Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Community-Led Sustainable Land Management: Adoption, Effectiveness, and Post-Project Durability in Northern and Central Ghana

Joseph Abazaami

jabazaami@uds.edu.gh

Research Article

Keywords: sustainable land management, community-led conservation, smallholder agriculture, soil fertility, post-project sustainability, Ghana

Posted Date: June 19th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9323253/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Soil degradation across sub-Saharan Africa has been mounting for decades, and reversing it demands more than good policy intentions, it demands practices that farmers actually adopt and keep using long after a project ends. Evidence on whether community-led sustainable land management (SLM) interventions can deliver that kind of durable change, especially across the varied agroecological zones of northern and central Ghana, remains thin. This study examines SLM adoption, effectiveness, and post-project sustainability through the end-of-project evaluation of the Research for Development and Innovation Agriculture and Learning (ReDIAL) project, a four-year (2020–2024) EU-funded initiative spanning five districts in Ghana. The evaluation drew on a convergent parallel mixed-methods design: 400 household surveys, 50 focus group discussions, and 60 key informant interviews. The results are striking. All but one percent of project participants reported receiving SLM training, and cover cropping, crop rotation, and conservation tillage were each practised by more than nine in ten beneficiaries by the time the project closed. Organic compost adoption reached 96% among those who had been trained. Three things made the difference: Village Savings and Loan Associations (VSLAs) that gave farmers a route to affordable credit; soil testing services embedded within government extension; and multi-stakeholder governance structures rooted in district institutions. The one major shortfall was stark, only 1,622 ha were brought under improved management against a 50,000 ha target, which reveals how hard it is to scale community-led SLM to the landscape level. The study concludes that community-led approaches can achieve impressive farm-level uptake, but moving to transformative scale requires deliberate landscape governance and concessional finance designed from the outset.

1 Introduction

Land degradation is not an abstract problem. Globally it affects around 1.5 billion people and has eaten into the productive capacity of roughly one third of the world's arable land (Nkonya et al. 2023). In sub-Saharan Africa the damage is visible and compounding: decades of continuous cultivation, insufficient soil amendment, deforestation, and increasingly erratic rainfall have stripped agricultural soils of the fertility that smallholder families depend on (Toensmeier et al. 2023; Weston et al. 2015). Ghana shares this trajectory. Soil nutrient depletion rates rank among the continent's highest, and average crop yields sit 20–60% below what the land could realistically produce (Adjei 2020). For farmers whose livelihoods rest on rainfed cereals and tubers, that gap is not a statistic, it is a compounding livelihood crisis felt every growing season.

Sustainable land management, a bundle of integrated practices that maintain or rebuild soil productivity, cut erosion and nutrient loss, sequester carbon, and support ecosystem services without sacrificing household food security has been widely accepted as the core response to this problem (Schwilch et al. 2022; Tondoh et al. 2021). Ghana's National Medium-Term Development Policy Framework and the African Union's Agenda 2063 both commit to SLM at scale. But the gap between those commitments and the reality of individual farms remains wide, because smallholders face real capital constraints,

limited extension support, and the practical burden of labour-intensive conservation practices (Kabore et al. 2022; Monjardino et al. 2021).

Community-led SLM approaches where local actors are knowledge co-producers, governance agents, and technology adapters rather than passive recipients have attracted growing attention as a more durable path to land management change (Reed et al. 2017; Zida et al. 2021). The logic is sensible: embedding new practices within existing social capital and local knowledge systems makes adoption more likely and more lasting. But the evidence base for how well these approaches essentially perform over time, particularly across the socially and ecologically complex zones of northern and central Ghana, remains fragmentary.

This paper addresses that gap. It presents a detailed analysis of SLM adoption, effectiveness, and post-project durability within the Research for Development and Innovation Agriculture and Learning (ReDIAL) project - a four-year EU-funded initiative (July 2020 - October 2024, with a one-year no-cost extension) implemented across five districts under the DeSIRA framework (Climate-relevant Development Smart Innovation through Research in Agriculture and food systems). ReDIAL combined scientific soil data generation, participatory technology deployment, community savings group formation, and multi-stakeholder dialogue to promote integrated agricultural transformation. Its SLM component covered conservation tillage, mulching, cover cropping, crop rotation, organic compost production, and agroforestry and was designed from the beginning to be community-led and institutionally embedded.

Three questions guide the analysis. What was the scale and pattern of SLM adoption among project beneficiaries by endline? How effective were the community-led mechanisms in generating adoption, and which institutional factors shaped that effectiveness? And what are the realistic prospects and constraints for SLM gains persisting once project support is withdrawn, and which design principles improve those odds? In working through these questions, the paper offers both empirical contributions to the SLM adoption literature in West Africa and a conceptual contribution to debates on community governance and agricultural sustainability.

