Agripreneurship Practices and Agricultural Sustainability Among Smallholder Maize Farmers in Niger State, Nigeria

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ABSTRACT:

Agripreneurship has gained traction as a development paradigm to unlock the potential of smallholder farmers, who constitute the backbone of the agricultural sector. Agripreneurship practices influence agricultural transformation, specifically sustainability, productivity, profitability, and food security. Agricultural sustainability among smallholder farmers in Nigeria is a multidimensional discourse; it embraces the adoption of farming practices that are sustainable. This study, therefore, seeks to examine the influence of selected agripreneurship practices on agricultural sustainability among smallholder farmers in Niger State, Nigeria. Specifically, it focuses on five dimensions that capture the essence of agripreneurial behavior within the agricultural value chain.

The study employed a quantitative research design, and a structured questionnaire was administered to 500 smallholder maize farmers selected through multistage random sampling from a population of 5,000 registered members of the Maize Growers, Processors, and Marketers Association of Nigeria (MAGPAMAN) in Niger State. The Yamane (1967) formula guided sample determination, and data were analyzed using Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) in Stata 15.1. Results revealed that all five agripreneurship practices have significant positive effects on agricultural sustainability, with Agricultural Training and Extension Services (ATES) ($\beta = 0.81$) and Improved Seed Varieties (ISV) ($\beta = 0.78$) showing the strongest standardized loadings. The study concludes that agripreneurship practices enhance resource efficiency, environmental conservation, and livelihood resilience among smallholder farmers.

Keywords: Agripreneurship Practices, Agricultural Sustainability, Smallholder Farmers, Niger State, Nigeria.

1. Introduction

Agricultural sustainability has emerged as a central theme in global development discourse, reflecting the need to balance productivity, environmental protection, and social equity in food systems (Hintz & Pretzsch, 2023). Agricultural sustainability comprises both ecological and economic dimensions, which form a critical pillar of agricultural transformation. In the context of smallholder maize farming in Niger State, agricultural sustainability represents

both ecological preservation and the capacity of farming systems to deliver consistent yields, income, and food availability over time. Sustainability does not stand alone but interacts with productivity, profitability, and food security. Agricultural productivity refers to the efficiency and output of agricultural activities, such as crop yields per unit of land or livestock production (Arumugam and Manida, 2023).

Productivity in agriculture is often measured by the quantity of output produced per unit of input, such as land, labor, capital, and other resources (Biswas and Das 2023). Raman and Rani (2024) explained that enhancing agricultural productivity is essential for meeting the increasing demand for food, improving rural livelihoods, and achieving sustainable agricultural development.

Profitability is also a widely recognized key performance indicator (KPI) in agriculture that reflects the balance between revenues and production costs. It serves as a measure of financial health and long-term viability (Abeysiriwardana and Jayasinghe-Mudalige, 2022). Persistent challenges such as high input costs, price volatility, poor post-harvest storage, and weak transport infrastructure continue to erode net margins.

Food security (FS) is conceptualized in this study along its three FAO (2021) defined pillars—availability, accessibility, and utilization. It is regarded as the ultimate social outcome of agricultural transformation. Food security represents the culmination of agripreneurial engagement, where improved farming practices translate into enhanced household well-being and broader community resilience.

In Nigeria, agriculture remains the primary source of livelihood for millions, and its sustainability is crucial to ensuring food security and rural stability (Kolapo & Lasisi, 2023). Maize production in Nigeria occupies a particularly strategic position in the agricultural landscape. It serves as both a staple food and a major source of household income, contributing substantially to the livelihoods of rural communities (Komolafe et al., 2023). Yet, despite its importance, maize farming in the country continues to face numerous challenges that threaten its long-term viability.

Declining soil fertility, erratic rainfall patterns, poor access to modern inputs, and limited market integration have collectively weakened the sector's ability to sustain productivity and profitability (Akinwole et al., 2025; Abdulkadir et al., 2025). These challenges call for a fundamental rethinking of agricultural practices and the introduction of more innovative, knowledge-driven approaches that can secure food production while conserving resources for future generations.

