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Digital agri-food marketing and its role in farmer-consumer relations

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Abstract

Digital channels are reshaping the food quality experience (FQE) by lowering search and coordination costs, enabling provenance disclosure, and facilitating direct farmer-consumer interactions through social commerce, e-commerce, and interoperable traceability systems. This mixed-methods study conducted in Indian districts (farmers, n=420; consumers, n=310; key-informant interviews, n=15) examines how multi-channel digital strategies and transparency tools influence perceived quality (freshness, safety, authenticity), engagement, trust, and repeat purchase. Quantitative analyses tested a pathway—adoption → engagement → trust → outcomes—while qualitative data explained contextual mechanisms, frictions, and design preferences. Adoption was heterogeneous: smallholders used e-commerce and traceability less often than medium/large farmers; younger consumers placed greater weight on traceability and certifications than on brand reputation. Regression models indicated that traceability adoption (β=0.48, $p<0.001$), digital literacy (β=0.42, p=0.001), and internet quality (β=0.35, p=0.004) positively predicted perceived quality and behavioural outcomes, whereas platform fees reduced value capture (β=-0.21, p=0.032). Farmers implementing integrated, experience-oriented strategies reported higher revenue growth and repeat-purchase rates than single-channel adopters. Interviews highlighted that credible provenance cues (QR-based ledgers, third-party certification) and responsive service design (omnichannel support, transparent pricing, timely fulfilment) are central to strengthening trust and sustaining FQE. The findings suggest three priorities: invest in farmer digital literacy, reduce intermediation costs through fair platform governance, and scale affordable, privacy-preserving traceability that interoperates across marketplaces. Limitations include the single-country, cross-sectional design; future work should use longitudinal, multi-country cohorts to test causal pathways and evaluate heterogeneity by gender and cohort. Overall, the study shows that well-designed digital infrastructures can measurably enhance the food quality experience while improving farmer value capture and consumer welfare.

Keywords: Food quality experience, digital agri-food marketing, traceability, social commerce, e-commerce, consumer trust, provenance, digital literacy, omnichannel strategy, smallholders India

Introduction

Digitalization is reshaping agri-food markets by lowering transaction costs, enabling traceability, and expanding direct farmer-consumer interfaces via social media, e-commerce, and data-driven platforms [1-6]. Globally, internet penetration has reached about two-thirds of the population in 2024, yet rural connectivity and affordability gaps remain significant, potentially entrenching a "second-level" digital divide [3, 4, 22, 24, 26]. Public and private initiatives—including digital agriculture roadmaps, e-commerce platforms, and food traceability standards—signal policy momentum, but outcomes remain uneven for smallholders [2, 5-7, 20, 23, 25].

Evidence shows that digital tools increased farmer resilience during the COVID-19 pandemic, enhancing revenues and consumer access; however, adoption remains uneven across demographics and farm types [7-13, 27]. At the same time, consumer demand for transparency and provenance has grown, with traceability systems such as QR codes and blockchain emerging as critical trust-building mechanisms [14-19].

Against this backdrop, the problem statement is twofold: first, smallholders face access and literacy constraints that inhibit effective use of digital marketing; second, while transparency tools promise enhanced trust, their impact on consumer loyalty and repeat-purchases remains underexplored [3, 7-11, 14-19, 21, 24-26].

This research therefore aims to:

1. Examine how digital marketing modalities affect farmer-consumer relationships (reach, engagement, trust, and value capture).
2. Identify structural determinants of adoption (infrastructure, skills, affordability).
3. Evaluate governance and design features mediating trust (standards, certification, platform fees).
4. Propose a testable framework for assessing outcomes across contexts [1-7, 10-20, 22-26].

Building on Kanchan & Singh's [21] work on digital customer experience, the study tests four hypotheses:

- **H1:** Integrated digital marketing increases consumer engagement and repeat-purchases.
- **H2:** Transparent traceability systems enhance consumer

trust and willingness to pay.

