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Reconfiguring Vegetable Supply Chains in Pakistan: Opportunities and Challenges of Farm-to-Consumer Marketing in a Developing-Economy Context

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Abstract

Conventional vegetable supply chains in Pakistan rely heavily on intermediaries, limiting farmer bargaining power, price transparency, and market access while contributing to post-harvest losses. Farm-to-consumer (F2C) models offer a potential alternative by shortening supply chains and connecting producers directly with households, institutional buyers, and digital markets. This study examines the opportunities and challenges of F2C vegetable supply chains in Pakistan using a qualitative exploratory design. Semi-structured interviews were conducted with 20 purposively selected stakeholders, including farmers, academics, government officials, supply-chain and logistics professionals, marketing and IT specialists, a farmers' association representative, and potential consumers. Interview data were transcribed, translated where required, and thematically analysed using NVivo. Eight interrelated themes emerged: intermediary dependence and market structure; economic viability; infrastructure and post-harvest constraints; digital readiness; consumer trust; corporate and institutional markets; government and policy support; and sustainability through hybrid models. Findings indicate that F2C models can improve market access and farmer returns, but disintermediation alone does not ensure supply-chain efficiency. Weak cold-chain infrastructure, high transport costs, limited digital literacy, trust deficits, and inadequate institutional support remain key barriers. Corporate and institutional buyers may provide a more viable entry point than fragmented household markets. The study therefore advocates a phased, hybrid F2C model integrating farmer cooperatives, digital platforms, logistics providers, institutional buyers, and targeted public-sector support rather than the complete removal of intermediaries. This

approach offers a more context-sensitive pathway toward efficient, inclusive, and sustainable vegetable supply chains in Pakistan.

Keywords: *digital agriculture; farm-to-consumer; intermediaries; Pakistan; short food supply chains; smallholder farmers; supply-chain resilience; vegetable marketing*

Introduction

Agrifood supply chains are undergoing rapid structural transformation as producers, intermediaries, retailers, consumers, and digital platforms respond to changing demands for efficiency, traceability, resilience, and sustainability. In developing economies, however, transformation occurs within supply chains characterized by fragmented production, weak infrastructure, information asymmetry, and strong intermediary dependence (Reardon et al., 2019). These conditions are particularly consequential for vegetables because perishability makes timing, transportation, storage, and market coordination central to economic performance.

Short food supply chains (SFSCs) and farm-to-consumer (F2C) arrangements have emerged as alternative configurations intended to reduce the distance between producers and consumers. Rather than defining short chains simply by physical distance, the literature emphasizes reduced intermediary involvement, producer-consumer relationships, traceability, and alternative forms of market coordination (Marsden et al., 2000; Renting et al., 2012; Jarzębowski et al., 2020). Such arrangements can strengthen producers' control over pricing, improve market information, and create opportunities for differentiated products and closer consumer relationships. They may also contribute to local economic development and resilience when integrated appropriately within broader food systems.

The potential benefits of direct marketing should nevertheless not be interpreted as automatic consequences of removing intermediaries. Intermediaries frequently perform aggregation, transportation, information, credit, and risk-bearing functions. Consequently, their removal without replacing these functions can transfer costs and risks to farmers. This issue is particularly important in developing countries, where infrastructure and institutional systems may be insufficient to support decentralized marketing (FAO, 2021). The COVID-19 pandemic further demonstrated both the vulnerability of centralized supply chains and the value of diversified and locally connected food channels (Richards & Rickard, 2020).

Digital technologies provide another potential mechanism for restructuring producer-consumer relationships. Mobile phones, online marketplaces, digital payments, demand forecasting, and information platforms can reduce information asymmetries and expand farmers' access to markets. Yet evidence cautions against viewing digitalization as a technological solution independent of social and institutional conditions. Adoption depends on digital literacy, trust, connectivity, usability, and complementary market infrastructure (Aker et al., 2016; Fabregas et al., 2019).

Pakistan provides an important setting for examining these tensions. Its vegetable marketing system remains characterized by multiple intermediaries and fragmented market coordination, while smallholders face constraints in transportation, storage, market information, finance, and bargaining power. The uploaded thesis identifies these structural conditions as central barriers to F2C adoption and emphasizes that direct access to consumers is difficult when farmers lack cold-chain capacity and organized distribution networks.

Although international literature increasingly examines SFSCs, digital agriculture, and alternative marketing channels, less attention has been given to how multiple stakeholders collectively perceive the feasibility of F2C vegetable marketing in Pakistan. Existing discussions frequently emphasize the advantages of disintermediation without sufficiently considering whether farmers can assume the logistical, technological, financial, and relational functions previously performed by intermediaries. This study therefore addresses a contextual gap by examining both the opportunities and structural conditions required for F2C development.

