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SOCIO-ECONOMIC DETERMINANTS OF POST HARVEST LOSS (PHL) AMONG COWPEA FARMERS IN KURFI LOCAL GOVERNMENT AREA OF KATSINA STATE

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ABSTRACT

The study investigated socioeconomic determinants of post-harvest loss (PHL) among cowpea farmers in Kurfi LGA of Katsina State. Using an expo facto research design; a multi-stage sampling procedure was used to select 132 respondents (generated using the ROASOFT calculator). Data were collected using a structured questionnaire and summarized using frequency counts and percentages. The Probit regression model was used for inferential deductions. The results show that the majority (76%) of the respondents' experience PHL at the winnowing stage while 28% during the transit stage. Wind was found to be the main (57.6%) cause of PHL at the winnowing stage; crude means of transportation (42.4%) at the transit stage; rainfall at the assembling stage; and poor packaging materials (57.6%) at the packaging stage. Probit regression results showed that household size (negatively) and practice of subsistence (positively) farming influence PHL at the winnowing stage; household size and extension visit at the packaging stage with negative influence; while the practice of subsistence/commercial farming and access to financial support all have negative influence on PHL as extension visit positively influence it. Agricultural extension agencies and other relevant stakeholders should facilitate avenues such as access to adequate support and commercialization of farming activities to discourage PHL among cowpea farmers in the study area.

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INTRODUCTION

Postharvest losses of food grains are now considered a global challenge to the attainment of the sustainable development goals of zero hunger and responsible consumption and production patterns in recent times (Apurba, 2019). The author further stressed that a decrease in the incidence of postharvest food loss is key for sustainable improvement in food and nutrition security. In Sub-Saharan Africa (SSA) in which the study area belongs, postharvest loss is mainly important owing not only to low yields but also because about 374 million people are feared to experience severe food insecurity (FAO, IFAD, UNICEF, WFP and WHO, 2018). As a result, Apurba (2019) asserted that "there is a renewed international attention to reducing postharvest food losses following the African Union member states and United Nations pledging to halve food losses by 2025 and 2030, respectively". Large amounts of food are physically lost at different stages as food commodities move across their value chains. According to the Food and Agriculture Organization (FAO) of the United Nations, each year about one-third of all food produced for human consumption is lost worldwide. While in developing countries, even though people attempt to

make the best use of the food produced by them, it is reported that a significant quantity of the produce is lost in postharvest operations primarily as a result of a lack of knowledge, inadequate technology and/or poor storage infrastructure (Deepak and Prasanta, 2017). According to a report by APHLIS+ (2019), one-third (equivalent to 1.3 billion tons) of the food produced for human consumption is lost or wasted yearly; and global economic losses from this loss and waste amount to about US$940 billion annually, according to the FAO. Similarly, Oliver, (2020) reported that in countries (to which the study area belongs) characterized by poor infrastructure and tropical weather, wastage is as high as 40-50%; a stance corroborated by FAO, 2019. In line with the above submission, Ariong et al. (2023) submitted that "the annual cost of food loss and waste is significant, estimated at United States Dollars (USD) 680 billion in industrialized countries and USD 310 billion in developing countries". These losses are said to have a major impact on socio-economic and food security status, particularly for people in the developing world (APHLIS+2017). International attention on the issue of food loss and waste is firmly reflected in. The 2030 Agenda for Sustainable Development reflects the stand of the international community on the issue relating to food loss and waste by Targeting 12.3 of the Sustainable Development Goals (SDGs), through calls for the halving by 2030 of per capita global food waste at the retail, consumer levels and along production and supply chains, PHL included (FAO, 2019). In addition, the African Union Member States have indeed set the ambitious target under the Malabo Declaration of reducing by 50% overall food PHL by 2025 (Stathers et al., 2020 in Daniele et al., 2022), this study becomes critical to provide insight into appropriate policy directions towards achieving this, particularly as it relates to cowpea production in Nigeria and the study area in particular. The importance of this study further stemmed from the report of FAO (2019) that It is forecasted that "a growing population and rising incomes will lead to an increase in demand for agricultural products by 35–50 percent between 2012 and 2050, exerting even more pressure on the world's natural resources. This emphasizes the urgency of reducing food loss and waste".

