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Assessment of Post-Harvest Management System of Cassava Production in Ogun State, Nigeria

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DECLARATION

I hereby declare that this thesis titled “Assessment of Postharvest Management system of cassava production in Ijebu-Ode, Ogun State, Nigeria.’’ is original and has been carried out by me as part of my program of study. I also confirm that all secondary materials has been properly acknowledged by me and referenced in my work with the help of my supervisor.

27th April 2017, Prague ……………..…………………

Sangodare Korede.O.

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ABSTRACT

Agriculture is noted as the back bone of many developing countries such as Nigeria. The development of the sector is faced with many challenges and one such challenge is post harvest losses. Post harvest losses which is the measure of both qualitatve and quantitative loss in a given product. These looses can occur during any of the various phase of post harvest system, such as on- farm losses, when grain is threshed,winnowed and dried also during transportation, storage and processing.The need for prevention of post harvest losses for an indigenous crop grown by subsistence farmer that will bring economic benefit is very important.

This study focused on various post harvest management practice of cassava production among small scale farmers in Ijebu ode, Ogun State, Nigeria. The study area and the crop (cassava) was selected because of its popularity, being one of the main crop planted and major staple food in the region. In addition, this study further helped to adddress the problems assocaited to this crop and the effect of post harvest losses in relation to food security of that region. 120 small scale cassava farmers were selected radomly and interviewed in the region for this purpose. A structured questionairre was administered to the farmers across 12 villages in the local goverment area. Data was collected using simple random sampling method and use of Chi-square with contingency tables was adopted for the analysis of the data.

The study revealed the different post harvest management practices among the smal scale farmers, the various stages and degree of losses experienced by these farmers, the type of support they received from goverment and NGOs. The study also evaluated the benefits they receive for belonging to an association. The study finds out the practices adopted by these farmers had an impact on their out put, sales and revenue earned. In addition, the study also revealed the socio characteistics of the farmers such as age and education also affect the adoption of new prctices.

The study concluded that post harvest practices adopted contributes to post harvest losses and the age, eduactional status and years of farming play a significant role in the adoption of new methods.

Keywords: Small scale farmers, Post Harvest loss, Management system, Farming systems, Nigeria.

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LIST OF ABBREVIATIONS

CAGR	Compound Annual Growth Rate
CPHP	Colorado Physician Health Program
FMARD	Federal Ministry of Agricultural and rural development
IMARC	India Marketing Research Group
GDP	Gross Domestic Product.
IITA	International Institute of Tropical Agriculture
NBS	National Bureau Statistic
FAO-	Food and Agriculture Organisation
RUSEP	Rural Sector Enhancement Project
OFN	Operation Feed the Nation
NGOs	Non -Governmental Organisations
SPSS	Statistical Package for the Social Science
USDA	United States Academic Decathlon
EU	European Union
PPD	Postharvest Physiological Deterioration
HQCF	High Quality Cassava Flour
CIAT	International Centre for Tropical Agriculture
WHO	World Health Organisation

1 INTRODUCTION

Postharvest management is pivotal in the agricultural sector of any country, as success in agricultural production and in marketing hinges upon proper postharvest handling, storage, and processing of cereals, oil seeds, legumes and horticultural crops (Andrew, 2002). Postharvest technologies are applied in the quality maintenance, conservation, processing, packaging, distribution and marketing of fresh agricultural produce. These technologies in turn stimulate agricultural production, reduce losses, improve nutrition and add value to products resulting in the generation of employment, reducing poverty and stimulating growth within other related economic sectors (IITA, 2010).

Cassava (Manihot esculenta Crantz) is a perennial woody shrub with an edible root, which grows in tropical and subtropical areas of the world Cassava plays a particularly important role in agriculture in developing countries, especially in sub-Saharan Africa, because it does well on poor soils and with low rainfall, and because it is a perennial crop that can be harvested as required. Its wide harvesting window allows it to act as a famine reserve and very useful in managing labour schedules. It offers flexibility to resource-poor farmers because it serves as either subsistence or a cash crop (Stone, 2002).

Cassava is a major staple crop in Nigeria. Cassava and its product are found in the daily meals of Nigerians. Currently, cassava is undergoing a transition from a mere subsistent crop found on the field of peasants to a commercial crop grown in plantations. The unprecedented expansion on this crop is attributed to its discovery as a cheap source of edible carbohydrate that could be processed into different forms of human delicacies and animal feeds (El-Sharkawy, 2003).

Post-harvest handling of cassava begins the moment it is harvested. It ranges from simple uprooting/lifting of the roots from the ground, ferrying them to the house for immediate consumption after cooking or subjected to sophisticated preparatory methods of processing into high quality food products. On the other hand, processing of cassava and other root crops into more storable forms offers an opportunity to overcome perish ability of the fresh produce which results in safe, palatable and storable products (El-Sharkawy, 2003). It provides a means of adding value to the crop. In addition, cassava processing is a means of stabilizing them to improve storage, increase shelf life and provide income generation opportunities especially for women in the rural areas (CPHP, 2000).

Several post-harvest problems have, however, reduced effective commercialization of the crop. Fresh cassava roots have a very short shelf-life of less than 72 hours after harvest in which post-harvest losses of more than 23% for freshly harvested roots have been reported. Therefore, cassava roots need to be processed to reduce these losses (Hahn, 2004).

The crop is used in diverse forms such as fresh root boiled and eaten as a snack or roots prepared into crisps or dried chips. Dried cassava chips are milled into flour to make stiff porridge and common porridge. The end products tend to be of low quality thus creating a need for improved processing into more stable products such as fermented and non-fermented flours, high quality sun dried chips, starches and culinary products (Hahn, 2004).

In addition, processing does not only improve shelf life but also reduces bulkiness, diversify products and enhance acceptability and marketability. On the other hand, fresh cassava contains varying amounts of cyanide which is toxic to both humans and animals, therefore, processing eliminates or reduces cyanogenic compounds to a safe level (WHO, 2006)

The importance of postharvest technology lies in its capacity to meet the food requirements of growing populations by reducing losses and increasing the production of nutritive food items from raw materials through processing and fortification. Postharvest technology also has a high potential to create rural industries.

Therefore, there is a need for the development of appropriate technologies for the establishment of agriculturally based rural industries in which farmers whose primarily role have been limited to production, should also engage in processing activities, thus increasing their earning potential (Wenham, 2005).

The project is aimed at accessing the post-harvest management practice of cassava in the eastern region of Nigeria, Ogun State. The region has been selected as a result of the characteristic predominant farming activities carried out by small-scale in this area. Post-harvest losses have caused significant food shortage and food insecurity in Ogun State especially among the small-scale farmers. Cassava is used as the crop of choice for the case study for this purpose due to the fact that it is one of the major crops planted and consumed in this region. In addition, this will further help to address the problems associated with cassava and also the effect of post-harvest losses related to the crop in this region.

2 LITERATURE REVIEW

2.1 The concept of Post-Harvest management

Postharvest management is a set of post-production practices that includes: cleaning, washing, selection, grading, disinfection, drying, packing and storage. These remove undesirable elements and improve product appearance, as well as ensuring that the product complies with established quality standards for fresh and processed products.

In addition, post-harvest losses have been termed as the reduction and depreciation in the quality and quantity of crops from the period of harvesting to consumption. Loss in quality and quantity of crops may arise at the nursery stage, planting stage, harvest stage and post-harvest stage.

Quality losses are usually the reduction in the nutritional value and edibility of the crops. This is a common occurrence in developed countries where farm produce are usually nurtured and preserved by artificial and generic engineering mean (Kader, 2002). Quantity losses on the other hand involve the reduction in the amount of crops usually at the post-harvest stage. A quantity loss usually arises at the post-harvest stage in the course of conversion of the crops to other consumable forms. This is therefore common in developing countries where the system of handling, storing, processing and transporting is poor (Kitinoja and Gorny 2010).

Postharvest practices also includes the management and control of variables such as temperature, relative humidity, selection, packaging and the application of supplementary treatments such as fungicides (FAO, 2011). The aim of postharvest management is therefore intended to maximize the added value which ultimately would benefit the whole community either through increased export earnings or extending the availability of fresh produce through the year. Conversely losses hurt everyone (FAO, 2013).

In addition, postharvest research aims to understand the influence of various factors and systems on postharvest conditions. The phenotypic quality of produce is based on genetic traits that are expressed through a cascade of reactions subjected to complex regulatory mechanisms and diverse environmental conditions. Ultimately, to fully understand postharvest phenomena, a systemic approach that links genetic and environmental responses which identifies the underlying biological networks is required. This is achieved by the development of high throughput omics techniques such system-wide approaches which have become a viable option to support traditional postharvest research (Hertog et al. 2011).

2.2 Nigeria Agricultural Sector

Nigeria is a country with a population of over 188.3 million and a GDP growth of $481.1 billion (World Bank, 2015). 70% of its population is engaged in agricultural production which makes it one of the important sectors in the country and it contributes 30% of the total annual GDP.

Nigeria is one the tropical regions of the world where cassava is highly produced. Cassava farming is practice at both subsistence and commercial level. Despite being regarded as the largest cassava producer in the world with a production of about 40 million metric tons, Nigeria is still missing out of the international trade.

After the independence in 1960, there has been a continuous increase in the population growth while the agricultural food production has declined as a result of the oil discovery in 1963. These increasing gaps between the population and food production in the country have resulted in an increase in food price.

Subsequently, the government established some developmental institutions, special programs and project to combat the disproportion between the population growth and food production. The institutions includes Agricultural Development Bank (ABD 1975), Operation Feed the Nation (OFN 1976), National Seed Service (NSS 1977), Nigeria Agricultural Cooperative and Rural Development Bank (NACRDB 2000), National Agricultural Development Fund (NADF 2002). Although, empirical records shows that most of these programmes and projects did not actually produce the transformation expected in the sector.

Moreover, recent evidence shows that cassava production has increased from 1999 to date (FMARD) but the post-harvest system such as processing, packaging, marketing, distribution and transportation have constrained sustainable cassava production in recent times (RUSEP 2000). Nigeria records over 40% post-harvest losses which have led to unprecedented hike in food importation in the country. Therefore, a reduction in the post-harvest losses could result in food availability thereby, reducing the need for importation.

In addition, in Nigeria, agricultural crops are usually lost at the post-harvest stage as a result of theft, invasion of predators and pest. The factors also include improper storage, handling, transportation, environmental hazards and wastage during conversion. These factors are connected to improper security of harvested crop, inadequate education of the farmers, and lack of proper supply chain and infrastructures which is fragile in developing countries.

2.3 Post Harvest loss and Food security

According to World food summit in 1996, food security exists when people have physical and economic access to food at all time in sufficient quantity and quality needed for their daily activities (World Bank, 1996). Food security touches on all the dimensions of human security such as economics, social relations, health, community development and structures of political power, and the environment. Therefore, food security has to be approached in a holistic way that recognises the complexity of intersecting multidimensional processes operating at all spatial scales (from the global to the individual), and in ways which are temporally discontinuous (IITA, 2010).

Food loss and food wastage account for the constraint to food security in which there is significant wastage across all food types. Per capita food loss in Europe and North America was reported to be high at about 95-115kg/per year, while in Sub- Sahara and south East Asia records about 6-11kg/per year (FAO, 2011). Total food losses in Sub-Saharan Africa were approximated to be worth $4 billion per year, an amount which can feed 48 million people (FAO, 2013). Losses on cereals are estimated to account for about 25% of the total crop harvested while losses can be even greater in perishable crops, which account for about 50% of harvested fruits, vegetables and root crops (Voices Newsletter 2006).

2.4 Cassava Production

Cassava, also known as (Manihot esculenta crant), is a root crop grown in tropical regions of the world. The woody shrub may grow from one to three meters in height depending on the species and the general planting condition. It is native to tropical America and has spread across many tropical regions of the world where it is consumed by millions of people. The high demand for cassava has made it to account for about 30 percent of roots and tubers produced in the world. It is a tuber crop very rich in carbohydrates and has the capacity to tolerate seasonal draught than any other root plant. It can survive under extremely poor condition even in acidic soil. Cassava has over five thousand varieties in which each has its distinguishing qualities and ability to adapt to different environment according to its nature.

Despite its popularity in tropical region, it is infamous for its toxicity. Its root and leave, if not properly examined, may be dangerous for consumption. Although, the mode of processing can remove the cyanide which is a poisonous substance in the crop (FAO, 2013).

