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Assessment of storage structures for some staple crops in Akwa Ibom North East Senatorial District, Akwa Ibom State, Nigeria

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Abstract

Increased post-harvest losses of staple crops due to poor handling and inadequate storage facilities have become a concern to stakeholders in the Nigerian Food Industry. Storage structures available for some staple crops in Akwa Ibom North East Senatorial District of Akwa Ibom State, Nigeria, were assessed. Questionnaires were administered to one hundred and fifty respondents randomly selected from a pool of farmers, processors, and marketers in the study area. The study also examined the physical state of some of the available storage facilities to ascertain some challenges limiting their usage and recommendations made on measures to address the concerns. According to the survey, 50% of the respondents used sag bags for storing maize for domestic consumption and marketing, while 29% preferred plastic containers. Less than 10% of the respondents agreed to the use of enclosed rooms and lamented changes in the physical outlook of the crop at the point of marketing them due to poor aeration. Findings revealed that materials for developing storage structures for products such as cassava and cocoyam were sourced locally. Rewetting of stored products, mold, microbial infestation, and theft were some identifiable challenges associated with using plastic containers as storage mediums. The lack of awareness on the part of farmers, poor maintenance culture, non-conformity of some of the storage structures with the environment, poor funding for the development of the structures based on available local materials, inadequate supervision, and misuse of the structures were some of the factors identified as challenges towards effective utilization of storage structures in the study area. The use of rodent glue, adequate fumigation, and efficient crop drying before storage are some of the measures that could help reduce the rate of post-harvest losses of stored agricultural products. The provision of silos and other modern storage structures in strategic farm locations and the upgrading of existing structures could also enhance the storage of agricultural products and value addition.

Key words: Staple Crops, Storage Structures, Maize, Cassava, Cocoyam, Silo, Post-Harvest Processing

1.0 Introduction

The storage of crops and other agricultural products is imperative to achieving food sufficiency. The need for the preservation of agricultural products is critical due to seasonal variations and the susceptibility of agricultural products to post-harvest losses. Inadequate storage facilities are one of the major causes of food losses Nigeria. The major staple crops grown in Akwa Ibom State are cassava, cocoyam, maize, rice, vegetables, potato, cocoyam, yam, and cassava. These crops constitute greater percentage of what is produced in Africa (Nteranga and Adiel, 2015; Adetunji, 2007).)

Although a large percentage of the population is engaged in agriculture, Akwa Ibom is yet to attain food sufficiency, a situation which is due to factors such as rural-urban migration, inconsistent policies for development of the agricultural sector, inability to mechanize agriculture, poor post-harvest technology development and inadequate storage facilities. Storage is important in the agricultural production because it helps in enhancing the market value of products (Antia-Obong, *et al.,* 2021). The recent surge in food prices across Nigeria has necessitated the authorities to prioritize developing storage facilities for staple crops across the states of the federation and in line with core areas of comparative advantage. Majunder (2005) noted that agricultural products are susceptible to attack by pests, diseases, and microbial agents.

Ayo *et al*. (2017) opined that post-harvest losses are underestimated and the majority of reports are based on guesswork rather than sound empirical analysis. In Sub-Saharan Africa, post-harvest losses are peculiar to granular materials such as grains, root and tuber crops, and perishable food products such as fruits and vegetables (Affognon *et al*., 2015). Although, Kaur *et al*. (2022) linked post-harvest losses to that the lack of adequate harvesting, transportation, storage, and marketing facilities, the economic impact of post-harvest losses on small-holder farmers cannot be overestimated. About 20 to 50 % of post-harvest losses occur between marketing and packaging (Kasso and Bekele, 2018).

Reduction in food losses increases availability and contributes immensely to poverty reduction and rural development (Hodges *et al.*, 2011). As reported in some recent studies, the choice of a storage structure is dependent on the type of produce to be stored, the volume of produce to be stored, technical and economic considerations of the environment which the produce is to be stored and a host of other factors (Afriyie *et al*., 2023; Bonciu *et al*., 2022; Bello *et al*., 2021; Alessandro Del Nobile and Conte, 2023).

