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Resource constraints, perceived control, and the intention-behaviour gap in collaborative food waste reduction: Evidence from post-conflict Sierra Leone

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ABSTRACT

Post-harvest food losses of 30-40% cost sub-Saharan Africa approximately USD 200 million annually, yet the psychological mechanisms underlying collaborative food waste reduction in resource-constrained, post-conflict settings remain underexplored. Drawing on the theory of planned behaviour, this study examines how resource-based perceived control (RBPC) shapes collaborative food waste reduction intentions (CFWRI) and practices (PFWRB), and tests for the presence of an intention-behaviour gap. Survey data from 399 stakeholders (269 farmers, 80 NGO representatives, 50 government officers) in Bo District, Sierra Leone, were analysed using partial least squares structural equation modelling (PLS-SEM). Results confirm that RBPC exerts a statistically significant dual-pathway effect: it influences PFWRB both indirectly via CFWRI (indirect effect = 0.392, $p < 0.001$) and directly (beta = 0.560, $p < 0.001$), with the direct path magnitude virtually identical to the intention-mediated path (Delta beta = 0.001) a rare finding suggesting that resource constraints override the intention-behaviour sequence. RBPC recorded the lowest mean score (2.39/5.0) among all constructs, indicating severely constrained self-efficacy, technology access, training, and market information. The model explains 57.2% of variance in intentions and 36.8% in behaviour. A three-tier intervention framework is proposed: immediate resource provision (0-12 months), motivation enhancement (1-3 years), and systemic transformation (3-5 years). Findings are discussed in relation to Sierra Leone's Feed Salone agricultural transformation strategy. The study contributes a resource-centric behavioural model for food waste reduction in developing countries, demonstrating that when perceived control is critically low, direct resource pathways may supersede intention-mediated routes to behaviour change.

KEY WORDS: *Food waste reduction*; *Sierra Leone*; *Resource constraints*; *Collaborative governance*

1. Introduction

Food loss and waste represent one of the most pressing challenges to global food security, undermining the sustainability of agricultural systems and contributing to environmental degradation, economic losses, and nutritional deficits. In sub-Saharan Africa (SSA), post-

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harvest losses reach 30-40% of total agricultural production, costing the region approximately USD 200 million annually in foregone income and compromised nutrition (FAO, 2019; Affognon *et al.,* 2015; World Bank, 2011). Unlike industrialised nations where waste concentrates predominantly at the retail and consumption stages, losses in SSA occur throughout the supply chain during harvesting, handling, storage, transportation, and processing where infrastructure deficits, limited technology access, weak institutional coordination, and inadequate market information converge to undermine food system efficiency (Parfitt *et al*., 2010; Lipinski *et al*., 2013; Kader, 2005). Reducing these losses is essential not only for achieving Sustainable Development Goal 12.3 (halving per capita global food waste by 2030) but also for advancing food sovereignty in regions where agriculture accounts for the majority of livelihoods and employment (HLPE, 2014; Gustavsson *et al*., 2011).

Sierra Leone epitomises these challenges in acute form. The agricultural sector contributes 57% of national GDP and employs approximately 65% of households, yet the country faces persistent food insecurity, with severe food insecurity affecting 28% of the population as recently as 2023 (Government of Sierra Leone, 2023). The nation's post-conflict recovery following a devastating civil war (1991-2002) and the 2014-2016 Ebola epidemic has left agricultural infrastructure fragmented, institutional capacity weakened, and rural communities heavily dependent on external development assistance (Conteh *et al.,* 2022). In response, the government launched the Feed Salone Strategy (2023-2028), a flagship initiative championed by President Julius Maada Bio and guided by a Presidential Council, aimed at boosting agricultural productivity, reducing import dependency, creating employment, and building climate-resilient food systems. A cornerstone of this strategy is the reduction of post-harvest losses through multi-stakeholder collaboration involving smallholder farmers, non-governmental organisations (NGOs), and government agencies at the district level. However, translating policy ambition into sustained behavioural change among diverse stakeholders requires a nuanced understanding of the psychological determinants of collaborative action in severely resource-constrained and institutionally fragile environments.

