



Post-Harvest Loses and Socioeconomic Sustenance of Yam Farmers in Southern Agricultural Zone of Nasarawa State

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Authors' contributions

This work was carried out in collaboration among all authors. Author DAI designed the study, wrote the protocol, managed the literature searches and wrote the first draft of the manuscript. Authors JTA and AAI supervised the work, read through different drafts of the work and made corrections while author SCN performed the statistical analysis and managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The study determined the effect of post-harvest losses of yam on the socio-economic sustenance of farmers in Nasarawa State Nigeria. It also described the socio-economic status of farmers; determined the average quantities of yam lost for the years in review (2014-2018).

Study Design: The study employed the use of cross sectional design.

Place and Duration of Study: The study was conducted in Nasarawa state, Nigeria between October 2019 to June 2020.

Methodology: Using the multistage sampling technique, data for the study were collected from a sample of three hundred and eighty seven (387) respondents.

Results: That majority of the respondents (322) 83%, were male, and within the age range of 31-40 years 158(41%) followed by the age bracket of 41-50: 97(25%); 323(84%) of the respondents were married with average household size of 8.0 persons per household while 87% of the respondents have had one form of formal education or the other.

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The Ordinary Least Square result of the effect of postharvest losses on the socioeconomic sustenance of the respondents revealed that the coefficient of simple determination (r^2) was 0.850 which implies that 85.00% of the variations in the socioeconomic sustenance of the respondents was explained by the independent variable included in the model (post-harvest losses) while 15.00% unexplained was due to error. F-prob. value of 0.0000 was observed from the analysis which is less than 0.05, indicating that the variables included in the estimated regression model were correct and significant at 1% significant level. The coefficient of post-harvest losses with the value of (-4.327) was statistically significant and negatively related to the socioeconomic sustenance of the respondents at 1 percent.

Conclusion: The study concluded that there is a relationship between the post-harvest losses and socioeconomic sustenance of farmers. Therefore, the relevant government and agricultural agencies, Non- Governmental Organizations (NGOs), Community Based Organizations (CBOs) as well as individuals need to strengthen their effort toward reducing post-harvest losses of yam by educating through demonstration and encouraging farmer to use modern technologies and materials in yam storage.

Keywords: Post-harvest; socioeconomic sustenance; yam farmers.

1. INTRODUCTION

In Africa, yam serves as the mainstay for about 300 million people [1]. In West Africa, the five countries that predominantly produce yam are; Benin, Côte d'ivoire, Ghana, Nigeria, and Togo. They account for about 94% of the total world yam production. Nigeria alone accounts for 71% of the total World yam production; Cote d'ivoir 12%, Ghana 11%, Benin 5% and Togo 1% [2,3]. Nigeria was ranked as the largest producer of yam globally [4,5,6] and [2] enumerated zones and States in Nigeria that produced yam as follows: the North Central; Benue, Nasarawa, Kwara, Kogi and Niger, Eastern parts are; Imo, Ebonyi and Anambra and the South Western parts.

It is eaten in different forms such as *fufu* (the so-called *poundo* yam and *Amala* in Nigeria), boiled, fried and roasted [7,8]. It performs a supportive role as far as the sustenance of human life is concerned as it supplied food for farmers all year round [9]. In yam producing zones especially during the harvesting season, it is eaten all day round as a staple food [10]. Yam also have some nutritional value such as dietary fiber which is good for digestion, and they are a good source of carbohydrates, vitamin C, potassium, manganese and other essential minerals such as vitamin B1 [8,5]. The Living Standards Measurement Study-Integrated Surveys on Agriculture in Nigeria report unveiled that the consumption patterns of yam differ from the poor and rich people [11]. Relatively, richer households consumed more yam than they sell; poorer households depend heavily on it for

income than their richer counterpart that has other sources of earnings [11].