2 Theoretical Framework and Literature Context

2.1 Sustainable Land Management: Concepts and Challenges

SLM is an umbrella term covering a broad range of practices across the soil–water–vegetation continuum. Schwilch et al. (2022) define it as land use systems and practices that maintain or enhance ecosystem services and natural resources while meeting changing human needs, a definition that, in agricultural settings, typically encompasses soil conservation (conservation tillage, terracing, mulching), nutrient management (organic and integrated fertilization), water harvesting, and agroforestry, all adapted to specific agroecological and socio-economic conditions (Liniger et al. 2021).

The factors that determine whether smallholders adopt SLM practices are well documented. Positive yield outcomes, labour savings, reduced input costs, and social norms supportive of conservation all encourage uptake (Weston et al. 2015; Tondoh et al. 2021). Against these, capital barriers, the time cost of conservation practices (felt most sharply by female-headed households), insecure land tenure, weak extension support, and the delayed payback of soil improvement all suppress it (Kabore et al. 2022; Monjardino et al. 2021).

The adoption literature draws an important distinction between first-order adoption (taking up a practice during an active intervention) and second-order adoption, meaning continued, self-directed practice after the project has ended (Westermann et al. 2018). Most SLM evaluations measure only the first. Evidence on the second is sparse, but the studies that exist point consistently to institutional anchoring as the decisive factor: whether SLM practices have become embedded in community governance norms, market incentives, or public extension systems (Reed et al. 2017).

2.2 Community-Led Approaches to SLM

Community-led SLM is defined by its emphasis on participatory governance, indigenous knowledge integration, and local ownership of land management decisions, a clear departure from conventional technology-transfer models. Reed et al. (2017) identify three conditions that enable it to work: collective action institutions that manage shared resources and govern practice norms; knowledge co-production processes that build on local ecological understanding; and policy environments that recognize and support community land rights and management authority.

In West Africa, community-led SLM has been documented across contexts ranging from Farmer-Managed Natural Regeneration (FMNR) in Niger and Burkina Faso (Zida et al. 2021) to integrated soil fertility management through farmer field schools in Ghana and Mali (Kabore et al. 2022). These studies consistently find that community ownership of the process (measured through local governance authority, knowledge co-production, and benefit sharing) predicts sustained adoption better than the technical characteristics of the promoted practices themselves.

That said, community-led approaches hit a ceiling at landscape scale. Widespread farm-level adoption does not automatically translate into the watershed-level outcomes of reduced runoff, improved water retention, biodiversity recovery that SLM is ultimately about (Liniger et al. 2021; Toensmeier et al. 2023). Coordinating change across hundreds or thousands of individual landholders is a collective action problem that community institutions alone, without external facilitation and policy backing, are rarely able to solve (Nkonya et al. 2023).

2.3 Financial Inclusion as a Mediating Mechanism

A growing body of evidence points to agricultural finance access as a proximate link between SLM knowledge and sustained practice change (Nyasimi et al. 2022). The capital requirements of SLM such as compost inputs, mulching materials, and agroforestry seedlings are individually modest but can be prohibitive for households operating close to subsistence. Community savings and credit mechanisms,

including VSLAs, have been shown to bridge this gap in several West African contexts, enabling farmers to invest in practices whose returns come slowly (Beaman et al. 2023; Ksoll et al. 2016).

The relationship between financial inclusion and SLM adoption is not automatic, however. Credit can be captured by better-off community members, tilting benefits toward male farmers with larger holdings while women with fragmented plots and limited collateral go underserved (Nyasimi et al. 2022). Genuinely gender-transformative financial inclusion requires deliberate targeting, literacy support, and governance structures designed to ensure equitable benefit distribution within savings groups and not just equitable membership on paper.

3 The ReDIAL Project: Context, Design, and SLM Intervention

3.1 Project Setting and Agroecological Context

ReDIAL was implemented across five districts covering the Northern, Bono East, Ashanti, Western North, and Eastern Regions of Ghana, collectively spanning forest, transitional, and Guinea savanna ecological zones. That ecological diversity matters for SLM because soil degradation processes, appropriate conservation practices, and the social organization of farming differ substantially across zones. In the savanna districts (Yendi and Ejura-Sekyeredumase), erratic rainfall and severe nutrient leaching on ferralsols make conservation tillage and organic matter management especially critical. In the forest and transitional zones (Sefwi-Wiawso, Techiman, Kwahu Afram Plains North), deforestation-driven fertility decline and high rainfall erosivity make agroforestry and cover cropping more pressing.

