Power for Food Partnership
Renewable, Regenerative, Resilient.

Gap Analysis: Regenerative Agriculture (RA) and Productive Use of Renewable Energy (PURE)

Unlocking the RA-PURE Nexus in Kenya for Scalable Agricultural Transformation

Bungoma
Busia
Kakamega
Kericho
Nakuru
Nandi
Uasin Gishu

Power for Food Partnership | March 2026

Developed by CoELIB, Egerton University

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Acronyms

CARE	Cooperative for Assistance and Relief Everywhere International
CIFOR-ICRAF	The Center for International Forestry Research and World Agroforestry
CBOs	Community-based Organisations
FAO	Food and Agriculture Organisation
FGDs	Focus Group Discussions
GESI	Gender, Equity, and Social Inclusion
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
KCDMS	Kenya Crops and Dairy Market Systems
KCSAP	Kenya Climate Smart Agriculture Project
KIIs	Key Informant Interviews
MSMEs	Micro, Small and Medium Enterprises
NARIGP	National Agricultural and Rural Inclusive Growth Project
NAVCDP	National Agricultural Value Chain Development Project
NGOs	Non-governmental Organisations
PAYGO	Pay-as-you-go
PURE	Productive Use of Renewable Energy
PV	Photovoltaic
RA	Regenerative Agriculture
REP	Rural Electrification Programme
SNV	Stichting Nederlandse Vrijwilligers (Foundation of Netherlands Volunteers)
USAID	United States Agency for International Development
WFP	World Food Programme

Executive Summary

This report presents a summary of a gap analysis conducted in February 2026 across seven counties in Kenya: Bungoma, Busia, Kakamega, Kericho, Nakuru, Nandi, and Uasin Gishu, under the Power for Food Partnership. The study assesses opportunities to strengthen smallholder productivity, resilience, and sustainability by integrating regenerative agriculture (RA) and the productive use of renewable energy (PURE).

Using data from 320 household farmers, 113 service providers, and 104 input and technology suppliers, the analysis reviews current adoption patterns, identifies key constraints, and highlights practical, scalable pathways to integrate agriculture and energy systems.

The findings reveal a clear pattern: the foundation for RA-PURE integration is strong, yet adoption is constrained by financial, technical, and structural barriers rather than by a lack of demand. While regenerative practices are widely adopted and energy access is relatively high, integration remains limited.

RA practices are widely adopted but not fully integrated: Compost/manure (79%), intercropping (74%), and crop rotation (73%) are common, yet applied in fragmented ways.

Energy access is high, but productive use is low: 59% of households use grid electricity and 53% use solar, yet 85% rely on energy mainly for lighting, with only 15% for irrigation.

Demand is strong, but constrained by affordability: 97% of farmers are willing to adopt RA-PURE systems; however, high upfront costs (71%) and limited access to finance (54%) remain the primary barriers.

Supply systems are active but fragmented: 60% of suppliers operate in silos, and only 3% offer integrated RA-PURE solutions.

Awareness is moderate, but adoption is low: 70% of farmers are aware of RA-PURE approaches, but only 17% have adopted them.

