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FOOD SECURITY, SUSTAINABILITY AND POST-HARVEST TECHNOLOGY AS A TRIPOD FOR NATIONAL SECURITY

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Abstract

Food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food. Food security is one of the indicators of assessing gross domestic Product (GDP), impacts on human well-being outcomes and National security; it depends on food availability, access, utilization and stability. Sustainability foods systems are affected by factors which include price volatility, climate change, food losses and waste. The term "Sustainable food" has been used as a way to combine the concepts of food security and sustainability. Both food security and sustainability depend upon the post-harvest technology for their stability. This paper seeks to illuminate the potential of review of literatures on climate change, food security, sustainability and post-harvest Technology. Relationship between food systems, and food security were examined, while the concept of post-harvest technology and roles in sustainable food production for food security was addressed. Interrelationships between food security, sustainability and Post-harvest Technology were enumerated.

1.0 Introduction

Food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food. Food security is one of indicators of assessing gross domestic Product (GDP) and also has impacts on human well-being outcomes; it depends on food availability, food access, food utilization and stability. Climate change is the worst threat to food security and the projections are devastating. Soon, our agricultural practices may not be able to meet the world's demand for food due to impacts of climate change. The absence of sustainability measures today implies a social and moral responsibility from governance, policy makers, farmers, and consumers to do their part in combating world hunger. Reducing risks to food security from climate change is one of the major challenges of the 21st century. Researchers' such as [1 – 3] recognised impacts of climate changes on agriculture which has being given the serious threats to food security. There is growing global recognition of the urgent need to identify and implement strategies that make food systems more resilient in the face of increasing climate variability. Africa is one of the world's most vulnerable regions to climate change [4 – 5], because most Africans' livelihoods and agri-food systems rely on rainfed farming. This climate change has created uncertainties on level of agricultural production globally; because not knowing exact shape of future climates or even next season, and these uncertainties are unlikely go away in the next decade [6]. Agriculture is important for food security in two ways: it produces the food people eat; and (Perhaps even more important) it provides the primary source of livelihood. Lack of attention to broader food security determinants attributed to uncertainties about the impacts of climate changes on food security. Climate change always has impacts on all dimensions of food security, namely availability, access, utilisation and stability, and has impacts over the whole food system [7]. It also has an impact on human health, livelihood assets, food production and distribution channels, as well as changing purchasing power and market flows [5]. Food availability is probably most frequently used as a measure of food security and it has a channel with climate change which directly affects food security [8]. The major direct impact of climate change is expected to have on food security is through food availability component due to changes in agricultural productivity [9]. This climate change reduces crop yields and in turn increase the price of food that force people to change production and consumption patterns and directly reduces calorie intake [10]. Sustainability foods systems are affected by these factors include price volatility, climate change, biofuels, and food losses and waste [11]. Food losses have an impact on food security for poor people, on food quality, safety, on economic development and on the environment. Food losses represent a waste of resources used in production such as land, water, energy and inputs, therefore, it affecting both food security and sustainability [12]. Although minimizing postharvest losses of already produced food is more sustainable than increasing the production to compensate for these losses [13]. Economically, avoidable food losses have a direct and negative impact on the income of both farmers and consumers. A major challenge in achieving sustainable food systems is the food security. The environmental and sustainability factors affecting long-term conditions for a food secure future. A sustainable food system supports food security, makes optimal use of natural and human resources, is culturally acceptable and accessible, environmentally sound and economically fair and viable. Besides, it provides the consumer with nutritionally adequate, safe, healthy and affordable food for present and future generations [11]. Sustainability should be considered as part

of the long-term time dimension in the assessment of food security. The concept of sustainable food could play a key role as a goal and a way of maintaining nutritional well-being and health, while ensuring the sustainability for future food security. This work was set out to examine the concept of food security and sustainability and the factors affecting both food security and sustainability. The concept of post-harvest technology and interrelationship between sustainability and post-harvest technology for National security was also treated.

2.0 Materials and methods

This report was based on a review of literature and personal observation and group discussion.

2.1 Food security:

It is defined by the United Nations' Committee on World Food Security, is the condition in which 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 [4]. Food Agricultural Organization [11] highlighted that "food security depends more on socio-economic conditions than on agroclimatic ones, and on access to food rather than the production or physical availability of food". Food security is built on four pillars: availability, access, utilization and stability. It stated that, to evaluate the potential impacts of climate change on food security, "it is not enough to assess the impacts on domestic production in food-insecure countries. One also needs to (i) assess climate change impacts on foreign exchange earnings; (ii) determine the ability of food surplus countries to increase their commercial exports or food aid; and (iii) analyse how the incomes of the poor will be affected by climate change" [4].The food systems were linked to food security by "dynamic interactions between and within the biogeophysical and human environments lead to the production, processing, preparation and consumption of food resulting in food systems that supported food security" [14].