Across all five districts, the demographic profile of project participants shares common features relevant to SLM adoption. Most have completed only primary schooling or no formal education, 58% have no formal education or only informal education. Four in five are married and therefore part of multi-adult households with some labour flexibility. The productive age groups of 18–35 and 36–45 years dominate, suggesting a farming population with long time horizons and the capacity to invest in soil health.

3.2 ReDIAL’s SLM Intervention Design

The SLM component of ReDIAL (designated Result Area 6 in the project's logical framework) aimed to reduce land degradation and biodiversity loss while building climate resilience through uptake of SLM and climate-smart agricultural (CSA) practices. Six design principles shaped the intervention package.

The foremost was building on indigenous knowledge. Composting methods were designed around materials already found in community environments such as household waste, animal manure, and crop residues, processed using locally fabricated compost bins rather than imported infrastructure. Reducing the cognitive and material distance between promoted technologies and existing farming practice was a deliberate choice, not an afterthought.

The second was using demonstration farms as experiential learning sites. Six farms were established across the project districts, and field days brought 170 participants to observe, compare, and replicate

soil amendment practices in real growing conditions. This farmer-to-farmer learning dynamic was actively leveraged to carry knowledge beyond the circle of direct training participants.

The third was integrating SLM with financial access. The project supported the formation of 19 VSLAs, community savings groups with 581 members in total to provide smallholder-appropriate credit for input procurement, enabling investment in conservation practices that carry upfront costs and delayed returns.

The fourth was embedding SLM knowledge within the formal extension system. A CSA manual was developed and distributed to District Departments of Agriculture as a reference tool for ongoing farmer training, creating a knowledge infrastructure that could outlast the project.

The fifth was connecting farm-level practice to policy. Multi-stakeholder dialogue platforms (MSDPs) translated SLM experience into policy advocacy, including the case for organic soil amendments within Ghana's revised Fertilizer Policy, an effort to build the enabling environment that sustained adoption ultimately depends on.

The sixth was formalizing community ownership. Post-ReDIAL Management Committees (PRMCs) were established in each district, anchored to District Assemblies and mandated to sustain project assets and governance platforms once external support ceased.

4 Methodology

4.1 Evaluation Design

The empirical foundation of this paper is the end-of-project (EoP) evaluation of ReDIAL conducted in 2024. The evaluation used a convergent parallel (concurrent triangulation) mixed-methods design in which quantitative and qualitative data were collected in a single, concurrent fieldwork phase and analyzed independently before integration at the interpretation stage. This approach allows statistical measurement of outcome indicators and contextual explanation of observed patterns, while cross-validating findings across data streams. The evaluation framework was built around the OECD DAC criteria of relevance, coherence, effectiveness, efficiency, sustainability, and impact; this paper foregrounds the effectiveness, sustainability, and impact findings for the SLM component, drawing in financial inclusion and governance findings where they illuminate the picture.

4.2 Data Collection and Sample

Three instruments provided the primary data. A structured household survey was administered to 400 purposively and randomly selected project participants across the five districts, 80 per district and covering 94 of ReDIAL's 413 project communities (22.8%). That sampling fraction falls within the 17–27% range accepted as statistically representative for large populations. The survey instrument was kept consistent with baseline and midterm instruments to support longitudinal comparison. Data collection was electronic via KoboCollect, enabling real-time quality monitoring.

Fifty focus group discussions were held with purposively selected farmer groups across the five districts (10 per district), engaging men, women, youth, and persons with disabilities in semi-structured participatory exercises that explored adoption experience, perceived effectiveness, and sustainability prospects. Sixty key informant interviews covered district- and national-level stakeholders such as Directors of Agriculture, District Assembly officers, traditional authorities, civil society representatives, and Ministry of Food and Agriculture officials (10 per district plus 10 in Accra). This targeting approach allowed for investigating institutional perspectives on adoption, policy alignment, and sustainability.

Fifteen locally recruited research assistants (three per district), with knowledge of local languages and farming contexts administered instruments under supervisory oversight. Survey tools were pre-tested and iteratively refined for cultural and contextual fit. Random back-checks with 10% of respondents verified data authenticity.

4.3 Analytical Approach

Quantitative data were analysed descriptively, with changes in key indicators assessed by comparing endline values against documented baseline and midterm metrics from the project results framework. District-level disaggregation enabled spatial comparison across agroecological zones and socio-cultural contexts, and gender-disaggregated analysis was applied to adoption and income variables. Qualitative data were analysed using thematic content analysis, with a deductive framework derived from the evaluation questions and a secondary inductive pass to capture emergent themes. Integration of quantitative and qualitative findings followed a building approach (Creswell and Clark 2017), where descriptive statistics identified patterns and qualitative themes explained and contextualized them.