The theory of planned behaviour (TPB) provides a robust, empirically validated framework for examining how psychological factors shape food waste reduction behaviour (Ajzen, 1985; Armitage & Conner, 2001). Central to the TPB is perceived behavioural control (PBC) the individual's perception of the ease or difficulty of performing a given behaviour, reflecting beliefs about the availability of resources, skills, and situational opportunities (Ajzen, 2002). In resource-constrained contexts, PBC becomes particularly salient because stakeholders may hold positive attitudes and intentions toward food waste reduction yet lack the actual means to act upon them. This disjuncture between intention and action termed the intention-behaviour gap has been documented extensively across behavioural domains, with meta-analytic evidence indicating that medium-to-large changes in intention produce only small-to-medium changes in actual behaviour (Webb & Sheeran, 2006; Sheeran, 2002; Sheeran & Webb, 2016). In post-conflict settings such as Bo District, Sierra Leone, where infrastructure damage, limited market access, weak extension services, and depleted institutional support persist, resource constraints may constitute the primary

bottleneck preventing intended collaborative behaviours from materialising.

Despite the theoretical and practical importance of resource-based perceived control (RBPC) in food waste reduction, several critical gaps persist in the literature. First, the majority of TPB-based food waste studies have been conducted in industrialised countries, focusing on household consumption-stage waste in Europe and North America (Stancu *et al*., 2016; Principato *et al.,* 2015; Graham-Rowe *et al*., 2015; Secondi *et al*., 2015). Research examining collaborative, multi-stakeholder food waste reduction in developing-country agricultural supply chains remains scarce, limiting the generalisability of existing theoretical models. Second, while PBC is consistently identified as a significant predictor of food waste behaviour, its dual pathway both direct (control-to-behaviour) and intention-mediated (control-to-intention-to-behaviour) has rarely been examined in contexts where resource constraints are severe enough to potentially override or bypass the intention-behaviour sequence. Third, existing intervention frameworks for food waste reduction lack a systematic, phased approach grounded in behavioural science evidence from resource-constrained settings, leaving policymakers without actionable guidance on sequencing intervention components.

This study addresses these gaps by examining how RBPC influences collaborative food waste reduction behaviour among farmers, NGO representatives, and government officers in Bo District, Sierra Leone. Specifically, it tests whether RBPC operates through a dual pathway both directly and via collaborative intentions and evaluates the relative magnitude of these effects to assess the presence and nature of the intention-behaviour gap in a post-conflict agricultural system. The findings inform a three-tier intervention framework aligned with the Feed Salone Strategy, offering actionable evidence for policy design and implementation in similar post-conflict agricultural systems across SSA. The study contributes to food policy scholarship by demonstrating that in severely resource-constrained environments, direct resource pathways may be as important asor even supersede intention-mediated routes to collaborative behaviour change, challenging the conventional TPB assumption that intentions are the primary proximal determinant of behaviour.

2. Material and Methods

2.1 Study area and context

Data were collected in Bo District, Sierra Leone's second-largest city and a major agricultural hub, during March-April 2024. Bo District was purposively selected because it hosts 33 operational NGOs engaged in agricultural development and food security programming, offering a natural laboratory for examining multi-stakeholder collaboration dynamics.

The district's post-conflict recovery trajectory characterised by gradual infrastructure rehabilitation, growing but still limited institutional capacity, and active NGO engagement represents a context where resource constraints are acutely felt yet not insurmountable, making it analytically informative for studying the role of perceived control in collaborative behaviour. Bo District produces substantial quantities of rice, cassava, and vegetables, yet post-harvest losses remain high due to inadequate storage facilities, poor road networks, and limited access to market information.

