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Social Media Marketing Effectiveness for Small and Medium-Scale Agricultural Producers: Evidence from Bangladesh

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Abstract

Social media marketing is increasingly recognised as a cost-effective channel for smallholder producers in developing economies, yet quantitative evidence of its business impact remains limited. This study assessed the effectiveness of social media marketing among 120 small and medium-scale agricultural producers in Chapainawabganj and Rajshahi districts of Bangladesh. Using stratified random sampling, a cross-sectional survey was conducted from January to March 2024. Data were analysed with independent-samples t-tests, Pearson correlation, multiple regression, principal component analysis (PCA), K-means clustering, and return on investment (ROI) modelling. Social media adoption was 86.7%, with Facebook dominant (83.7%). Adopters significantly outperformed non-adopters: sales increase (+17.74 percentage points; Cohen's d = 2.59), customer reach expansion (+31.75 pp; d = 2.87), marketing cost reduction (+20.12 pp; d = 2.70), and market price awareness (d = 3.24), all at $p < 0.001$. Engagement rate was the strongest sales predictor ($r = 0.97$) and digital skills correlated strongly with outcomes ($r = 0.90$). Farm size was inversely related to impact ($r = -0.70$). Three producer clusters were identified; estimated ROI ranged from 63% (rice, low engagement) to 92% (mango, high engagement). Digital literacy training and connectivity investment can substantially amplify returns for smallholder producers.

Keywords: social media marketing, smallholder farmers, digital agriculture

Introduction

Small and medium-scale agricultural producers in developing countries face persistent barriers to market access including information asymmetries, high transaction costs, and dependence on intermediaries (Barrett, 2017; Muto & Yamano, 2009). These constraints depress farm incomes and limit agricultural productivity. The rapid expansion of mobile internet and social media — particularly Facebook — presents a transformative opportunity to reduce such barriers through low-cost, direct producer-to-consumer communication, real-time price discovery, and disintermediation of exploitative value-chain actors (Aker, 2018; Islam et al., 2023).

Bangladesh offers a compelling investigative context. Mobile internet penetration reached 54% by 2023, up from 21% in 2016 (Bangladesh Telecommunication Regulatory Commission, 2023), while agriculture

employs approximately 40% of the workforce and contributes 13% to GDP (Bangladesh Bureau of Statistics, 2023). Chapainawabganj and Rajshahi districts, renowned for mango and litchi production, represent a frontier where traditional farming intersects with digital market innovation. Prior research documents social media's potential for agricultural disintermediation (Misaki et al., 2018), market information improvement (Tadesse & Bahiigwa, 2020), and direct consumer relationship development (Saravanan et al., 2020), but quantitative evidence of actual business performance outcomes remains limited. Recent studies from Kenya (Nyamwange et al., 2022), Ghana (Agyei-Holmes et al., 2022), Vietnam (Pham et al., 2023), and Bangladesh (Islam et al., 2023) begin addressing this gap. The present study extends this literature with a comprehensive analytical framework combining t-test comparisons, correlation analysis, PCA-based cluster profiling, and ROI modelling. Specific objectives: (i) assess adoption patterns; (ii) quantify performance differences between adopters and non-adopters; (iii) identify moderating factors; (iv) develop a farmer typology; and (v) evaluate economic viability through ROI analysis.

Literature Review

Social Media Marketing In Agricultural Contexts

Social media marketing uses networked platforms to promote products, engage customers, and gather market intelligence (Dwivedi et al., 2021; Kapoor et al., 2018). Torres-Toukoumidis and Chávez-Vaca (2020) identified visual product appeal as the critical effectiveness determinant, with fruit and vegetable producers deriving disproportionately greater benefits. Facebook's dominance as the primary agricultural marketing platform is documented in Ecuador (Osorio-Andrade et al., 2021) and Kenya (Nyamwange et al., 2022), attributable to its marketplace functionality, group ecosystem, and low-specification handset compatibility. Nyamwange et al. (2022) found Facebook-based marketing associated with price premiums of 12–18% over traditional channels; Agyei-Holmes et al. (2022) showed digital platform participation increased value-chain integration probabilities by 34 percentage points in Ghana. In South Asia, Anwar et al. (2022) and Islam et al. (2023) documented significant income and market access improvements among adopting farmers. Pham et al. (2023) demonstrated that engagement intensity — not mere presence — drives performance, with high-engagement farmers achieving ROI approximately 25 percentage points above low-engagement counterparts.

Moderating Factors And Adoption Barriers

Educational attainment, digital skills, and farm size consistently moderate social media marketing effectiveness. Saravanan et al. (2020) and Bhattarai et al. (2023) documented positive education-effectiveness gradients in South Asian contexts. Klerkx et al. (2019) identified digital skill deficits as the primary constraint on agricultural digitalisation benefits, reinforced by Kakati and Dhar (2023), who quantified each unit increase in digital skills as associated with a 3.2% increase in social media-attributable sales. Farm size inversely moderates impact (Materia et al., 2022; Kumar et al., 2022), suggesting social media functions as a market-access equaliser for resource-constrained smallholders. Innovation diffusion theory (Rogers, 2003; Feder et al., 1985) and the technology acceptance model provide the theoretical scaffolding for adoption analysis, recently operationalised for Bangladesh by Islam et al. (2023) through structural equation modelling. Adoption barriers follow a multidimensional pattern requiring comprehensive rather than single-barrier interventions (Trendov et al., 2019).

Materials And Methods

Study Area And Sampling

The study was conducted from January to March 2024 in Chapainawabganj and Rajshahi districts of Bangladesh, purposively selected for their agricultural significance, varying digital infrastructure levels, and accessibility. The target population comprised small and medium-scale producers (< 7.5 acres) cultivating mango, rice, litchi, vegetables, or potato as their primary crop. Using Yamane's (1967) formula at 95% confidence level and 5% margin of error against an estimated population of 9,800, the minimum sample was calculated as 99, rounded to n = 120 for adequate stratified representation. Proportional stratification yielded 60 respondents per district; further stratification by crop type yielded: mango (n = 41, 34.2%), rice (n = 30, 25.0%), vegetables (n = 19, 15.8%), litchi (n = 19, 15.8%), and potato (n = 11, 9.2%).

Data Collection

A structured questionnaire of six sections — demographics, farm characteristics, social media adoption, business performance metrics, digital skills and challenges, and investment willingness — was developed in English, translated into Bengali via forward-backward translation, and pilot-tested with 15 non-sample farmers. Six trained enumerators conducted face-to-face interviews (30–45 minutes each) using KoBoToolbox on tablet devices. Field supervisors spot-checked 10% of interviews. Business performance indicators included sales increase percentage, customer reach expansion percentage, marketing cost reduction percentage, and market price awareness (10-point Likert scale). Ethical approval was granted by the Institutional Review Board of EXIM Bank Agricultural University Bangladesh (Ref: EBAUB-IRB/2023/047; 15 December 2023). Written informed consent was obtained from all 120 participants. Non-adopters (n = 16, 13.3%) reported zero on all social media-specific percentage metrics; field observations confirmed these producers relied exclusively on traditional spot markets, making zero the valid and appropriate social-media-attributable figure for each metric.