4.4 Limitations

The absence of a matched control group means definitive causal attribution is not possible and so concurrent initiatives and broader agroclimatic conditions may have contributed to observed outcomes. The cross-sectional design, even benchmarked to baseline data, cannot fully account for unobserved pre-project differences across communities. Landscape-scale land management indicators, particularly hectares under improved management, were substantially under-reported due to weak measurement protocols, which limits confidence in landscape-scale findings. And EoP evaluation data capture adoption and sustainability intentions rather than verified post-project continuation, which is why longitudinal follow-up studies are needed.

5 Results

5.1 SLM Knowledge Acquisition and Training Coverage

By endline, 99% of survey respondents confirmed receiving SLM capacity support. That near-universal coverage reflects a multi-channel delivery strategy that combined formal training workshops, community sensitization, farmer field days at demonstration farms, and radio programming broadcast through ten

community stations across the five project districts. The three most widely received training packages were cover cropping, crop rotation, and conservation tillage, each reaching over 90% of participants.

For organic soil amendment specifically, 81% of project participants confirmed receiving training in alternatives for improved soil fertility. The most common modalities were field days at demonstration farms observing crops treated with organic compost (74% of trained participants) and practical application of KCARP (Kumasi Compost and Recycling Plant) compost fertilizer during cultivation (72%). In total, 1,518 farmers (569 male, 949 female) across 25 farmer groups were trained in sequential organic compost production using household materials and 239 community-supplied bins.

CSA training across the broader programme reached 6,877 stakeholders (3,354 male; 3,523 female) over the project lifetime, more than six times the original target of 1,000. That overperformance reflects the multiplier dynamics of peer-to-peer knowledge diffusion: 80% of FarmSense technology trainees reported extending their knowledge to other community members, and 68% had shared with between one and ten individuals outside the formal training cohort. Table 1 presents the full summary of SLM-related project indicators.

Table 1
— Performance of SLM and CSA indicators in the ReDIAL project (2020–2024)

Indicator	Baseline	Target	Endline Achievement	Variance
Hectares under improved management (3 ecological zones)	0	50,000 ha	1,622.1 ha	−48,377.9 ha
Farmers trained in CSA practices (O6.2)	0	1,000	6,877 (3,354 M; 3,523 F)	+ 5,877
Farmers applying CSA practices on farms (O6.3)	0	1,000	4,126 (72% at endline)	+ 3,126
Farmers receiving SLM capacity support (survey)	0%	-	99%	N/A
Farmers practising cover cropping / crop rotation	Low	-	93% each	N/A
Farmers practising conservation tillage	Low	-	91%	N/A
Farmers expressing confidence SLM will continue post-project	-	-	93%	N/A
Hectares with soil fertility profiled (SO.1.2)	0	50,000 ha	12,725,064.63 ha	+ 12,675,064 ha

Source

ReDIAL End-of-Project Evaluation (EGCL/FoN 2024–2025). M = Male; F = Female.

5.2 Adoption Levels and Practice-Specific Outcomes

Knowledge transfer is not the same as behavioural change, so this analysis tracks both. On active adoption, roughly nine in ten project participants confirmed they were applying at least one SLM practice on their farms at endline, a result that, in absolute terms, represented 4,126 farmers actively using CSA practices due to the project, exceeding the O6.3 target of 1,000 by 3,126.

Practice by practice, the most widely adopted techniques were KCARP-derived organic compost making (96% among trained beneficiaries), minimum or zero tillage (89%), and mulching (80%). What these practices share is instructive: they can be started incrementally without large upfront investment, they draw on locally available materials, and they produce visible results such as improved soil structure, moisture retention, and weed suppression within one or two growing seasons. Low entry barriers and quick feedback loops are exactly what diffusion-of-innovations theory (Rogers 2003) identifies as the conditions that accelerate uptake, and the evidence here is consistent (Kabore et al. 2022).

Participants' own assessments of effectiveness were strongly positive. Of those who received SLM capacity support, 62% rated it 'very effective' and a further 19% 'highly effective', suggesting an aggregate positive rating of 81%. Satisfaction with soil fertility training was similarly high, with 56% reporting satisfaction with both the training and the accompanying knowledge products. Directors of Agriculture consulted at Techiman, Ejura, and Yendi independently confirmed through key informant interviews that ReDIAL participants who had adopted organic soil enrichment practices were consistently achieving higher yields than conventional farmers in the same communities. These are the kinds of agronomic validations that travel through informal networks and reinforce continued practice.

On sustainability intentions, 93% of respondents expressed confidence that the SLM practices they had adopted during the project would continue after it ended. In focus group discussions, participants attributed this to three interrelated things: the resonance of promoted practices with traditional farming knowledge; the availability of organic compost materials within the community environment; and the ongoing backstopping accessible through the government extension service and VSLA networks. This is precisely the sustainability logic that Reed et al. (2017) map out, namely; local knowledge alignment, input availability, and institutional support - as the three pillars of durable SLM adoption.