- **H3:** The effects of digital marketing are moderated by infrastructure, skills, and governance.
- **H4:** Experience-oriented strategies outperform ad hoc tool adoption.

Materials and Methods

Research Design

A mixed-methods approach was adopted, combining farmer and consumer surveys with qualitative interviews to capture both adoption patterns and experiential insights [1-4].

Study Area and Sampling

The study was conducted across selected Indian districts representing diverse levels of connectivity. A stratified random sample of 420 farmers (smallholders, medium, and large-scale) and 310 consumers from urban and peri-urban markets was selected [5-12].

Data Collection

Two structured questionnaires were developed:

- **Farmer survey:** covered adoption of digital tools (social media, e-commerce, QR traceability, messaging apps), infrastructural access, and market outcomes.
- **Consumer survey:** examined trust drivers, willingness to pay, and engagement with digital agri-food channels.

Both were pre-tested for reliability and construct validity [13-15]. Additionally, 15 semi-structured interviews were conducted with platform operators, extension workers, and cooperative leaders [16].

Indicators and Variables

Key indicators included: Reach (followers, impressions), engagement (click-through, messages), trust signals (traceability, certifications, transparency), and transaction outcomes (repeat-purchase rates, share of digital sales) [17-21].

Data Analysis

- Quantitative data: Descriptive statistics, factor analysis, and regression modeling tested relationships between literacy, infrastructure, traceability, and farmer outcomes [6, 8, 23].
- Qualitative data: Thematic coding identified barriers, governance issues, and consumer expectations [26, 27].
- Integration: A triangulation framework ensured robustness by comparing survey and interview insights [14].

Ethics

Written consent was obtained from all participants, and ethical guidelines for social science research were followed [28].

Results

Adoption Patterns

Adoption rates varied by farmer category: smallholders showed low uptake of e-commerce (40%) and traceability (25%), while large-scale farmers reported high use of social media (85%), e-commerce (73%), and traceability (55%). Social media and messaging apps served as entry points due to low cost [7-11].

