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Effect of Post-Harvest Loss Reduction Practices on Households Welfare Among Cowpea Farmers in Niger and Nasarawa States, Nigeria

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ABSTRACT

This research evaluated the effect of post-harvest loss reduction practices and selected socio-economic factors on households' welfare of cowpea farming households in Niger and Nasarawa States, Nigeria. A multistage sampling technique was employed, and a sample size of 216 cowpea farming households was randomly selected across six local government areas. (i.e., 108 respondents from each state chosen). Descriptive and inferential statistics were utilized. Results indicated that traditional drying was the most common post-harvest practice, while modern technologies such as Purdue Improved Cowpea Storage (PICS) bags and super grain bags were moderately adopted. Household welfare was measured using a composite index based on per capita expenditures on food, education, health, accommodation, and consumer durables, and the result showed that the cowpea farming household had low welfare. The beta regression showed that access to training was significant at ($p \leq 0.01$), the use of super grain bags at ($p \leq 0.05$), the use of wood ash at ($p \leq 0.05$) while the use of Purdue-improved cowpea bags, level of education of household head, and the use of metallic silos were all significant at ($p \leq 0.10$). Distance to market and access to credit, though not statistically significant, remain relevant barriers to welfare enhancement, highlighting the importance of infrastructural and financial interventions. The study, therefore, recommends the need for targeted training programs tailored towards post-harvest loss reduction practices, increased access to improved storage technologies, such as the super grain bags readily available to cowpea farming households, and Integrated policies that address educational relevance, credit accessibility, and rural market linkages.

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Introduction

Post-harvest loss is the term used to describe the deterioration of agricultural food production, both in terms of quantity and quality that takes place between the period of harvest and consumption (PHL) Food and Agriculture Organization (2011). Globally, according to an analysis of the Food and Agriculture Organization (FAO), one-third of the food produced for human consumption is lost or wasted (FAO, 2011). Also, research by the United Nations Environmental Programme (UNEP) estimated that the percentage of food wasted at the retail and consumer level was about 17% (UNEP, 2021). This shows a great concern considering the ever-increasing population in Nigeria. Deterioration of plant crops can take place at different stages after harvest which may include during handling, drying, threshing, storage, transportation, packaging and marketing (Ovharhe et al., 2021). However, numerous chemical, economic, biological and cultural factors can influence losses after crop harvest, including Locations; which can also affect the extent and intensity of this damage in the food supply chains. After-harvest losses typically result in a waste of resources that were used to produce food crops but weren't eaten or used for other purposes (Abbas et al., 2018). This directly falls back to the farmers' standard of living and affects their means of income. Additionally, it negatively impacts well-being by causing a shortfall of availability (food stocks), a balance in food supply for a long period and an increase in marketable produce which should significantly contribute to the farming household financial commitments. There have been initiatives in developing countries including Nigeria to optimize food production; nevertheless, due to inadequate technology, ignorance, and/or inadequate storage infrastructure, low effect of demand and supply and delay in delivery due to poor transportation problem, a

significant amount of produce is lost during postharvest processes (Kumar & Kalita, 2017). Post-harvest loss reduction in Nigeria must be given priority because this can bridge the gap of food supply in different parts of the country and ensure food harvests are preserved and utilized and will increase effective means of improving the standard of living and income of smallholder farmers, who produce most of our food. If farmers can embrace a better and more efficient technology, especially for cowpeas in the context of this research, a bulk of cowpeas harvested will be preserved from post-harvest losses. Although, according to research, some of these farmers in impoverished countries like Nigeria have decreased post-harvest loss with the use of Purdue Improved Cowpea Storage (PICS) bags, metallic silos, super grain bags, and other hermetic storage solutions to store cowpea after they have been harvested and dried for consumption and sale. Also, there are woven polypropylene bags injected with an insecticide used by these cowpea farmers to stop pest infestations. All these techniques are to lower postharvest losses in cowpeas and research has also shown that some of these storage materials are popular and affordable (Kumar & Kalita, 2017).