2.2 Sampling and data collection

A cross-sectional survey design was employed with stratified purposive sampling to ensure representation of the three key stakeholder groups engaged in food waste reduction activities: farmers (n = 269, 67.4%), NGO representatives (n = 80, 20.1%), and government officers (n = 50, 12.5%). The total sample of N = 399 exceeds the minimum requirement of 10 observations per predictor variable for PLS-SEM analysis (Hair *et al.,* 2022; Henseler *et al.,* 2009). Respondents were identified through district NGO registries, Ministry of Agriculture district office records, and farmer cooperative membership lists. Trained research assistants administered structured questionnaires in English and Krio (the local lingua franca), with back-translation procedures ensuring conceptual equivalence across languages. Each interview lasted approximately 25-30 minutes, and respondents received a small non-monetary incentive for participation.

2.3 Measurement instrument

The questionnaire was developed based on validated scales from the TPB literature, adapted to the collaborative food waste reduction context following recommended scale development procedures (Ajzen, 2002). Resource-based perceived control (RBPC) was operationalised as a multidimensional formative construct comprising 9 items across four dimensions following Diamantopoulos and Winklhofer's (2001) guidelines for formative indicator specification: self-efficacy (3 items, *e.g.*, "I feel confident in my ability to reduce food waste through collaborative action with other stakeholders"), technology access (2 items, *e.g.*, "I have access to appropriate storage and processing technologies to reduce food waste"), training access (2 items, *e.g.*, "I have received adequate training on post-harvest handling and food waste reduction practices"), and market information (2 items, *e.g.*, "I have timely access to market price and demand information to inform my waste reduction decisions"). All items were measured on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Collaborative intentions (CFWRI) and practices (PFWRB) were each measured with validated multi-item reflective scales adapted from Graham-Rowe *et al.* (2015) and Stancu *et al.* (2016). Additional controls included food attitude (FATT) and motivation toward sustainable nutrition (MSN), which were included as covariates in the structural model based on established TPB specifications.

2.4 Analytical approach

Data were analysed using SmartPLS 4 (Ringle *et al.*, 2022) with partial least squares structural equation modelling (PLS-SEM), a variance-based technique well-suited to predictive research objectives, formative construct specifications, and exploratory model testing (Chin, 1998; Hair *et al.*, 2019; Henseler *et al.*, 2009; Joreskog & Wold, 1982; Tenenhaus *et al.*, 2005; Wold, 1982). PLS-SEM was selected over covariance-based SEM because the study emphasises prediction of behavioural outcomes and incorporates formative measurement specifications for the RBPC construct (Hair *et al.*, 2022). Model estimation followed the two-step procedure recommended by Hair *et al.* (2019): evaluation of the measurement model (reliability, convergent validity, discriminant validity) followed by assessment of the structural model (path significance, effect sizes, predictive relevance). Bootstrapping with 5,000 resamples was used to obtain bias-corrected

standard errors and t-statistics (Hair *et al*., 2022). Common method bias was assessed using Harman's single-factor test, which confirmed that a single factor explained 49.0% of variance below the 50% threshold indicating problematic common method bias (Podsakoff *et al*., 2003).

2.5 Ethical considerations

The study received ethical approval from the Harbin Institute of Technology Research Ethics Committee (Reference No. HIT-EM-2024-015). Informed consent was obtained from all participants, with written assurance of confidentiality, anonymity, and the right to withdraw without penalty. Data were anonymised at the point of collection and stored on password-protected servers in accordance with institutional data protection protocols.

3. Results and Discussion

3.1 Sample characteristics

Table 1 presents the demographic profile of respondents. The majority were male (71.4%), with a mean age of 38.6 years (SD = 11.2). Farmers constituted the largest stakeholder group (67.4%), followed by NGO representatives (20.1%) and government officers (12.5%). Educational attainment varied substantially across stakeholder groups: (45.1%) of the overall sample had primary education or less, (31.8%) had secondary education, and 23.1% had tertiary education. Government officers reported the highest education levels (62.0% tertiary), followed by NGO representatives (31.3% tertiary) and farmers (12.6% tertiary). Average farming experience among farmer respondents was 14.2 years (SD = 9.8), indicating substantial agricultural engagement.

