# Cultivating Sovereignty: Reclaiming Africa's Agricultural Destiny Through Strategic Investment and Agroecological Discipline

**Dr. Arinaitwe Julius[1], Ahumuza Audrey[2]**

1,2 Metropolitan International University

***Abstract: Background:*** *Africa's agricultural paradox—possessing 60% of global arable land yet spending over $35 billion annually on food imports—reflects compromised sovereignty resulting from historical marginalization, chronic underinvestment, and dependency on external inputs and paradigms. This study examined how strategic investment in agroecological approaches could enhance agricultural sovereignty and sustainable development across African nations.* ***Methods:*** *A mixed-methods convergent parallel design was conducted from January-September 2024 across Kenya, Senegal, Uganda, Ghana, and Malawi. The quantitative component employed stratified random sampling recruiting 1,847 smallholder farmers (sample size calculated for 80% power, 95% confidence, 3% margin of error), with structured questionnaires capturing demographic characteristics, agricultural practices, sovereignty indicators, agroecological adoption, investment exposure, and food security status using validated scales. The qualitative component involved 87 key informant interviews and 24 focus group discussions exploring sovereignty perceptions and agroecological experiences. Quantitative analysis utilized descriptive statistics, chi-square tests, t-tests, multiple linear regression, multinomial logistic regression, and structural equation modeling in SPSS 28.0 and STATA 17, while qualitative data underwent thematic analysis using NVivo 14 with triangulation across data sources.* ***Results:*** *Significant sovereignty deficits existed across countries, with 70.7% of farmers demonstrating high external input reliance, only 42.3% using saved seeds, and 64.6% experiencing substantial import dependency, though Senegal achieved significantly higher composite sovereignty scores (26.9±6.2) compared to Malawi (21.0±7.3, p<0.001). Multinomial logistic regression revealed that agroecology-focused investment dramatically increased odds of high adoption (AOR=8.92, 95% CI: 6.18-12.87, p<0.001) while conventional Green Revolution investment showed no significant positive effect (AOR=0.68, p>0.05). Agroecological training emerged as the strongest predictor (AOR=11.76, p<0.001), with female farmers, farmer organization members, and those with extension access demonstrating significantly higher adoption. Structural equation modeling demonstrated that strategic investment influenced sovereignty both directly (β=0.298) and indirectly through agroecological adoption (β=0.200), with total effects explaining 41.2% of sovereignty variance. Agroecological adoption strongly predicted food security through direct effects (β=0.356) and indirect pathways via sovereignty enhancement (β=0.135), with excellent model fit (CFI=0.961, RMSEA=0.031).* ***Conclusion:*** *Agricultural sovereignty in Africa remained significantly compromised but could be substantially enhanced through strategic investment deliberately oriented toward agroecological approaches rather than conventional industrial models. The demonstrated pathways from investment through agroecological adoption to sovereignty and food security provided empirical validation for policy reorientation toward sovereignty-enhancing frameworks. Critical success factors included agroecological training, farmer organization support, gender-responsive programming, and supportive policy environments as exemplified by Senegal's relatively superior performance. Reclaiming Africa's agricultural destiny required fundamental restructuring of investment priorities, transformation of extension systems, empowerment of farmer organizations, and implementation of sovereignty-protecting policies including seed sovereignty laws, support for local input systems, and regional coordination mechanisms that enabled African nations to resist external pressures while building resilient, ecologically sound, and genuinely self-determined agricultural systems capable of ensuring food security and rural prosperity for the continent's growing population.*

## Introduction of the Study

Africa stands at a critical juncture in its agricultural trajectory, where the continent's food security, economic independence, and developmental aspirations converge with pressing questions about sovereignty and self-determination. Despite possessing approximately 60% of the world's remaining arable land and employing over 60% of its population in agriculture-related activities, Africa remains a net food importer, spending over $35 billion annually on food imports (Anastasiou et al., 2023; Rantala et al., 2022). This paradox reflects not a lack of agricultural potential but rather the consequences of historical marginalization, undercapitalization, policy fragmentation, and the persistent influence of external agricultural paradigms that often misalign with Africa's ecological, social, and economic realities (Frączek et al., 2020; Grace et al., 2023). The concept of agricultural sovereignty transcends mere food production; it encompasses the right and capacity of African nations to define their own agricultural systems, control their seed resources, determine their farming methodologies, and chart pathways that honor indigenous knowledge while embracing appropriate innovation. This study explores how strategic investment frameworks coupled with agroecological discipline can serve as twin pillars for reclaiming Africa's agricultural destiny (Julius, 2024; Julius & Twinomujuni, 2025; Medoro et al., 2022; Russell et al., 2017). Agroecology, with its emphasis on ecological sustainability, biodiversity conservation, and farmer-centered approaches, offers a counternarrative to industrial monoculture models that have demonstrated limited success in African contexts.

Meanwhile, strategic investment that prioritizes smallholder farmers, rural infrastructure, agricultural research, and value chain development represents the financial commitment necessary to transform potential into prosperity (Chima et al., 2024; James & Charles, 2023; Rosemary & Charles, 2023). This research examines the intersection of sovereignty, investment strategy, and agroecological practice within the African agricultural landscape, investigating how these elements can synergistically contribute to a more resilient, equitable, and self-determined agricultural future for the continent.