As a cash crop, yam plays important role in the livelihoods of at least 60 million people in West Africa [12,13,14]. The income generated from yam production improves the living standards of yam farmers. The harvested stored yam represents stored "wealth" which farmers sell all-year-round to earn income [15]. This stored "wealth" usually translates to the farmers' wellbeing; that is, the earnings from stored yam help farmers to access basic necessities of life such as; shelter, food, education, health care, and so on. [16] Stressed that; yam cultivation in Nigeria remains a lucrative enterprise, with a potential rate of return of 78%. Each dollar invested in yam research generates US\$52 worth of additional food for the poor, relative to US\$124 for all households. After harvest and storage, the average profit per yam seed in Nigeria was calculated at over US \$13,000 per hectare [17].

Also, yam production, processing and marketing offers vast employment opportunities for millions of people [18]. Furthermore, some households especially in yam production zones used it during ceremonies and as special gifts to people. It is important in terms of economic, social, pharmaceutical and industrial value [19]. Yam is a staple, mainstay and source of income for livelihood of yam farmers in some communities especially in Nigeria. It serves as a major source of income and stored wealth too to farmers in production zones .Despite this, about 25% of yam produced is lost after harvest [20]. These losses are both in quantity and quality and hence

reduce social and economic value. In Southern Agriculture Zone of Nasarawa State, farmers experience huge post-harvest losses because of antiquated methods of post-harvest handling of yam. Most of the yam tubers are destroyed or perished at the farm, in transit, during storage and or at the market places. These losses translate not just into human hunger and financial loss to farmers. It affects the standard of living of yam farmers who depends on it as source of livelihood. Other basic necessities of life of the farmers are also affected such as; education, accessing health care, clothing, housing, portable water and so on. As important as yam is, it suffers from post-harvest losses. Post-harvest loss of yam is the quantity and quality of yam tubers that are lost from the time of harvest until the produce gets to the final user. It is a function of the post-harvest management practices adopted by the individual farmer [21]. Post-harvest loss of yam includes losses in quantity and quality of tubers, arising from physical damage, rodent attack, fungal and bacterial diseases, and physiological processes such as sprouting, dehydration, and respiration [22].

Roughly one-third of the edible parts of yam produced for human consumption gets lost or wasted globally, which is about 1.3 billion tonnes per year [23,24]. Post-harvest loss of yam estimate of 10-60% has been reported in Nigeria [24] it further reported that weight loss during storage in traditional or improved barns, or clamp storage is about 10-12% in the first 3 months and 30-60% after 6 months. [25] Maintained that weight losses of 33-67% occur after 6 months storage in yam. [26] Estimated post-harvest losses of yam in Nigeria to be above 25% annually. Also, transit losses of yam of about 15-40% occur due to inefficient storage and transport facilities [27].

In Nigeria, the current estimates of post-harvest losses indicate that quantitative and quality loss of yam is high and this translates to substantial amounts of money farmers lost annually [27]. These losses translate not just into human hunger and financial loss to farmers. It affects the standard of living of yam farmers who depends on it as source of livelihood. Other basic necessities of life of the farmers are also affected such as; education, accessing health care, clothing, housing, portable water and so on. Incidentally, few literatures if any have addressed this phenomenon in Southern Agricultural Zone of Nasarawa State. Regrettably 95% of the

research investment in the past 30 years has only focused on increasing productivity; only 5% of the research has been devoted to reducing post-harvest losses of yam [28,29,30].

[31] Studied post-harvest losses of yam and strategies to reduce them in less developed countries where the Action Contre la Faim (ACF) missions intervene. Revealed that there are technologies, if adopted, would enable smallholder's farmers and larger producers to improve the quality and quantity of yam produced and stored. [32] Examined post-harvest handling of yam and needed information by farmers in Kogi and Benue States, Nigeria. He found that farmers were engaged in transportation of yam from farm to home, home to markets or farm to markets. Yam farmers were highly in need of information on storage of tubers. Also yam farmers to have access to improved post-harvest management technologies. These scholars did not dwell on socioeconomic sustenance of yam farmers in their studies.

Little or nothing so far has been done on post-harvest losses of yam and socioeconomic sustenance of in Nasarawa State. Therefore this an empirical study is necessary to fill the gap in knowledge on post-harvest losses of yam and its socioeconomic sustenance of the farmers in Nasarawa State between 2014 and 2018. The study described the socio-economic status of the farmers; determined the average quantities of yam lost for the years in review (2014-2018) and determined the effect of post-harvest losses of yam on the socio-economic sustenance of the farmers in Southern Agricultural Zone of Nasarawa State.