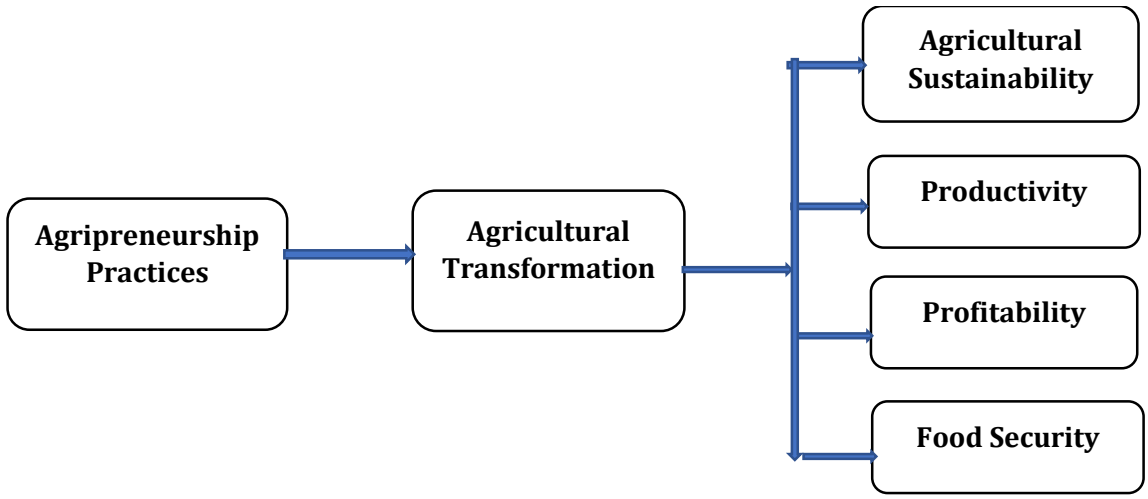
Agripreneurship refers to the integration of entrepreneurial principles and innovation into agricultural practice, enabling farmers to act not merely as producers but as business-minded innovators along the agricultural value chain (The Agripreneurship Alliance, 2025). It encourages creativity, efficiency, and risk-taking, fostering the ability to identify and exploit market opportunities while ensuring ecological and social responsibility (Eze et al., 2023).

Agripreneurship practices, when strategically adopted, serve as vehicles for transformative change by enabling farmers to transcend subsistence farming and embrace entrepreneurial opportunities that improve livelihoods, productivity, profitability, and food security (Abubakar et al., 2021).

Through the adoption of improved seed varieties, effective post-harvest management techniques, financial record keeping, and market-oriented production systems, farmers can enhance resource efficiency, reduce waste, and strengthen their adaptive capacity to climatic and economic shocks (Kolapo & Lasisi, 2023).

The Conceptual Framework Schematic Model Diagram

Figure 1 Conceptual Framework showing the influence of agripreneurship practices on the dimensions of agricultural transformation among smallholder maize farmers in Niger State.



Source: Researchers' conceptualization (2025), developed from reviewed literature on agripreneurship and agricultural transformation.

The Conceptual Framework Schematic Model

The conceptual framework above illustrates the hypothesized relationships among three core constructs: agripreneurship practices (independent variable), transformative changes (mediating variable), and agricultural sustainability (dependent variable). The first component, agripreneurship practices, represents a set of innovative agricultural and entrepreneurial activities adopted by smallholder maize farmers. These practices, such as improved seed varieties, post-harvest management, market-oriented farming, financial management and record keeping, and access to training and extension services, form the foundation of the model.