Cassava is the fourth supplier of dietary energy in the tropics (after rice, sugar and maize) and the ninth world-wide. Its cultivation and processing provide household food security, income and employment opportunities for 500 million people in Africa, Asia and the Americas. The crop is tolerant of low soil fertility, climatic conditions, and most pest and diseases with no critical date of harvest. These attributes have made cassava into a crop of primary importance for the food security. In communities having access to markets, cassava can become a good source of income and employment for both men and women (CIAT, 2004).

In addition, cassava is a staple food in tropical countries and provides more than 10 percent of the daily dietary caloric intake to about 300 million people in 15 African countries and in Paraguay. In the Democratic Republic of Congo, cassava is estimated to provide more than 1000 kcal/day to over 40 million people. However, in Thailand, the third world largest producer, cassava contributes less than 1 percent to the dietary calories in which about 90 percent of the total produce are exported mainly to Europe while the remaining amount is mostly used for industrial applications (Cassava Master Plan, 2006).

Despite its importance, cassava is mostly grown by small scale farmers on small plots of land. Urban consumers and factories obtain their cassava from rural areas where it is grown. Cassava root is usually processed instantly after it is taken from the ground because it is highly perishable nature. Spoiling starts within 48 to 72 hours after harvest. A mature cassava root (hereafter referred to as 'root') may range in length from 15 to 100 cm and weigh 0.5 to 2.5 kg. Circular in cross-section, it is usually fattest at the proximal end and tapers slightly towards the distal portion. . Cassava roots are used only to store energy, unlike the roots of sweet potato and yam that are reproductive organs. It is connected to the stem by a short woody neck and ends in a tail similar to a regular fibrous root (CIAT, 2004).

Furthermore, cassava is the source of raw materials for a lot of industrial products such as starch, flour and ethanol. The production of cassava is relatively easy as it is tolerant to the biotic and edaphic encumbrances that hamper the production of other crops. in spite of their agronomic advantages, root crops are far more perishable than the other staple food crops. Once out of the ground, some root crops have a shelf life of only few days. Roots as living part of plants continue to metabolize and respire after harvest. Cassava has a shelf life that is generally accepted to be of the order of 24 to 48 h after harvest (Andrew, 2002).

Cassava utilization patterns differ considerably in different parts of the world. In Nigeria, the majority of cassava produced (90%) is used as human food (IITA, 2010). Cassava is very resourceful and its derivatives are applicable in various types of products such as foods, confectionery, sweeteners, glues, plywood, textiles, paper, biodegradable products, monosodium glutamate, and drugs. Cassava chips and pellets are used in animal feed and alcohol production. Animal feed and starch production are just minor uses of the crop in Nigeria. Cassava, in its processed form, is a reliable and convenient source of food for tens of millions of rural and urban dwellers in Nigeria (IITA, 2010).

Figure 1: Harvested cassava

Source: IITA, 2010.

2.5 Global production of cassava

More than 240 million tons of cassava was produced globally in 2012, of which Africa accounted for 58% (IITA, 2012). Nigeria currently produces about 54 million metric tonnes (MT) per annum (FAO, 2013), making her the highest cassava producer in the world, producing a third more than Brazil and almost double the production capacity of Thailand

and Indonesia. However, Nigeria is missing out of cassava trade in the international markets because most of her cassava is targeted at the domestic food market. The production methods are primarily subsistence in nature and therefore unable to support industrial level demands (FAO, 2013). In Ghana, cassava accounts for a daily caloric intake of 30% and is grown by nearly every farming family. The importance of cassava to many Africans, cassava is the fifth-largest crop in term of production, after rice, sweet potato, sugar cane and maize. China is also the major export market for cassava produced in Vietnam and Thailand. Over 60% of cassava production in China is concentrated in a single province, Guangxi, averaging over 7 million tons annually (Frederick, 2008). Cassava leaves are important in some countries, like Sierra Leone, where leaves have greater market value than roots. In the subtropical region of southern Chi

The world trade in cassava pellets have since been dominated by Thailand, beginning around 1967, a few years after the starting of its cassava exports to the European Union (EU). Although Thailand exports cassava chips and pellets to other Asian countries, especially China, where pellets are used both for animal feed and for the production of ethanol, the production and trade in cassava starch has significantly increased in recent years. Cassava starch has product characteristics that are precisely superior to those of maize, starch and this sub-sector promises to be a viable new market segment for industrial cassava (IITA, 2010).

Furthermore, in order to meet with the global starch demand, large companies specializing in the production of starch and modified starch have invested hugely in Thailand, Brazil and Indonesia. Cassava flour is also largely consumed in Brazil and in most of Latin America region, as farinha (farinha is important only in Brazil), with various levels of sophistication in its processing from primitive family to large mechanized methods in factories (IITA, 2011).

2.6 The Nigerian Cassava industry

Over time, cassava has evolved from being a peasant’s crop to cash and industrial crop. Cassava root in Nigeria is used for two main purposes: 80% as human food and only 10 to 20% as secondary industrial material (used mostly as animal feed). 75% of the cassavas produced are process into garri (a local food) (Cassava Master Plan, 2006). Other common cassava products for human foods are lafun, Abacha and fufu/Akpu. About 15% of Nigeria’s industrial demand consists of high quality cassava flour (HQCF) used in biscuits, confectioneries, adhesives, pharmaceuticals products and seasonings.

Furthermore, processed products can be classified into primary and secondary products. The primary processed products such as gari, fufu, starch, chips, and pellets are obtained directly from raw cassava roots, while the secondary processed products are obtained from further processing of primary processed products which includes glucose syrup, dextrin, and adhesive. Cassava production in Nigeria has been on increase every year, but Nigeria still keep to import starch, flour, sweeteners which can be made from cassava (Cassava Master Plan, 2006).

This paradox however, is due to how cassava is produced, marketed, and consumed in Nigeria comprising of a largely subsistence to semi-commercial manner. Consequently, to fully utilize cassava’s immense potential, especially as a substitute for imported raw materials and as an export commodity, there is a need to change how cassava is grown and traded in the country using a value-chain development approach. Nigerian cassava-based industrial products are just a fraction of imports, and the growth potential is huge (IITA, 2010).

Transformation in the production of cassava in Nigeria was embarked upon under the Agricultural Transformation Agenda of President Goodluck Jonathan and implemented by the Honourable Minister of Agriculture, Dr. Akinkumi Adesina. The cassava transformation seeks to create a new generation of cassava farmers, oriented towards commercial production and farming as a business, and to link them up to reliable demand, either from processors or a guaranteed minimum price scheme of the government (Cassava Master Plan, 2006).

The overarching plan of the cassava transformation agenda is to turn the cassava sector in Nigeria into a major player in local and international starch, sweeteners, ethanol, HQCF, and dried chips industries by adopting improved production and processing technologies, and organizing producers and processors into efficient value-added chains. However, there are three major limitations of increased utilization of cassava roots which includes the poor shelf life, low protein content and as well as its naturally occurring cyanogens (IITA, 2012).

2.7 Postharvest handling and storage of cassava

Cassava is harvested by hand by raising the lower part of the stem and pulling the roots out of the ground, and then, removed from the base of the plant. The upper parts of the stem with the leaves are earlier plucked off before harvest.

Cassava undergoes postharvest physiological deterioration (PPD) immediately the tubers are separated from the main plant. The tubers, when damaged, normally respond with a healing mechanism. However, the same mechanism, which involves coumaric acids, initiates about 15 min after damage, and fails to switch off in harvested tubers (Sánchez et al., 2010). This continues until the entire tuber is oxidized and blackened within two to three days after harvest, rendering it unpalatable and useless. PPD is one of the major obstacles currently preventing farmers from exporting cassava out of the country and generating foreign exchange income.

Post-harvest strategies therefore, include the development of effective and simple machines and tools that reduce processing time, labour and production losses. With these machines, losses can be reduced by 50% and labour by 75% (Andrew, 2002).

Cassava can be preserved in various ways such as coating in wax or freezing. On the other hand, plant breeding has resulted in cassava that is tolerant to PPD. Four different tolerance sources to PPD have been identified. Firstly, from Walker's Manihot (M. walkerae) of Southern Texas in the United States and Tamaulipas in Mexico. Secondly, a source was induced by mutagenic levels of gamma rays, which putatively silences one of the genes involved in PPD genesis. The third involves a group of high-carotene clones. The antioxidant properties of carotenoids are supposed to protect the roots from PPD (mainly an oxidative process). Finally, tolerance was also observed in a waxy starch (amylase-free) mutant. This tolerance to PPD was thought to be co-segregated with the starch mutation, and is not a pleiotropic effect of the latter (Sánchez et al., 2010).

In addition, two types of post-harvest deterioration are recognized: Primary physiological deterioration and secondary physiological deterioration. Primary physiological deterioration involves internal discoloration and is the initial cause of loss of market acceptability. Secondary deterioration is due to microbial spoilage. The primary physiological deterioration is considered to be a consequence of tissue damage during harvesting, in most cases it is seen as a blue-black discoloration of the vascular tissue referred to vascular streaking. These initial symptoms are followed by a more general discoloration of starch bearing tissue (Andrew, 2002).

2.8 Postharvest System in Cassava Production

Some features are prominent in postharvest system that account for the degree of losses during postharvest period. The kind of crop under review will determine the features of postharvest system. Grain crops have some features that are not present in tuber crops. Due to the fact that cassava is a tuber crop, the main features of its postharvest system are usually harvesting, transportation, storage, processing and marketing.

2.8.1 Harvesting

The period of maturity determines the time of cassava harvest. The maturity period of cassava varies based on its species, mode of planting, weather, and environmental condition. The period can range between 6 to 18 months.

Harvesting is the first stage of postharvest system which determines the extent of postharvest losses. The training given to the labourers, the kind of equipment employed in harvesting, the maturity of the crop during harvesting period, the size of the tubers, handling and treatment of the crops have substantial impact on postharvest system.

2.8.2 Transportation

This is the movement of farm produce from the place of harvesting or farmland to a desired destination. Cassava crops are usually processed and consumed outside the farmland. Transportation of the tubers to the processing unit after harvesting is therefore inevitable. Transportation must therefore be painstakingly undertaken using the best means of transportation. Transportation of cassava often involves the use of human labour, animal, cart or motor vehicle in moving the tubers to their desired destination.

2.8.3 Storage

Storage is a way of keeping and preserving crops from deterioration for a period of time beyond its normal lifespan. Several factors determine the mode of storing crops. Cassava as a tuber crop has its own special means of storage different from other tuber crops. Although, cassava can survive under tough condition during the planting period before harvesting however it is very susceptible to deterioration as soon as it is harvested.

Contrary to yam which can be stored in a barn for a long time without applying any artificial preservative to keep it safe, cassava cannot be stored for a long time. It is stored for a short period of time and either consumed or taken for processing.

2.8.4 Processing

This is the refining and transformation of cassava to a desired product. During the processing, by-products of cassava are extracted. The most common by-product of cassava are the peels. The peels often used as animal feeds or farm manure. Processing is an important stage of postharvest system especially for crops that are usually converted to other consumable products. Cassava is hardly consumed unless it is processed because it can be highly toxic for consumption without proper processing.

Therefore, great care needs to be taken at the processing stage to preserve the bulk of the crop from being lost in the course of processing. Substantial postharvest losses of cassava occur at the processing stage. In case where the inappropriate technique is adopted during the processing stage, the entire crop can be lost. The crop has a tendency of being lost at different stages of the processing as processing of cassava has different stages. Proper and careful handling of the crop at each stage of processing is material in reducing postharvest loss and maximizing gains (Cassava Master Plan, 2006).

2.8.5 Marketing

Sales of cassava can take place in different modes. Farmers often sell the crop on the farmland when it reaches the stage of maturity and leave the buyer to conduct the task of harvesting. The buyer will bear the cost and risk of harvesting if the farmer sells the crops to him before harvesting.

Farmers may also choose to harvest the crops first and sell the tubers to buyer after the harvest. This method rarely happens because farmers prefer to shift the cost and risk of harvesting on buyers. Sometimes, farmers take the risk of processing the crops and sell the products after it has passed through the value chain and converted into other finish commodities. The two prominent cassava products in the market are gari and starch. Postharvest economic loss of cassava is determined at this stage.

