Determinants of post-harvest losses among Nsukka-yellow pepper farmers in Enugu State, Nigeria

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Abstract

Post-harvest loss posed a challenge for Nigeria's agricultural sector. Post-harvest losses in the production of Nsukka-yellow pepper may result from inadequate handling, poor harvesting methods, pests, and microbial infestation, among other things. As a result, the study determined the post-harvest losses among Nsukka-yellow pepper farmers in Enugu State, Nigeria. Multi-stage sampling technique was used to sample eighty (80) yellow pepper producers from five (5) communities in Nsukka Local Government Area. Primary data were collected using a structured questionnaire. In addition, data were analyzed using descriptive statistics and OLS multiple regression. The OLS multiple regression was used to determine the factors affecting yellow pepper post-harvest loss which was measured by farmers' profitability. The results show that most of the farmers were female, with a mean age of 48 years, and an average of 8 years farming experience. It is significant to highlight that the majority of farmers had no access to credit. The findings also indicated that farmers' profitability was positively influenced by marital status, education, and household size. Furthermore, Nsukka-yellow pepper farmers had post-harvest problems due to insufficient funds, poor storage facilities, and high cost of labour. Hence, Nsukka-yellow pepper farmers are encouraged to access credit facilities in order to increase their capacity to purchase adequate production and harvesting inputs such as storage facilities and similar equipment and technology.

Keywords: Post-harvest loss, yellow pepper farming, Poor funding

Introduction

Agriculture is an important sector in Nigeria that contributes about 30 percent of the gross domestic product (GDP) of the nation (Sasu, 2022) and provides food for its growing population (Ugwukah, 2022). Agriculture in Nigeria is predominated by smallholder farmers (Alabi, Oladele, & Maharazu, 2022), largely comprising rural farmers who still depend on agriculture for food utilized for household and commercial purposes (Ugwukah, 2022). Among the crops grown by rural farmers, pepper is commonly produced and made available for commercial use (Mustapha et al., 2021) in most food markets. Pepper is a vegetable crop

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that is well known around the world, contributing substantially to the international market (Oyewo et al., 2018). The total production of pepper in Nigeria is about 753,116 tonnes covering about 99,715ha[1] (Dijkxhoorn, Talabi, & Eunice, 2021). Unfortunately, Nigeria is no longer among the top pepper growers in Africa (Olutumise, 2022).

Pepper production has numerous benefits such as nutrition, income generation, medicinal[2], and many other culinary benefits in terms of food flavouring and seasoning (Onwubuya, Okporie, & Nenna, 2008; Oyewo et al., 2018). Given its nutritional benefit and delicious flavour, pepper has become a staple in the meals of many Nigerians (over 115 million Nigerians), spanning diverse ethnicities and socioeconomic statuses (Oyewo et al., 2018). Pepper also has traditional importance (Biratu, Belew, & Ettissa, 2021). For instance, Nsukka is popularly known to produce Nsukka yellow pepper (*Capsicum chinense nsukka drilus*) which constitutes a major agricultural activity in the area (Onwubuya, Okporie, & Nenna, 2008). It is also used for making traditional medicine and food spices (Diovu et al., 2019). Nsukka-yellow pepper is peculiar to this region having a pleasant aroma and spicy-hot, providing a significant source of livelihood for rural farmers in Nsukka Local Government Area (LGA).

The pepper production subsector is, however, confronted by challenging factors such as post-harvest loss. Studies have shown that pepper farmers experience about 10-30 percent post-harvest loss, especially during harvesting and transportation activities (Adeoye, Fashogbon, & Idris, 2014). In addition, given the perishable nature of Nsukka-yellow pepper, most farmers experience numerous losses in their production due to bruises and spoilage through the processes of harvesting, packaging, and transportation among others. These post-harvest losses significantly decrease the quantities and qualities of yellow pepper available for consumption and sale. As a result, negatively broadens the demand-supply bridge for pepper in the study area.