Cowpeas (Vigna unguiculata) are an essential legume crop grown throughout Nigeria for food, vegetables, green manure and cover crops. According to (Das et al., 2012), they are less expensive than animal proteins and higher in amino acids like lysine and tryptophan which are a source of nutrient-dense and contribute to one's nutrition. Its production is primarily concentrated in the country's savanna region, which includes the states of Niger and Nasarawa States. Cowpea is considered a staple crop which is a source of plant protein. It also offers superior nutritional and nutraceutical qualities along with several agronomic, environmental, and economic advantages that support food security and welfare (Hall, 2012). Then it can be said that cowpeas are grown for consumption and increase household income and well-being through sales.

Nigeria's population is growing at an exponential rate, hence the demand for agricultural food including cowpeas. Therefore, there is a need to increase production and most importantly focus on the utilization of the cowpea produced especially after harvest to ensure resources invested are not wasted. This approach can reduce post-harvest losses, thereby boosting farmers' income and improving their general well-being (Abbas et al., 2018). Therefore, the study will encourage further research into ways for reducing post-harvest loss while considering its effects on household welfare, also national and international agricultural-related entities would also act as a repository for information or reference resources.

This study therefore assessed the impact of post-harvest loss reduction measures on the welfare of cowpea-farming households in the Nigerian States of Niger and Nasarawa.The broad objective of this study is to determine the effect of post-harvest loss reduction practices on welfare of cowpea farming households in Nigerian Niger and Nasarawa states, while the specific objectives were to identify the post-harvest reduction practices used by the cowpea farming households and determine the effect of post-harvest loss reduction practices on the welfare of the cowpea farming households.

Methodology

The study was carried out in the Nigerian states of Niger and Nasarawa. Niger State was created in April 1976. Minna, the capital of the state, is geographically located between longitudes 3°30′E and 7°20′E, and at a latitude of 8°22′N. Niger State has a land area or mass of about 76,363 km^2 and a projected population of 5.556.247million with an annual growth rate of 3.4% as of 2016, (National bureau of statistics, 2016). There are twenty-five Local Government Areas in the State. According to (NiMet, 2022) the rainfall is between 120mm-200mm, and the mean temperature is 29^{o}c-32^{o}c. The maximum average temperature ranges from maximum in March and June, while the minimum is usually between December and January. With this climatic pattern, the type of soil in Niger state is the flood plain type and is characterized by variations.

Nigerian state of Nasarawa, Lafia serves as the State capital. It was created on 1st October 1996. The State lies in Guinea Savannah region between latitude 9º North and longitude 7º and 1º East and is accessible through Benue State to the South and Kogi State to the West, the Federal Capital Territory (FCT), Abuja to the North-West, Kaduna and Plateau States to the North – East, and Taraba States to the South-East. Taraba States to the South-East. The land area of Nasarawa State is 27.117 square kilometers, and the estimated population of 2.523.395 (NBS, 2016). It encompasses 13 local government areas, where agricultural practices predominate. It also has solid minerals and salt, including bauxite. Nasarawa State experiences both dry and rainy seasons, with an average of 131.73 mm of precipitation each year.

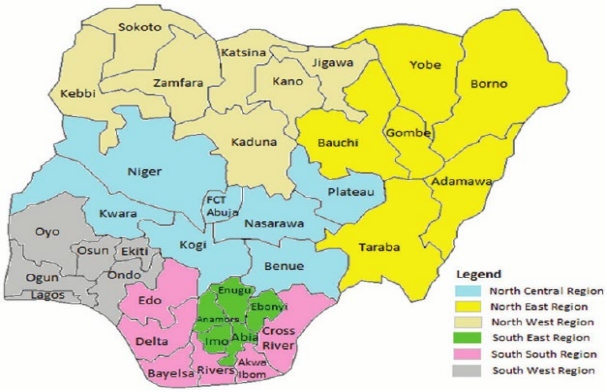

Figure 1. Map of Nigeria showing regions including Niger and Nasarawa states
Source: (Gayawan, et al., 2014)

To choose the respondents for this study, a multistage sampling procedure was utilized. Firstly, three (3) Local Government Areas from the agricultural region in each state that produces cowpeas were purposefully chosen because of their significant contribution to cowpea production in the country. The Local Governments Areas selected for Niger State are Bosso, Wushishi, and Bida, the Local Governments Areas for Nasarawa state are Karu, Keffi, and Kokona Local Government Areas. The second stage involved a random selection of three (3) villages from each of the three selected Local Government Areas of each state, making a total of eighteen (18) villages.