Most farmers in developing countries are used to traditional storage structures for certain staple crops. These structures are comparatively economical, climate-friendly and enhance the shelf life of products. However, some of them do not guarantee the acceptability of these products in the market (Mobolade *et al.,* 2021). Onyenwoke and Simonyan (2014) opined that tuber crops such as cassava are susceptible to post-harvest losses once the tuber has been separated from the main plant, hence the need to ensure adequate facilities are in place to fast-track processing and storage of the product after harvest.

Traditionally acceptable storage structures for grains in Nigeria are granaries, earthen pots, mud silos, crabs, baskets, underground pits, and open-air storage structures (Okparavero *et al.*, 2024). However, the storage of products on these structures is largely characterized by environmental factors such as humidity, temperature, and activities of pest and microbial agents. Similar, observation was made by Abiodun *et al.*, (2012) when they assessed grain storage structures for states in the South-Western region of Nigeria.

Although there has been significant development in research on the subject from a country point of view, there is little or no literature with respect to storage facilities and their usage for staple crops and granular food materials in the study area. Researching and putting to the works credible information about the state of storage facilities in the study area will provide farmers, processors, marketers, investors and even policy makers with the right tool to make informed decisions on the medium adequate for some crops they intend growing in the study area as well as optimizing the shelf life and market value of such products through efficient post-harvest storage and processing.

This paper analyses storage structures used by farmers in Akwa Ibom North East for some staple crops in the past three decades. Some recommendations toward improving these storage structures are highlighted in the study, while the need to reduce the spate of post-harvest losses for products such as granular materials, root and tuber crops is also emphasized.

2.0 Materials and Methods

2.1 Study Area

The study area was Akwa Ibom North East (Uyo) Senatorial District of Akwa Ibom State, Nigeria. Data were collected using questionnaires and on-site assessment of some storage structures used for storage of some of the staple crops considered in the study area. According to the National Bureau of Statistics (NBS, 2023), Akwa Ibom State has a total population of nearly seven million two hundred thousand people of which 88 % dwell in rural areas, while 12 % are resident in urban centers. Akwa Ibom State has a total land space of 7,249 km^2. Akwa Ibom is made up of 31 Local Government Areas, with Uyo, Eket and Ikot Ekpene being the most developed. The study area consists of 9 Local Government Areas namely: Uyo, Ibiono Ibom, Itu, Ibesikpo Asutan, Uruan, Nsit Atai, Nsit Ibom, Nsit Ubium, and Etinan.

2.2 Data Collection and Analysis

A total of 150 questionnaires were administered randomly to farmers, processors and product marketers in strategic farm locations to obtain information on storage structures available for maize, cassava, and cocoyam in the locations considered for the study. Visual inspection of available storage facilities was done to ascertain their level of acceptance, functionality and adoption by farmers within the study area. Data obtained from the questionnaires were analyzed using graphical illustrations to ascertain the level of awareness of residents on the availability and use of storage structures within the study area. The farmers were asked to indicate the type of storage structure they make use of and the duration of which stored products would last before possible deterioration.

3.0 Results and Discussion

3.1 Storage of Maize Grains

The shelf life of maize on different storage mediums in the study area was obtained and presented in Figure 3.1, from a survey of one hundred and fifty respondents drawn from the market and strategic farm locations.

