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Post-Harvest Spoilage Losses and Shelf-Life Outcomes Among Aquaculture and Crop Farmers in Lagos State, Nigeria: Associations with Storage Infrastructure, and Extension Access

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Abstract

This study assessed self-reported post-harvest spoilage losses and achieved shelf-life categories among 240 aquaculture and crop farmers in Lagos State, Nigeria, and examined their unadjusted associations with storage-point electricity access and recent extension contact. The study used a cross-sectional survey dataset and descriptive statistics, as well as Pearson chi-square tests. Provisionally recoded responses indicated that 59.6% of respondents reported spoilage losses of 5–10%, 17.9% reported 11–20%, and 7.1% reported losses above 20%; 56.3% classified achieved shelf life as short, and 5.8% as very short. Unreliable electricity was reported by 62.5% of respondents, and no electricity by a further 15.8%. In the initial unadjusted tests, electricity-access and extension-contact categories were associated with the reported outcomes ($p < 0.001$). These associations are exploratory rather than causal: the outcomes are self-reported, some contingency-table cells are sparse, and the source file contains date-like strings that appear to be spreadsheet-converted response categories. Those labels must be verified against the original questionnaire and data-entry records before the inferential results are accepted. The observed patterns nevertheless point to the importance of commodity-appropriate storage infrastructure, practical post-harvest extension, and validated outcome measurement. The study offers a preliminary outcome-focused analysis of post-harvest storage among mixed farming groups in an urban Nigerian setting; confirmation of the category coding and adjusted analysis is required before the findings are used for policy or publication claims.

Keywords: *post-harvest losses; spoilage; shelf life; electricity access; extension contact; aquaculture; crop farmers; Lagos State.*

1. Introduction

Post-harvest loss can involve deterioration in quantity, quality, marketability and the economic value of agricultural products. Reviews of food loss in sub-Saharan Africa stress that losses are heterogeneous across commodities and value-chain stages and that interventions must be assessed against their actual objectives and local conditions (Sheahan & Barrett, 2017; Affognon et al., 2015; Ariong et al., 2023). Fresh fish is highly perishable and typically requires rapid chilling, icing or another effective preservation method; evidence from Nigeria and other African settings identifies inadequate handling, lack of ice, limited storage facilities and transport constraints among important loss factors (Akinneye et al., 2018; Abelti & Teka, 2024; the Ghanaian Marine Policy study, 2020). Crop products differ in moisture content, respiration, sensitivity to bruising, pest exposure and storage requirements. Therefore, assessing storage outcomes requires attention not only to routine practices but also to reported losses and the shelf life farmers achieve.

Storage outcomes depend on technical practices and enabling conditions. Electricity can support refrigeration and ice production, while extension services may help farmers recognize deterioration risks and apply appropriate methods. Evidence on fish post-harvest losses in Ghana and sub-Saharan Africa highlights the importance of ice, preservation facilities, handling, and transport (Akande & Diei-Ouadi, 2010; Abelti & Teka, 2024). Awolumate and Inyang (2020) likewise identified power-supply inadequacy, processing-facility

limitations, skills, and finance among constraints to value addition in commercial aquaculture. For crops, conventional storage may leave grain vulnerable to insects, mould, and moisture-related deterioration (Manandhar et al., 2018; Sheahan & Barrett, 2017).

Research on fish value chains in Nigeria offers a complementary economic and technological perspective. Awolumate et al. (2022) examined profitability and challenges among smoked and dried fish marketers in Lagos State, while Awolumate and Muyiwa (2025) examined financial constraints among small-scale roadside fish processors. Agbo and Awolumate (2024) compared oven drying, sun drying, and freezing in relation to the nutrient composition of African catfish, illustrating that preservation methods can produce different product-quality outcomes. Awolumate et al. (2026) further examined natural antioxidant treatments to improve the oxidative stability and sensory quality of hot-smoked fish. These studies establish the relevance of preservation choices and enterprise constraints, but they are not direct measurements of the spoilage-loss rates reported by the present sample.

A related article based on this survey examined behavioural and infrastructural determinants of storage behaviour among aquaculture and crop farmers in Lagos State (Amos & Awolumate, 2026). The present manuscript focuses instead on self-reported spoilage-loss and shelf-life outcomes and their unadjusted associations with electricity access and extension contact. It asks: (1) what spoilage-loss and shelf-life categories did respondents report; (2) how were these outcomes distributed by electricity access; and (3) how were they distributed by extension contact?

