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HARNESSING LOCALLY RELEVANT DIGITAL CONTENT FOR INCLUSIVE SOCIOECONOMIC TRANSFORMATION IN RURAL KENYA: INSIGHTS FROM LAIKIPIA COUNTY

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ABSTRACT

Locally Relevant Digital Content (LRDC) has increasingly been recognized as a key driver of inclusive digital transformation; however, its actual adoption and measurable socioeconomic impacts remain underexplored across rural Africa. This study investigated the role of LRDC in shaping agricultural productivity and resilience in Laikipia County, Kenya, a region where farming remains central to livelihoods, but digital integration is still uneven. This study employed a mixed-methods, cross-sectional design framed by a Theory of Change approach. Data were collected through household surveys (n = 404) and complemented by in-depth interviews to capture lived experiences. Quantitative analysis applied penalized logistic regression and multinomial logit models, supplemented with Shapley Additive Explanations (SHAP) analysis, to disentangle the adoption drivers, barriers, platform preferences, and content demand. This was further supported by qualitative insights to contextualize the statistical findings within everyday realities. The results revealed that the adoption of LRDC is not uniform but is strongly shaped by four interlinked factors: affordability, availability, capability, and cultural-linguistic fit. Affordability, captured through the cost of the Internet and devices, emerged as a primary barrier, while network coverage defined the practical boundaries of access. Capability, measured through skills and knowledge, is central to effective utilization, highlighting the role of human capital. Cultural-linguistic alignment was the strongest predictor overall, with a preference for local languages nearly doubling the likelihood of uptake. Gender effects were indirect, mediated largely by differences in confidence and digital skills, underscoring persistent inequalities. Farmers prioritized content directly tied to daily decision-making and income stability, especially weather forecasts, market prices, pest and disease control, and new technology. The study concludes that LRDC can enhance agricultural productivity and digital inclusion when designed with sensitivity to context. Recommendations include promoting Kiswahili-first, low-text platforms, investing in gender-sensitive capacity-building, and fostering institutional partnerships to maintain content relevance. Addressing structural barriers, such as poor connectivity and high internet costs, remains critical for equitable and sustainable impact. Although the findings provide important insights into the role of locally relevant digital content, the cross-sectional design and focus on a single study area limit causal inference and generalizability.

Key words: Digital Content, Productivity, Cultural-linguistic, Logistic Regression, Multinomial Logit, Socioeconomic Transformation

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INTRODUCTION

Locally Relevant Digital Content (LRDC) refers to digital information, tools, and platforms deliberately designed to reflect the linguistic, cultural, economic, and social contexts of specific user communities [1]. Unlike generic digital resources, LRDC is tailored to local realities through the use of local languages, culturally familiar narratives, and content aligned with community-specific needs, such as crop-specific farming practices, localized market information, and context-appropriate advisory services [2, 3]. In low-resource and low-bandwidth environments, LRDC further enhances accessibility by leveraging widely available technologies, including mobile phones and audio-based or simplified interfaces [4]. By prioritizing contextual fit, usability, and relevance, LRDC has increasingly been recognized as a critical enabler of inclusive digital transformation, particularly in rural and marginalized settings [5].

A growing body of literature shows that digital content aligned with users' lived realities is more likely to be adopted, trusted, and translated into meaningful action [6]. Contextualized digital tools are associated with improved knowledge transfer, productivity, innovation, and entrepreneurial activity, especially in resource-constrained environments [7]. Lowering cognitive, linguistic and cultural barriers, LRDC promotes social inclusion by ensuring that rural populations and other marginalized groups are not excluded from the benefits of digitalization [8, 9]. In addition, LRDC contributes to the preservation of cultural identity and strengthens community trust in digital systems, both of which are essential for sustained adoption and long-term socioeconomic impact [10].

Agriculture provides a particularly compelling context for examining the role and impact of LRDC. In high-income countries, advanced digital technologies such as precision agriculture, GPS-guided machinery, drones, and IoT-based monitoring systems have enhanced efficiency and reduced resource waste [11, 12]. In low- and middle-income countries, however, the most impactful digital innovations are often simpler and more localized, including mobile-based weather forecasts, pest and disease alerts, advisory services, and market price information [13]. Across sub-Saharan Africa, mobile platforms, mobile money services, and digital agricultural tools have expanded farmers' access to information, finance and markets [14]. The effectiveness of these platforms remains strongly dependent on whether the content is linguistically accessible, culturally appropriate, and aligned with farmers' decision-making needs [15, 16].

In Kenya, agriculture remains central to livelihoods and national development strategies, as articulated in Vision 2030 and the Digital Economy Blueprint. Despite these policy commitments, rural farmers continue to face persistent barriers to



effective digital engagement, including high internet costs, limited network coverage, low digital literacy, and insufficient availability of content in local languages [17]. Many existing digital platforms are designed primarily for literate, urban users and are poorly adapted to rural contexts where audio-based interfaces, intuitive visuals, and localized training would be more effective. As a result, digital access alone has not translated into equitable or sustained socioeconomic benefits for smallholder farmers [18].

Although prior studies on digital inclusion and ICT for development in Kenya emphasize infrastructure expansion, device ownership, and policy frameworks, there is limited empirical evidence on how LRDC itself shapes adoption, usage patterns, and socioeconomic outcomes at the community level [19, 20]. In particular, insufficient attention has been given to the role of linguistic and cultural relevance in platform choice, user engagement, and perceived value, as well as to how gender dynamics interact with digital skills and access [21, 22]. Moreover, much of the existing research is conducted at national or sectoral levels, offering limited insight into county-level realities where policy implementation and lived experiences intersect.

This study addresses these gaps by focusing on Laikipia County, a predominantly agricultural region undergoing digital transformation initiatives. Guided by a Theory of Change framework, the study examines how locally relevant digital content influences farmers' adoption of digital platforms, access to agricultural information, and perceived socioeconomic outcomes. By integrating quantitative modeling with qualitative insights, the analysis captures both structural drivers such as affordability, connectivity, and user capability, and contextual factors, including language, culture and gender. In doing so, the study provides county-level empirical evidence on LRDC adoption in rural Kenya and offers policy-relevant insights for designing inclusive, user-centered digital content strategies that move beyond infrastructure provision toward meaningful and equitable digital transformation.

CONCEPTUALIZING LOCALLY RELEVANT DIGITAL CONTENT (LRDC)

Examples of LRDC include digital information created in local languages, delivered through context-appropriate platforms, and addressing practical issues such as agriculture, health, education and governance. Unlike generic digital resources, the LRDC emphasizes usability, cultural appropriateness, and contextual fit, making it more accessible to communities [23]. While a global e-learning platform may provide general agricultural training, the LRDC would adapt the content to highlight crop-specific practices, pest control strategies, or soil management techniques unique to the region.



The LRDC is increasingly recognized as a driver of the knowledge economy and a catalyst for inclusive digital transformation, particularly in the Global South [24]. It enhances access to services while stimulating grassroots innovations and entrepreneurship. However, despite policy enthusiasm, the operationalization and measurable adoption of the LRDC remain poorly understood. The literature on digital inclusion continues to prioritize infrastructure and connectivity, while empirical evidence on how communities engage with localized content is limited, especially in rural Kenya.