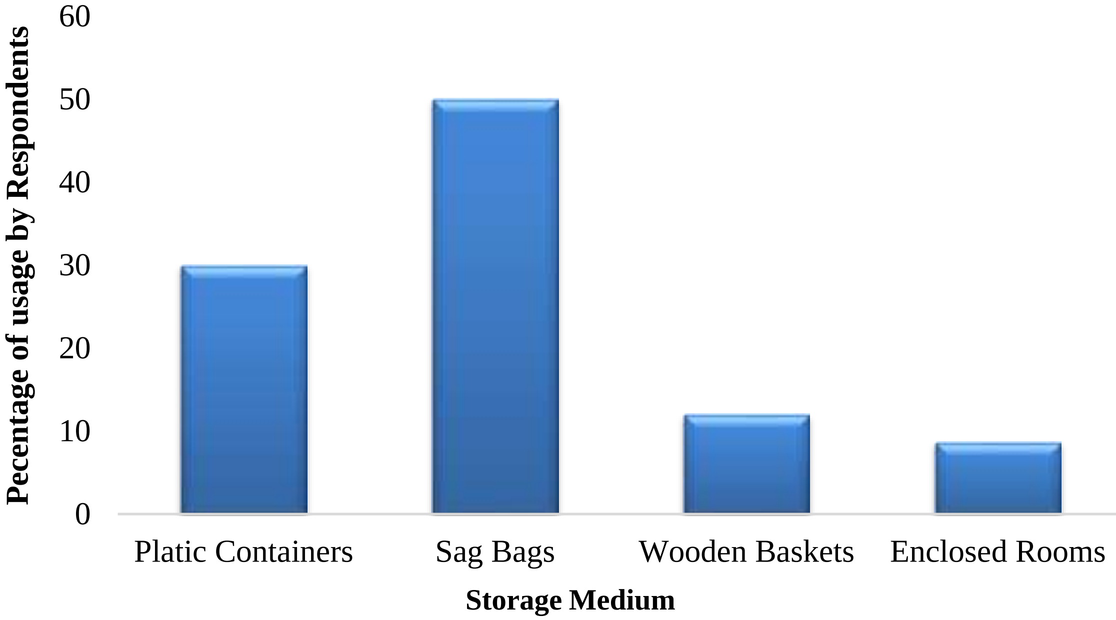

Figure 3.1: Patronage of available storage mediums for maize grains in the study area.

Most of the respondents opined that sag bags were the widely used storage medium in the study area with 50 % of them affirming to this. About 30 % of the respondents confirmed that they use of plastic containers to store maize grains after harvest, while 12 % of the respondents preferred wooden baskets as storage medium for the product as shown in Figure 3.1. The least utilized medium for storage of the product was enclosed rooms (8.7 % of the respondents agreed to have been utilizing the structure). The survey also revealed that none of the respondents within the study area used silo for storage of maize grains. Despite the availability of such structures within the study area, most farmers are not aware of their existence or abreast with the use of such facilities.

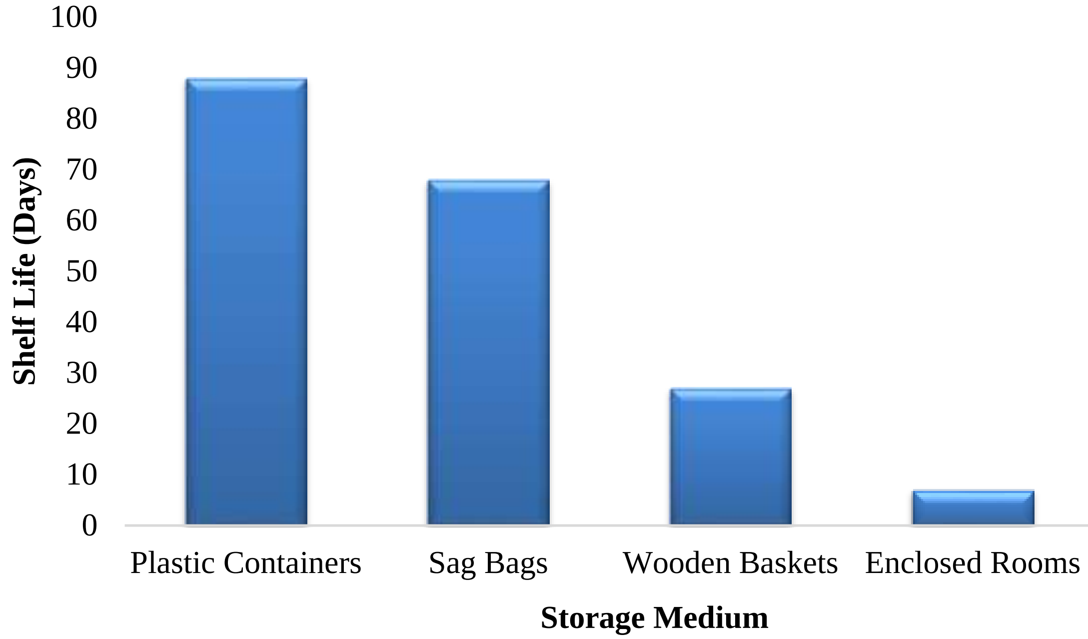

Figure 3.2: Shelf life of maize grains on various storage mediums available in the study area.