1.1 Hypothesis

Ho₁: Post-harvest losses of yam have no significant effect on the socioeconomic sustenance of yam farmers in Southern Agricultural Zone of Nasarawa State.

2. MATERIALS AND METHODS

This study was conducted in Southern Agricultural Zone of Nasarawa State, Nigeria. It is located in the North Central Zone of Nigeria. It lies between latitude $7^{\circ}45'$, $9^{\circ}37'$ N of the equator and between longitude $7^{\circ}03'2''$ N, $9^{\circ}37'$ E, of the Greenwich meridian. Nasarawa State shares boundary with Kaduna State in the North, Plateau State in the East, Taraba and Benue States in the south while Kogi and the

Federal Capital Territory flanks it in the West. The State occupies a land mass of 27, 271,497 square kilometers with a population of 2, 171,900 people [33] with the population density of about 67 persons per square kilometer [34]. Lies within the guinea Savannah region and has tropical climate with moderate rainfall (annual mean rainfall of 1311:75 cm). The state is made up of plain lands and hills measuring up to 300 ft above the sea level at some points. Nasarawa state has some of the most beautiful sites and landscapes in the country and these include beautiful hills, striking and unique natural lakes. The State has a climate typical of the tropical zone because of its location and is quite pleasant. It has a maximum and minimum temperature of 81.7 °F and 16.7 °F respectively. Rainfall varies from 131.73 cm in some places to 145 cm in others.

Nasarawa State is made up of thirteen Local Government Areas, namely, Akwanga, Awe, Doma, Karu, Keana, Kokona, Lafia, Nasarawa, NasarawaEggon, Obi, Toto, Wamba and Keffi. The multilingual State has the following tribes; Gwandara, Alago, Eggon, Gbagi, Egbira, Migili, Kantana, Fulani, Hausa, Kanuri, Tiv, Afo, Gade, Nyankpa, Koro, Jukun, Mada, Ninzam, Buh, Basa, Agatu, Arum, Kulere, and also settler groups like the Igbo, Yoruba and Hausa [34].

Nasarawa State is divided into Northern, Western and Southern Agricultural Zones [35].

Southern Agricultural Zone of Nasarawa State was purposively sampled. This is because of the intensity of yam production in the area. Thereafter, simple random sampling was used to select four (4) Local Government areas in Southern Agricultural Zone of Nasarawa State. The selected Local Government areas include; Doma, Keana, Lafia and Obi. Two wards were selected from each of the four selected Local Government areas. The total number of registered household heads in the eight (8) selected wards is 14356. [36]. This figure therefore represents the sample frame. The sample size for each ward was determined by a mathematical formula given by Taro Yamane.

$$n = \frac{N}{1 + N(e)^2} \dots \quad (1)$$

Where,

n = Sample size
 N = Population size

e = Level of significance which is taken to be 0.05

1 = Constant value

$$\begin{aligned} n &= \frac{N}{1 + N(e)^2} = \frac{14356}{1 + 14356(0.05)^2} \\ &= \frac{14356}{1 + 14356(0.0025)} \\ &= \frac{14356}{1 + 35.89} = \frac{14356}{36.8} \approx 37 \\ &= 386.6 \approx 388 \end{aligned}$$

The sample size for each ward was purposively selected from the sampling frame of that ward (these were household heads that yam cultivation is their major farm enterprise). This gave a total sample size of 388 heads of households. This study used structured questionnaire to collect data. A combination of analytical techniques was used for data analysis to achieve the objectives of the study; descriptive and inferential statistics were used in the analysis of generated field data.

3. RESULTS AND DISCUSSION

3.1 Socio Economic Characteristics of the Respondents

The socioeconomic characteristics of the respondents are presented in this section. These characteristics include sex, age, marital status, educational status and family size.

The result shows the preponderance of male yam farmers in the study. This is an indication that yam cultivation is dominated by male farmers and could be attributed to the nature and difficulty in cultivating yam. It is a well known fact that yam cultivation requires a lot of physical strength, especially when it comes to clearing the land, making mounds, staking the yam and weeding, hence mostly done by men. The females on the other hand may not have both the physical strength and financial resources to go into yam farming.