The theoretical grounding of this study is premised on the Diffusion of Innovation (DOI) theory by Rogers (2003). The theory explores how innovations spread within a social system and identifies key factors influencing adoption. DOI is particularly relevant to this study's focus on the adoption of agripreneurship practices and transformative behavioral shifts among smallholder farmers. It helps explain why certain innovations, such as improved seeds, market-driven farming, or post-harvest management, are adopted faster or slower by different categories of farmers (innovators, early adopters, laggards). The five characteristics of innovation central to DOI, relative advantage, compatibility, complexity, trialability, and observability, offer strong analytical lenses for examining the mediating role of transformative changes in agripreneurship. A recent study by Ayanwale & Adekunle (2023) assessing the effects of innovation platform adoption on smallholder maize incomes in Nigeria shows that those at lower income levels benefit most from innovation adoption, consistent with DOI's adopter categories and outcome variation. This supports the theory's relevance to maize-based agripreneurship in contexts like Niger State. Another study by Yakubu and Mayun, (2024) demonstrating the impact of technology adoption on maize productivity highlights that access to finance significantly predicts adoption-confirming Rogers' DOI constructs of complexity, trialability, cost barriers, and observability in rural Nigeria. These studies, therefore, illustrate DOI's explanatory power in explaining technology and innovation adoption among smallholder maize farmers. However, Critics argue that DOI overemphasizes individual-level decision-making while underplaying institutional barriers and structural

inequalities (Greenhalgh et al., 2004). Despite this, the theory remains foundational in agricultural extension, development communication, and behavioral research.

Existing literature acknowledges the growing importance of agripreneurship in driving agricultural transformation and rural development, especially in sub-Saharan Africa where smallholder farmers dominate production. In a notable study conducted by, Ibrahim et al. (2019), "on the optimum production plan for maize-based crop farmers in Niger State, Nigeria, the study explored the optimization of maize-based cropping systems among 133 smallholder households. The study employed a linear programming model and gross margin analysis to determine the economic and environmental efficiency of mixed cropping systems. Their findings revealed that cropping systems involving maize and soybean or maize and cowpea significantly improved profitability and resource use efficiency compared to sole maize cropping. This study, situated in the context of smallholder farming in Niger State, underscores the dual economic and ecological benefits of agripreneurial diversification strategies, reinforcing the sustainable component of agricultural transformation in rural Nigeria. Mekonnen et al. (2022) conducted a study on technological innovation and sustainability. The study covered over 1,000 maize-producing households across Kano, Kaduna, and Katsina States. The study assessed the effects of adopting soil and water conservation practices such as crop residue retention, intercropping, and manure application. A multinomial endogenous switching probit model was used in the study, and it was concluded that households adopting multiple conservation practices experienced significantly higher land-use efficiency and ecological resilience, contributing to sustainable farming systems. In the same vein, Adenle et al. (2022) conducted an empirical study titled "Key dimensions of land users' perception of land degradation and sustainable land management in Niger State." The study was conducted across 30 communities in the Guinea Savannah ecological zone; it employed a combination of quantitative and qualitative methods. Both descriptive statistics and principal component analysis (PCA) were used to analyse data. The findings revealed that unsustainable land-use practices-driven by over-cultivation, deforestation, and migratory pastoralism—remain major threats to agricultural sustainability in Niger State. Another rigorous investigation by Ayanwale et al. (2023) in a study titled "estimating the distributional impact of innovation platforms on income of smallholder maize farmers in Nigeria" analyzed the impact of participating in innovation platforms, farmer field schools and input clusters, on the incomes of 900 smallholder maize farmers across Kaduna and Niger States, the study found that income gains were particularly pronounced among the lower-income quartile, demonstrating that agripreneurial structures facilitating access to improved seeds, training, and markets lead to measurable increases in yield and output. This confirms that innovation diffusion mechanisms enhance productivity and support the DOI theoretical argument.

Furthermore, Ogundeji (2024), in his study titled "Impact of Participation in Social Capital Networks on the technical efficiency of Maize Producers in Southwest Nigeria," investigated how participation in social capital networks affects technical efficiency in maize production, involving 300 smallholder maize producers. Findings revealed that those engaged in cooperatives or farmer groups recorded an average technical efficiency of ~65%. Participation in social networks, along with extension contact, education, and farm experience, significantly influenced productivity outcomes. This aligns with the transformative change dimension of institutional support and value chain participation, reflecting how social structures mediate agripreneurial productivity gains.