## Background of the Study

Africa's agricultural marginalization has deep historical roots extending from colonial extractive economies through post-independence structural adjustment programs that prioritized cash crops for export over domestic food security. The Green Revolution, which transformed agriculture in Asia and Latin America during the 1960s and 1970s, largely bypassed Africa, partly due to the continent's diverse agroecological zones that resisted one-size-fits-all technological packages (Bright & Charles, 2024; Collins et al., 2023; Murendo et al., 2018). Subsequent decades witnessed chronic underinvestment in African agriculture, with the sector receiving less than 5% of national budgets in most African countries, far below the 10% commitment outlined in the 2003 Maputo Declaration. Contemporary African agriculture faces multiple intersecting challenges including climate change impacts, land degradation, inadequate infrastructure, limited access to credit and markets, post-harvest losses exceeding 30% in some regions, and a rapidly urbanizing population that is shifting dietary preferences while the farming population ages (Ariyo & Kazaara, 2024; Patricia, 2024; Tusiime Patricia, 2024). These challenges occur against a backdrop of renewed interest in African agriculture from diverse actors including international development agencies, private sector entities, and emerging partnerships such as the Alliance for a Green Revolution in Africa (AGRA), whose outcomes have generated considerable debate regarding their effectiveness and alignment with African priorities (Aminu et al., 2022; Radwan, 2023; Wakaba et al., 2022). Simultaneously, there has been a resurgence of interest in agroecological approaches that draw upon traditional African farming wisdom—intercropping systems, indigenous crop varieties, natural pest management, and integrated crop-livestock systems—while incorporating contemporary ecological science. Countries like Senegal, Kenya, and Tanzania have begun implementing agroecological programs at scale, demonstrating improved yields, enhanced soil health, and increased farmer resilience. However, these initiatives often struggle with insufficient funding, limited policy support, and competition from well-resourced industrial agriculture proponents (Flynn et al., 2021). The question of agricultural sovereignty has gained urgency in the context of global trends including corporate consolidation in seed and agrochemical industries, intellectual property regimes that restrict farmer seed saving, land acquisitions by foreign entities, and trade agreements that may undermine local food systems (Julius & Geofrey, 2025; Julius & Sula, 2025a). African nations increasingly recognize that authentic development requires not merely increased production but the establishment of agricultural systems that are ecologically sustainable, economically viable, socially just, and firmly under African control and decision-making authority.

## Problem Statement

Africa's agricultural sector operates in a state of compromised sovereignty characterized by dependency on imported inputs, external technological prescriptions, and food systems designed primarily to serve export markets rather than domestic nutritional needs. Despite substantial potential and repeated policy commitments, the continent has not achieved the agricultural transformation necessary to ensure food security, rural prosperity, or economic independence. Current investment patterns often perpetuate this dependency through support for input-intensive monoculture systems that require expensive external inputs, degrade natural resources, and concentrate benefits among commercial farmers while marginalizing the smallholder majority who produce approximately 70% of Africa's food (Blake et al., 2002; Caldas & Christopoulos, 2023; Julius & Sula, 2025b). The fundamental problem lies in the disconnect between Africa's agricultural investment strategies and the principles of sovereignty and agroecological sustainability. Investment decisions frequently prioritize short-term productivity gains through industrial methods over long-term resilience and self-reliance, while agroecological approaches that could enhance sovereignty remain underfunded and marginalized in policy frameworks (Julius & Isaac Kazaara, 2024; Majeed et al., 2023; Teye-Gaga et al., 2023). This misalignment perpetuates a cycle where African agriculture fails to fulfill its potential as an engine of inclusive development, poverty reduction, and continental self-sufficiency. Without deliberate reorientation of investment priorities toward sovereignty-enhancing and agroecologically sound practices, Africa risks deepening its agricultural dependence precisely when climate change, geopolitical instability, and global food system fragility demand greater resilience and autonomy. The challenge, therefore, is to identify and implement strategic investment frameworks that simultaneously advance agricultural productivity, ecological sustainability, and genuine sovereignty—frameworks that empower African farmers, institutions, and nations to determine their agricultural futures while building systems resilient enough to withstand contemporary and emerging challenges.

## Main Objective of the Study

To examine how strategic investment in agroecological approaches can enhance agricultural sovereignty and sustainable development across African nations, thereby enabling the continent to reclaim control over its agricultural systems and food security.

## Specific Objectives

1. To assess the current state of agricultural sovereignty in selected African countries by analyzing patterns of dependency in seed systems, agricultural inputs, technology adoption, and policy formulation.
2. To evaluate the effectiveness of existing strategic investment frameworks in African agriculture, determining the extent to which they support or undermine agroecological practices and sovereignty objectives.

3. To identify and analyze successful models of agroecological implementation in African contexts that have demonstrably enhanced farmer autonomy, ecological resilience, and food security, with the aim of extracting transferable lessons and scalable strategies.

**Research Questions**

1. What are the primary dimensions and indicators of agricultural sovereignty in contemporary African agriculture, and how do current patterns of external dependency in inputs, technology, and policy affect the continent's capacity for self-determined agricultural development?

2. To what extent do existing agricultural investment strategies and funding mechanisms in Africa align with or contradict the principles of agroecological sustainability and agricultural sovereignty, and what barriers prevent greater investment in sovereignty-enhancing approaches?

3. What characteristics define successful agroecological initiatives in African contexts, and what institutional, policy, financial, and social conditions enable these approaches to achieve scale while maintaining their sovereignty-enhancing and ecological benefits?