2.9 Post-Harvest Loss

Post-harvest loss is the adverse reduction and depreciation in the quality and quantity of crops from the period of harvesting to consumption. Losses of farm produce usually occur at the post-harvest stage. The losses at post-harvest stage is so detrimental to the economy and even to the progress of agriculture because all the financial and material resources imputed in the cultivation of crops become a waste if the crops are lost before they get to the final consumer (IITA, 2011).

Cassava as a versatile root crop convertible into several products can be lost at the post-harvest stage through diverse channels in which majority is lost during storage before processing. Most farmers in Nigeria do not have the facility to store cassava for a long time; therefore, the bulk of the crop is damaged during storage. The tubers that survive the storage system are successfully transported to the factory for processing into other consumable products such as garri, fufu, cassava-flour (elubo), cassava-chips, starch etc. which are further lost in the process of conversion (Osunde and Fabiyi. 2011).

2.10 Factors contributing to Post-harvest Loss in Cassava Production

Various factors contribute to postharvest losses and these factors vary in different countries. Postharvest losses vary substantially among various crops. The mode of production, season, environment and biological factors have impact on postharvest loss. Postharvest loss begins to occur as the crops are moved from the harvesting stage until they get to the final consumer. During the movement of the crop, in the postharvest chain, some are lost to improper handling, pests, predators, thieves, bad processing techniques, improper management or wastage (Wenham, 2005). The factors contributing to postharvest loss can be divided into internal and external factors.

2.10.1Internal Factors

2.10.1.1 Harvesting

The bulk of the losses at the harvesting stage are caused by the use of improper harvesting techniques. Ordinarily, harvesting should be done when crops are matured. Trained personnel with appropriate harvesting tools are needed at this stage. Substantial loss occurs when crops are not matured enough at the time of harvesting. Even when crops are matured, untrained personnel can damage crops in the process of harvesting due to mishandling and ignorance. Damage to crops during harvesting can lead to further damage during storage of crops (Coursey, 2007).

Harvesting requires a degree of monitoring and mathematical calculation. Animals such as rodents, goats, pigs, sheep and cows can feast on the tubers if the process is not properly monitored. Theft of cassava tubers usually happens at the harvesting period because it is difficult for farmers and merchants to know the number of cassava tubers in each ridge (Wenham, 2005).

2.10.1.2 Transportation

This is another factor that accounts for high loss in postharvest period. There are lots of challenges in the transportation stage because of poor infrastructure, inappropriate transportation system, diversion and stealing of crops in the cause of transportation.

Some of the rural farmers use beast of burden and carts to transport cassava tubers to the storage zone or processing unit. Farmers and merchants use beast and carts for transportation because of bad roads and high cost of hiring a motor vehicle to perform the task. However, using animals as a means of transportation has its odds. The animal may feast on the tubers in the course of transportation. The animal may become weary and accidentally throw off the cassava tubers from the cart thus damaging the tubers in the process (Osunde and Fabiyi. 2011)

In addition, postharvest loses occur even when cassava tubers are transported by motor vehicle as some of the tubers are damaged in the process of loading them into the van. Also, some of the tubers are stolen, diverted or lost by falling off from the vehicle as a result of excessive loading on the vehicle. This can also be explained as a result of the fact that the cost of vehicle transportation is determined per trip rather than mass of tubers. Therefore, merchants try as much as possible to load all the tubers on the vehicle to reduce number of trips and save cost. This in turn, leads to excessive loading on the vehicle and results in some of the tubers falling off the vehicle in the course of transportation. Subsequently, the poor road condition of mainly the rural areas where cassava farms are usually situated also damage the tubers during transportation. Sometimes vehicles break down on the farm and it takes some days to get another vehicle to transport tubers on the damaged vehicle because commercial vehicle operators usually decline undertaking such task because of the poor road condition. Substantial part of the tubers get damaged in the process if the merchant is unable to get another vehicle to move the tubers to the market or processing unit or get a mechanic who can repair the vehicle before the cassava starts deteriorating, (Kader, 2002).

2.10.1.3 Storage

The entire tubers can be lost at this stage due to poor storage system. Most of the farmers still use the traditional storage system that are out-dated and not in conformity with the recent change in climate. Poor storage facility causes the tubers to decay and become unhygienic.

Pest infested tubers also spread deterioration through the storage facility. Most farmers do not apply pest control devices and chemical in their storage facility. As a result of this, one infested tuber can cause an irreparable damage to other tubers at this stage. Inadequate monitoring of the tubers during storage gives room to substantial damage of tubers.

The peasant farmers are unaware of modern storage system that can ensure proper monitoring of the tubers condition during storage. In addition, lack of support from the government and inadequate capital also militate against some of the farmers who could have acquired modern storage facilities that would better preserve the cassava tubers (Ravi, et al. 1996).

The traditional storage system cannot preserve the tubers for a long time. The storage traditional storage facilities lack capacity to control temperature and humidity, therefore, the tubers deteriorate under adverse conditions. Tubers are also under serious threat whenever rodents, predators or pests sneak into the storage facilities which are usually observed when the storage facilities have no pest control mechanism. When this situation arises, it leads to total damage of the tubers most often (Rawel and Krooj, 2003).

2.10.1.4 Peeling

This is an art of removing peels covering cassava tubers. Cassava peel needs to be removed so that the peeled crop can go through the processing stage of conversion into other consumable products. Two kinds of losses are prevalent at this stage. These are loss of by-products and loss of tubers. Peeling of cassava is often done by using knife because most machines invented for peeling has not satisfactorily solved the challenges associated with peeling. Peeling of small tubers with knife is extremely difficult. Small tubers are damaged in the process of peeling and some of them discarded due to impossibility of peeling them.

Among the challenges encountered in peeling is the difficulty of peeling woody tubers. Woody tubers cannot be peeled with knifes, therefore, they are discarded. The damaged and discarded small and woody tubers during peeling result in postharvest loss of cassava. Useable potion of normal tubers is also lost to improper peeling. Also, part of the tubers is cut away and wasted if the peeling is not carefully done. A big tuber may be reduced to a small fraction by an unskilful peeling process thereby wasting some good part of the tuber in the process. (Julie, et al. 2005)

Another loss at this stage involves cassava by-products. By-product is a secondary or incidental commodity obtained in the course of manufacturing or in the chain of production. Cassava peel is the main by-product of cassava tuber. Cassava peel has its value but farmers usually discard it as trash. Cassava peel is source of fertilizer. It can be used to grow hygienic mushrooms edible for consumption. The peel is also a good animal feed as many domestic animals such as pigs, goats, sheep and cattle consume the peel. However, farmers do not place much value on the peel so it is often thrown away into the bush where it serves no useful purpose for soil and animals (Wenham, 2005).

2.10.1.5 Grating

This is the grinding of cassava tubers into mash. The grating machine is often powered by a diesel engine, sometimes, electric engine. Due to recurrent electric power failure in the country, the diesel engine is often used by the processing unit. The grater must be in good shape to process tubers into useable mash. A bad grater can waste the entire mash or substantial part of it. The grater needs to be changed regularly to prevent wastage of mash during grating (IITA, 2010).

Postharvest loss occurs at this stage to a large extent because of bad grating machine. Changing the grater regularly would keep the machine in good shape. However, the processing unit operators are more interested in saving cost of production, therefore usually unwilling to spend much money on changing the grater regularly. If the grater remains unchanged and becomes blunt, it would make tubers that could have been grated into useable mash to become a waste thus bringing about postharvest loss (IITA, 2011).

2.10.1.6 Drying of Mash

This technique may not be adopted by manufacturers with standard mash presser and dewatering system. It is common in the rural areas of Ogun State among peasant farmers and manufacturers in cassava processing. Traditionally, drying is done by spreading the mash to the sun to allow the water in the mash evaporate before the mash is fried or conveyed for further processing (Kormawa and Akoroda, 2003).

This is possible during the dry season when it is sunny. The technique works adversely during the raining season because rain may fall on the mash and wash some potion or all the potion away before it is removed to a save place. The mash can be spread in a dry and neat place where it would be open to the sun. When it becomes dry, it would be sieved and fried (Philips, et al. 2004).

In addition, animals often feast on the mash where it is spread to dry. Wind also blows some part of the mash away and contaminates some part of it making it unhygienic and unusable. All these result in postharvest loss in the course of production. The wasted mash at this stage could be saved for consumption if proper technique is adopted.

2.10.1.7 Frying

Frying is an important stage in garri production but not needed in starch production. Manual labour is usually employed in the frying of cassava into garri. The worker fries it in a large caldron or pot being heated by fire until the remaining water in the mash evaporates and the mash gets cooked.

Due to negligence arsing from fatigue, part of the mash sometimes get burnt in the course of frying. The burnt potions are usually thrown away because it is a regarded as waste. Situation where garri is not properly fried, it may affect the quality of the garri. It may also be unhygienic for human consumption if not properly fried leading to discarding the poorly fried potion. It is very common that some quantity of garri incidentally gets thrown away in the process of frying. The floor of the unit where garri is being fried is usually littered with some quantity of garri that have fallen out of the pot in the course of frying and becomes wasted (Wenham, 2005).

The losses that occur at this stage are usually loss of finished products that could have been usable if proper technique was available to take care of the process. This is because no machine has been invented in Ogun State for frying of cassava mash. Waste during the frying mainly results from weariness of the labourers. The unit where the mash is fried is very hot and this makes them to get weary quickly and become careless in handling the frying of the mash (Osunde and Fadeyibi, 2011).

2.10.1.8 Packing

After frying, garri is measured with a can to determine the quantity processed into finished product and packed into sacks. The can used for measurement has a volume of 10 kilogram (kg). Garri is usually packed in 25kg or 50kg by merchants. Retailers pack it in smaller units according to the demands of their customers. Upon packing, it is either transported to store or market. Measurement and packing of garri is done manually by merchants in Ogun State because most of the merchants do not have machine for measuring and packing the commodity. In the process of packing, some portion of the garri accidentally falls out and is wasted. Preventing wastage of garri during manual packing is difficult because of incidental human error (Osunde and Fadeyibi, 2011).

Loss during packing is not limited to garri as loss also occurs during packing of starch especially when the packing is done manually. Quantity of loss in packing of starch is less than quantity of loss in packing of garri. This is because machine is often employed in processing and packing of starch, therefore, there is lower rate of error and waste in the process. Losses that occur at this stage are usually loss of finished products. The loss at this stage is not as substantial as losses encountered in other stages of cassava production. The losses may however be significant if the volume of wasted product during packing is high (Onabolu, Abass and Bokanga, 2008).

2.10.1.9 Supply Chain

In addition, lack of functioning supply chain has also contributed to a major setback in cassava agricultural business. In recent research reports by (Gustavsson et al. 2011), estimated annual quantitative food loss in the supply chain globally approximates 45-50% fresh produces; 25% for cereals; 20% for oilseeds, meat and dairy. Regardless of different drivers and incentives, one of the most main reasons attributing to lower availability of fresh produce is its huge quantity loss that occur at different phases of supply channel (Prusky, 2011). Pariser,(1982) argued that factors for food loss in developing countries are results of comprehensive, administrative and technical constraints in harvesting methods, storage, transport, process, cold chain, road infrastructures, package and market integration system. Rutten, (2013) also confirmed that a 45% decrease in food loss along supply chain in the EU would lead to, small, but positive, a decrease in food prices (0.2%) while an increase in food consumption (0.04%) in Sub Saharan Africa.

Moreover, postharvest losses are very much dependent on some particular conditions and local situations in a given country. In logical terms, as per (World Bank 2010), food losses are influenced by production and processing choices, patterns and technologies, internal infrastructure and capacity, supply chains and channels for distribution and consumer food use practices.

2.10.1.10 Biological Cause

Postharvest loss of cassava can arise from biological causes. This includes compositional changes which may affect the flavour, texture, nutritional value and colour of cassava tuber or its finished products. This usually depends on environmental factors. The factors can be humidity, sanitation procedure, temperature, and general weather condition as well as human and animal factors. Biological factor can therefore, cause deterioration of cassava tubers or its finished products such as garri, starch, fufu and cassava-flour. When these factors are averse to the commodities, it results to damage to the product and lead to postharvest loss (Kader, 2002).

2.10.1.11 Microbiological Causes

Micro-organism can cause deterioration of cassava tubers and products. When micro-organism infects food, it makes it unhygienic for consumption. Micro-organism attacks cassava tubers more often during storage. When it attacks cassava tubers or product, it may destroy the entire tubers or products, thus leading to their loss. However, micro-organism rarely infects garri. It ravages mainly cassava tubers and other cassava products such as starch, cassava-flour, eba, fufu, pupuru, lafu and others (Osunde and Fadeyibi, 2011).

