

POST-HARVEST LOSSES AMONG ADOPTERS AND NON-ADOPTERS OF VALUE-ADDED INNOVATIONS OF SWEET POTATOES IN VANDEIKYA LOCAL GOVERNMENT AREA OF BENUE STATE, NIGERIA

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Abstract

Post-harvest losses of sweet potatoes pose a major challenge to food security, income generation, and agricultural sustainability, particularly among smallholder farmers in developing regions. This study investigates the extent of post-harvest losses among adopters and non-adopters of value-added innovations of sweet potatoes in Vandeikya Local Government Area of Benue State, Nigeria. The objective is to evaluate the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes, the population comprises sweet potatoes farmers, Cochran's (1977) formula was utilised and a sample size of 384 was determined. A mixed methods design was employed and data were collected using structured interview, focus group discussion and key informant interview. The data obtained were triangulated making use of descriptive analysis, frequencies, means and t-test statistics. The result showed that, a greater number of 349 respondents were non-adopters of modern value-added innovations of sweet potatoes, while only 35 respondents were adopters. The result revealed that adopters of value-added innovations fell most within the smaller extent of post-harvest losses, (0-20%) while non-adopters seemed to maintain a steady rise in post-harvest losses, majority fell within (80-100%) and there was a significant difference in the extent of post-harvest losses between adopters and non-adopters of value-added innovations of the crop. The study concluded that increase in adoption of value-added innovations of sweet potatoes resulted in a decrease in the extent of post-harvest losses. Therefore, the government, could use this result as reference point for advocacy via mass media, for the adoptions of value-added innovations of sweet potatoes. Moreover, philanthropist, Non-Governmental Organisations and the government should provide cottage industries and logistics to farmers for enhancing adoption of value-added innovations and control postharvest losses of sweet potatoes in the study area and Nigeria at large.

Keywords: Post-harvest Losses, Sweet-Potatoes, Adopters, Non-Adopters, Value-Added Innovations

Introduction

Sweet potatoes are a nutritional powerhouse, which offers numerous health benefits, and further plays a crucial role in food security and income generation for smallholder farmers (Shee, Stathers, Bechoff & Bennett, 2019). However, post-harvest losses remain a significant challenge to the highly perishable crop, in spite of the mitigating potentials of value-added innovations. The adoption of modern value-added innovations of sweet potatoes has remained limited, while most farmers still rely on traditional methods, leading to continues post-harvest losses (Sugri, Maalekuu, Gaveh, Kusi & Lamini, 2019).

Post-harvest losses of sweet potatoes vary between 15 and 65 percent globally, due to either loss in fresh weight or root rot between one and four months of storage (Adedire et al.,

2023). In Nigeria, Abebe (2020), held that estimates of the production losses are hard to judge, but some estimate the losses of sweet potatoes to be very high, amounting to about 30-50% of the total produce (1.3 million tons) is lost after harvest. Limited adoption of modern technologies and innovations has been implicated as a major hindrance to post-harvest management (Shee et al., 2019). According to Mlaviwa and Missanjo (2019), in their study on recent trends and future directions of value addition of sweet potato among smallholder farmers in Malawi found that, majority (70%) of the farmers were influenced by knowledge of value addition. The situation in Nigeria seems to be different as the level of adoption of value-added innovations is low. Evidently, Omoare, Fakoya, Fapojuwo and Oyediran (2015), noted that despite the clear potential of sweet potato in helping to meet Nigerian's food needs, full exploitation and utilization in South-west and North-central Nigeria is constrained by its bulkiness, perishability and low farmers adoption on its value addition.

There are several value-added innovations of sweet potato, which included the traditional and modern methods. Kim (2020), observes that traditionally, the roots of sweet potato are most frequently boiled, fried or baked, while using modern methods; they are processed into starch, flour and industrial alcohol. Moyo et al. (2022) and Oluoch, Lagat, and Langat (2016), categorised forms of sweet potato value addition adopted into post-harvest level or primary processing such as cleaning, sorting, grading and packing raw tubers for sale. The basic processing includes steaming, boiling or roasting, grinding, packing the flour into different sizes. Lastly, high end processing which involves activities such as frying sliced root tubers to obtain potato chips, noodles, candy, desserts. Others are baking bread, buns, cakes and doughnuts using sweet potato flour. Omoare et al. (2015), also recognize some value addition of sweet potatoes adopted by farmers in Osun State, Nigeria and those not adopted. The ones adopted include, sweet potato sparrri, chips, flour, vegetable, 'kunu' and animal feed, while sweet potato bread, meat pie, fruit juice chin-chin, doughnut, biscuits, puff-puff, noodles and industrial alcohol with economic potential were not known to the farmers nor adopted.