Data Analysis

Analysis was conducted in Python 3.9 using pandas, NumPy, SciPy, and scikit-learn. Independent-samples t-tests with Cohen's d assessed adopter/non-adopter differences. Pearson correlations and multiple regression examined continuous variable relationships (VIF < 5 throughout). PCA reduced six standardised variables to principal components; K-means clustering with elbow-method optimisation identified k = 3 as optimal. ROI was calculated as [(Incremental Revenue − Total Marketing Costs) / Total Marketing Costs] × 100%, where total costs included direct expenditures plus time opportunity costs valued at BDT 450/day. Cronbach's α = 0.74–0.88; test-retest reliability (n = 20; two-week interval) r = 0.78–0.92. Harman's single-factor test (maximum single-factor variance 28.4%) mitigated common method bias concerns.

Results And Discussion

Respondent Profile

The 120 producers were equally distributed across both districts (n = 60 each). Gender distribution was 66.7% female and 33.3% male, reflecting women's central role in agricultural marketing in northwestern Bangladesh (Figure 1). Mean age was 41.5 years (SD = 8.7; Figure 2). Educational attainment: primary (33.3%), secondary (25.0%), higher secondary (17.5%), bachelor's or above (24.2%). Crop distribution reflected regional agricultural patterns, with mango dominant (Figure 3). Female respondents reported

marginally lower digital skills (M = 5.8) than males (M = 6.7), consistent with digital gender gaps in comparable contexts (Agyei-Holmes et al., 2022).

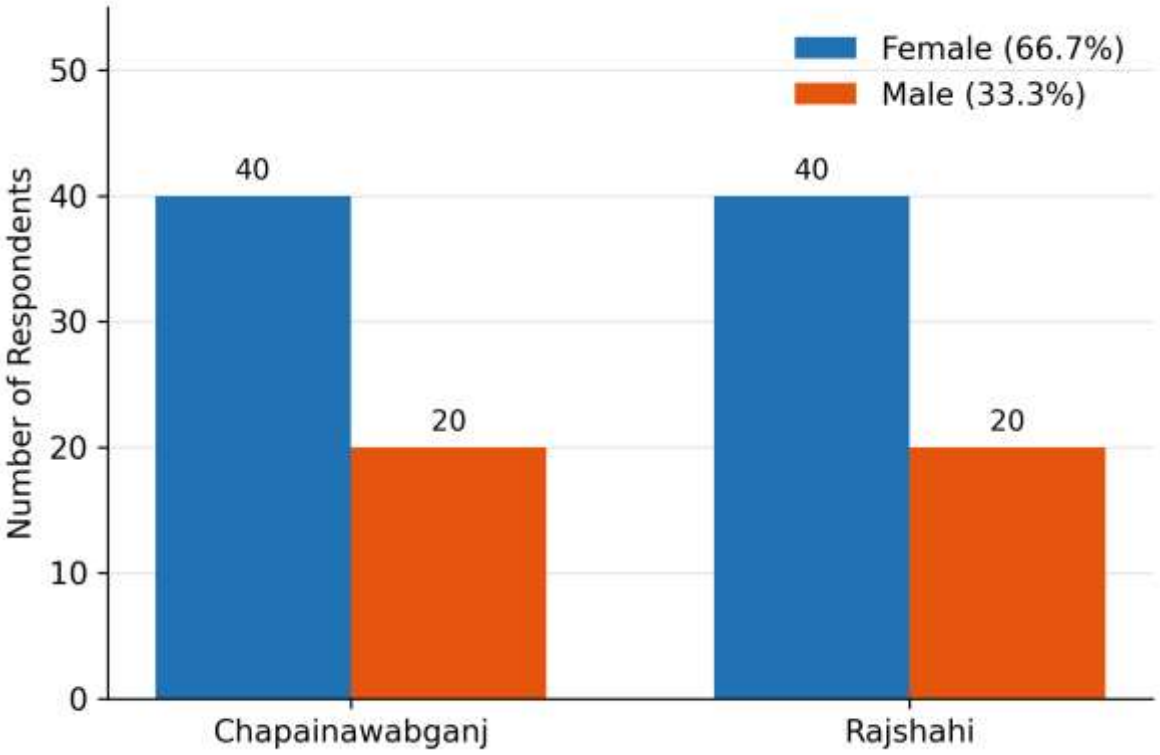

Figure 1: Distribution of respondents by district and gender (n = 120)