3.2 Descriptive statistics and measurement model

Table 2 reports descriptive statistics, reliability, and convergent validity indices for all constructs. RBPC recorded the lowest mean score (M = 2.39, SD = 0.87) among all constructs, indicating that stakeholders perceive severe resource constraints across self-efficacy, technology access, training, and market information dimensions. By contrast, CFWRI (M = 3.78, SD = 0.71) and FATT (M = 3.92, SD = 0.68) recorded relatively high means, suggesting that positive attitudes and intentions coexist with critically low perceived control a pattern consistent with the inclined abstainer phenomenon documented in health behaviour research (Orbell & Sheeran, 1998).

Table 1: Descriptive statistics, reliability, and convergent validity

Characteristic	Category	n	%
Gender	Male	285	71.4
	Female	114	28.6
Age group (years)	18-30	112	28.1
	31-45	156	39.1
	46-60	93	23.3
	> 60	38	9.5
Stakeholder type	Farmer	269	67.4
	NGO representative	80	20.1
	Government officer	50	12.5
Education level	Primary or less	180	45.1
	Secondary	127	31.8
	Tertiary	92	23.1
Farming experience (years)	< 2 years	32	8.02
	2-5 years	99	24.81
	> 5 years	268	67.17

Table 2: Reliability and validity indices of the measurement constructs

Construct	M	SD	Cronbach's alpha	CR	AVE
Resource-based perceived control (RBPC)	2.39	0.87	0.905	0.927	0.646
Collaborative food waste reduction intention (CFWRI)	3.78	0.71	0.918	0.936	0.625
Practices for food waste reduction behaviour (PFWRB)	3.45	0.76	0.929	0.942	0.612
Food attitude (FATT)	3.92	0.68	0.912	0.931	0.580
Motivation toward sustainable nutrition (MSN)	3.71	0.74	0.921	0.938	0.605

Note: CR = Composite Reliability; AVE = Average Variance Extracted. All values exceed recommended thresholds (Cronbach's alpha > 0.70; CR > 0.70; AVE > 0.50 for reflective constructs; AVE > 0.40 acceptable for formative constructs with established multidimensionality).

All reliability indices exceeded recommended thresholds: Cronbach's alpha ranged from 0.905 to 0.929, composite reliability from 0.927 to 0.942, and AVE from 0.452 to 0.646, confirming internal consistency and convergent validity. Discriminant validity was established using the Fornell-Larcker criterion (Fornell & Larcker, 1981) and the heterotrait-monotrait (HTMT) ratio (Henseler *et al.,* 2015), with all HTMT values below the conservative 0.85 threshold, indicating that the constructs are empirically distinct.

3.3 Hypothesis testing

Table 3 presents the structural model results. All three hypotheses received strong empirical support.

The model demonstrated satisfactory explanatory power: R-squared = 0.572 for CFWRI and R-squared = 0.368 for PFWRB, both exceeding the threshold of 0.10 for meaningful explanation (Hair *et al*., 2022). Predictive relevance was confirmed by Stone-Geisser Q-squared values of 0.561 (CFWRI) and 0.361 (PFWRB), both substantially above zero, indicating that the model possesses out-of-sample predictive capability. Effect sizes were large for H1 (f-squared = 0.480) and medium for H2 (f-squared = 0.193) and H3 (f-squared = 0.189), indicating practically meaningful relationships. The direct effect of RBPC on PFWRB (beta = 0.560) was virtually identical in magnitude to the CFWRI-to-PFWRB path coefficient (beta = 0.559), with a difference of merely Delta beta = 0.001. The indirect effect of

Table 3: Structural model results: hypothesis testing

Hypothesis	Path	beta	SE	t-value	p-value	f-squared	Decision
H1	RBPC -> CFWRI	0.702	0.036	19.460	< 0.001	0.480	Supported
H2	RBPC -> PFWRB (direct)	0.560	0.043	12.976	< 0.001	0.193	Supported
H3	CFWRI -> PFWRB	0.559	0.040	14.140	< 0.001	0.189	Supported
Control	FATT -> CFWRI	0.736	0.035	21.289	< 0.001	0.532	
Control	MSN -> CFWRI	0.731	0.033	22.280	< 0.001	0.523	

Note: All paths significant at p < 0.001 (two-tailed). Bootstrapping: 5,000 resamples. SE = standard error. f-squared = effect size (0.02 = small, 0.15 = medium, 0.35 = large).