The study also revealed that maize grains stored in plastic containers had a much improved shelf life when compared with other mediums of storage for the product. According to the respondents, maize stored in containers could last for maximum of eighty-eight days. Farmers and off-takers who use plastic containers for storing maize said the storage structure was characterized by the growth of molds, insect attacks, infestation by micro-organisms, and theft. Despite these challenges, most of the farmers still prefer to use the storage structure ahead of others. The study also highlighted that maize grains stored in sag bags could last for an average of sixty-eight days. They opined that moisture penetration and infestation by rats were some of the leading challenges they faced in storing the product in sag bags. For respondents who affirmed that they store the product using wooden baskets, they confirmed that the product could last for twenty-seven days as shown in Figure 3.2. Theft and attack by microbial agents and rodents were some of the shortcomings of using the medium as expressed by the respondents. Farmers in the study area produced maize largely for domestic consumption, with little emphasis on large-scale marketing and bulk storage.

3.2 Storage of Cassava and Cocoyam

Investigations revealed that farmers in the study area generally do not use plastic containers and silos for storage of cassava and cocoyam.

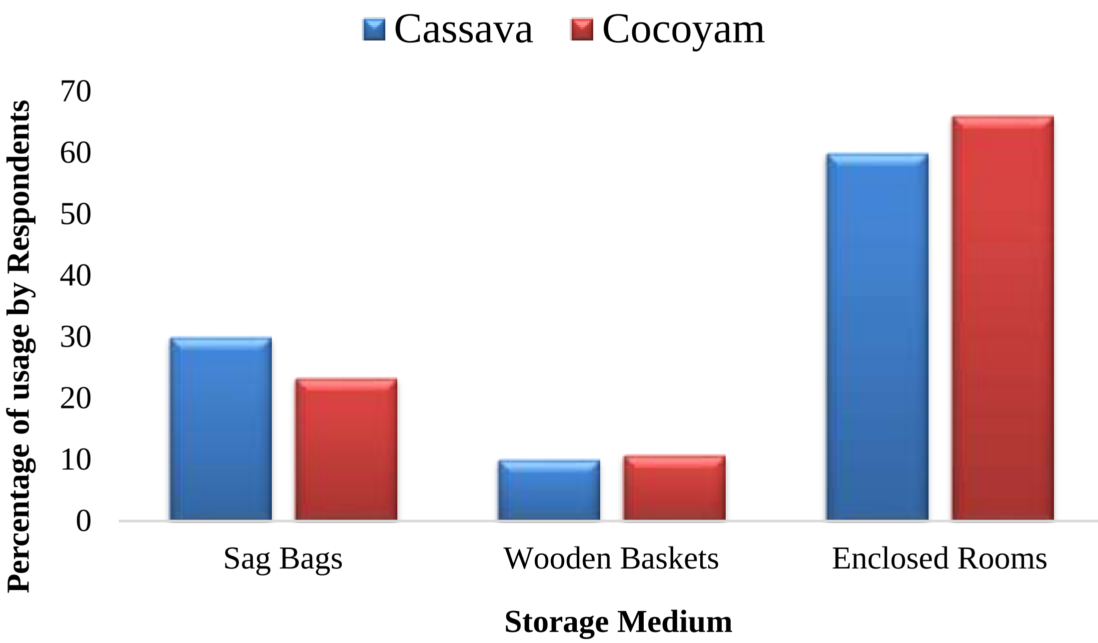

Figure 3.3: Patronage of available storage medium for cassava and cocoyam in the study area.

3.2.1 Cassava

About 60 % of the respondents preferred storage of cassava tubers in enclosed rooms. The products are usually heaped on the floor and watered daily to keep them fresh, or coated with mud to preserve freshness. No fewer than 30 % of the respondents said that store the product in sag bags, while 10 % said they preferred wooden baskets as shown in Figure 3.3. Most of the respondents however opined that their choice of enclosed rooms for storage of tuber crops was based on traditional beliefs inherited by their ancestors. This assertion underscores the relevance of culture and tradition in enhancing food production.