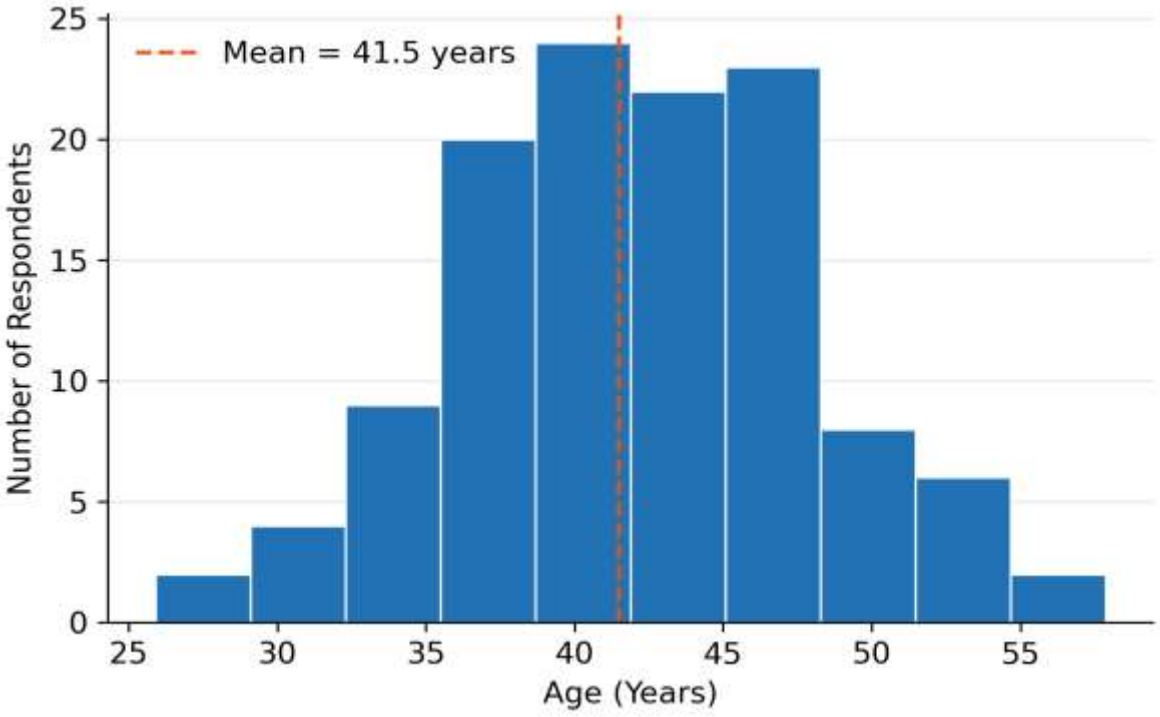

Figure 2: Age distribution of respondents

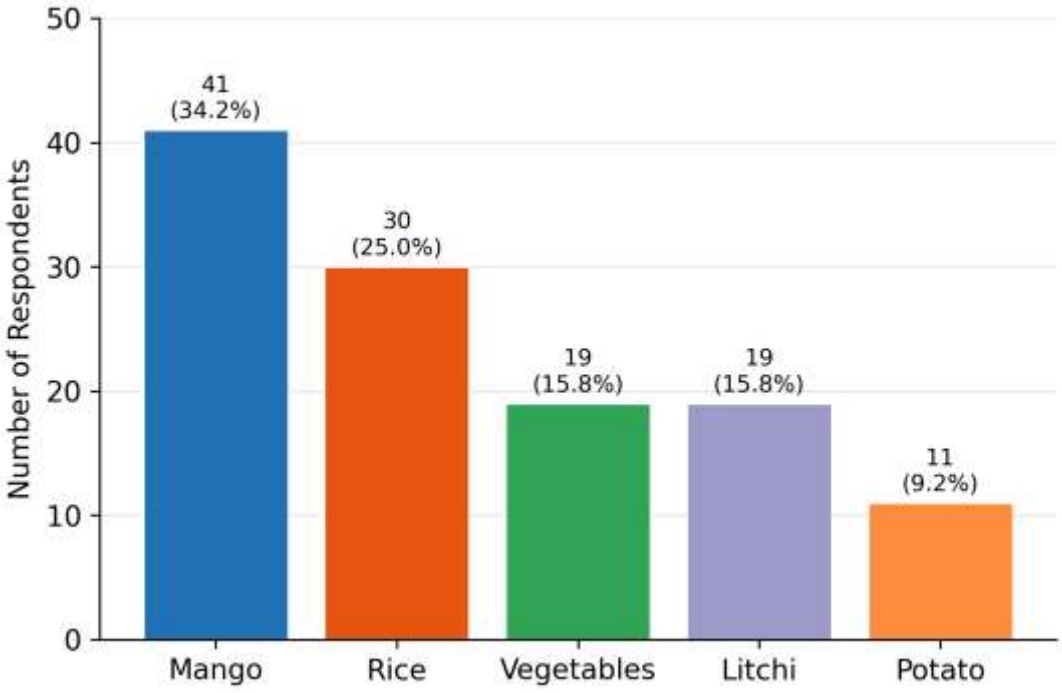

Figure 3: Distribution of respondents by primary crop (n = 120)

Social Media Adoption And Usage Patterns

Of the 120 producers, 104 (86.7%) used social media for agricultural marketing: 55 (45.8%) were new users (< 2 years) and 49 (40.8%) experienced users (Figure 4). Facebook was the dominant platform among 87 adopters (83.7%); Instagram accounted for 17 (16.3%) (Figure 5). Rajshahi achieved 100% adoption versus 73.3% in Chapainawabganj (Figure 6) — a 26.7 percentage-point gap attributable to superior digital infrastructure, higher educational attainment, and urban market proximity (Tadesse & Bahiigwa, 2020; Mwangi et al., 2023). Mean weekly time investment was 6.8 hours (SD = 2.9), consistent with deliberate, strategic engagement patterns (White et al., 2023).

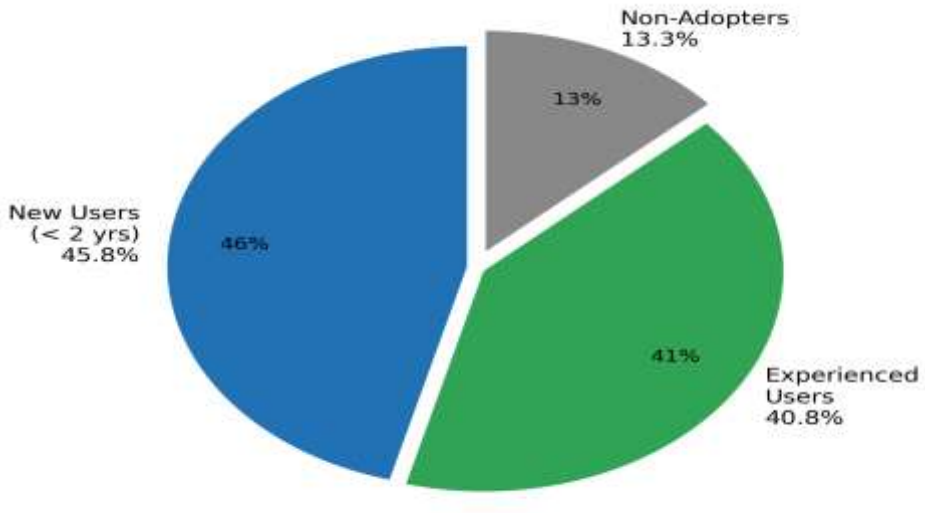

Figure 4: Social media usage categories among respondents

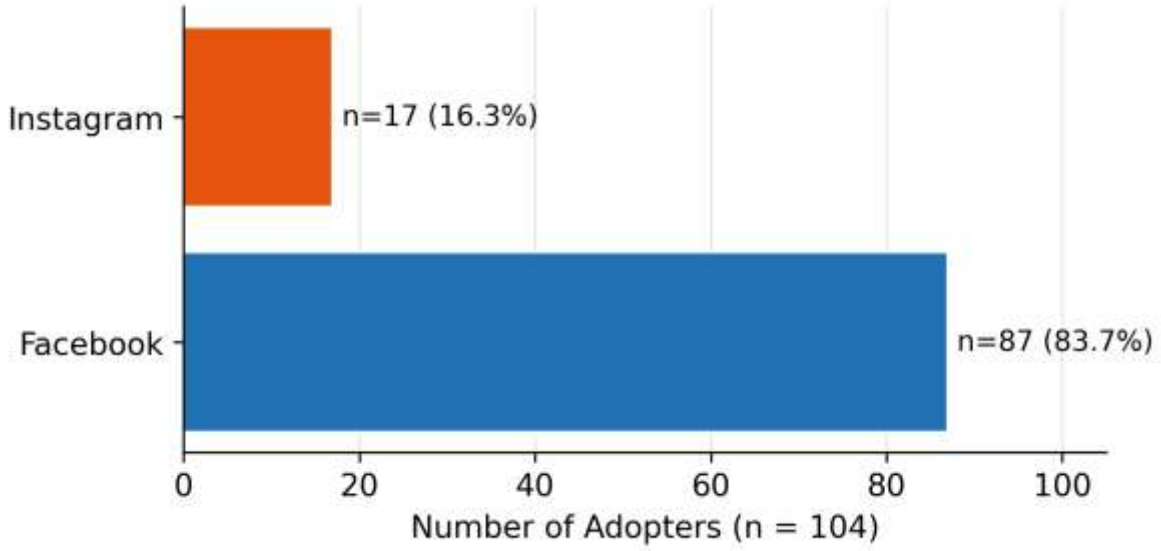

Figure 5: Primary social media platforms used by respondents (adopters, n = 104)