Table 1. Multistage sampling techniques of the respondents in the study area

State	LGAs	Villages	SS
Niger	Bosso	Bejo	12
		Maikunkele	12
		Garatu	12
		Akare	12
	Wushishi	Batan-Ndaba	12
		Bankwagi	12
		Banwu	12
	Bida	Bariki	12
		Dutsen kura gwari	12
Nasarawa	Karu	Kabusa	12
		Mararaban-Gurku	12
		Agada	12
		Tila	12
	Keffi	Kaibo Mada	12
		Dan Dabi	12
		Garaku	12
	Kokona	Dari	12
		Ninkoro	12
Total	6	18	216

LGAs: Local government areas; SS: Sample size (Cowpea households); Source: Computed from Field Data, in 2024

The third stage was a snowball sampling of twelve (12) households from each of the 18 villages selected which resulted in a sample size of two hundred and sixteen (216) households. The data used was from primary sources and collected using computer assisted personal interviewers (CAPI) via kobo toolbox.

Model Specification

Descriptive and inferential statistics were used to achieve the objectives of the study. To deduce the level of household welfare, the household welfare index was employed, and Beta regression for the effect of post-harvest loss reduction strategies on welfare at the household level. Following the Human Development Index (HDI) stated by the United Nations Development Program in 2010, (Kumar, 2021) constructed a new index for measuring welfare at the household level which this study adapted, and it is made up of per capita expenditure on consumption, education, housing or accommodations, investments, and health or medical care. This is known as the geometric mean of dimension indices. The indicator is normalized and spans from 0 to 1. It is then multiplied, and its cube root is found. Food and non-food consumption (education, health, housing, and consumer durables) are included in the per capita expenditure for this study. Per capita spending on food consumption, per capita spending on education, per capita spending on health, per capita spending on housing, and per capita spending on consumer durables are the five indicators.

The model is specified as:

$$FC = \frac{I}{n}\sum_{1=i}^{n} In = \frac{ln(FCi)-ln(ECI)}{ln(ECh)-ln(ECI)} \quad (1)$$

FC: Food Consumption Index

$$EI = \frac{I}{n}\sum_{1=i}^{n} In = \frac{ln(EEi)-ln(EEI)}{ln(EEh)-ln(EEI)} \quad (2)$$

EI : Education Index

$$HI = \frac{I}{n}\sum_{1=i}^{n} In = \frac{ln(EHi)-ln(EHI)}{ln(EHh)-ln(EHI)} \quad (3)$$

HI: Health Index

$$AI = \frac{I}{n}\sum_{1=i}^{n} In = \frac{ln(EAi)-ln(EAI)}{ln(EAh)-ln(EAI)} \quad (4)$$

AI : Accommodation Index

$$CD = \frac{I}{n}\sum_{1=i}^{n} In = \frac{ln(CDi)-ln(EDI)}{ln(EDh)-ln(EDI)} \quad (5)$$

CD : Consumers Durable Index

Where, FC = per Capita Expenditure on Food Consumption, EE = per Capita Expenditure on Education, EH = per Capital Expenditure on Health, EA = per Capita Expenditure on Accommodation, ED = per Capita Expenditure on Consumers durable, i = individual household, h = highest value, l = lowest value, n = total number of households.

Also, the geometric mean for the five indices stated in the equations above is as follows.

$$HWI = \sqrt[5]{FC.\ EI.\ HI.\ AI.\ CD}$$

Or

$$\text{Geo Mean of HWI} = (FC \times EI \times HI \times AI \times CD)^{1/5} \quad (6)$$

With regard to "lower level of household welfare," Between 0 and 0.5 is the HWI score range, between 0.51 and 0.8 is the "moderate level of household welfare" score, and between 0.81 and 1.0 is the "higher level of household welfare" score (Kumar, 2021).