The most common micro-organism contributing to postharvest loss are bacteria and fungi. Micro-organism develops in tubers and cassava products when the tubers or products are not properly preserved.

2.10.2 External Factors

These are factors outside the cassava production system chain such as environmental factors. Environmental condition affects the quantity and quality of cassava harvest. Good climatic conditions such as favourable temperature, proper rainfall and humidity affect cassava postharvest (Grolleaud, 2002).

2.11 Estimation of Post-harvest loss

Different methods have been designed to estimate post-harvest loss using various crops. These methods vary due to different factors which include region, climatic conditions, crop species, nature of crop (perishable or non-perishable) and post-harvest practice.

In the United State, different post agricultural stages are used to generate the US-Loss-Adjusted Food Availability data, in calculating waste. Loss Adjusted Food Availability (LAFA) data is a Standard proxy for food consumption as it provides the estimates of amount of food available for human consumption after accounting for food spoilage and other losses (ERS, 2011 Buzby and Hyman, 2012). Per capita food availability number, total food supply, food availability data and population census are all used for calculating (LAFA),

This program was created in 1970 by USDA to report food waste. It faced a lot of constraint regarding factors required for its calculation due to inconsistent methodology to determine the measurement and estimation of post-harvest losses regarding food processing. FAO's food balance sheet data also calculate per capital food availability for all countries for which they have data based on a methodology related to USDA's.

2.12 Research problems

The loss of food in the post-harvest system has been persistent for quite a long time. Most importantly, in this present day, where the population is rapidly enlarging in the poorest countries of the world where food is already short, there is an increasing urgency to do a better job of conserving mankind food supply in order to alleviate hunger and malnutrition. Cassava has the possibility of being processed into numeral products through value addition. Many cassava-based products have been developed and technologies disseminated to farming communities in various regions.

Despite its great potential as a source of food, feed and industrial application, it’s processing and marketing remains economically unexploited. The current survey sought to assess post-harvest management practices and food security of cassava among small-scale farmers.

3. AIMS OF THE THESIS

The study examines post management practices of cassava production among small scale farmers in Ijebu-ode Local Government Area, Ogun State, Nigeria.

3.1 Specific Objectives

Specific objectives of the study include the following:

1. To examine the effect of various post-harvest management practices on the output of cassava production among small-scale farmers.

2. To determine the major factors faced by farmers with high losses in cassava production.

3. To examine the constraints in adoption of post-harvest management practices of cassava among small-scale farmers.

4. To propose changes/actions towards effective post-harvest management practices among small-scale farmers.

3.2 Research Questions and hypotheses

The issues of post-harvest management practices of cassava among small-scale farmers in our society pose questions in the mind of people. The following research questions were derived from the objectives thus;

1. Does various post-harvest management practices of cassava have different production output among small-scale farmers?
2. What are the limiting factors for adoption of other post-harvest management system among small-scale farmers?
3. What other factors can reduce the losses incurred by small-scale farmers with high losses?
4. What are the changes/ actions to enhance effective post management practice of cassava among small-scale farmers?

3.2.1 Research Hypothesis

The following research hypotheses were formulated to guide this study:

1. There is a correlation between social characteristics (Age, farming experience and Educational level) and the adoption of post harvest management practices.
2. The type of post harvest loss management practice adopted significantly affects the rate of post harvest loss.

4. METHODOLOGY

Research methodology is the process which deals with the objective, planning and systematic collection, analysis, interpretation and reporting of data and information Eheduru (2002). In this section, the method employed in the execution of this research is exploited.

This research is focused on research design, study location, study population, sampling size and sampling techniques, research instrument, and procedure for data analysis, ethical consideration and limitation of methodology.

4.1 Research design

This is the strategic plan for a research project, setting out the broad outline and key features of the work to be undertaken. This includes the methods of data collection and analysis to be employed. In addition, it also includes showing how the research strategy addresses the objectives of the study (Agbonifoh & Yomere, 1999). The research design used in this study is the non-experimental research design.

The design is a case study survey research, because it detailed the various post-harvest management practices of cassava among small-scale farmers, and its impact on their output in Ijebu-ode Local Government Area, Ogun-State, Nigeria. The design is adopted due to the fact that it focuses on gathering opinions and views of the respondents on the research problem and it also allows the researcher to choose a fraction of the study population.

4.2 Study background

The research was conducted in Ijebu-north local government, Ogun-State, Nigeria. Ijebu-Ode is a city located in South-West Nigeria, close to the highway. The city is located 110 km by road north of Lagos; it is within 100 km of the Atlantic Ocean in the eastern part of Ogun State and possesses a moderate tropical climate. It is the second largest city in Ogun state after Abeokuta. Since pre-colonial times it has been the capital of the Ijebu kingdom, The LGA has an area of 192 km² and a population of 154,032 at the 2006 census. It is the largest city inhabited by the Ijebusa sub-group of the Yoruba ethnic group who speak the Ijebu dialect of Yoruba.

In Ijebu Ode there are several smaller towns and villages. They are mostly referred to as Egure "this way to"; some of them include Odo-Agamegi, Ogbo, Italupe (a neighbourhood within Ijebu-Ode), Ososa, Imomo, Imawen, OdoOgbun, Apa(Mesan), Okelamuren, Abapawa, Erunwon, Apunren, Isonyin, Imoru, Oke-Eri, Imagbon, Ijebu-Isiwo, Odo-lewu, Odo-Arawa, Idowa, Iworo, Ala, Atiba and Ibefun among others. Ijebu-Ode is divided into three main parts - Iwade, Ijasi and Porogun. Italupe is a ward in Iwade, not an Egure of Ijebu Ode.

Agemo is the unity of Ijebu. There are 16 Agemos in various part of Ijebu. They come out every July and they all meet at Ijebu-Ode before moving to ImodiMosan, where the Agemo Festival takes place. The Agemo of Ijebu-Isiwo is the leader of all Agemo in Ijebu land. Agemo festival has masquerades and is a performing art of the Yoruba religion. It is forbidden for women to see the Agemo on their way to Ijebu-Ode.

Ijebu Ode is the trade centre of a farming region where yam, cassava, grain, tobacco and cotton are grown.The selection is characterized mostly where the crop is majorly produced and with population of small-scale farmers. The choice of state is characterized due to high agricultural activities. The locals are well known for their special made processing garri called ‘Ijebugarri’ (cassava flour) which can be eating, soaked for drinking and as well to make ‘eba’ (Nigeria delicacy).

NIGERIA **OGUN STATE**

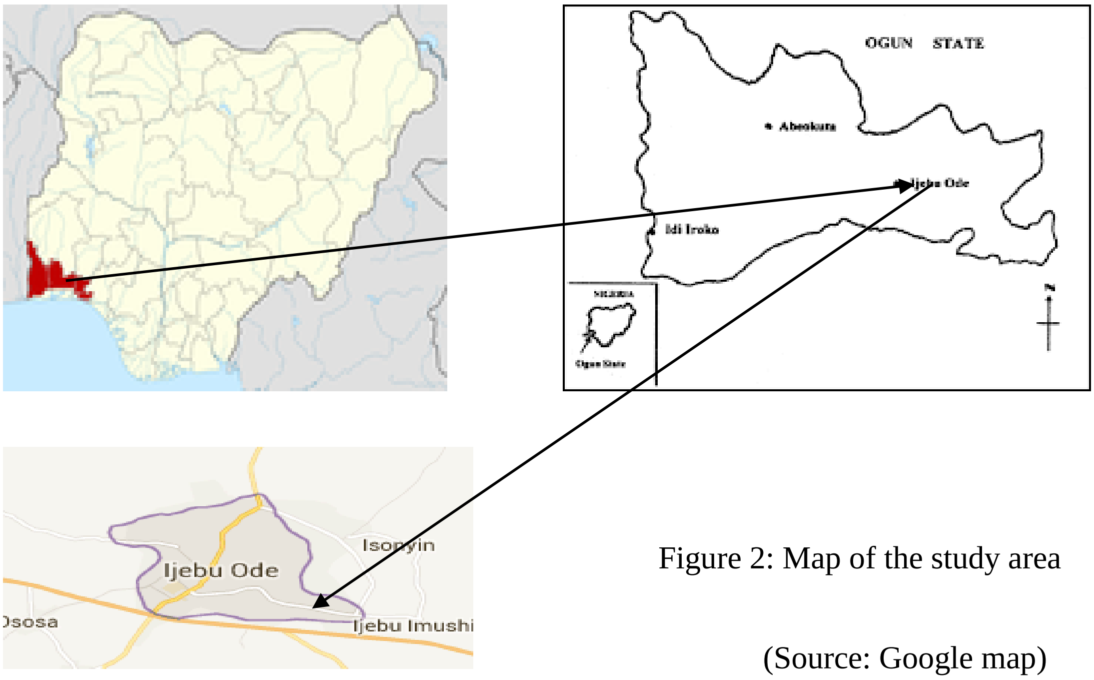

Figure 2: Map of the study area

(Source: Google map)

4.3 Study population

This refers to the subjects or respondents from which a researcher obtains information relevant to his study (Kothari, 2004). The population for this study comprises of small-scale farmers (male and female) in Ijebu-ode Local Government Area, Ogun State, Nigeria. The age brackets accessed was between 30 years and above which was made up of both indigenes and non-indigenes resident in the town. It is intended that this enlarged scope of the study population makes it possible for us to obtain contrasting data that useful for a wide range of comparisons.

4.4 Sampling size and sampling techniques

Sampling size can be simply defined as the act of selecting a suitable sample Soyombo and Taiwo (2003). The sampling size of this research work was drawn from small-scale farmers who were between the age limits of 30years and above in Ijebu-Ode Local Government Area, Ogun-State, Nigeria. The research was intended to cover the entire community but due to limited financial resources and time constraint, 50 participants were selected to represent the study population. This therefore, eased the collection of data from respondents on the topic, that is, post-harvest management practices of cassava. Hence, the study employed proportional stratified sampling and simple random sampling method.

The proportional stratified method was used to select the five wards from the ten wards in the study area after which simple random sampling was employed to randomly select participants from the chosen wards. This was found helpful in reducing errors of omission or biases in the selection process; above all, it ensured equal chances of representativeness.

4.5 Method of data collection

The survey was carried out using Investigative Survey Research Approach (ISRA) (Anazodo et al, 1986). Information was collected using structured questionnaire which sought for the following information: age, family size, years of experience and level of education, the periods, crop storage awareness, and structures used and for how long, loss during storage and processing method and degree of post-harvest losses of cassava produce. The study also took some personal observation to get significant information that would help identify problems faced by the farmers.

In addition, in order to achieve the objectives of the study, the researcher resorted to the use of two main sources to gather information, namely: primary and secondary source. The researcher adopted questionnaire in collecting relevant information for the study. The questionnaire was developed with the research objectives. Structured questionnaires made of open and close-ended questions were designed and used to gather the following data:

i) Data of respondent characteristics includes: age, sex, education, marital status, experience in farming, mode and household size, which reveal respondent social status and indicate is capacity to grasp new knowledge

ii) Cassava cultivation practices included variety selection, planting, mode of harvesting, nutrient management and disease, weed and pests management

iii) Postharvest handling practices included data on harvesting, sorting, treatment, storage, packaging, transportation and level of food safety education.

4.6 Method of data analysis

The data was sorted, edited and coded to identify and eliminate or minimize errors, omission, incompleteness and general gaps in the data that was gathered. The quantitative data obtained was evaluated through univariate and bivariate modes of analysis. The statistical Package for

Social Sciences (S.P.S.S) version 23.0 was used to in the collation in order to facilitate the data description and also analyse the collected data. Descriptive statistics analyses, such as simple percentage and frequencies was used to give insight in the cassava production, and various post-harvest management practices as well relation between variables, in order to explain some key factors that determine the decision making of the small-scale farmers.

Furthermore, in order to give a clear concept of cassava post-harvest management system, other information gathered was summarized and presented in form of tables and charts to facilitate interpretation and analysis. Chi-square was used to test the relationships between the variables in the hypotheses formulated. The values of observed and expected value were computed.