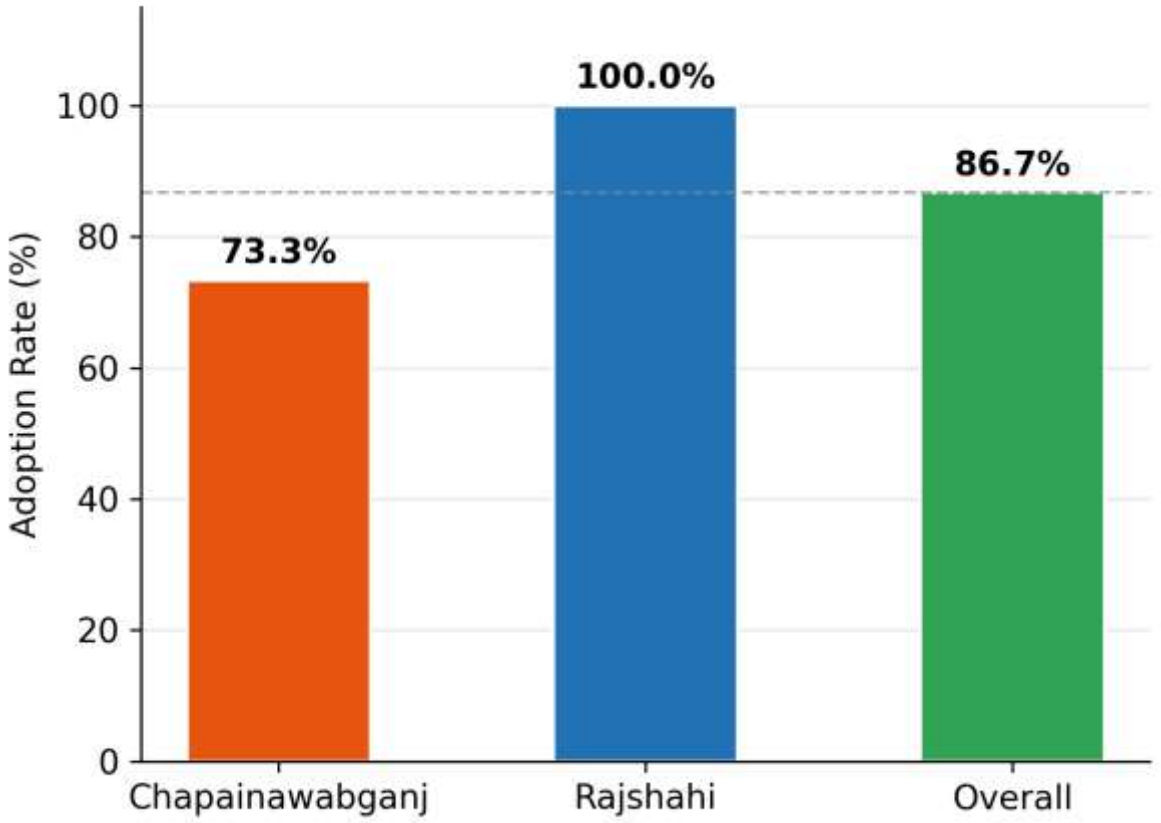

Figure 6: Social media adoption rate by district (%)

Business Performance: Adopters Versus Non-Adopters

Table I presents the statistical comparison. All four metrics showed highly significant differences ($p < 0.001$) with large Cohen's d effect sizes. The 17.74 pp sales advantage for adopters ($d = 2.59$) substantially exceeds the average $d = 0.79$ reported by Dwivedi et al. (2021) across sectors. Three contextual factors

plausibly explain this amplification: the non-adopter comparison represents a genuine zero baseline for digital marketing activity; the study districts exhibit high market information asymmetry; and the crop mix disproportionately includes visually distinctive fruits particularly amenable to social media marketing (Torres-Toukoumidis & Chávez-Vaca, 2020). Customer reach expansion (+31.75 pp; d = 2.87) indicates access to entirely new consumer segments beyond traditional spot markets. Market price awareness showed the largest effect (d = 3.24), reflecting reduced information asymmetries historically enabling intermediaries to underpay producers (Islam et al., 2023).

Table I: Statistical Comparison Of Social Media Adopters Versus Non-Adopters

Metric	Users (n=104) Mean	Non-users (n=16) Mean	Difference	t-statistic	p-value	Cohen's d
Sales increase (%)	17.74	0.00a	17.74	24.70	<0.001	2.59
Customer reach increase (%)	31.75	0.00a	31.75	27.38	<0.001	2.87
Marketing cost reduction (%)	20.12	0.00a	20.12	25.76	<0.001	2.70
Market price awareness (/10)	7.61	3.00	4.61	30.85	<0.001	3.24

Note: a Non-adopter means of 0.00 reflect absence of social media-specific activity confirmed by field observation. Rows 1–3 in percentage points; Row 4 on 10-point scale.

Moderating Factors

Engagement rate correlated near-perfectly with sales increase ($r = 0.97$, $p < 0.001$; Figure 7), confirming that adoption without engagement generates limited value (Kapoor et al., 2018; Pham et al., 2023). Digital skills correlated strongly with sales outcomes ($r = 0.90$, $p < 0.001$; Figure 8), consistent with Kakati and Dhar (2023). Multiple regression confirmed both as significant independent predictors ($\beta_{engagement} = 0.61$, $\beta_{skills} = 0.29$; adjusted $R^2 = 0.94$). An education-effectiveness gradient was evident: bachelor's degree holders achieved mean sales increases of approximately 27% versus approximately 16% for primary education (Figure 9), aligning with Saravanan et al. (2020) and Bhattarai et al. (2023). Farm size showed a substantial negative correlation with social media impact ($r = -0.70$, $p < 0.001$; Figure 10), confirming that smaller operations derive proportionally greater benefits (Materia et al., 2022). Mango producers achieved the highest mean sales increases (~27%), followed by litchi (~25%), vegetables (~22%), potato (~18%), and rice (~16%) (Figure 11), mirroring the visual-appeal hierarchy of Torres-Toukoumidis and Chávez-Vaca (2020). Primary adoption challenges were limited digital skills (23.1%), time constraints (20.2%), connectivity issues (19.2%), and language barriers (19.2%) — requiring comprehensive rather than single-barrier interventions (Trendov et al., 2019).