Beta Regression Model

Utilizing the beta regression model, it was possible to ascertain how post-harvest loss reduction measures affected household welfare. The open standard unit interval (0, 1) is a good range of values for continuous variables y to model using beta regression. Components like proportions, percentages, and fractions are limited to (0, 1) in this response. (Ferrari & Cribari-Neto, 2004) are the authors of the beta regression model. Using a monotone differentiable function known as the link function, which links the response variable's mean function to a group of linear predictors. The variate mean and a precision parameter are two additional ways that the beta density is parameterized in this model (Ferrari & Cribari-Neto, 2004).

Assume that y is a continuous random variable with a probability density function of the following, following a beta distribution:

$$f(y;\mu,\varphi) = \frac{\gamma(\phi)}{\gamma(\mu\phi)\gamma((1-\mu)\phi)} y\mu^{\varphi-1(1-y)(1-\mu)\varphi-1},\ 0<y<1 \quad (7)$$

where $\gamma(.)$ is the gamma function and ϕ is the accuracy parameter

The beta probability distribution has the following mean and variance:

$$E(y) = \mu,\ var(y) = \mu(1-\mu)^{\sigma 2}. \quad (8)$$

The model permits μi, depending on variables, using the logit link function.

Here is a definition of the beta regression model:

$$g(\mu_i) = \log\left(\frac{\mu i}{1-\mu i}\right) = X_i^T\beta = \eta\iota \quad (9)$$

where the systematic and random components are related by a monotonic differentiable link function denoted by g(.) where $\beta = (\beta_1,...,\beta_k)^T$ is a k × 1unknown regression parameters vector (k <η), xi=$(x_{i1}, \ldots, x_{ik})^T$ is the independent variables or covariates and ηi isa linear predictor (i.e., $\eta i = \beta_1 x_{i1} + \cdots + \beta_k x_{ik}$; usually $x_{i1} = 1$ for all *i* so that the model has an intercept).

One uses the maximum likelihood estimator to estimate the beta regression parameters (MLE) method that requires that both a link and distribution functions are specified.

The beta regression model's log-likelihood function can be found by:

$$L(\mu_\iota,\phi,y_i) = \sum_{i=1}^{n}\{log\ _\gamma(\beta) - \log_\gamma(\mu_\iota)(C)) \text{ -log } _\gamma ((1-\mu_\iota)(\mu_\iota)) + (\mu_\iota(\phi) - 1)\log(y_i) + ((1-\mu)(\phi) - 1)\log(1-yi)\} \quad (10)$$

$$\text{Log } L(\beta) = \sum_{i-1}^{N} wi \log_\gamma(\phi) - wi\ log_\gamma(X_1\beta\phi) - wi\ log_\gamma[(1-X_1\beta\phi)\phi] + wi(X_1\beta\phi - 1)\log HW_1 + wi[(1-X_1\beta\phi - 1]\log(1-X\ HW_1) \quad (11)$$

Where; household welfare index (HWI) is the dependent variable, N denotes sample size, X is a matrix of independent variables for post-harvest loss reduction measures, *wi* is an optional weight, ϕ is the precision parameter, and $_\gamma$ is the gamma link function. The link function $_\gamma$(.) follows a logit distribution such that equation (2.11) turns into Equation (2.12) below;

$$g(X`_1\beta) = \frac{e^{x}{}_1^{\beta}}{1+e^{X'_1\beta}} \quad (12)$$

$$Y=\beta o+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}+\beta_{12}X_{12}+\beta_{13}X_{13}+\beta_{14}X_{14}+\beta_{15}X_{15}+\mu \quad (13)$$

Where Y= dependent variable (Household welfare Index)

X = control variable (post-harvest loss reduction measures among cowpea farming households)

μ = error term (a random error with mean zero that is equally distributed and happens independently and constant variance)

