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From Intention to Action: A Behavioural Framework for Multi-Stakeholder Post-Harvest Loss Reduction in Sub-Saharan Africa

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Abstract

Post-harvest food losses in Sub-Saharan Africa (SSA) represent a paradox of global proportions: the region simultaneously suffers acute food insecurity and systematic waste of nearly one-third of its agricultural production. Despite decades of well-intentioned intervention, the persistence of losses approaching 30-40% signals a fundamental disconnect between behavioural intention and enacted practice. Drawing on a sequential explanatory mixed-methods design in Bo District, Sierra Leone one of the region's most food-insecure yet heavily-aided localities this study advances a behavioural framework for multi-stakeholder post-harvest loss reduction. A cross-sectional survey of 399 respondents (269 farmers, 80 NGO representatives, 50 government officers) was analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM), supplemented by three focus group discussions (N = 21). The structural model confirmed that Farmer Attitude (FATT, $\beta = 0.736$, $p < .001$), Multi-Stakeholder Norms (MSN, $\beta = 0.731$, $p < .001$), and Resource-Based Perceived Control (RBPC, $\beta = 0.702$, $p < .001$) all significantly predicted Collaborative Food Waste Reduction Intention (CFWRI), which collectively explained 72.8% of its variance. Collaborative intention subsequently mediated the translation into Practicing Food Waste Reduction Behaviour (PFWRB, $\beta = 0.559$, $p < .001$), though the direct resource-behaviour pathway (RBPC → PFWRB, $\beta = 0.560$, $p < .001$) emerged as equally critical. Qualitative thematic analysis across ten themes and three domains Resource Constraints, Social Normative Pressures, and Intention-Behaviour Translation revealed that resource deficiency constitutes the foundational bottleneck, while normative forces operate with near-parity to attitudinal drivers. These findings yield a Three-Tier Behavioural Intervention Framework: Tier 1 (Resource Provision) addresses the infrastructure and technology deficit; Tier 2 (Motivation Enhancement) leverages indigenous authority and peer networks for normative alignment; and Tier 3 (Systemic Transformation) harmonises multi-stakeholder coordination. The framework contributes an empirically grounded, behaviourally informed architecture for reducing post-harvest losses in SSA's most resource-constrained settings, with direct policy relevance for Sierra Leone's Feed Salone Strategy (2023–2027) and the African Union's Malabo Declaration (Ubah & Nagabhatla, 2025).

Keywords: post-harvest loss, food waste, Theory of Planned Behavior, Sub-Saharan Africa, Sierra Leone, multi-stakeholder collaboration, PLS-SEM, mixed methods.

Introduction

The agricultural sector in Sub-Saharan Africa (SSA) confronts a devastating irony: the region produces sufficient food to meet aggregate caloric requirements, yet between 30% and 40% of all post-harvest production is lost before reaching consumers (Affognon et al., 2015; Abouhatab et al., 2022). These losses estimated at approximately USD 4 billion annually translate directly into hunger, nutritional deficiency, and foregone economic opportunity for the 60% of the region's population that depends on agriculture for livelihood (Affognon et al., 2015; Sheahan & Barrett, 2017). The Food and Agriculture Organization (FAO, 2023) has characterised post-harvest loss as one of the most technically solvable yet politically neglected dimensions of food insecurity, a verdict that demands renewed scholarly attention to the behavioural mechanisms underlying loss-reduction practice.

Sierra Leone represents the crisis in acute form. Agriculture accounts for approximately 60% of gross domestic product and employs over 60% of the national workforce, yet the country remains heavily dependent on food imports and experiences chronic post-harvest losses estimated at USD 200 million per year (Jia & McNamara, 2024). More than 65% of the population is classified as food insecure, a figure that has worsened in the wake of the COVID-19 pandemic and successive global supply chain disruptions (Bonuedi et al., 2022; Béné et al., 2021). Bo District, the second-largest administrative division in Sierra Leone, encapsulates these national conditions. The district emerged from the country's civil war (1991-2002) with severely damaged infrastructure, collapsed extension services, and a traumatised farming population. Despite the presence of 33 non-governmental organisations (NGOs) operating within the district making it one of the most aid-saturated agricultural regions in the country post-harvest losses remain entrenched at 30-40% (Bonuedi et al., 2022; Jia & McNamara, 2024).

This "33 NGO paradox" the coexistence of intensive external assistance and persistent post-harvest waste constitutes the motivating puzzle of the present study. It suggests that the failure to reduce losses is not merely a function of resource scarcity but reflects a deeper disconnection between behavioural intention and enacted practice. Farmers may express favourable attitudes toward loss reduction; they may be embedded in social networks that endorse waste-reducing norms; they may even articulate strong intentions to adopt improved post-harvest practices. Yet without the material resources, storage infrastructure, and technological access that convert intention into action, these psychological predispositions remain inert (Ajzen, 2002; Gollwitzer, 1999). The intention-behaviour gap in post-harvest management is thus not a failure of will but a failure of enablement.