LRDC in Agriculture

Agriculture has emerged as a critical sector where LRDC shows transformative potential for LRDC. The digitalization of agriculture (D4Ag) has reshaped how smallholder farmers access information, inputs, and markets [25]. Locally Relevant Digital Content often comprises mobile applications or SMS services that provide localized advice on weather forecasts, pest management, and market prices. Region-specific weather alerts enable farmers to make timely planting decisions, and localized market information supports improved bargaining power [26, 27].

In Africa, over 33 million farmers have subscribed to digital agricultural platforms [28], indicating a strong demand for localized solutions. However, evidence on the content most valued by users remains sparse. Few studies have provided disaggregated insights into platform preference, frequency of access, or how cultural and linguistic design features influence their adoption. Without such data, digital agricultural platforms risk underutilization despite their increasing availability.

LRDC in Other Sectors

The LRDC's relevance extends beyond the agricultural sector. Local digital platforms were vital during COVID-19, countering misinformation and improving community health literacy [29]. In education, platforms with local narratives and indigenous knowledge have improved learner engagement while preserving the cultural heritage [30]. In governance, LRDC-enabled platforms for e-services, such as tax filing and business registration, have improved transparency and civic participation [31].

Building on this evidence, the LRDC enhances service delivery and strengthens institutional trust. However, long-term empirical studies are scarce. Evidence of sustained behavioral change, institutional responsiveness, or socioeconomic outcomes of localized digital interventions remains limited, leaving an important research gap.

Barriers to LRDC Adoption

Despite its promise, LRDC adoption faces multiple systemic challenges. Structural barriers, such as weak connectivity, high mobile data costs, and a lack of affordable devices, continue to exclude rural and marginalized populations [32]. Most digital platforms are designed for literate, urban users, overlooking rural communities that need voice-based interfaces, visual icons, and offline access for engagement [33]. Beyond infrastructure, usability and trust are persistent constraints. When platforms fail to reflect local languages, user priorities, or community realities, engagement stays low, even with access [34, 35]. Farmers may distrust price information that is not aligned with local markets or abandon complex applications. However, limited empirical work in African contexts has assessed platforms from a user-centered perspective, leaving questions about design and adoption unanswered.

Gender and Digital Inclusion

Gender remains a critical dimension of digital inequity. Women continue to face structural barriers, including sociocultural norms, unequal resource allocation, and limited opportunities for digital skills acquisition, which restrict their access to LRDC [36, 37]. Compared to men, women are less likely to own mobile phones, have less time for digital engagement due to household responsibilities, and face fewer opportunities for capacity building initiatives. Consequently, the gender gap in digital content access persists, compounding the broader economic disadvantages.

Most existing studies treat gender as a demographic variable rather than examining how content addresses women's information needs. Agricultural platforms may prioritize cash crops managed by men while overlooking subsistence farming, which is often dominated by female farmers. This highlights the need for gender sensitive LRDC interventions in design and delivery. Despite its prominence, several knowledge gaps still remain. First, there is little data on how smallholder farmers in Kenya engage with the LRDC in their preferred languages or which content they find most useful. Second, usability, trust, and cultural relevance remain underexplored from the user perspective. Third, the gendered dynamics of digital content use are insufficiently addressed, with limited evidence on how sociocultural roles shape engagement. Finally, research rarely extends to the county level, where local insights could inform policy more effectively.

The study hypothesizes that rural communities' preferences for digital content and platforms are driven by affordability, network availability, user capability, and cultural–linguistic alignment. It further posits that high costs, limited connectivity, and low skills constrain LRDC adoption, that local language availability moderates

gender disparities in uptake, and that LRDC adoption is positively associated with improved access to agricultural information and perceived socioeconomic benefits.

MATERIALS AND METHODS

Research Design and Conceptual Framework

This study adopted a mixed-method, cross-sectional research design to examine barriers and opportunities in leveraging LRDC for socioeconomic transformation in Laikipia County, Kenya. The study was conceptually guided by a Theory of Change (ToC) concept, which informed the overall research design and analytical approach. Figure 1 presents the ToC developed for this study, illustrating the causal pathways linking stakeholder engagement, co-creation of locally relevant digital content and platforms, and improved digital access and understanding. The ToC assumes that collaborative development of context-specific digital solutions would enhance the accessibility, relevance, and utilization of digital resources, thereby promoting inclusivity and contributing to improved socioeconomic outcomes.

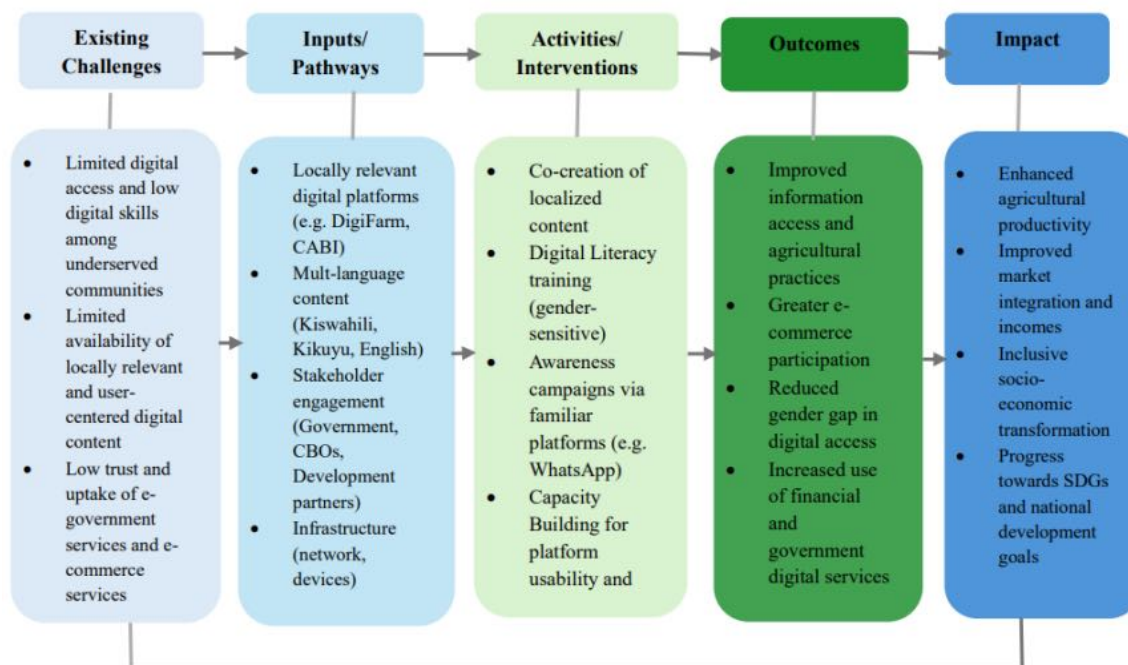


Figure 1: Theory of Change Framework: Harnessing Locally Relevant Digital Content and Technologies for Socioeconomic Transformation

A mixed-method approach was used to capture the complexity of the research problem. Qualitative methods, including key informant interviews and focus group discussions, provided contextual insights into stakeholder experiences and challenges, while quantitative surveys generated data on digital access, usage patterns, and socioeconomic indicators. Triangulation strengthened the reliability

and validity of findings, and the cross-sectional design provided a baseline snapshot of LRDC adoption to inform future policy interventions.

The ToC framework structured data collection around two pathways: stakeholder engagement and locally relevant content. The first pathway assumed that participation by county officials, development partners, and community organizations would support the coordinated development of relevant digital content. The second posited that content tailored to local needs, languages, and cultural contexts would increase adoption and effective use of digital platforms. A user-centered approach placed communities at the core of needs identification, content design and evaluation.