The control variables that were used include;

X_1= Educational level of the cowpea farming household head (Measured in years)

X_2=Access to Training's Dummy (Measured as 1 if yes, 0 if otherwise)

X_3= Distance to the Market (Measured in Kilometers)

X_4= Access to credit Dummy (Measured as 1 if yes, 0 if otherwise)

X_5=The use of purdue improved cowpea bags (PICS)Dummy (Measured as 1 if yes, 0 if otherwise)

X_6=The use of metallic silos Dummy (Measured as 1 if yes, 0 if otherwise)

X_7=Fumigation of storage Dummy (Measured as 1 if yes, 0 if otherwise)

X_8= Drying on roadsides Dummy (Measured as 1 if yes, 0 if otherwise)

X_9= Super grain bags Dummy (Measured as 1 if yes, 0 if otherwise)

X_{10}= Literacy ratio (Measured in ratio)

X_{11}=The use of tarpaulin for drying Dummy (Measured as 1 if yes, 0 if otherwise)

X_{12}=Storage in granaries Dummy (Measured as 1 if yes, 0 if otherwise)

X_{13}=The use of Aluminium phosphate Dummy (Measured as 1 if yes, 0 if otherwise)

X_{14}=The application of pirimiphos-methyl for storage Dummy (Measured as 1 if yes, 0 if otherwise)

X_{15}=The use of wood ash for storage Dummy (Measured as 1 if yes, 0 if otherwise)

Results and discussion

Post-Harvest Reduction Practices Used by The Cowpea Farming Households in The Study Area

Table 1a below shows the result on the post-harvest loss reduction practices used by the cowpea farming households in Niger and Nasarawa States. The use of Purdue –improved cowpea bags (PICS) was observed as 36.1% of the farming households used this reduction practice to store their produce till when it gets out of season, this approves of the study by (Zeigler & Nakata, 2014) that storage technologies like the use of (PICS) bags are becoming very popular and cost-effective in several countries. To disinfect certain storage locations and commodities, storage facilities (63.9%) were fumigated. The typical method of drying to minimize moisture contents was seen to be used by the majority of households involved in cowpea farming. This assents with (Ariong et al., 2023) who assessed the losses, costs, and grain moisture content (MC) associated with traditional storage practices linked with the harvest and postharvest practices used by smallholder bean farmers in Uganda discovered that grains stored above the floor surface could reduce MC by an additional 1.5%. The cowpea farming households also used the super grain bags which are waterproofs in storage and transportation. The proportion, 42.6%, is consistent with research done by (Baoua et al., 2013) to evaluate the effectiveness of PICS and Super Grain bags. The results showed that after four months, the Super Grain bags had less cowpea weevil egg infestation (18.5 eggs per 100 seeds) than the PICS bags (26.1 eggs per 100 seeds). The temperature and relative humidity in both bags also remained equal throughout time.

The primary post-harvest loss reduction strategies employed by the cowpea farming households in Niger and Nasarawa States are displayed in Table 1b and Figure 2. It is clear that the majority of farming households (55.6%) used the traditional drying technique (drying on roadsides) to lower the moisture content of the produced cowpeas. As may be seen in the table above and Figure 1b below, additional techniques were also applied. Table 2a shows the five indices that include food and non-food total expenditure of the cowpea farming households. Information about the total expenditure and the percentage of each index is given as seen on the Table below.

Table 1a. Post-harvest loss reduction practices used by cowpea farming households