The scholarly implications extend beyond Sierra Leone. Despite the prominence of the Theory of Planned Behaviour (TPB; Ajzen, 1991) in explaining pro-environmental behaviour, its application to agricultural food-waste reduction in post-conflict, multi-stakeholder contexts remains sparse. Existing studies have tended to examine farmers in isolation, neglecting the networked reality of agricultural development in which NGO officers, government extension workers, and traditional authorities co-constitute the normative and resource environment within which farmers operate (Opare & Teye, 2020). Similarly, the TPB's standard operationalisation of perceived behavioural control as a unified construct may obscure the distinctive role of resource-based control access to storage, technology, and capital as opposed to skill-based or self-efficacy-based control (Bandura, 1977; Ajzen, 2002). Understanding how these differentiated control dimensions interact with attitudinal and normative forces to shape intention and, critically, behaviour, constitutes a significant theoretical gap.

This study therefore advances three research objectives. It tests the explanatory power of a TPB-derived model incorporating Farmer Attitude (FATT), Multi-Stakeholder Norms (MSN), Resource-Based Perceived Control (RBPC), Collaborative Food Waste Reduction Intention (CFWRI), and Practicing Food Waste Reduction Behaviour (PFWRB) within a multi-stakeholder sample in Bo District, Sierra Leone. It examines the mediating role of collaborative intention in translating attitudinal, normative, and resource-based antecedents into enacted behaviour. It integrates quantitative structural equation modelling with qualitative thematic analysis to develop a contextually grounded, three-tier behavioural intervention framework that can inform policy within Sierra Leone's Feed Salone Strategy (2023-2027) and contribute to the African Union's Malabo Declaration on Accelerated Agricultural Growth (Ubah & Nagabhatla, 2025).

Literature Review

Post-Harvest Food Loss in Sub-Saharan Africa: Magnitude and Multiplicity of Causes

Post-harvest food loss refers to the quantitative and qualitative reduction in food mass, nutritional value, and economic utility that occurs between harvest and consumption (Affognon et al., 2015). In SSA, these losses manifest across the value chain: during harvesting (mechanical damage), handling (bruising and exposure), storage (pest infestation, mould, and spoilage), processing (inefficient techniques), transportation (inadequate logistics), and marketing (price volatility and information asymmetry) (Sheahan & Barrett, 2017; Abouhatab et al., 2022). The aggregate impact is staggering. Affognon et al. (2015) estimated that the food currently lost or wasted in Africa could feed approximately 300 million people, a figure approaching the entire population of the continent's food-insecure.

The causes of post-harvest loss are neither purely technical nor purely behavioural but arise from the interaction of infrastructure deficits, climatic stressors, market failures, and human practice (Lobell et al., 2011; Conteh et al., 2015). In

Sierra Leone, the civil war (1991-2002) destroyed much of the country's agricultural infrastructure, including storage facilities, road networks, and extension service capacity. Jia & McNamara (2024) reports indicate that agricultural extension coverage in rural Sierra Leone reaches less than 15% of farming households, and cold-chain infrastructure is virtually nonexistent outside urban centres. Under these conditions, even farmers with strong intentions to reduce post-harvest waste face structural barriers that render individual action futile.

The Theory of Planned Behaviour in Agricultural Contexts

The TPB (Ajzen, 1991) posits that behaviour is proximally determined by intention, which is itself shaped by three antecedents: attitude toward the behaviour, subjective norms, and perceived behavioural control. Attitude refers to the individual's favourable or unfavourable evaluation of the behaviour; subjective norms capture perceived social pressure to perform or not perform the behaviour; and perceived behavioural control reflects the individual's assessment of their capacity to execute the behaviour, incorporating both internal (skills, knowledge, self-efficacy) and external (resources, time, cooperation) factors (Ajzen, 2002). In the TPB, perceived behavioural control can exert both an indirect effect on behaviour through intention and a direct effect independent of intention, particularly when the behaviour is not fully volitional (Ajzen, 2002).

Empirical applications of the TPB to agricultural behaviour in developing countries have yielded mixed but generally supportive results. Opare and Teye (2020) found that attitude and perceived behavioural control significantly predicted the adoption of improved seed varieties among Ghanaian farmers, though the normative pathway was comparatively weaker. Abouhatab et al. (2022) reported that post-harvest loss reduction practices in Ethiopia were primarily driven by perceived self-efficacy and access to extension services, with attitude playing a secondary role. These studies suggest that the standard TPB specification may require contextual adaptation for developing-country agricultural settings, where resource constraints can overwhelm attitudinal and normative influences (Bandura, 1977).