The study asks: **(1)** What opportunities do F2C vegetable supply chains create for farmers and other stakeholders in Pakistan? **(2)** What infrastructural, logistical, technological, economic, and institutional barriers constrain their adoption? **(3)** How can digital technologies facilitate F2C coordination? and **(4)** What implementation configuration is most feasible for the Pakistani context?

Methodology

Research Design

An exploratory qualitative design was employed within an interpretivist orientation. This design was appropriate because the study sought to understand stakeholder experiences, perceptions, expectations, and interpretations rather than statistically estimate relationships between predetermined variables. The approach is consistent with qualitative inquiry in which contextual meaning and experiential knowledge are central to understanding complex social and organizational phenomena (Creswell & Poth, 2018).

Participants and Sampling

Purposive sampling was used to identify information-rich participants with direct or professional knowledge of agricultural marketing, vegetable production, supply-chain management, logistics, digital marketing, information technology, agricultural policy, or consumer purchasing. Twenty stakeholders participated.

The sample comprised three academics (15%), two government officials (10%), two logistics experts (10%), three marketing/digital-marketing professionals (15%), two supply-chain experts (10%), one IT expert (5%), three vegetable farmers (15%), one farmers' association representative (5%), and three potential consumers (15%).

The sample was considered adequate on the basis of information richness and thematic saturation rather than statistical representativeness. Methodological literature suggests that sample adequacy in qualitative interviews should be determined by the information power of the sample, specificity of participants, study purpose, quality of dialogue, and analytic strategy (Malterud et al., 2016). Hennink et al. (2017) further distinguish code saturation from meaning saturation, demonstrating that richer interpretive saturation may require more interviews than merely identifying recurring topics. The thesis reports saturation within the 20-interview sample.

Data Collection

Semi-structured interviews were conducted over a three-month period. Interviews lasted approximately 45–60 minutes and were conducted face-to-face or remotely depending on participant location and availability. Interviews were conducted in Urdu or English, audio-recorded with permission, transcribed verbatim, and translated into English where necessary.

The interview protocol explored current vegetable-marketing practices, intermediary dependence, perceptions of F2C, economic benefits and costs, transportation and storage, digital platforms, consumer trust, institutional purchasing, government support, and future adoption. The interview structure was adapted to the expertise of different stakeholder categories.

Data Analysis

The data were analysed using thematic analysis. The process involved familiarization with transcripts, initial coding, development of broader categories, theme identification, review and refinement of themes, and interpretation in relation to the research objectives and conceptual framework. NVivo was used to organize the qualitative data and facilitate coding. Both deductive codes derived from the research objectives and inductive codes emerging from participant accounts were considered.

Analytic credibility was strengthened through stakeholder triangulation and discussion of coding discrepancies. Thematic analysis is particularly suitable for identifying patterned meanings across heterogeneous qualitative data when the purpose is to interpret experiences rather than produce statistical estimates (Braun & Clarke, 2006). Contemporary guidance also emphasizes coherence between research questions, epistemological position, analytic procedures, and claims made from thematic analysis (Braun & Clarke, 2021).

Ethical Considerations

Participants were informed about the purpose and procedures of the research, participation was voluntary, and informed consent was obtained. Confidentiality and anonymity were maintained through participant codes and secure storage of recordings and transcripts. Participants could withdraw without consequence.

Results

Overview of Emergent Themes

The analysis generated eight interconnected themes: (1) intermediary barriers and market structure; (2) economic viability of F2C; (3) infrastructure and post-harvest constraints; (4) digital readiness and technology adoption; (5) consumer trust and buying behaviour; (6) corporate and institutional buyers as an entry point; (7) government and policy support; and (8) sustainability through gradual and hybrid implementation. The thesis codebook further identified market access, storage constraints, transportation costs, trust, digital literacy, price volatility, infrastructure, government support, digital platforms, corporate demand, consumer preferences, post-harvest losses, branding, certification, and hygiene as recurrent analytical codes.

Intermediary Dependence and Market Structure

The first theme concerned the structural dependence of vegetable farmers on the traditional mandi system. Participants described commission agents and other intermediaries as influential in price discovery and market access. Farmers' limited bargaining power and exposure to daily price fluctuations were viewed as major disadvantages.

Importantly, participants did not describe intermediaries solely as exploitative actors. They also recognized their functional role in aggregation, rapid disposal of perishable produce, logistics, and immediate cash flow. The mandi therefore operates not simply as a marketing channel but as an institutional response to gaps in infrastructure and coordination.

