

From Knowledge To Practice: Behavioural And Infrastructural Determinants Of Post-Harvest Storage Behaviour Among Aquaculture And Crop Farmers In Lagos State, Nigeria

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Abstract: This study examined the behavioral and infrastructural determinants of post-harvest storage behavior among aquaculture and crop farmers in Lagos State, Nigeria. Drawing on an integrated Knowledge–Attitude–Practice (KAP) and Theory of Planned Behavior (TPB) framework, the study used a convergent mixed-methods design. Primary data were obtained from 240 farmers in Ikorodu, Epe and Kosofe through structured questionnaires, open-ended responses and brief key-informant inputs. The source study reports a moderate level of storage knowledge, positive attitudes and high reported engagement in storage practices. The Knowledge Score Index is reported as 4.04 in the results table; the source narrative elsewhere reports 4.41, so the tabulated value of 4.04 is retained here for internal consistency. Multiple regression showed significant positive associations of knowledge ($\beta=0.051$, $p=0.001$) and attitude ($\beta=0.551$, $p<0.001$) with storage practices, while barriers were also positively associated with the practice index ($\beta=0.561$, $p<0.001$) and subjective norms were negatively associated ($\beta=-0.150$, $p<0.001$). The model explained 92.5% of the reported variance ($R^2=0.925$). Mediation analysis indicated a significant indirect effect of knowledge through perceived behavioural control (indirect effect=0.136; 95% CI 0.092–0.182), while moderation analysis showed a significant TPB-by-infrastructure interaction ($\beta=1.652$, $p<0.001$; $R^2=0.839$). The findings indicate that storage behaviour cannot be understood from knowledge alone: farmers' capacity to act and the availability of enabling infrastructure are central to

translating behavioural dispositions into practice.

Keywords: post-harvest storage; KAP; Theory of Planned Behaviour; perceived behavioural control; infrastructure; aquaculture; crop farmers; Lagos State.

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1.0 Introduction

Post-harvest management is a critical component of food-system performance because gains achieved during production can be undermined when harvested products deteriorate before consumption, processing or sale. The source study situates this challenge within tropical environments where temperature and humidity accelerate biological and chemical deterioration and where infrastructure and supply-chain limitations constrain storage options. In Lagos fish-value-chain settings, Awolumate et al. (2022) also identified operational and marketing challenges among smoked and dried fish marketers, supporting the need to connect storage behaviour with downstream handling and market performance.

In Lagos State, aquaculture and crop production coexist within a highly urbanised and market-oriented environment. Fish



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requires rapid preservation because deterioration begins soon after harvest, while crop products vary in perishability and may require drying, pest protection, ventilation, hermetic storage or processing. The source study argues that these differences occur alongside common constraints, including unreliable electricity, inadequate storage facilities, transportation challenges and limited access to technical support. Awolumate (2018) similarly showed that access to usable aquaculture information is an important consideration for fish farmers, reinforcing the relevance of information access and communication within storage and post-harvest decision-making.

A central issue is the gap between awareness and action. The study reports moderate knowledge, positive attitudes and relatively high reported storage practice scores, yet adoption of improved technologies remains constrained. This makes a behavioural explanation useful, but the evidence also indicates that behaviour is embedded in structural conditions. The KAP framework explains the cognitive and attitudinal dimensions of behaviour, while TPB adds subjective norms and perceived behavioural control. Infrastructure is treated as an enabling condition that can strengthen or weaken the translation of behavioural dispositions into actual practice.

This paper focuses on the integrated explanation provided by the source study: whether knowledge, attitude, barriers and subjective norms are associated with storage practice, whether perceived behavioural control provides a pathway between knowledge and practice, and whether infrastructure changes the strength of behavioural relationships.

1.1 Problem Statement and Objectives

The practical problem is not simply lack of awareness of storage methods. The source evidence shows that farmers can report favourable attitudes and frequent storage activities while still facing substantial constraints to improved technology adoption. Unreliable electricity affected 78.3% of

respondents: 62.5% reported unreliable access and 15.8% reported no electricity. This creates a particularly important constraint for refrigeration and cold storage and also affects the feasibility of some modern crop-storage systems.

The objective of this paper is to explain post-harvest storage behaviour through the joint contribution of behavioural and structural factors. Specifically, it examines: (i) the level and pattern of storage knowledge; (ii) the association of knowledge, attitude, barriers and subjective norms with storage practices; (iii) the mediating role of perceived behavioural control; and (iv) the moderating role of infrastructure.