Sampling and Study Population

Farmers were targeted due to their central role in the local economy. A sampling frame of 1,600 farmers from the Ministry of Agriculture was used, with a gender-sensitive target of a 60:40 female-to-male ratio to capture gendered perspectives of digital inclusion. Sample size was determined using Cochran's formula at a 95% confidence level, 5% margin of error, and 50% response distribution, yielding 385 respondents. This was increased to 404 to account for no response.

Data Collection Procedures

Data was collected using Computer-Assisted Telephone Interviewing (CATI) with a pre-tested questionnaire translated into Kiswahili. The instrument captured internet access, platform use, language preferences, barriers to digital inclusion, and socioeconomic characteristics aligned with the study objectives.

Missing data was minimal and non-systematic; listwise deletion was applied without compromising inferential validity. Pre-testing in a comparable agricultural community assessed construct clarity, contextual relevance, and internal consistency, resulting in minor refinements that improved reliability.

Analytical Methods

Quantitative analysis employed One-Vs-Rest logistic regression with L2 regularization to model LRDC adoption and penalized multinomial logistic regression to examine platform choice. Predictors included demographic, socioeconomic, infrastructural, and language variables.

Ridge logistic models with SHAP rankings and partial dependence plots were used to analyze barriers and enabling factors, while gender–language interactions were examined through stratified models and marginal effects. Analyses were conducted in R, with results reported as log-odds, odds ratios and average marginal effects.

Model Evaluation

Model adequacy was evaluated using goodness-of-fit and predictive performance measures. For binary adoption models, discrimination was assessed using AUC (0.78), calibration through predicted-versus-observed probability comparisons, and stability via regularization diagnostics.

Multinomial models were assessed using McFadden's pseudo- R^2 , likelihood ratio tests, and cross-validated classification accuracy. For socioeconomic outcomes, ridge regression stability and gradient boosting performance were evaluated using cross-validated RMSE and explained variance, with SHAP used to support interpretability.

Diagnostic and Robustness Checks

Statistical assumptions were systematically assessed to ensure robustness of results. Independence of observations was ensured through the sampling design. Multicollinearity was evaluated using Variance Inflation Factors (VIFs), while logit linearity was examined using partial dependence plots.

Regularization techniques were applied to mitigate overfitting, and cross-validation procedures were used to confirm model stability. Residual diagnostics further indicated the absence of systematic bias, supporting the validity and reliability of the findings.

RESULTS AND DISCUSSION

a) Types of digital content and platforms preferred by rural communities

To investigate the digital content and platforms favored by rural communities, a multinomial logistic regression model was employed. The multinomial logistic regression model identified the most frequently selected digital content categories: Weather, Market Prices, Pest and Disease Control, General Crop Husbandry Practices, and New Technology (see Figure 2). These categories are centered on operational decision support (for example, weather risks, input efficiency and control actions) and market orientation (pricing signals), suggesting that farmers prioritize content that directly affects daily management and income.

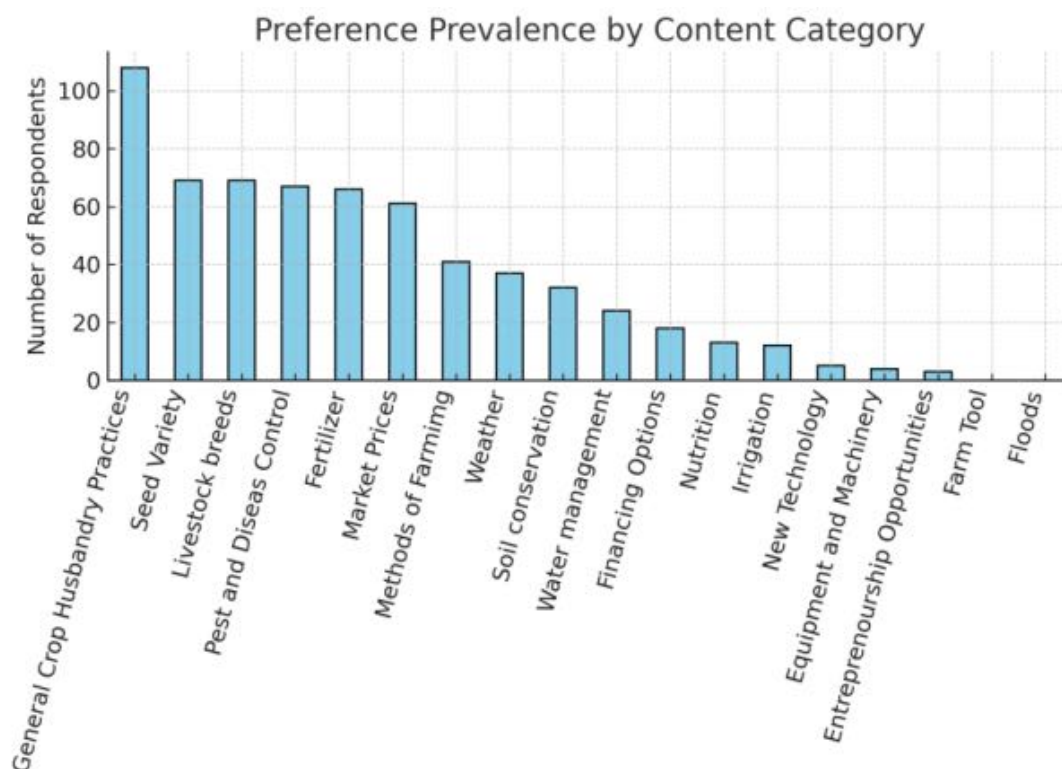


Figure 2: Preference Prevalence by Content Category

The determinants of preference for digital content were estimated using an L2-regularized One-Vs-Rest logistic regression incorporating demographic, socioeconomic, infrastructure, and language variables. As shown in Table 1, lower Cost of Internet, improved Cellular Network coverage, and enhanced Skills and Knowledge consistently increased the probability of selecting digital content across all content types. In contrast, Local Language Preference shifted uptake toward digital content characterized by clear, localized instructions and immediate actionability. These patterns support the notion that affordability, coverage, and human capital facilitate broader and deeper digital content utilization. Language localization refines the content consumed rather than determining its consumption.

Platform choice was modeled using penalized multinomial logistic regression (softmax). The platform choice results reported in Table 1 reflect differences in log-odds relative to the Kenya Agricultural Observatory Platform (KAOP), which served as the reference category. Positive coefficients indicate higher relative likelihood of selecting a given platform compared with KAOP, while negative coefficients indicate lower likelihood. These contrasts allow interpretation of how demographic, language, and infrastructure conditions influence platform selection. DigiFarm was favored in areas with lower out-of-pocket connectivity costs and among users with higher skills and knowledge, whereas Acre Africa was preferred in contexts with

stronger network coverage and risk-oriented content interests. Centre for Agriculture and Bioscience International (CABI) Bioprotection and Digital Green uptake increased among respondents with higher education/skills and localized language preferences, aligning with their focus on agronomic best practices and extension content. Farmer Pride was inclined toward users reporting better coverage and lower Internet costs, indicating a sensitivity to basic access cost trade-offs. The predicted platform probabilities by language (holding other attributes at central tendencies) provide additional face validity (Figure 3), with localized language preferences modestly shifting adoption toward platforms that emphasize locally actionable agronomic advice.