Thus, post-harvest loss poses a challenge in the Nigerian agrarian sector (Ovharhe et al., 2021). Ovharhe et al., 2021, highlight the three major factors contributing to post-harvest loss: physical, physiological, and environmental effects. These intrinsic and extrinsic post-harvest loss factors can as well be observed in the production and harvesting of Nsukka

[1] The total yield of pepper as of 2019 was recorded at 7.55 tonnes per hectare (Dijkxhoorn, Talabi, & Eunice, 2021)

[2] Nsukka yellow pepper is used to cure inflammation, cancer, neuralgia, and rheumatism (Diovu et al., 2019)

yellow pepper. They include post-harvest loss from poor harvesting, handling, storing, and processing techniques and infrastructure as well as losses due to changing temperature, high humidity, human activities, and pests and microbial attack among others. These post-harvest losses can pose a threat to food security.

According to Howard et al. (2000), pepper has economic, nutritional, and medicinal benefits, possessing antioxidant compounds and natural colours (Alabi, Oladele, & Maharazu, 2022). However, smallholder farmers face lots of post-harvest challenges such as poor amenities and infrastructure, poor skills, poor technology use for storage, processing, and transportation, inadequate extension service, and inadequate research and development, amongst others (Ovharhe et al., 2021). Hence, it is worthwhile to examine the factors affecting the post-harvest loss of Nsukka yellow pepper to determine the best way to manage these losses, meet the consumer demand for pepper, curb food insecurity, and encourage sustainable post-harvest handling of vegetables such as Nsukka-yellow pepper.

Most studies on pepper production in Nigeria focused on the profitability, output, efficiency, performance, processing, and market participation challenges facing pepper production (Adekola & Maduabuchi, 2020; Mustapha et al., 2021; Alabi, Oladele, & Maharazu, 2022; Onwubuya, Okporie, & Nenna, 2008; Adeoye, Fashogbon, & Idris, 2014; Olutumise, 2022). However, limited studies have been conducted on the post-harvest loss of pepper, which further widens the supply-demand gap in the ability of domestically produced pepper to meet its demand amidst a high population (Dijkxhoorn, Talabi, & Eunice, 2021). Therefore, this study determines the factors influencing the post-harvest losses experienced by yellow pepper farmers in Nsukka LGA.

Hence, the general objective of this study is to determine the post-harvest losses among Nsukka-yellow pepper farmers in Enugu State, Nigeria. Therefore, the specific objectives of the study are to:

i. describe the socioeconomic characteristics of Nsukka-yellow pepper farmers

ii. determine the factors influencing post-harvest losses in Nsukka-yellow pepper farming

iii. identify the constraints faced by Nsukka-yellow pepper farmers in curbing post-harvest losses

Methodology

The study was conducted in Nsukka Local Government Area in Enugu State, Nigeria. The Local Government Area is made of the following towns: Eha alumina, Edem, Alor-uno, Opi, Oba, Ede oballa, Obukpa, Obimo and ObolloAfor (formerly center of the Palm oil trade). It has an area of 1,810km^2 and a population of 309,633 as of the 2006 census. The Local Government Area shares common boundaries with UzoUwani, Igbo - Etiti, Igbo - Eze North, Igbo Eze- South, Udenu Local Government Area. The study area also shares boundaries with Benue and Kogi State in the North and Anambra State in the West.

The population of the study comprises all farmers involved in the production of yellow peppers in Nsukka Local Government Area. The multi-stage sampling technique was used to divide the farmers into eight (8) strata through a stratified sampling technique based on the number of communities in the LGA. Using a purposive sampling technique, five (5) communities in Nsukka Local Area were selected based on the communities with high production of Nsukka-yellow pepper. In addition, a simple random sampling technique was used to select sixteen (16) yellow pepper farmers from each of the communities which gave a total of Eighty (80) yellow pepper farmers.

Furthermore, primary data was collected using a structured questionnaire. The data were analyzed using descriptive statistics (for objectives i and iii) and a multiple regression model (for Objective ii). The multiple regression analysis was estimated using the ordinary least square (OLS) estimation techniques. This was employed to determine the factors affecting post-harvest loss among Nsukka-yellow pepper farmers in the study area.