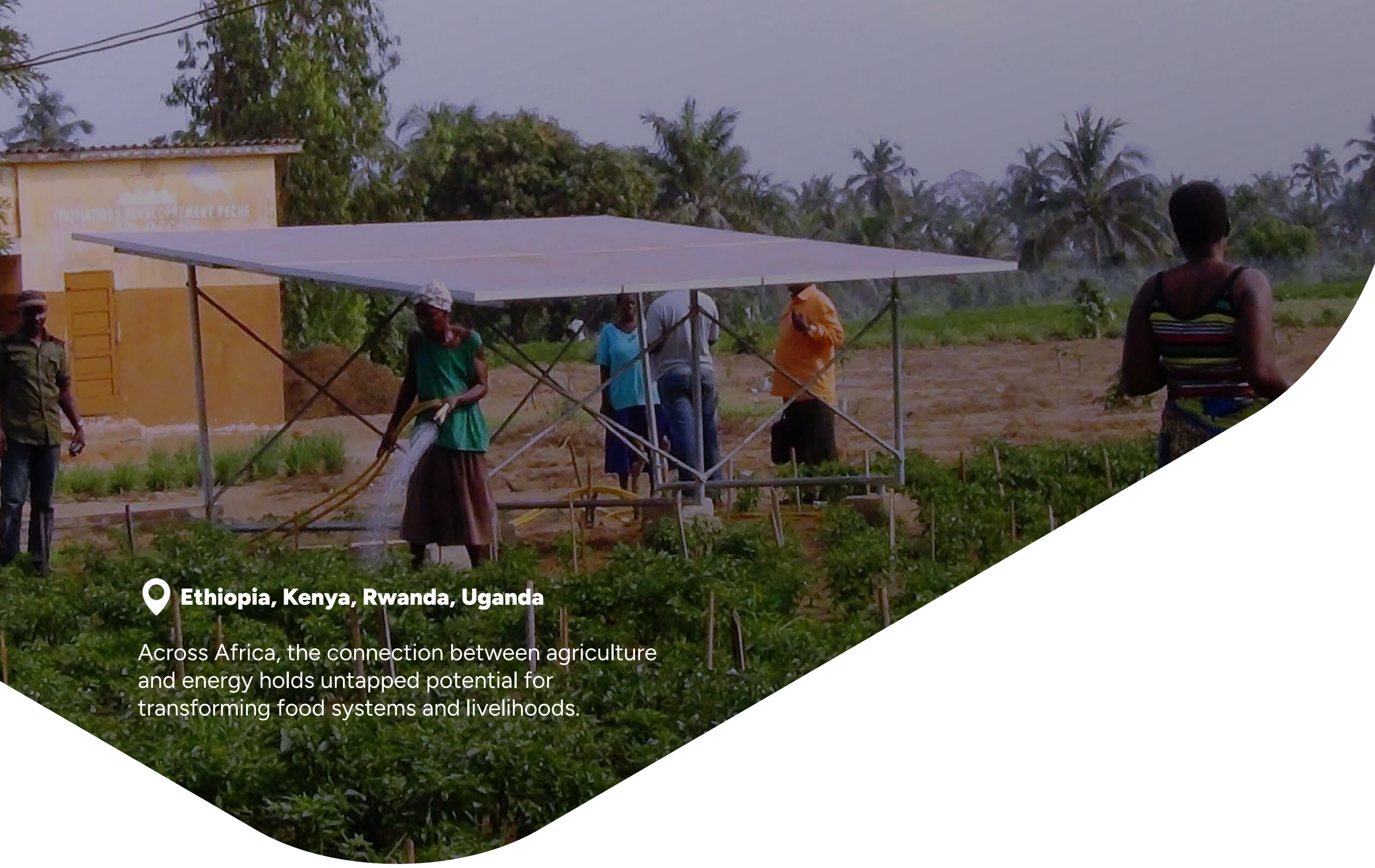
Solar irrigation is the most viable entry point: Preferred by 69% of farmers and aligned with the dominant challenge of drought (83%), making it a critical climate adaptation and productivity solution.

Institutional and delivery gaps persist: While support for RA exists, only 14% of institutions fund integrated RA-PURE initiatives, and key delivery channels remain underutilised.

Biogas shows strong localised potential: Overall adoption is low (6%), uptake reaches 26% in livestock-based systems such as Nandi.

The analysis highlights a significant opportunity to accelerate RA-PURE adoption by addressing affordability, strengthening technical capacity, and improving integration across supply chains. Prioritising solar-powered irrigation as an entry point, supporting bundled solutions, and leveraging high-performing counties such as Nandi and Uasin Gishu as learning hubs will be critical for scaling integrated, climate-resilient farming systems.

RA-PURE adoption in Kenya is not limited by demand, but by financing, integration, and delivery systems.



Power for Food Partnership

The **Power for Food Partnership** is a multi-country initiative in Eastern Africa led by SNV and funded by the IKEA Foundation aimed at transforming agri-food systems by integrating regenerative agriculture (RA) with the productive use of renewable energy (PURE).

Its core idea is that agriculture and energy systems, which often operate separately, can generate greater social, economic, and environmental benefits when combined.

The partnership seeks to address key challenges facing rural communities—such as low agricultural productivity, limited access to clean energy, and vulnerability to climate change—by promoting sustainable farming practices powered by renewable energy solutions like solar irrigation and energy for processing and storage.

This integrated approach aims to improve livelihoods, strengthen food security, and build climate resilience while reducing environmental pressure.

The partnership operates through three main pathways:

- **Learn** (generating evidence and knowledge sharing),
- **Link** (building partnerships and networks), and
- **Leverage** (influencing policy, investments, and scaling solutions).

Together, these pathways aim to create an enabling environment for widespread adoption of integrated agriculture–energy solutions.

A strong emphasis is placed on inclusion, ensuring women, youth, and marginalized groups benefit from access to resources, technology, and decision-making opportunities.

Overall, the Power for Food Partnership envisions a future where renewable energy-driven, resilient food systems provide equitable and sustainable opportunities for communities across Eastern Africa.

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1 Introduction

1. Introduction

Kenya's agriculture sector remains a cornerstone of the national economy, contributing significantly to employment and gross domestic product (GDP). However, the sector continues to face persistent structural constraints, including erratic rainfall, declining soil fertility, land degradation, and limited market integration.

These challenges are particularly pronounced in key agricultural regions such as the Rift Valley and Western Kenya, where years of intensive conventional farming and inadequate soil management have reduced productivity and increased vulnerability to climate shocks.