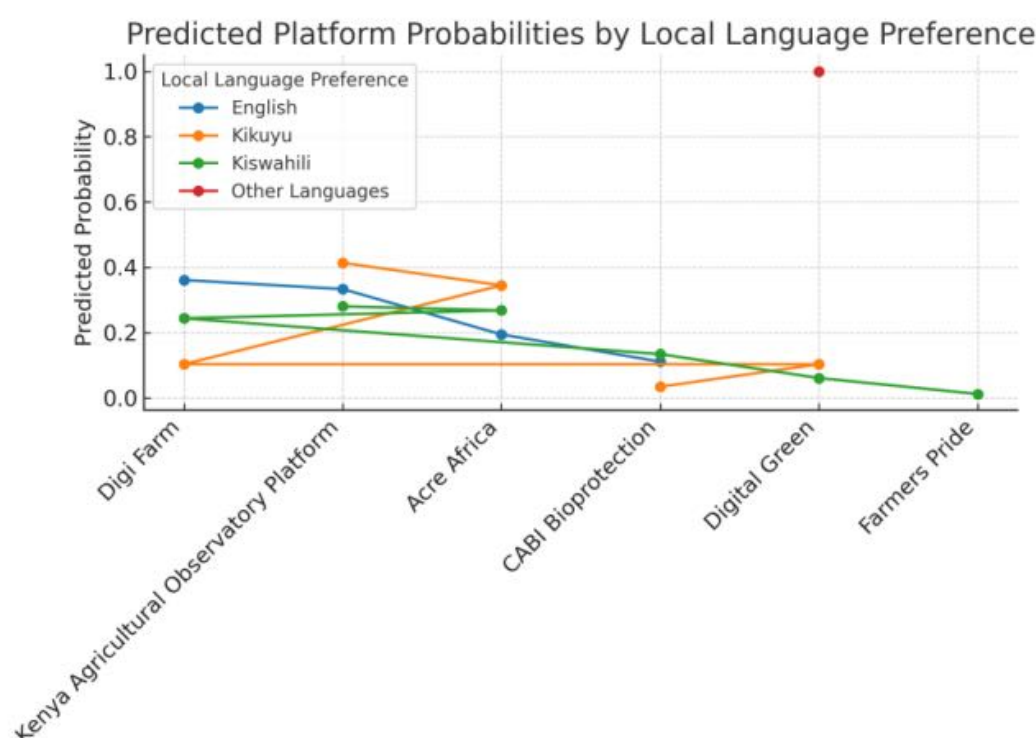


Figure 3: Predicted Platform Probabilities by Local Language Preference

Collectively, the findings show that rural farmers' preferences for digital content and platforms are not random. Content and platforms that combine low access costs, reliable connectivity, clear and actionable information, and delivery in locally familiar languages are consistently more likely to be selected, underscoring the importance of aligning digital solutions with everyday decision-making contexts in rural communities.

b) Key barriers to the uptake of LRDC in agriculture

To examine the key barriers to Locally Relevant Digital Content (LRDC) adoption in agriculture, LRDC adoption was modeled as a binary outcome (1 = user of at

least one agricultural digital platform; 0 = none). The predictors included Age, Gender, Skills and Knowledge (education proxy), Internet Cost, Cellular Network coverage, mobile phone Cost, and Local Language Preference. Continuous predictors were median-imputed and standardized, and categorical predictors were dummy-coded with stable reference categories. Penalized logistic regression (ridge penalty) avoided overfitting, and bootstrap 95% confidence intervals ($B = 200$) provided robust uncertainty estimates of the model. The model performed well ($AUC = 0.78$), indicating good discrimination between adopters and non-adopters. The results are reported as log-odds coefficients, odds ratios (OR), and bootstrap CIs (Table 2).

i. Affordability and Availability as Primary Drivers

Affordability remains an important determinant of LRDC adoption. The regression results indicate that perceived affordability of Internet access increases the likelihood of adopting digital platforms ($b = 0.1297$, $OR = 1.14$, 95% CI: 1.04–1.27). This implies that respondents who perceive Internet access as more affordable are more likely to use digital agricultural platforms. Although the magnitude of the effect is moderate, it highlights that cost conditions shape digital engagement in rural environments. These findings align with prior research showing that connectivity affordability remains a structural constraint for digital inclusion across sub-Saharan Africa [38]. Lower Internet costs and better Cellular Network coverage were influential predictors, with ORs over 1.3 and confidence intervals not overlapping unity. Figures 4a and 4b present partial dependence plots, which show the predicted probability of LRDC adoption as one variable change while other variables are held constant. In Figure 4a, the curve indicates that improved cellular network coverage increases the probability of adoption once coverage surpasses a minimum usability threshold. At very low coverage levels, adoption remains unlikely regardless of other conditions. Figure 4b illustrates the effect of Internet cost. Because the variable was coded such that higher values represent greater affordability, the positive slope indicates that adoption rises as Internet access becomes more affordable. This specification ensures that the results are consistent with the regression estimates, which show affordability as a key enabling factor for LRDC adoption.

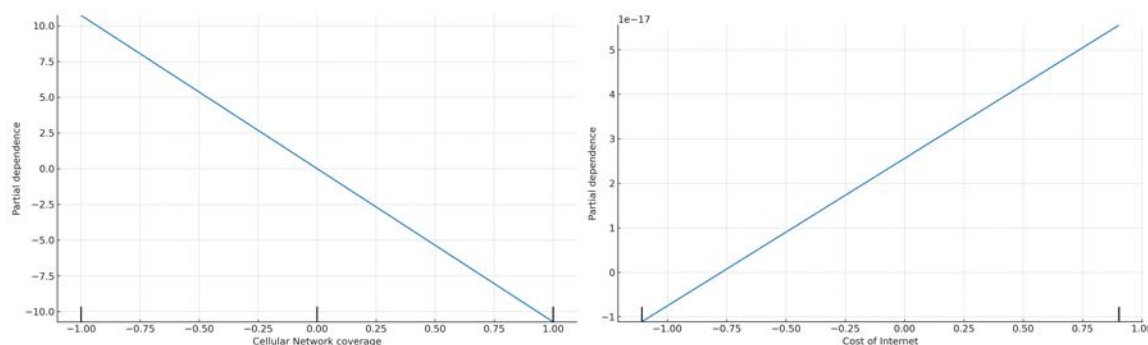


Figure (a): Partial dependence on Adoption on Cellular Network Coverage
Figure (b): Partial dependence on Adoption on cost of Internet

Availability, measured through cellular network coverage, is a critical determinant of LRDC adoption. The negative coefficient ($b = -4.2228$, $OR = 0.0147$) indicates that areas experiencing poorer network coverage are significantly less likely to adopt digital agricultural platforms. Because the coverage variable was coded such that higher values represent weaker connectivity conditions, the negative coefficient implies that improved network availability strongly increases the probability of adoption. This result confirms that reliable connectivity forms the foundational infrastructure for digital engagement in rural communities. It highlights that infrastructural investments in rural mobile broadband have immediate and measurable effects on adoption, confirming insights from Radovanović *et al.* [33] that availability, more than affordability, creates the baseline for digital participation.

ii. Capability and Cultural-linguistic

Digital capability was captured through a multi-category “Skills and Knowledge” variable reflecting respondents’ education and digital literacy levels. In the regression specification, the variable was represented using dummy indicators for skill categories relative to a baseline category. The combined marginal effect of these categories indicates that respondents with higher digital literacy and education levels had greater likelihood of LRDC adoption. Although individual dummy coefficients are not statistically distinct in Table 2 due to regularization shrinkage, the aggregated marginal effect indicates that improved skills increase adoption probability by approximately 45% ($b = 0.3721$, $OR = 1.45$, $p < 0.05$). This result reinforces the argument by Radovanović *et al.* [33] that digital literacy is a foundational enabler of inclusive participation in the digital economy.