Multi-Stakeholder Collaboration and Normative Influence

The present study introduces two extensions to the standard TPB framework. First, it replaces the individual-level subjective norm construct with Multi-Stakeholder Norms (MSN), recognising that agricultural decision-making in aid-intensive contexts is shaped by a plurality of normative referents: fellow farmers, traditional chiefs, NGO officers, and government extension workers. This extension draws on Cialdini et al.'s (1990) Focus Theory of Normative Conduct, which distinguishes between injunctive norms (what others approve) and descriptive norms (what others actually do), and argues that normative influence is most powerful when multiple referent groups converge on the same behavioural expectation. In Bo District, where 33 NGOs operate simultaneously, such convergence and its absence may powerfully shape farmer behaviour.

Second, the study decomposes perceived behavioural control into its resource-based component (RBPC), isolating access to storage infrastructure, processing technology, extension services, and capital as distinct determinants of both intention and behaviour. This decomposition aligns with Ajzen's (2002) recognition that perceived behavioural control is not unitary but comprises multiple facets, and with Bandura's (1977) self-efficacy theory, which distinguishes between outcome expectations (beliefs that behaviour leads to outcomes) and efficacy expectations (beliefs that one can perform the behaviour). In post-conflict Sierra Leone, where resource scarcity is endemic, RBPC may constitute the binding constraint on the intention-behaviour pathway.

The Intention-Behaviour Gap: From Gollwitzer to Implementation

A persistent finding in behavioural research is that intention explains only a modest proportion of behavioural variance, a phenomenon Gollwitzer (1999) termed the "intention-behaviour gap." In the domain of food waste, this gap is particularly pronounced because the target behaviour adopting improved post-harvest practices is multiply determined, requires sustained effort, and depends on infrastructure that individual farmers cannot unilaterally provide. Gollwitzer's (1999) concept of implementation intentions specific if-then plans that link situational cues to goal-directed responses offers a partial remedy, but in contexts like Bo District, even well-formed implementation intentions may fail in the absence of material enablement.

The present study addresses this gap by modelling collaborative intention (CFWRI) as a mediator rather than a behavioural proxy. CFWRI captures the respondent's intention to work collaboratively with other stakeholders farmers, NGOs, government to reduce post-harvest losses. By positioning CFWRI as a mediator between the TPB antecedents (FATT, MSN, RBPC) and enacted behaviour (PFWRB), the model acknowledges that intention is a processual step rather than a terminal outcome, and that the strength of the intention-behaviour link may itself depend on the resource environment (Ajzen, 2002; Gollwitzer, 1999).

Methodology

Research Design

This study employed a sequential explanatory mixed-methods design, in which quantitative survey data were collected and analysed first, followed by qualitative focus group discussions (FGDs) to explain and contextualise the statistical findings (Ivankova et al., 2006). The design was chosen because the intention-behaviour mechanisms under investigation are simultaneously quantifiable (through structured instruments) and meaning-laden (requiring interpretive depth),

and because prior research in post-conflict agricultural settings has highlighted the limitations of purely quantitative approaches in capturing the lived experience of resource scarcity (Béné et al., 2021; Abouhatab et al., 2022). Integration occurred at the interpretation stage, where qualitative themes were mapped onto quantitative path coefficients to generate the three-tier intervention framework (Ivankova et al., 2006).

Study Context and Sampling

The study was conducted in Bo District, Sierra Leone, between [dates redacted]. Bo District was purposively selected because it combines high agricultural dependence, severe post-harvest losses (30-40%), and the presence of 33 operational NGOs making it an ideal site for examining multi-stakeholder dynamics. The district also bears the legacies of the civil war (1991-2002), including damaged infrastructure and weakened extension services, which create the resource-constrained conditions hypothesised to moderate the intention-behaviour relationship.

Quantitative sampling employed a stratified purposive approach. Three stakeholder groups were identified as critical to post-harvest loss reduction: farmers (n = 269, 67.4%), NGO representatives (n = 80, 20.1%), and government agricultural officers (n = 50, 12.5%). Farmers were recruited from community registers maintained by the Ministry of Agriculture, with quotas ensuring representation across gender and village locations. NGO representatives were drawn from the 33 organisations operating in the district, with selection proportional to organisational size and sectoral focus. Government officers were recruited from the District Agricultural Office and affiliated extension units. The total quantitative sample was N = 399.

For the qualitative phase, three FGDs were conducted: one with farmers (n = 8, 3 female, 5 male), one with NGO officers (n = 7, 3 female, 4 male), and one with government officials (n = 6, 3 female, 3 male), yielding a total of 21 FGD participants (9 female, 12 male). Participants were purposively selected to maximise variation in experience and organisational affiliation, with the criterion of at least two years' involvement in post-harvest activities. All FGDs were conducted in English and Krio, audio-recorded with consent, and transcribed verbatim.