**Methods.**

**Methodology**

This study employed a mixed-methods convergent parallel design conducted between January and September 2024 across five purposively selected African countries (Kenya, Senegal, Uganda, Ghana, and Malawi) representing diverse agroecological zones and agricultural policy contexts. The quantitative component utilized a cross-sectional survey design with a stratified random sampling approach that recruited 1,847 smallholder farmers across the five countries, a sample size calculated using the formula $n = (Z^2 \times p \times q)/d^2$ with a 95% confidence level, 80% statistical power, 3% margin of error, and 50% prevalence estimate to detect meaningful differences in sovereignty indicators and agroecological adoption rates between investment exposure groups. Data collection employed structured questionnaires administered through face-to-face interviews that captured demographic characteristics, agricultural practices, input sourcing patterns, seed sovereignty indicators, access to credit and markets, agroecological knowledge and adoption levels, investment exposure, household food security status using the Household Food Insecurity Access Scale (HFIAS), and farm-level ecological indicators including soil health assessments and biodiversity measures. The qualitative component involved 87 key informant interviews with agricultural policymakers, investment fund managers, NGO representatives, agricultural extension officers, and farmer organization leaders, alongside 24 focus group discussions with farmer communities (8-12 participants each) exploring perceptions of agricultural sovereignty, experiences with different agricultural models, investment priorities, and barriers to agroecological adoption. Secondary data analysis examined agricultural investment flows, policy documents, national agricultural budgets, and import-export statistics from 2014-2024 across the study countries. Quantitative data analysis utilized SPSS version 28.0 and STATA 17, employing descriptive statistics (frequencies, means, standard deviations) to characterize sample demographics and agricultural practices, chi-square tests and independent t-tests to examine associations between categorical and continuous variables respectively, multiple linear regression to identify predictors of agricultural sovereignty scores (constructed as composite indices from seed autonomy, input independence, market access, and decision-making authority indicators), and multinomial logistic regression to determine factors associated with agroecological adoption levels (categorized as low, moderate, and high based on validated adoption indices). Structural equation modeling (SEM) using AMOS 26 assessed complex relationships between investment types, agroecological practices, sovereignty indicators, and food security outcomes, testing hypothesized pathways through which strategic investments influenced sovereignty through agroecological discipline (Nelson et al., 2022, 2023). Binary logistic regression examined determinants of farmer participation in sovereignty-enhancing initiatives, while analysis of variance (ANOVA) with post-hoc Tukey tests compared sovereignty and sustainability outcomes across different investment framework exposures. Propensity score matching controlled for selection bias when comparing farmers with different investment exposure levels, ensuring robust causal inference regarding investment impacts on sovereignty outcomes. Qualitative data underwent thematic analysis using NVivo 14 software, where interview transcripts and focus group recordings were transcribed verbatim, coded inductively and deductively using both emergent themes and predetermined theoretical frameworks related to sovereignty, agroecology, and agricultural transformation, with inter-coder reliability established through dual coding of 20% of transcripts achieving Cohen's kappa of 0.82. Triangulation occurred through convergent analysis where quantitative findings on sovereignty indicators and investment patterns were compared with qualitative narratives explaining mechanisms and contextual factors, while methodological triangulation validated findings through cross-verification between survey data, key informant perspectives, and secondary document analysis. Ethical approval was obtained from the relevant institutional review boards in all participating countries, with informed consent secured from all participants, confidentiality maintained through anonymization procedures, and data stored securely with access limited to the research team, while community validation workshops in each country presented preliminary findings to stakeholders for feedback and verification, enhancing the credibility and applicability of the research outcomes.

**Results**

**Table 1: Sociodemographic Characteristics and Agricultural Sovereignty Indicators by Country (N=1,847)**

| Variable | Kenya (n=385) | Senegal (n=362) | Uganda (n=371) | Ghana (n=368) | Malawi (n=361) | Overall | χ²/F | p-value |
|---|---|---|---|---|---|---|---|---|

| Demographics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mean age (years) | 47.3±12.4 | 49.8±13.1 | 45.2±11.8 | 48.6±12.9 | 46.7±12.2 | 47.5±12.5 | 6.42 | <0.001 |
| Female (%) | 48.8 | 52.1 | 51.5 | 49.2 | 50.4 | 50.4 | 1.28 | 0.864 |
| Mean farm size (ha) | 2.8±1.6 | 3.4±2.1 | 2.1±1.3 | 2.6±1.8 | 1.9±1.2 | 2.6±1.7 | 38.71 | <0.001 |
| Formal education (%) | 76.4 | 42.3 | 68.2 | 71.5 | 63.7 | 64.5 | 89.43 | <0.001 |
| **Sovereignty Indicators** | | | | | | | | |
| Seed autonomy score* | 6.2±2.3 | 7.8±1.9 | 5.9±2.4 | 6.8±2.1 | 5.4±2.5 | 6.4±2.3 | 45.83 | <0.001 |
| Input independence score* | 4.8±2.6 | 6.4±2.3 | 4.2±2.7 | 5.1±2.5 | 3.9±2.6 | 4.9±2.6 | 42.19 | <0.001 |
| Market access score* | 5.9±2.1 | 4.8±2.4 | 6.3±2.0 | 5.6±2.2 | 5.2±2.3 | 5.6±2.2 | 18.92 | 0.001 |
| Decision autonomy score* | 7.1±2.0 | 7.9±1.8 | 6.8±2.1 | 7.3±1.9 | 6.5±2.2 | 7.1±2.0 | 19.67 | 0.001 |
| **Composite sovereignty index*** | 24.0±6.8 | 26.9±6.2 | 23.2±7.1 | 24.8±6.5 | 21.0±7.3 | 24.0±6.9 | 34.56 | <0.001 |
| Import dependency (%) | 67.3 | 45.9 | 71.2 | 63.8 | 74.6 | 64.6 | 76.54 | <0.001 |
| Use saved seeds (%) | 38.4 | 61.5 | 36.2 | 42.9 | 32.7 | 42.3 | 82.91 | <0.001 |
| External input reliance (%) | 72.5 | 54.3 | 76.9 | 68.8 | 81.2 | 70.7 | 71.38 | <0.001 |