5.3 The Landscape-Scale Gap: O6.1 Performance

The starkest number in the results framework is indicator O6.1 (hectares of land under improved management across three ecological zones). Against a target of 50,000 ha, the project recorded 1,622.1 ha at endline: a shortfall of 48,377.9 ha, representing roughly 3.2% of the target. Nothing else in the results framework comes close to this level of underperformance.

Two distinct explanations account for the gap and deserve to be kept separate. The first is measurement failure. The evaluation explicitly records that O6.1 was 'highly under-reported due to measurement challenges', which means actual improved management may substantially exceed what was recorded,

but systematic GPS-based farm mapping and landscape-level documentation were not in place to capture it. This is a programme design failure, not an SLM failure, and it is correctable.

The second explanation is a genuine governance gap: community institutions capable of governing farm-scale practice may simply not have the authority, coordination capacity, or resources to govern landscape-scale land use change. Bringing 50,000 ha under improved management would have required coordinated change across hundreds of individually managed farms and potentially multiple land use categories such as cropland, fallows, community forests, and pastoral areas. That is a collective action problem that VSLAs and PRMCs cannot solve without formal landscape governance authority, such as that provided by District Assembly land use planning or watershed management legislation. Future programmes need to invest explicitly in landscape governance such as participatory land use planning, bylaws on soil conservation, and district-level SLM coordination committees (Reed et al. 2017; Schwilch et al. 2022).

5.4 VSLA-Mediated Financial Access and SLM Adoption

One of the study's more analytically interesting findings concerns the role VSLAs played in SLM adoption, particularly in the project's third and fourth years. Project staff and focus group participants across seven communities independently identified VSLA loan access as a decisive enabling factor, not just for agricultural inputs, but for farm improvement investments more broadly. Members of VSLAs were consistently noted to be implementing CSA practices more effectively because they had reliable access to finance when they needed it.

Across the five districts, the 19 VSLAs mobilized over GHS 1.2 million (approximately USD 109,100) in member savings and circulated loans to more than 70% of the membership at interest rates of 5–10%. Loans went partly into agricultural inputs such as securing farmland, purchasing agro-inputs, hiring labour, and partly into livelihood diversification (food vending, fish processing, beekeeping, piggery) and climate adaptation assets, including mobile phones for accessing climate information and household storage improvements.

The gender composition of VSLAs, mostly 70% female (409 of 581 members) reflects the project's deliberate gender-mainstreaming design. For women farmers, VSLA membership offered something beyond credit: regular group meetings created structured spaces for knowledge exchange on SLM practices, troubleshooting of technical problems, and collective advocacy for better extension support. This dual function expressed in financial institution and social learning network is precisely what Ksoll et al. (2016) and Beaman et al. (2023) identify as the multiplier effect of savings groups embedded within agricultural development programmes.

5.5 Institutional Sustainability Architecture

Post-project sustainability was built into ReDIAL's design through four interlocking institutional mechanisms, all functional at endline.

Foremost, FarmSense soil testing services were institutionalized within District Departments of Agriculture. Thirty FarmSense kits were procured and three supplied to each district's Department. By the project's close, extension officers in all five districts were conducting soil testing for farmers as part of routine field visits, an institutional arrangement that no longer depends on project funding to function.

Additionally, a CSA manual was developed and distributed to local government agricultural authorities as a reference tool for ongoing farmer training. This is a durable knowledge product that extension staff can use without further project involvement.

Moreover, Post-ReDIAL Management Committees were established in each project district, with seven-member committees representing farmer groups, VSLAs, persons with disability groups, local artisans, MSDP representatives, and district government. PRMCs are legally anchored to District Assemblies and mandated to manage project assets, sustain governance platforms, and advocate for continued SLM practice.

Furthermore, VSLAs were supported to register as formal cooperatives and linked to MSD platforms, opening pathways to government agricultural support programmes and formal financial markets. By endline, several groups had initiated contact with microfinance institutions and were exploring cooperative farming ventures.

Collectively these mechanisms address the most common failure mode in agricultural development: institutional collapse following donor exit. The evaluation found positive evidence that each was functional at endline. But one critical qualification emerged from key informant interviews with the ReDIAL consortium: no formal written exit strategy document was produced or distributed during the project. Despite verbal assurances about post-project arrangements, stakeholder clarity on roles and responsibilities varied considerably across districts - a fragility that could undermine institutional continuity unless addressed.