According to [37] the pattern of yam production in many parts of the world is undergoing changes. However, yam production process from bush clearing, cultivation, chemical application, harvesting and transporting to markets remains labour-intensive. It is disheartening to note that yam production is still left into the hands of the farmers in Nigeria despite its social, cultural and economic importance. The farmers look forward to does not enjoy the required government support.

Table 1. Socio-economic characteristics of respondents

Variable	Frequency	Percentage
Sex		
Female	65	17
Male	322	83
Total	387	100.00
Age		
Below 21	10	2
21-30	92	24
31-40	158	41
41-50	97	25
51-60	30	8
Total	387	100.00
Mean	37.20	
Marital status		
Single	28	7
Married	323	84
Widowed	27	7
Separated	9	2
Divorced	0	0.00
Total	387	100.00
Education		
No Formal Education	50	13
Basic primary school	99	26
Secondary school	66	17
Tertiary	172	44
Total	387	100.00
Family Size		
1-5	193	50
6-10	127	33
11-15	35	9
16-20	32	8
Total	387	100.00
Mean	7.5 persons	

Source: Field survey, 2020

Yam cultivation is carried out by young energetic persons in the study area. According to the findings, the mean age was 37 years, implying that the study area has relatively young people engaged in yam farming which is insurance for food production continuity, especially as it

concerns physical strength and time. Young people are very active on the farm and more responsive to agricultural extension programmes.

The finding therefore asserts that domination in yam farming varies from place to place and that the variance depends on the value placed on yam production in the area as yam production could be a lucrative venture in the area. The result ascertained that a greater proportion of yam farmers in the area are married individuals. Most of the (87%) of the respondents have had one form of formal education or the other, implying that literacy level is high in the study area. By implication, the respondents are enlightened, learned, informed and receptive to production and marketing innovation. It also implies that yam farming is a lucrative venture in the area though it can be linked to the inability of government to create jobs for her citizens. With education, the respondents can easily access support of various kinds from formal institutions for expansionary purposes which can in turn boost their performance. Averagely, household size of the respondents was 8.0 persons. By and large, fairly large household size is a proxy to labour availability and reduction in the cost of hired labour.

3.2 Quantity of Yam Tubers Lost from 2014 to 2018

Tables 2, 3 and 4 shows the losses of different sizes of yam tubers from 2014 to 2018

The amount of losses could be attributed to poor production system, poor postharvest handling, poor marketing systems, distribution and processing system [38]. It could also be attributed to physical damage during harvesting and transportation, rodent attack, fungal and bacterial diseases, and physiological processes such as sprouting, dehydration, and respiration.

Table 2. Quantity of big yam tubers lost from 2014-2018

Qty of yam	Tons (average)	2014		2015		2016		2017		2018	
		F	%	F	%	F	%	F	%	F	%
0-499	0.50	206	53.23	252	65.12	244	63.05	248	64.08	261	67.44
500-999	1.25	113	29.19	69	17.83	79	20.41	83	21.45	64	16.54
1000-1499	2.08	30	7.75	28	7.24	44	11.37	26	6.72	22	5.68
1500 and above	2.92	38	9.83	38	9.81	20	5.17	30	7.75	40	10.34
Total		387	100.00	387	100.00	387	100.00	387	100.00	387	100.00

Source: Field survey, 2020

Table 3. Quantity of medium sized yam tubers lost from 2014-2018

Qty of yam	Tons (average)	2014		2015		2016		2017		2018	
		F	%	F	%	F	%	F	%	F	%
0-499	0.37	155	40.05	202	52.19	147	37.98	173	44.70	190	49.09
500-999	0.94	141	36.43	99	25.58	164	42.38	128	33.07	113	29.19
1000-1499	1.56	22	5.69	10	2.58	14	3.62	34	8.79	14	3.62
1500 and above	2.19	69	17.83	76	19.65	62	16.02	52	13.44	70	18.10
Total		387	100.00	387	100.00	387	100.00	387	100.00	387	100.00