Some farmers adopt these value-added innovations, while others remain non-adopters due to various constraints such as; lack of awareness, limited access to resources, or resistance to change (Amah, Maziya-Dixon & Alamu, 2021). This divergence in innovation adoption, which is also observed as common among sweet potatoes farmers in Vandeikya Local Government Area of Benue State, raises a critical question as to the difference in post-harvest losses between the two groups. Lack of adequate empirical evidence comparing the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes in the study area is of interest. This study therefore, seeks to investigate the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes, in order to understand these differences for designing targeted interventions, promoting technology uptake, and improving overall sweet potato value chain efficiency.

Objective of the study

The study objective is to evaluate the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes in Vandeikya Local Government Area of Benue State.

Hypothesis

There is no significant difference in the extent of post-harvest losses of sweet potatoes between adopters and non-adopters of value-added innovations of the crop in Vandeikya Local Government Area of Benue State.

Conceptual Review

Sweet Potatoes

Sweet potato (*Ipomoea batatas*) also called Atsaka in Tiv language is a dicotyledonous plant that belongs to the bindweed or morning glory family, Convolvulaceae. Its large, starchy, sweet-tasting tuberous roots are used as a root vegetable (Amagloh & Nyarko, 2021). The

young shoots and leaves are sometimes eaten as greens. Cultivars of the sweet potato have been bred to bear tubers with flesh and skin of various colours. Sweet potato is only distantly related to the common potato (*Solanum tuberosum*), both being in the order Solanales (Keoke & Porterfield, 2009).

According to Low, Mwanga, Andrade, Carey and Ball (2017), sweet potato plant is an herbaceous perennial vine, bearing alternate triangle-shaped leaves and medium-sized sympetalous flowers. The stems are usually crawling on the ground and form adventitious roots at the nodes. The leaves are screwed along the stems. The leaf stalk is 5 to 20 inches long. The leaf blades are very variable, 5 to 13cm (2.0 to 5.1 inch) long, the shape is hart, kidney-to egg-shaped, rounded or triangular. Most of the leaf surfaces are bare, rarely hairy, and the tip is rounded to pointed. The leaves are mostly green in colour, but due to the accumulation of anthocyanins, especially along the leaf veins, they can be purple in colour, depending on the variety. The plant does not tolerate frost. It grows best at an average temperature of 24 °C (75 °F), with abundant sunshine and warm nights. Annual rainfalls of 750-1,000 mm (30-39 inch) are considered most suitable, with a minimum of 500 mm (20 inch) in the growing season. The crop is sensitive to drought at the tuber initiation stage 50-60 days after planting, and it is not tolerant to water logging, which may cause tuber rots and reduce the growth of storage roots if aeration is poor.

Post-harvest Losses

Post-harvest losses occur between harvest and the moment of human consumption. They include on-farm losses as well as losses along the food value chain during transportation, storage and processing. Post-harvest loss is often thought of in physical terms, as the percentage of food produced that is no longer available for consumption and the value lost estimated as the value of that food that has disappeared from the food chain (Aulakh, Regmi, Fulton & Alexander, 2013). Post-harvest losses may arise from the fact that freshly harvested agricultural produce is a living thing that breathes and undergoes changes during post-harvest handling. Lowenberg-DeBoer (2015), observed that the loss in value may be much larger than the value of the absolute quantity that is eaten by insects and pests, that is no longer useable because of contamination with mycotoxins, or that spoils because of poor handling and storage conditions. Thus, for sweet potatoes, post-harvest losses may be viewed as losses of the crop after harvest. These losses may occur in all the stages of post-harvest losses but may be more eminent during storage or preservation. These losses could be in form of mechanical injury, weight loss, sprouting and pests and diseases.

Food losses can be the result of a quantitative loss or a qualitative loss. Quantitative loss of food implies a reduction in the available quantity as a result of infestation by pests at harvest or storage, physical loss during handling, or reduction in quantity because of changes in temperature, moisture content, or chemical composition. Qualitative loss of food results in changes which lower its economic or nutrient value, often requiring that it be discarded (i.e., resulting in quantitative loss). This can occur due to spoilage due to pests or diseases, physical or chemical changes due to a lack of climate-controlled storage and handling facilities, food contaminated with non-food material, or adverse taste, texture, or other changes due to improper processing (Aulakh *et al.*, 2013).

Value-added Innovations

Value-added innovation is a process in which a company introduces new technologies or upgrades that are designed to achieve both product differentiation and low costs (Cole, 2023). The changes implemented through value innovation create new or improved elements for the product or service, but also result in cost savings by eliminating or reducing unnecessary aspects during the product lifecycle. Value-added is making something better or more useful by adding new elements. By adding value to raw sweet potato root or tuber, it is processed into

other by-products, which can be more enticing and profitable than selling its raw products (Chan, 2022).