This finding changes the interpretation of disintermediation. The challenge is not merely to remove intermediaries but to replace or redesign the functions they currently perform. The thesis explicitly reports that dependence on the mandi is often perceived as a structural necessity because it provides rapid disposal of perishable produce and short-term financial security.

Economic Viability of F2C

Participants generally perceived direct marketing as economically attractive because it could reduce commission deductions and increase farmers' control over price realization. However, economic benefits were considered conditional rather than automatic.

Direct marketing transfers several responsibilities to producers, including transportation, packaging, storage, branding, customer communication, delivery, and the risk of unsold inventory. Consequently, a higher selling price does not necessarily translate into higher net income. The economic attractiveness of F2C depends on crop perishability, transaction volume, geographical distance, logistics efficiency, and demand predictability.

Corporate buyers were perceived as particularly promising because they can purchase larger volumes and provide more predictable demand. Hotels, restaurants, factories, supermarkets, and other institutional buyers were therefore viewed as potentially more viable initial customers than dispersed household consumers.

Infrastructure and Post-Harvest Constraints

Infrastructure emerged as one of the strongest constraints. Participants repeatedly identified insufficient cold storage, limited refrigerated transportation, poor rural roads, high fuel costs, and fragmented logistics as barriers to F2C implementation.

For highly perishable vegetables, direct delivery without appropriate temperature control can increase rather than decrease losses. Participants therefore rejected the assumption that shortening the marketing channel automatically improves supply-chain efficiency. Without supporting infrastructure, additional handling and last-mile delivery can expose farmers to greater spoilage and financial risk.

The findings indicate that infrastructure is not merely an operational support variable; it is a prerequisite for viable F2C implementation. The thesis identifies cold-chain and transportation limitations as recurring concerns across stakeholder groups.

Digital Readiness and Technology

Digital platforms were viewed as important enablers of F2C marketing. Participants identified online marketplaces, mobile ordering, demand-supply matching, pre-orders, digital payments, forecasting, and customer communication as potential mechanisms for reducing information gaps and coordinating transactions.

However, technology adoption was constrained by low digital literacy and limited familiarity with online marketing. Participants emphasized that smartphone ownership does not necessarily imply the capacity to manage digital commerce. They therefore advocated simple, mobile-first solutions, including familiar communication applications and assisted digital services.

A central finding was that technology cannot substitute for weak physical infrastructure. A digital platform may generate an order, but it cannot independently solve transportation, cold storage, packaging, or delivery problems. This supports broader evidence that ICT interventions are most

effective when they address specific information constraints and are supported by trusted services and appropriate local infrastructure (Aker et al., 2016).

Consumer Trust, Quality, and Traceability

Consumer trust represented another major condition for F2C viability. Participants expressed concerns about product authenticity, hygiene, quality consistency, payment security, reliability, and the possibility of fraudulent transactions.

The proposed solution was not simply greater advertising but institutionalized mechanisms of trust. Participants emphasized certification, traceability, transparent pricing, invoices, quality assurance, customer reviews, and verifiable producer information.

The findings therefore suggest that F2C creates a relational supply chain in which information becomes part of the product value proposition. Consumers must have credible evidence regarding where vegetables originate, how they were handled, and whether promised quality standards are met.

Corporate and Institutional Buyers as an Entry Point

One of the most distinctive findings was the perceived superiority of business-to-business (B2B) entry over immediate mass business-to-consumer (B2C) adoption. Corporate and institutional buyers were viewed as more feasible because of bulk purchasing, regular procurement, predictable demand, and established logistical arrangements.

However, participation in institutional markets requires formal documentation, invoices, consistent quality, traceability, and reliable supply. This implies that farmer organization is essential. Individual smallholders may struggle to meet these requirements, whereas cooperatives or producer groups can aggregate output and standardize quality.

The findings therefore suggest a staged market-development strategy: organize farmers, aggregate supply, establish quality standards, and initially target predictable institutional demand before attempting highly fragmented household delivery.

Government and Policy Support

Participants identified government intervention as a major enabling condition. Suggested interventions included investment in cold-storage infrastructure, improved rural roads, affordable logistics, interest-free or subsidized financing, dedicated farmer markets, digital training, and public-private partnerships. Government was not viewed as a substitute for private-sector coordination but as an institution capable of reducing the fixed costs and risks associated with market transition. Long-term policy consistency was considered particularly important because F2C adoption requires learning, infrastructure development, trust formation, and organizational adjustment.

Long-Term Sustainability and Hybrid Models

The final theme concerned the sustainability of F2C transformation. Participants generally rejected rapid, complete disintermediation. Instead, they advocated gradual implementation through pilot projects, farmer cooperatives, digital platforms, logistics providers, institutional buyers, and government facilitation.