Source: Field survey, 2020

Table 4. Quantity of yam seeds lost from 2014-2018

Qty of yam	Tons (average)	2014		2015		2016		2017		2018	
		F	%	F	%	F	%	F	%	F	%
0-499	0.12	213	55.04	205	52.97	161	41.60	163	42.12	179	46.25
500-999	0.30	75	19.38	88	22.74	141	36.44	139	35.92	119	30.75
1000-1499	0.50	22	5.69	18	4.65	0	0.00	10	2.58	18	4.65
1500 and above	0.70	77	19.89	76	19.64	85	21.96	75	19.38	71	18.35
Total		387	100.00	387	100.00	387	100.00	387	100.00	387	100.00

Source: Field survey, 2020

Post-harvest losses of yam occur at various stages of the production and marketing cycles, particularly on the farm, in-transit, storage and at market. The evidence regarding levels of loss suggests a broad range of quantities that can be lost at post-harvest, for instance ranging from loss of 10-50% or as high as 80% during storage and 3-40% at the retail stage [39,40,41]. From the above consensus, post-harvest losses of yam occur mostly during storage of yam. Disease contributed to about 25% of post-harvest losses of yam in storage [42]. [43] Stressed that, yam diseases and pest constitutes great threat to post-harvest losses of yam. The problem of how much yam is lost after harvest to processing, spoilage, insects and rodents, or to other factors takes on greater importance as the world demand for increase in yam yields [31].

According to the result, the level of losses of yam is corroborated by [44] in their assessment of global initiative on food loss and waste reduction. They noted that postharvest losses of yam in Africa amounts to about 40% to 50%. Post-harvest losses in roots and tubers have their origin in damage during harvesting, physiological processes, infection by decay organisms and, occasionally, pest infestation (please include reference). Losses caused by these processes may occur during all stages of the food supply system from crop maturity, through harvesting, transportation and storage (please include

reference). The degree of loss associated with these factors is determined by the plant material involved, the prevailing environmental conditions and management of the food supply system.

The study thus concludes that Farmers in the study area suffer post-harvest losses throughout yam production chain in various measures. The extent of losses differs from farmer to farmer but does not differ in the communities sampled in the study area. This is because farmers in the study area use the same production pattern grow and hence experience the same measure of losses. Again, farmers are unable to calculate the quantity of crops lost because they do not keep records of their farm activities. But they could estimate the quantities lost each farming season.

Table 5 is a multiple response table, the frequencies were based on multiple responses, which means that a respondent might identify more than one effect of post-harvest losses in the study area. The result above revealed that postharvest losses of yam affects the generality of the yam farmers. It is evident from the result that losses incurred by farmers have several adverse impacts on farmer income, consumer prices and nutritional quality of the produce. Because of the poor planting material, cultural practices including harvesting methods and handling practices, the quality of harvested produce is below standard.

Table 5. Effect of postharvest Losses on the Economic Sustenance

Effects of postharvest losses of yam	Frequency	Percentages
losses affects access to quality food	376	97
Losses affects availability of planting materials	354	91.5
Losses affects planned projects for the year	356	92
affects the standard of living of their households	381	98
Reduced profit margin and/or income of yam farmers	386	99.7
Affects access to good health care services	382	98.7
Affects access to good housing	312	80.6
Affects access to education	345	89

Source: Filed survey 2020 (Multiple Response Table)

The study revealed that post-harvest losses affect the income of farmers. The appearance of the farm crop influences the price of the crop. Take for instance, a tuber of yam punctured or cut as a result of careless harvesting will not be sold at the price that it would have been sold for if it had not been punctured. Majority of the sampled farmers are unable to buy their needs from the money realized after selling their farm produce. Many also said that they hardly meet their production cost after sales while great number of them out rightly said that they do not make profit after the sales of their produce and to embark on other planned project for the household considering the inputs made on the farm lands.

Although it may be hard to calculate the cost of production of, for instance a piece of land and the profit made from the sales of the crops from the said land but the income from sales of the respondents indicated that they meet their production cost after making sales only a few do not which could be because they encounter loss in every step of the yam production chain (harvesting, transportation, storing and marketing). Thus, post harvest losses adversely affect the income of farmers.