Chi- Square: $\mathbf{X^2 = (O–E)^2 / E}$

Equation 1: Chi Square

Where: **O** - Observed value

E - Expected value

4.7 Ethical consideration

As a social researcher who is bound to protect the interest of the respondents, the researcher took into cognizance the issues in research ethics. The researcher sought the consents of the respondents before the commencement of the research. The researcher told them what the research was all about and the purpose of conducting it. All the respondents participated through their free-wills. The researcher equally protects respondents from being identified. The anonymity was followed duly. The questionnaire does not bear any means that identify any of the respondents. The responses from the data eventually analysed and interpreted in aggregate without any link to a specific respondent. Furthermore, the information was kept confidential and used purposely for this research work

5. RESULT

This section contains the results of the statistical analysis of the data collected, which attempts to examine on post-harvest management practices of cassava among small-scale farmers. Data collection was through a cross sectional survey of one hundred and twenty small-scale farmers in Ijebu-Ode Local Government Area, Ogun-State, Nigeria. While 106 interviews was conducted successfully, therefore, giving a success rate of 88%. The respondents’ demographic characteristics and the research questions were presented using frequency distribution tables and charts, while the four hypotheses were tested using Pearson Product Moment Chi-square. The analysis was done using the statistical product and service solutions (SPSS) version 23.

5.1 Statistical analysis

The first step in data analysis is to organize and present data so that the essential features of the data are easily communicated (Pretorius, 2007). The statistical analysis in this section attempted to meet the objectives of the study. The statistical analysis was done using the statistical product and service solutions (SPSS) version 23 to determine the distribution of individual variables and compute descriptive statistics. In addition, Chi-square was used to test the research hypotheses to see the correlation between the variables.

5.2 Socio Demographic characteristics of respondent

5.2.1 Age category of respondents

Various age distributions were employed in the research procedure. The age distribution includes 22.64% between the ages of 30 – 40, 46.06% between the ages of 41 – 50 years and 28.30% between the ages of 50 and above. This therefore indicates the fact that the respondents are matured enough to understand the post-harvest technique. The table below shows the age distribution of the respondents.

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Table 1: Age category of respondents

Age	Frequency	Percentage
30-40	25	22.6
41-50	50	46.0
50 above	31	31
Total	106	100

Source: Authors

5.2.2 Gender

The gender of the respondent included, 76.42% as male and 23.58% as female. This is shows that the male farmers are the ones involved in the cassava production. This explains the decision maker for the use of these practices.

Table 2: Gender of Respondents

Gender	Frequency	Percentage
Male	81	76.4
Female	25	23.6
Total	106	100

Source: Authors

5.2.3 Marital Status

The marital status distribution included 39.62% as married, 19.81% as single, 29.25% as separated or divorced while 11.32% as others. The table below represents the marital status distribution.

Table 3: Marital Status of Respondent

Marital Status	Frequency	Percentage
Married	42	39.6
Single	21	19.8
Divorced	31	29.3
Others	12	11.3
Total	106	100

Source: Authors

5.2.4 Households

The table below reveals that 27.4% of the respondents have 1-3members in their households,50% has 4-5 members and 22.6% has 6 members and above. This shows that the majority of the respondents have 4-5 members

Table 4: Number of household of Respondents

Number of household	Frequency	Percentage
1-3 members	8	7.55
4-5 members	53	50
6 and above	24	27
Total	106	100

Source: Authors

5.2.5 Educational qualification of respondents.

Although majority of the respondent possessed at least a secondary school certificate. The educational qualification includes 25.47% having only primary education certificate, 12.26% obtaining tertiary education, 6.60% obtained post-graduate education and 7.5% had no form of formal education. This shows that most of the farmers should be understand simple technologies introduced. The educational qualification of the respondents is represented in the figure below

Table 5: Educational Status of Respondent

Educational Status	Frequency	Percentage
Non formal	8	7.55
Primary	27	25.5
Secondary	51	48.11
Tertiary	13	12.6
Post Graduate	7	6.6
Total	106	100

Source: Authors

5.3 Economic characteristics of respondents

5.3.1 Years in farming

Majority (45.28%) of the respondents got farming experience of 11years and above, 28.30% are 5-10 years and 26.42%b got less than 5 years farming experience as presented in figure below.

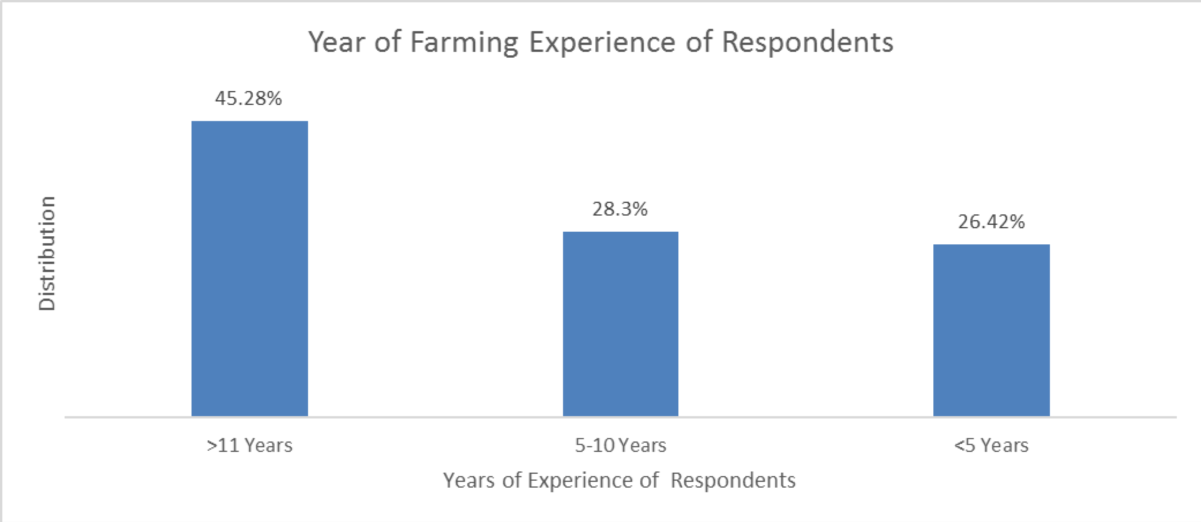

Figure 3: Years of faming experience of respondents

Source: Authors

5.3.2 Average size of farm

This reveals that majority (56.6%) of the respondents' average size of farming is 1-2 acres, 25.5% is less than 1 acre, 10.4% is 3-4acres and 7.6% is above 5 acres as presented in figure below

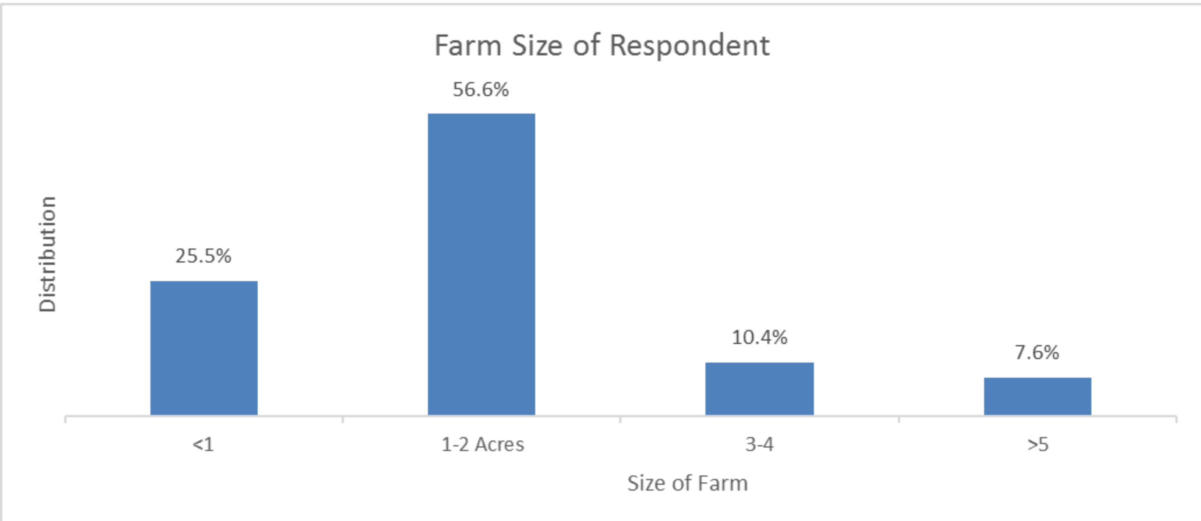

Figure 4: Farm Size of Respondents

Source: Authors

5.3.3 Criteria for selecting the site of farm

The table below indicates that majority (18.8%) of the respondents agreed that the most important factor for selecting the site of farm is Fertility of the soil, 16.9% emphasized on nearness to residence, 15.1% stressed on accessibility, 12.3% supported price of the land, 14.2% agreed on availability of water, 15.1% stressed on good road network and 7.5% emphasized on other factors.

Table 6: Criteria for selecting the site of farm

Factors	Frequency	Percent	Valid Percent	Cumulative Percent
Fertility of the soil	20	18.9	18.9	18.8
Nearness to residence	18	16.9	16.9	25.6
Accessibility	16	15.1	15.1	40.0
Price of the land	13	12.3	12.3	52.3
Availability of water	15	14.2	14.2	67.1
Good road network	16	15.1	15.1	71.4
Other	8	7.5	7.5	100.0
Total	**106**	**100.0**	**100.0**	

Source: Authors

5.3.4 Mode of farming

This figure below shows that majority (54.7%) still engage in manual mode of farming. The manual indicates the use of man power. The combined (use of labour and machines)

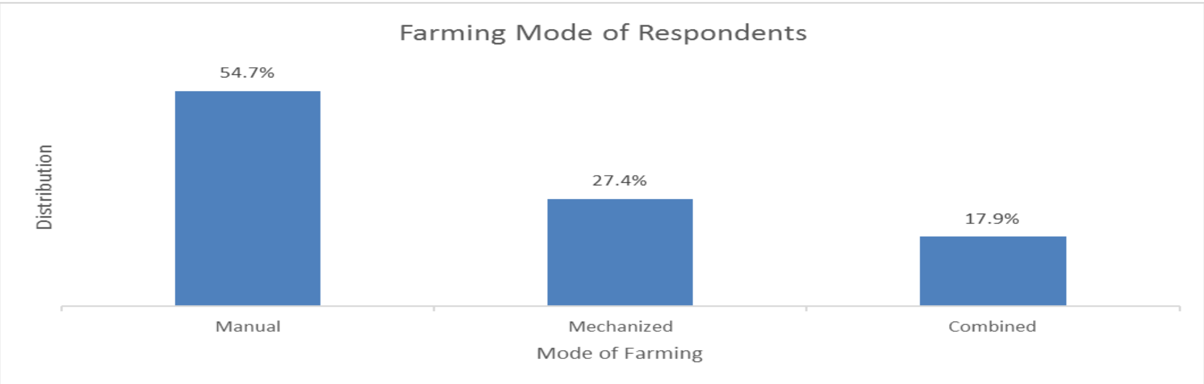

Figure 5: Farming Mode of Respondents

Source: Authors

5.3.5 Rate of post harvest loss by respondents

The tables 7 and 8 below shows that 100% of the cassava farmers experience losses at all stages, however, the degree of losses at each stage varies. As seen from table 9, 52.2% of the total number of respondents agreed to the fact that they experience post harvest loses at most time as compared to 16.9% who rarely experience losses.

