



# **Evaluation of Income and Postharvest Losses of Yam in Southern Agricultural Zone of Nasarawa State**

**Daniel Akaakohol Iorzua<sup>1</sup>, Agnes Agbanugo Ikwuba<sup>1</sup>, James Timbee Aan<sup>1</sup> and Solomon Chimela Nwafor<sup>2\*</sup>**

<sup>1</sup>*Department of Sociology, Benue State University, Makurdi, Nigeria.*

<sup>2</sup>*Department of Research Outreach, National Root Crops Research Institute Umudike, Nigeria.*

## **Authors' contributions**

*This work was carried out in collaboration among all authors. Author DAI designed the study, wrote the first draft of the manuscript and literature searches authors AAI and JTA wrote the protocol and supervised the work and also read through the several drafts of the work. 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**

The study evaluated the income and postharvest losses of yam in Nasarawa State Nigeria from 2014 to 2018. The study employed the use of cross sectional design. The study was conducted in Nasarawa state, Nigeria between October 2019 and June 2020. Data for the study were collected using multistage sampling technique from a sample of three hundred and eighty seven (387) respondents. The result showed 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. The spearman correlation matrix showing the relationship between the income and post-harvest losses of the farmers further revealed that there is a significant relationship between income and postharvest

\*Corresponding author: Email: [Solomonnwafor8@gmail.com](mailto:Solomonnwafor8@gmail.com);

losses of yam farmers in the studied area. Coefficient of determination (R square) value was 0.922 with a P value of 0.00. The result reveals a significant and strong positive correlation between the income and post-harvest losses of the farmers. The study thus concluded that most of the respondents were high income earners but 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.

**Keywords:** Evaluation; income; postharvest losses; yam.

## 1. INTRODUCTION

Yam (*Dioscorea* species) is a root tuber bearing plant with more than 600 species out of which six are socially and economically important for food, income and medicine [1]. It is indigenous to West Africa [2]. However, *Dioscorea alata* species originated from Asia and spread to other yam producing zones. Growing of yam is almost exclusively confined to Africa which accounts for 96% of total global production; the relatively small levels of production in Latin America 3% and Asia 1% have very little impact on the aggregate developing country statistics. Therefore Africa is the major producer of yam in the whole World [3].

In 2012, the estimated total production of yam in Sub-Saharan Africa was 254 million tonnes per annum [4]. 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% [5,6]. [7,5] 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.

As a cash crop, yam plays important role in the livelihoods of at least 60 million people in West Africa [8,9,10]. 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 [11]. 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. [12] 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 [13].

Also, yam production, processing and marketing offers vast employment opportunities for millions of people [14]. 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 [15]. 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 [16]. 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 [17].

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 [18,19]. Post-harvest loss of yam estimate of 10-60% has been reported in Nigeria [18] 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. [20] maintained that weight losses of 33-67% occur after 6 months storage in yam. [21] 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 [22].

In West Africa alone, about one million tons of yam tubers are lost annually [23]. Qualitative and nutritional losses are also high in yam and these have both economic, social and health implications particularly in the growing areas where it is a staple food [22]. Post-harvest

losses of yam reduce the quantity and quality of yam leading to price discounts; it contributes to economic losses to the farmers and others involved in yam value chain [24,25] 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 [22]. The recurrent post-harvest losses of yam have a negative impact on the socioeconomic wellbeing of yam farmers in Nigeria.

Despite the current awareness, the phenomenon of post-harvest losses of yam seems to persist among famers. It may be as a result of poor post-harvest handling practices associated with yam production resulting in high losses to the farmers [26,27]. Post-harvest losses of yam may continue if not checked and this could have a negative consequence of income of yam farmers in many facets. Therefore, the major objective of the study was to evaluated the income and postharvest losses of yam farmers in Southern Agricultural Zone of Nasarawa State.

### 1.1 Hypothesis

**Ho<sub>1</sub>:** There is no significant relationship between the income of yam farmers and the extent of post-harvest losses of yam tubers 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 7A°45', 9A° 37™N of the equator and between longitude 7A°032'N, 9°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 [28] with the population density of about 67 persons per square kilometer [29]. Lies within the guinea Savannah region and has tropical climate with moderate rainfall (annual mean rainfall of 1311:75 cm). 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 131.73cm 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 [29].

Nasarawa State is divided into Northern, Western and Southern Agricultural Zones [30].

Southern Agricultural Zone of Nasarawa State which is made up of five Local Government areas; Awe, Doma, Keana, Lafia and Obi 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) out of (5) 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 [31]. This figure therefore represents the sample frame. The sample size for each ward was determined by a mathematical formula given by Taro Yamane.

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

Where-  
 n = Sample size  
 N = Population size  
 e = Level of significance which is taken to be 0.05  
 1 = Constant value

$$n = \frac{N}{1 + N(e)^2} = \frac{14356}{1 + 14356(0.05)^2} = \frac{14356}{1 + 14356(0.0025)}$$

$$= \frac{14356}{1 + 35.89} = \frac{14356}{36.8} \approx 37$$

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 statistics such as frequencies, percentages and mean and inferential statistics such as correlation 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 Ennin, Otoo and Tetteh [32] 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**

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Sex</b>		
Female	65	17
Male	322	83
Total	387	100.00
<b>Age</b>		
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	
<b>Marital status</b>		
Single	28	7
Married	323	84
Widowed	27	7
Separated	9	2
Divorced	0	0.00
Total	387	100.00
<b>Education</b>		
No Formal Education	50	13
Basic primary school	99	26
Secondary school	66	17
Tertiary	172	44
Total	387	100.00
<b>Family Size</b>		
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 Cost of Producing Yam from 2014-2018

This result implies that most of the respondents were marginal farmers. This could be attributed to the nature of land ownership in Nigeria which is characterized by land fragmentation. Of course, the availability of land varies from state to state and from zone to zone. So it is possible that an average farmer in Cross River can map out 3 hectares of land for yam cultivation while in

Nassarawa, an average yam farmer have 1hectre of land for yam cultivation considering land availability. There is also big variation in the cost of yam production depending on respondents' farm sizes. Generally, the cost of producing yam is said to be moderate in the study area though it varied from year to year.

