ADDRESSING FOOD LOSS AND WASTE IN THE AGRICULTURAL PERISHABLE FOOD SUPPLY CHAINS OF EMERGING RURAL INDIA - B2B CONTEXT

A THESIS

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Thesis Abstract

Food loss and waste (FLW) in agricultural perishable food supply chains (APFSCs) constitutes a significant challenge for emerging economies, with adverse implications for food security, rural incomes, environmental sustainability, and supply chain performance. In India, FLW is particularly pronounced due to fragmented market structures, infrastructural inadequacies, limited coordination among supply chain actors, and uneven development of organisational capabilities across business-to-business (B2B) agri-food systems. Although existing literature has documented the extent of FLW and identified several operational drivers, empirical evidence remains limited in explaining how organisational capabilities interact under institutional and contextual constraints to generate FLW, which capabilities act as binding constraints, and how FLW subsequently affects sustainability performance. This doctoral thesis addresses these gaps through three interrelated empirical essays grounded in the Contingent Resource-Based View (CRBV) and a capability-based (Dynamic and Operational Capabilities) perspective.

The first essay examines the causal complexity associated with FLW in rural B2B APFSCs by identifying organisational capabilities that are necessary, sufficient, or effective only in specific combinations. Using survey data from 333 APFSC actors in India including farmers, wholesalers, processors, distributors, and cold storage operators, the study adopts a multi-method analytical approach combining Partial Least Squares Structural Equation Modelling (PLS-SEM), Necessary Condition Analysis (NCA), and fuzzy-set Qualitative Comparative Analysis (fsQCA). PLS-SEM is used to validate latent constructs and estimate relationships among capabilities and FLW. The resulting latent variable scores are subsequently employed in NCA to identify minimum capability thresholds and in fsQCA to uncover non-linear and equifinal capability configurations associated with varying FLW outcomes. The findings indicate that FLW does not arise from isolated deficiencies but from interdependent and context-contingent capability gaps, particularly related to cold-chain infrastructure, digital information systems, training, market linkages, and coordination mechanisms. Several capabilities emerge as necessary but not sufficient conditions, while others influence FLW only within particular configurations, highlighting asymmetric and complementary effects. This essay extends CRBV by demonstrating that the effectiveness of capabilities in APFSCs depends on institutional conditions, actor interdependencies, and minimum resource thresholds.

The second essay investigates how capability misalignments within B2B APFSCs influence perceived FLW severity and how FLW, in turn, affects triple bottom line sustainability outcomes. Drawing on the same dataset, this essay employs PLS-SEM to analyse the effects of operational, digital, relational, and human capabilities on FLW exposure and the downstream impacts of FLW on economic, environmental, and social sustainability. The results show that deficiencies in ICT knowledge, weak supply chain partnerships, and inefficient stakeholder behaviour are positively associated with FLW, whereas

operational capabilities exhibit limited direct effects once relational and knowledge-based capabilities are incorporated into the model. Contrary to conventional assumptions regarding the role of intermediaries, the findings indicate that Farmer Producer Companies (FPC) are associated with lower FLW, reflecting their aggregation, coordination, and governance functions. The analysis further confirms that FLW exerts a statistically significant and negative effect across all three sustainability dimensions. This essay contributes to CRBV by showing that the sustainability value of resources in APFSCs is contingent on relational and institutional alignment rather than on resource availability alone.

The third essay focuses on the interaction between dynamic capabilities, operational capabilities, and education and training in shaping FLW outcomes in rural B2B contexts. Using a moderated mediation framework and analysing the data through PLS-SEM, the essay examines the direct and indirect effects of dynamic capabilities on FLW and the conditional role of education and training. The findings indicate that stronger dynamic capabilities, particularly ICT knowledge and supply chain partnerships, are associated with lower FLW. While operational capabilities display a direct negative relationship with FLW, their mediating role is limited, except in ICT-related pathways. Education and training do not consistently moderate relationships; however, conditional analyses suggest that higher levels of training reduce the adverse impact of ICT deficiencies on FLW. The results indicate the contingent effectiveness of capabilities in resource-constrained, perishable agri-food systems.

Taken together, the three essays provide a comprehensive and empirically grounded explanation of FLW in APFSCs. The thesis contributes theoretically by extending CRBV to incorporate causal asymmetry, equifinality, and minimum capability thresholds in the analysis of sustainability outcomes. Methodologically, it demonstrates the value of integrating PLS-SEM, NCA, and fsQCA to address causal complexity in supply chain research. From a managerial and policy perspective, the findings highlight the importance of coordinated capability development, strengthening intermediary institutions such as Farmer Producer Companies, targeted ICT capacity building, and collaborative governance mechanisms to reduce FLW and support Sustainable Development Goal 12.3 in emerging rural economies.

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List of Abbreviations

AHP	Analytic Hierarchy Process
APFSCs	Agricultural Perishable Food Supply Chains
AVE	Average Variance Extracted
B2B	Business-to-Business
CMB	Common Method Bias
CR	Composite Reliability
CRBV	Contingent Resource-Based View
DCs	Dynamic Capabilities
DCV	Dynamic Capabilities View
DEMATEL	Decision Making Trial and Evaluation Laboratory
ET	Education and Training
FAO	Food and Agriculture Organization
FLW	Food Loss and Waste
FPC	Farmer Producer Companies
fsQCA	fuzzy-set Qualitative Comparative Analysis
GHG	Greenhouse Gas
HOC	Higher Order Construct
HTMT	Heterotrait-Monotrait Ratio
ICT	Information and Communication Technologies
IoT	Internet of Things
ISM	Interpretive Structural Modeling
KPIs	Key Performance Indicators
LCA	Life Cycle Assessment
LOC	Lower Order Construct
MCDM	Multi-Criteria Decision-Making
MICMAC	Matrix-based Cross-Impact Multiplication Applied to a Classification
NCA	Necessary Condition Analysis
OCs	Operational Capabilities
PLS-SEM	Partial Least Squares Structural Equation Modelling
RBV	Resource-Based View
SCM	Supply Chain Management
SCP	Supply Chain Partnership
SDG	Sustainable Development Goal
TBL	Triple Bottom Line
TISM	Total Interpretive Structural Modeling
VIF	Variance Inflation Factors

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