Table 7: Rate of pre harvest loss by respondents

Post Harvest Stage	Frequency	Percentage	Valid (%)	Cumulative (%)
Yes	106	100	100	99
No	0	0	0	100
Total	106		100	100

Source: Authors

Table 8: Degree of post harvest loss by respondents

Degree	Frequency	Percentage (%)	Valid (%)
At times	32	30.2	30.2
Most times	56	52.2	80.7
Rarely	18	16.9	100
Total	106	100	100

Source: Authors

5.3.6 Factors considered as the major cause of losses at each stage

Respondents were also asked on the factors that they consider as a major cause of post harvest loss. This question was important as the researcher will be able to identify the factors that lead to post harvest losses and the technique to implement to curb losses at the post harvest stage. The first stage of concern was the pre-harvest stage. Majority (35.85%) of the respondents considered domestic animals such as goats, as major cause of pre-harvest loss, 23.58% emphasized on insects and pests, 16.98% stressed on improper cultivation and 9.43% suggested other factors as presented in figure below

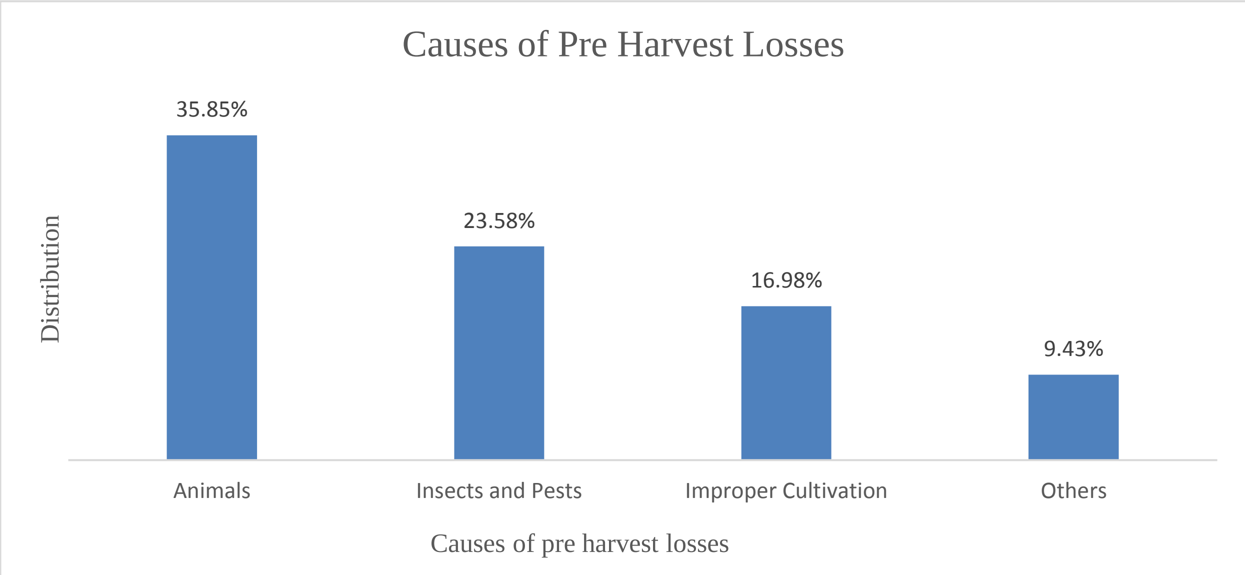

Figure 6: Causes of Pre harvest

Source: Authors

The next stage is the harvest stage. Response from the field survey indicated that, the most cause of harvest lost at the harvesting stage was due to domestic animals. Majority (26.4%) of the respondents considered domestic animals as major cause of harvest loss, 22.6% emphasized on pests and diseases, 16.9% stressed on mishandling, 13.2% agreed on adverse weather, 9.4% suggested other factors while 10.4% emphasized on use of bad harvesting tools and 10.4% also stressed on other factors as presented in figure below

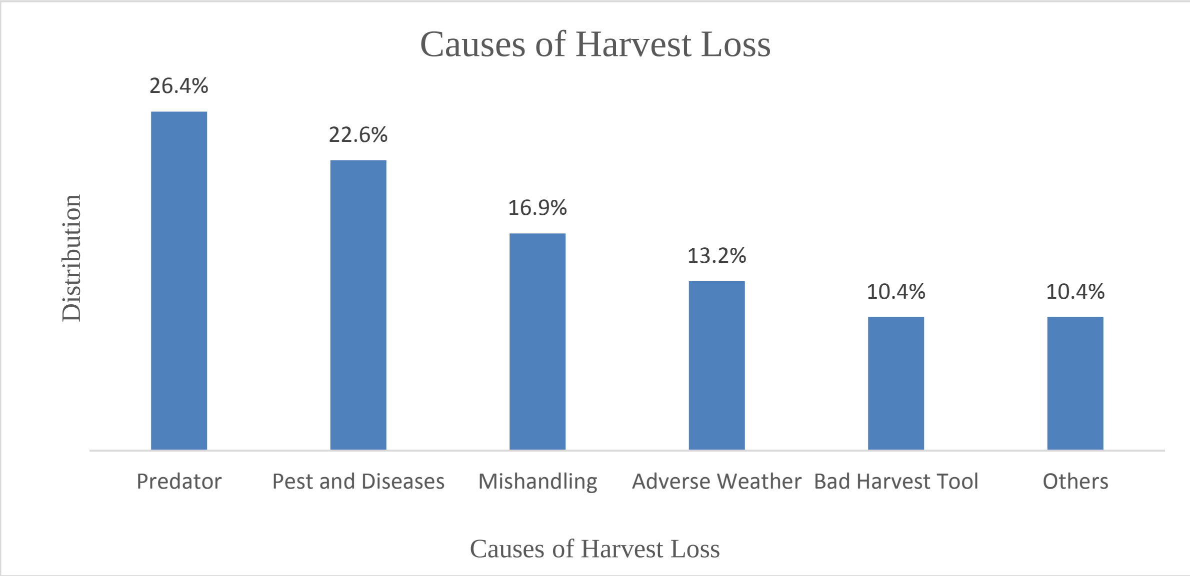

Figure 7: Cause of harvest loss at harvesting stage

Source: Authors

The stage is the post harvest stage. Majority (26.4%) of the respondents considered storage atmosphere as the major cause of post-harvest loss, 23.6% considered initial quality of the crops, 22.6% considered mechanical injury, 14.2% considered other factors and 13.2% considered temperature as presented in figure below

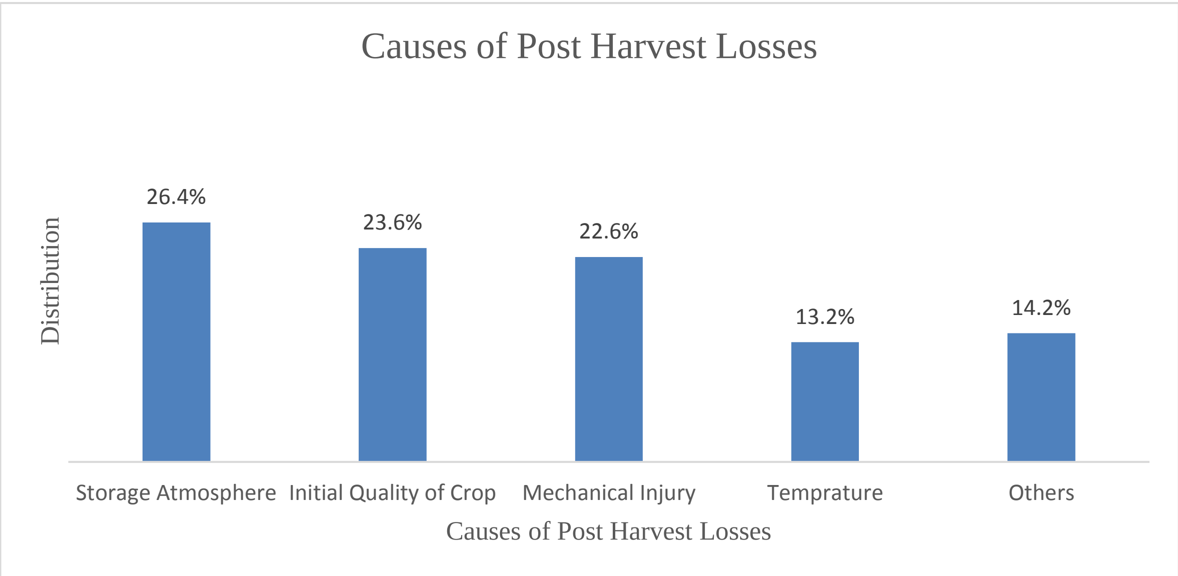

Figure 8: Major Causes of Post-Harvest Losses

Source: Authors

5.3.7 Issues considered as the major cause of post harvest loss

The table 9 below reveals that most of the respondents (20.7%) agreed on heavy incidence of storage pests as difficulties encountered after harvesting of cassava, 16.9% stressed on Non-availability of processing units, 21.7% emphasized on Inadequate storage facilities, 18.9% agreed on High fluctuation prices of cassava in market and 7.6% agreed on other issues.

Table 9: Major Causes Considered

Issues	Frequency	Percentage	Valid (%)	Cumulative (%)
High fluctuation prices of cassava in market	20	18.9	18.9	18.9
Non-availability of processing units	18	16.9	16.9	34.6
Inadequate storage Facilities	23	21.7	21.7	40.2
Lack of transportation facility	15	14.2	14.2	64.2
Heavy incidence of storage pests	22	20.7	20.7	93.7
Other	8	7.6	7.6	100.0
Total	**106**	**100.0**	**100.0**	

Source: Authors

5.3.8 Techniques used for harvesting

Majority (46.2%) of the respondents used traditional tool as their harvest device, 38.7% used handpicking, 10.4% used medium technology and 4.7% used advanced tools as presented in figure below:

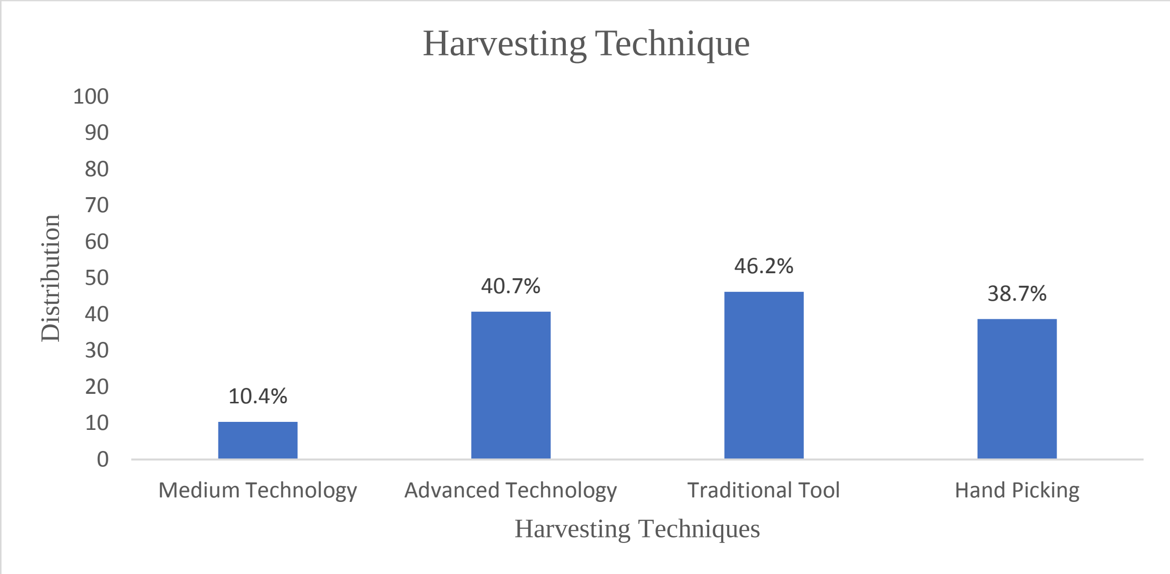

Figure 9: Harvesting techniques used by farmers

Source: Authors

5.3.9 Post harvest management practices

This section deals with the various post harvest management practices adopted by the small scale farmers. The adopted practices affect Post harvest losses and thus have implication for food security on the farmers' family, the corresponding village and region. The following tables show the different post harvest methods adopted by the farmers in that region.