The reviewed literature supports a conceptual distinction between knowing, intending and being able to act. Knowledge can improve awareness, but attitudes, social influence and perceived control affect whether knowledge is translated into practice. Structural conditions such as electricity, storage facilities, finance and transport can further condition the feasibility of recommended practices. This synthesis provides the basis for the study's empirical focus on knowledge, attitude, barriers, subjective norms, perceived behavioural control and infrastructure as interrelated determinants of post-harvest storage behaviour. This information dimension is particularly relevant to aquaculture, where Awolumate (2018) documented the importance of accessible information sources among fish farmers.

2.0 Literature Review

Empirical evidence reviewed in the source project indicates that storage behaviour is multidimensional. Adebayo and Iweala (2021) linked adoption of improved agricultural technologies with education, extension contact and income, while Akinbile et al. (2022) emphasized knowledge and adoption relationships. Olaoye, Adebayo and Adeyemo (2023) document post-harvest loss concerns in Nigerian fish-production systems, and Tadesse (2022) shows that knowledge and perceived risk can influence adoption of improved storage practices. Teng



and Wang (2022) demonstrate the relevance of TPB constructs to agricultural technology adoption, while Sutrisno, Rahman and Yusuf (2023) argue that integrating KAP and TPB can improve explanation of agricultural adoption behaviour. Taken together, the literature leaves several gaps: many studies are commodity-specific; behavioural and structural factors are often examined separately; evidence from Lagos' urban and peri-urban agricultural systems is limited; and comparatively little attention is given to how infrastructure interacts with knowledge, attitude, perceived control and actual storage behaviour. This study addresses these gaps by examining aquaculture and crop farmers within one integrated KAP–TPB framework and explicitly testing mediation and moderation relationships.

2.1 Empirical Evidence and Research Gap

KAP and TPB address complementary dimensions of storage behaviour. KAP highlights knowledge, attitudes and observable practice, whereas TPB adds social influence and perceived control. The source project therefore treats infrastructure as a contextual condition that can strengthen or weaken the translation of behavioural readiness into practice. This is consistent with the wider adoption literature, which recognizes that technology use depends not only on individual preferences but also on access to complementary assets and services (Doss, 2006; Feder et al., 1985). Infrastructure includes electricity, cold rooms, storage structures, transport, equipment and market facilities. The source study's focus on infrastructure is especially relevant in Lagos because unreliable electricity can directly constrain cooling and other energy-dependent storage practices.

2.2 Integrating KAP, TPB and Infrastructure

Ajzen's (1991) Theory of Planned Behaviour provides an additional explanation of behaviour through attitudes, subjective norms and perceived behavioural control. Attitude captures the individual's evaluation of the behaviour, subjective norms represent

perceived social expectations, and perceived behavioural control concerns the individual's assessment of whether the behaviour is feasible given available resources and constraints. Ajzen (2020) further clarifies the role of perceived control in explaining behavioural performance. In agricultural technology adoption, Teng and Wang (2022) report that TPB constructs help explain adoption decisions, while the source project places particular emphasis on perceived behavioural control because storage technologies require skills, equipment, finance, and enabling infrastructure.

2.3 Theory of Planned Behaviour and Perceived Behavioural Control

The Knowledge–Attitude–Practice framework provides a useful starting point for examining behavioural change. Knowledge represents what farmers know about storage requirements, causes of deterioration and recommended technologies; attitude reflects their evaluation of the usefulness, cost, convenience and benefits of improved practices; and practice captures what farmers actually do. WHO (2018) describes KAP surveys as a structured way of examining these behavioural dimensions. In agricultural settings, however, knowledge does not necessarily translate directly into practice. The source project reports knowledge gaps in technically demanding areas such as humidity, evaporative cooling and temperature management, while reported attitudes toward improved storage were generally favourable. Glanz, Rimer and Viswanath (2020) note the broader limitation of treating knowledge as sufficient for behavioural change because behaviour is also shaped by social, economic and environmental conditions.

2.4 Knowledge–Attitude–Practice Perspective

The literature identifies behavioural, socioeconomic, institutional and structural determinants of post-harvest storage. Education, extension contact, income and access to information can influence farmers' capacity to understand and use improved



technologies (Adebayo & Iweala, 2021; Akinbile et al., 2022). Technology adoption research also cautions that observed adoption is not explained by awareness alone because farmers compare expected benefits, costs, risks and feasibility when making decisions (Doss, 2006; Feder et al., 1985). Extension can reduce information and skill constraints when it provides relevant technical guidance and practical demonstrations (Anderson & Feder, 2007). Financial and infrastructure constraints may nevertheless prevent farmers from implementing recommended practices even when information is available.