The uses of sweet potatoes have been diversified considerably over the last four decades, having great potential as a source of local value-added products and as ingredients in other production processes. Oluoch et al. (2016), noted that value addition may take various forms that could be summarized in three levels that include: Level 1 - Post-harvest level/primary processing: this includes proper cleaning, sorting, grading and packing sweet potato raw tubers for sale. This is the most common type of value addition practiced by farmers. Level 2 - Secondary/ basic processing: this includes steaming, boiling or roasting the raw tubers. In addition, it can also take the form of grinding sweet potatoes into flour and packing the flour into different respective sizes. Level 3 - High end processing; involves activities such as frying sliced root tubers to obtain potato chips, noodles, candy, desserts. In addition, it involves baking breads, buns, cakes and doughnuts using sweet potato flour, preparing mandazi and chapatti using the same grinded flour or making sweet potato juice. This level also involves actual packaging of processed sweet potato products, branding, and marketing. Thus, value-added innovation are inventions or improved methods that are adopted to add value to sweet potatoes other than the traditional or indigenous methods previously used by farmers. These value-added innovations include, but are not limited to sweet-potato noodles, meat pies, candy, bread, buns, cakes, doughnuts, biscuits, camote chips, puff-puff, juice, chin-chin and industrial alcohol.

Theoretical Base: Diffusion of Innovation Theory (DIT)

The diffusion of innovation theory was first proposed by Everett Rogers in 1962. It is a social science theory that explains how, why, and at what rate new ideas, technologies, or products spread through cultures of social systems. The major assumptions of the theory are based on the following assertions:

- i. That development is largely the result of the spread of certain cultural patterns and material benefits from the developed to the underdeveloped nations.
- ii. That within each underdeveloped nation a similar process of diffusion takes place from the modern to the traditional sectors.
- iii. Diffusion centres on the conditions which increase or decrease the likelihood that a new idea, product, or practice will be adopted by members of a given culture.
- iv. Diffusion is the process by which an innovation is communicated through certain channels over a period of time among the members of a social system (Rogers, 2015).

The underlying assumption of diffusionist approach is the traditional/modern dichotomy. The dualistic conception of underdevelopment Centre's in the common point of identifying and classifying the various characteristics of the traditional and modern sectors of underdeveloped countries (in order to justify the transformation of the former into the institutional framework of the latter). The acceptance of the dual society thesis, then has led developmentalists to argue that for development to occur, capital, technology, institutions and values must be diffused from the developed to the underdeveloped countries, and within each underdeveloped nation the same process of diffusion be repeated from the modern to the traditional sector of the society.

Rogers (2015), further specify five adopter categories classifying individuals or other decision-making units in their rate of adoption of an innovation. They included; innovators, early adopters, early majority, late majority and laggards. According to Rogers (2015), adoption of new technology via a dispersal of innovation with a social system takes place through its adoption by individual or groups. Adoption is a decision to make full use of an innovation as the best course of action available. The decision to adopt an innovation, involves

$$n = \frac{Z^2 \cdot p \cdot (1 - p)}{e^2}$$

Whereas n = Sample size

Z = Z-value corresponding to the desired confidence level (1.96 for a 95% confidence level)

p = the estimated proportion of an attribute that is present in the population (0.5)

$q = 1 - p$ (if $p = 0.5$, $q = 0.5$)

e = Margin of error (desired level of precision) (0.05).

Methods of Data Collection

Three methods of data collection were employed in this study. These included; Structured Interview, Focus Group Discussion and Key Informant Interview. A structured interview guide was used to elicit information from 384 respondents (sweet potato farmers) on the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes. Focus group discussion (FGD) was used to allow greater freedom from discussants to express their views towards topical questions in the study, so that certain facts that would have probably been ignored could be revealed. About 6-10 discussants constitute a group in each of the council wards. Two (2) separate sessions comprising of adult male and female sweet potato farmers were held. This was to avoid domination by any gender during discussions. Key informant interview (KII) was conducted with extension agents in the Department of Agriculture, Vandeikya Local Government Council Secretariat. These categories of persons were selected for sampling because of their expertise in the subject under assessment. They were also selected to give their views on issues of concern in the study, and to further verify responses from the sweet potato farmers.

Data Analysis

The study utilised both quantitative and qualitative techniques. Data collected through these two techniques were triangulated. Quantitative data, utilised frequencies, simple percentages, mean, standard deviation, chart and t-test statistics. The qualitative technique gathered data with the use of focus group discussion (FGD) and key informant interview (KII), after which the data was cleaned, transcribed in English language and presented in content form using empirical quotations. The data were analysed qualitatively using descriptive analytical approaches. The formulated hypothesis was tested using t-test statistic.

