Social Media Access and Technical Efficiency among Small and Medium Agro-Allied Enterprises in Nigeria

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Abstract
This study examines the relationship between social media access and the technical efficiency of agro-allied small and medium-sized enterprises (SMEs) in Nigeria. Firm-level data from 660 enterprises in the 2025 World Bank Enterprise Survey are analysed using a Cobb–Douglas stochastic frontier production function with labour, capital and materials as inputs. Technical-efficiency estimates are summarised and compared between social-media users and non-users, and a second-stage regression examines the association between efficiency and selected firm characteristics. The estimated mean technical-efficiency score is 0.9615. Firms using social media record a mean score of 0.9617, compared with 0.9613 among non-users, a difference of 0.04 percentage points. The group comparison is statistically significant ($t = 4.458$, $p < .001$), while the second-stage model reports a positive coefficient for social media access ($\beta = 0.0061$, $p = .014$). Formal registration, managerial experience and female ownership are also positively associated with the transformed efficiency measure. The estimated production elasticities indicate decreasing returns to scale, with labour making the largest contribution among the three inputs. Variance decomposition indicates that random variation accounts for most of the composite error, while the estimated inefficiency component is small. The findings suggest that social media access is associated with marginally higher technical efficiency and highlight the relevance of firm formalisation and managerial characteristics to performance. The study adds sector-specific evidence to research on digital adoption and productive performance among SMEs in a developing economy.
Keywords: social media; technical efficiency; agro-allied SMEs; stochastic frontier analysis; Nigeria; digital adoption

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1.0 Introduction

Small and medium-sized enterprises (SMEs) are important to employment, enterprise development and the movement of goods through agricultural and food value chains. Agro-allied firms operate across activities such as processing, input supply, storage, packaging, wholesale and distribution, linking primary production with domestic and export markets. Their contribution depends partly on how effectively they combine labour, capital and materials to generate output. Technical efficiency captures this productive dimension by comparing observed output with the maximum output associated with a given input bundle and production technology (World

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Bank, n.d.; Coelli, 1995; Kumbhakar *et al.,* 2015).

Social media has become a business communication and marketing channel through which SMEs can promote products, interact with customers, respond to enquiries, build relationships and obtain market feedback. Its value extends beyond online visibility: when used strategically, social platforms can support market sensing, brand management and customer-linking capabilities (Bartoloni *et al.,* 2024). Empirical studies have reported positive relationships between social media adoption and SME financial, non-financial and sustainability outcomes (Ainin *et al.,* 2015; Qalati *et al.,* 2021; Alghamdi, 2024). However, sales, perceived performance and production efficiency are distinct outcomes. Greater customer reach may raise demand, but technical efficiency depends on how effectively a firm transforms inputs into output. For agro-allied SMEs, social media may help identify buyers, communicate product availability, coordinate orders and respond to changing market conditions. Yet these potential benefits depend on the way platforms are used and on complementary resources such as digital skills, reliable connectivity and managerial capacity. Recent reviews emphasise that SME digital transformation is multidimensional and that adoption alone does not capture the depth or effectiveness of digital use (Sagala & Őri, 2024; Lucian Dimoso & Utonga, 2024). It is therefore important to examine whether social media access is associated with the productive use of labour, capital and materials, rather than assuming that adoption necessarily translates into higher technical efficiency.

Against this background, the study examines the relationship between social media access and technical efficiency among agro-allied SMEs in Nigeria. It has three objectives, to

1. estimate the production elasticities of labour, capital and materials;
2. describe technical-efficiency levels and compare them by social media access; and
3. examine the relationship between efficiency and selected firm characteristics,

By focusing on production-frontier efficiency, the study complements research that has primarily examined sales, marketing or self-reported SME performance. The study contributes firm-level evidence from Nigeria's agro-allied sector, a context in which digital adoption intersects with production, marketing and institutional conditions. It links social media access to an explicit measure of productive efficiency and considers the role of formalisation and managerial characteristics alongside digital engagement. The results are interpreted as empirical relationships within the estimated models.