3.2.2 Cocoyam

About 66 % of the respondents agreed to the use of enclosed rooms for the storage of cocoyam, while 23.3 % preferred to use sag bags. A relatively lower percentage of the respondents (10.7 %) preferred the use of baskets for the storage of cocoyam. However, these structures were observed to be dominantly used by small-holder farmers for domestic consumption with little emphasis on commercialization. Poor aeration and increased microbial activities were dominant reasons why the farmers preferred to store roots and tuber crops in structures that were not air-tight. Increased theft of the products also discouraged the farmers from enhancing production capacity.

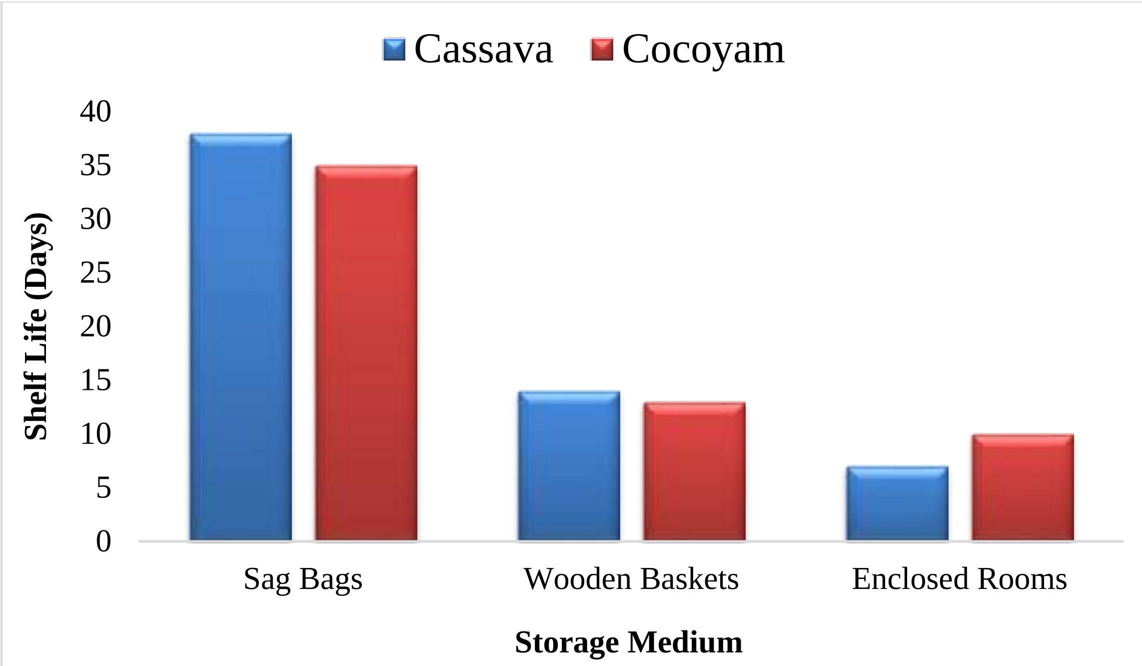

Figure 3.4: Shelf life of Cassava and Cocoyam on the various storage mediums available in the study area

The study revealed that the crops stored in enclosed rooms had prolonged shelf life when compared to other storage mediums. The respondents averred that cassava and cocoyam stored in enclosed rooms could last for a maximum of 38 days on average respectively before eventual deterioration. The basic concern expressed by the farmers was the inability of the product in the storage medium to be preserved for the next planting season. Low aeration and attack by microbial agents were the core challenges noticed. The farmers also showed their preference for the storage of root crops in sag bags. Cocoyam reportedly had a shelf life of 14 days. They however expressed concern that the medium does not provide adequate protection for the crop. The farmers highlighted exposure to theft and insufficient ventilation as major concerns. The cost of sag bags in the market was also mentioned as a concern by most of the farmers.

Cassava stored in wooden baskets had a minimal shelf life of less than a week, while cocoyam had a shelf life of 10 days. The respondents noted that cassava and cocoyam stored in baskets were easily carted away by thieves, especially in areas that are not adequately protected.