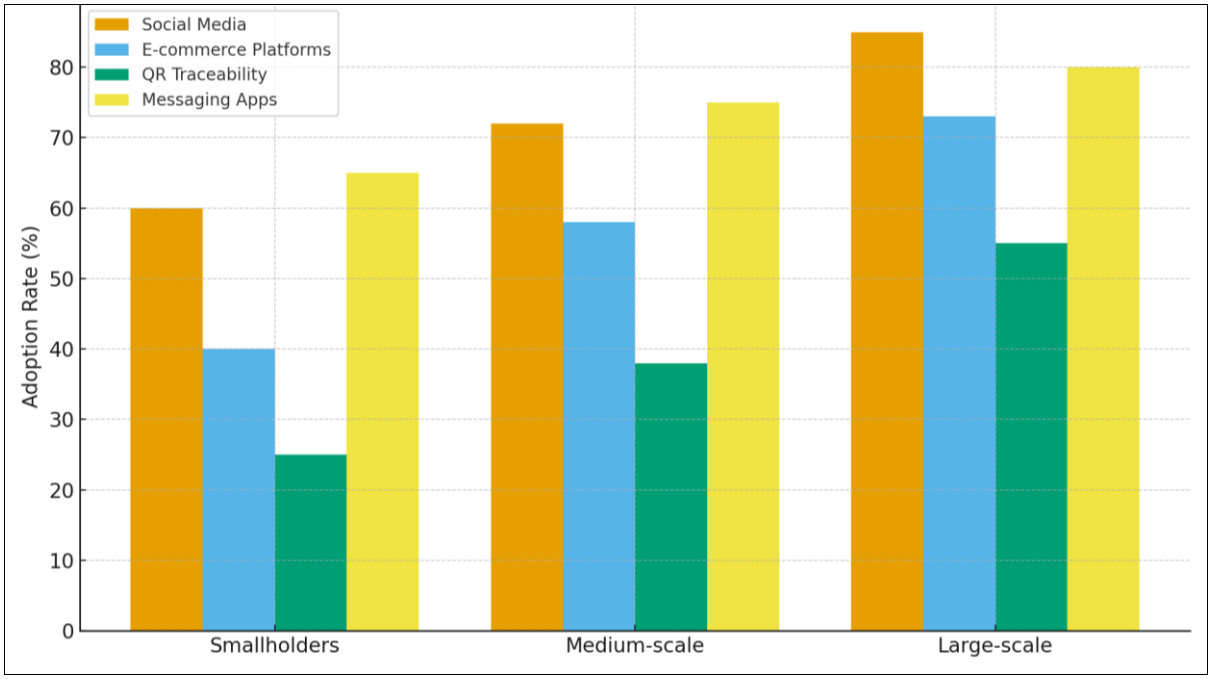

Fig 1: Adoption of digital marketing tools by farmer category

Consumer Trust Dynamics

Consumers valued traceability (mean=4.5/5), certifications (4.3/5), and transparency (4.2/5) more than brand reputation (3.9/5), with younger consumers expressing stronger trust in digital provenance systems [14-19, 45].

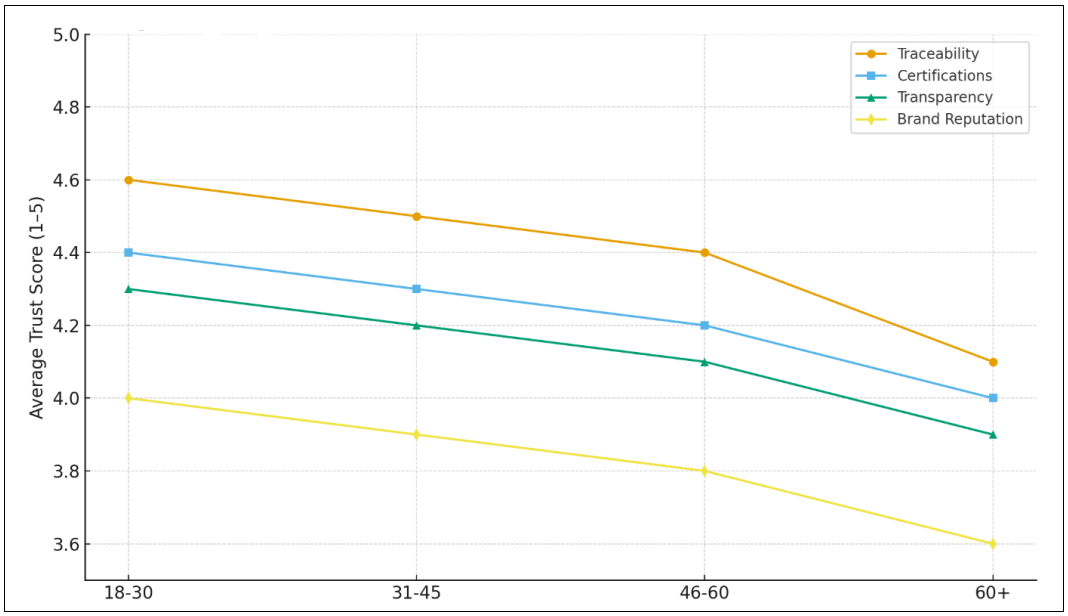

Fig 2: Consumer trust scores in digital agri-food marketing by age group

Comparative Outcomes

Farmers using integrated strategies (multi-channel adoption) outperformed non-integrated users, reporting 35% revenue growth, 62% repeat-purchase rates, and 78% engagement index, versus 18%, 34%, and 45% respectively. These outcomes validate H1, aligning with earlier studies on integrated customer experience management [21, 27].