Results

The socio-demographic characteristics of respondents in the study indicated that males comprised 163(42.4%), while females were 221(57.6%). In terms of respondents' age, those who fell within the age category of 18-30 years old were 154(40.1%), those within 31-64 years old were 209(54.4%), and those whose ages ranged 65 years old and above were made up of 21(5.5%). In regards to respondents' marital status, single respondents were made up of 70(18.2%), the married respondents were 218(56.8%), those divorced or separated were 31(8.1%), and the respondents who were widowed were 65(16.9%). The respondents' educational level showed that those with no formal education were 11(2.9%), while those who had primary education were 103(26.8%), those who obtained secondary education were 202(52.6%), and those who attained tertiary education were 68(17.7%). Regarding respondents' primary occupation, 46(12.0%) were civil servants, 252(65.6%) were farmers, 19(5.0%) were traders, 53(13.8%) were artisans, while others who neither of the aforementioned occupations were made up 143.6%). The respondents' years of farming indicated that those who had farmed within the range of 1-10 years were 67(17.5%), those within the range of 11-20 years were 172(44.8%), those within 21-30 years were 113(29.4%), and those who had been farming for 31 years and above were 32(8.3%) respectively.

Result on the objective, evaluating the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes in Vandeikya Local Government Area of Benue State, is shown in table 1 and further elaborated in figure 2.

Table 1: Extent of post-harvest losses of sweet potatoes between adopters and non-adopters of value-added innovations

Extent of PHL	Adopters		Non-Adopters	
	Frequency = 35	(%) 100	Frequency = 349	(%) 100
0-20%	29	82.8	24	6.9
21-40%	4	11.4	51	14.6
41-60%	1	2.9	47	13.5
61-80%	1	2.9	98	28.0
81-100%	0	00	129	37.0

Source: Field Survey, 2024.