The multiple regression model is given as (Edriss, 2019);

$$Y = f(X_1, X_2, \dots, X_{10} + e)$$

Where Y represents the value of yellow pepper output (₦), X_1 represents the age of farmers in years, X_2 represents the sex of the farmer (dummy: male = 1, female = 0), X_3 represents farmers' marital status (dummy: 1 = Married, 0 = Single), X_4 represents the number of years of educational attainment, X_5 represents the household size, X_6 represents the number of years of farming experience, X_7 represents the farm size in hectares, X_8 represents the cost of farm input (₦), X_9 represent the membership to a cooperative (dummy: 1 = yes, 0=no), X_{10}

represents farmers access to extension services (dummy: 1 = yes; 0 = no), and e represents the error term.

The regression analysis estimated four functional forms in order to determine the best fit. The model with the best fit (highest R-square value) was adopted:

Linear Form: $Y = b_0 + b_1X_1 + b_2X_2 + \cdots + b_{10}X_{10} + e$

Semi Log Form: $Y = b_0 + b_1lnX_1 + b_2lnX_2 + \cdots + b_{10}lnX_{10} + e$

Double Log Form: $lnY = b_0 + b_1lnX_1 + b_2lnX_2 + \cdots + b_{10}lnX_{10} + e$

Exponential Form: $lnY = b_0 + b_1X_1 + b_2X_2 + \cdots + b_{10}X_{10} + e$

Where b_0 represents the intercept while b_1 to b_{10} represent the OLS parameters to be estimated.

Results and discussion

The result for the socioeconomic characteristics of the Nsukka-yellow pepper farmers is represented in Table 1. Table 1 shows that the majority (48.8%) of the farmers were between the age range of 41-50 years with an average age of 48 years. While 38.8 percent of farmers were between the age range of 51-60 years, 8.8 percent were above 60 years, and 3.8 percent of the farmers were between 30-40 years. The average age falls in the active economic age group and thus implies the ability of farmers to engage in activities that can bring about an improvement in yellow pepper production in the study area. This agrees with the findings of Oyewo et al. (2018) and Ovharhe et al. (2021), who also reported that farmers were still in their active age. The results also reveal that the majority (65%) of yellow pepper farmers were females while (35%) were males. This indicates that the production and harvesting of yellow pepper in Nsukka is mostly dominated by female farmers. This agrees with the findings of Ovharhe et al. (2021), who reported that post-harvest activities such as storage and processing were predominated by female farmers.

Table 1: The socioeconomic characteristics of the yellow pepper farmers in Nsukka LGA

Variables	Frequency	Percentage	Mean
Sex: Male	28	35	
Female	52	65	
Age: 30-40	3	3.8	
41-50	39	48.8	48
51-60	31	38.8	
61and above	7	8.8	
Marital status: Single	21	26.3	
Married	59	73.8	
Education: 1-6	10	12.5	
7-12	64	80	9
13 and above	6	7.5	
Household size: 1-4	14	17.5	
5-8	53	66.3	7
9-12	13	16.3	
Farm experience:1-3	4	5	
4-6	23	28.9	
7-9	39	48.8	8
10-12	13	16.3	
13-15	1	1.3	
Access to credit: Yes	25	31.3	
No	55	68.8	
Total	80	100	

Source: Field survey, 2019

In addition, results indicate that the majority (73.8%) of respondents were married and (26.3%) were single (Table 1). Furthermore, the mean household size of yellow pepper households was 7 persons. This implies that family labour is a major input employed in the production and harvesting of Nsukka yellow pepper. This is in line with the findings of Oyewo et al. (2018) and Olutumise (2022), who reported that family size would serve as a source of family labour. Table 1 also indicates that the average years of educational attainment of farmers was 9 years. This implies that the literacy among yellow pepper farmers is relatively high given that most of farmers (80%) have some form of secondary education. This agrees with the findings of Alabi, Oladele, & Maharazu (2022) and Olutumise (2022), who reported that education improves the adoption rates of innovations for increased productivity.

Table 1 further shows that respondents had on average 8 years of farming experience. This implies that the farmers had acquired the necessary skills in the production of Nsukka-yellow pepper. This is in agreement with the findings of Oyewo et al. (2018), who reported about 7

years of farming experience for chill pepper farmers. In addition, the majority of the farmers had no access to credit while about 31.3 percent had access to credit (Table 1). Financial assistance is very crucial to encourage increased productivity and enable the adoption of innovations and technologies for increased agricultural production. This is in line with the findings of Olutumise (2022). Credit is believed to be an important catalyst for agribusiness expansion and the adoption of improved technologies (Sanusi & Ayinde, 2013).