It causes reduction in producers out puts, unavailability of food, affects of economy of the farmers, people and the entire country. So far the magnitude of post-harvest loss is high in yam compared to other crops [45]. Post-harvest loss of yam affects the wellbeing of yam farmers. Yam is a pillar of food security, income, medicine and employment generation its production has not been given the utmost attention in the yam production zones leading to losses [46]. Losses due to rots affect availability, food security and revenue of farmers and those involved in its value chain [47]. Post-harvest losses of yam

affect the farmers' livelihood and social status in yam production zones.

Ho₁: Post-harvest loses of yam have no significant effect on the socioeconomic sustenance of yam farmers in Southern Agricultural Zone of Nasarawa State.

The Ordinary Least Square result of the effect of postharvest losses on the socioeconomic sustenance of the respondents is presented in Table 4. The coefficient of simple determination (r^2) was 0.850 which implies that 85.00% of the variations in the socioeconomic sustenance of the respondents was explained by the independent variable included in the model (post-harvest losses) while 15.00% unexplained was due to error. F-prob. value of 0.0000 was observed from the analysis which is less than 0.05, indicating that the variables included in the estimated regression model were correct and significant at 1% significant level.

According to the findings, post-harvest losses of yam have significant effects on the socioeconomic sustenance of yam farmers in Southern Zone of Nasarawa State. The coefficient of post-harvest losses with the value of (-4.327) was statistically significant and negatively related to the socioeconomic sustenance of the respondents at 1 percent which is an indication that as the post-harvest losses of the respondents increase, their socioeconomic sustenance decreases. This suggests that when households' postharvest losses increase, their socioeconomic sustenance worsens. This result collaborate with [9] who reported that households' postharvest losses exerted negative effect on socioeconomic sustenance of yam farmers in Kintampo Municipality of the Brong Ahafo Region Of Ghana. Many important cultural values are attached to yam, especially during wedding and

Table 6. Test of hypothesis

Variable	Coefficient	Std error	t-ratio
Constant	1636013.664	197645.149	8.278***
Postharvest Losses	-4.327	0.922	-46.767***
R ²	0.850		
F-ratio	2187.178		

*Field survey, 2020, *** 1% level of significance, ** 5% level of significance, * 10% level of significance*

other social ceremonies. In many farm communities in West Africa countries, Nigeria and other countries, the size of the yam enterprise that one has is a reflection of the person's social stature. That is the worth of the persons' wealth. Due to the importance attached to yam some communities in yam production zones celebrate the new yam festival annually [48].

Traditional ceremonies still accompany yam production indicating the high status given to the crop [49]. Improving agricultural production is essential to achieving a high socioeconomic status and sustainable development process that will contribute to reducing poverty, enhancing food security and income growth. High yielding varieties and new production technology have vastly increased the world's agricultural potential and provided rural income sources and affordable food for large parts of the population. Increasingly, agricultural products are not consumed in their raw form, and post-harvest activities such as transport, storage, processing, and marketing account for a growing part of their final value. Post-harvest loss reduction techniques could alleviate the socio economic sustenance of farmers by avoiding losses and providing better quality food and nutrition, more raw materials for processing, thus ensuring better socioeconomic standing of farmers.

4. CONCLUSION

Farmers in the study area suffer post-harvest losses throughout yam production chain in various measures. The extent of losses differs from farmer to farmer but does not differ in the communities sampled in the study area. On the effect of post-harvest losses on economic sustenance of yam farmers, the study concludes that losses incurred by farmers have several adverse effects on farmer income, consumer prices and nutritional quality of the produce which generally affects their socioeconomic sustenance.

Finally, the study concluded that there is a relationship between the post-harvest losses and

socioeconomic sustenance of farmers and that yam plays significant roles in the socioeconomic sustenance of thousands of people in yam production zones Nasarawa State. Therefore, the relevant government and agricultural agencies, Non- Governmental Organizations (NGOs), Community Based Organizations (CBOs) as well as individuals need to strengthen their effort toward reducing post-harvest losses of yam by educating through demonstration and encouraging farmer to use modern technologies and materials in yam storage; this may help in minimizing post-harvest losses of yam, increase farmers income and hence elevate their socioeconomic sustenance.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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