Variables	Types of variables	Frequency	Percentage (%)
The use of Purdue-improved cowpea bags (PICS)			
No	0	138	63.9
Yes	1	78	36.1
Total		216	100
Utilizing metallic silos			
No	0	214	99.1
Yes	1	2	0.9
Total		216	100
Fumigation of storage			
No	0	78	36.1
Yes	1	138	63.9
Total		216	100
Drying on roadsides			
No	0	53	24.5
Yes	1	163	75.5
Total		216	100
The use of tarpaulin for drying			
No	0	125	57.9
Yes	1	91	42.1
Total		216	100
The use of zero fly bags (polypropylene bags)			
No	0	216	100
Yes	1	0	0
Total		216	100
The usage of super grain bags			
No	0	124	57.4
Yes	1	92	42.6
Total		216	100
The use of diatomaceous earth (DE) Inert dust			
No	0	216	100
Yes	1	0	0
Total		216	100
Storage of cowpea in granaries			
No	0	188	87
Yes	1	28	13
Total		216	100
The application of ashes during storage of cowpea			
No	0	187	86.6
Yes	1	29	13.4
Total		216	100
The use of Aluminum phosphate for storage of cowpea			
No	0	194	89.8
Yes	1	22	10.2
Total		216	100
The application of pirimiphos-methyl for storage of cowpea			
No	0	214	99.1
Yes	1	2	0.9
Total		216	100

Source: Computed from Field Data, in 2024

Figure 3 represents the distribution of household welfare based on lower (0-0.5), moderate (0.51-0.8), and higher (0.81-1) (Kumar, 2021). The essence of the convergence at the graph between 0.0-0.01 is an indication that majority of the cowpea farming households fell under the category of lower welfare indicating that their welfare is very low. This agrees with (Kumar, 2021) that up to 72.02% households are in the lower level of welfare.

Effect of Post-Harvest Loss Reduction Practices On Welfare of Cowpea Cultivating Households in the Study Area

Table 2b computes the outcome of the beta regression analysis of the effects of post-harvest loss reduction measures on household welfare. The model below tested the usage of Purdue-improved cowpea bags (PICS), the use of metallic silos, the use of super grain bags, the application of wood ash for storage, the level of education level, and training accessibility.

Table 1b. Main post-harvest loss reduction practices of used by the cowpea farming households

Practices	Frequency	Percentage (%)
The use of Purdue-improved cowpea bags (PICS)	6	2.8
Fumigation of storage	27	12.5
Drying on roadsides	120	55.6
The utilization of tarpaulin for drying	8	3.7
The use of super grain bags	19	8.8
Storage of cowpea in granaries	10	4.6
The use of Aluminum phosphate in storage of cowpea	11	5.1
The application of ashes for storage of cowpea	15	6.9
Total	216	100

Source: Computed from Field Data, in 2024

Table 2a. Per capita household expenditure and household welfare

Household welfare indices	Total expenditure (#)	Total expenditure percentage (%)
Expenditure on Food	8.866.158	28.70
Expenditure on Health	418.850	1.36
Expenditure on Accommodation	15.622.600	50.59
Expenditure on Education	3.423.700	11.08
Expenditure on Consumer durables	2.555.900	8.27
Total	30.887.208	100