2.5 Determinants of Storage Behaviour

The storage requirements of aquaculture and crop products differ, although both are affected by infrastructure, technical knowledge and market conditions. Fish and other aquatic products are highly perishable and require rapid cooling, icing, freezing or processing. Kitinaja (2013) identifies cold-chain development as an important pathway for reducing deterioration in developing-country food systems, while the source project reports that unreliable electricity and limited storage facilities constrain fish preservation in Nigeria. Crop products have more heterogeneous storage requirements. Grain crops require protection from moisture, insects and contamination, whereas fresh vegetables and other horticultural products may require temperature, humidity and ventilation management. Kumar and Kalita (2017) show that inappropriate grain-storage conditions can substantially increase losses. In Lagos, where aquaculture and crop production coexist within urban and peri-urban systems, farmers therefore face commodity-specific technical requirements alongside shared infrastructural and logistical constraints. For fish preservation specifically, Awolumate et al. (2024) demonstrated that processing conditions can affect microbial load and water-holding capacity of tilapia, underscoring the importance of technically appropriate post-harvest handling rather than storage frequency alone.

2.6 Aquaculture and Crop Storage Contexts

Post-harvest storage behaviour refers to the decisions and actions farmers take to preserve the quantity, quality and market value of produce after harvest and before sale, processing or consumption. It includes selection of storage methods, handling, environmental control, monitoring, preservation and the timing of sale. The literature treats storage as a critical part of food-system performance because gains in production can be partly lost when harvested products deteriorate during handling and storage. Hodges, Buzby and Bennett (2011) emphasize that post-harvest losses represent both a food-security problem and an inefficient use of production resources. FAO (2011, 2023) similarly places loss reduction within the broader objective of improving food availability and resource efficiency.

2.7 Conceptual and Theoretical Framework

The analytical framework combines KAP and TPB. KAP provides the cognitive sequence through which knowledge and attitudes relate to observable practices, while TPB contributes subjective norms and perceived behavioural control. Ajzen's TPB proposes that attitudes, subjective norms and perceived behavioural control shape behavioural intentions and behaviour. Bandura's social cognitive perspective further emphasizes the interaction between personal capability and environmental conditions.

In this study, infrastructure is positioned as a contextual condition rather than merely another individual characteristic. The moderation result reported in the source document is consistent with the proposition that favourable behavioural dispositions are more readily converted into practice when farmers have access to enabling facilities. Perceived behavioural control is likewise treated as a capability mechanism through which knowledge can influence practice.

3.0 Methodology

The source study adopted a convergent mixed-methods design. The quantitative component used a cross-sectional survey of 240 farmers, while qualitative information



came from open-ended questionnaire responses and brief key-informant interviews. The population comprised aquaculture farmers, crop farmers and farmers engaged in both activities. Three Lagos State LGAs—Ikorodu, Epe and Kosofe—were purposively selected; farming clusters, markets and cooperative groups were then identified and individual farmers selected systematically. Data collection used a structured questionnaire covering socio-demographic characteristics, knowledge, attitudes, TPB constructs, storage practices and outcome variables.

Knowledge was measured using objective items; attitude and practice were assessed mainly with five-point scales. The source study reports Cronbach's alpha values of 0.779 for the attitude scale and 0.948 for the storage-practice scale. Analysis included descriptive statistics, multiple regression, binary logistic regression, mediation analysis and moderation analysis. The present manuscript reproduces the reported results rather than generating new estimates from respondent-level data.

4.0 Results

4.1 Respondent Farming Category and Electricity Access

The distribution of respondents according to farming category and access to electricity is presented in Table 1. The results show that crop farmers constituted the largest proportion of the respondents, accounting for 93 (38.8%) of the sample. This was followed by farmers engaged in both aquaculture and crop production, with 75 (31.3%) respondents, while aquaculture farmers accounted for 72 (30.0%). Thus, the sample represented both crop and aquaculture production systems, with a substantial proportion of respondents combining the two activities.

With respect to electricity access, only 52 (21.7%) respondents reported having reliable electricity supply. The majority, 150 (62.5%), reported that electricity supply was unreliable, while 38 (15.8%) had no access to electricity. Therefore, 78.3% of the respondents either experienced unreliable electricity supply or had no electricity access. This finding is particularly relevant to post-harvest storage because unreliable or absent electricity may constrain the operation of refrigeration, cooling, drying, processing, and other electricity-dependent storage facilities.

Overall, the results indicate that infrastructure availability represents a potentially important contextual factor in translating farmers' knowledge and intentions into effective post-harvest storage practices (Table 1).

Table 1. Respondent farming category and electricity access

Variable	Category	n	%
Farming type	Aquaculture	72	30.0
	Crop	93	38.8
	Both	75	31.3
Electricity access	Reliable	52	21.7
	Unreliable	150	62.5
	None	38	15.8

Source: Field survey reported in the attached project document, 2026.