In developed countries, cowpea is mostly grown commercially under irrigation and with fertilizers and applied pesticides, while in developing countries it is mostly grown on smallholder farms as a rained subsistence crop, with little to no fertilizer or insecticide input, as well as commonly as an intercrop with maize or other grains, which can lower yield rates. The differences are notable in terms of yield: in the United States, the 2017 yield rate for cowpeas was 1,700 kg/ha compared to 902 kg/ha in Nigeria and just 464 kg/ha in Uganda (FAOSTAT, 2019).

Food and Agriculture Organization (FAO, 2017) indicate that the West Africa sub-region produced about 81% (4,525,891 metric tons) of the global production of cowpea (5,589,216 metric tons) in 2014. Nigeria's production of 2,137,900 metric tons for the same period accounted for 38.3% and 47.2% of global and West African production, respectively. Consequently, Nigeria has remained the largest producer of the commodity globally despite the fall in production of about 58.5% between 2012 and 2016 which was largely attributed to insurgency in the Northern part of the country which dislodged many farmers from their farms. Katsina, Kano, Jigawa and Borno are notable States in cowpea production in northern Nigeria. However, in these States cowpea yield has been on the decline due to some problems such as outdated farming practices that often result in post-harvest losses, parasitic weeds, and insect pest before and after harvest, diseases as well as drought (FAO, 2017); and most recently, security challenges in form of insurgency and banditry in the Northern part of the country where the grain is majorly produced.

Nigeria is a great country in Africa endowed with the supply of different crops such as cereal, vegetables, oil & pulses, spices, roots and tuber as well as legumes. However, most of these crops begin to lose in the field before harvesting, during harvest and after separation from parent plants or uprooted from the ground (Omotesho et al., 2015). In African countries, Nigeria produces different agricultural products but post-harvest losses are a great concern. Because the majority of farm produce particularly cowpea is lost due to insect pest attacks, diseases, rodents, and improper post-harvest management practices (Bolarin, and Bosa, 2015). Losses of farm produce also occur during harvesting, handling, assembling, transporting, packaging, processing, and storage (Akintobi et al., 2018). Roughly one-third of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tons per year (Ahmed et al., 2015). Post-harvest loss is one of the major concerns of food

security and poverty reduction strategies in many developing countries including Nigeria. The magnitude of post-harvest loss in the food supply chain varies considerably among different crop produce and economies. In developing countries, a significant amount of produce is lost in post-harvest operations due to lack of knowledge, inadequate technology and/or poor storage facilities. In the light of the forgone, this study specifically identified the stages and causes of post-harvest loss; as well as the determinants of post-harvest loss among cowpea farmers in Kurfi local government of Katsina State.

METHODOLOGY

An expo facto research design was adopted for the study. Purposive and multi-stage sampling techniques were adopted in the selection of respondents. In the first stage, one Agricultural Development Project zone in Katsina State (ADP) out of three zones (namely Ajiwa zone1, Funtua zone2, and Dutsin-Ma Zones3) was purposively selected. In the second stage, five communities or villages from Kurfi local Government Area in Dutsin-Ma zone were randomly selected, and these include Kaware, Rawayau, Barkiya, Kaguwa, and Tsauri. In the third stage, cowpea farmers' associations were identified and confirmed having a total of 200 populations of cowpea farmers from the five villages. The fourth stage involves a determination of the sample size. Based on the reconnaissance survey conducted, it was established that the population size of cowpea farmers in the study area is 200 and after being fed into the RAOSOFT calculator at 95% confidence level, 5% margin of error and 50% response distribution, a sample size of 132 was generated. The fifth stage was the proportionate distribution of the sample size to the five selected villages using the relation:

$$x = X/_N \times n \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

where; x = number of respondents to be selected proportionately per village; X = number of cowpea farmers per village; N = total number of cowpea farmers in the selected villages; n = sample size for the study

Table 1. Sample Frame and Sample Size.