A particularly important finding was the possibility of transforming intermediaries rather than eliminating them. Commission agents or other market actors could potentially shift from price-setting roles toward logistics, aggregation, fulfillment, and service provision. The resulting hybrid model would

preserve useful supply-chain functions while reducing information asymmetry and excessive dependence on intermediaries.

The thesis identifies cooperative and public-private configurations as the most sustainable pathway because they distribute operational responsibilities across actors rather than transferring the entire burden to farmers.

Discussion

This study demonstrates that F2C vegetable marketing in Pakistan is best understood as a supply-chain reconfiguration problem rather than a simple disintermediation strategy. Although participants recognized potential benefits in farmer income, transparency, market access, and consumer relationships, the results show that removing intermediaries without replacing their logistical and coordination functions may increase rather than reduce supply-chain risk.

The prominence of cold storage, transportation, and post-harvest constraints is consistent with evidence that resilient agrifood systems require connectivity, diversified channels, and infrastructure capable of absorbing shocks (FAO, 2021). The findings also support the SFSC literature, which emphasizes the economic and relational potential of shorter chains while recognizing that local systems require appropriate organizational structures (Jarzębowski et al., 2020; Marsden et al., 2000).

The study's findings concerning digitalization similarly reinforce rather than contradict previous research. Digital technologies can reduce information asymmetry and improve coordination, but their effectiveness depends on user capability, trust, and complementary infrastructure (Aker et al., 2016; Fabregas et al., 2019). Thus, digital platforms should be treated as coordination infrastructure rather than as standalone technological interventions.

A particularly important contribution is the identification of institutional buyers as a feasible entry point. Unlike fragmented household demand, B2B purchasing provides volume, regularity, and more predictable transactions. This suggests that Pakistan's F2C transition may be more effectively initiated through organized farmer groups supplying hotels, restaurants, retailers, processors, and other institutional customers.

Finally, the finding that intermediaries may be reconfigured rather than eliminated provides a more context-sensitive interpretation of supply-chain reform. The evidence suggests that the feasible pathway is hybridization: farmer cooperatives provide aggregation, digital platforms improve information and demand coordination, logistics providers manage distribution, institutional buyers stabilize demand, and government reduces infrastructural and financial barriers.

Conclusion

The study concludes that F2C vegetable supply chains represent a promising but conditional pathway for improving agricultural marketing in Pakistan. The principal opportunity lies in increasing farmers' market access, strengthening price transparency, improving producer-consumer relationships, and potentially increasing value captured by producers. Nevertheless, these benefits cannot be achieved through disintermediation alone.

The major constraints identified were weak cold-chain and storage infrastructure, high transportation costs, limited digital literacy, consumer trust deficits, fragmented supply, financial constraints, and insufficient institutional support. The evidence further indicates that corporate and institutional buyers provide a more practical initial market than dispersed household consumers.

The most appropriate strategy for Pakistan is therefore a **gradual hybrid F2C model**. Such a model should combine farmer cooperatives, digital demand-matching platforms, shared logistics, quality and traceability systems, institutional buyers, and targeted government support. Intermediaries should not necessarily disappear; where they provide valuable aggregation and logistics functions, these functions can be redesigned within a more transparent and producer-oriented supply-chain architecture.

Practical and Policy Implications

Three implications follow directly from the findings.

First, policy should prioritize physical supply-chain infrastructure before large-scale digitalization. Cold storage, refrigerated transportation, rural connectivity, packaging facilities, and aggregation centers are foundational requirements.

Second, F2C initiatives should begin with organized producer groups and institutional buyers. Cooperatives can aggregate smallholder output, standardize quality, reduce transaction costs, and improve bargaining power. Institutional procurement can then provide predictable demand before more complex household delivery systems are introduced.

Third, digital transformation should focus on simple, trusted, farmer-centered platforms. Mobile-first ordering, pre-orders, demand forecasting, digital payments, traceability, and customer-feedback mechanisms can improve coordination, but training and institutional trust mechanisms must accompany technology adoption.

Limitations and Future Research

The qualitative design and purposive sample provide contextual depth but do not permit statistical generalization to all vegetable farmers in Pakistan. The study also relies primarily on stakeholder perceptions rather than measured changes in income, post-harvest losses, logistics costs, or profitability. In addition, the study focused principally on selected areas of Punjab and did not systematically compare provinces.

Future research should therefore combine qualitative evidence with quantitative supply-chain and cost-benefit analysis. Comparative studies across provinces could identify differences in infrastructure, market access, and digital readiness. Longitudinal studies should assess whether F2C initiatives produce sustained improvements in farmer income and post-harvest efficiency. Further research should also examine consumer willingness to pay, institutional procurement behaviour, cooperative governance, and the economic feasibility of hybrid digital-logistics models.

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