2. Materials and Methods

2.1 Study design and data source

The study used a cross-sectional survey of 240 respondents engaged in aquaculture, crop production, or both activities in selected communities in Lagos State. The source project identifies Ikorodu, Epe and Kosofe Local Government Areas. This observational design supports description and association, not causal inference.

2.2 Measures and coding

The outcomes were self-reported percentage of produce lost to spoilage (<5%, 5–10%, 11–20%, 21–30%, and >30%) and achieved shelf life (very short, short, moderate, long). Explanatory variables were electricity at the storage point (reliable, unreliable, none), extension visits in the preceding six months (none, one to two, three or more), and farming type (aquaculture, crop, both). The CSV contains date-like strings that appear to be spreadsheet conversions of category labels. “05-Oct” was interpreted as 5–10%, “Nov-20” as 11–20%, and “01-Feb” in the extension variable as one to two visits. These interpretations must be checked against original data-entry records before submission.

2.3 Analysis

Frequencies and percentages were calculated. Pearson chi-square tests of independence assessed unadjusted associations between electricity access, extension contact, and each outcome, as well as farming type and each outcome. The significance threshold was $p<0.05$. Sparse cells may render asymptotic chi-square p-values unreliable; exact or Monte Carlo tests and adjusted ordinal models should be considered after validating the coding.

3. Results

3.1 Respondent profile and enabling conditions

Crop farmers accounted for 38.8% of respondents (93/240), aquaculture farmers for 30.0% (72/240), and respondents engaged in both activities for 31.3% (75/240). Reliable electricity was reported by 21.7% (52/240), unreliable by 62.5% (150/240), and no electricity by 15.8% (38/240). Extension contact was reported as one to two visits by 58.8% (141/240), three or more visits by 28.8% (69/240), and no visits by 12.5% (30/240).

Table 1. Respondent farming type, electricity access, and extension contact

Variable	Category	n	%
Farming type	Aquaculture	72	30.0
	Crop	93	38.8
	Both	75	31.3
Electricity	Reliable	52	21.7
	Unreliable	150	62.5
	No access	38	15.8
Extension visits	None	30	12.5
	1–2 visits	141	58.8
	3 or more visits	69	28.8

3.2 Spoilage losses and shelf-life outcomes

The most common spoilage-loss category was 5–10%, reported by 143 respondents (59.6%). A further 43 respondents (17.9%) reported 11–20%; 37 (15.4%) reported less than 5%; eight (3.3%) reported 21–30%; and nine (3.8%) reported above 30%. Thus, 25.0% reported losses of 11% or more. For shelf life, 135 respondents (56.3%) selected "short", 74 (30.8%) "moderate", 17 (7.1%) "long", and 14 (5.8%) "very short". These are self-reported categories, not independently measured physical loss rates or elapsed shelf-life durations.

Table 2. Self-reported spoilage-loss and shelf-life categories

Outcome	Category	n	%
Spoilage loss	<5%	37	15.4
	5–10%	143	59.6
	11–20%	43	17.9
	21–30%	8	3.3
	>30%	9	3.8
Shelf life	Very short	14	5.8
	Short	135	56.3
	Moderate	74	30.8
	Long	17	7.1

3.3 Electricity access and outcome

Spoilage-loss category was associated with electricity access in the unadjusted cross-tabulation (χ^2=103.90, df=8, p<0.001). The shelf-life category was also associated with electricity access (χ^2=80.92, df=6, p<0.001). The pattern was not monotonic. In particular, the reliable-electricity group had a large count of "short" shelf-life responses. This counterintuitive result could reflect differences in commodities handled, subjective interpretation, or coding/measurement problems; it is not evidence that reliable electricity reduces shelf life.