S/N	Name of Villages	Number of Cowpea Farmers(X)	Number of Respondents Selected(x)
1	Kaware	50	50/200 x 132 = 33
2	Rawayau	30	30/200 x 132 = 20
3	Barkiya	35	35/200 x 132 = 23
4	Kaguwa	40	40/200 x 132=26
5	Tsauri	45	45/200 x 132 =30
Total		200	132

The primary data was collected through structured questionnaires. The latter was validated through face validity and close examination of the research instrument by a team of professionals and experts in the field of agricultural extension and administrators here at the federal university Dutsinma, Nigeria for them to ascertain the strength of the instrument to measure the highlighted issues regarding post-harvest lost among cowpea farmers, as well as the degree to which it conveyed the intended meaning to the sampled farmers. The reliability, on the other hand, was established through a pre-test of the instrument carried out in neighbouring Zamfara State Nigeria using the split-half method of reliability. A high-reliability coefficient of 0.86 was obtained indicating good and desirable consistency of the instrument; and according to Kuder and Richardson (1937), a reliability coefficient that is not less than 0.85 shows that the instrument is highly consistent and reliable.

Descriptive statistics were used to achieve the objective of the study. Probit analysis was used for the inferential statistic. The Probit model is specified as follows:

$$Yj = \alpha + \beta j \sum_{i=1}^{n} Ij + \mu j \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where; Y is the dependent variable

Y_1 = winnowing; Y_2 = packaging; Y_3 = transportation; Y_4 = assembling

α and βj are parameters of the estimates

n = number of variables

μ_j = Error term

I_1 – I_{10} are the independent variables

I_j = the explanatory/independent variables specified below; where $_j$ = 1, 2, 3 …………n

Therefore,

I_1= Age; I_2= Gender; I_3= Marital status; I_4= level of Education; I_5= Household size; I_6= Farm size; I_7= Experience; I_8= Subsistence cropping; I_9= Commercial cropping; I_{10}= Access to extension services

Stages of post-harvest losses

The result in Table 2 shows that the majority of the respondents (76%) recorded losses at the winnowing stage, with 38% recording losses during transportation while the least (as depicted by 7% of the respondents) recorded losses at the packaging stage. Deepak (2014) and Agatha (2020) also established that soybean farmers experience losses at the winnowing, transportation and packaging stages. FAO (2011) also showed that in Sub-Saharan Areas, the major losses of food occurred after harvest and assumed the losses at each stage to include 6% at harvesting; 8% at postharvest handling and storage; 3.5% at processing and packaging stage etc. These imply that the loss of cowpea grain at the winnowing stage is a general phenomenon in the study area.

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Table **2.** Stages of post-harvest losses.

Stages	Frequency	Percentage
Winnowing	100	76
Packaging	9	7
Transportation	37	28
Assembling	10	8
Total	156	119

Causes of post-harvest losses at each stage

Table 3 shows the causes of the post-harvest loss experienced by cowpea farmers at the various stages. At a winnowing stage, the results unveiled that the majority (57.6%) witness losses caused by wind while the least cause of losses here is rainfall. The result further reveals that bad roads (34.1%), crude means of transportation (42.4%) and poor packaging materials (37.1%) are responsible for post-harvest loss of cowpeas during shipment from one point to another. Use of animals (donkeys, camels, horses etc.), head load, bullock carts, trolleys and old worn-out vehicles coupled with bad feeder roads characterize most farming communities in Nigeria and these have been responsible for difficulties in transporting farm produce to markets or point of sale. As a result, loss becomes unavoidable during the transportation process. Other causes unveiled by the results as being the main causes of post-harvest loss as expressed by the majority of the respondents include rainfall (37.9%) at the assembly stage and poor packaging materials (57.6%) at the packaging stage (see table 6). These findings are supported by the assertion of Apurba et al (2019) that the level of postharvest losses can be influenced by several factors among which are exposure to temperature, rain, humidity, pest infestation, transport and poor processing and storage techniques. Furthermore, Sheahan and Barrett (2017) also observed that poor road, transport and marketing infrastructures throughout Sub-Saharan areas result in postharvest losses.