6 Discussion

6.1 What Drives High Farm-Level Adoption? A Community-Led Perspective

The near-universal SLM knowledge coverage (99%) and high active adoption rate (~ 90%) documented here exceed the thresholds reported in most comparable SLM intervention evaluations across sub-Saharan Africa (Weston et al. 2015; Tondoh et al. 2021; Kabore et al. 2022). Three mechanisms account for it.

The first is indigenous knowledge alignment. Designing composting methods around materials already present in community environments rather than around imported inputs requiring supply chain access substantially lowered adoption barriers. As focus group participants noted, organic composting did not feel like an alien practice; it felt like a formalization of what farmers already did with household waste.

This mirrors the pattern that Zida et al. (2021) found for Farmer-Managed Natural Regeneration in Burkina Faso, where the highest adoption rates clustered around practices that closely resembled existing land stewardship traditions.

The second mechanism is experiential learning through demonstration farms. Watching treated and untreated plots develop side by side in real growing conditions such as applying compost with one's own hands and tracking the results over a season is categorically different from receiving the same information in a classroom. Agricultural extension research consistently shows that observational learning at demonstration sites increases adoption intent more powerfully than lecture-based information transfer (Nyasimi et al. 2022). The fact that 80% of FarmSense trainees went on to share their knowledge with at least one other person confirms that experiential learning at demonstration sites activated informal peer diffusion networks beyond the reach of formal training.

The third mechanism is the temporal sequencing of financial support. VSLA membership was most important for adoption in years three and four of the project, after the groups had accumulated enough revolving fund capital to make loans meaningful. This matters because it implies that introducing SLM technologies before financial access mechanisms are operational may produce knowledge acquisition without practice change. ReDIAL's trajectory makes the case for building financial infrastructure early in the project cycle, even if its adoption-enabling function only becomes fully operative later.

6.2 The Landscape-Scale Problem: Governance Gaps and Measurement Failures

The dramatic underperformance on the O6.1 hectares indicator raises a question that community-led SLM advocates need to take seriously: can these approaches, however effective at farm level, reach landscape-scale outcomes without additional governance mechanisms? The evidence here says probably not, and the finding is consistent with Liniger et al. (2021) and Nkonya et al. (2023).

The two explanations need to be kept analytically distinct. Where the indicator shortfall reflects measurement failure such as land managed well but not recorded, the fix is straightforward: GPS-based farm mapping, remote sensing validation, and participatory landscape assessment built into project design from the start rather than added as an afterthought. This is correctable without rethinking the community-led approach.

Where the shortfall reflects a genuine governance gap such as community institutions capable of governing farm practice but not landscape land use, the fix is more demanding. Coordinating change across hundreds of individually managed farms and multiple land use categories is a collective action problem that VSLAs and PRMCs were not designed to solve on their own. Solving it requires formal landscape governance authority: District Assembly land use planning, watershed management legislation, district-level SLM coordination committees with real mandates. Future programmes should invest in these mechanisms explicitly and not assume they will emerge from farm-level adoption.

6.3 Gender Dimensions of SLM Adoption and Sustainability

Women made up 63.4% of project beneficiaries targeted for income improvement and 70% of VSLA membership - proportions that reflect deliberate gender targeting. But equitable participation is not the same as equitable outcomes, and achieving the latter required attending to constraints specific to women's situation: lower literacy levels that made interpreting FarmSense results and managing VSLA financial records harder; time constraints tied to domestic responsibilities that limited training attendance; and limited land security that reduced incentives for long-term soil investment.

The results show that well-designed interventions can push past these constraints. Women's average income more than doubled across the project span from GHS 310 (approximately USD 28) at baseline to GHS 703 (approximately USD 64) at endline, which is a substantial economic gain within four years. VSLAs were particularly important here: by providing structured saving and lending within trusted community settings and linking women to agricultural advisory services through MSDP participation, they simultaneously addressed financial, knowledge, and social capital barriers to SLM adoption. This integrative function supports the argument made by Nyasimi et al. (2022) that gender-transformative agricultural interventions need to address the institutional context of women's farming, not just the technical content of the practices being promoted.

6.4 Prospects and Conditions for Post-Project Durability

Assessing whether SLM gains will persist after project exit requires distinguishing between three categories of outcome, because they carry very different sustainability risks.

Practices with strong indigenous knowledge alignment and no ongoing external input requirements such as conservation tillage, mulching, cover cropping, and crop rotation, have good prospects. These are embedded in farming routines, draw on existing labour and materials, and have demonstrated yield benefits that create positive reinforcement for continuation (Monjardino et al. 2021).

Practices requiring periodic external input access face moderate sustainability risk. Organic compost production depends on KCARP supply chains or continued community composting infrastructure. The 239 compost bins across 25 communities provide production capacity but maintaining them requires governance support through PRMCs and continued VSLA financing of input procurement.

