern Region of Bangladesh. *International Journal of Applied Research*. Vol.(01)03 pp 56-65.
- Boxall, R.A. (2002) Damages and Loss caused by the Larger Grain Borer *protephanus truncates*, Integrated Pest Management, Reviews. vol.7, pp105-121.
- Buzby, J. C. and Hyman, J. (2012) Total and per capita value of food loss in United States. *Journal of Food Policy*. 37(5), 561-570.
- FAO (2011). Global Food Losses and Food Waste, FAO Rome.
- FAO (2012), The Effect of Reducing Food Losses and Food Waste on Global Food Insecurity, Natural Resources and Green House Gas Emissions
http://www/fao.org/world/food_situation/wfs-home/food_pricesindex/en
- FAO (2013). Global Food Losses and Food Waste, Extent, Causes and prevention, Rome.

- FAO (2014). Save Food: Global initiative on Food Loss and Waste Reduction. Definitional Framework of Food Loss, working paper, Feb. 2014 www.fao.org/foodloss,12/9/2017
- FAO (2017) www.fao.org/foodlossandfoodwaste.26/07/17
- Folayan, J.A (2013) Determinant of Post-Harvest Losses of Maize in Akure local Government Area of Ondo state, Nigeria. *Journal of sustainable society vol 2(1)* pp12-19.
- Fulgei, K. (2014) The Evolving Institutional Structure of Public and Private Agricultural Research. *American Journal of Agricultural Economics* 96 (3): 862-883.
- Gustavsson, J., Cederberg, C., Sonesson, U., Van, R. and Maybeck, A. (2011) Global Food Losses and Food Waste: Extent, Causes and Prevention, Rome. Food and Agriculture Organization of the United Nations.
- Hodges, R. J., Buzby, J. C. and Bennett, B. (2011) Postharvest Losses and waste in developed and less developed countries: opportunities to improve resource use. *Journal of Agricultural Sciences*, 149: 37-45.
- International Food Policy Research Institutes (2014) Sustainable solution for ending hunger and poverty, Brief No.2. Washington DC 20006-1002 USA.
- Jaspreet, A. and Regimi, A. (2013) Postharvest Food Losses Estimation, Development of Consistent Methodology.
- Kadjo, D., Ailbert, J.R., Alexander, C. and Tahiru, A. (2013). Effects of Storage Losses and Grain Management Practices on Storage: Evidence from Maize Production in Benin. Paper presented at the Agricultural and Applied Economics Associations AAEEA Joint Annual Conference Washington DC. 1st September, 2012.
- Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L. and Waite, R. (2013) Reducing Food Losses and Waste, Working Paper, Instalment, of Creating a Sustainable Food Future, Washington DC, World Resource Institute.
- Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L., Waite, R. and Tim, S. (2013) Reducing Food Losses and waste, instalment 2 of creating a sustainable Food Future. World Resources Institute Working Paper.
- Maboudou, A.G., Adegbola, P.Y. and Amouzou, M.E. (2004) Factors Affecting the use of Improved Clay Store for Maize Storage in the Central and Northern Benin. In: Fischer: T. (ed), New Direction for a diverse planet. Proceedings of the 4th international crop science congress, Brisbane, Australia, 26 september to 1st October, 2004.
- Morisaki, I. (2011) Pattern of Food Losses in Households: A case study in Japan. Thesis presented to the Higher Degree Committee of Ritsumeikan Asia Pacific University.
- Musemwa, L., Zhou, L., Nahleve, S and Aghdas, F. (2013) Factors Affecting Household Access to Enough Food in Eastern Cape Province of South Africa. *Journal of Development and Agricultural Economics*, Vol.5 (3) pp84-91
- Nohman, A., Lange, W., Oelafee, S. and Geofry, L. (2012): The Cost of Household Food Waste in South Africa. <http://dx.dio.org/10.1016/i.wasman,2012,012>
- Park, A. (2006) Risk and Household Grain Management in Developing Countries, *Economic Journal* vol.116 pp1088-1155.
- Regimi, A., Deepak, M. S., Scale, J. L. and Bernstein, J. (2011): Analysis of food consumption pattern. *Journal of Tropical Agriculture*. 121: 121-133.
- Rutten, M.M., (2013) What Economic Theory tells us about the impacts of reducing food losses and/or waste: implication for research, policy and food security. *Agricultural and food security* DoI:10.1186/2048-7010-2-13.

- Segre, A., Falasconi, L., Politano, A. and Vittuari, M. (2014). Save Food, Global Initiative on Food Loss and Waste Reduction. Working Paper on Economics of food loss and waste, university di Bologna, Italy.
- Speranza, C.T., Kiteme, B. and Weismann, U. (2007) Drought and Famine: the Underlying Factors and the Casual Links Among Agro-pastoral households in Semi-Arid Makueni District, Kenya. <http://dx.dio.org/10.1016/j.gloencha.2007.05.001>
- Voices Newsletter (2006): Available online at: <http://www.famradio.org/wpcontent/uploads/voices-79pdf>. Accessed April 2, 2013.
- Williams, H., Wikstron, F., Otterbring, T., Martin, L. and Anders, G. (2012): Reason for Household Food Waste with special attention to packaging *Journal of cleaner production* vol. 24, pp 141-148.
- World Bank (2011) The Challenge of Hunger in Africa: A call for action: Washington DC. International Bank for Reconstruction and Development.
- World Hunger News (2017) PS:/www.worldhunger.org.com
- Zakari, S., Ying, L. and Song, B. (2014) Factors Influencing Household Food Security in West Africa: The Case of Southern Niger. *Journal of Sustainability*, 6, 1191-1202 pp.1193-1194