Factors influencing post-harvest losses among cowpea producers in Kurfi LGA

Table 4 shows the results of factors influencing the stages of post-harvest losses in the study area. The most identified stages that account for most post-harvest losses in cowpea production are: winnowing, packaging, transportation and assembling. Each of these stages was subjected to Probit regression analysis as shown in the table.

In the Probit model using winnowing as a dependent variable; the results reveal that two variables were established to be significant factors influencing post-harvest loss at the winnowing stage in the study area. These significant variables were: household size ($Z=0.042$, $p < 0.081$); and subsistence farming ($Z=0.729$, $p < 0.017$). This denotes that post-harvest loss at the winnowing stage in the study area has a direct relationship with household size and subsistence farming implying further that an increase in these parameters will likely increase post-harvest losses at the winnowing stage of post-harvest process due to their positive coefficient. The results reveal that the parameter of household size was statistically significant

at 10% with a negative coefficient (-0.042) to post-harvest loss at the winnowing stage. This significance means that as the household size increases by a unit, there is a marginal decrease in the loss of cowpea at the winnowing stage by 0.042, suggesting that a large family size would mean a decrease in loss at the winnowing stage perhaps because more hands will make the winnowing activity easier, faster and less boredom. Furthermore, the parameters of subsistence farming were positive (0.729) and significant at a 5% level of probability.

This indicates that subsistence farming encourages post-harvest losses at the winnowing stage. It suggests that farmers whose mode of production is subsistence farming are bound to experience losses at the winnowing stage of post-harvest activities.

Table 3. Causes of post-harvest losses at each stage

	Frequency	Percentage
Causes at the Winnowing stage		
Equipment used	36	27.3
Wind	76	57.6
Rainfall	14	10.6
Theft	29	22.0
Causes at the Transportation stage		
Bad road	45	34.1
the crude mean of transportation	56	42.4
Poor packaging material	49	37.1
Causes at the Assembling stage		
Assembling on bare ground	36	27.3
Sunlight	34	25.8
Rainfall	50	37.9
Theft	40	30.3
Causes at the Packaging stage		
Poor packaging materials	76	57.6
Theft	22	16.7
Spillage	48	36.4

Furthermore, Table 8 shows the Probit model using packaging as the dependent variable. Two variables were established to be factors that significantly influence post-harvest losses at the packaging stage. These variables were: household size ($Z= -2.08$, $p<0.037$); and extension visit ($Z= -1.73$, $p < 0.084$). This result indicates a negative relationship and suggests post-harvest loss tends to decrease at the packaging stage as the number of extension visits and household size increase. An increase in extension visits enables the extension agents to have close monitoring of the activities of the farmers and would therefore advise promptly and appropriately. In addition, as the number of households becomes sizable, the household head would be in a position to effectively monitor the activities of every household member during the packaging and in the long run check the possibilities of losses. These findings, therefore, suggest that extension visits should be increased in the study area to prevent or significantly reduce the loss of cowpeas at packaging. The findings further suggest that engaging a few hands from the household helps to significantly reduce post-harvest losses during the packaging process.

In addition, by considering the transportation stage as the dependent variable, Table 8 further revealed that one variable was found to be a significant determinant for post-harvest loss during transportation of farm produce by farmers in the study area. The variable is extension visit ($Z= 1.80$, $p < 0.072$) and positively influences post-harvest loss during transportation, indicating that as extension visits increase, losses during transit of farm produce also increase in the study area. This may suggest that such visits do not impact positively on losses during transit as the extension

agents may not be aware of such losses to advise appropriately.