### 3.3 Seasonal Income from Sales of Yam

The result implied that most of the respondents were high income earners. The reasons could be that yam farmers in the area are efficient in yam production and marketing in the study area. Despite big losses of farm produce, farmers still find away to recoup resources spent and make their gains- this is evident in the result of the study. This follows the law of demand, when there is high demand and a limited supply due to losses, the prices are increased during which the farmer can break even, and this represents a shift to the right in the demand curve. This implies that it is not only farmer that bears the brunt from farm produce losses. In fact, from the result, it could be seen that the effect of postharvest losses spreads across the all-producers, marketers and consumers. This finding agrees with the assertions of [25] that the extent of post-harvest losses of yam significantly differs across countries and different value chains within a single country as they depend largely on how yam is produced, processed and consumed and on the level of coordination among value chain actors.

### 3.4 Quantity of yam Tubers Lost

The amount of losses could be attributed to poor production system, poor postharvest handling, poor marketing systems, distribution and processing system [33]. 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. Cost of producing yam from 2014 to 2018 is presented**

Cost (N)	2014		2015		2016		2017		2018	
	F	%	F	%	F	%	F	%	F	%
10000-99000	63	16.28	58	14.99	59	15.25	54	13.95	71	18.35
100000-199000	31	8.01	45	11.63	50	12.92	108	27.91	43	11.11
200000-299000	189	48.84	179	46.25	160	41.34	102	26.36	144	37.21
300000 and above	104	26.87	105	27.13	118	30.49	123	31.78	129	33.33
Total	387	100.00	387	100.00	387	100.00	387	100.00	387	100.00

Source: Field survey, 2020

**Table 3. Seasonal income from sales of yam from 2014-2018**

Seasonal income (₦)	2014		2015		2016		2017		2018	
	F	%	F	%	F	%	F	%	F	%
0-499000	65	16.79	54	13.96	47	12.14	86	22.22	32	8.27
500000-999000	80	20.67	77	19.89	84	21.71	33	8.53	96	24.81
1000000 and above	242	62.54	256	66.15	256	66.15	268	69.25	259	66.92
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 [34,35,36]. 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 [37]. [38] 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 [39].

According to the result, the level of losses of yam is corroborated by [40] 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. Losses caused by these processes may occur during all stages of the food supply system from crop maturity, through harvesting, transportation and storage. 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 [41].

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. The study agrees with the result of the field observations by [42], [43], which said that the magnitude of losses varies greatly from place to place and that losses are often difficult to calculate since losses are related to improper temperature management, and other factors and that 40% to 50% of agricultural crops produced in developing countries are lost before they are consumed, mainly because of high rate of bruising, water loss, and subsequent decay during handling. It also in conformity with the work of [44], which observed that post-harvest food loss can reach up to 50% of total food production

### 3.5 Relationship Between the Income and Post-Harvest Losses

The spearman correlation matrix showing the relationship between the income and post-harvest losses of the farmers is shown in Table 7. The coefficient of determination (R square) value was 0.922 with a P value of 0.00. The result reveals a significant and strong positive correlation between the income and post-harvest losses of the farmers. Hence, considering the correlation value of 0.922; the hypothesis which states "Ho: there is no significant relationship between the income and post-harvest losses was rejected. Therefore, there is a significant relationship between income and postharvest losses of yam farmers in the studied area.

**Table 4. 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 5. 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 6. 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*

**Table 7. The relationship between the income and post-harvest losses of the farmers**

		Correlations	
		Post harvest losses	Sustenance
Post harvest losses	Pearson Correlation	1	.922**
	Sig. (2-tailed)		.000
	N	387	387
Income	Pearson Correlation	.922**	1
	Sig. (2-tailed)	.000	
	N	387	387

\*\* Correlation is significant at the 0.01 level (2-tailed)

The result also revealed a significant and strong positive correlation between income and post-harvest losses of the farmers. Hence, considering the correlation value of 0.922; the study concluded that there is a significant relationship between income and postharvest losses of yam farmers in the studied area. Yam improves the revenue generating base of yam farmers. Post-harvest loss of yam is not a saboteur to food available for farmers alone; it affects farmers' income negatively. Income which would have transformed their social status in terms of acquisition of quality shelter, clothes, education and health is lost. Post-harvest losses of yam made Nigeria yam farmers far from being completely food secured [45]. Thus, Post-harvest losses of yam significantly endanger the socioeconomic sustenance of stakeholders and farmers by reducing valuable income and profitability. Instead of making profit and good fortunes from post-harvest yam, farmers are busy counting their losses. This sometimes could push some yam farmers to bad agricultures practices through the use of forbidden chemicals for preserving their yam. According to [46],[47], the link between agriculture, rural infrastructure and farmers' income are crucial given that agriculture is the mainstay of the economy, the largest source of employment and income generation for the majority of rural dwellers in Nigeria.

#### 4. CONCLUSION

The study thus concludes that yam farming is dominated by male farmers who are relatively young and mostly married and literate. The average household size in the study area was 8 persons. 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. Considering the income level of yam farmers in

the area, they were classified as moderate income earners.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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