3.3 Silos as Storage Structure in Akwa Ibom North East

Silos are used for the storage of grains and forage. In Akwa Ibom North East Senatorial District, there are only two known locations where silos are situated for bulk storage of grains. The silos are located at: The main campus of the University of Uyo in Uyo Local Government Area, and Ikot Ada Idem in Ibiono Ibom Local Government Area. The silo at Ibiono Ibom (A Federal Government Intervention Project) has not been put to use since completion. An on the spot assessment of these structures was conducted to outline possible challenges preventing the use of the silos and adequate recommendations for its efficient maintenance and utilization were also made.

3.3.1 The Silos Located at the Main Campus of the University of Uyo

The silos located at the University of Uyo in Use Offot, Uyo, Akwa-Ibom State, were installed more than two decades ago with the aim of serving as storage medium granular food materials produced in Uyo and environs for the purposes of consumption and research. The silos at the point of installation were five in number, but yet to be put to use. The base of the silos were casted with concrete which provided a support base for loads. The silos were constructed with steel. The silos are of high storage capacity which could be of reasonable use to farmers who produce grains within the study area in larger quantity. Plate 1 shows a pictorial evidence of the current status of the silos as of December, 2023.

Plate 3.1: Site of the Silo at the University of Uyo, showing wild growth of weeds

A technical tour of the site revealed that the silos were designed with an effective aeration system for adequate air penetration into the system. The material used construction was steel of high resistance to rust. The roof was made of galvanized and ribbed steel plates, appropriate to take heavy loads. The assembly was made using bolts of great mechanical characteristics and fortified against corrosion. The body was cylindrical in shape and made of corrugated iron panels reinforced with strong external metal sheets. The silos were embedded with conveyor systems, bucket elevators, and discharge chutes for easy flow of the materials into and out of the system.

3.3.2 Possible Causes of Failure/ Non-utilization of the Silo located at the University of Uyo

A technical audit of the silos at the University of Uyo, suggests that non-utilization of the silo is the major reason for inadequate maintenance and failure. Non-utilization of the silo has made it difficult for improvement of the structures. Regular preventive maintenance measures such as the repair of the walls and liner used to enhance the flow and protection of the structure would have sustained the structure. The exterior of the silos (Plate 3.1) is ravaged by corrosion. Corrosion on the outside of the silo resulted in the formation of small holes in the wall thus leaving room for water to penetrate and eventual rusting of the interior section of the structure. The growth of weeds and other unwanted plants and the presence of dangerous animals such as termites, millipedes, and snakes within the structure has made it difficult for the facility to be accessed by farmers and persons who would have loved to explore for use. Though none of these animals could be cited at the time of the visit to the site, farmers within the neighborhood enunciated the threat they face as a result of the infestation of the silos and environs by highly venomous snakes who have found solace in the structure. The farmers also highlighted high initial cost of developing such massive structure as basis for not contemplating owning one. The respondents agreed that negligence on the part of the authorities and inability to product granular food materials at a larger scale were some of the challenges limiting the use of the structure.

3.4 The Federal Government Intervention (FGI) Silo Project at Ibiono Ibom

The Federal Government Intervention Silo Project (Plate 3.2) is located at Ikot Ada Idem (along Uyo-Ikot Ekpene Road), a village in Ibiono Ibom Local Government Area, Akwa Ibom state.

Plate 3.2: The Federal Government Intervention Silo in Ikot Ada Idem, Ibiono Ibom Local Government Area of Akwa Ibom State, Nigeria

The facility comprises of the following units: A tipping unit, drying unit, storage unit, warehouse/bagging unit, administrative unit, maintenance unit (power and water), security unit, control unit, and accommodation unit (for truck drivers). The storage unit has ten compartments, each having a capacity of 25,000 Metric Tonnes (MT), totaling 250,000 MT. Each silo is equipped with two blowers for effective cooling and ventilation. The initiative was facilitated during the era of President Goodluck Ebele Jonathan to encourage farmers in Akwa Ibom and states in the South-South geopolitical zone of the country to venture into mass production of grains, reduce the rate of post-harvest losses of granular food materials, stabilize the prices of grains in the market, and create employment for Nigerians. The project was replicated in five other states in the different geopolitical zones of the country.