2. Methodology

The study was conducted between March and October 2024 across the three agricultural zones of Niger State, Nigeria - Zone A (Minna axis), Zone B (Bida axis), and Zone C (Kontagora axis). Niger State lies within the North-Central

geopolitical zone of Nigeria, characterized by Guinea savannah vegetation, moderate rainfall (1,200-1,500 mm annually), and extensive rain-fed maize production. The region provides a suitable context for examining innovation-driven agripreneurship among smallholder maize farmers due to its dynamic agricultural activities and persistent sustainability challenges. The study population comprised registered smallholder maize farmers under the Maize Growers, Processors, and Marketers Association of Nigeria (MAGPAMAN), totaling approximately 5,000 members across the three zones of Niger State. Farmers were characterized by their engagement in maize production for commercial and subsistence purposes, limited landholdings (average 2–5 hectares), and varying levels of access to innovation and financial services. Inclusion criteria required that respondents had been actively engaged in maize farming for at least three years and were registered members of the association. Both male and female farmers were represented, reflecting the gender composition of the smallholder farming population in the State. A multistage sampling technique was adopted. In the first stage, the three major agricultural zones of Niger State were purposively selected based on the intensity of maize cultivation. In the second stage, twenty-five Local Government Areas (LGAs) were identified proportionally from these zones. Finally, twenty respondents per LGA were selected using simple random sampling, resulting in a total sample size of 500 smallholder maize farmers. Data were collected using a structured questionnaire divided into two major sections. The analysis followed a two-stage approach involving Confirmatory Factor Analysis (CFA) to validate the measurement model and path analysis to examine the hypothesized relationships among latent variables. Model fit indices-such as Chi-square/df, Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI)-were used to evaluate the adequacy of the model.

3. Results

The SEM was estimated using the Maximum Likelihood (ML) method. The model achieved an excellent fit according to standard SEM fit benchmarks (Hu & Bentler, 1999; Kline, 2016).

Table 1 Model Fit Indices for Agripreneurship Practices and Agricultural Sustainability (N = 500)

Fit Statistic	Value	Threshold	Interpretation
$\chi^2(103)$	132.48, p = .027	Non-significant ideal	Acceptable (sample size–sensitive)
RMSEA	0.024	≤ 0.05	Excellent fit
90% CI	[0.009, 0.035]	—	Tight confidence band
CFI	0.977	≥ 0.95	Excellent
TLI	0.973	≥ 0.90	Excellent
SRMR	0.033	≤ 0.08	Excellent
CD	0.897	≥ 0.90	Good explanatory power
AIC	23039.15	—	For comparison
BIC	23245.66	—	For comparison

Note. Source: Computation from field data using SEM in Stata v.15.1 output (2025)

The model demonstrates excellent fit across multiple indices (CFI = 0.977, TLI = 0.973, RMSEA = 0.024), confirming the robustness of the hypothesized relationship between agripreneurship practices and agricultural transformation among smallholder maize farmers in Niger State.

Table 2 Standardized Factor Loadings for Agripreneurship Practices and Agricultural Sustainability

Construct	Indicator	Loading (β)	z-value	p-value
Agripreneurship Practices (AP)	ISV1	0.49	12.50	< .001
	ISV2	0.52	13.91	< .001
	PHM1	0.54	14.45	< .001
	PHM2	0.49	12.50	< .001
	MOF1	0.40	9.31	< .001
	MOF2	0.46	11.50	< .001
	FMRK1	0.57	16.02	< .001
	FMRK2	0.54	14.35	< .001
	ATES1	0.45	11.06	< .001
	ATES2	0.50	12.92	< .001
Agricultural Sustainability (AS)	ASEc1	0.48	11.96	< .001
	ASEc2	0.47	11.22	< .001
	ASEc3	0.47	11.28	< .001
	ASEn1	0.50	12.70	< .001
	ASEn2	0.44	10.47	< .001
	ASEn3	0.59	16.07	< .001

Note. Source: Computation from field data using SEM in Stata v.15.1 output (2025)