Source: Computed from Field Data, in 2024

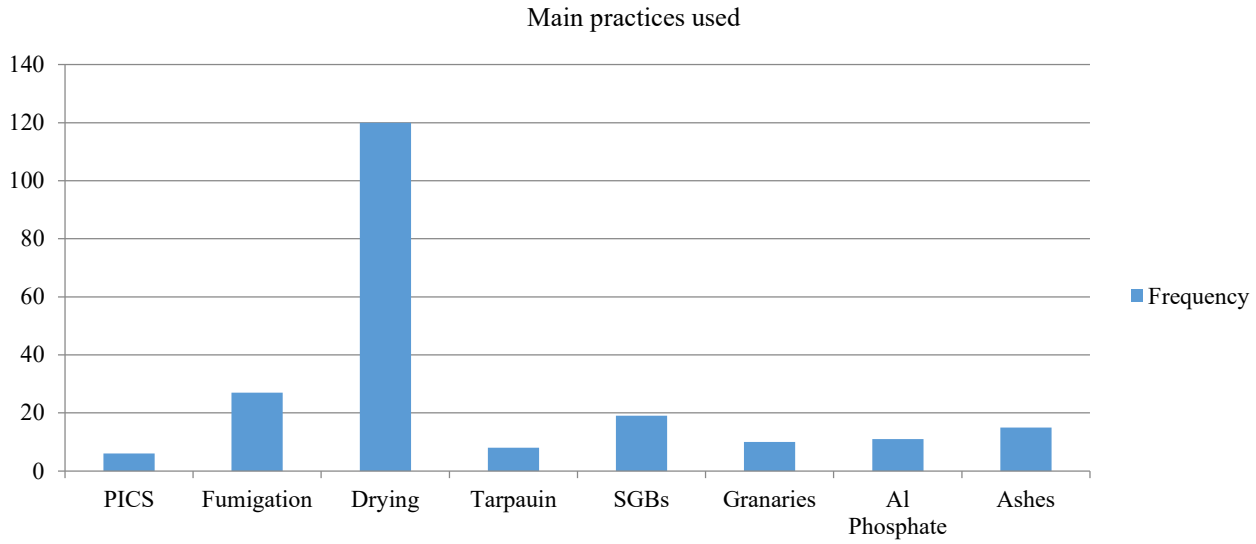

Figure 2. Distribution of the main post-harvest loss reduction practices
Source: Computed from Field Data, in 2024

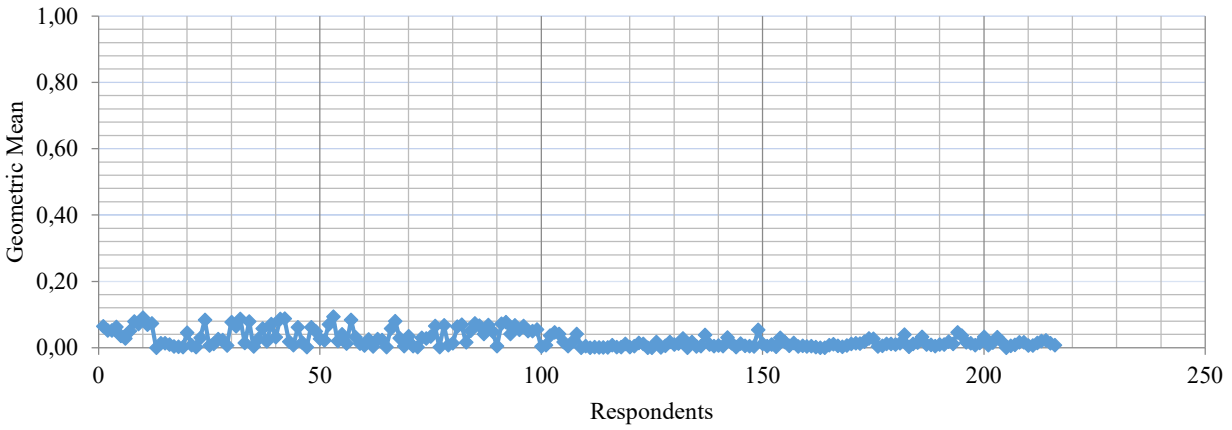

Figure 3. Household distribution based on welfare level
Source: Computed from Field Data in, 2024

Table 2b. Result on the effect of post-harvest loss reduction measure on household welfare of cowpea farming households

Explanatory variables	Parameter	Coefficients	Standard Error	Z-value	p-value
Educational level of the cowpea farming household (X_1)	β_1	-0.0233	-0.0121	-1.92*	0.054
Access to Training's (X_2)	β_2	0.4514	0.1357	3.33***	0.001
Distance to the Market (X_3)	β_3	-0.0022	0.0057	-0.38	0.702
Access to credit (X_4)	β_4	0.1178	0.1705	0.69	0.489
The use of Purdue improved cowpea bags (PICS) (X_5)	β_5	0.2466	0.1341	1.84*	0.066
The use of metallic silos (X_6)	β_6	-1.4164	0.7233	-1.96*	0.050
Fumigation of storage (X_7)	β_7	0.1392	0.1366	1.02	0.308
Drying on roadsides (X_8)	β_8	0.11510	0.1585	0.73	0.464
Super grain bags (X_9)	β_9	0.2351	0.1139	2.06**	0.039
Literacy ratio (X_{10})	β_{10}	-0.0529	0.0327	-1.62	0.106
The use of tarpaulin for drying (X_{11})	β_{11}	0.0501	0.1347	0.37	0.710
Storage in granaries (X_{12})	β_{12}	-0.0858	0.2114	-0.41	0.685
The use of Aluminium phosphate (X_{13})	β_{13}	0.35210	0.2214	1.59	0.111
The application of pirimiphos-methyl for storage (X_{14})	β_{14}	-0.2569	0.6680	-0.38	0.701
The use of wood ash for storage (X_{15})	β_{15}	-0.4999	0.2046	-2.44**	0.015
Diagnostics Statistics:					
Chi square	71.17***				
p> chi2	0.0000				
log Likelihood	634.354				
Number of observations	216				