4.2 Descriptive Statistics and Reliability of Behavioural Indicators

Table 2 presents the descriptive statistics for the major behavioural indicators. The mean Knowledge Score Index (KSI) was 4.04 ± 1.85 on a scale of 0–8, indicating a moderate level of knowledge concerning post-harvest storage practices among the respondents. The relatively large standard deviation suggests considerable variation in knowledge levels across farmers.

The mean attitude score was 3.99 ± 0.79 on a 1–5 scale, indicating generally favourable attitudes towards appropriate post-harvest storage practices. Similarly, the Practice Index had a mean of 4.23 ± 1.04 , suggesting that respondents generally reported relatively favourable storage practices. However, the variation in practice scores indicates that farmers did not uniformly adopt appropriate storage practices.

The reliability coefficients demonstrate satisfactory internal consistency of the measurement instruments. The six-item attitude scale produced a Cronbach's alpha of 0.779, which indicates acceptable reliability. The eight-item storage-practice scale produced a substantially higher alpha of 0.948, indicating excellent internal consistency. These results support the use of the attitude and storage-practice measures in subsequent analyses (Table 2).



Table 2. Core behavioural indicators

Indicator	Mean	SD	Scale/Range
Knowledge Score Index	4.04	1.8544	0–8
Attitude composite	3.99	0.79	1–5
Practice Index	4.23	1.04	1–5
Attitude scale reliability	$\alpha=0.779$		6 items
Storage-practice reliability	$\alpha=0.948$		8 items

4.3 Predictors of Post-Harvest Storage Practices

Table 3 presents the multiple regression results examining the determinants of storage practices. The overall regression model was statistically significant, $F = 253.96$, $p < 0.001$, and explained 92.5% of the variance in storage practices ($R^2 = 0.925$), with an adjusted R^2 of 0.921. This indicates that the predictors jointly accounted for a very

substantial proportion of the observed variation in respondents' storage practices.

Knowledge had a positive and statistically significant association with storage practices ($\beta = 0.051$, $p = 0.001$). This suggests that higher knowledge scores were associated with higher reported storage-practice scores, although the coefficient was relatively small compared with some other predictors.

Table 3. Multiple regression model for storage practices

Predictor	β	SE	t	p	95% CI
Knowledge (KSI)	0.051	0.016	3.28	0.001	0.012–0.046
Attitude	0.551	0.043	12.94	<0.001	0.522–0.710
Barriers	0.561	0.051	10.95	<0.001	0.498–0.726
Subjective norms	-0.15	0.024	-6.24	<0.001	-0.228– 0.120

Model: $R^2=0.925$; adjusted $R^2=0.921$; $F=253.96$; $p<0.001$.

Attitude demonstrated a positive and statistically significant relationship with storage practices ($\beta = 0.551$, $p < 0.001$). Thus, respondents with more favourable attitudes towards appropriate post-harvest storage tended to report better storage practices. The confidence interval for the coefficient (0.522–0.710) does not include zero, further supporting the statistical significance of the relationship.

Barriers also showed a positive and statistically significant coefficient ($\beta = 0.561$, $p < 0.001$). This finding should be interpreted according to how the barrier variable was coded. If higher scores represent greater ability to overcome or manage identified barriers, the positive coefficient indicates that stronger barrier-management capacity was associated with better storage practices. However, if higher scores represent greater severity of barriers, the positive coefficient

would require careful substantive interpretation because it would run counter to the conventional expectation that greater barriers reduce practice adoption.

Subjective norms had a statistically significant negative relationship with storage practices ($\beta = -0.15$, $p < 0.001$). This indicates that, holding the other predictors constant, higher scores on the subjective-norm measure were associated with lower storage-practice scores. The confidence interval (–0.228 to –0.120) excludes zero, confirming the statistical significance of this association.

Taken together, the regression results demonstrate that knowledge, attitude, barriers and subjective norms were significant predictors of post-harvest storage practices, although their directions and magnitudes differed (Table 3).



4.4 Mediating Role of Perceived Behavioural Control

The mediation analysis examining whether perceived behavioural control (PBC) mediates the relationship between knowledge and storage practice is presented in Table 4. The results indicate a positive relationship between knowledge and perceived behavioural control, with a coefficient of 0.11. Perceived behavioural control was, in turn, positively associated with storage practice (coefficient = 1.236).

The estimated indirect effect of knowledge on practice through perceived behavioural control was 0.136, with a 95% confidence interval of 0.092–0.182. Because the confidence interval does not include zero, the indirect effect is statistically distinguishable from zero. This provides evidence that perceived behavioural control constitutes a pathway through which knowledge is associated with storage practices.

The direct effect of knowledge on practice after accounting for PBC remained positive ($c' = 0.264$), while the total effect was 0.400. The persistence of a positive direct effect alongside a non-zero indirect effect indicates that the knowledge–practice relationship operates through both a direct pathway and a pathway involving perceived behavioural control. In substantive terms, possessing knowledge about appropriate storage practices appears to be associated with practice partly through farmers' perceived ability or control to implement those practices (Table 4).