Finally, the table shows the Probit model considering assembling as the dependent variable. Three variables were established to be factors that considerably influence -post-harvest losses among cowpea farmers in the study area. These variables were: subsistence farming (Z=-2.03, p<0.043); commercial farming (Z=-2.01, p <0.045); and financial support (Z=-2.14, p <0.032). These indicate that as more farmers practice subsistence and commercial farming as well as get financial support, the less the probability that they would experience loss during the assembling of their cowpea produce. This suggests that enhanced financial status probably assists the farmers to be able to procure the necessary inputs such as good assembling materials. It further suggests that farmers who practice commercial farming in the study area tend to be well equipped to curtail losses at the assembling stage just as subsistence farmers also exercise great care at this stage of production to minimize losses. Apurba et al. (2019) reported that socioeconomic factors influence postharvest losses at different stages of commodity value chains. Current literature reviews such as Affognon et al. (2015) also emphasize the importance of understanding at what stages in the value chain losses occur and what socioeconomic factors influence such losses.

Table 4. Factors influencing post-harvest loss among cowpea farmers in Kurfi LGA, Katsina State.

	Winnowing	Packaging	Transporting	Assembling
Parameter	Est (S.E)	Est (S.E)	Est (S.E)	Est (S.E)
Age	-040(.025)	060(.028)	016(.024)	0.006(.027)
Gender	399(.721)	0(omitted)	-380(.634)	0.516(.951)
Marital Status	-513(.574)	-480(.724)	-297(.491)	-.224(.742)
Level of Education	-001(.095)	.159(.150)	-015(.093)	-139(.136)
Household	-042(.024)***	-071(.034)**	-028(.023)	0.040(.034)
Farm size	-006(.126)	150(.172)	.023(.123)	195(.166)
Experience	.034(.028)	-051(.035)	.003(.027)	-044(.031)
Extension visits	.060(.211)	-418(.242)***	.370(.206)***	-0.275(.282)
Subsistence farming	.729(.305)**	-157(.394)	.193(.302)	-0.840(.414)**
Commercial farming	.163(.472)	-501(.665)	-367(.488)	-1.48(.736)**
Support	047(.286)	301(.388)	017(.281)	-1.06(.495)**
Pseudo R^2	0.0932	0.1504	0.0943	0.1479
LRChi^2(7)	13.78	10.38	15.04	13.18
Prob > Chi^2	0.2457	0.2603	0.1808	0.2820
Log Likelihood	-67.1	-35.0	-72.2	-37.9

Source: Computation from Computer Printout of Probit Regression Analysis. Note: *, ** and ***means 1%, 5% and 10% level of significance respectively

CONCLUSION

The study showed that the majority of cowpea farmers experience losses during winnowing and in the course of transit. Furthermore, the wind was the main cause of loss at the winnowing stage as poor means of transportation were chiefly responsible for losses during the transportation of cowpeas. Similarly, poor packaging materials were attested by the majority of the farmers to be responsible for cowpea loss at the packaging stage. The findings further indicate that household size significantly and indirectly influences post-harvest loss during winnowing while the practice of subsistence farming has a significant and direct relationship to the variable at this stage. The results also indicate a significant and indirect relationship between post-harvest loss and household size as well as visits by extension agents at the packaging stage; just as it was also established that the practice of commercial agriculture and access to financial support have a significantly indirect relationship with post-harvest loss at the assembly stage. To check post-harvest loss of cowpeas, it is therefore recommended that farmers are encouraged to target moderate wind periods and engage plenty of hands from the family labour for their winnowing activities as well as use good and durable packaging materials. This will be enhanced if the farmers are well supported financially and encouraged to operate at commercial rather than subsistence levels. In

line with this, the government should come up with necessary policies that would facilitate easy access to credit facilities for cowpea farmers in general; and also evolve training programmes that would enhance the production capacity of these farmers to enable them to be well-equipped with requisite capacity to expand the scope of production into commercial status. The government should work towards bridging the gap created by an acute shortage in extension personnel in the area as this study as established the relevance of access to extension services as a necessity for combating the menace of PHL among cowpea farmers in the area. more so, these extension agents should be updated with the findings of studies like this to serve as a guide in their enlightenment programmes towards maximizing farmers' output through avoidance of losses and waste.

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REFERENCES

Affognon, H., Mutungi, C., Sanginga, P. and Borgemeister, C. 2015. Unpacking postharvest losses in subSaharan Africa: A meta-analysis. World Development, 66: 49–68.

Agatha, A. 2020. The literature review of post-harvest loss mitigation as a method for sustainable agriculture.