Food availability: It refers to the existence of sufficient quantities of food with appropriate quality, and supplied through domestic production or import [8]. Food availability is probably most frequently used as a measure of food security and it has a channel with climate change which directly affects food security [15]. The major direct impact of climate change is expected to have on food security is through food availability component due to changes in agricultural productivity [9].

Food accessibility: Access to food refers to the ability of individuals, communities and countries to purchase food in sufficient quantities and quality [16]. Accessibility depends on the transport infrastructure; fewer roads mean reduced food access.

Food utilization: It depends on how food is used, whether food has sufficient nutrients and whether diet can be maintained. Food utilization refers to the individual or household capacity to consume and benefit from the food [11]. Although food availability and access are necessary conditions for food utilization, they are not sufficient conditions to reduce malnutrition. A household which has physical as well as economic access to food could be food insecure if it cannot get a balanced and nutritious diet [17]. The utilization component of food security is generally related to nutritional aspects of food consumption. Evidence indicates that more frequent and more intense extreme weather events (droughts, heat and cold waves, heavy storms, floods), rising sea levels and increasing irregularities in seasonal rainfall patterns (including flooding) are already having immediate impacts on not only food production, but also food distribution infrastructure, incidence of food emergencies, livelihood

assets and human health in both rural and urban areas.

Food system stability: The concept of stability can therefore refer to both the availability and access dimensions of food security.

2.2 Food Systems: It is sometimes referred to as a food chain. Global Environmental Change and Food Systems [18] defined food systems as processes that encompassed (i) activities related to the production, processing, distribution, preparation and consumption of food; and (ii) the outcomes of these activities contributing to food security (food availability, with elements related to production, distribution and exchange; food access, with elements related to affordability, allocation and preference; and food use, with elements related to nutritional value, social value and food safety). The outcomes also contribute to environmental and other securities (e.g. income).

2.3 Sustainability: It is based on concept of sustainable food. There is no legal definition of 'sustainable food,' Our working definition for good food is that it should be produced, processed, distributed and disposed of in ways that:

- Contribute to thriving local economies and sustainable livelihoods
- Protect the diversity of both plants and animals and the welfare of farmed and wild species,
- Avoid damaging or wasting natural resources or contributing to climate change;
- Provide social benefits, such as good quality food, safe and healthy products, and educational opportunities.

[19] reported that sustainability should be considered as part of the long-term time dimension in the assessment of food security. From such a perspective the concept of sustainable food could play a key role as a goal and a way of maintaining nutritional well-being and health, while ensuring the sustainability for future food security. A major challenge in achieving sustainable food systems is the food security. Infrastructures contribute to food sustainability. Sustainability is affected by price volatility, biofuel, infrastructures, food losses and waste. Inadequacy of food infrastructure could lead to food losses and waste. The factors affecting food security also affect sustainability. It is not possibility of achieving a food secure in the world without sustainable development. The main objective of sustainability focuses explicitly on food by seeking to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture which leads to National security. This objective can be achieved only by application of on climate change adaptation and mitigation and application of post-harvest technology. Characteristics of a sustainable food system are outline below [20]:

(i) is secure, and therefore reliable and resilient to change (including climate change, rising energy prices, and others) and accessible and affordable to all members of society:
(ii) is energy efficient'
(iii) is healthy and safe;
(iv) is environmentally beneficial or benign'
(v) contributes to both community and ecological health;
(vi) builds soil quality and farmland through the recycling of organic waste;

(vii) supports multiple forms of urban as well as rural food production'
(viii) ensures that food processing facilities are available to farmers and processors;
(ix) preserves biodiversity in agro-ecosystems as well as in the crop selection;
(x) Reduction of losses and waste

The connection between food security and food system sustainability include the reduction of food losses and waste [21]. [21] highlighted that Food Security for achieving food and nutrition security involves (a) ensuring consistent availability and accessibility of sustainably produced, nutritious and safe food; and (b) reducing and/or eliminating losses and waste in food production, processing and consumption. Food production and availability should be increased in ways that are environmentally, socially and economically sustainable.