*** is significant at 1% level, ** is significant at 5% level, and *is significant at 10% level of significance; Source: Computed from Field Data, in 2024

The beta regression on Table 2b revealed that education level had a negative and significant relationship with household welfare which means that a unit increase in education level results in a 0.02 drop in the coefficient of the wellbeing of the cowpea farmers. This is contrary to a priori expectations, as formal education is to inform farmers about resource management and productivity enhancement but it is not farfetched, given that the majority of the cowpea farmers in the study area had both secondary and non-formal schooling as their highest level of education. Access to training also had a positive and significant relationship with household welfare. This implies that household wellbeing in cowpea farming will rise with a coefficient of 0.45 for every unit increase in training accessibility. This suggests that the extension services have provided the cowpea farmers with extensive training on post-harvest loss reduction techniques, which may have a favorable impact on their welfare. This disagrees with the findings (Ahungwa & Ahungwa, 2020) who asserted access to extension trainings had a negative impact on post-harvest loss reduction practices. If more Purdue-improved cowpea bags (PICS) are used, the welfare of cowpea farmers will increase by 0.25 units. The result from Table 3.2b also revealed that the use of PICS bags had a positive and significant relationship with household welfare and this indicates that the three-layered structural design of the Purdue-improved cowpea bags and their ability to store cowpea without insecticide infestation have made it simple for cowpea farmers to use these bags to reduce post-harvest losses and enhance their own welfare. The use of Purdue-improved cowpea bags reduces the incidence of poverty among cowpea farmers, according to (Abraham et al., 2023). The use of metalic silos was significant with a negative relationship with the household welfare of cowpea farmers, indicating that the coefficient of 1.42, will decline the welfare of the cowpea farmers with a rise in the use of metallic silos. This can be because purchasing metallic silos is expensive. Also, the use of super grain bags had a positive and significant relationship with household welfare. And because super grain bags are airtight and can protect cowpea from moisture, they can reduce losses after harvest. This also means that a unit increase in their use will result in a 0.24 coefficient rise in the welfare of cowpea farmers. Additionally, the amount of wood ash application in storage of cowpeas had a negative and significant relationship with household welfare. Indicating that if the application of wood ash is increased by one unit, the welfare of the cowpea farmers will decrease by 0.50 units. This could be because certain resources will be needed to effectively safeguard the commercial quantity of cowpeas that must be stored.

Conclusion and Recommendation

According to the study's findings, it is concluded that access to training has a positive effect on household welfare. This implies that increased access to training increases household welfare. It is therefore imperative to facilitate targeted training on post-harvest loss practices. There is a positive and significant relationship between the use of super grain bags for storage and household welfare. Therefore, the use of super grain bags should be encouraged and readily available to households. Although there is a relationship between the educational level of cowpea-farming households, the use of Purdue Improved Cowpea Storage (PICS) bags and metallic silos, and household welfare, this relationship is not consistent.

Declarations

Ethical Approval Certificate

There was no experimental procedure in this study. However, data collection and this dissertation were approved by the dissertation examination Committee of the agricultural economics department, university of Abuja. 28 November 2024 approval date and number: 2024-11

Author Contribution Statement

O. M.A.: The author supervised the work.

O. T.: The author carried out the conceptualization, methodology, analysis, and editing.

Fund Statement

No funding was received to conduct the research.

Conflict of Interest

The author declares no conflicts of interest.

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