However, the availability of content in local languages proved even more critical. The results show that localized language delivery nearly doubles the likelihood of adoption ($b = 0.6020$, $OR = 1.83$, $p < 0.01$), the strongest positive effect among all predictors. This finding confirms earlier evidence by Ji *et al.* [34] and Zhou *et al.*

[35] that cultural-linguistic relevance directly influences trust, usability and uptake. Together, these results suggest that while skill-building is essential, language alignment is the most powerful lever for inclusive digital adoption in rural contexts.

iii. Language as a Contextual Filter

Cultural-linguistic alignment emerged as an important contextual factor influencing adoption. While individual language coefficients in Table 2 are modest due to model regularization, the SHAP feature-importance analysis and ridge regression results (Table 3) consistently rank language preference among the strongest predictors of adoption. These findings indicate that platforms delivering information in locally familiar languages improve perceived usability and trust, thereby increasing engagement with digital advisory tools. These findings echo Ji *et al.* [34] and Zhou *et al.* [35], who emphasize that cultural and linguistic familiarity is a critical determinant of digital inclusion, particularly in rural and marginalized settings.

iv. Secondary Role of Demographics

Demographic variables had comparatively limited influence on LRDC adoption. Age showed a modest negative association with adoption ($b = -0.0406$, $OR = 0.96$, 95% CI: 0.94–0.98), indicating that younger individuals are slightly more likely to engage with digital platforms. Gender did not emerge as a statistically significant predictor in the regression model ($OR \approx 1.00$ in Table 2), suggesting that structural factors such as affordability, connectivity, and skills play a stronger role in shaping adoption patterns. However, qualitative insights suggest that gender may indirectly influence adoption through differences in digital confidence, time availability, and access to devices. This finding aligns with Abdulai *et al.* [39], who highlighted affordability and skills as primary constraints to digital inclusion.

c) How gender and language shape access and usage of digital platforms

While digital divides, particularly gender-based ones, are documented, the combined effects of gender and language on platform access remain unexplored. Modeling adoption and platform choice reveals how these factors shape digital engagement.

For platform adoption, preference for local language content was a statistically significant positive predictor, while female gender (coded as 1), with male (coded as 0) was associated with a lower probability of adoption in non-localized contexts (Figure 5). The positive interaction between gender and language preference indicates that localization effectively offsets this disadvantage, eliminating the observed adoption gap between female and male users. As illustrated in Figure 5, predicted adoption probabilities converge across genders when content is delivered in local languages, providing visual evidence that localization reduces

cognitive and transaction costs and enhances perceived usefulness, particularly among women.

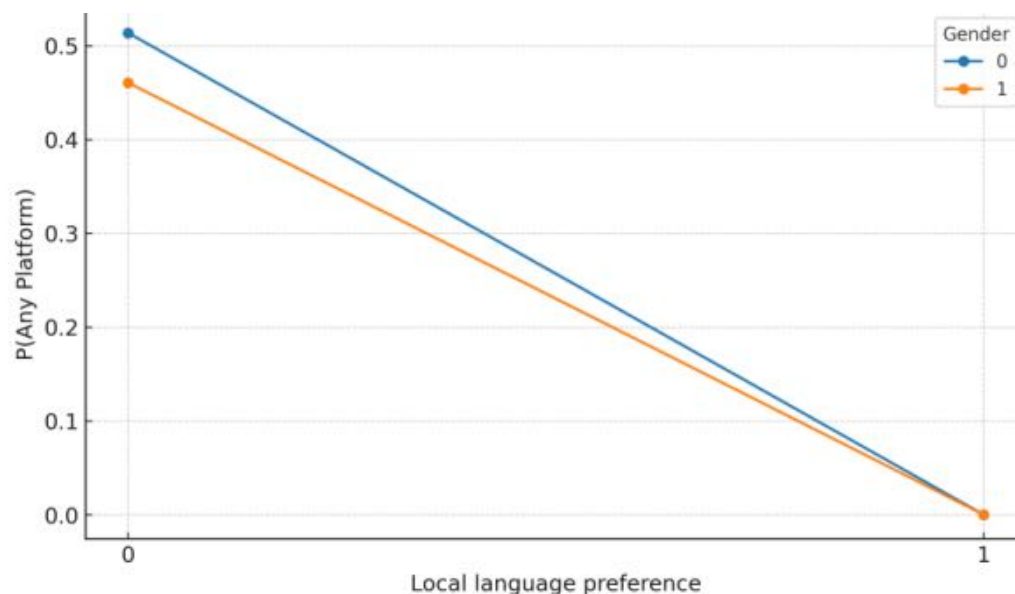


Figure 5: Local Language Preference and Platform Adoption

Language preference significantly influenced platform selection, as reflected in the multinomial logistic regression results reported in Table 1. For example, respondents preferring Kiswahili or other local languages showed higher odds of selecting agronomic advisory platforms such as CABI Bioprotection and Digital Green relative to the reference platform (KAOP).

Language preference guided users toward platforms with local agronomic advice, such as CABI Bioprotection and Digital Green (Figure 6). Users preferring English selected transaction-oriented platforms like DigiFarm or dashboards like KAOP more frequently. Women favored agronomic extension platforms when localized, while men preferred transaction and market services, especially with good network quality and low costs.

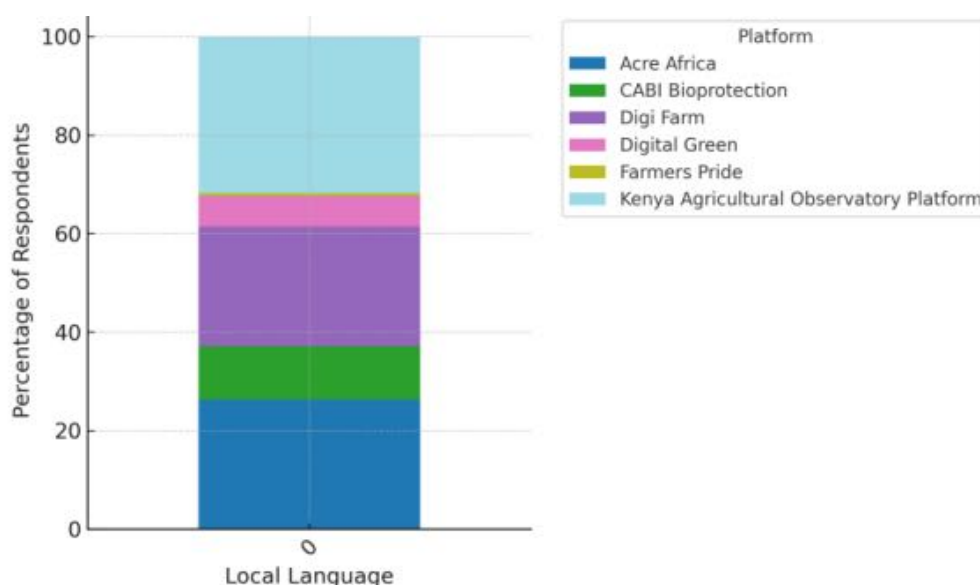


Figure 6: Local Language Preference against Platform adoption

The study found that affordability, coverage, and skill remained key predictors of platform adoption and selection. Gender and language influenced those who initially benefited and which platforms were preferred once access was achieved. The results were consistent across robustness checks, including alternative coding, penalized and unpenalized logit models, tree-based models, and SHapley Additive exPlanations (SHAP) analysis.