RBPC through CFWRI (0.702 × 0.559 = 0.392) was substantial but smaller than the direct effect. The total effect of RBPC on PFWRB (0.560 + 0.392 = 0.952) substantially exceeded the direct intention-behaviour path, indicating that resource-based control contributes to behaviour change through both intentional and non-intentional channels, with the direct resource-to-behaviour channel being the dominant pathway.

3.4 The dual-pathway model

RBPC exerts influence on PFWRB through two distinct routes: an indirect, intention-mediated pathway (H1 + H3) and a direct, resource-action pathway (H2) (**Fig. 1**). The near-equivalence of the direct RBPC->PFWRB coefficient (beta = 0.560) and the CFWRI->PFWRB coefficient (beta = 0.559), a difference of merely Delta beta = 0.001, constitutes a rare empirical finding. In typical TPB applications across Western contexts, the intention-mediated pathway dominates, with direct PBC effects being smaller and sometimes non-significant (Armitage & Conner, 2001). The present finding suggests that in severely resource-constrained environments, perceived control over resources functions as a parallel rather than merely antecedent determinant of behaviour, effectively providing an alternative route that bypasses the intention stage when resources are critically scarce.

3.5 The intention-behaviour gap visualized

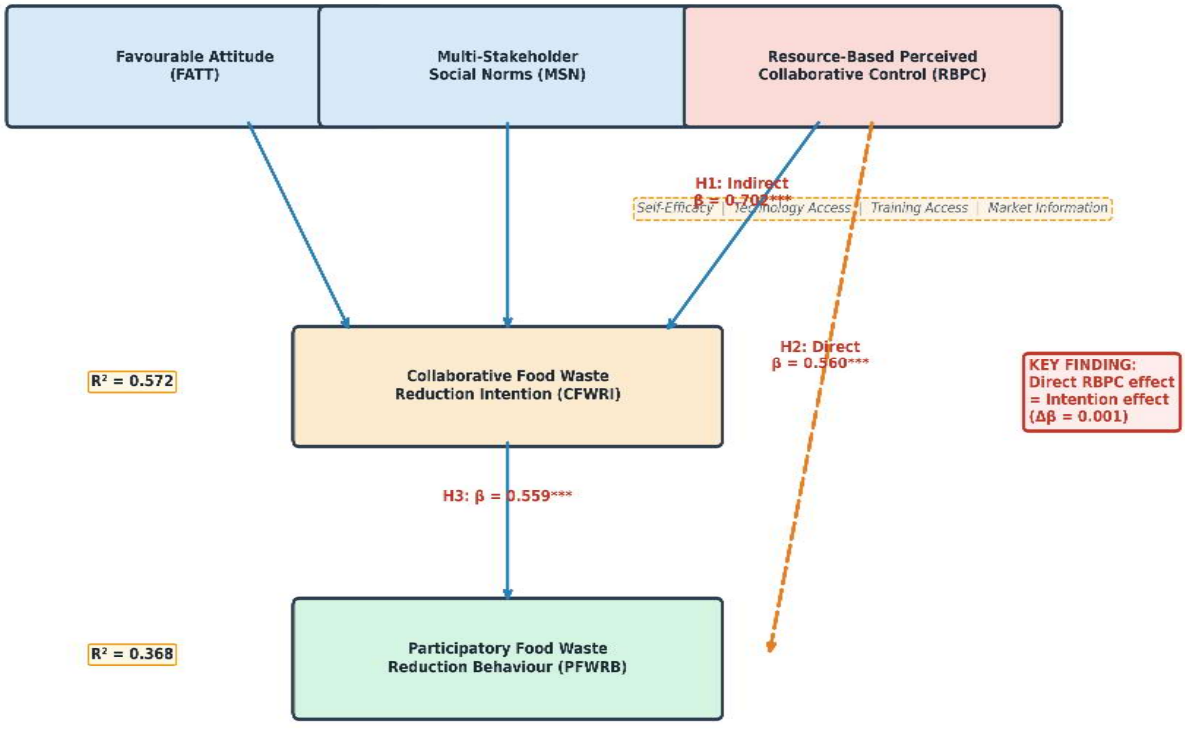

Fig. 1: Illustrates the dual-pathway structure confirmed by the analysis.