3.4.1 Challenges Faced by the Contractor while Constructing the Structure
The completion of the structure was delayed against the scheduled time due to some factors highlighted by the contractor, which were but not limited to the following:

3.4.1.1 Inadequate Funding: Funding for the project was done in tranches as captured in the project Work Base Structure (WBS), but the timelines were not adequately followed. Delay and inconsistency in funding of the project affected its completion as the costs of materials soared higher with time. The project was subjected to different stages of variation.

3.4.1.2 Poor Supervision and Lack of Interest on the Part of the Government: Relevant agencies saddled with supervisory responsibility for the project were not forthcoming. The project managers experienced significant bridge in communication especially in the area of outlining deliverables for the project.

3.4.1.3 Raw Materials Availability in the Local Market: Some of the raw materials required for the construction work were sourced from the international market. At the later stages of the work, due to high exchange rate, the materials were now sourced for locally. However some component parts did not match with what was earlier acquired from the foreign market due to non-compatibility. Sourcing for materials from the local market would have been more ideal from the initial point of fabricating the silos to allow for ease of replacement of parts when there is need.

3.4.1.4 Politics and Continuity in Governance: The project suffered huge setback following the end to the tenure of President Goodluck Ebele Jonathan in May 2015 as the Buhari led administration did not provide adequate funding and support for its completion. This is a basic challenges often faced by projects of similar magnitude as a result of inconsistency in policies change of regime.

3.4.1.5: Poor Collaboration between Stakeholders: The collaboration between major stakeholders of the project which include: the contractor; project sponsor (Federal Government); farmers and research institutions within the study area was not very adequate. The development limited the sharing of technical information before, during, and after the completion of the project. Expert opinion was not sought for in the choice of materials for construction of the facility. The materials ought to have conformed to the environment and synergy between the stakeholders aforementioned would have enhanced such possibility. There is need to seek expert advice, while also fostering strong collaboration between operators of the facility and institutions of higher learning within the South-South zone for research opportunities.

4.0 Conclusion
The storage mediums presently used by farmers and marketers of maize, cassava, and cocoyam are not adequate for preserving these crops for a lengthy period, to minimize shortage of the products in subsequent planting seasons, re-introducing the stored products into the market when the demand is high for efficient price control. For these goals to be achieved, certain infrastructures must be put in place to reduce post-harvest losses to the recommended corridor of 5 to 26 %. To guarantee efficient storage of agricultural products and promote the shelf life of crops in Akwa Ibom State, the following recommendations are made:

i. Extension services should be revamped to enable adequate sensitization farmers on the essence of storing harvested agricultural products for prolonged shelf life and market value optimization.
ii. Farmers should be encouraged to adopt modern storage facilities such as silos for the storage of granular food materials for adequate protection against theft.
iii. The use of plastic containers, sag bags, and wooden baskets to store grains should be encourage, but adequate attention paid to sourcing of materials locally for design and development of such storage mediums.
iv. Farmers should embark on the construction and use of less expensive storage structures like cribs, which can protect their grains from rodent attacks due to the inculcation of baffles on the legs of the crib.
v. Fumigation should be carried out around storage facilities before storing crops to get rid of rodents, insects, and reptiles.
vi. The site of the silos at the University of Uyo should be cleared of weeds and adequately fumigated to reduce the threat of harmful animals and enable farmers gain access to the facility for possible recovery and utilization.
vii. Economic analysis should be done to ascertain whether it is more viable to recover and revamp the silos at the University of Uyo or develop new ones to meet the demands for storage of granular food materials within the study area.
viii. Information on the type of agricultural products which can be stored in the silos should be made public and regular awareness done to encourage farmers to increase production for such produce, knowing that there is a large scale facility for storage, which will limit post-harvest losses.
ix. The authorities should immediately develop framework for off-taking of such products that would be stored in the silos available in the study area to ensure the facilities are serviced and also encourage farmers to increase their production capacity. This will be helpful during drought and period of inflation, where the products would be obtained from the storage facility and introduced to the market for optimal price control.
x. Strong synergy between the project managers, policy-makers, farmers and research institutions within the study area is necessary to ensure promotion of research opportunities which could help in efficient maintenance of the structures and provision of technical information required for development of similar facilities in the future.

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