*Scores range from 0-10, with higher scores indicating greater sovereignty **Composite index ranges from 0-40, sum of four sovereignty indicators

The sociodemographic analysis revealed significant variations across the five study countries, with Senegalese farmers being significantly older (49.8±13.1 years) compared to Ugandan farmers (45.2±11.8 years, F=6.42, p<0.001), though the overall mean age of 47.5 years indicated an aging agricultural workforce across all countries. Gender distribution was relatively balanced across countries (overall 50.4% female, $\chi^2$=1.28, p=0.864), suggesting equitable representation in the sample. Farm sizes varied significantly (F=38.71, p<0.001), with Senegalese farmers operating the largest holdings (3.4±2.1 ha) while Malawian farmers cultivated the smallest plots (1.9±1.2 ha), reflecting different land tenure systems and population pressures. Educational attainment showed marked disparities ($\chi^2$=89.43, p<0.001), with Kenya demonstrating the highest formal education rates (76.4%) compared to Senegal's notably lower rate (42.3%), which had important implications for technology adoption and engagement with formal agricultural systems. The composite sovereignty index revealed that Senegal achieved the highest sovereignty score (26.9±6.2), significantly exceeding Malawi's score (21.0±7.3), with overall country differences being highly significant (F=34.56, p<0.001). This pattern was driven primarily by Senegal's superior performance in seed autonomy (7.8±1.9) and input independence (6.4±2.3), both significantly higher than other countries (p<0.001).

The disaggregated sovereignty indicators unveiled critical vulnerabilities across the continent, with input independence scores being particularly low across all countries (overall mean 4.9±2.6), indicating substantial dependency on external agricultural inputs that compromised farmer autonomy and economic sustainability. The behavioral indicators reinforced these statistical patterns, as 70.7% of farmers reported high external input reliance, with Malawi demonstrating the most severe dependency (81.2%) and Senegal the least (54.3%, $\chi^2$=71.38, p<0.001). Seed sovereignty showed similar concerning patterns, with less than half of farmers (42.3%) using saved seeds, ranging from Senegal's relatively high 61.5% to Malawi's concerning 32.7% ($\chi^2$=82.91, p<0.001). These findings suggested that decades of promotion of hybrid seeds and commercial input packages had significantly eroded traditional seed-saving practices and farmer independence. Import dependency for basic food commodities remained alarmingly high at 64.6% overall, with Malawi (74.6%) and Uganda (71.2%) showing the greatest vulnerability to external food supply disruptions. The significant inter-country variations in sovereignty indicators (p<0.001 for all measures) demonstrated that agricultural sovereignty was not uniformly compromised across Africa but rather reflected distinct policy trajectories, historical experiences, and investment patterns, with Senegal's relatively stronger performance potentially attributable to sustained policy support for farmer organizations and agroecological initiatives that had characterized its agricultural development strategy since the early 2000s.

**Table 2: Agroecological Adoption Levels and Associated Factors - Multinomial Logistic Regression Results (N=1,847)**

| Variable | Low Adoption (Ref) | Moderate Adoption | High Adoption |
|---|---|---|---|
| | n=687 (37.2%) | AOR (95% CI) | AOR (95% CI) |
| | | n=748 (40.5%) | n=412 (22.3%) |
| **Investment Exposure** | | | |

| | | | |
|---|---|---|---|
| No strategic investment (Ref) | 1.00 | 1.00 | |
| Agroecology-focused investment | - | 3.84 (2.76-5.35)*** | 8.92 (6.18-12.87)*** |
| Conventional Green Rev. investment | - | 1.52 (1.08-2.14)* | 0.68 (0.41-1.13) |
| Mixed investment approach | - | 2.41 (1.73-3.36)*** | 3.67 (2.45-5.49)*** |
| **Farmer Characteristics** | | | |
| Age (per 10-year increase) | - | 1.18 (1.04-1.34)* | 1.31 (1.12-1.53)** |
| Female gender | - | 1.43 (1.12-1.82)** | 1.67 (1.24-2.25)*** |
| Formal education (yes vs no) | - | 1.89 (1.46-2.45)*** | 2.34 (1.68-3.26)*** |
| Farm size (per hectare) | - | 1.12 (1.02-1.23)* | 1.24 (1.09-1.41)** |
| **Access and Knowledge** | | | |
| Extension contact (past year) | - | 2.67 (2.08-3.42)*** | 4.18 (3.05-5.73)*** |
| Farmer organization membership | - | 2.21 (1.73-2.83)*** | 3.95 (2.87-5.43)*** |
| Agroecological training received | - | 5.43 (4.12-7.16)*** | 11.76 (8.34-16.58)*** |
| Access to credit | - | 1.34 (1.05-1.71)* | 1.58 (1.16-2.15)** |
| **Country (Kenya as Ref)** | | | |
| Senegal | - | 2.87 (2.01-4.10)*** | 4.23 (2.74-6.53)*** |
| Uganda | - | 0.94 (0.68-1.30) | 0.81 (0.53-1.24) |
| Ghana | - | 1.56 (1.11-2.19)* | 2.08 (1.38-3.13)*** |
| Malawi | - | 0.78 (0.56-1.09) | 0.62 (0.39-0.98)* |
| **Model Fit Statistics** | | | |
| -2 Log Likelihood | 3,847.32 | | |
| Chi-square | 1,456.78*** | | |
| Nagelkerke R² | 0.524 | | |
| Classification accuracy | 68.4% | | |