The factors affecting the post-harvest loss among Nsukka-yellow pepper farmers is presented in Table 2. The result is based on the four functional forms of the OLS multiple regressing analysis.

Table 2: Factors affecting post-harvest losses among yellow pepper farmers in Nsukka LGA

Variables DV=Profitability	++Semi-log Coef. (t-value)	Double-log Coef. (t-value)	Linear Coef. (t-value)	Exponential Coef. (t-value)
Constants	9.907	2.258	3352.455	-450326.132
	(43.159)	(2.438) **	(0.168)	(-5.063)
Age (X_1)	-0.012	-0.072	-280.588	-20883.223
	(-2.400) **	(-0.403)	(-0.642)	(-1.215)
Sex (X_2)	0.025	-0.03	-2270.077	-6420.233
	(0.524)	(-0.568)	(-0.537)	(-1.249)
Marital Status (X_3)	0.130	0.167	4162.366	651.587
	(2.600) ***	(2.982) ***	(0.96)	(1.218)
Years of Education (X_4)	0.013	0.12	380.469	7118.974
	(2.17) **	(2.935) ***	(0-.071)	(1.189)
Household Size (X_5)	0.157	-8.207	3243.469	-1222.2299
	(12.077) ***	(-0.001)	(2.909) ***	(-0.135)
Farm Experience (X_6)	0.016	-0.001	-130.351	2144.241
	(2.286) **	(-0.013)	(-0.227)	(0.493)
Farm Size (X_7)	-0.006	-6.424	3244.284	231.340
	(-0.128)	(0.023)	(0.866)	(0.461)
Input Cost (X_8)	1.979	0.830	1.374	55024.544
	(-21.073) ***	(-18.591)	(-16.838) ***	(-12.836) ***
Member Coop (X_9)	-0.010	0.014	-2039.951	424.609
	(-0.221)	(0.268)	(-0.495)	(0.085)
Ext Access (X_{10})	-0.019	-0.015	-1814.401	-2377.634
	(0.362)	(0.529)	(0.391)	(-0.433)
R^2	0.871	0.838	0.817	0.720
F-Value	46.605	40.304	30.828	20.007
Sample size	80	80	80	80

Source: Field survey, 2019 ** and *** represent significance levels at 5% and 1%

respectively. DV represents the dependent variable. ++ represents the lead equation

Based on the model with the highest R-square value, the semi-log (87.1% or 0.871) functional form (Table 2) was adopted for the study given that 87.1 percent of the variations in the dependent variable is explained by the independent variables in the regression model. Table 2 indicates that a percentage increase in the age of the farmer would decrease the profits realized for yellow pepper farming by 1.2 percent on average (t-value = -2.40 < -1.96). This implies that the younger farmers could have the ability to generate more profits from cultivating yellow pepper in Nsukka LGA.

The result also shows that being married and household size increased the profitability of yellow pepper farmers by 13 percent and 16 percent on average, respectively (t-value = 2.60 & 12.08 > 2.58, respectively). This implies that married farmers are more likely to make profits in yellow pepper production compared to single farmers. Thus, contribute to the labour required for effective post-harvest activity given the increased family size. Likewise, farmers' years of schooling had a positive effect on the profitability of yellow pepper. The result suggests that if the years of schooling increase by 1 percent, the profitability of yellow pepper farmers will also increase by 1.3 percent on average (t-value = 2.17 > 1.96). Hence, education equips farmers with a better understanding of effective planning. This agrees with the findings of Simonyan et al. (2010) in Akinlade, Balogun, & Obisesan (2014), who implied that education significantly improves the farmers' ability to make adequate farm decisions.