4.5 Moderating Role of Infrastructure

Table 5 presents the moderation analysis examining whether infrastructure changes the relationship between behavioural factors and storage practices. The TPB composite had a positive and statistically significant association with storage practices ($\beta = 0.388$, $p < 0.001$). Infrastructure was also positively and significantly associated with storage practices ($\beta = 0.277$, $p < 0.001$).

Importantly, the interaction term between the TPB composite and infrastructure was positive and statistically significant ($\beta =$

1.652, $p < 0.001$). This indicates that infrastructure significantly modifies the relationship between the behavioural factors represented by the TPB composite and storage practices. Specifically, the positive interaction coefficient suggests that the association between behavioural determinants and storage practices becomes stronger as infrastructure conditions improve.

Table 4. Mediation of knowledge–practice relationship by perceived behavioural control

Path/Effect	Coefficient
KSI → PBC	0.11
PBC → Practice	1.236
Indirect effect	0.136
95% CI	0.092–0.182
Direct effect (c')	0.264
Total effect (c)	0.4

The moderation model produced an R^2 of 0.839, indicating that the model accounted for 83.9% of the variation in storage practices. The significant interaction therefore suggests that knowledge, attitudes, perceived control and related behavioural dispositions cannot be considered independently of the infrastructural environment in which farmers operate. In practical terms, favourable behavioural dispositions may translate more readily into appropriate storage practices where farmers have access to adequate infrastructure, particularly reliable electricity and associated post-harvest facilities (Table 5).

Table 5. Moderating role of infrastructure

Term	β	p
TPB composite	0.388	<0.001
Infrastructure	0.277	<0.001
TPB × Infrastructure	1.652	<0.001

Moderation model $R^2=0.839$.

4.6 Overall Interpretation of the Results

Taken together, the results provide evidence of a knowledge–behaviour–infrastructure pathway underlying post-harvest storage behaviour among aquaculture and crop farmers in Lagos State. Although respondents



demonstrated moderate knowledge and generally favourable attitudes and reported practices, electricity access remained a major infrastructural constraint, with most respondents experiencing unreliable electricity or having no electricity access (Table 1). The regression results further show that behavioural factors were significantly associated with storage practices (Table 3).

The mediation analysis indicates that perceived behavioural control provides an important mechanism linking knowledge to practice, while the moderation analysis demonstrates that infrastructure conditions influence the strength of the relationship between behavioural determinants and storage practices (Tables 4 and 5). Collectively, these findings suggest that increasing farmers' knowledge alone may not be sufficient to achieve improved post-harvest storage outcomes. The translation of knowledge and favourable behavioural dispositions into practice is also associated with farmers' perceived ability to act and the infrastructural conditions available to support implementation.

Important statistical note: Before finalizing the manuscript, the confidence interval reported for the knowledge coefficient in Table 3 (0.012–0.046) should be checked against the reported $\beta = 0.051$ and $SE = 0.016$, because those values do not appear internally consistent. Also, the coding direction of the Barriers variable should be explicitly stated, since its positive coefficient has different substantive interpretations depending on whether higher scores represent greater barriers or greater capacity to overcome barriers.

5.0 Discussion

The findings of this study provide evidence that post-harvest storage behaviour among aquaculture and crop farmers in Lagos State is shaped by an interaction between knowledge, attitudes, perceived behavioural control, social influences, barriers and the availability of supporting infrastructure. The results are particularly important because they demonstrate that possession of

knowledge does not necessarily translate automatically into appropriate storage practices. Rather, the conversion of knowledge into practice appears to depend partly on farmers' perceptions of their ability to act and on whether the physical infrastructure required to implement recommended practices is available.

5.1 Farming Characteristics and Electricity Access

The distribution of respondents shows a relatively broad representation of the farming systems investigated. Crop farmers constituted 38.8% of the sample, while 31.3% were engaged in both crop and aquaculture production and 30.0% were aquaculture farmers. This distribution provides a useful basis for examining post-harvest behaviour across farming activities with different storage requirements. Crop and aquaculture products differ substantially in perishability, handling requirements and dependence on temperature control. Consequently, the availability of appropriate storage infrastructure can be expected to influence the capacity of farmers to implement recommended practices.

A particularly important finding is the limited reliability of electricity supply. Only 21.7% of respondents reported reliable electricity, whereas 62.5% reported unreliable electricity and a further 15.8% reported having no electricity access. Thus, nearly four out of every five respondents were operating without reliable electricity. This finding provides important context for interpreting the behavioural results. Appropriate post-harvest storage may require refrigeration, freezing, cooling, mechanical drying, lighting, processing and other energy-dependent activities. Where electricity is unreliable or unavailable, farmers may be unable to implement practices even when they understand their importance.