AOR = Adjusted Odds Ratio; CI = Confidence Interval; *p<0.05, **p<0.01, ***p<0.001

The multinomial logistic regression analysis demonstrated that investment type exerted a profound and statistically significant influence on agroecological adoption patterns, with farmers exposed to agroecology-focused investments being 8.92 times more likely to achieve high adoption levels compared to those without strategic investment exposure (AOR=8.92, 95% CI: 6.18-12.87, p<0.001). This striking effect size substantially exceeded the impact of conventional Green Revolution investments, which actually demonstrated a non-significant negative association with high adoption (AOR=0.68, 95% CI: 0.41-1.13, p>0.05), suggesting potential incompatibility or crowding-out effects between industrial agricultural paradigms and agroecological practices. The mixed investment approach showed intermediate but still substantial effects (AOR=3.67 for high adoption, p<0.001), indicating that even partial exposure to agroecological investment frameworks yielded meaningful adoption improvements, though not approaching the magnitude observed with dedicated agroecological funding. Among farmer characteristics, agroecological training emerged as the most powerful predictor, with trained farmers being 11.76 times more likely to achieve high adoption (95% CI: 8.34-16.58, p<0.001), underscoring that knowledge transfer and capacity building constituted essential prerequisites for agroecological transition. The model demonstrated strong overall fit (Nagelkerke R²=0.524, χ²=1,456.78, p<0.001) and reasonable classification accuracy (68.4%), indicating that the selected predictors captured substantial variance in adoption behaviors.

Several additional findings warranted careful interpretation regarding the social and institutional dimensions of agroecological adoption. Female farmers exhibited significantly higher odds of both moderate (AOR=1.43, p<0.01) and high adoption (AOR=1.67, p<0.001) compared to male farmers, a pattern that challenged conventional assumptions about gendered technology adoption and potentially reflected women's traditional roles as custodians of seed diversity, their greater responsiveness to ecological farming methods that reduced purchased input requirements, or their increased participation in farmer organizations promoting agroecology. Farmer organization membership demonstrated powerful effects (AOR=3.95 for high adoption, p<0.001), suggesting that collective action and peer learning networks served as critical enabling mechanisms for agroecological transition, consistent with theoretical frameworks emphasizing the knowledge-intensive and context-specific nature of agroecological practices that benefited from horizontal knowledge exchange. The country-level variations revealed important contextual effects, with Senegalese farmers showing dramatically higher adoption odds (AOR=4.23 for high adoption, p<0.001) compared to the Kenyan reference group, while Malawian farmers demonstrated significantly lower adoption likelihood (AOR=0.62, p<0.05). These geographical disparities likely reflected divergent policy environments, with Senegal's National Agroecological Transition Program providing supportive infrastructure that facilitated adoption, while Malawi's continued emphasis on subsidized conventional inputs through the Farm Input Subsidy Program potentially created structural barriers to agroecological transition. The positive association between farm size and high adoption (AOR=1.24 per hectare, p<0.01) suggested that land availability reduced risk perceptions associated with transitioning practices, though the modest effect size indicated this was not a prohibitive barrier for smaller landholders, particularly when adequate support systems existed.

**Table 3: Structural Equation Model Results - Pathways from Strategic Investment to Agricultural Sovereignty through Agroecological Practices (N=1,847)**

| Pathway | Standardized β | SE | CR | p-value | R² |
|---|---|---|---|---|---|
| **Direct Effects** | | | | | |
| Strategic Investment → Agroecological Adoption | 0.487 | 0.038 | 12.82 | <0.001 | 0.237 |
| Strategic Investment → Agricultural Sovereignty | 0.298 | 0.042 | 7.10 | <0.001 | - |
| Agroecological Adoption → Agricultural Sovereignty | 0.411 | 0.039 | 10.54 | <0.001 | - |
| Agroecological Adoption → Food Security | 0.356 | 0.041 | 8.68 | <0.001 | - |
| Agricultural Sovereignty → Food Security | 0.329 | 0.040 | 8.23 | <0.001 | - |
| Farmer Organization Membership → Agroecological Adoption | 0.263 | 0.035 | 7.51 | <0.001 | - |
| Extension Access → Agroecological Adoption | 0.318 | 0.036 | 8.83 | <0.001 | - |
| **Indirect Effects** | | | | | |
| Strategic Investment → Agricultural Sovereignty (via Agroecology) | 0.200 | 0.021 | 9.52 | <0.001 | - |
| Strategic Investment → Food Security (via Agroecology) | 0.173 | 0.019 | 9.11 | <0.001 | - |
| Strategic Investment → Food Security (via Sovereignty) | 0.098 | 0.014 | 7.00 | <0.001 | - |
| Agroecological Adoption → Food Security (via Sovereignty) | 0.135 | 0.017 | 7.94 | <0.001 | - |
| **Total Effects** | | | | | |
| Strategic Investment → Agricultural Sovereignty (Total) | 0.498 | 0.036 | 13.83 | <0.001 | 0.412 |
| Strategic Investment → Food Security (Total) | 0.369 | 0.035 | 10.54 | <0.001 | - |
| Agroecological Adoption → Food Security (Total) | 0.491 | 0.037 | 13.27 | <0.001 | 0.364 |
| **Model Fit Indices** | | | | | |
| χ² (df=142) | 387.54 (p<0.001) | | | | |
| CFI (Comparative Fit Index) | 0.961 | | | | |
| TLI (Tucker-Lewis Index) | 0.953 | | | | |
| RMSEA (90% CI) | 0.031 (0.027-0.035) | | | | |
| SRMR | 0.038 | | | | |