5.3.9.1 Mode of storage

Majority (46.2%) of the respondents stored their harvested cassava in the barn, 23.6% left it in the soil, and 18.9% stored it in other places and 13.2% kept it in plastic bowls as presented in figure below

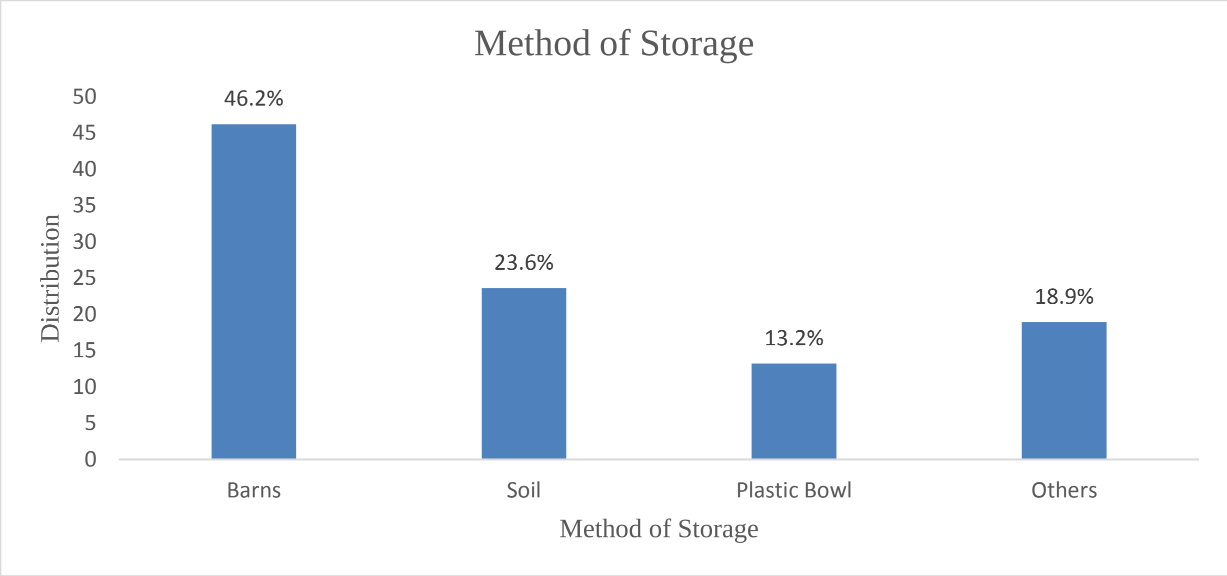

Figure 10: Response on the mode of storage by farmers

Source: Authors

5.3.9.2 Mode of Transportation

The table below shows that majority (38.7%) of the respondents means of transporting their cassava output is Vans/Trucks, 23.6% agreed open buses, 14.2% emphasized on Taxis, while 18.9% used other transportation means such as canoes, by foot etc. It further shows that majority (49.1%) of the respondents agreed that the nature of their roads to farm is poor, 22.6% emphasized on fairly good, 18.9% supported good and 9.4% agreed on very good. This makes it difficult to transport the produce.

Table 10: Mode of Transporting Cassava

Transportation Method	Frequency	Percentage (%)	Valid (%)	Cumulative (%)
Vans/Truck	41	38.7	38.7	38.7
Open buses	30	28.3	28.3	67
Taxis	15	14.2	14.2	81.1
Others	20	18.9	18.9	100
Total	106	100	100	

Source: Authors

5.3.9.3 Processing of Cassava

The table below shows that majority (76.4%) of the respondents used manual method to process their cassava, while 23.6% used the factories. It further shows that majority (62.3%) of the respondents emphasized that there are no enough processing factories to process cassava in the area while 37.7% were in opposite view.

Table 11: Processing of Cassava

Processing Method	Frequency	Percentage (%)	Valid (%)	Cumulative (%)
Manual	81	76.4	76.4	23.6
Factories	25	23.6	23.6	100
Total	106	100	100	

Source: Authors

5.3.9.4 Mode of packaging cassava

Majority (39.82%) of the respondents used polythene sacks to package their cassava, 32.08% used baskets, and 21.7% used plastic bowls and6.60% used other means of package as presented in figure below

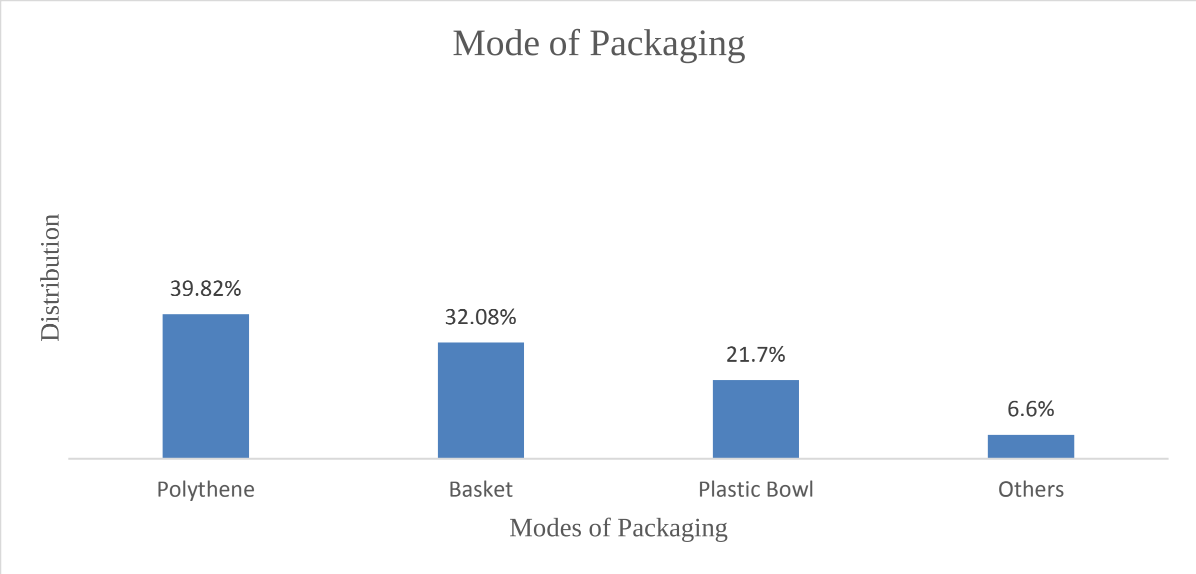

Figure 11: Response on mode of packaging

Source: Authors

5.3.9.5 Method often used to control weeds

Majority (50%) of the respondents used often used weeding by labour to control weeds, 22.64% used Agro-chemicals, and 16.9% used growing of cover crops and 10.4% used intercropping also as presented in figure below

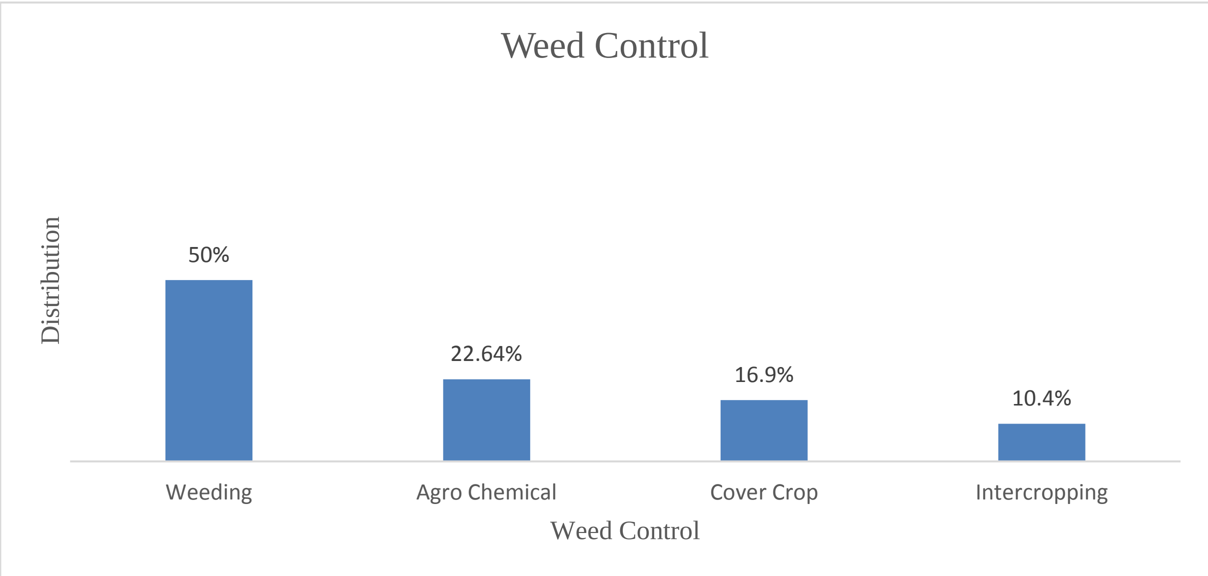

Figure 12: Method of weed control

Source: Authors

5.3.9.6 Method often used to control pests

Majority (29.2%) of the respondents used often used chemical to control pests, 28.3% used biological method, 22.6% used cultural method and 19.81% used physical method as presented in figure below

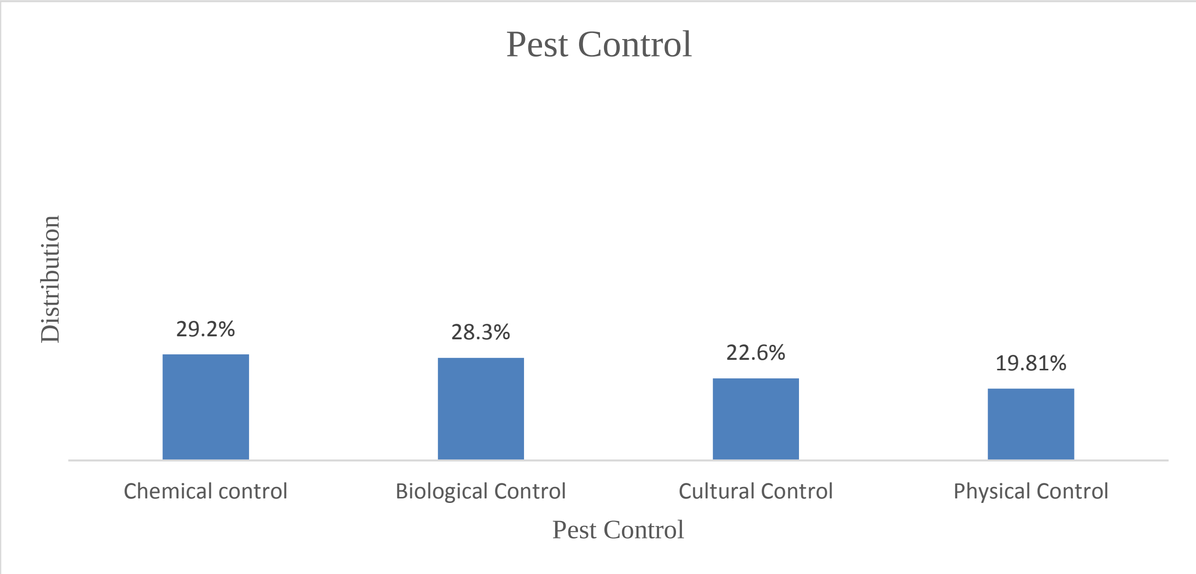

Figure 13: Method of pest control

Source: Authors

5.3.10 Marketing and sales of cassava

The findings revealed that majority (36.8%) of the respondents markets their crops through market women, 26.4% marketed through direct sales to the consumers, 25.5% gave it the processors and 11.3% sold it to the exporters. The table also reveals that majority (56.6%) of the respondents gave their excess output of cassava harvest for processing, 11.3% sold them cheaply, 23.6% dried them for future use and 8.5% discard them.

Table 12: Marketing and sales distribution of the farmers

	Frequency	Percentage (%)	Valid (%)	Cumulative (%)

Excess produce for processing	60	56.6	56.6	56.6
Selling cheaply	12	11.3	11.3	67.9
Dried for future use	25	23.6	23.6	91.5
Discard	9	8.5	8.5	100
Total	106	106	100	

Source: Authors

5.3.10.1 Grading methods used by the farmers.

The table below revealed that majority (43.4%) of the respondents used varieties and weights as criteria to grade crops after harvesting, 29.2% used size and shape and 27.4% used other criteria. This process is used to determine value of the cassava and price. Farmers who experience high losses thus have a lower grading in weight; therefore will affect his revenue earned, while farmers with good variety (buyer's preference) have a better market advantage.

Table 13: Grading and standardizing of cassava

Grading	Frequency	Percentage (%)	Valid (%)	Cumulative (%)
variety and weight	46	43.4	43.4	43.4
Size and shapes	31	29.2	29.2	89.5
Others	29	27.4	27.4	100
Total	106	100	100	

Source: Authors

5.3.10.2 Sales

The table below shows that majority (69%) of the farmer sell their cassava between $21 -$30. This is the average standard price.15% sell below and 16% sell above the average price. It was discovered that majority of the farmers who sell above the average is because of the added value the give to their product (processing).

Table 14: Sales of cassava

Sales ($)	Frequency	Percentage (%)
15-20	17	16
21-30	73	69
31-40	16	15
Total	106	100

Source: Authors

5.3.11 Quantities of cassava produced

The table below shows that majority of the farmer produce less than average yield which is 10.6t/ha, while 27.4% of respondents were able to produce above the average yield. This explains that losses incurred by these farmers affect their output.