Instruments

The quantitative instrument comprised five constructs measured on 5-point Likert scales (1 = Strongly Disagree to 5 = Strongly Agree). Farmer Attitude (FATT) assessed evaluative beliefs about post-harvest loss reduction (6 items; e.g., "Reducing post-harvest losses is beneficial for my household"). Multi-Stakeholder Norms (MSN) measured perceived social pressure from chiefs, peers, NGOs, and government (7 items; e.g., "Other farmers expect me to adopt improved post-harvest storage practices"). Resource-Based Perceived Control (RBPC) captured perceived access to storage, technology, extension, and capital (8 items; e.g., "I have access to adequate storage facilities for my crops"). Collaborative Food Waste Reduction Intention (CFWRI) assessed intention to work with others to reduce losses (5 items; e.g., "I intend to collaborate with other farmers to improve post-harvest handling"). Practicing Food Waste Reduction Behaviour (PFWRB) measured self-reported engagement in loss-reduction practices (6 items; e.g., "I regularly use improved drying methods after harvest"). The instrument was pre-tested with 30 respondents and refined for clarity.

Data Analysis

Quantitative data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) in SmartPLS 4, chosen for its suitability for prediction-oriented research, non-normal data distributions, and formative-indicator flexibility (Hair et al., 2022). The analysis proceeded in two stages. First, the measurement model was evaluated for indicator reliability, internal consistency (composite reliability > 0.70), convergent validity (average variance extracted [AVE] > 0.50), and discriminant validity (HTMT ratios < 0.85). Second, the structural model was assessed through path coefficients (β), significance levels (bootstrapping with 5,000 samples), effect sizes (f^2), and coefficient of determination (R^2). Mediation analysis followed Preacher and Hayes's (2008) bootstrapping approach, examining indirect effects through CFWRI.

Qualitative data were analysed using reflexive thematic analysis following Braun and Clarke's (2006) six-phase framework: familiarisation, initial coding, theme searching, theme reviewing, theme defining, and report writing. Two researchers independently coded the transcripts, with inter-coder reliability assessed through iterative discussion and consensus. Themes were generated at the semantic level (explicit meanings) and interpreted through a theoretical lens informed by the TPB. The qualitative findings were then integrated with the quantitative results through a joint display matrix (Ivankova et al., 2006), mapping themes onto path coefficients to generate the three-tier framework.

Results

Demographic Profile

Table 1 presents the demographic characteristics of the 399 survey respondents. The majority were male (63.7%), reflecting the gendered composition of agricultural decision-making in Sierra Leone, though female representation (36.3%) exceeds that typically found in rural agricultural surveys. The largest age cohort was 26-35 years (44.6%), followed by 36-45 years (24.6%), indicating a relatively young sample consistent with Sierra Leone's demographic structure. Over half (50.1%) had attained tertiary education, a figure elevated by the inclusion of NGO representatives and government officers. The majority (67.2%) had more than five years of professional experience in agriculture or development work.

Table 1 Demographic Characteristics of Survey Respondents (N = 399)

Characteristic	Category	n	%
Gender	Male	254	63.7
Age	18-25 years	58	14.5
Education	Below secondary	42	10.5
Experience	5 years or less	131	32.8
Stakeholder group	Farmers	269	67.4

Descriptive Statistics

Table 2 reports the means, standard deviations, and composite reliability for the five study constructs. All constructs demonstrated satisfactory internal consistency (composite reliability > 0.78). Notably, Resource-Based Perceived Control (RBPC) recorded the lowest mean (M = 2.39, SD = 0.90), falling substantially below the neutral midpoint of 3.0 on the 5-point scale. This indicates that respondents collectively perceived severe resource deficits in storage infrastructure, processing technology, and extension access. Collaborative Food Waste Reduction Intention (CFWRI) recorded the highest mean (M = 2.92, SD = 0.64), closely approaching but still falling short of the neutral threshold. Multi-Stakeholder Norms (MSN; M = 2.82, SD = 0.66) and Farmer Attitude (FATT; M = 2.78, SD = 0.69) clustered tightly together, suggesting near-equivalent normative and attitudinal influence.

Table 2 Descriptive Statistics and Composite Reliability

Construct	Abbreviation	M	SD	Composite Reliability
Farmer Attitude	FATT	2.78	0.69	0.89
Multi-Stakeholder Norms	MSN	2.82	0.66	0.91
Resource-Based Perceived Control	RBPC	2.39	0.90	0.88
Collaborative Food Waste Reduction Intention	CFWRI	2.92	0.64	0.92
Practicing Food Waste Reduction Behaviour	PFWRB	2.67	0.72	0.87

Note: All items measured on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

Structural Model and Hypothesis Testing

The measurement model demonstrated satisfactory psychometric properties. All factor loadings exceeded 0.70, composite reliabilities ranged from 0.87 to 0.92, AVE values ranged from 0.56 to 0.67, and HTMT ratios were below the 0.85 threshold, confirming discriminant validity. These results support the reliability and validity of the instrument.