3.0 Food losses and food waste

Definition of food losses and food waste: Food losses refer to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption. Food losses take place at production, postharvest and processing stages in the food supply chain [22]. Food losses occurring at the end of the food chain (retail and final consumption) are rather called "food waste", which relates to retailers' and consumers' behaviour. [22] reported that food waste or loss is measured only for products that are directed to human consumption, excluding feed and parts of products which are not edible. Per definition, food losses or waste are the masses of food lost or wasted in the part of food chains leading to edible products going to human consumption. In the developing world, most food is wasted before it reaches the consumer. Inadequate anti-pest safeguards such as proper silos account for significant loss, whilst poor road infrastructure and lack of proper refrigeration leads to goods spoiling whilst in transit. Adverse weather conditions and disease can also have a significant impact.

3.1 Causes and prevention of food losses and waste

The causes of food losses and preventive have been reported by [12, 23 – 28] which includes:

(a) *Inadequate Marketing Systems*: This problem exists mostly in developing countries. It is accentuated by lack of communication between producers and receivers, and lack of market information [12].
Preventive: Marketing cooperatives should be encouraged among producers of major commodities in important production areas. Advantages of marketing cooperatives include: providing central accumulation points for the harvested commodity, purchasing harvesting and packing supplies and materials in quantity, providing for proper preparation for market and storage when needed, facilitating transportation to the markets, and acting as a common selling unit for the members, coordinating the marketing program, and distributing profits equitable [12].

(b) *Inadequate Transportation Facilities*: In most developing countries, roads are not adequate for proper transport of agricultural products. The majority of producers have small holdings and cannot afford to own their own transport vehicles [24].
Preventive: In a few cases, marketing organizations and cooperatives have been able to acquire transport vehicle and, but

they cannot do much about poor road conditions [24].

(c) *Production exceeds demand.* In order to ensure delivery of agreed quantities while anticipating unpredictable bad weather or pest attacks, farmers sometimes make production plans on the safe side, and end-up producing larger quantities than needed, even if conditions are "average".[28]

Preventive: Communication and cooperation between farmers. Cooperation among farmers could reduce of overproduction by allowing surplus crops from one farm to solve a shortage of crops on another [28].

(d) *Lack of Information*: Most handlers involved directly in harvesting, packaging, transporting, and marketing in developing countries have limited or no appreciation for the need for, or how, to maintain quality [28].

Preventive: An effective and far-reaching educational (extension) program on these aspects is needed critically now and will continue to be essential in the future [28]

(e) *Poor Maintenance*: In many developing countries, some good facilities that were built a few years ago are currently "out of order" or not functioning properly because of lack of maintenance and unavailability of spare parts. This problem is especially true of public- sector facilities [23].

Preventive: Any new project should include in its plan adequate funds for maintenance to ensure its success and extended usefulness [23]

(f) *Lack of processing facilities.* In many situations the food processing industry doesn't have the capacity to process and preserve fresh farm produce to be able to meet the demand. Part of the problem stems from the seasonality of production and the cost of investing in processing facilities that will not be used year-round [27].

Prevention: develop contract farming linkages between processors and farmer. Governments should create a better 'enabling environment' and investment climate, to stimulate the private sector to invest in the food industry and to work more closely with farmers to address supply issues [27].

(g) *Poor storage facilities and lack of infrastructure:* Fresh products like fruit vegetables, meat and fish straight from the farm or after the catch can be spoilt in hot climates due to lack of infrastructure for transportation, storage, cooling and markets [27 – 28].

Preventive: Governments should improve the infrastructure for roads, energy and markets. Subsequently, private sector investments can improve storage and cold chain facilities as well as transportation [26]

(h) *The herdsmen/farmers crisis*: This crisis has slowed down economy activities. In these situations the agricultural product and human life were lost due to herdsmen invasions in Nigeria. It also has negative impact on food security.

Preventive: Governments should establishing grazing reserves (ranching) and enact ant-grazing law. Advantages of establishment of ranching and ant-grazing law: Preventing the clash between the farmers and heard men and also eliminating the destroying of farm produce. Besides, planting jathropha, senna alata and castor plants their smell of those plants put animals off

4.0 Post-Harvest Technology

Post-harvest technologies constitute an inter-disciplinary science and techniques applied to agricultural commodities after harvest for the purpose of preservation, conservation, quality control/enhancement, processing, packaging, storage, distribution, marketing, and utilization to meet the food and nutritional requirements of consumers in relation to their needs. Postharvest technology involves all treatments or processes that occur from time of harvesting until the food stuff reaches the final consumer's table

4.1 Importance of Post-harvest Technology

: The important are as follows: (i)Prevents post-harvest losses; (ii) improves nutrition; (iii) adds value to agricultural products; (iv) opens new marketing opportunities, introduction high yielding and (v) generates new jobs.

The three main objectives of applying postharvest technology to agricultural produce are: (1)to maintain quality (appearance, texture, flavour and nutritive value);(2) to protect food safety, and (3) to reduce losses between harvest and consumption.