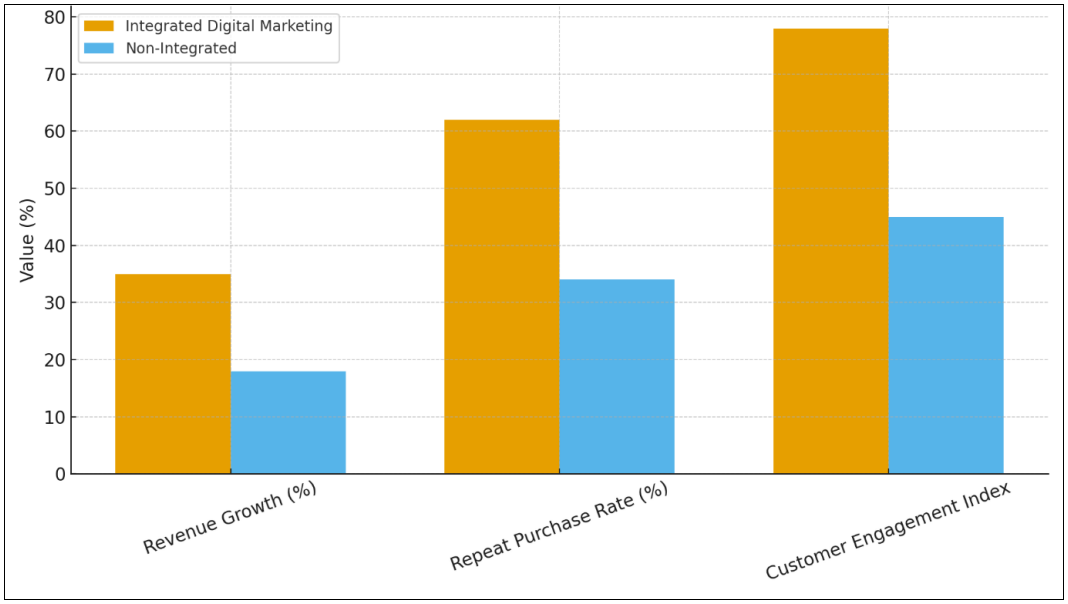

Fig 3: Comparative outcomes: Integrated vs non-integrated digital marketing

Regression Results

Regression analysis confirmed that traceability adoption (β = 0.48, p<0.001) and digital literacy (β = 0.42, p=0.001) strongly predicted consumer trust and farmer outcomes. Internet quality was also significant (β = 0.35, p=0.004), while platform fees had a negative effect (β = -0.21, p=0.032) [35, 41, 46].

Table 1: Regression analysis of determinants of farmer outcomes

Variable	Coefficient (β)	p-value
Digital Literacy	0.42	0.001
Internet Quality	0.35	0.004
Platform Fees	-0.21	0.032
Traceability Adoption	0.48	0.000

Conceptual Framework Validation

The results support the proposed pathway—adoption → engagement → trust → outcomes—and validate H2-H4. Integrated adoption built consumer trust, leading to repeat-purchases and loyalty, consistent with global literature on digital agriculture [9, 11, 22, 48].