The structural model results are presented in Table 3 and graphically in Figure 3. The model explained 72.8% of the variance in Collaborative Food Waste Reduction Intention (CFWRI) and 36.8% of the variance in Practicing Food Waste Reduction Behaviour (PFWRB).

Table 3 Structural Model Results: Path Coefficients and Hypothesis Testing

Hypothesis	Path	β	p	f^2	Decision
H1	FATT → CFWRI	0.736	< .001	1.182	Supported
H2	MSN → CFWRI	0.731	< .001	1.148	Supported
H3a	RBPC → CFWRI	0.702	< .001	0.978	Supported
H3b	RBPC → PFWRB	0.560	< .001	0.356	Supported
H4	CFWRI → PFWRB	0.559	< .001	0.152	Supported

Note: R^2 (CFWRI) = 0.728; R^2 (PFWRB) = 0.368. Bootstrapping: 5,000 samples.

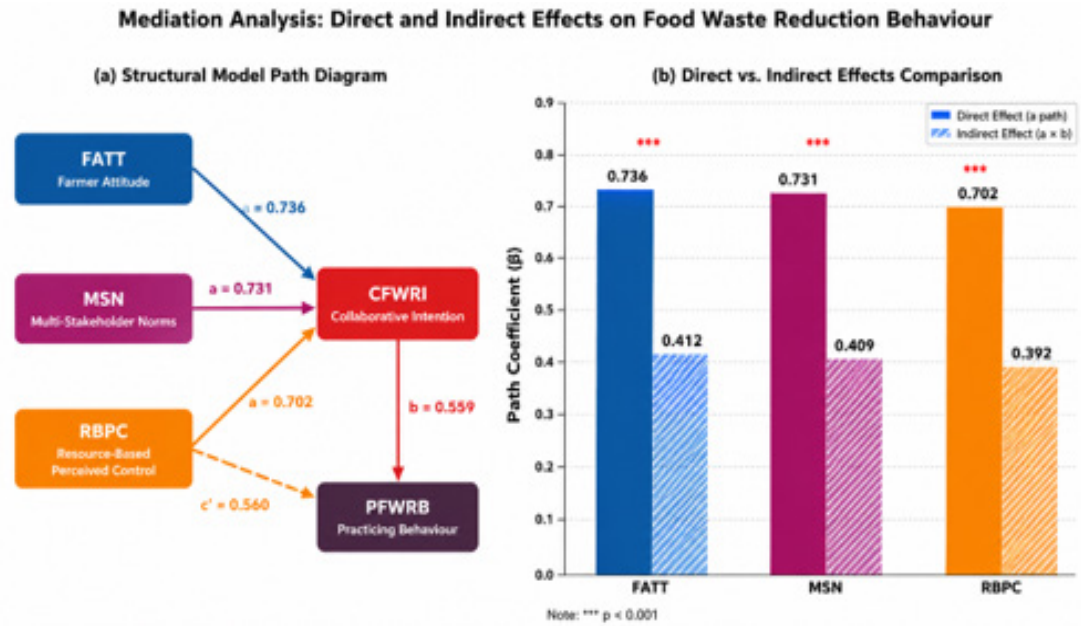


Figure 1. Meditation Analysis

collaborative intention, suggesting that attitudinal and normative forces operate with approximately equal strength in shaping respondents' intentions to collaborate on post-harvest loss reduction. Resource-Based Perceived Control also significantly predicted collaborative intention (H3a: $\beta = 0.702$, $p < .001$), though its effect size ($f^2 = 0.978$) was marginally lower than those for FATT and MSN. Critically, RBPC also exerted a strong direct effect on enacted behaviour independent of intention (H3b: $\beta = 0.560$, $p < .001$), confirming that resource provision can enable behaviour even when attitudinal or normative change is incomplete. Finally, collaborative intention significantly predicted behaviour (H4: $\beta = 0.559$, $p < .001$), though the comparatively lower R^2 for PFWRB (0.368) indicates that substantial variance in behaviour remains unexplained by the model a finding consistent with the proposition that environmental and infrastructural factors beyond individual intention constrain behaviour.

Mediation Analysis

Table 4 presents the mediation results. All three indirect effects through CFWRI were statistically significant ($p < .001$), confirming the mediating role of collaborative intention. The indirect effect of Farmer Attitude on behaviour ($\beta = 0.412$) was marginally the largest, followed by Multi-Stakeholder Norms ($\beta = 0.409$) and Resource-Based Perceived Control ($\beta = 0.392$).