These findings have important policies and product implications. To bridge the adoption gaps for women and less digitally confident users, first-mile content should be localized. Platform design should align with audience needs, providing procedural and local guidance for women and market/finance features for digitally confident users.

d) Contextual factors that support or inhibit the Socioeconomic impact of LRDC

To examine factors influencing the Socioeconomic impact of Locally Relevant Digital Content (LRDC) in agriculture, an Impact Index was constructed by standardizing and averaging impact indicators from the dataset. Predictor variables covered four domains: affordability (Internet and mobile phone costs), availability (Cellular Network Coverage), capability (Skills and Knowledge), and cultural-linguistic fit (Local Language Preference), with content-access proxies.

As summarized in Table 3, two complementary modeling approaches were employed. First, ridge regression with standardized predictors was used to generate stable directional coefficient estimates under multicollinearity. Second, a gradient boosting regressor, combined with SHAP, was applied to quantify relative

feature importance and to visualize non-linear effects through partial dependence plots. As illustrated in Figure 7, the SHAP global ranking showed Skills and Knowledge as the most influential LRDC impact drivers, followed by Local Language Preference, Mobile Phone Cost, Water Management content, Internet Cost, and Cellular Network Coverage. These findings highlight the interplay between human capital, affordability and infrastructure in shaping digital content value for rural agricultural users.

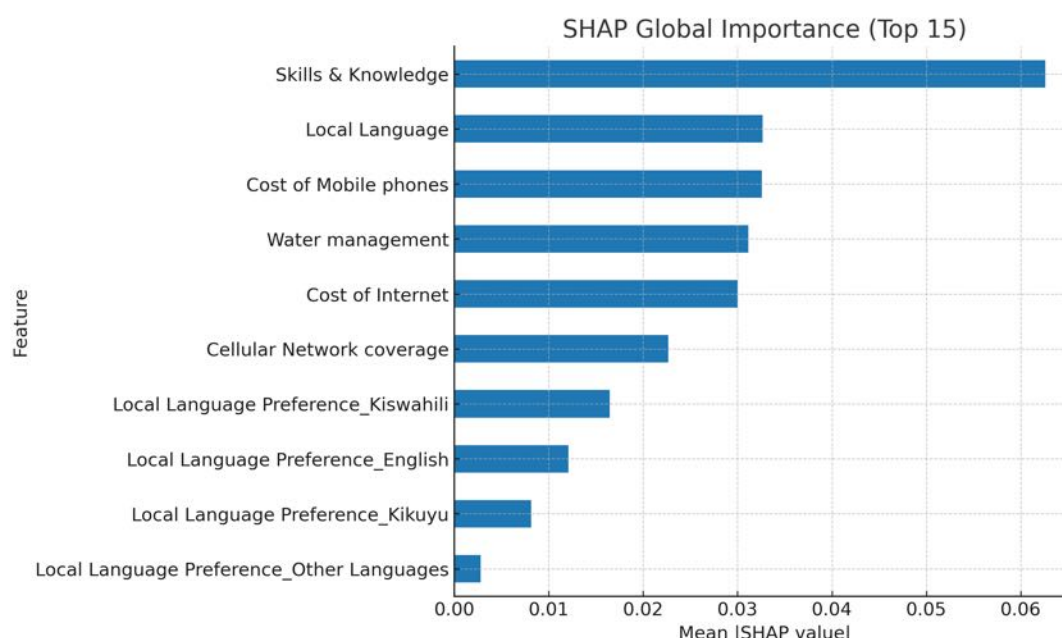


Figure 7: SHAP Global Feature Importance (Top 15)

As shown in Table 3, the standardized ridge coefficients corroborate the SHAP-based interpretations, indicating that higher user skills, stronger local-language alignment, and lower connectivity costs are consistently associated with greater socioeconomic impact from locally relevant digital content (LRDC). These findings reinforce the feature-importance patterns and confirm that content relevance and affordability play a central role in shaping digital adoption and perceived benefits in rural contexts.

Taken together, the multivariate regression results (Table 3), SHAP-based feature importance analyses, and robustness checks across alternative model specifications indicate that affordability, availability, user capability, and cultural–linguistic alignment are the principal determinants of effective locally relevant digital content (LRDC) adoption and impact. The consistency of these relationships across penalized and unpenalized model specifications strengthens confidence in their robustness and policy relevance.

Some limitations should be considered when interpreting these findings. Cross-sectional design restricts the analysis to contemporaneous associations and does not capture longitudinal adoption dynamics or longer-term socioeconomic effects. In addition, some outcome measures, particularly perceived socioeconomic benefits, are based on self-reported data and may be subject to recall bias. As discussed in the methods section, triangulation and robustness checks mitigate but do not eliminate these concerns.

Accordingly, the observed relationships should be interpreted as correlational rather than causal. While LRDC adoption is significantly associated with improved access to agricultural information and perceived benefits, the study design does not permit causal attribution. Despite these constraints, the findings provide clear practical implications. They indicate that digital inclusion strategies emphasizing infrastructure alone are insufficient and that investments in localized content design, low-literacy interfaces, and user capacity building are critical. Conceptually, the results extend digital inclusion frameworks by demonstrating that contextual relevance is as important as access in shaping meaningful digital engagement.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

Locally Relevant Digital Content (LRDC) plays a critical role in supporting agricultural practices in rural settings by delivering timely, context-specific information aligned with farmers' everyday decision-making needs. This study demonstrates that LRDC adoption is shaped by affordability, network accessibility, user capability and linguistic alignment, with language emerging as a stronger determinant of platform choice than gender. Rural users consistently prefer content that directly supports routine agricultural activities and reflects local practices.

Enhancing LRDC accessibility, therefore requires targeted strategies that prioritize the use of Kiswahili and local dialects, maintain low-cost access mechanisms, and deliver seasonally relevant agricultural content. Complementary interventions, including digital skills training, particularly for women, and partnerships with trusted local institutions, can further strengthen user trust and sustained engagement.

Focusing on Laikipia County, Kenya, the findings show that cost, connectivity, skills and language compatibility are significantly associated with digital platform usage, leading to improved access to agricultural information and perceived socioeconomic benefits. These results highlight the central importance of content relevance in driving meaningful digital adoption.

The study is limited by its cross-sectional design, reliance on self-reported data, and focus on a single county, which may constrain causal inference and generalizability. Future research should adopt longitudinal approaches, integrate



objective outcome measures, and extend analysis across multiple regions. Overall, the findings suggest that digital inclusion efforts should prioritize localized content design, user capability development, and affordability alongside infrastructure expansion.

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Authors' Contributions

All the authors participated in writing the article or revising the manuscript and gave final approval for submission of this manuscript and agreed to be accountable for all aspects of the work.

Ethical Approvals

All inquiries involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

After informed consent, subjects volunteered to complete the detailed questionnaire.

Availability of data and Materials

Not available to public.

Competing Interest

The authors certify that they have no known financial interest or personal relationships that could have influenced materials presented in this manuscript.