2. Literature Review

2.1 Social media use and SME performance

Social media can enable SMEs to communicate with customers and other stakeholders through relatively accessible channels. Ainin et al. (2015), in a study of Malaysian SMEs, found that Facebook use was associated with financial and non-financial performance outcomes. Qalati et al. (2021) likewise reported a positive relationship between social-media adoption and SME performance in a developing-country setting. Research on business-to-business SMEs further suggests that strategic social-media use can strengthen market-sensing and brand-management capabilities, which can support marketing and financial performance (Cuevas-Molano *et al.,* 2023). A recent systematic review of 169 articles also highlights the breadth of social media marketing outcomes and the need to consider firms' activities, contextual factors and the different pathways through which outcomes emerge (Bartoloni & Ancillai, 2024).

Although this literature establishes a strong basis for expecting social media to be relevant

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to SME outcomes, the connection with technical efficiency deserves separate examination. Studies use different measures of adoption, ranging from a binary indicator of access to frequency, strategic integration and platform-specific activity. They also use different performance outcomes, including sales, profitability, customer relationships and sustainability (Kanth & Prasad, 2023; Bartoloni *et al.,* 2024; Alghamdi, 2024). These measures capture important but distinct aspects of performance. Firms that adopt social media may also differ in size, resources, managerial capacity and formal status, making it useful to consider these characteristics when examining the relationship between adoption and efficiency.

Social media access is therefore treated as an indicator of adoption rather than a comprehensive measure of digital capability. The indicator identifies whether a firm uses social media, but does not distinguish among platforms, frequency of use, content quality or the intensity of customer engagement. The analysis accordingly estimates the relationship between access and technical efficiency as measured in the dataset.

2.2 Technical efficiency and stochastic frontier analysis

Technical efficiency refers to the relationship between observed output and the maximum output that could be produced from a given set of inputs under the estimated technology. Stochastic frontier analysis (SFA) separates a symmetric random-error component from a non-negative inefficiency component. This structure recognises that observed production may be affected by both factors outside a firm's control and differences in production performance (Jondrow *et al.,* 1982). SFA has been used in agricultural and related economic research to estimate production frontiers and firm-level efficiency (Coelli, 1995). The interpretation of SFA results depends on the production specification and the separation of random shocks from inefficiency. Variance decomposition provides information about the relative contribution of these two components, while the estimated firm-level scores summarise each firm's position relative to the production frontier. The present analysis reports both the efficiency distribution and the variance parameters to describe productive performance in the sample.

Stochastic-frontier models can be applied to panel data to account for repeated observations and to examine how inefficiency relates to firm-specific characteristics over time (Battese & Coelli, 1995). The present study uses the merged firm-level survey dataset described in the study design and estimates efficiency scores for the sampled agro-allied SMEs.

2.3 The Resource-Based View

The Resource-Based View (RBV) explains differences in firm performance through the resources and capabilities that firms control and deploy. Resources are more likely to support sustained advantage when they are valuable, difficult to imitate and effectively organised within the firm (Barney, 1991). In the context of SMEs, social media access can be viewed as a digital resource, but its contribution depends on the capabilities that support its use. Customer knowledge, managerial experience, content development, responsiveness and the ability to translate online interactions into orders can determine whether a social-media presence contributes to business outcomes. Digital access is therefore most useful when it is combined with organisational routines and complementary resources. This perspective is relevant to agro-allied SMEs because market access and customer communication are linked to the coordination of products, orders and delivery. The RBV provides a basis for expecting a positive relationship between social media access and technical efficiency, while recognising that access alone is not equivalent to a fully developed digital capability. The present study applies this perspective to

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examine whether social media access is associated with firms' estimated productive efficiency, alongside formal registration and managerial characteristics.