This observation is consistent with evidence from Nigeria showing that inadequate electricity, storage facilities and other infrastructure contribute to post-harvest losses. Recent Nigerian evidence identifies



poor electricity supply, inadequate storage facilities and poor transport infrastructure among important factors associated with post-harvest losses. Similarly, research among Nigerian crop farmers has identified inadequate modern storage and processing facilities, insufficient training and unstable power supply as important constraints to improved post-harvest handling. The present findings therefore reinforce the argument that post-harvest behaviour should not be examined solely as an individual farmer's behavioural choice; it is also conditioned by the material environment in which the behaviour takes place.

5.2 Knowledge, Attitudes and Storage Practices

The mean Knowledge Score Index of 4.04 on a 0–8 scale indicates a moderate level of knowledge among respondents. This suggests that farmers possessed some awareness of appropriate post-harvest storage practices, but that knowledge was neither uniformly high nor equally distributed across the sample. The standard deviation of 1.85 further indicates substantial differences in respondents' knowledge levels.

The moderate knowledge level is consistent with findings from other Nigerian studies. For example, research on tomato farmers in Enugu State reported that most farmers possessed moderate post-harvest handling skills and identified inadequate knowledge of post-harvest technologies as one of the important constraints. The similarity suggests that knowledge gaps may remain an important issue in post-harvest management even where farmers have considerable practical experience.

However, the mean attitude score of 3.99 on a 1–5 scale indicates generally favourable attitudes towards appropriate storage practices. The mean Practice Index of 4.23 also indicates relatively favourable reported storage practices. The combination of moderate knowledge with relatively favourable attitudes and practices is noteworthy. It suggests that farmers may develop positive orientations towards

appropriate storage through experience, extension exposure, market demands or practical knowledge even when their formal or measured knowledge is incomplete.

This finding also supports the broader literature showing that farmers' behaviour is not determined by knowledge alone. Studies applying the Theory of Planned Behaviour to agricultural decision-making have demonstrated that attitudes, subjective norms and perceived behavioural control can influence farmers' intentions and adoption decisions. More recent work has similarly shown that psychological constructs can explain farmers' agricultural decisions beyond conventional socioeconomic characteristics.

The reliability results strengthen confidence in the behavioural measures. The attitude scale produced a Cronbach's alpha of 0.779, indicating acceptable internal consistency, while the storage-practice scale produced an alpha of 0.948, indicating very high internal consistency. Thus, the observed relationships are unlikely to be attributable simply to poorly constructed measurement scales.

5.3 Knowledge as a Determinant of Storage Practice

Knowledge was positively associated with storage practices and was statistically significant in the regression model ($\beta = 0.051$, $p = 0.001$). This finding supports the proposition that farmers who possess greater knowledge about appropriate post-harvest storage are more likely to report appropriate storage practices.

Nevertheless, the relatively small coefficient compared with attitude and the other predictors is important. It indicates that knowledge, although significant, may have a more limited direct association with practice than some of the behavioural and contextual variables. This finding is theoretically important because it challenges a simple assumption that increasing knowledge automatically produces behavioural change.

Evidence from agricultural research supports this interpretation. An extended TPB study among farmers found that knowledge was



important but operated through behavioural and psychological mechanisms, including attitudes and perceived behavioural control. Similarly, research on conservation agriculture found that knowledge contributed significantly to farmers' intentions, while attitude had a particularly strong direct relationship with intention.

The present result therefore suggests that farmer education should move beyond simply communicating information. Training should also develop practical skills and farmers' confidence in applying recommended storage technologies. Demonstrations, hands-on training, extension support and locally appropriate storage technologies may be more effective than information dissemination alone.

5.4 Attitude and Storage Practice

Attitude emerged as a strong positive predictor of storage practice ($\beta = 0.551$, $p < 0.001$). This indicates that farmers who viewed appropriate post-harvest storage more favourably tended to report better storage practices. The magnitude of the coefficient suggests that attitudes were considerably more strongly associated with storage practices than the direct knowledge coefficient.

This finding aligns with the central proposition of the TPB that favourable evaluations of a behaviour contribute to the motivation to perform it. Research among farmers has similarly shown that attitude is an important determinant of agricultural adoption and behavioural intention. Research on small-scale post-harvest practices among plantain farmers and traders in Nigeria also found attitude to be a significant predictor of intention to use improved post-harvest practices.

The implication is that interventions aimed at improving storage practices should not focus exclusively on the technical benefits of storage. They should also strengthen farmers' perceptions of the usefulness, economic value and practicality of improved storage. Farmers are more likely to maintain practices they perceive as beneficial, feasible and

relevant to their production and marketing circumstances.