Ahmed, B.O., Adeniyi, K.M., and Lawal, A.O. 2015.food security and post-harvest losses in fruit marketing in Lagos metropolis, Nigeria: Journal of Agriculture and Food Sciences, 3(3): 52-58.

Akintobi, O.S., Evinemi, C.A. and Achagwa, S. M. 2018. Analysis of the problems associated with cowpea storage among farmers in Kuje area council, federal capital territory Abuja, Nigeria. FUDMA Journal of Agriculture and Agricultural Technology, 4 (1): 91- 98.

APHLIS, 2017. Estimating nutritional postharvest losses – the Nutri-P-Loss project. 27th July. https://www.aphlis.net/en. Retrieved online on the 28th of October, 2023.

APHLIS, 2019. Postharvest losses and the road to food security. 2nd September. https://www.aphlis.net/en. Retrieved online on the 28th of October, 2023.

Apurba, S., Sarah, M., Eria S., Tanya, S., Aurelie, B. and Ben, B. 2019. Determinants of postharvest losses along smallholder producers maize and Sweetpotato value chains: an ordered Probit analysis. Food Security, 11:1101–1120.

Ariong, R.M., Okello, D.M., Otim, Michel H. O and Pamela, P. 2023. The cost of inadequate postharvest management of pulse grain: Farmer losses due to handling and storage practices in Uganda. Agriculture and Food Security, 12 (20): 1–22

Bolarin, F. M and Bosa, S. O. 2015. Post- Harvest Losses: A Dilemma in Ensuring Food Security in Nigeria: Journal of Natural Sciences Research, 5(7).

Deepak, K. and Prasanta, K. 2017. Reducing Postharvest Losses during Storage of Grain Crops to Strengthen Food Security in Developing Countries. Foods, 6(8): 1–22

Deepak, S, 2014. Empirical Assessment of Pre- and Post-Harvest Losses of Soybean Crop in Maharashtra. journal of the Gokhale Institute of Politics and Economics, 3: 307-317

FAOSTAT, 2019. Crops Retrieved April 5, 2019, from http://www.fao.org/faostat/en/#data/QC. Retrieved online on the 20th of October, 2021 FAO, 2011. Global Food Losses and Food Waste: Extent, Causes and Prevention. FAO, Rome, Italy. 38pp.

FAO, 2019. The state of food and Agriculture: Moving forward on food loss and waste reduction. FAO, Rome, Italy, pp xii. https://creativecommons.org/licenses/by-ncsa/3.0/igo).

FAOSTAT, 2019. Crops Retrieved April 5, 2019, from http://www.fao.org/faostat/en/#data/QC. Retrieved online on the 20th of October, 2021

FAO, 2017. Rome, Available at http://www.fao.org/faostat/en/#data/

FAO, IFAD, UNICEF, WFP and WHO, 2018. The state of food security and nutrition in the world 2018: Building climate resilience for food security and nutrition. FAO: Rome.

Kuder, G. F. and Richardson, M. W. 1937. The theory of the Estimation of test Reliability. Psychometrika, 2(3):151-160.

LAW, M. and KIM, S. 2005. Specialization and regulation: The rise of professionals and the emergence of occupational licensing regulation. Journal of Economic History, 65:723-756.

Oliver, O. O. 2020. Postharvest Losses: Key Contributor to Food Insecurity and Possible Interventions. Future African Forum. https://forum.futureafrica.com/postharvestlosses-key-contributor-to-food-insecurity-andpossible-interventions/

Omotesho, K. F., I. Ogunlade and O. E. Ayinde. 2015. Analysis of farmers' perception of the accountability of agricultural extension services in Oyo State, Nigeria. Sarhad Journal of Agriculture, 31(2): 94-100.

Sheahan, M. and Barrett, C. B. 2017. Review: Food loss and waste in sub-Saharan Africa. Food Policy, 70: 1–12.

World Bank, NRI, FAO, 2011. Missing food: The case of post-harvest grain losses in sub-Saharan Africa. In: Economic sector work report no. 60371-AFR. World Bank, Washington, DC.