Table 1: Platform Choice Predictors Relative to KAOP

Multinomial Logistic Regression; Log-Odds (Δb) and Odds Ratios (OR)

Feature	Acre Africa Δb	Acre Africa OR	CABI Bioprotection Δb	CABI Bioprotection OR	Digital Green Δb	Digital Green OR	Farmers Pride Δb	Farmers Pride OR
Gender	- 0.342	0.71	0.045	1.046	0.027	1.028	-0.295	0.745
Local Lang: English	- 0.322	0.725	0.152	1.164	-1.136	0.321	-0.386	0.68
Cost of Internet	0.262	1.3	-0.242	0.785	0.447	1.563	0.609	1.838
Cost of Mobile Phones	0.194	1.215	0.113	1.12	0.012	1.012	0.145	1.156
Local Lang: Other	0.129	1.138	0.327	1.387	1.203	3.329	0.355	1.426
Local Lang: Kiswahili	0.127	1.136	0.415	1.514	-0.022	0.978	0.535	1.707
Local Lang: Kikuyu	0.065	1.068	-0.894	0.409	-0.045	0.956	-0.504	0.604
Skills & Knowledge	- 0.053	0.948	0.289	1.335	-0.133	0.875	-0.851	0.427
Age	- 0.012	0.988	0.572	1.772	0.05	1.051	-0.49	0.613
Cellular Network Coverage	0	1	0	1	0	1	0	1

Table 2: Barriers model—log-odds, odds ratios, and bootstrap 95% CIs (penalized logistic regression)

Predictor	b (log-odds)	95% CI (b) L	95% CI (b) U	OR	OR 95% CI L	OR 95% CI U
Intercept	0.0062	-0.5447	0.5700	1.0062	0.5800	1.8
Age	-0.0133	-0.1139	0.0792	0.9868	0.9	1.08
Cost of Internet	0.1297	0.0352	0.2411	1.1385	1.036	1.27
Cellular Network coverage	-4.2228	-4.2275	-4.1820	0.0147	0.015	0.02
Cost of Mobile phones	0.0072	-0.0725	0.1004	1.0072	0.930	1.11
Gender_1	0.0000	0.0000	0.0000	1.0000	1.000	1.00
Skills & Knowledge_2	0.0000	0.0000	0.0000	1.0000	1.000	1.00
Skills & Knowledge_3	0.0000	0.0000	0.0000	1.0000	1.000	1.00
Skills & Knowledge_4	0.0000	0.0000	0.0000	1.0000	1.000	1.00
Skills & Knowledge_5	0.0000	0.0000	0.0000	1.0000	1.000	1.00
Local Language Preference - Kikuyu	-0.0291	-0.1498	0.0846	0.9713	0.861	1.09
Local Language Preference - Kiswahili	-0.0004	-0.1196	0.1022	0.9996	0.887	1.11
Local Language Preference - Other Languages	-0.0150	-0.0543	0.0334	0.9851	0.947	1.03

Table 3: Standardized ridge coefficients

Predictor	Standardized Ridge Coefficient
Local Language Preference - Other Languages	-0.4000
Local Language Preference - Kikuyu	0.1706
Local Language Preference - English	0.1524
Local Language	0.1107
Local Language Preference - Kiswahili	0.0768
Water management	0.0550
Cost of Internet	-0.0169
Cost of Mobile phones	-0.0141
Cellular Network coverage	0.00798
Skills & Knowledge	0.00425

REFERENCES

1. **Abima B, Engotoit B, Kituyi GM, Kyeyune R and M Koyola** Relevant local content, social influence, digital literacy, and attitude toward the use of digital technologies by women in Uganda. *Gender, Technology and Development*. 2021; **25(1)**: 87–111.
<https://doi.org/10.1080/09718524.2020.1830337>
2. **Junaedi AT, Yovita I, Veronica K, Panjaitan HP, Jahrizal J and N Renaldo** Advancing Digital and Technology Literacy through Qualitative Studies to Bridging the Skills Gap in the Digital Age. *Journal of Applied Business and Technology*. 2024; **5(2)**: 123–133.
<https://doi.org/10.35145/jabt.v5i2.170>
3. **Farinloye T, Moharrak M, Omotoye O, Mogaji E and A Oginni** Bridging the digital divide: Consumer engagement with transportation payment apps in emerging economies. *Journal of Consumer Behaviour*. 2024; **23(6)**: 3011–3029. <https://doi.org/10.1002/cb.2388>
4. **Saikanth RA, Chaudam D, Sravani V, Nayak S, Dam SH and A Shukla** Impact of Mobile Technology on Extension Service Delivery in Remote Farming Communities: A Review. *Journal of Scientific Research and Reports*. 2024; **30(3)**: 1–13. <https://doi.org/10.9734/jsrr/2024/v30i31853>
5. **Ewim C, Okeke N, Alabi O, Igwe A and O Ofodile** Customer-Centric digital transformation framework: Enhancing service delivery in SMES for underserved populations. *International Journal of Management and Entrepreneurship Research*. 2024; **6(10)**: 3493–3516.
<https://doi.org/10.51594/ijmer.v6i10.1658>
6. **Connolly R, Sanchez OP, Compeau D and F Tacco** Understanding Engagement in Online Health Communities: A Trust-Based Perspective. *Journal of the Association for Information Systems*. 2023; **24(2)**: 345–378.
<https://doi.org/10.17705/1jais.00785>
7. **Quishpe-Quishpe L, Acosta-Vargas I, Rodríguez-Rojas L, Medina-Arias J, Coronel-Navarro DA, Torres-Gutiérrez R and P Acosta-Vargas** Impact of a Contextualized AI and Entrepreneurship-Based Training Program on Teacher Learning in the Ecuadorian Amazon. *Sustainability*. 2025; **17(19)**: 8850. <https://doi.org/10.3390/su17198850>

8. **Anastasiou E, Manika S, Ragazou K and I Katsios** Territorial and Human Geography Challenges: How Can Smart Villages Support Rural Development and Population Inclusion? *Social Sciences*. 2021; **10(6)**: 193.
<https://doi.org/10.3390/socsci10060193>
9. **Fahmi FZ and A Arifianto** Digitalization and Social Innovation in Rural Areas: A Case Study from Indonesia. *Rural Sociology*. 2021; **87(2)**: 339–369. <https://doi.org/10.1111/ruso.12418>
10. **Kitole FA, Mkuna E and JK Sesabo** Digitalization and agricultural transformation in developing countries: Empirical evidence from Tanzania agriculture sector. *Smart Agricultural Technology*. 2023;**7**: 100379. <https://doi.org/10.1016/j.atech.2023.100379>
11. **Antony AP, Leith K, Jolley C, Lu J and DJ Sweeney** A Review of Practice and Implementation of the Internet of Things (IoT) for Smallholder Agriculture. *Sustainability*. 2020; **12(9)**: 3750. <https://doi.org/10.3390/su12093750>
12. **Costa F, Frecassetti S, Rossini M and A Portioli-Staudacher** Industry 4.0 digital technologies enhancing sustainability: Applications and barriers from the agricultural industry in an emerging economy. *Journal of Cleaner Production*. 2023; **408**: 137208. <https://doi.org/10.1016/j.jclepro.2023.137208>
13. **Ngulube P** Leveraging information and communication technologies for sustainable agriculture and environmental protection among smallholder farmers in tropical Africa. *Discover Environment*. 2025; **3(1)**. <https://doi.org/10.1007/s44274-025-00190-1>
14. **Misaki E, Apiola M, Gaiani S and M Tedre** Challenges facing sub-Saharan small-scale farmers in accessing farming information through mobile phones: A systematic literature review. *The Electronic Journal of Information Systems in Developing Countries*. 2028; **84(4)**: e12034. <https://doi.org/10.1002/isd2.12034>
15. **Wyche S and C Steinfeld** Why Don't Farmers Use Cell Phones to Access Market Prices? Technology Affordances and Barriers to Market Information Services Adoption in Rural Kenya. *Information Technology for Development*. 2015; **22(2)**: 320–333. <https://doi.org/10.1080/02681102.2015.1048184>