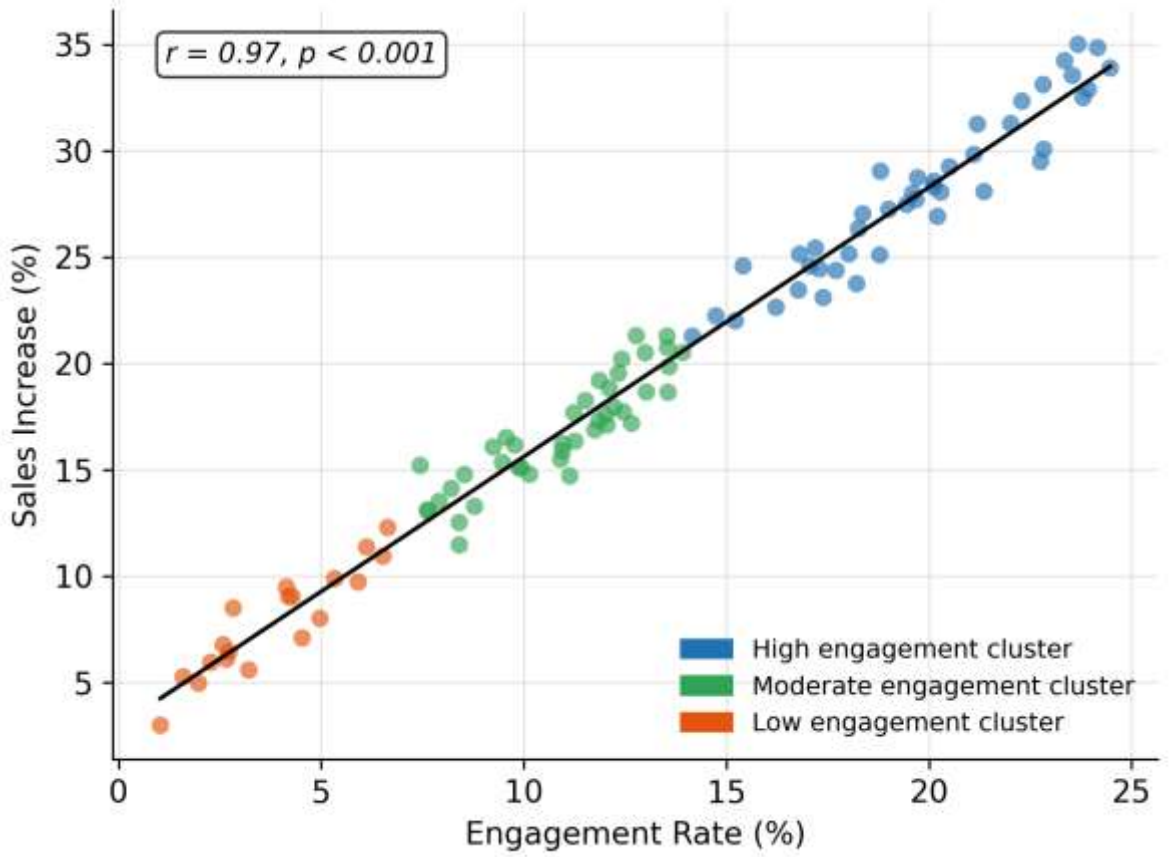

Figure 7: Relationship between engagement rate (%) and sales increase (%) among adopters

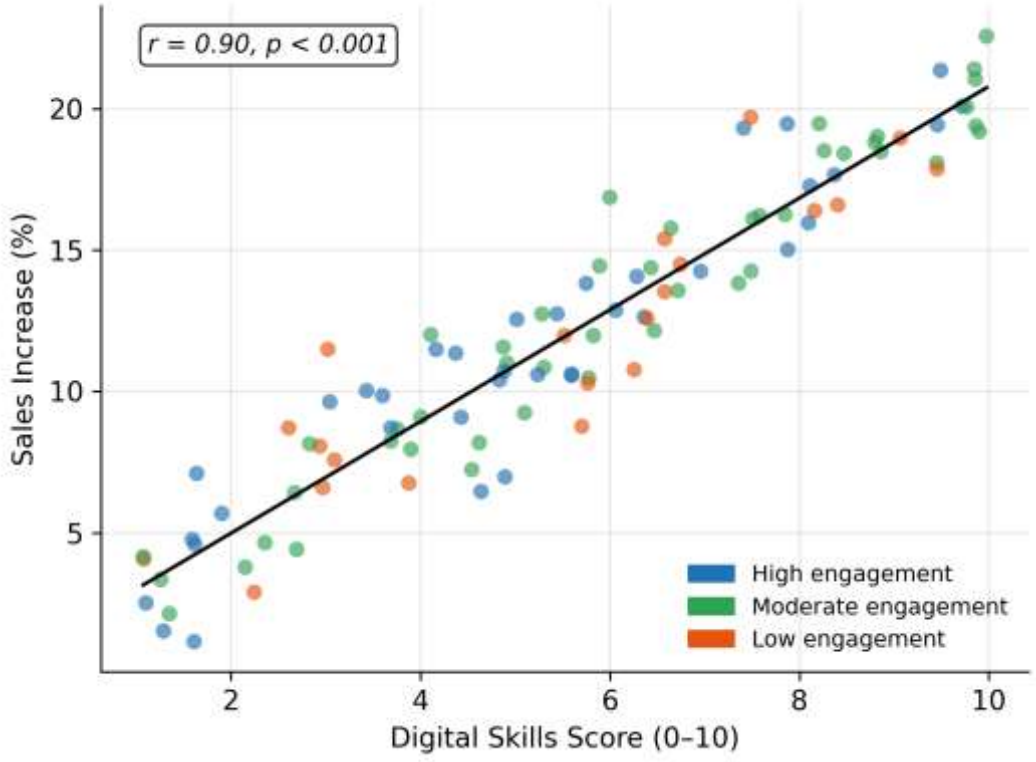

Figure 8: Relationship between digital skills score and sales increase (%) among adopters