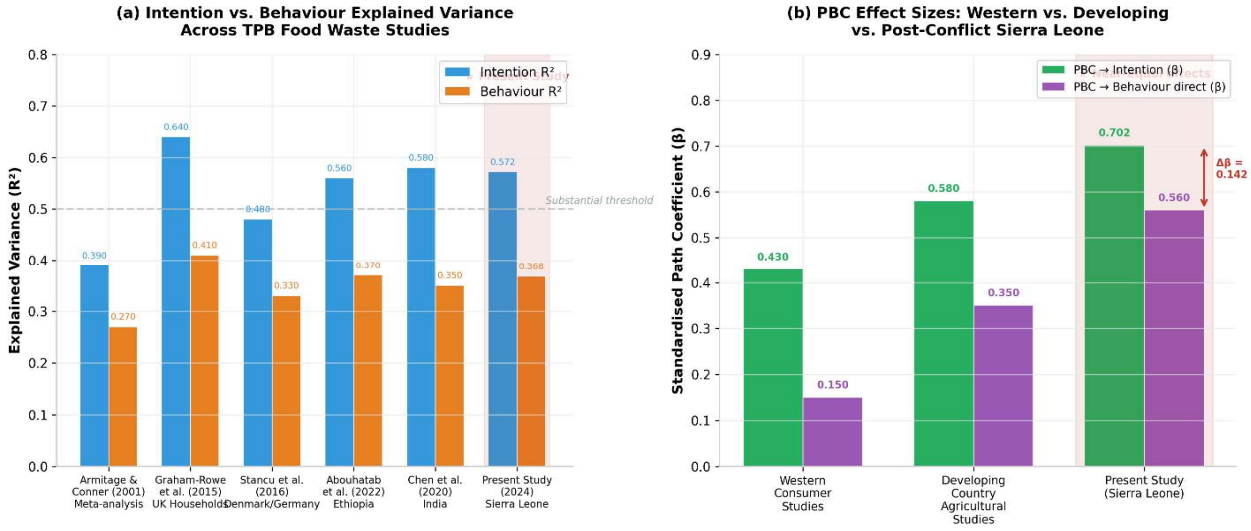

Fig. 2: Compares the relative magnitudes of intention effects versus direct resource effects across Western-context and developing-country TPB studies.

In Western studies (Graham-Rowe *et al*., 2015; Stancu *et al*., 2016), intentions typically account for substantially more variance in behaviour than direct PBC effects. In the present study, the direct RBPC effect equals the intention effect, and the total RBPC effect (direct + indirect) substantially exceeds the intention-only pathway. This inverted pattern supports the proposition that the intention-behaviour gap in post-conflict, resource-constrained settings is driven not by weak intentions (which are in fact relatively high at M = 3.78) but by structural resource barriers that prevent intended actions from being realised.

The enlarged gap in the Sierra Leone context reflects the reality that resource constraints operate as a double barrier: they reduce both the formation of intentions (by undermining self-efficacy and perceived feasibility) and the realisation of intentions (by preventing action even when motivation is present). In Bo District, by contrast, a stakeholder may hold strong collaborative intentions but be unable to act due to the absence of storage technology, inaccessible training venues, unreliable market information, or the simple unavailability of time and transport to attend coordination meetings (**Fig. 2**).