16. **Krell NT, Giroux SA, Guido Z, Hannah C, Lopus SE, Caylor KK and TP Evans** Smallholder farmers' use of mobile phone services in central Kenya. *Climate and Development*. 2020; **13(3)**: 215–227.
<https://doi.org/10.1080/17565529.2020.1748847>
17. **Li G and H Zhang** The Efficiency and Challenges of E-Commerce Logistics in Enhancing Market Access for Agricultural Products in Rural China. *Law and Economy*. 2024; **3(2)**: 31–43. <https://doi.org/10.56397/le.2024.02.07>
18. **Ortiz-Crespo B, Steinke J, Quirós CF, Van De Gevel J, Daudi H, Gaspar Mgimiloko M and J Van Etten** User-centred design of a digital advisory service: enhancing public agricultural extension for sustainable intensification in Tanzania. *International Journal of Agricultural Sustainability*. 2020; **19(5–6)**: 566–582.
<https://doi.org/10.1080/14735903.2020.1720474>
19. **Petros C, Feyissa S, Sileshi M and C Shepande** Factors Influencing Climate-Smart Agriculture Practices Adoption and Crop Productivity among Smallholder Farmers in Nyimba District, Zambia. *F1000Research*. 2024; **13**: 815. <https://doi.org/10.12688/f1000research.144332.2>
20. **Smidt HJ and O Jokonya** Factors affecting digital technology adoption by small-scale farmers in agriculture value chains (AVCs) in South Africa. *Information Technology for Development*. 2021; **28(3)**: 558–584.
<https://doi.org/10.1080/02681102.2021.1975256>
21. **Essien A, Salami A, Ajala O, Adebisi B, Shodiya A and G Essien** Exploring socio-cultural influences on generative AI engagement in Nigerian higher education: an activity theory analysis. *Smart Learning Environments*. 2024; **11(1)**. <https://doi.org/10.1186/s40561-024-00352-3>
22. **Joshi BM, Khatiwada SP and RK Pokhrel** Influence of Socioeconomic Factors on Access to Digital Resources for Education. *Rupantaran: A Multidisciplinary Journal*. 2024; **8(01)**: 17–33.
<https://doi.org/10.3126/rupantaran.v8i01.65197>
23. **Roman R and RD Colle** Content creation for ICT development projects: Integrating normative approaches and community demand. *Information Technology for Development*. 2003; **10(2)**: 85–94.
<https://doi.org/10.1002/itdj.1590100204>

24. **Bhatt S and R Dani** Social Media and Community Engagement. *IGI Global*. 2024; 113–122. <https://doi.org/10.4018/979-8-3693-6819-0.ch009>
25. **Morepje MT, Msweli NS, Sithole M and Al Agholor** The Influence of E-Commerce Platforms on Sustainable Agriculture Practices among Smallholder Farmers in Sub-Saharan Africa. *Sustainability*. 2024; **16(15)**: 6496. <https://doi.org/10.3390/su16156496>
26. **Rajkhowa P and M Qaim** Personalized digital extension services and agricultural performance: Evidence from smallholder farmers in India. *PLoS ONE*. 2021; **16(10)**: e0259319. <https://doi.org/10.1371/journal.pone.0259319>
27. **Muzari W, Gatsi W and S Muvhunzi** The Impacts of Technology Adoption on Smallholder Agricultural Productivity in Sub-Saharan Africa: A Review. *Journal of Sustainable Development*. 2012; **5(8)**: 69-77. <https://doi.org/10.5539/jsd.v5n8p69>
28. **Nwangwu KN, Ume CO, Onyenekwe CS, Opata PI and NNC Ume** Can digital technology promote market participation among smallholder farmers? *International Food and Agribusiness Management Review*. 2024; **27(4)**: 706–728. <https://doi.org/10.22434/ifamr2023.0065>
29. **Madziva R, Nachipo B, Musuka G, Chitungo I, Murewanhema G, Phiri B and T Dzinamarira** The role of social media during the COVID-19 pandemic: Salvaging its ‘power’ for positive social behaviour change in Africa. *Health Promotion Perspectives*. 2022; **12(1)**: 22–27. <https://doi.org/10.34172/hpp.2022.03>
30. **Heitner KL and M Jennings** Culturally Responsive Teaching Knowledge and Practices of Online Faculty. *Online Learning*. 2016; **20(4)**: 54-78. <https://doi.org/10.24059/olj.v20i4.1043>
31. **Zhang M and M Kaur** Toward a theory of e-government: Challenges and opportunities, a literature review. *Journal of Infrastructure, Policy and Development*. 2024, **8(10)**: 7707. <https://doi.org/10.24294/jipd.v8i10.7707>
32. **Kumar A, Agarwal SK, Chakraborty D, Rajput N and AA Nanavati** VOISERV: Creation and Delivery of Converged Services through Voice for Emerging Economies. 2007. <https://doi.org/10.1109/wowmom.2007.4351733>

33. **Radovanović D, Noll J, Holst C, Belur SB, Miliza J, Srivastava R, Le-Quentrec E, Winkler AS and GV Houngbonon** Digital Literacy Key Performance Indicators for Sustainable Development. Social Inclusion. 2020; **8(2)**: 151–167. <https://doi.org/10.17645/si.v8i2.2587>
34. **Ji M, Seligman M and P Bouillon** Translation Technology in Accessible Health Communication. Cambridge University. 2023. <https://doi.org/10.1017/9781108938976>
35. **Zhou C, Yuan F, Huang T, Zhang Y and J Kaner** The Impact of Interface Design Element Features on Task Performance in Older Adults: Evidence from Eye-Tracking and EEG Signals. *International Journal of Environmental Research and Public Health*. 2022; **19(15)**: 9251. <https://doi.org/10.3390/ijerph19159251>
36. **Nzilano KL and SN Magoti** Digitalisation of Banking Services and Financial Inclusion Potential of Women Entrepreneurs in Dodoma Municipality, Tanzania. *African Journal of Empirical Research*. 2025; **6(2)**: 398–411. <https://doi.org/10.51867/ajernet.6.2.33>
37. **Kulkarni L and A Ghosh** Gender disparity in the digitalization of financial services: Challenges and promises for women's financial inclusion in India. *Gender, Technology and Development* (ahead-of-print). 2021; **25(2)**: 233–250. <https://doi.org/10.1080/09718524.2021.1911022>
38. **Mhlanga D and E Ndhlovu** Digital Technology Adoption in the Agriculture Sector: Challenges and Complexities in Africa. *Human Behavior and Emerging Technologies*. 2023; **6951879**: 1–10. <https://doi.org/10.1155/2023/6951879>
39. **Abdulai AR, Fraser E, Duncan E and P Tetteh-Quarshie** Is agricultural digitization a reality among smallholder farmers in Africa? Unpacking farmers' lived realities of engagement with digital tools and services in rural Northern Ghana. *Agriculture & Food Security*. 2023; **12(1)**. <https://doi.org/10.1186/s40066-023-00416-6>