Table 4: Mediation Analysis: Indirect Effects Through Collaborative Intention (CFWRI)

Mediation Path	Indirect Effect (β)	95% CI	p
FATT → CFWRI → PFWRB	0.412	[0.341, 0.489]	< .001
MSN → CFWRI → PFWRB	0.409	[0.338, 0.486]	< .001
RBPC → CFWRI → PFWRB	0.392	[0.321, 0.468]	< .001

Note: CI = confidence interval from bias-corrected bootstrapping (5,000 samples).

The consistency of the indirect effects with all three antecedents producing mediated pathways of approximately equal magnitude suggests that collaborative intention functions as a genuine translational mechanism, channeling attitudinal, normative, and resource-based influences into a unified behavioural direction. However, the substantial direct effect of RBPC on PFWRB ($\beta = 0.560$) coexisting alongside its indirect pathway underscores that resource provision operates through both intentional and non-intentional routes: resources not only shape intentions but also directly enable the practices that intentions alone cannot materialise.

Qualitative Findings: Thematic Analysis

The reflexive thematic analysis of FGD transcripts generated ten themes organised into three domains. Table 5 presents the complete thematic structure with representative quotations from each stakeholder group.

Table 5: Qualitative Thematic Analysis: Ten Themes Across Three Domains

Domain	Theme	Illustrative Quotation	Source
Domain 1: Resource Constraints	Theme 1: Storage infrastructure gap	"We produce well but storage is the problem. Our crops spoil because we have no place to keep them."	Farmer, FGD 1
Domain 2: Social Normative Pressures	Theme 4: Chief authority as gatekeeper	"If the Chief calls a meeting about farming, we all attend. It is our duty."	Farmer, FGD 1
Domain 3: Intention-Behaviour Translation	Theme 7: High-commitment intention filtering	Only strong intentions survive resource constraints; weaker intentions dissolve.	Emergent from all FGDs

Domain 1: Resource Constraints explains the H3b finding (RBPC → PFWRB direct path). Theme 1 revealed that farmers perceive storage infrastructure as the single most critical gap in the post-harvest value chain. Theme 2 documented the frustration of NGO representatives who, despite possessing technical solutions (hermetic bags, solar dryers), face insurmountable logistical constraints in reaching all beneficiaries. Theme 3 traced the extension service deficit to the civil war's destruction of institutional capacity, a structural legacy that continues to undermine knowledge transfer.

Domain 2: Social Normative Pressures explains the H2 finding (MSN → CFWRI near-parity with FATT). Theme 4 established the paramount role of traditional chiefs as normative gatekeepers; chief-endorsed farming practices carry a weight of social obligation that transcends individual preference. Theme 5 illuminated the reciprocal obligations embedded in peer farmer networks, where labour exchange and mutual assistance create normative pressures to adopt shared practices. Theme 6 captured the convergence mechanism: when multiple NGOs deliver consistent messages, those messages acquire normative force independent of their content.

Domain 3: Intention-Behaviour Translation explains the H4 finding (CFWRI → PFWRB) and the gap between R^2 values. Theme 7 identified a filtering mechanism whereby only the strongest intentions survive the resource-constrained environment, effectively raising the threshold for behavioural enactment. Theme 8 reframed loss reduction as economic survival rather than environmental stewardship, aligning with the low means observed across all constructs. Theme 9 and Theme 10 together confirmed the collaborative and resource-dependent nature of post-harvest practice, with NGO officers noting that direct resource provision can activate behaviour even among farmers whose attitudes remain neutral or ambivalent.

Integration of Quantitative and Qualitative Findings

The joint display in Table 6 integrates quantitative path coefficients with qualitative theme explanations, generating the evidentiary foundation for the three-tier intervention framework

Table 6 Joint Display: Integration of Quantitative Path Coefficients and Qualitative Themes

Quantitative Finding	Qualitative Explanation	Framework Tier
RBPC lowest mean (2.39); RBPC → PFWRB direct ($\beta = 0.560$)	Themes 1-3: Storage, technology, and extension deficits constitute the foundational barrier	Tier 1: Resource Provision
MSN near-parity with FATT ($\beta = 0.731$ vs 0.736)	Themes 4-6: Chief authority, peer reciprocity, and NGO convergence powerfully shape intention	Tier 2: Motivation Enhancement
CFWRI mediates but R^2 (PFWRB) = 0.368	Themes 7-10: Intention alone insufficient; collaborative infrastructure required for enactment	Tier 3: Systemic Transformation

The integration reveals a hierarchy of intervention priority. Resource provision (Tier 1) constitutes the necessary foundation: without storage infrastructure, processing technology, and extension services, neither attitudinal nor normative change can materialise in behaviour. Motivation enhancement (Tier 2) leverages the powerful normative forces chief authority, peer networks, NGO convergence that operate with near-parity to attitudes. Systemic transformation (Tier 3) addresses the institutional fragmentation that undermines both resource efficiency and normative coherence, particu-

larly the need to harmonise the operations of 33 competing NGOs within a unified national strategy.