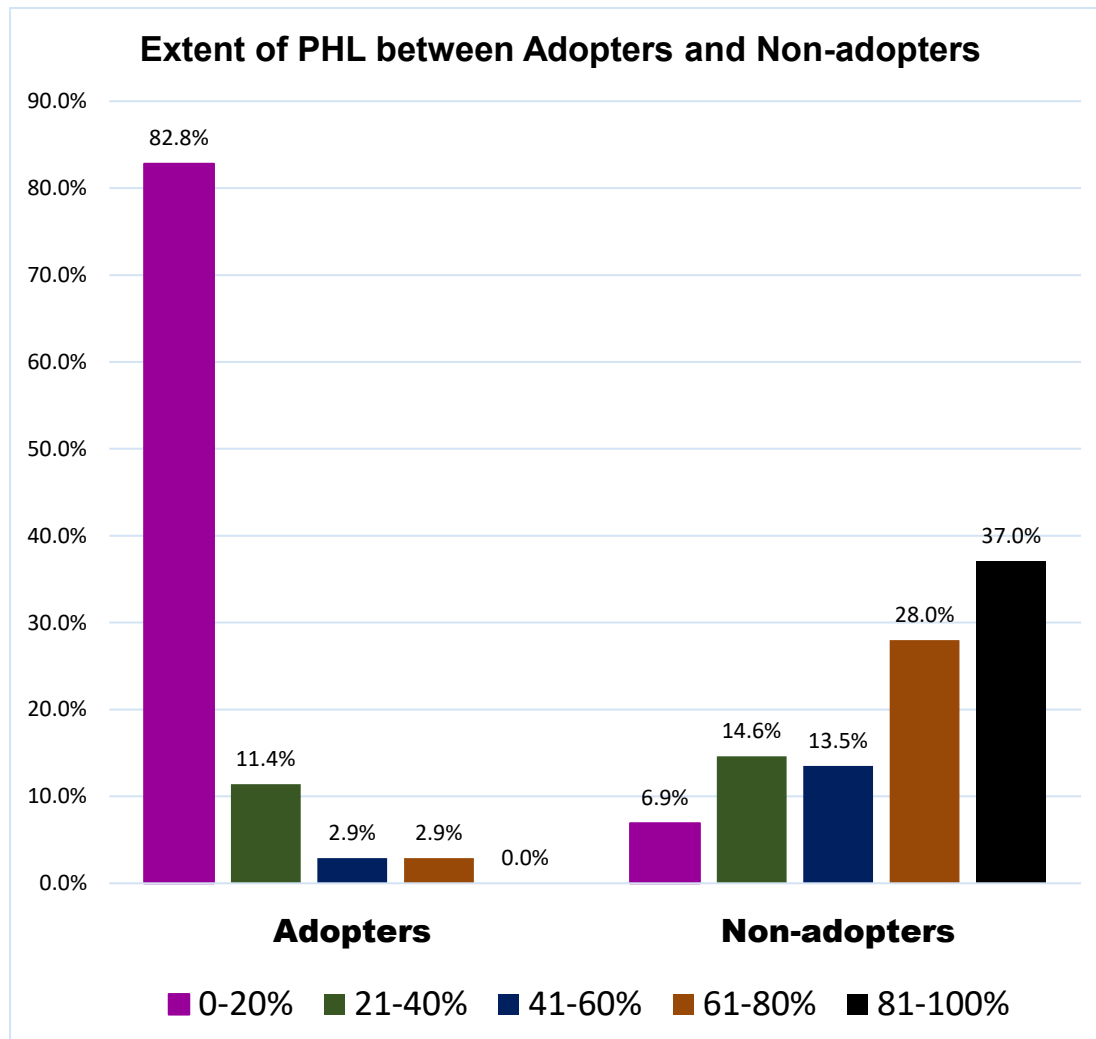


Figure 2: Extent of Post-harvest Losses between Adopters and Non-adopters of Value-added Innovations of Sweet Potatoes

Source: Field Survey, 2024.

Table 1 shows the extent of post-harvest losses of sweet potatoes between adopters and non-adopters of value-added innovations of the crop. The result on Table 1 is complimented by the pictorial chart on Figure 2, which aids to summarize the result at a glance.

The result on Table 1 shows that out of the total of 384 respondents, only 35 respondents were adopters of the modern value-added innovations of sweet potatoes, which included; sweet-potato meat pies, candy, bread, buns, cakes, doughnuts, camote chips, puff-puff, juice

and chin-chin. A greater number of 349 respondents were non-adopters of the value-added innovations.

The result on table 1 further shows the extent of post-harvest losses between adopters and non-adopters in percentages ranges. Thus, the result indicates that within the range of 0-20 per cent, there were 29 (82.8%) adopters, while non-adopters were 24 (6.9%).

Corroborating the findings on the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes, focus group discussants with male farmer from Tsambe and a female farmer from Mbayongo confirmed thus respectively:

Based on my opinion, it is we, the non-adopters of these modern value-added innovations of sweet potatoes that suffer greater post-harvest losses. The farmers that adopt these modern value-added innovations do not experience post-harvest losses. In fact, those who adopt diverse value-added innovations enjoy maximum benefit of their sweet potatoes, and they hardly have any waste from rot and decay, as they normally use the sweet potatoes before it starts getting spoilt. (FGD, 2024)

We that don't adopt the modern value-added innovations suffer many losses, unlike the adopters that experience low or no losses of their sweet potatoes produce. What am saying in summary is that the adopters may have less than 20 per cent of the losses but the non-adopters will experience very high losses over 80 percent. (FGD, 2024)

Furthermore, the results regarding sweet potato extent of post-harvest losses in table 1 indicated that for the range of 21-40 per cent, there were 4 (11.4%) adopters, while there were 51 (14.6%) non-adopters.

In line with this finding, a male discussant from Nyumagbagh and a female discussant from Mbadede in an FGD upheld thus respectively:

Those who do not adopt the modern value-added innovation of sweet potatoes will suffer post-harvest losses more continuously, but for those that adopt these modern value additions of sweet potatoes, will have significantly low losses always. (FGD, 2024)

I observed that those who do not adopt these modern value-added innovations of sweet potatoes, do have many losses in higher percentages regularly, than the people who adopt. The adopters even run short of sweet potatoes tubers in no time and need more, because they use sweet potatoes for so many things. (FGD, 2024)

Further results from Table 1 on the extent of post-harvest losses of sweet potatoes disclosed that, within the range of 41-60 per cent, there was 1 (2.9%) adopter, and there were 47 (13.5%) non-adopters.

Corroborating the findings on the extent of post-harvest losses of sweet potato, a male farmer from Ningev and a female farmer from Mbakyaha council wards in an FGD discussions maintained thus respectively:

In our community, most of us are unable to adopt these modern value-added innovations. Therefore, majority of us do experience over half of our sweet potatoes produce wasted. We are still limited to the traditional use of sweet potatoes for pounding, which we use for swallow, and boiling to eat. (FGD, 2024)

Here in Mbakyaha, we hardly adopt these modern value-added innovations, so we experience high losses. For example, last year I produced up to 9basins and ended up losing over 4basins as waste. I believe strongly adopters may not experience much losses. Thank you. (FGD, 2024)

Moreover, findings on table 1 on the extent of post-harvest losses, further revealed that within the range of 61-80 per cent, there was also 1 (2.9%) adopter, while there were 98 (28.0%) non-adopters.

In validating the findings on the extent of post-harvest losses of sweet potato, a female discussant from Tsambe and a male discussant from Mbayongo in an FGD discussions established thus sequentially:

In my opinion, to be sincere, we that do not adopt these value-added innovations do have very high sweet potatoes post-harvest losses over 70 percent more than half of the stored tubers. Unlike those who adopt, whom hardly experience losses or wastage of the produce. (FGD, 2024)

Here in Mbayongo, based on my observation on the extent of post-harvest losses of sweet potatoes, majority of the farmers usually experience very high losses of the stored produce, because we don't adopt these modern value-added innovations, rather we normally dig holes or pits covered with tach-grasses and stored the produce. However, at the end the losses used to be excessive up to 80 percent. (FGD, 2024)

Furthermore, the outcome of result on table 1 on the extent of post-harvest losses of sweet potatoes, also showed that within the range of 81-100 per cent, there was 0 (0.0%) adopter, and there were 129 (37.0%) non-adopters of the said value-added innovations of sweet potatoes.