Technology-dependent practices such as soil testing through FarmSense devices especially are most vulnerable to post-project discontinuation if device maintenance, software updates, and replacement kit supply are not sustainably institutionalized within government extension systems. Institutionalization within District Departments of Agriculture is a genuinely positive step, but the limited number of devices per district (three) was already constraining demand during the project period, and that constraint will intensify once project resources are no longer available.

Across all three categories, the absence of a formal written exit strategy represents a systemic risk. The finding that verbal accounts of post-project arrangements were 'altogether inconsistent' among consortium partners suggests institutional memory is fragile and may not survive staff turnover or organizational restructuring. This is fixable: exit strategy documentation should be treated as a

mandatory programme management output, produced with genuine community input, disseminated widely across district stakeholders, and reviewed at both the mid-term and final evaluation stages, not written retrospectively at project closure.

7 Conclusions and Implications for Practice and Research

This study has examined community-led SLM adoption, effectiveness, and post-project durability across five agroecologically diverse districts in northern and central Ghana. Several substantive conclusions emerge from the analysis.

Foremost, community-led SLM achieves high farm-level adoption when it aligns with indigenous knowledge systems, deploys experiential learning through demonstration infrastructure, and times financial enablement to coincide with the adoption window. The near-universal coverage and roughly 90% active adoption rate documented here are among the highest reported for any SLM intervention in sub-Saharan Africa, and each is traceable to these specific design choices.

Furthermore, VSLAs are not peripheral instruments, they are central institutional infrastructure for community-led SLM. Their role as financial intermediaries enabling input procurement is well established. This study extends that understanding by documenting their additional function as social learning networks and gender-transformative empowerment platforms. Programmes that treat VSLAs as secondary financial add-ons are likely leaving much of their potential on the table.

Moreover, the landscape-scale gap documented in O6.1 is simultaneously a measurement failure and a governance failure. Correcting the measurement dimension means investing in GPS-based farm mapping, remote sensing validation, and participatory landscape assessment from the project's inception. Correcting the governance dimension means deliberately investing in landscape-scale coordination mechanisms such as participatory land use planning and district-level SLM governance bodies capable of coordinating farm management decisions at watershed or landscape scale.

Furthermore, institutionalization within the state extension system is necessary but not sufficient. Embedding FarmSense within Departments of Agriculture and distributing CSA manuals are real achievements, but they require continued monitoring, adequate resourcing of extension officers, and sustained district-level governance commitment to maintain momentum without project support.

Finally, the absence of a formal exit strategy is a critical programme management failure with potentially large sustainability costs. Exit strategy development should be a first-order programme output that is produced with meaningful community input, disseminated widely, and reviewed at both mid-term and final evaluation stages.

For researchers, this study highlights the persistent gap in longitudinal evidence on second-order SLM adoption. End-of-project evaluations capture first-order adoption and stated intentions; what remains largely unknown is whether the institutional mechanisms put in place such as PRMCs, VSLAs, and

extension integration actually sustain practice change two to five years later. Longitudinal follow-up studies in ReDIAL communities, designed with matched comparison communities, would fill a real evidence gap and meaningfully inform programme design across West Africa and beyond.

Declarations

Competing interests:

The author has no relevant financial or non-financial interests to disclose.

Ethics approval:

Data collection for the end-of-project evaluation adhered to the ethical principles of informed consent, voluntary participation, anonymity, and confidentiality. Research assistants received formal training on ethical data collection and handling of sensitive personal information. Evaluation activities were approved by the European Union delegation under the project's Terms of Reference.

Funding:

This study draws on evaluation data generated under the ReDIAL project, funded by the European Union under the DeSIRA initiative. Total project budget: €2,120,000 (EU contribution: €2,000,000; consortium partner contribution: €120,000). No separate funding was received for preparation of this manuscript.

Author Contribution

This is a sole authorship. I solely contributed to the conceptualization, analysis, writing, and revision of this paper. The corresponding author takes responsibility for the final version.

Acknowledgements

The empirical basis for this article is the end-of-project evaluation of the ReDIAL project conducted by Endogen Global Consult Ltd. (EGCL) for which the author was the Team Lead. The author acknowledges the contributions of the ReDIAL consortium: Friends of the Nation (FoN) as Lead, Tropenbos Ghana (TBG), the Faculty of Renewable Natural Resources of Kwame Nkrumah University of Science and Technology (FRNR-KNUST), SAYeTECH Company, and SESI Technologies. The ReDIAL project was funded by the European Union under the DeSIRA initiative. The views expressed here are those of the author and do not necessarily reflect those of the European Union or the implementing consortium. Thanks are owed to all smallholder farmers, VSLA members, government officials, and community leaders across the five project districts who gave their time to data collection.