Table 3. Spoilage-loss category by electricity access (counts)

Electricity	<5%	5–10%	11–20%	21–30%	>30%	Total
Reliable	4	38	9	1	0	52
Unreliable	16	99	33	1	1	150
No access	17	6	1	6	8	38

Table 4. Shelf-life category by electricity access (counts)

Electricity	very short	short	moderate	long	Total
Reliable	2	47	3	0	52
Unreliable	6	75	64	5	150
No access	6	13	7	12	38

3.4 Extension contact and outcomes

Extension-contact category was associated with spoilage-loss category (χ^2=97.24, df=8, p<0.001) and shelf-life category (χ^2=53.55, df=6, p<0.001). Respondents reporting no extension visits showed a dispersed loss distribution, including six respondents reporting 21–30% losses and six reporting losses above 30%. The three-or-more-visit group contained 19 respondents reporting losses below 5%, compared with seven in the one-to-two-visit group. These patterns do not demonstrate that extension visits caused lower losses: the analysis is cross-sectional and does not adjust for commodity, resources or other possible confounders.

Table 5. Spoilage-loss category by extension contact (counts)

Extension visits	<5%	5–10%	11–20%	21–30%	>30%	Total
None	11	6	1	6	6	30
1–2 visits	7	104	26	2	2	141
3 or more visits	19	33	16	0	1	69

Table 6. Shelf-life category by extension contact (counts)

Extension visits	very short	short	moderate	long	Total
None	2	12	6	10	30
1–2 visits	3	93	39	6	141
3 or more visits	9	30	29	1	69

3.5 Differences by farming type

Farming type was associated with spoilage-loss category (χ^2=34.81, df=8, p<0.001) and shelf-life category (χ^2=78.14, df=6, p<0.001). Aquaculture respondents were concentrated in the 5–10% spoilage category (54 of 72), while the mixed-farming group accounted for 8 of 9 observations in the >30% category. For shelf life, 61 of 72 aquaculture respondents selected "short". Since mixed farmers may handle commodities with different storage requirements, these findings require commodity-specific follow-up rather than a simple ranking of farming groups.

Table 7. Spoilage-loss category by farming type (counts)

Farming type	<5%	5–10%	11–20%	21–30%	>30%	Total
Aquaculture	4	54	14	0	0	72
Crop	21	50	19	2	1	93
Both	12	39	10	6	8	75

Table 8. Shelf-life category by farming type (counts)

Farming type	very short	short	moderate	long	Total
Aquaculture	0	61	11	0	72
Crop	11	56	24	2	93
Both	3	18	39	15	75

4. Discussion

Most respondents reported spoilage losses of 5–10%, but one quarter reported losses of 11% or more, and 62.1% described the achieved shelf life as short or very short. These self-reported categories should not be equated with independently measured loss rates. Nevertheless, the broad pattern is consistent with research documenting persistent post-harvest losses across African food systems and the role of handling, storage, and infrastructure (Sheahan & Barrett, 2017; Abelti & Teka, 2024). Storage options need to match commodity characteristics and local conditions; grain-storage reviews also emphasize that improved systems may be constrained by cost and practical suitability (Manandhar et al., 2018).

Electricity access was associated with both reported outcomes, but the counterintuitive distribution of shelf life among respondents reporting reliable electricity cautions against a causal interpretation. Electricity is only one element of storage capacity; access to ice, insulated containers, cold rooms, appropriate crop structures, transport and maintenance may also matter. Farmers with reliable power may handle more perishable products, or respondents may interpret "short shelf life" differently. The available survey does not distinguish these explanations.

Extension contact was also associated with outcome categories, but contact frequency does not measure the quality, relevance or uptake of advice. Extension agents may visit farmers who already experience serious storage problems, creating selection effects. Awolumate (2018) found that mobile phones and other information channels were used by fish farmers in Lagos to access aquaculture information, while noting barriers to effective ICT use. This supports the importance of accessible information channels, but does not establish a direct effect on the present study's self-reported storage outcomes. Evidence from Nigerian smallholder farming also links access to extension and information with technology adoption, although such evidence does not establish a direct effect on the present study's outcomes (Ikoyo-Eweto et al., 2024).

Awolumate et al. (2022) provide a locally relevant fish value chain perspective by examining profitability and challenges among smoked and dried fish marketers in Lagos State. Awolumate and Muyiwa (2025) examine financial constraints among small-scale fish processors in Lagos; Awolumate and Inyang (2020) document constraints to value-addition investment, including inadequate power supply and processing facilities. Agbo and Awolumate (2024) and Awolumate et al. (2026) add product-level evidence that drying, freezing, and antioxidant treatments are relevant to preservation and quality. Awolumate (2018) provides a complementary information-access perspective. These publications support

the broader relevance of preservation, infrastructure, and information constraints, but they should not be cited as direct validation of the spoilage rates in this sample. The present paper contributes a separate outcome-focused analysis.