Corroborating the finding on the extent of post-harvest losses of sweet potatoes, FGD discussions with a female farmer from Nyumagbagh and a male farmer from Mbadede council wards maintained thus respectively:

The extent of post-harvest losses of sweet potatoes here in our district Nyumagbagh is very high. Some people end up with total losses of the preserved produce for future use. As for me last year my losses were pitiable, almost all destroyed, apart from the little ones I was consuming during the harvesting period. I think for those farmers who are adopting these modern value-added innovations may not have losses. (FGD, 2024)

Some of us have not adopted the modern value-added innovations of sweet potatoes. On that note, we do have very high post-harvest losses ranging to 90 percent. My total harvest was up to 13basins and apart from what I used for pounded swallow food the rest in my preserved hole was damages amounting to over 10basins. (FGD, 2024)

These results showed that adopters of value-added innovations fell most within the smaller extent of post-harvest losses, while non-adopters of value-added innovations seemed to maintain a steady rise in post-harvest losses with increasing extents.

Figure 2 further emphasize the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes. The columns on the chart showed a significant spark of over (80%) for adopters within the least extent of post-harvest losses (0-20%). As there was increase in the extent of post-harvest losses, adopters significantly reduced absolutely. While, non-adopter having post-harvest losses within the highest range of extent of post-harvest losses (81-100%). Figure 2 further showed that non-adopters of value-added innovations had a steady increase in post-harvest losses, with the greater number of them (37.0%) suffering the greatest extent of post-harvest losses (81-100%).

Collaborating the findings, in a Key Informant Interview (KII) on the extent of post-harvest losses between adopters and non-adopters of value-added innovations of sweet potatoes with a male staff of the Department of Agriculture Vandeikya local government area. He maintained that:

As a professional agricultural extensionist in Vandeikya local government, based on my observations in the past years, it is those who do not adopt these modern value-added innovations that experience very high (that is more than half of the produce) post-harvest losses of sweet potatoes. As for the adopters, they usually have little or no losses in most cases, because they are using the sweet potatoes tubers for many value additions. (KII, 2024)

In a similar vein, another female staff of the Department of Agriculture Vandeikya local government area upheld that:

I observe that. those who adopt the modern value-added innovations of sweet potatoes experience less post-harvest losses, which I assume is around 20 per cent compared to the over 70 per cent post-harvest loss suffered by non-adopters of the modern value-added innovations of sweet potatoes. In a way, I will confidently say that adopters of the modern value-added innovations of sweet potatoes experience little or no losses as against the high losses suffered by non-adopters, who usually have no idea about converting sweet potatoes to other products, or do not care about the adoption of any modern value-added innovations of sweet potatoes in Vandeikya local government. That’s my position. (KII, 2024)

From the discussion in table 1 above, it is clear that the extent of post-harvest losses of sweet potatoes, when one does not adopt value added innovations is usually high, as shown in the table and pictorial chart above. There was increase in the extent of post-harvest losses for non-adopters, amounting to over 37.0 per cent, who suffer losses ranging from (81-100%). While adopters’ losses significantly reduced absolutely to 0.0 percent, within the highest range of post-harvest losses (81-100%). Figure 2 further showed that non-adopters of value-added innovations had a steady increase in post-harvest losses.

Tomlins, Ndunguru and Rwiza (2019), also in line with the present study, did an assessment of the sweet potatoes, immediately after harvesting, indicated that approximately 20% to 35% of the sweet potatoes had minor cuts, 14% to 28% had breaks, 19% to 60% had signs of minor skinning, 13% to 59% had skin weevil and 1% to 4% burrowing weevil damage. After transport from the farm to the market, the level of damage in freshly harvested sweet potatoes increased such that 100% of the sweet potatoes had skinning damage, most severely, and 38% to 56% had breaks. Transport had little impact on the proportion of sweet potatoes with cutes or weevil damage. Shriveled sweet potatoes were less susceptible to damage. The presence of rots, however, led to the sweet potatoes receiving a nominal market value. These findings are in line with the present study, indicating that post-harvest losses of sweet potatoes are enormous and worrisome to farmers. Hence there are more post-harvest losses of sweet potatoes for non-adopters compare to the adopters of value-added innovations in Vandeikya Local Government Area, Benue State, Nigeria.