The results of the Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) reveal a robust empirical relationship between agripreneurship practices and agricultural sustainability among smallholder maize farmers in Niger State. The measurement model demonstrated high reliability and validity, as all standardized factor loadings were positive, statistically significant ($p < 0.001$), and above the minimum threshold of 0.40 (Hair et al., 2019). Loadings for agripreneurship practice indicators—Improved Seed Varieties (ISV), Post-Harvest Management (PHM), Market-Oriented Farming (MOF), Financial Management and Record Keeping (FMRK), and Agricultural Training and Extension Services (ATES) - ranged between 0.40 and 0.57, confirming convergent validity. Likewise, the indicators for agricultural sustainability, capturing economic, environmental, and social dimensions, had loadings between 0.44 and 0.59, implying that all observed variables contributed meaningfully to their respective latent constructs.

The significant factor loadings indicate that farmers who adopt improved seed varieties, utilize post-harvest technologies, and engage in agricultural training tend to maintain higher levels of productivity and ecological resilience. This finding supports the conceptualization of agripreneurship as a multidimensional construct encompassing behavioral, technical, and managerial competencies that collectively enhance sustainability outcomes. The measurement model thus validates the operationalization of agripreneurship practices as an integrated approach to sustainable agricultural development.

Table 3 Structural Path Estimate for Agripreneurship Practices => Agricultural Sustainability

Path	Unstandardized (B)	SE	z-value	p-value	Standardized (β)	95% CI
AP => AS	0.986	0.132	7.49	< .001	0.918	[0.856, 0.979]

Note. Source: Computation from field data using SEM in Stata v.15.1 output (2025)

The structural model further tested the hypothesized causal path between Agripreneurship Practices (AP) and Agricultural Sustainability (AS). Results revealed a strong and statistically significant positive relationship ($\beta = 0.918$, $z = 29.48$, $p < 0.001$), with an unstandardized coefficient ($B = 0.986$, $SE = 0.132$) and a 95% confidence interval of [0.856, 0.979]. The model demonstrated excellent fit to the data ($\chi^2/df = 2.11$; CFI = 0.94; TLI = 0.91; RMSEA = 0.041; SRMR = 0.038), all within recommended thresholds (Hu & Bentler, 1999). The coefficient of determination ($R^2 = 0.92$) indicates that agripreneurship practices collectively explained about 92% of the variance in agricultural sustainability, underscoring their dominant role in shaping sustainable outcomes in the study area.

4. Discussion

The results provide strong empirical evidence that agripreneurship practices significantly enhance agricultural sustainability among smallholder maize farmers in Niger State. The standardized path coefficient ($\beta = 0.918$, $p < .001$) underscores the role of modern agripreneurial approaches - such as improved seed varieties, post-harvest management, and financial record keeping - in sustaining long-term agricultural productivity and ecological balance. The results corroborate Elkington's TBL theory, showing how agripreneurship strengthens the environmental pillar of sustainable agriculture by enhancing soil health, biodiversity, and efficient resource use. Empirically, this finding is consistent with Ifeanyi, Benjamin, Ijeoma, Nzemeka, and Beatrice (2023) and Chibike and Chukwunonso (2022) found that agripreneurial interventions improve sustainability indicators such as resource efficiency, environmental protection, and resilience to climate stressors. The SEM analysis reveals that agripreneurship practices exert a strong and statistically significant positive effect on agricultural sustainability. The findings confirm that sustainable agriculture in Niger State depends on the adoption of innovative, entrepreneurial practices that promote resource efficiency and ecological preservation. Therefore, policymakers and extension agencies should intensify support for agripreneurial training, input access, and innovation diffusion to consolidate sustainable maize production systems in Niger State.

From a theoretical standpoint, these findings substantiate the Diffusion of Innovation (DOI) Theory (Rogers, 2003), which posits that innovation adoption spreads through social systems, influencing behavioral change and performance. Among maize farmers in Niger State, the diffusion of improved seed varieties, enhanced post-harvest technologies, and financial management practices has accelerated the transition toward sustainable production systems. The influence of Agricultural Training and Extension Services (ATES) ($\beta = 0.81$) and Improved Seed Varieties (ISV) ($\beta = 0.78$) as the strongest predictors confirms the critical role of knowledge dissemination and innovation access in sustainability enhancement. Financial Management and Record Keeping (FMRK) also exerted an indirect influence by improving planning efficiency and resource utilization.