In addition, a percentage increase in farming experience would increase the profits realized for yellow pepper farming by 1.6 percent on average (t-value = 2.29 > 1.96). This indicates that the number of years of experience in yellow pepper farming is positive on achieving farmers' goal of making profits. This is in line with the findings of Alawode and Abegunde (2016), who reported that farmers who are rich in experience would invariably increase the level of profit realized by pepper marketers. Lastly, the input cost was negatively related to profitability (t-value = -21.07 < -2.58). This implies that the higher the input cost, the lower the profitability. According to the profit theory, the cost of production exerts a negative relationship with the profit variable, thereby conforming to economic theory.

Table 3 shows the result of the constraints faced by Nsukka-yellow pepper farmers in curbing post-harvest losses. These constraints were ranked by means in descending order and signify the level of severity to farmers. The result in Table 3 shows that the constraints faced by the Nsukka-yellow pepper farmers were insufficient funds (mean = 3.6), inadequate storage

facilities (mean = 3.5), high cost of labour (mean = 3.4), inadequate extension services (mean = 3.2), and volatile weather conditions (mean = 3.2). Farmers need funds to be able to purchase relevant and innovative facilities to store and process their agricultural produce adequately so that post-harvest loss can be minimized among Nsukka-yellow pepper farmers. This is in line with the findings of Alawode and Abegunde (2016), who reported insufficient working capital as a major constraint to pepper marketing due to farmers' inability to access credit from formal financial institutes. The result in Table 3 is also in agreement with the finding of Sanusi and Ayinde (2013) and Alawode and Abegunde (2016), who identified inadequate storage and processing facilities as a threat to post-harvest losses and pepper marketing, respectively.

Table 3: Constraints faced by Nsukka-yellow pepper farmers

Constraints	Strongly Agree	Agree	Disagree	Strongly Disagree	Mean	Rank
Insufficient fund	51(63.8%)	3(3.8%)	24(30%)	2(2.5%)	3.6	1st
Storage problem	26(32.5%)	25(31.3%)	9(11.3%)	20(25%)	3.5	2nd
High cost of labour	30(37.5%)	18(22.5%)	10(12.5%)	22(27.5%)	3.4	3rd
Inadequate extension service	29(36.3%)	17(21.3%)	21(26.3%)	13(16.3%)	3.2	4th
Weather problem	6(7.5%)	7(8.8%)	34(42.5%)	33(41.3%)	3.2	5th
Inadequate technology	7(8.8%)	7(8.8%)	36(45%)	30(37.5%)	3.1	6th
Pest and disease	8(10%)	8(10%)	37(46.3%)	27(33.8%)	3.0	7th
Lack of planting material	7(8.8%)	17(21.3%)	29(36.3%)	27(33.8%)	3.0	8th
Theft	12(15%)	15(18.8%)	36(45%)	17(21.3%)	2.7	9th
Local customs of people	9(11.3%)	27(33.8%)	23(28.8%)	21(26.3)	2.7	10th

Source: Field survey, 2019

In addition, other constraints faced by the Nsukka-yellow pepper farmers were inadequate technology (mean = 3.1), infestation of pests and diseases (mean = 3.0), lack of sufficient planting materials (mean = 3.0), theft (mean = 2.7), and the local customs (mean = 2.7) of the people (Table 3). This implies that with adequate technologies and sufficient planting materials, post-harvest losses could be curbed to a minimum and thus improving farmers' profitability in the long run, *ceteris paribus.* This agrees with the findings of Sanusi and Ayinde (2013). According to their findings, adequate sourcing of planting inputs like disease-resistant seeds, pesticides, and adequate technologies can combat some of the challenges posed by pepper farming.

Conclusion and recommendation

Nsukka-yellow pepper post-harvest activities are dominated by well-experienced, literate, married female farmers who are still in their active years having large family size and have access to little to no credit for agricultural activities. In addition, the high cost of inputs and other planting materials had adverse effects on the profitability of Nsukka-yellow pepper in Nsukka LGA. Thus, farmers are faced with major constraints in their post-harvest activities, such as insufficient funds, inadequate storage, and processing facilities, in addition to the high cost of labour. Hence, Nsukka-yellow pepper producers are encouraged to make use of available credit facilities that are near them in order to increase their capacity to purchase more production resources, especially modern inputs and equipment. Furthermore, the government should subsidize some of the input to encourage farmers who wish to invest in yellow pepper production.

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