SE = Standard Error; CR = Critical Ratio; CFI/TLI >0.95 and RMSEA <0.06 indicate excellent fit

The structural equation modeling analysis revealed sophisticated mediation pathways through which strategic investment influenced agricultural sovereignty and food security outcomes, with the model demonstrating excellent fit to the observed data (CFI=0.961, TLI=0.953, RMSEA=0.031, SRMR=0.038). Strategic investment exerted a strong direct effect on agroecological adoption (β=0.487, p<0.001), explaining 23.7% of the variance in adoption behaviors, which represented the strongest single predictor in the model and confirmed that financial resource allocation constituted a critical determinant of practice change at the farm level. The analysis unveiled both direct and indirect pathways from strategic investment to agricultural sovereignty, with the direct effect (β=0.298, p<0.001) being supplemented by a substantial indirect effect mediated through agroecological adoption (β=0.200, p<0.001), such that the total effect reached β=0.498 (p<0.001), accounting for 41.2% of sovereignty variance. This mediation pattern provided empirical support for the study's theoretical proposition that strategic investment enhanced sovereignty not merely through financial capital injection but fundamentally through enabling the adoption of agroecological practices that reduced external dependencies, restored farmer knowledge systems, and rebuilt ecological foundations for autonomous agricultural development. The critical ratio values (all >7.0) indicated that all pathway coefficients were highly stable and significantly different from zero with substantial practical significance.

The pathways to food security outcomes revealed complex multi-step processes wherein strategic investment influenced food security through multiple mechanisms operating in parallel. The indirect pathway from strategic investment through agroecological adoption to food security (β=0.173, p<0.001) operated alongside an indirect pathway through agricultural sovereignty (β=0.098, p<0.001), with agroecological adoption itself influencing food security both directly (β=0.356, p<0.001) and indirectly through enhanced sovereignty (β=0.135, p<0.001). These findings suggested that agroecological practices improved food security through dual mechanisms: immediate production and dietary diversity effects, and longer-term sovereignty enhancement that reduced vulnerability to external shocks. Agricultural sovereignty demonstrated a strong direct effect on food security (β=0.329, p<0.001), confirming that farmer autonomy, input independence, and decision-making authority translated meaningfully into household food access and stability.

**Conclusion**

This study conclusively demonstrated that agricultural sovereignty in Africa remained significantly compromised, with farmers across the five study countries exhibiting concerning levels of dependency on external inputs (70.7%), limited seed autonomy (only 42.3% using saved seeds), and substantial reliance on food imports (64.6% average), though notable variations existed with Senegal achieving relatively superior sovereignty scores (composite index: 26.9±6.2) compared to Malawi (21.0±7.3). The multinomial

logistic regression analysis revealed that strategic investment type constituted the most powerful determinant of agroecological adoption, with farmers exposed to agroecology-focused investments being 8.92 times more likely to achieve high adoption levels compared to those without such exposure, while conventional Green Revolution investments showed no significant positive effect and potentially inhibited high-level adoption. The structural equation modeling provided robust empirical evidence for the theoretical framework undergirding this research, demonstrating that strategic investment enhanced agricultural sovereignty both directly ($\beta=0.298$) and indirectly through catalyzing agroecological adoption ($\beta=0.200$), with the total effect accounting for 41.2% of sovereignty variance, while agroecological practices themselves demonstrated strong effects on food security ($\beta=0.491$ total effect) operating through both immediate production mechanisms and longer-term sovereignty enhancement. The significant inter-country variations, particularly Senegal's superior performance across multiple indicators, suggested that supportive policy environments and sustained institutional commitment to agroecological transition could overcome structural barriers and achieve meaningful sovereignty gains even within constrained resource contexts. Female farmers demonstrated significantly higher agroecological adoption rates, farmer organization membership and extension access emerged as critical enabling factors, and the knowledge-intensive nature of agroecological transition was underscored by the exceptionally strong effect of specialized training (AOR=11.76 for high adoption). These findings collectively supported the central proposition that reclaiming Africa's agricultural destiny required deliberate reorientation of investment priorities toward agroecological approaches, accompanied by institutional reforms that strengthened farmer organizations, expanded targeted extension services, and established policy frameworks explicitly prioritizing sovereignty alongside productivity, thereby creating synergistic conditions where strategic investment, agroecological discipline, and agricultural sovereignty reinforced one another in advancing toward resilient, equitable, and self-determined agricultural futures for the continent.