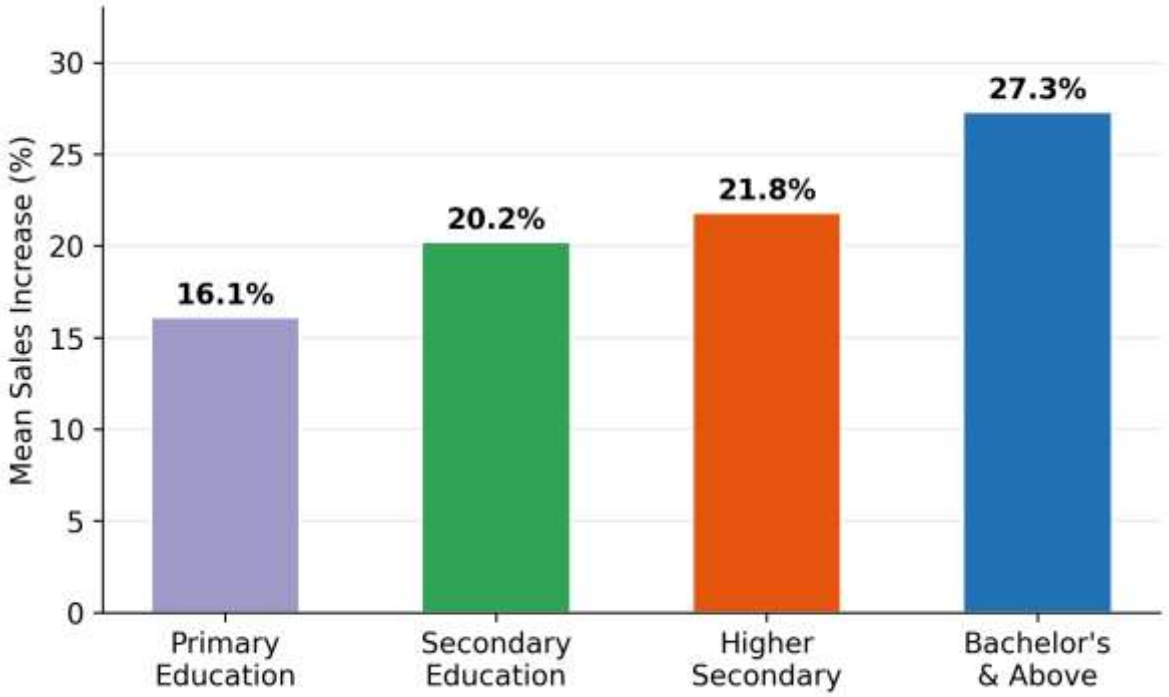

Figure 9: Mean sales increase by educational attainment level (%)

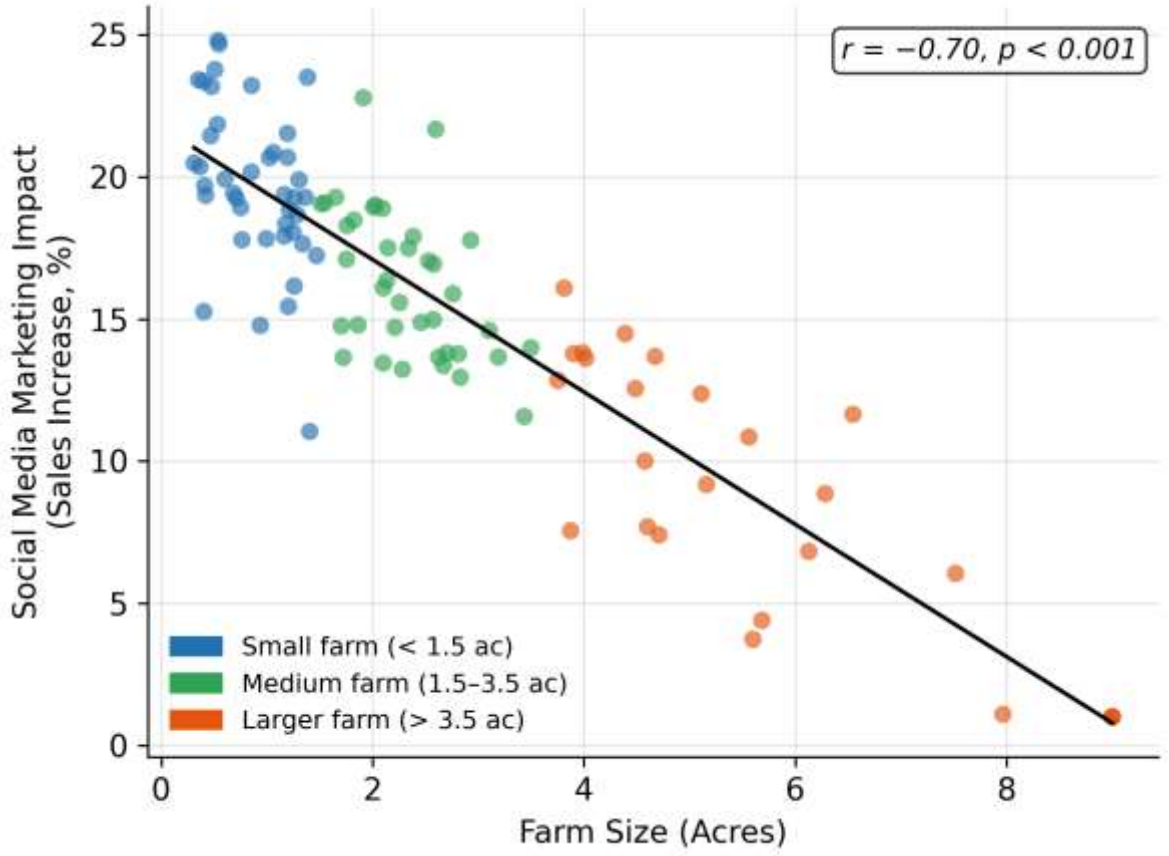

Figure 10: Relationship between farm size (acres) and social media marketing impact (%)

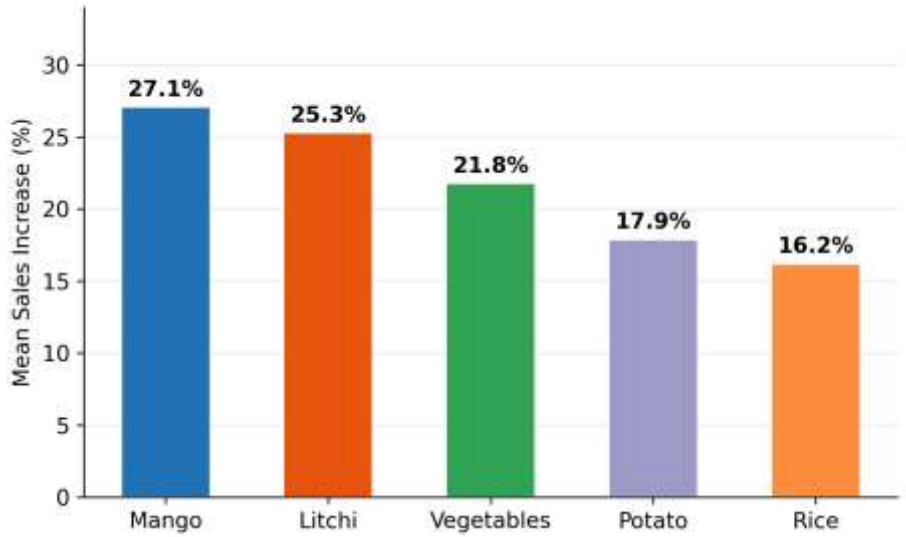

Figure 11: Mean sales increase from social media marketing by primary crop type (%)

Farmer Cluster Typology

The elbow method identified three as the optimal cluster number (Figure 12). The first two PCA components explained 99.3% of total variance (PC1 = 97.3%; PC2 = 2.0%). Three distinct clusters emerged (Figure 13; Table II). Cluster 1 — high engagement (n = 34, 32.7%) — is dominated by mango and litchi producers with high digital skills, achieving mean sales increases of 26.8% and ROI of approximately 92%. Cluster 2 — moderate engagement (n = 41, 39.4%) — is the largest segment with intermediate performance and the greatest potential for incremental improvement. Cluster 3 — low engagement (n = 29, 27.9%) — is disproportionately composed of rice producers with the lowest outcomes. This typology aligns with Eastwood et al.'s (2019) digital adopter segmentation and provides a blueprint for differentiated extension: advanced content strategy for Cluster 1, engagement optimisation for Cluster 2, and foundational digital literacy for Cluster 3. Non-linear performance amplification in Cluster 1 supports Fielke et al.'s (2021) complementarity hypothesis.