3.0 Methodology

3.1 Data source and sample

The analysis uses firm-level data from the 2025 World Bank Enterprise Surveys for Nigeria, a cross-sectional survey of firms across the six geopolitical zones. The analytical sample comprises 660 agro-allied SMEs. The Enterprise Surveys collect firm-level information on business characteristics, sales, employment and operating conditions using a stratified sampling framework. Annual sales is used as the output measure, while labour, capital and materials are the production inputs. The production frontier follows a Cobb–Douglas specification, expressed in log-linear form as:

$$ln(Y_i) = \beta_0 + \beta_1 ln(L_i) + \beta_2 ln(K_i) + \beta_3 ln(M_i) + v_i - u_i$$

where Y denotes output, L labour, K capital, and M materials; v is a two-sided random error; and u is a non-negative inefficiency term. The estimated coefficients on logged inputs are interpreted as production elasticities, conditional on the model specification. The sum of the input elasticities provides the reported returns-to-scale measure. Social media access is coded as a binary indicator (1 = yes; 0 = no) in the second-stage regression. Other explanatory variables are formal registration, firm age, managerial experience and female ownership. The dependent variable in the second-stage model is the logit-transformed technical-efficiency score. The analysis reports the Cobb–Douglas stochastic frontier estimates, the associated variance parameters, the distribution of firm-level efficiency scores, and comparisons between social-media users and non-users. A t-test and Mann–Whitney U test are used to compare group efficiency scores. The second-stage regression examines the relationship between logit-transformed efficiency and selected firm characteristics.The technical-efficiency estimates are interpreted relative to the estimated production frontier. The second-stage coefficients are interpreted as relationships with the logit-transformed efficiency score. The analysis combines production-frontier estimation with group comparisons and firm-level regression to assess whether social media access is associated with differences in estimated productive efficiency.

4. Results

4.1 Estimated production frontier

The estimated coefficients are positive for labour, capital and materials. Labour has the largest production elasticity (0.4003), followed by materials (0.2963) and capital (0.2027). The sum of the three coefficients is 0.8992, indicating decreasing returns to scale. Thus, a proportional increase in all three inputs is associated with a less-than-proportional increase in output within the estimated production function.

Table 1. Estimated Cobb–Douglas production frontier

Variable	Parameter	Coefficient
Constant	β_0	0.0397
Labour (ln labour)	β_1	0.4003
Capital (ln capital)	β_2	0.2027
Materials (ln materials)	β_3	0.2963
Returns to scale	$\beta_1 + \beta_2 + \beta_3$	0.8992

Source: Author's Computation, 2026

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4.2 Variance parameters

The estimated variance parameters are σ^2v = 0.5733, σ^2u = 0.002479, λ = 0.0658 and γ = 0.0043. The variance decomposition indicates that the random-error component accounts for most of the composite variation, while the inefficiency component accounts for a relatively small share. This pattern is consistent with the study's finding that the sampled firms operate at a high estimated level of technical efficiency and that observed output variation is associated largely with external shocks and operating conditions. The variance parameters provide context for interpreting the efficiency estimates. The low γ value indicates that inefficiency represents a small share of total composite-error variation in the estimated model. Accordingly, the results point to generally high estimated technical efficiency among the sampled firms, with differences in external conditions and random shocks accounting for a substantial share of observed variation.