Data availability:

The evaluation data underpinning this analysis are held by Friends of the Nation (FoN) and Endogen Global Consult Ltd. Requests for data access may be directed to the corresponding author, subject to consortium approval and data protection obligations.

References

1. Adjei EO (2020) Ghana soil management policy: relevance, concepts and processes for its attainment. Int J Creat Res Thoughts 8(11):1338–1345
2. Beaman L, Karlan D, Thuysbaert B, Udry C (2023) Selection into credit markets: Evidence from agriculture in Mali. Econometrica 91(5):1595–1627. https://doi.org/10.3982/ECTA18916
3. Creswell JW, Clark VL (2017) Designing and conducting mixed methods research, 3rd edn. Sage, Thousand Oaks
4. EGCL (Endogen Global Consult Ltd.) (2025) End-of-project evaluation report: Research for Development and Innovation Agriculture and Learning (ReDIAL) project, 2020–2024. Endogen Global Consult Ltd., Tamale, Ghana
5. FoN (Friends of the Nation) (2024) ReDIAL project updated factsheet 2024. Friends of the Nation, Accra
6. Kabore PN, Bayala J, Ouedraogo I, Ouedraogo SJ, Sanou J (2022) Adoption of improved agroforestry practices and their determinants in Burkina Faso: A farm household analysis. Agrofor Syst 96:1023–1038. https://doi.org/10.1007/s10457-022-00742-z
7. Ksoll C, Lilleør HB, Lønborg JH, Rasmussen OD (2016) Impact of village savings and loan associations: Evidence from a cluster randomized trial. J Dev Econ 120:70–85. https://doi.org/10.1016/j.jdeveco.2015.12.003
8. Liniger H, Studer RM, Hauert C, Gurtner M (2021) Sustainable land management in practice: Guidelines and best practices for sub-Saharan Africa. TerrAfrica, World Overview of Conservation Approaches and Technologies (WOCAT) and FAO, Rome
9. Monjardino M, Silburn DM, Gupta M, Strickland R (2021) Sustainable agricultural intensification: Reviewing the evidence, constraints, and drivers across smallholder farming systems in Africa. Agron Sustain Dev 41:14. https://doi.org/10.1007/s13593-021-00669-4
10. Nkonya E, Anderson W, Kato E, Koo J, Mirzabaev A, von Braun J, Meyer S (2023) Global cost of land degradation. In: von Braun J, Gerber N, Mirzabaev A, Nkonya E (eds) Economics of land degradation and improvement. Springer, Cham, pp 117–165. https://doi.org/10.1007/978-3-319-19168-3_6
11. Nyasimi M, Radeny M, Mungai C, Kinyangi J (2022) Gender and climate-smart agriculture: Lessons from Kenya. Clim Dev 14(5):420–431. https://doi.org/10.1080/17565529.2021.1937823
12. Reed MS, Allen K, Attlee A et al (2017) A place-based approach to payments for ecosystem services. Glob Environ Change 43:92–106. https://doi.org/10.1016/j.gloenvcha.2016.12.009

13. Rogers EM (2003) Diffusion of innovations, 5th edn. Free, New York
14. Schwilch G, Hessel R, Verzandvoort S (eds) (2022) Desired ground: A DESIRE approach to combat desertification. Wageningen Academic, Wageningen. https://doi.org/10.3920/978-90-8686-777-8
15. Toensmeier E, Daly J, Dixon J, Hamrick K (2023) The role of perennial crops in achieving land degradation neutrality: Evidence from sub-Saharan Africa. Land Degrad Dev 34(2):490–506. https://doi.org/10.1002/ldr.4452
16. Tondoh JE, Kouame FN, Guei AM, Sey B, Konan Waidjé B, Gnancadja LS (2021) Ecological changes and soil carbon dynamics following land use and land cover changes in West Africa: A review. CATENA 197:104956. https://doi.org/10.1016/j.catena.2020.104956
17. Westermann O, Thornton P, Förch W (2018) Reaching more farmers: Innovative approaches to scaling up climate-smart agriculture. Agric Syst 165:283–293. https://doi.org/10.1016/j.agsy.2018.04.005
18. Weston P, Hong R, Kaboré C, Kull CA (2015) Farmer-managed natural regeneration enhances rural livelihoods in dryland West Africa. Environ Manag 55:1402–1417. https://doi.org/10.1007/s00267-015-0469-1
19. Zida M, Sawadogo H, Tougiani A, Garba M, Nikiema A (2021) Farmer-managed natural regeneration in the Sahel: Evidence from Niger and Burkina Faso. Land Degrad Dev 32(6):2072–2085. https://doi.org/10.1002/ldr.3869