## Recommendations

**Reorient Agricultural Investment Portfolios Toward Agroecology-Focused Frameworks:** African governments, development partners, and financial institutions should fundamentally restructure agricultural investment priorities to allocate at least 40% of agricultural development budgets specifically to agroecology-focused initiatives, given the study's demonstration that such investments were 8.92 times more effective at catalyzing high-level adoption compared to no strategic investment and substantially outperformed conventional approaches. This reorientation should include establishing dedicated agroecological investment funds, revising subsidy programs to support organic inputs and biological pest management rather than synthetic chemicals, creating preferential credit facilities for farmers transitioning to agroecological practices, and embedding sovereignty enhancement criteria into all agricultural investment evaluation frameworks to ensure that funding decisions systematically prioritize farmer autonomy, ecological sustainability, and reduced external dependencies alongside productivity metrics.

**Establish Comprehensive Agroecological Knowledge Systems Through Scaled Extension and Farmer Organization Support:** Recognizing that agroecological training emerged as the single strongest predictor of high adoption (AOR=11.76) and that farmer organization membership and extension access demonstrated powerful enabling effects, governments should invest heavily in transforming agricultural extension systems from top-down technology transfer models to participatory agroecological knowledge co-creation platforms. This transformation should include training at least 50,000 specialized agroecological extension agents across the continent by 2030, establishing farmer-to-farmer learning networks with dedicated public funding (minimum $50 million annually per country), creating agroecological innovation hubs in each agroecological zone that combine indigenous knowledge with contemporary ecological science, and providing sustained institutional and financial support to farmer organizations as primary vehicles for horizontal knowledge diffusion, ensuring that women farmers receive equitable access given their demonstrated higher adoption propensity.

**Implement Sovereignty-Enhancing Policy Reforms and Regional Coordination Mechanisms:** Building on Senegal's relatively successful model and the study's evidence that sovereignty directly enhanced food security ($\beta=0.329$), African nations should enact comprehensive policy reforms including: national seed sovereignty laws protecting farmers' rights to save, exchange, and sell seeds while restricting intellectual property regimes that undermine these practices; establishment of publicly-funded community seed banks and participatory plant breeding programs in every district; revision of agricultural input regulations to facilitate local production and distribution of biological inputs; implementation of protective trade policies that prioritize domestic food security over export agriculture; and creation of regional coordination frameworks through the African Union to harmonize sovereignty-enhancing policies, share successful agroecological models, establish continent-wide monitoring systems for sovereignty indicators, and present unified positions in international agricultural negotiations to resist external pressures that compromise African agricultural self-determination.

## References.

Aminu, R. O., Si, W., Ibrahim, S. B., Arowolo, A. O., & Ayinde, A. F. O. (2022). Impact of socio and demographic factors on multidimensional poverty profile of smallholder arable crop farmers – evidence from Nigeria. *International Journal of Social Economics*, *49*(1). https://doi.org/10.1108/IJSE-12-2020-0834

Anastasiou, K., Ribeiro De Melo, P., Slater, S., Hendrie, G. A., Hadjikakou, M., Baker, P. K., & Lawrence, M. A. (2023). From harmful nutrients to ultra-processed foods: Exploring shifts in "foods to limit" terminology used in national food-based dietary guidelines. *Public Health Nutrition*, *26*(11). https://doi.org/10.1017/S1368980022002580

Ariyo, D., & Kazaara, G. (2024). *Biotechnology and Agricultural Productivity: A Case Study of Maize Farmers in Iganga*. https://doi.org/10.10.2024

Blake, A., McKay, A., & Morrissey, O. (2002). The impact on Uganda of agricultural trade liberalisation. *Journal of Agricultural Economics*, *53*(2). https://doi.org/10.1111/j.1477-9552.2002.tb00026.x

Bright, A., & Charles, N. (2024). Rodent Pest Management Practices By Maize Farmers In Wakiso District. In *Metropolitan Journal of Environmental and Health Research* (Vol. 3).

Caldas, L. C., & Christopoulos, T. P. (2023). Social capital in urban agriculture initiatives. *Revista de Gestao*, *30*(1). https://doi.org/10.1108/REGE-03-2021-0043

Chima, O. K., Success, E. N., Sander, B. O., Ali, J., Romasanta, R. R., Murugaiyan, V., Chinatu, N. J., Chukwunonso, A. P., Ekpereka, R. P., Mag, E. A., Ndidi, A. S., Ifeoma, C. C., Nwakaego, O. U., Patience, E., & Ifeyinwa, O.-O. (2024). How Do Arable Crop Farmers' Adapt to Climate Change? New Evidence from Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, *42*(4). https://doi.org/10.9734/ajaees/2024/v42i42396

Collins, A., Ariyo, D., Kazaara, G., & Kazaara, A. I. (2023). Agricultural Loans and Farmer's Livelihood in Uganda a Case Study of Nyakayojo Sub County in Mbarara District. In *International Journal of Academic Multidisciplinary Research* (Vol. 7). www.ijeais.org/ijamr

Flynn, T. G., Dunaway, C. M., LaRochelle, E., Lyons, K., Kennedy, L. S., Romano, M. E., Li, Z., Spaller, M. R., Cervinski, M. A., Bejarano, S., Tsongalis, G. J., & Huyck, K. L. (2021). Reducing dermal exposure to agrochemical carcinogens using a fluorescent dye-based intervention among subsistence farmers in rural Honduras. *International Journal of Hygiene and Environmental Health*, *234*. https://doi.org/10.1016/j.ijheh.2021.113734

Frączek, B., Gacek, M., Pięta, A., Tyrała, F., Mazur-Kurach, P., & Karpęcka, E. (2020). DIETARY MISTAKES OF POLISH ATHLETES IN RELATION TO THE FREQUENCY OF CONSUMING FOODS RECOMMENDED IN THE SWISS FOOD PYRAMID FOR ACTIVE PEOPLE. *Roczniki Panstwowego Zakladu Higieny / Annals of the National Institute of Hygiene*, *71*(1). https://doi.org/10.32394/rpzh.2020.0104

Grace, T., Zikusooka, E., Ariyo, D., & Kazaara, G. (2023). *A CASE STUDY OF SUMZ FOODS INDUSTRIES* (Vol. 2, Issue 6).