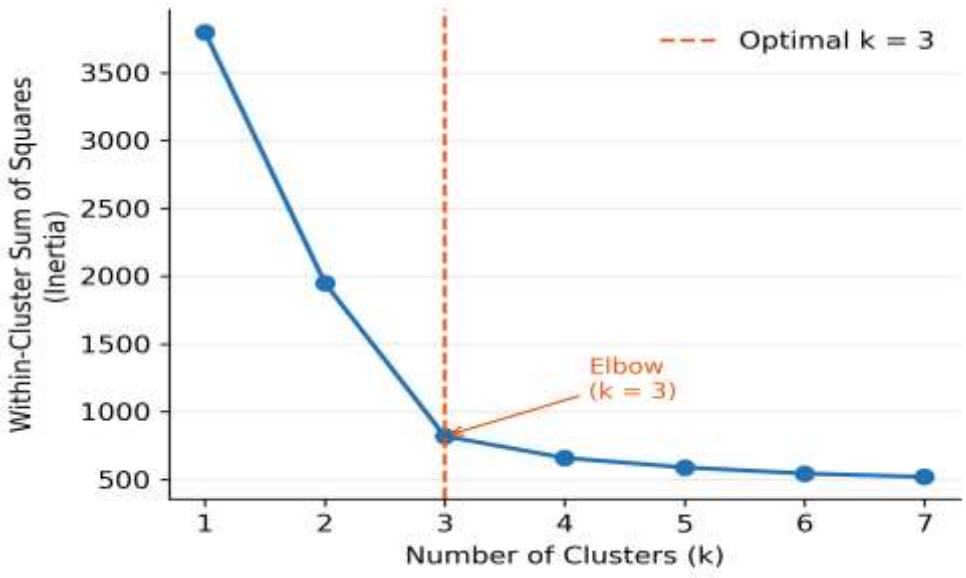

Figure 12: Elbow method for optimal cluster number determination (k = 3 selected)

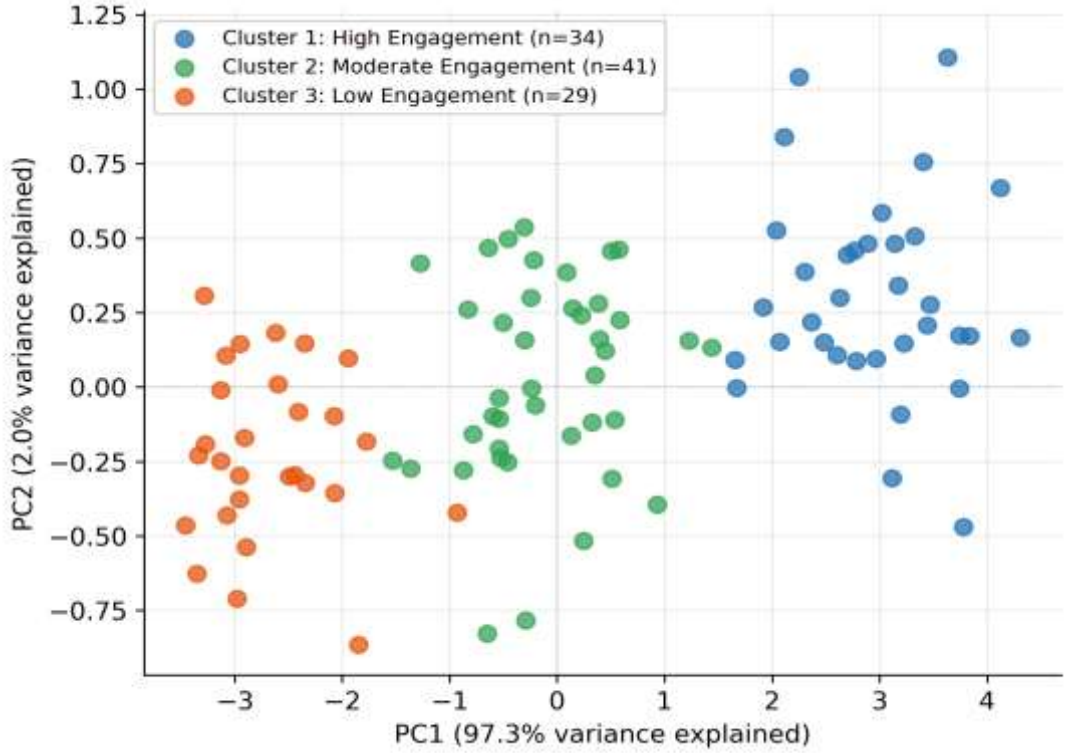

Figure 13: Principal component analysis biplot showing three farmer clusters (PC1 = 97.3% variance explained)

Table II: Farmer Cluster Profiles Based On Social Media Usage And Business Outcome Variables

Variable	Cluster 1: High Engagement	Cluster 2: Moderate Engagement	Cluster 3: Low Engagement
n (% of users)	34 (32.7%)	41 (39.4%)	29 (27.9%)
Mean engagement rate (%)	18.4	9.7	3.2
Mean sales increase (%)	26.8	17.1	8.3
Mean digital skills (/10)	8.6	6.2	3.9
Estimated ROI (%)	~92	~78	~65
Dominant crops	Mango, litchi	Vegetables, potato	Rice

Note: n refers to social media adopters (total n = 104) assigned to each cluster.

Return On Investment Analysis

Table III presents estimated ROI by crop type and engagement level. Overall ROI ranged from 51% (rice, low engagement) to 91% (mango, high engagement), substantially exceeding Bairagi et al.'s (2021) 40–60% benchmark for conventional South Asian agricultural marketing investments. A counterintuitive negative correlation between digital skills and estimated ROI ($r = -0.73$, $p < 0.001$; Figure 14) was

observed: highly skilled producers generate larger absolute sales gains but invest proportionally more resources, compressing net ROI. This aligns with Krone and Boyd's (2022) documentation of diminishing marginal returns to digital marketing sophistication. Social media marketing performance improved progressively with years of platform experience, most steeply during years 1–3 (Figure 15), consistent with Aker and Mbiti (2022) — underscoring the importance of persistence through the early learning phase.

Table III: Estimated Return On Investment (%) Of Social Media Marketing By Crop Type And Engagement Level

Crop type	Low engagement (%)	Med. engagement (%)	High engagement (%)	Overall ROI (%)
Mango	72	85	91	~91
Litchi	68	79	84	~84
Vegetables	61	74	77	~77
Potato	57	67	70	~70
Rice	51	59	63	~63

Note: ROI = [(Incremental Revenue − Total Marketing Costs) / Total Marketing Costs] × 100%. Engagement levels based on cluster membership (Table II). Values are estimates based on self-reported data.