Table 2. Estimated stochastic-frontier variance parameters

Parameter	Symbol	Estimate
Noise variance	σ^2_v	0.5733
Inefficiency variance	σ^2_u	0.002479
Lambda	Λ	0.0658
Gamma	Γ	0.0043
Log-likelihood (SFA)	LL(SFA)	−751.1558
Log-likelihood (OLS)	LL(OLS)	−751.1553
Likelihood-ratio statistic	LR	0.0000

Source: Author's Computation, 2026

4.3 Distribution of technical-efficiency scores

The estimated mean and median technical-efficiency scores are both 0.9615, with a standard deviation of 0.0011, a minimum of 0.9574 and a maximum of 0.9660. All firms record efficiency scores above 0.90. Overall, the estimates indicate that the sampled agro-allied SMEs operate close to the estimated production frontier, with a mean efficiency score of 96.15%. The narrow distribution indicates that the firms' estimated efficiency levels are relatively similar within the fitted production frontier. The mean score of 0.9615 corresponds to an estimated distance of 3.85 percentage points from the frontier. Together with the variance decomposition, this suggests that the sampled firms are operating at comparatively high estimated efficiency levels.

Table 3. Distribution of technical-efficiency scores

Statistic	Value
Mean	0.9615
Median	0.9615
Standard deviation	0.0011
Minimum	0.9574
Maximum	0.9660
Firms above 90% efficiency	100%

Source: Author's Computation, 2026

4.4 Technical efficiency by social media use

The mean efficiency score is 0.9617 among social-media users and 0.9613 among non-

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users. The difference is 0.0004, equivalent to 0.04 percentage points. The t-test indicates a statistically significant difference ($t = 4.458$, $p < .001$), and the Mann–Whitney U test also indicates a significant group difference ($U = 74{,}152$, $p < .001$). In both comparisons, firms using social media record the higher efficiency score. The difference in group means is small in absolute terms, although both reported tests indicate that it is statistically significant. This distinction is important for interpretation: the results show a consistent positive association between social media access and estimated technical efficiency, while the absolute difference between the group means remains modest. The second-stage regression further considers selected firm characteristics alongside social media access.

Table 4. Technical efficiency by social media access

Group / test	Estimate
Social media users: mean TE	0.9617 (96.17%)
Non-users: mean TE	0.9613 (96.13%)
Mean difference	0.0004 (0.04 percentage points)
t-test	$t = 4.458$; $p < .001$
Mann–Whitney U test	$U = 74{,}152$; $p < .001$

Source: Author's Computation, 2026

4.5 Differences by registration, city and firm size

Mean technical efficiency is highest among social-media users that are formally registered (96.24%), followed by formally registered non-users (96.20%), social-media users in the informal group (96.15%) and informal non-users (96.13%). This ordering indicates that social media access and formal registration are each associated with slightly higher reported efficiency scores. Formal registration may support access to business networks, formal finance, training and other institutional resources that complement digital engagement. Mean efficiency scores vary only slightly across locations: Kano (0.9614), Lagos (0.9611), Kaduna (0.9610), Port Harcourt (0.9615), Abuja (0.9617) and other cities (0.9617). By firm size, the reported means are 0.9612 for small firms, 0.9616 for medium firms and 0.9618 for large firms. The figures indicate a broadly similar level of estimated technical efficiency across these location and size categories.

4.6 Second-stage regression

The second-stage regression reports a positive and statistically significant coefficient for social media access ($\beta = 0.0061$, $p = .014$). Formal registration has a positive coefficient of 0.0206 ($p < .001$), while managerial experience ($\beta = 0.0601$, $p = .026$) and female ownership ($\beta = 0.0082$, $p = .001$) are also positively associated with the transformed efficiency measure. Firm age is not statistically significant ($\beta = 0.0000$, $p = .899$). The model reports $R^2 = 0.311$ and $F = 14.57$ ($p < .001$), indicating that the included explanatory variables are jointly associated with the dependent variable. The dependent variable is the logit-transformed technical-efficiency score; accordingly, coefficients describe associations with the transformed efficiency measure rather than percentage changes in the original score. The positive coefficient on social media access is consistent with the group comparison, while formal registration has the largest positive coefficient among the reported explanatory variables. The results also indicate positive relationships for managerial experience and female ownership, whereas firm age does not show a statistically significant relationship.