Test of hypothesis

There is no significant difference between adopters and non-adopters of the value-added innovations on the extent of post-harvest losses of sweet potatoes in Vandeikya Local Government Area of Benue State.

Table 2: t-test result showing the difference between adopters and non-adopters of value-added innovations on the extent of post-harvest losses of sweet potatoes

Variables	N	Mean	SD	df	t	p-value	Decision
Adopters	93	20.667	2.771	382	-55.211	.002	Significant
Non-adopters	291	34.223	1.778				

Source: **Field Survey, 2024.**

Table 2 is a t-test result showing the difference between adopters and non-adopters of value-added innovations on the extent of post-harvest losses of sweet potatoes. The mean score

of adopters of value-added innovation is 20.667 with a standard deviation score of 2.771, while the mean score for non-adopters of value-added innovations is 34.223 with a standard deviation score of 1.778. The t-value of -55.211 and the significant level (p-value) of .002 ($p < .05$), indicates that there was a significant difference between adopters and non-adopters of value-added innovations of sweet potatoes on the extent of post-harvest losses of the crop, $t(382) = -55.211, p < .05$. With the greater mean score of 34.223 for non-adopters over the score of 20.667 for adopters, the result further reveals that the significant level is skewed to non-adopters indicating they had greater post-harvest losses. Thus, the null hypothesis stating that there is no significant difference between adopters and non-adopters of the value-added innovations on the extent of post-harvest losses of sweet potatoes in Vandeikya Local Government Area of Benue State was rejected, thus, alternative accepted.

Discussion of Findings

The study showed that the extent of post-harvest losses of sweet potatoes, when farmer did not adopt value-added innovations was usually high. There was increase in the extent of post-harvest losses for non-adopters, amounting to over 37.0 per cent, who suffer losses ranging from (81-100%), while adopters' losses significantly reduced absolutely to 0.0 percent, within the highest range of post-harvest losses (81-100%), further indicating that non-adopters of value-added innovations had a steady increase in post-harvest losses.

This is in line with the global estimated suggestion that 45 to 54 percent of roots and tubers are loss after harvest in sub-Saharan Africa. (Parmar et al., 2017). Sweet potato roots are more perishable than most crops and are reported to suffer significantly higher post-harvest losses in sub-Saharan Africa. The meta-analysis by Affognon et al. (2015) reports the magnitude of quantitative losses as high as 45-69% for sweet potato. Parmar et al. (2017) report farm-level harvesting losses of 5 to 20% for the sweet potato value chain in Ethiopia. Similarly, Ray and Ravi (2005), post-harvest losses of sweet potato vary between 15 and 65 percent due to either loss in fresh weight or root rot between one and four months of storage. The short shelf life is a major constraint for marketing. The review still remains relevant as it gives estimations of post-harvest losses of sweet potatoes in the tropics. These findings collaborate the present study, indicating that there are more post-harvest losses of sweet potatoes for non-adopters compare to the adopters of value-added innovations in Vandeikya local government area of Benue state, Nigeria.

Conclusion/Recommendations

Findings of the study showed revealed that the extent of post-harvest losses for adopters of value-added innovations of sweet potatoes was low against non-adopters, who experience high post-harvest losses. Increase in value-added innovations by farmers resulted in a decrease in the extent of post-harvest losses of sweet potatoes. This implies that farmers who adopt value-added innovations of sweet potatoes would potentially enjoy food security, economic viability and sustainability. Given the practical benefits of adopting value-added innovations of sweet potatoes, it would be noteworthy for the government, through Ministry of Education, via Universities and Colleges of Agricultures to use this result as reference point for advocacy via mass media, for the adoptions of value-added innovations of sweet potatoes in Nigeria. Furthermore, philanthropist, Non-Governmental Organisations and the government should support farmers with cottage industries and logistics to adopt value-added innovations as; sweet-potato noodles, meat pies, candy, bread, buns, cakes, doughnuts, biscuits, camote chips, puff-puff, juice, chin-chin and industrial alcohol, instead of remaining limited to the traditional ones, which typically have relatively low economic value, and contribute little to reducing post-harvest losses in the study area