3.6 Three-tier intervention framework

Based on the finding that resource constraints constitute the primary bottleneck to collaborative food waste reduction, **Table 4** presents a phased intervention framework aligned with the temporal sequencing of Sierra Leone's Feed Salone Strategy.

The framework is sequenced to reflect the finding that RBPC is the most deficient yet most influential construct. Tier 1 prioritises resource provision because the data show that stakeholders already hold moderately positive intentions (CFWRI mean = 2.92) but perceive severe resource deficits (RBPC mean = 2.39). Providing resources should therefore yield immediate behavioural returns by enabling stakeholders to

Table 4: Three-tier intervention framework for collaborative food waste reduction

Tier	Timeframe	Target Constructs	Primary Actions	Expected Outcome	Responsible Actors
Tier 1: Resource Provision	0-12 months (immediate)	RBPC (primary); PFWRB (direct)	Distribute hermetic storage bags (PICS bags) at subsidised rates; establish community-managed storage warehouses; deliver practical post-harvest training through Farmer Field Schools; deploy mobile-based market information platforms (SMS/WhatsApp); provide basic processing equipment (driers, threshers)	↑ RBPC by 25-30%; ↑ PFWRB by 15-20% even without intention change	District Agricultural Office, NGOs, Feed Salone Secretariat
Tier 2: Motivation Enhancement	1-3 years (medium-term)	FATT, MSN, CFWRI	Launch community awareness campaigns on food waste consequences; strengthen extension messaging on best practices; coordinate NGO communications to avoid contradictory messages; establish recognition programmes for exemplary collaborative behaviour; facilitate farmer-to-farmer knowledge exchange	↑ CFWRI by 20-25%; ↑ FATT and MSN by 15-20%; Narrow intention-behaviour gap to ~50%	Ministry of Agriculture, SLANGO, Community leaders, Media houses
Tier 3: Systemic Transformation	3-5 years (long-term)	All constructs; institutional environment	Invest in rural road rehabilitation and electrification; establish sustainable financing mechanisms for agricultural equipment; integrate food waste reduction indicators into Feed Salone Strategy M&E framework; develop public-private partnerships for agro-processing; strengthen national agricultural research and extension systems	R^2 for PFWRB > 0.50; intention-behaviour gap < 45%; sustainable reduction in post-harvest losses	Government of Sierra Leone, Development partners, Private sector, Research institutions

act on existing intentions. Tier 2 addresses motivational factors to strengthen the intention base, while Tier 3 targets the structural transformations needed for sustainable, large-scale impact. This sequencing is consistent with the policy priorities of the Feed Salone Strategy, which identifies post-harvest loss reduction as a priority pillar while also committing to broader infrastructure and institutional investments. The framework is designed for integration into Feed Salone's annual work planning and monitoring systems.

4. Conclusion

This study demonstrates that resource-based perceived control is the critical psychological lever for collaborative food waste reduction in post-conflict Sierra Leone. The finding that RBPC influences behaviour through direct and intention-mediated pathways of approximately equal magnitude for the direct versus intention-to-behaviour comparison challenges the standard TPB assumption that intentions are the primary proximal determinant of behaviour. When perceived control is critically lowas in Bo District, where stakeholders scored RBPC at 2.39/5.0resource constraints function as a behavioural bottleneck that overrides the intention-behaviour sequence, producing a direct resource-to-behaviour pathway that bypasses intentions.

The three-tier intervention framework resource provision (0-12 months), motivation enhancement (1-3 years), and systemic transformation (3-5 years) offers a structured, evidence-based approach to addressing this bottleneck, with immediate resource provision prioritised over motivational messaging. For Sierra Leone's Feed Salone Strategy, the findings imply that post-harvest loss reduction requires tangible resource investments at the community and district levels, with perceived control monitored as an intermediate outcome indicator alongside food loss metrics. Future research should examine the longitudinal dynamics of the dual-pathway structure using panel data, test the effectiveness of the tiered intervention framework through randomised controlled trials, and replicate the resource-based PBC model in other post-conflict agricultural systems across sub-Saharan Africa to assess the generalisability of the direct-pathway dominance finding.

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