The current manuscript uses the same survey as Amos and Awolumate (2026), whose paper focused on behavioral and infrastructural determinants of storage behavior. To avoid redundant publication, the current article focuses on the outcome distributions and their bivariate associations, and the shared dataset should be disclosed to the editor. Its distinct contribution depends on transparent data cleaning and validated outcome analysis.

5. Implications for Practice and Policy

i. Provide commodity-specific post-harvest guidance: fish farmers require rapid temperature management and hygienic handling, while crop farmers need methods matched to crop type, moisture, ventilation, and pest exposure.
ii. Strengthen practical extension through demonstrations and follow-up that assess farmers' ability to apply advice, rather than relying only on the number of visits.
iii. Improve access to appropriate shared infrastructure, including cooperative cooling options for fish and suitable drying, ventilation or pest-resistant storage for crops.
iv. Measure post-harvest outcomes more directly in future research, including quantities lost, storage duration, temperature/moisture where feasible, and marketable quality at the end of storage.
v. Validate category coding and preserve an auditable record of every data-cleaning decision before submitting the paper.

6. Limitations

The outcomes are self-reported categories rather than measured quantities or elapsed shelf-life durations. The cross-sectional design cannot establish causality. Chi-square tests are unadjusted, and some contingency cells are sparse, so p-values are exploratory. The sample combines aquaculture, crop, and mixed farmers with different storage requirements. The source file also includes a name field despite stated assurances of anonymity; it was excluded from analysis, but the data custodian should review the original consent and anonymization procedures before further sharing.

7. Conclusion

Among 240 aquaculture and crop farmers surveyed in Lagos State, 59.6% reported spoilage losses of 5–10%, 25.0% reported losses of 11% or more, and 62.1% described shelf life as short or very short. Electricity access, extension contact, and farming type were associated with reported outcome categories in unadjusted analyses. However, the counterintuitive shelf-life pattern in the reliable-electricity group and the date-like category coding require validation. The findings support commodity-appropriate storage infrastructure, practical extension, and improved outcome monitoring, but should be treated as exploratory until the data are checked and adjusted analyses are completed.

Data Availability Statement

The data derive from the 2026 Lagos State student research survey. A de-identified analytical dataset may be made available subject to the original consent conditions and institutional requirements. Personal identifiers should not be shared.

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Declarations

Conflict of Interest: The authors declare that they have no conflicts of interest or competing interests that could have influenced the conduct, analysis, interpretation, or reporting of this research.

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Ethics Approval and Informed Consent: This study involved a secondary analysis of an existing survey dataset collected from aquaculture and crop farmers in Lagos State, Nigeria. The ethics approval or exemption status of the original survey has not yet been verified from the available study records. The authors will confirm the applicable institutional ethics requirements and the informed-consent arrangements governing the original data collection and secondary analysis before publication.

Author Contributions: Amos O. A. contributed to the conceptualization of the original study, data collection, investigation, data curation, formal analysis, and preparation of the original manuscript draft. The author is responsible for reviewing and approving the final manuscript and accepting accountability for the integrity and accuracy of the research.

Both authors are responsible for reviewing and approving the final manuscript and accepting accountability for the integrity and accuracy of the research.

Related Publication and Dataset Disclosure: The present study draws on the same underlying Lagos State survey dataset used in the related publication by Amos and Awolumate (2026), titled *"From Knowledge to Practice: Behavioral and Infrastructural Determinants of Post-Harvest Storage Behavior among Aquaculture and Crop Farmers in Lagos State, Nigeria."*

Although both studies share a common dataset, they address distinct research questions and analytical objectives. The related publication examines behavioral and infrastructural determinants of post-harvest storage practices, whereas the present study focuses on self-reported spoilage-loss and shelf-life categories and their unadjusted associations with electricity access, agricultural extension contact, and farming type.

The present analysis, therefore, provides a separate outcome-focused examination of post-harvest storage conditions. The shared dataset and relationship between the manuscripts are disclosed to promote transparency, clarify the distinct analytical contributions, and support responsible scholarly publication.

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