References

- Abebe, C. D. (2020). Prospects and challenges of postharvest losses of potato (*Solanum tuberosum* L.) in Ethiopia. *Global Journal of Nutrition and Food Science*, 2(5), 1–7. Iris Publishers. <https://irispublishers.com/gjnfs/pdf/GJNFS.MS.ID.000549.pdf>
- Adedire, O., Onuwa, G., John, C. W., Oladejo, A. O., Mbah, J. J., Sadiku, Y., & Keghter, V. S. (2023). Impact of storage methods on sweet potato spoilage in Plateau State, Nigeria. *International Journal on Food, Agriculture and Natural Resources*, 4(2), 9–14. <https://doi.org/10.46676/ij-fanres.v4i2.93>
- Affognon, H., Mutungi, C., Sanginga, P., & Borgemeister, C. (2015). Unpacking post-harvest losses in sub-Saharan Africa: A meta-analysis. *World Development*, 66, 49-68.
- Amagloh, F. K., & Nyarko, E. S. (2021). Bioactive compounds in sweet potato: Implications for human health. *Food Research International*, 147, 110538. <https://doi.org/10.1016/j.foodres.2021.110538>
- Amah, D., Maziya-Dixon, B., & Alamu, E. O. (2021). Postharvest handling and processing of root and tuber crops to reduce food losses and improve household food security. *Frontiers in Sustainable Food Systems*, 5, 654994. <https://doi.org/10.3389/fsufs.2021.654994>
- Aulakh, J., Regmi, A., Fulton, J., & Alexander, C. (2013). Estimating post-harvest food losses: Developing a consistent global estimation framework. Selected poster prepared for presentation at the Agricultural and Applied Economics Association's 2013 AAEA and CAES *Joint Annual Meeting*, Washington, DC, August 4-6.
- Chan, C. (2022). *What makes innovation? Creativity and value-added*. <https://linkedin.com/pulse/...>
- Cole, B. (2023). *Definition: Value innovation*. <https://techtargget.com/...>
- Keoke, E. D., & Porterfield, K. M. (2009). *Encyclopedia of American Indian contributions to the world: 15,000 years of inventions and innovations*. New York: Infobase Publishing.
- Kim, C. (2020). China grows most of the sweet potatoes. *Chatham-Kent Agri-Development*, Ontario.
- Low, J., Mwangi, R. O. M., Andrade, M., Carey, E., & Ball, A. (2017). Tackling vitamin, A deficiency with biofortified sweet potato in sub-Saharan Africa. *Global Food Security*, 14, 23–30. <https://doi.org/10.1016/j.gfs.2017.01.004>
- Lowenberg-DeBoer, J. (2015). Cost-effective measurement of the economic value of post-harvest losses in Africa. *In the Proceedings of the First International Congress on Postharvest Loss Prevention*. Rome, Italy, October 4-7, pp.25-28.
- Mlaviwa, J., & Missanjo, E. (2019). Recent trends and future directions on value addition of irish potato (*Solanum Tuberosum* L.) among smallholder farmers. *Emerging Science Journal*, 3(1), 41-52.
- Moyo, M., Truong, V. D., Simunovic, J., Pankuku, J., Abong, G. O., Amagloh, Fuchs, R., Magnaghi, A., Rajendran, S., Grant, F., & Muzhingi, T. (2022). Orange-fleshed sweet potato puree: A breakthrough product for the bakery sector in Africa. In Thiele, G.,

- Friedmann, M., Campos, H., Plar, V., Bentley, J. W. (eds). *Root, Tuber and Banana Food System Innovations* (pp.145-172). Springer, Cham.
- Oluoch, A. A., Lagat, J. K., & Langat, J. K. (2016). Evaluation of effects of value addition in sweet potatoes on farm income in Homa Bay County, Kenya. *Journal of Economics and Sustainable Development*, 7(20), 1-4.
- Omoare, A. M., Fakoya, E. O., Fapojuwo, O. E., & Oyediran, W. O., (2015). Awareness of Value Addition of Sweet Potato (*Ipomoea batatas* (L.) Lam) In Osun State, Nigeria. *World Academy of Science, Engineering and Technology International Journal of Agricultural and Biosystems Engineering*. 8(1):2-4.
- Parmer, A., Hensel, O., & Sturm, B. (2017). Post-harvest handling practices and associated food losses and limitations in the sweet potato value chain of Southern Ethiopia. *NJAS – Wageningen Journal of Life Sciences*, 80, 65-74.
- Ray, R. C., & Ravi, V. (2005). Post-harvest spoilage of sweet potato in tropics and control measures. *Critical Reviews in Food Science and Nutrition*, 45(7), 623-644.
- Rogers, E. M. (2015). *Diffusion of innovations*. New York: Free Press.
- Shee, A., Stathers, T., Bechoff, A., & Bennett, B. (2019). Determinants of postharvest losses along smallholder producers' maize and sweet potato value chains: *An ordered profit analysis*. *Food Security*, 11, 1101–1120. <https://doi.org/10.1007/s12571-019-00949-4>
- Sugri, I., Maalekuu, B. K., Gaveh, E., Kusi, F., & Lamini, S. (2019). Assessment of low-cost postharvest techniques to reduce storage losses in sweet potato. *Sustainable Agriculture Research*, 9(4), 17–29. <https://doi.org/10.5539/sar.v9n4p17>
- Tomlins, K. I., Ndunguru, G. T., & Rwiza, E. (2019). Losses in sweet potato quality at harvest and during the post-harvest handling in the Mwanza region of Tanzania. *Working Paper*.