5.5 Barriers and Storage Practice

Barriers produced a statistically significant positive coefficient ($\beta = 0.561$, $p < 0.001$). This result requires particular attention because its substantive interpretation depends on how the barrier variable was coded. If a high barrier score represents greater capacity to overcome or manage storage constraints, the positive relationship is logically consistent with improved storage practices. Conversely, if a high score represents greater severity or frequency of barriers, the positive coefficient would appear counterintuitive and should be investigated.

This issue matters because previous Nigerian studies generally identify inadequate infrastructure, high equipment costs, poor transportation, insufficient training, and unreliable electricity as constraints to improved post-harvest handling. Consequently, the manuscript should clearly define the direction of the barrier scale before drawing a substantive conclusion from this coefficient.

If higher scores indeed represent greater barriers, possible explanations include reverse coding, adaptation by farmers who face more constraints, or a measurement effect in which farmers more engaged with storage practices are also more aware of the barriers they face. The variable should therefore be examined carefully before the result is interpreted as evidence that barriers improve storage practices.

5.6 Subjective Norms and Storage Behaviour

Subjective norms had a significant negative association with storage practices ($\beta = -0.15$, $p < 0.001$). This indicates that, within the study's coding, higher subjective-norm scores were associated with lower reported storage-practice scores after controlling for the other predictors.

The direction differs from the conventional TPB expectation that supportive social norms should encourage desirable behaviour. However, the result should not automatically



be interpreted as evidence that social influence is harmful. The meaning depends on how the subjective-norm items were worded and coded. For example, if higher scores indicate perceived pressure to follow traditional or commonly practiced storage behaviours rather than recommended practices, the negative association could reflect tension between prevailing social practices and improved storage methods.

The finding illustrates the importance of examining the specific social context in which farmers make storage decisions. Farmers may be influenced by family members, neighbouring farmers, traders, buyers, extension agents and community expectations. TPB research emphasizes that subjective norms represent perceived expectations from important social referents rather than social influence in a general sense. Thus, extension programmes could potentially use influential community members, farmer groups and trusted agricultural advisers as channels for promoting improved storage behaviour.

5.7 Perceived Behavioural Control as a Mediating Mechanism

One of the most important findings is the evidence that perceived behavioural control mediates the relationship between knowledge and storage practice. Knowledge had a positive relationship with PBC (coefficient = 0.11), while PBC had a positive relationship with practice (coefficient = 1.236). The indirect effect was 0.136, with a 95% confidence interval of 0.092–0.182.

Because the confidence interval does not contain zero, the indirect pathway is statistically supported. Moreover, the direct effect remained positive at 0.264, while the total effect was 0.400. This pattern indicates that the relationship between knowledge and storage practice is partially mediated by perceived behavioural control rather than being transmitted entirely through PBC.

This result is highly consistent with the TPB framework. Perceived behavioural control concerns an individual's perception of the ability and resources required to perform a

behaviour. Agricultural TPB studies have demonstrated that PBC is particularly important when farmers face resource, technical or institutional constraints.

In the context of the present study, a farmer may know that fish, vegetables or other agricultural products should be cooled, dried, protected or appropriately stored, but knowledge alone may not be sufficient. The farmer must also believe that the practice can realistically be implemented with the available facilities, skills, finance, electricity and equipment. The mediation finding therefore provides empirical support for the knowledge-to-practice pathway proposed by the study.

5.8 Infrastructure as a Moderator of Behavioural Effects

The moderation analysis provides the strongest evidence for the study's central argument. TPB composite scores were positively associated with storage practice ($\beta = 0.388$, $p < 0.001$), while infrastructure was also positively associated with storage practice ($\beta = 0.277$, $p < 0.001$). Most importantly, the TPB $\times$ Infrastructure interaction was positive and statistically significant ($\beta = 1.652$, $p < 0.001$).

The significant interaction means the relationship between behavioural determinants and storage practices varies with infrastructural conditions. In other words, behavioural motivation does not operate in isolation from the physical environment. Where infrastructure is more adequate, favourable behavioural dispositions may be more readily converted into actual storage practices.

This finding is particularly relevant given that 78.3% of respondents reported either unreliable or no electricity access. It suggests that a farmer can possess appropriate knowledge, maintain favourable attitudes and perceive strong personal control, yet still face practical difficulties implementing appropriate storage practices when essential infrastructure is unavailable.

The finding is consistent with Nigerian evidence showing that unreliable power



supply, poor infrastructure, equipment costs and limited accessibility constrain post-harvest technology adoption. Recent evidence on rural infrastructure similarly identifies electricity, storage, and transportation as important environmental components determining post-harvest outcomes.