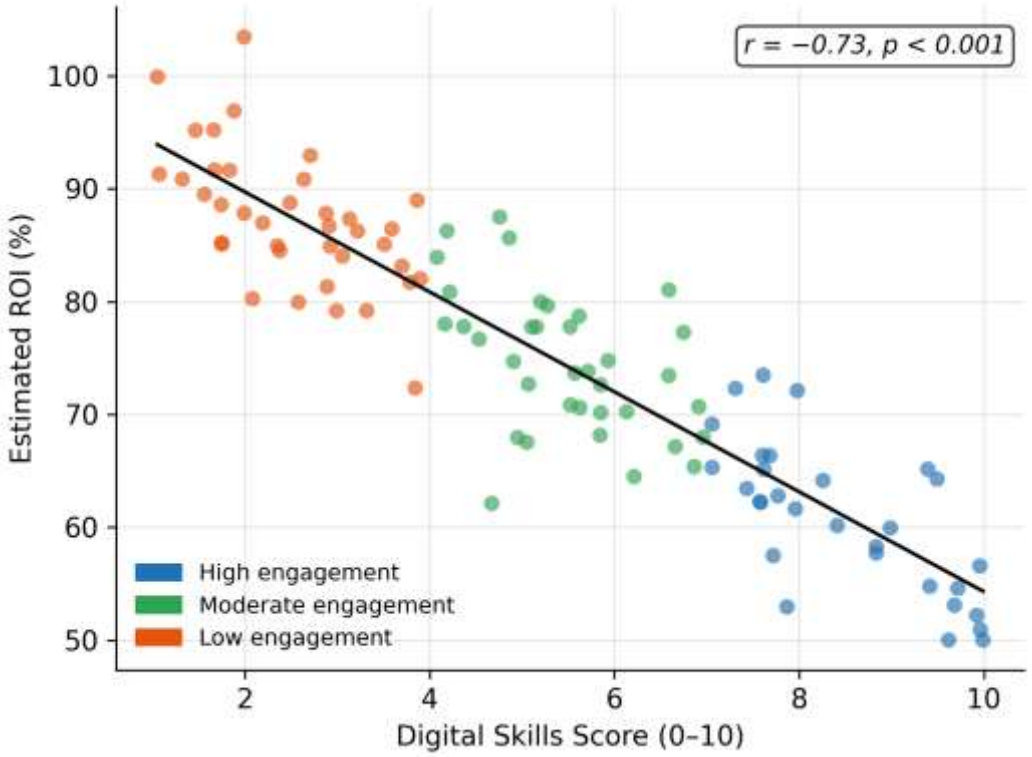

Figure 14: Relationship between digital skills score and estimated ROI (%)

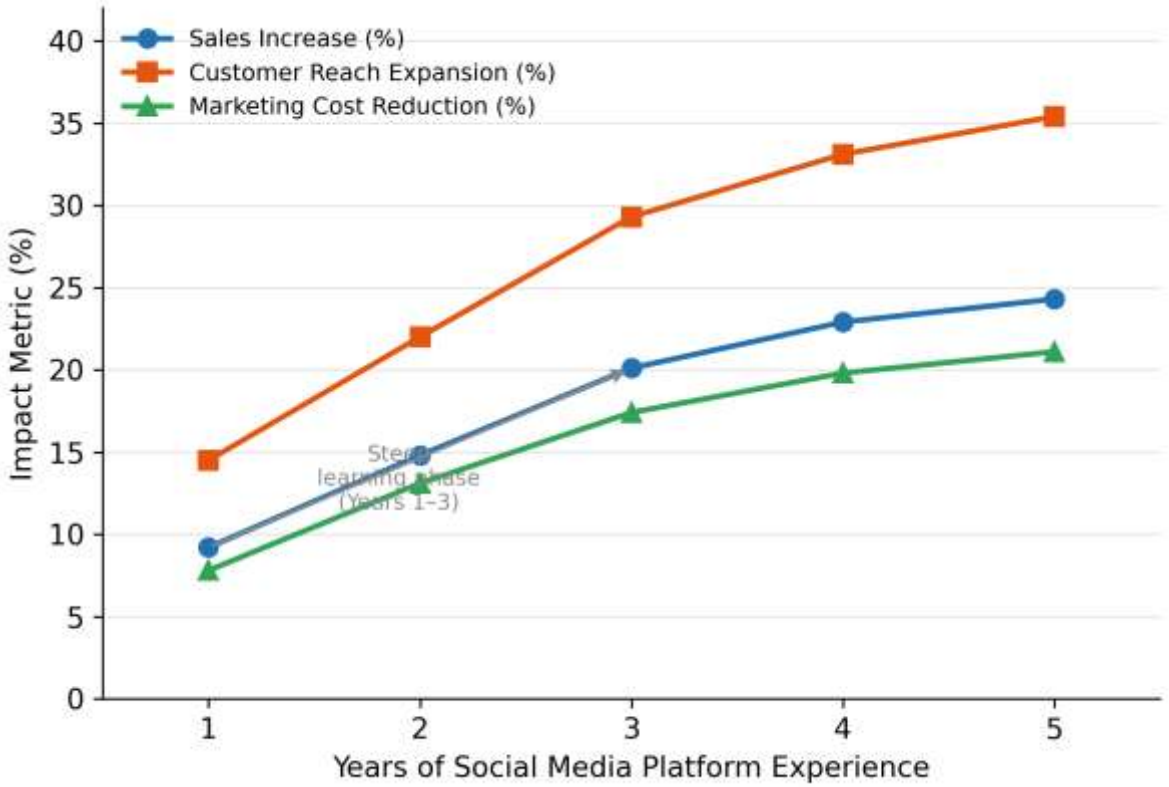

Figure 15: Social media marketing impact metrics by years of platform experience

Conclusion

This study provides robust quantitative evidence that social media marketing substantially enhances business outcomes for small and medium-scale agricultural producers in Bangladesh. Adopters outperformed non-adopters across all metrics with large effect sizes; estimated ROI of 63–92% substantially exceeded conventional agricultural marketing benchmarks. Engagement rate ($r = 0.97$) and digital skills ($r = 0.90$) were the strongest performance predictors, while farm size negatively moderated impact ($r = -0.70$), confirming social media as a competitive equaliser for resource-constrained smallholders. Three producer clusters provide a practical segmentation framework for differentiated extension intervention. Three priority policy actions emerge: first, integrate tiered digital literacy training differentiated by cluster profile into agricultural extension programmes; second, prioritise connectivity infrastructure investment in lagging districts such as Chapainawabganj; and third, develop Bangla-language content templates and posting guides tailored to specific crop types to reduce digital skills and language barriers among the 13.3% non-adopters and the low-engagement cluster. Limitations include the cross-sectional design, self-reported metrics, and two-district scope. Future longitudinal and multi-region studies are recommended to strengthen causal inference and generalisability.

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