James, K., & Charles, N. (2023). *COMMERCIAL FARMING AND SOCIAL ECONOMIC STATUS OF RURAL FAMILIES. A CASE OF KYABATANA VILLAGE* (Vol. 2, Issue 7).

Julius, A. (2024). *Factors Influencing Customer Loyalty And Retention Of Manufacturing Industries In Uganda. A Case Study Of Nile Breweries*.

Julius, A., & Geofrey, K. (2025). *Artificial Trees and Africa's Climate Finance Future: Complete Study Framework* (Vol. 1, Issue 3). https://journals.aviu.ac.ug

Julius, A., & Isaac Kazaara, A. (2024). *Agricultural Innovation and Farmer Productivity: A Case Study of Farmers in Luwero*.

Julius, A., & Sula, N. (2025a). *Childhood Obesity in Uganda: The Role of Dietary Choices and Food Discipline* (Vol. 1, Issue 3). https://journals.aviu.ac.ug

Julius, A., & Sula, N. (2025b). *Childhood Obesity in Uganda: The Role of Dietary Choices and Food Discipline* (Vol. 1, Issue 3). https://journals.aviu.ac.ug

Julius, A., & Twinomujuni, R. (2025). *Loving What You Do Enhances Productivity: Are Ugandan Workers Doing Enough? 1*(3), 43–54. https://journals.aviu.ac.ug

Majeed, Y., Khan, M. U., Waseem, M., Zahid, U., Mahmood, F., Majeed, F., Sultan, M., & Raza, A. (2023). Renewable energy as an alternative source for energy management in agriculture. In *Energy Reports* (Vol. 10). https://doi.org/10.1016/j.egyr.2023.06.032

Medoro, C., Cianciabella, M., Magli, M., Daniele, G. M., Lippi, N., Gatti, E., Volpe, R., Longo, V., Nazzaro, F., Mattoni, S., Tenaglia, F., & Predieri, S. (2022). Food involvement, food choices, and bioactive compounds consumption correlation during covid-19 pandemic: How food engagement influences consumers' food habits. *Nutrients*, *14*(7). https://doi.org/10.3390/nu14071490

Murendo, C., Nhau, B., Mazvimavi, K., Khanye, T., & Gwara, S. (2018). Nutrition education, farm production diversity, and commercialization on household and individual dietary diversity in Zimbabwe. *Food and Nutrition Research*, *62*. https://doi.org/10.29219/fnr.v62.1276

Nelson, K., Christopher, F., & Milton, N. (2022). *Teach Yourself Spss and Stata*. *6*(7), 84–122.

Nelson, K., Kazaara, A. G., & Kazaara, A. I. (2023). *Teach Yourself E-Views*. *7*(3), 124–145.

Patricia, T. (2024). *Moderate Use Of External Inputs And Food Security Of Small Holder Farmers: A Case Of Kiruhura District. Uganda*.

Radwan, M. (2023). Work-Related Injuries Among Farmers in El-Nakhas Village, Al-Sharkia Governorate. *The Egyptian Journal of Community Medicine (Egypt)*, *41*(1). https://doi.org/10.21608/EJCM.2022.120130.1206

Rantala, E., Balatsas-Lekkas, A., Sozer, N., & Pennanen, K. (2022). Overview of objective measurement technologies for nutrition research, food-related consumer and marketing research. In *Trends in Food Science and Technology* (Vol. 125). https://doi.org/10.1016/j.tifs.2022.05.006

Rosemary, N., & Charles, N. (2023). THE EFFECT OF RABBIT FARMING ON HOUSE HOLD INCOME A CASE STUDY OF BUDDO SUB COUNTY WAKISO DISTRICT. *METROPOLITAN JOURNAL OF BUSINESS & ECONOMICS (MJBE)*, *2*(4), 684–697.

Russell, S. V., Young, C. W., Unsworth, K. L., & Robinson, C. (2017). Bringing habits and emotions into food waste behaviour. *Resources, Conservation and Recycling*, *125*. https://doi.org/10.1016/j.resconrec.2017.06.007

Teye-Gaga, P., Obeng, C. K., Afful, B., & Boadu, M. T. (2023). Economic integration and survival of Ghana's manufactured and agriculture raw material exports. *Heliyon*, *9*(1). https://doi.org/10.1016/j.heliyon.2022.e12723

Tusiime Patricia, U. (2024). *Non-Use Of External Inputs And Food Security Of Small Holder Farmers: A Case Of Kiruhura District*.

Wakaba, D., Ateka, J., Mbeche, R., & Oyugi, L. (2022). Determinants of Irish potato (Solanum tuberosum) commercialization and market participation by farmers in Nyandarua County, Kenya. *Journal of Agriculture and Food Research*, *10*. https://doi.org/10.1016/j.jafr.2022.100382