Discussion

The Three-Tier Behavioural Intervention Framework

The integrated findings yield a Three-Tier Behavioural Intervention Framework for multi-stakeholder post-harvest loss reduction (Figure 1). The framework synthesises the PLS-SEM results, mediation analysis, and thematic findings into a hierarchical, actionable architecture grounded in the TPB and its extensions.

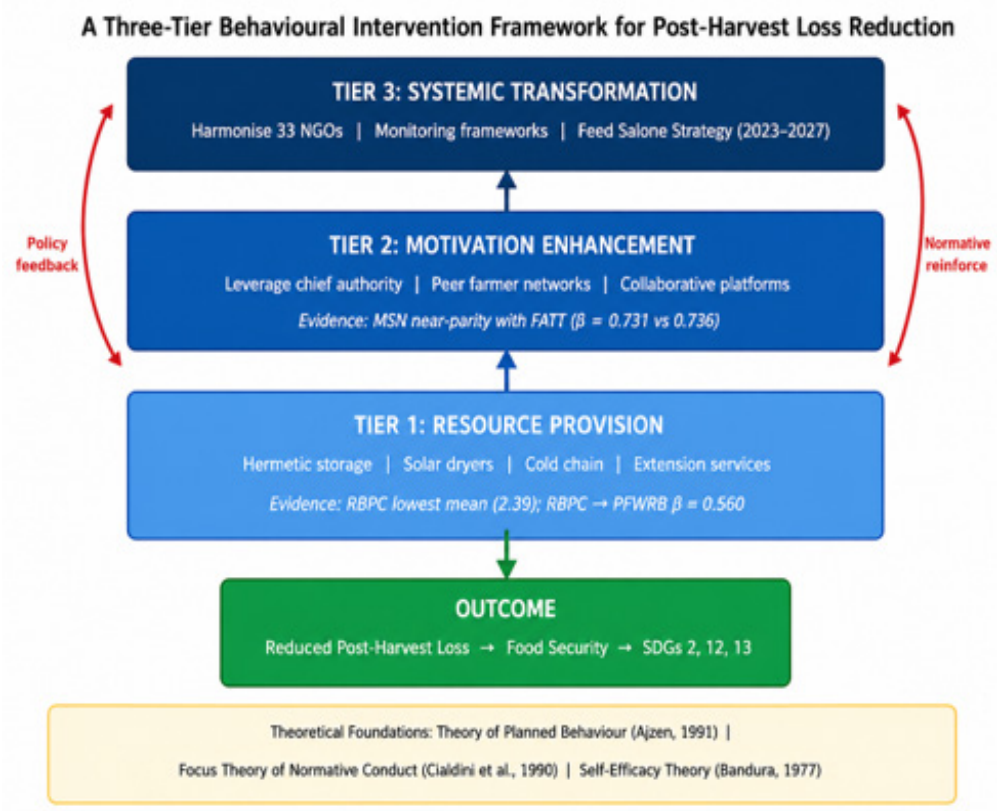


Figure 2. Three-Tier Behavioural Intervention Framework

Tier 1: Resource Provision addresses the foundational deficit identified through RBPC's status as the lowest-mean construct and its direct pathway to behaviour (β = 0.560). The thematic analysis confirmed that farmers experience storage infrastructure, processing technology, and extension services as binding constraints. Interventions at this tier include the provision of hermetic storage bags, solar dryers, cold-chain infrastructure, and the rehabilitation of extension service networks. The direct RBPC → PFWRB path suggests that resource provision can enable behaviour even in the absence of complete attitudinal or normative alignment a finding with immediate policy relevance for contexts where time and funding do not permit extended behaviour-change campaigns (Ajzen, 2002).

Tier 2: Motivation Enhancement leverages the near-parity of normative and attitudinal influences on collaborative intention. The PLS-SEM results showed MSN (β = 0.731) and FATT (β = 0.736) as virtually equivalent predictors of CF-WRI, a finding that challenges the common assumption in agricultural development that attitude change must precede behaviour change. The qualitative data revealed three potent normative levers: traditional chief authority (Theme 4), peer reciprocity networks (Theme 5), and NGO message convergence (Theme 6). Interventions at this tier should engage chiefs as normative endorsers of post-harvest best practices, strengthen peer farmer networks as vehicles for social learning, and coordinate NGO messaging to maximise normative convergence rather than contradictory signals.

Tier 3: Systemic Transformation addresses the institutional context within which Tiers 1 and 2 operate. The "33 NGO paradox" intensive aid presence alongside persistent losses signals a coordination failure that undermines both resource efficiency and normative coherence. The mediation analysis revealed that collaborative intention explains only 36.8% of behavioural variance, indicating that individual and group-level psychological variables, while necessary, are insufficient without systemic alignment. Tier 3 interventions include the harmonisation of NGO activities within Sierra Leone's Feed Salone Strategy (2023-2027), the establishment of district-level monitoring frameworks for post-harvest outcomes, and the integration of private-sector actors into collaborative platforms.