4.2 Post-Harvest Industries

The post-harvest industry includes the following main components:
Harvesting and threshing; Drying and storage; Processing (conservation and / or transformation of the produce); Utilization by consumer including home processing
Other components of the system include**:**
Transportation and distribution; Marketing; Grading and quality control; Pest control; Packaging; Communication among all concerned; Information, demonstration and advisory systems; Manufacture and supply of essential equipment and machinery; Financial control; Price stabilization, and Management and integration of the total system.

5.0 The Interrelationship between Food Security, Sustainability and Post-harvest Technology.

Food security components are the accessibility, availability and utilization. All the components depend on post-harvest Technology industries for their stability. Sustainability can be referred to sustainable food and it is affected by food losses and waste. The food losses and waste can be prevented by post-harvest technology. The interrelationship between food security, sustainability and post-harvest Technology is presented in Fig. 1. Food security must be national security priority.

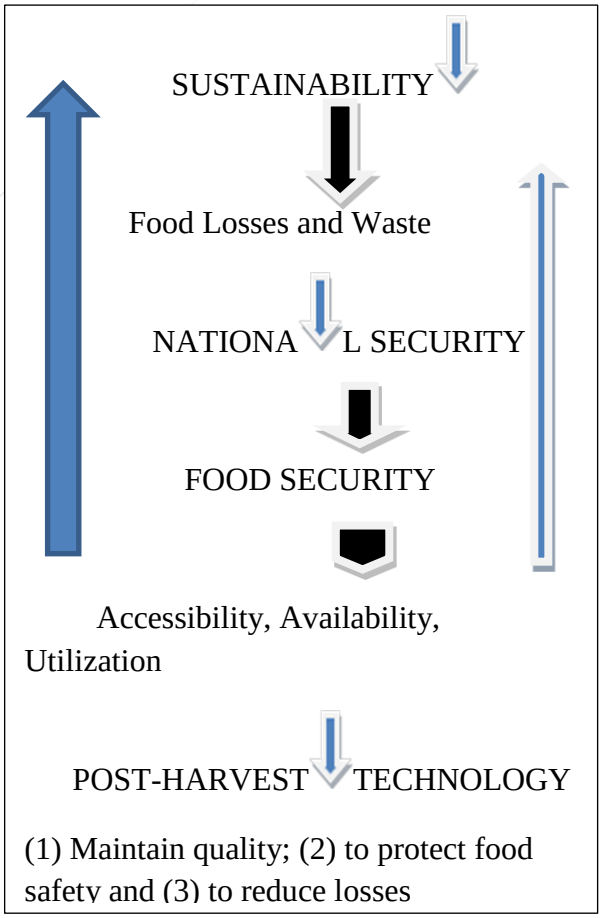

Figure: 1 Interrelationship between food security, sustainability and post-harvest Technology

6 Conclusions and Recommendations

6.1 Conclusions

Both food security and sustainability are affected by climate change. Food security depends on availability, accessibility, utilization and stability, while sustainability is affected by price volatility, biofuel, infrastructures, food losses and waste. Sustainability diets are goal and way of maintaining nutritional well-being and health and also ensuring the sustainability for future food security. Postharvest technology research and education have a major impact on reducing food losses and waste, enhancing sustainability and food security, leading to improved human well-being outcomes (access to food, shelter, clothing, education and health) which promoting national security

6.2 Recommendations

Cultivar adjustment (e.g., developing new crop varieties that are tolerant to drought, heat and salt via breeding or genetic modification)

Sustainability should be an integral part of food security planning

Private should involve in large agricultural production

Government should provide Policies that support agriculture's enabling environment and also invest on research, innovation and rural infrastructural development

Relocating buildings and roads that have experienced repeated flooding can reduce future risk.

Government should ensure that food security as integral to its national security.

An integrated approach for postharvest science and education from grade school through trade school or university could help to reduce global food losses, by integrating postharvest information into the general agricultural curriculum in each country or state and their extension services, with much more emphasis on preventing losses, maintaining quality and nutritional value after harvest and ensuring food safety.

Establishing a Postharvest Working Group in each country could be very useful in providing a forum for communications among all those concerned with postharvest biology and technology research and outreach. A link among the various Postharvest Working Groups in each region would further facilitate exchange of information and regional collaboration on training and other areas of mutual interest, and help to reduce duplication of efforts.

Actions should not only be directed towards isolated parts of the food chain, since what is done (or not done) in one part has effects in others.

Crop storage structure should be located on a land where there is no chance of flood

Creation of procurement and warehouses in the federal and State levels

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