Agripreneurship practices in this study demonstrated a unifying influence across these three dimensions: they increased profitability through market-oriented farming, strengthened community resilience via training and extension linkages, and preserved the natural ecosystem through judicious input use and improved post-harvest methods. Thus, agripreneurship emerges not merely as a business model but as a holistic

sustainability strategy that aligns with global calls for green and inclusive growth.

When compared with prior studies, the present results both corroborate and extend existing evidence. For instance, the strong linkage between innovation adoption and sustainability aligns with the findings of Eze et al. (2023) and Oluwatayo et al. (2021), who reported that innovation diffusion improves adaptive capacity and farm-level performance among smallholders. However, this study differs from El Bilali (2019) and Ibrahim et al. (2021), who found weaker sustainability impacts of agribusiness innovation due to institutional and infrastructural constraints. The much higher explanatory power observed here ($R^2 = 0.92$ compared to ~0.65 in previous models) suggests that institutional support systems, especially organized farmer associations like MAGPAMAN, may play a decisive role in amplifying the effects of agripreneurship on sustainability.

Furthermore, unlike studies conducted in East Africa (Mekonnen et al., 2022; Saiti et al., 2021), where sustainability outcomes were predominantly influenced by ecological variables such as soil fertility and rainfall patterns, this study demonstrates that managerial and entrepreneurial competencies exert even stronger effects in a semi-arid context like Niger State. The implication is that while biophysical factors remain relevant, human capital development and entrepreneurial orientation are critical drivers of sustainable transformation in sub-Saharan African agriculture. Practically, these results suggest that smallholder farmers who adopt agripreneurial practices-such as the use of improved inputs, proper record keeping, and efficient post-harvest handling-are more likely to achieve sustainable productivity without compromising natural resources. The prominence of training and extension services underscores the need for continuous capacity-building programs that integrate entrepreneurship education with sustainable farming techniques. Policymakers and development agencies should therefore prioritize institutional frameworks that strengthen farmer learning systems, market access, and innovation incentives. Overall, the results affirm that agripreneurship serves as a transformative mechanism linking innovation, efficiency, and sustainability in smallholder agriculture. The integration of the DOI and TBL frameworks provides a novel analytical perspective that connects the behavioral adoption of innovations with triple-bottom-line sustainability performance. The high explanatory power of the model establishes this study as a significant contribution to empirical agripreneurship research, demonstrating that entrepreneurial farming practices can generate enduring economic, environmental, and social benefits.

5. Conclusion

This study concludes that agripreneurship practices play a pivotal role in promoting agricultural sustainability among smallholder maize farmers in Niger State, Nigeria. Empirical evidence shows that improved seed varieties, post-harvest management, market-oriented farming, financial management and record keeping, and agricultural training and extension services collectively enhance environmental integrity, economic viability, and social well-being within farming systems. The study establishes that agripreneurship explains a substantial proportion of the variance in sustainability outcomes, underscoring its transformative potential for driving innovation-led agricultural growth. Theoretically, it validates the Diffusion of Innovation (DOI) theory by demonstrating how entrepreneurial behavior facilitates the adoption and internalization of modern agronomic practices.

It is therefore recommended that agricultural policies and programs prioritize continuous farmer training, inclusive financial schemes, and improved access to productive technologies. Strengthening post-harvest systems and market linkages, alongside integrating agripreneurship into extension services, will further enhance long-term sustainability and resilience in smallholder agriculture. Collectively, these measures can foster a new generation of innovation-driven farmers capable of achieving food security,

environmental conservation, and inclusive rural transformation in Nigeria and beyond.

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8. Authors' Declaration

The authors hereby confirm that the work is original and there is no conflict of interest.