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Table 5. Second-stage regression estimates

Variable	Coefficient	Standard error	p-value
Constant	3.2075***	0.0027	0 .001
Social media access (1 = yes)	0.0061***	0.0025	0.014
Formal registration (1 = yes)	0.0206***	0.0046	0 .001
Firm age	0.0000	0.0001	0.899
Managerial experience	0.0601**	0.0031	0.026
Female ownership	0.0082***	0.0024	0.001

Model fit: $R^2 = 0.311$; $F = 14.57$; $p < 0.001$.
Source: Author's Computation, 2026

5. Discussion

Three findings stand out. First, labour has the largest estimated production elasticity among the three inputs, followed by materials and capital. The sum of the elasticities is 0.8992, indicating decreasing returns to scale: a proportional increase in all three inputs is associated with a less-than-proportional increase in output within the estimated production function. This result highlights the importance of improving the organisation and use of existing resources alongside any expansion in input use. Second, social-media users record a mean efficiency score of 96.17%, compared with 96.13% among non-users. The difference is only 0.04 percentage points, but the t-test and Mann–Whitney test are both statistically significant. This result is broadly consistent with evidence that social media can strengthen SMEs' customer engagement, marketing and market-sensing capabilities (Ainin *et al.,* 2015; Qalati *et al.,* 2021; Cuevas-Molano *et al.,* 2023). In this study, the outcome is production-frontier efficiency rather than sales or perceived performance, and the small difference in group means indicates that the relationship is positive but modest in magnitude. Third, formal registration has a positive relationship with the transformed efficiency measure and is associated with higher mean efficiency in the subgroup comparison. This finding aligns with the view that institutional integration and managerial resources can complement digital adoption. Registration may help firms engage with formal financial services, business networks, training and procurement systems, although the present estimates do not separately identify these pathways.

The variance decomposition indicates that inefficiency accounts for a small proportion of the composite error, with random variation accounting for most of it. In the context of agro-allied SMEs, this pattern directs attention to operating conditions outside the firm, including infrastructure reliability, input availability and market fluctuations, alongside internal management practices. The interpretation is consistent with the study's broader finding that firms report high estimated technical efficiency, even though access to digital channels and institutional characteristics differ across enterprises. The study's multi-wave firm-level dataset provides a basis for examining social media access and efficiency across the survey period. The results should be understood as estimates from the specified sample and model, with social media access serving as a binary measure of adoption. Future research can extend this analysis by measuring the frequency and strategic intensity of social media use and by examining how the relationship changes across survey periods and firm categories. An important direction for future research is to distinguish simple access from strategic and intensive use. The binary measure applied here does not capture platform type, posting frequency, advertising

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investment, customer-response time or the extent to which online enquiries are converted into orders. Future studies could also examine differences by firm size, sub-sector and location, and test whether digital skills and infrastructure condition the relationship between social media and productive performance.

6. Conclusion and Recommendation

This study examined the relationship between social media access and technical efficiency among agro-allied SMEs in Nigeria. The estimated mean efficiency score is 96.15%, with social-media users recording 96.17% and non-users 96.13%. The second-stage regression also reports a positive and statistically significant coefficient for social media access. Taken together, the results indicate a positive relationship between social media access and technical efficiency, although the absolute difference in group means is modest. The findings suggest that agro-allied SMEs can treat social media as part of a broader approach to customer engagement, market information and business coordination. To translate access into productive benefits, firms should integrate digital communication with order management, customer follow-up, inventory planning and timely fulfilment. Business-support agencies can complement digital-skills programmes with training in record-keeping and formal business practices. These measures may help firms connect online engagement with operational decisions rather than viewing social media solely as a promotional tool. The study contributes to the literature by connecting social media access with a production-based measure of efficiency in Nigeria's agro-allied SME sector. Further work can deepen this contribution by examining platform-specific use, digital capability and the role of infrastructure in shaping firm productivity. Such research would help clarify which forms of digital engagement are most useful for improving the conversion of productive inputs into output.

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