Table 15: Quantities of cassava produce

Quantity	Frequency	Percent	Valid (%)	Cumulative (%)
Less than 5t/ha	31	29.2	43.4	43.4
5- 10 t/ha	46	43.4	29.2	89.5
10 above t/ha	29	27.4	29.2	100.0
Total	**106**	**100.0**	**100.0**	

Source: Authors

5.3.12 Constraints in adoption of new post-harvest management practices of cassava

The table below shows that majority of the farmers have not tried any other method, and 70% of the farmers show willingness to try new method if introduced, 30% not willingly to accept, and 6% not sure if they will.

Table 15: Use of new methods

Use of new Methods	Frequency	Percentage (%)	Valid (%)
Yes	100	56.6	56.6
No	0	11.3	11.3
Total	106	100	100

Source: Authors

5.3.13 Membership in Cassava Associations

The table below indicates majority of the farmers belongs to am association. This was important for the respondents because it allows them to receive support from government and also as a result of being a member, farmers with high recorded of losses are given special support. From the table, majority (90.6%) of the respondents were members of cassava Associations while 9.4% were not. The table above indicates that 18.8% of the respondents have less than 10 members in their Association, 46.9% got 10 - 20 members and 34.4% have 21members and above. This implies that the majority of the respondents participate in association with 10-20 members.

Table 15: Membership of Respondent

Membership	Frequency	Percentage (%)	Valid (%)	Cumulative (%)
Yes	96	90.6	90.6	90.6

No	10	9.4	9.4	100
Total	106	100	100	

Source: Authors

5.3.14 Facilities and supports Association provided

The table below shows that majority (78.1%) of the respondents agreed that they received support from the government and other N.G.Os while 21.9% disagreed. It also shows the form of support received. 32.2% of the respondents agreed that they receive education and training support from the government and N.G.Os, 21.9% emphasized the provision of farm inputs such as cutlass and hoes, 29.1% agreed on facilitation of loans from banks and 16.7% emphasized on other means of support was rendered. For example, Health care's service.

Table 16: Support from Government/NGOs

Support from Government/ NGOs	Frequency	Percentage (%)	Valid (%)	Cumulative (%)
Yes	75	78.1	78.1	78.1
No	21	21.9	21.9	100
Total	96	100	100	

Source: Authors

Table 16: Types of Support from Government/NGOs

Type of Support	Frequency	Percentage (%)	Valid (%)	Cumulative (%)
Education/Training	31	18.8	18.8	18.8
Farm input	21	46.9	46.9	65.6
Loans from banks	28	29.1	29.1	88.3
Others	16	16.7	16.7	100
Total	96	100	100	

Source: Authors

5.4 Test of Research Hypotheses

This section focuses on testing the hypothesis formulated for the study. The Chi-square test statistics was used in testing if there were statistical significance in respondents' perceptions towards each of the two hypotheses formulated for the study. The test and findings are summarized below.

5.4.1 Empirical Analysis.

5.4.1.1 Hypothesis One

There is a correlation between social characteristics (Age, farming experience and Educational level) and the adoption of Post Harvest Loss Management practices.

Table 17 shows that, there is a high correlation between the social characteristics and the type of management system adopted by small scale farmers in Nigeria. The high correlation shows that, an increase in the age, educational level and farming experience of a farmer tends to drive the need for a small scale cassava farmer in adopting a particular post harvest technique. For example, from the field survey, most of the farmers were in the category of age group above 40 years and are used to the use of old technology of storage which leads to high degrees of loss after harvest. A farmer's educational background also determines his/her knowledge level on adopting a particular improved post harvest technology.

Table17: Correlation analysis between social characteristics of farmers and the adoption of Post Harvest Loss Management practices.

Correlation					
		TOMP	AGE	EDC	EXP
TOMP	Pearson Correlation	1	.752**	.782**	.741**
	Sig. (2-tailed)		.000	.000	.000

N	106	106	106	106

Source: Authors

5.4.1.2 Hypothesis two

The type of post harvest loss management practice adopted significantly affects the rate of post harvest loss.

To answer the research hypotheses (2), the study employed the use of Chi-Square statistical tool. The type of post harvest loss management practice adopted significantly affects the rate of post harvest loss.

This helps answer the second hypothesis of the study;

Hypothesis one (Null and Alternative)

H_0: =0 There is a significance effect on the type of post harvest loss management practice adopted and the rate of post harvest loss.

H_1: ≠0. There is a no significance effect on the type of post harvest loss management practice adopted and the rate of post harvest loss.

Decision Rule:

If p calculated < p at 0.05 significance level, we reject the null hypothesis (H_0) and accept the alternative hypothesis, otherwise, we accept it.

Table 18: Chi-square analysis of the type of management practice and the rate of post harvest loss

Chi-Square Tests	Value	Significance Level
Pearson Chi-Square	0.923^a	**.000****

Significant at p (0.05) **

Source: Authors

The table above represents the Chi-Square analysis of the type of post harvest loss management practice adopted significantly affects the rate of post harvest loss. From the table, a look at the two-sided asymptotic significance of the chi-square statistic reaches 0.000 and thus is less than level of confidence of 0.05. This statistically confirms that, the type of management system contributes to the rate of harvest lost. We thus reject the null hypothesis and conclude that Social-economic factors such as farmer’s educational Status, size of farm land and farmer’s willingness to change, significantly affect the adoption of post-harvest practices among small-scale farmers in Nigeria.

6. DISCUSSION

This research work examined Post management practices of Cassava among small-scale farmers in Ijebu-Ode Local Government Area, Ogun-State, Nigeria.

The study identified that, there is a high correlation between the social characteristics of a farmer and his/her ability to adopt a particular post harvest loss technology. The educational level, age of a farmer and experience of a farmer all affects a farmer’s adoption of improved technologies on post harvest losses. This affirms the findings of Oshue (1991) who worked on post harvest loss in Nigeria concluded that, experience of farmers attributes to the method of post harvest practice.

Furthermore, the findings revealed that 49.06% of the farmers who were between 41- 50 years are well represented, 28.30% who are between 31- 40 yrs which are regarded as youth are less represented. Adegboye (2004) explained in his work the reason for this, that many of the youths in Nigeria find agriculture as an unattractive business and due to beliefs of the society that farmers are poor. These findings are synonymous with the observation from Idachaba (2004) that the major reason for reduction in agriculture production in Nigeria is due to unattractiveness of agricultural business as a result of low returns and compensation given to farmers, which tends to decrease food production, owing to the fact that most people who engage in agricultural business are usually old, poor, and they are relatively small-scale farmers.

In addition, young people (below age 30) are not represented, indicating that young people venturing into farming is decreasing because of the migration of youths to urban settlements in search of white-collar jobs. In reference to this, it is a known fact that most people from this region are always well educated. The result also supports the work of Ekong (2003) which proved that farming in Nigeria is dominated by older farmers especially between ages 41-50.

The second hypothesis shows that the type of management practice adopted significantly affects the rate of post harvest lost. Improved technologies help in reducing post harvest losses and as such the adoption of such technologies, such as processing factories goes a long way to increase the Shelve life of a commodity.

Results from this study back those of Idachaba (2004), Ekong (2003), Omoniyi and Oshue (1991). Adding to this, the study identified that majority of the farmers are engaged in traditional storage system, and this was also been identified as a the factor of the causes of post harvest losses, as most farmers still engage in old storage methods such as storage in soil to keep freshness, barns, and plastic bowl. These methods are less effective as compared to new technologies. Produce stored under the traditional system usually do not keep long and the farmers usually suffer great losses Mughogho (1989), Omoniyi and Oshue (1991) and Tyler (1984). On the contrary, post-harvest strategies therefore, include the development of effective and simple machines and tools that reduce processing time, labour and production losses. Andrew, (2002) identified the use of improved technology reduces losses by 50% and labor by 75%.

Furthermore, the study shows that majority of the farmers belong to one association or the other, to receive social support from the government or NGOs. It also allows farmer's to support themselves.

In addition, the study also revealed that they receive support from the government and other NGO’s but not adequately enough. To confirm this, 62.3% emphasised that there is no enough processing factories for cassava and no enough farm input provided. Basically, the major support they receive is soft loan which mostly does not cater enough for the whole operational activities of the farm. In support of this, Ravi, et al. (1996) identified lack of adequate support from the government and inadequate capital also militate against some of the farmers who could have acquired modern storage facilities that would better preserve the cassava tubers (Ravi, et al. 1996).

In addition, the findings also revealed that the small-scale farmers experience pre-harvest and post-harvest losses most times, and issued considered being the major cause is inadequate storage facilities, predators and heavy incidence of storage pest. Use of chemicals and biological methods are used by the respondent to an extent to control the pest, but the health effects were also considered. Wenham, (2005) cited the losses faced by farmers from the harvesting stage to the final consumers are improper handling, pests, predators, thieves, bad processing techniques, improper management or wastage.

Furthermore, the study revealed that 73% of the respondents had not export their cassava output, which was due to that lack of functioning supply chain. This also limits the willingness of farmers to expand their production (Gustavsson et al 2011). The study also revealed that excess cassavas are further processed in order to save it from decaying and further wastage.

In addition, the study revealed that due to the difference in sales distribution of cassava produce among farmers, are compelled to sell their produce earlier in order to avoid losses. This in turn, affects the net revenue generated by the farmers.

In addition, lack of storage facilities and low quality production also play a major role, as most of the cassava produce are below the international standard. This further explained the reason why Nigeria is missing out it in the international trade of cassava as cited by NBS (2007).

Moreover, majority of the respondents has informal training in harvesting cassava; which they obtain from friends, family and neighbours. This however, may be due to the fact that they stayed in rural areas where social belonging is very common. As a result, the harvesting method of cassava such as handpicking and use of traditional tools are predominant among these farmers, thus constrained the farmer's willingness to seek new methods.

6.1 Limitation of methodology

The research work is limited to data obtained from Ijebu-Ode Local Government Area, Ogun-State, Nigeria. In addition, time constrained was another important factor that limited the extent of the research work. The escalating cost of transportation and financial impediments which made the cost of carrying out the research was expensive. On the whole, the respondents are reluctant to give information even after being assured of confidentiality, but the researcher made the best efforts in optimizing the available resources and information without allowing the limitation to negatively affect the quality of the final output.

7. CONCLUSION

The importance of cassava in the world is mainly a reflection of the agronomic influence of the crop. However, its importance in sustaining the livelihood of less privileged individuals reveals the importance of the crop's post-harvest handling, processing and marketing.

In addition, it can also be deduced from research that, post-harvest management practices have a significant effect on the output of cassava production among small-scale farmers and there are significant factors that lead to post-harvest losses in cassava production among small-scale farmers.

The post-harvest handling practices that could enhance the quality of cassava and increase its shelf-life include harvesting methods and maturity indices, sorting and grading, packing and packaging, transport and transportation, processing and preservation, cold storage facilities, control of postharvest diseases disorders and pests, the use of acceptable produce technologies and proper sanitation practices. The effective use of the appropriate post-harvest practices would enable the handlers to offer consumers the best quality produce, increase the shelf-life of fruits, reduce the perennial losses and increase the income of the handlers.

Cassava products are important for food security and add variety to the menu of many consumers. There exist challenges in processing, storage and handling of cassava and its products. Capacity building and training as concerns value addition, cassava storage and preservation should be considered by both researchers and government agencies directly associated with cassava traders and processors. Increased efforts on adult education may be considered by the government to improve literacy in the current study area.

7.1 Recommendations

For the quality of cassava to be well developed and compete favourably on the international and local markets, the following recommendations on the appropriate post-harvest practices are made:

1. Ministry of Agriculture should support the small-scale cassava farmers with adequate improved planting materials, packaging materials and proper transportation and also adequate storage facilities should be put in place in the major areas of production to store the produce.
2. Small-scale farmers should learn more about improved practices especially the post-harvest aspect on cassava management on their fields and also serve as out growers for the large-scale producers and exporters.
3. Banks and Government should provide financial assistance to small-scale farmers. Adequate financial assistance should be given to, especially, the growers and others, to venture into the processing of the cassava to help stabilize prices and to remove excess produce from the markets.
4. Ministry of agriculture should create mass diseases and pests control programs to sanitise small-scale farmers in order to control and reduce the massive loss of cassava in every growing season.
5. The transportation system in the growing communities should be improved to reduce post-harvest losses so as to ease the movement of the products to the market.

6. There is the need for continuous education and training for all the stakeholders in the cassava business – farmers, sellers, processors and exporters.
7. Adequate storage facilities should be put in place in the major areas of production to store the produce.

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