Theoretical Implications

The findings advance the TPB in three respects. First, the decomposition of perceived behavioural control into its resource-based component (RBPC) and the demonstration of its dual indirect and direct pathways supports Ajzen's (2002) theoretical elaboration while extending it to a developing-country agricultural context. Second, the substitution of individual subjective norms with multi-stakeholder norms (MSN) provides a framework for operationalising normative influence in aid-intensive settings where multiple referent groups simultaneously shape farmer decision-making (Cialdini et al., 1990). Third, the mediating role of collaborative intention (CFWRI) as opposed to individual intention extends Gollwitzer's (1999) implementation intention framework to collective action contexts, where the "if-then" plans must incorporate social coordination.

The near-parity of attitudinal and normative path coefficients ($\beta = 0.736$ vs. 0.731) challenges the hierarchy typically assumed in Western TPB applications, where attitude often dominates. In Bo District, where survival interdependence and chiefly authority structures remain robust, normative pressures may carry equivalent or even greater weight than individual evaluation. This finding aligns with Cialdini et al.'s (1990) focus theory and underscores the need for culturally adaptive TPB operationalisations in collectivist, high-interdependence contexts.

Policy Implications

The framework carries direct implications for Sierra Leone's Feed Salone Strategy (2023-2027), which aims to achieve food self-sufficiency through import substitution and productivity enhancement. The strategy's current emphasis on input provision (seeds, fertiliser) should be complemented by a Tier 1 focus on post-harvest infrastructure, which the present findings identify as the most binding constraint. The Feed Salone monitoring framework should incorporate post-harvest loss indicators alongside production metrics, recognising that increased harvests without reduced losses may yield minimal net food security gains.

The framework also contributes to the Sustainable Development Goals. SDG 2 (Zero Hunger) is directly advanced through the reduction of post-harvest food loss, which increases the effective food supply without requiring additional land, water, or input use. SDG 12 (Responsible Consumption and Production) is served through the promotion of efficient food systems. SDG 13 (Climate Action) benefits because post-harvest losses contribute to greenhouse gas emissions through the decomposition of wasted biomass; reducing these losses offers a low-cost mitigation pathway relative to production-side interventions (Lobell et al., 2011).

Conclusion

Key Contributions

This study makes three contributions. It provides the first systematic application of the TPB to multi-stakeholder post-harvest loss reduction in a post-conflict African context, demonstrating that the theory's core propositions hold while requiring contextual adaptation specifically, the extension to multi-stakeholder norms and resource-based perceived control. The mixed-methods integration yields a Three-Tier Behavioural Intervention Framework that translates behavioural science into actionable policy architecture, addressing the resource-norm-behaviour hierarchy that governs post-harvest practice in Bo District and, by extension, similar contexts across SSA. The empirical documentation of the "33 NGO paradox" intensive aid presence alongside persistent losses provides a case study in coordination failure that should inform the design of multi-stakeholder agricultural initiatives globally.

Recommendations for the NGOs

Based on the findings, the following recommendations are directed at the NGO community in Bo District. Adopt a resource-first approach: prioritise storage infrastructure and technology provision over awareness campaigns, given that resource deficits constitute the foundational bottleneck and can enable behaviour independent of attitude change. Engage traditional chiefs as normative endorsers rather than bypassing indigenous authority structures; chief-endorsed practices carry greater behavioural weight than externally imposed protocols. Establish inter-NGO coordination platforms to harmonise messaging, pool resources, and eliminate contradictory signals that undermine normative convergence. Fourth, integrate collaborative intention-building into programme design by framing post-harvest practices as collective undertakings requiring mutual commitment rather than individual adoption decisions.

Limitations and Future Research

This study is subject to several limitations. First, the cross-sectional design precludes causal inference; the structural relationships, while theory-grounded, may reflect reverse causation or unmeasured confounding. Longitudinal designs tracking the implementation of the three-tier framework would strengthen causal claims. Second, the reliance on self-reported behaviour for PFWRB introduces potential social desirability bias, though the anonymity of survey administration and the convergence of farmer self-reports with NGO and government assessments partially mitigate this concern. Third, the sample is geographically concentrated in Bo District, and while the district's characteristics are representative of much of rural Sierra Leone, generalisation to other SSA countries requires caution. Future research should test the three-tier framework in additional districts and countries to assess its external validity. Experimental or quasi-experimental designs randomising the sequential implementation of Tiers 1, 2, and 3 would illuminate their relative contributions and potential interaction effects. The incorporation of objective post-harvest loss measurements rather than self-reported behaviour would strengthen the

outcome assessment and enable cost-effectiveness analyses of tier-specific interventions.

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