The R^2 of 0.839 further indicates that the moderation model accounted for a large proportion of the observed variation in storage practices. However, the large R^2 should be interpreted cautiously because it does not by itself establish causality, and the study appears to rely on survey-based cross-sectional measurements.

5.9 Implications for the Theory of Planned Behaviour

The findings generally support the usefulness of TPB for explaining post-harvest storage behaviour, while also suggesting the value of extending the framework to incorporate knowledge and infrastructure. Attitude was positively associated with practice, perceived behavioural control played a significant mediating role, and subjective norms were statistically significant, although their direction was negative under the study's coding.

The findings therefore support an extended behavioural framework in which knowledge contributes to behaviour partly by influencing farmers' perceived control, while infrastructure determines how effectively behavioural dispositions can be translated into actual practice. This interpretation is consistent with recent agricultural research showing that knowledge, psychological factors and institutional or environmental support jointly influence farmers' behaviour.

The study consequently moves beyond a simple “knowledge → practice” explanation. Its results suggest a more complex sequence: *Knowledge → Perceived behavioural control → Storage practice while simultaneously: Behavioural factors × Infrastructure → Storage practice*

This provides a useful conceptual contribution because post-harvest storage is

not purely an informational behaviour. It requires access to physical facilities and resources that farmers may not individually control.

5.10 Implications for Agricultural Extension and Policy

The findings have several practical implications. First, agricultural extension programmes should strengthen farmers' knowledge of post-harvest handling and storage, but training should be practical and technology-oriented rather than limited to theoretical information. Nigerian evidence indicates that inadequate knowledge and inadequate access to improved technologies can coexist, reinforcing the need to combine training with practical support.

Second, interventions should strengthen farmers' perceived behavioural control. This could involve demonstrations, access to appropriate equipment, technical assistance, farmer field schools and extension follow-up. When farmers believe that they have the skills, resources and opportunity to implement improved practices, knowledge is more likely to translate into behaviour.

Third, infrastructural interventions are essential. Improving electricity reliability, developing community-scale cold storage and processing facilities, supporting solar-powered storage systems and improving access to appropriate post-harvest technologies could reduce the gap between what farmers know and what they are able to do.

Finally, interventions should recognize differences between crop and aquaculture farmers. Storage requirements and perishability differ across commodities, so a uniform intervention may not address the specific needs of all farmers. Community-based infrastructure and shared storage facilities may be particularly relevant where individual farmers cannot afford modern equipment.

Overall, the findings indicate that post-harvest storage behaviour is a multidimensional phenomenon involving knowledge, psychological dispositions,



perceived control and physical infrastructure. The moderate level of knowledge demonstrates that an information gap exists, while the favourable attitude and practice scores indicate that respondents are generally receptive to appropriate storage behaviour. However, the regression results show that knowledge alone has a relatively smaller direct association with practice than attitude and other predictors.

The mediation analysis demonstrates that perceived behavioural control is an important mechanism through which knowledge is translated into practice. The moderation analysis further indicates that infrastructure changes the strength of the relationship between behavioural determinants and storage practices. This is particularly significant in a setting where most respondents reported unreliable or absent electricity.

The findings therefore support the central proposition of the study: moving from knowledge to practice requires more than information. Farmers need favourable attitudes, a sense of behavioural control and an enabling infrastructural environment. This interpretation is consistent with broader TPB research in agriculture and with Nigerian evidence identifying infrastructure, training and access to appropriate post-harvest technologies as important components of improved post-harvest management.

One statistical issue should be resolved before publication: the confidence interval reported for Knowledge in Table 3 (0.012–0.046) does not appear to correspond to the reported $\beta = 0.051$ and $SE = 0.016$. The coding of the Barriers and Subjective Norms variables should also be explicitly stated because their coefficient directions depend on how the scales were coded. These checks are important before drawing definitive substantive conclusions from those coefficients.

6.0 Conclusion

The evidence from the attached study indicates that post-harvest storage behavior among aquaculture and crop farmers in Lagos

is jointly shaped by knowledge, attitudes, perceived constraints, perceived behavioral control, and infrastructure. The central implication is that behavioural change cannot be treated as an exclusively informational problem. Knowledge contributes to practice, but capability and enabling infrastructure determine how effectively knowledge and favorable behavioral dispositions translate into improved adoption of storage technology.

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Conflict of interest

The authors declare that they have no conflict of interest.

Ethical Consideration

Not applicable

Author's contributions

Odunayo Abosede Amos contributed to the conceptualization, literature review, field data collection, methodology, data analysis, and drafting of the manuscript. Samuel Awolumaté contributed to study design, methodological refinement, interpretation of results, critical review, editing, and supervision. Both authors contributed to the development of the theoretical framework, validation of findings, revision of the manuscript, and approval of the final version.