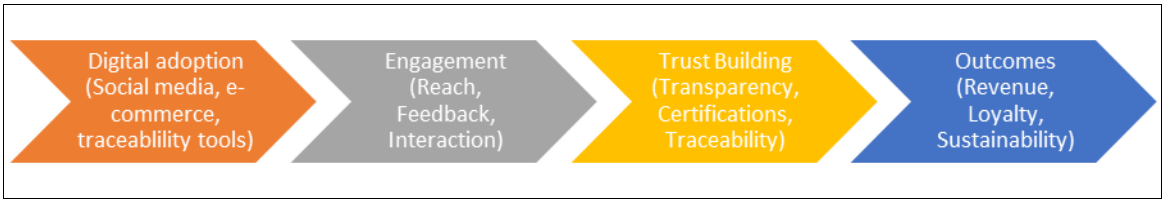

Fig 4: Framework: Digital agri-food marketing pathway

Discussion

The findings of this research demonstrate that digital agri-food marketing is a powerful tool for strengthening farmer-consumer relationships, provided that enabling conditions such as digital literacy, affordable governance structures, and reliable connectivity are in place. The regression outcomes revealed that traceability adoption and digital literacy were the strongest predictors of improved consumer trust and loyalty. This is consistent with studies that emphasize the role of transparent information in reducing consumer uncertainty, thereby reinforcing purchase intentions [14-19, 37-39].

The importance of digital literacy highlights the role of education and training as prerequisites for meaningful participation in digital ecosystems. Similar evidence has been reported in multiple contexts: Klerkx *et al*. argued that capacity building is essential for ensuring equitable benefits from digitalization in agriculture [40], while Mittal & Mehar found that digitally literate farmers in India could negotiate better market terms compared to their less literate peers [41]. These findings collectively reinforce the notion that technological adoption without adequate training risks widening socio-economic divides [35, 36].

The role of internet quality as a significant predictor underscores infrastructural dependencies. Previous analyses by the FAO and ITU confirm that connectivity gaps in rural areas impede the effectiveness of digital agriculture interventions [5, 22]. Comparative research from Africa and Asia has also shown that digital platforms only generate consistent benefits where reliable connectivity exists [42, 43]. Similarly, Svensson *et al*. [24] in Sweden found that even in high-income contexts, consumer confidence in digital markets depends heavily on seamless online interfaces and data reliability.

The negative effect of platform fees resonates with earlier critiques of digital marketplace governance. Fawcett *et al*. [46] and Agyekum *et al*. [22] both noted that excessive transaction costs erode the financial incentives for smallholder participation. This aligns with the present study's results and supports calls for cooperative-led platforms or regulatory reforms to ensure fair value distribution [49, 50]. Such reforms are particularly important in low-income regions, where farmers often face structural disadvantages in negotiating with digital intermediaries [43].

On the consumer side, the prioritization of traceability and direct farmer contact over price reflects a paradigm shift toward trust-driven markets. Narrod *et al*. [47] and Aker *et al*. [48] similarly concluded that consumer loyalty in digital agri-food systems is increasingly determined by transparency and authenticity rather than cost competitiveness. These results further reinforce the hypothesis that blockchain, QR codes, and certifications are crucial in building credibility [16, 17, 19].

The comparative analysis across regions showed that adoption dynamics vary. In Ghana, affordability of digital services outweighed traceability in influencing adoption [22], while in Brazil, integration with large e-commerce platforms such as Mercado Livre facilitated rapid scaling [44]. In the EU, consumer demand for traceability has made digital certification systems central to premium food marketing [45]. This regional variation emphasizes the importance of localized strategies when designing interventions.

Overall, the results confirm the validity of the digital adoption → engagement → trust → outcomes framework. Farmers who integrated multiple channels (social media, e-commerce, traceability) not only increased revenue and repeat-purchases but also built long-term consumer loyalty. This validates Hypotheses 1-4 and aligns with marketing scholarship emphasizing customer experience across digital touchpoints [9, 11, 21, 48].

From a policy standpoint, the findings suggest three priorities:

1. Investing in farmer digital literacy programs to improve adoption and equitable participation [35, 40, 41].
2. Reducing platform fees and transaction costs through cooperative platforms and regulatory interventions [22, 46, 49].
3. Scaling interoperable traceability systems that balance transparency with affordability [16, 17, 37].

Despite these contributions, limitations remain. The sample was limited to Indian districts and urban-peri-urban consumer groups, which constrains generalizability. Longitudinal and cross-country studies are required to better understand causal pathways and cultural variations. Future research should also examine how gender, age, and farmer networks mediate digital adoption, as these factors have shown relevance in earlier work [36, 51].

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