In response, RA and PURE have emerged as complementary approaches with the potential to transform smallholder farming systems. RA focuses on restoring soil health, enhancing biodiversity, and improving ecosystem resilience through practices such as composting, intercropping, crop rotation, and conservation tillage. PURE emphasises the use of renewable energy technologies, including solar, biogas, and hybrid systems, to support irrigation, processing, storage, and value addition. When effectively integrated, the RA-PURE nexus offers a pathway to more climate-resilient, resource-efficient, and economically viable agri-food systems.

Despite this potential, the extent of RA and PURE adoption and integration at the county level remains insufficiently understood. While Kenya has made significant progress in expanding renewable energy nationally, these gains have not fully translated into productive agricultural use, particularly among smallholder farmers in rural and off-grid areas. At the same time, RA practices are increasingly promoted but often implemented in isolation, limiting their overall impact.

This highlights a critical systemic gap: the limited integration of ecological farming practices with energy solutions to enhance productivity and resilience. Existing data are largely aggregated at national or regional levels, with limited county-level evidence to inform targeted, context-specific interventions.

In this context, RA-PURE Gap Analysis was undertaken within the Power for Food Partnership. The study assesses the current state of RA practices and energy access and use, and the level of integration between the two, across seven counties: Bungoma, Busia, Kakamega, Kericho, Nakuru, Nandi, and Uasin Gishu (see Figure 3.1). Drawing on insights from farmers, service providers, and suppliers, it identifies key gaps, barriers, and opportunities for scaling integrated RA–PURE solutions.

This report provides critical evidence base for programme design, investment prioritisation, and policy engagement. By identifying constraints in financing, access to technology, knowledge, and system integration, it supports the development of targeted interventions to unlock the full potential of the RA-PURE nexus and advance sustainable, climate-resilient agricultural transformation in Kenya's Agricultural systems.

2 Literature Review

2. Literature Review

2.1 Policy, Institutional, and Socio-economic Context for RA and PURE

Recent Kenyan policy frameworks have indirectly supported RA and renewable energy through broader climate-smart agriculture and rural development strategies. Key frameworks include the Climate-Smart Agriculture Strategy (2017-2026) and the National Agricultural and Rural Inclusive Growth Project (NARIGP, 2019-2024), which promote climate-smart practices in the Rift Valley and Western regions. At the county level, initiatives in Kakamega and Uasin Gishu support agroforestry and extension services, while Busia promotes crop resilience through improved varieties. The Agricultural Sector Transformation and Growth Strategy further incentivises soil health practices such as manure application and mulching.

However, the renewable energy policy landscape remains less clearly defined. Evidence shows that diffusion of renewable energy technologies in Kenya is highly dependent on government policy and regulatory conditions (Blohmke et al., 2013). Key barriers include limited access to finance, weak business environments, and high tariffs. Historical policy inconsistencies, such as changes in photovoltaic tariffs and limited investment in rural electrification, have also constrained uptake (Acker et al., 1996). More recent initiatives, such as the Kenya Climate Smart Agriculture Project (KCSAP) and related programmes, demonstrate growing policy support for climate-smart agriculture and agroforestry (Ndung'u et al., 2023), though implementation gaps persist.

Institutional Landscape

A range of actors with complementary roles shapes the RA and PURE ecosystem in Kenya. Government agencies, both national and county-level, play a central role in coordination, regulation, and farmer support through subsidies and extension services. Non-governmental organisations (NGOs) and development partners provide technical assistance, financing, and research support, with organisations such as the Cooperative for Assistance and Relief Everywhere (CARE) International; the Center for International Forestry Research and World Agroforestry (CIFOR-ICRAF); the International Fund for Agricultural Development (IFAD); and the United States Agency for International Development (USAID) playing prominent roles in RA and PURE.

Private-sector engagement in renewable energy is more advanced than in RA. Companies supplying solar technologies provide products, training, and maintenance services, while financial institutions support adoption through microfinance and asset-financing models. Farmer organisations and cooperatives contribute to coordination, collective marketing, and knowledge sharing. Despite this broad institutional presence, coordination among actors remains limited, particularly in delivering integrated RA-PURE solutions.

2.2 RA Adoption and Evidence

The literature indicates that adoption of RA practices remains uneven, with most farmers adopting individual practices, such as manure application, crop rotation, and intercropping, rather than fully integrated systems. Where adopted, RA practices improve soil organic matter, water retention, and yield stability, particularly in maize, dairy, and horticultural systems. However, adoption is constrained by labour requirements, limited extension services, knowledge gaps, and weak short-term financial incentives.

RA-related practices in the study regions include soil management (e.g., composting, mulching, zero tillage), agroforestry, crop diversification, water conservation, and crop-livestock integration. However, inconsistent terminology, ranging from regenerative agriculture to climate-smart agriculture and organic soil management, limits comparability across studies.

2.2.1 Factors Affecting RA Adoption

RA adoption is shaped by a combination of socioeconomic, institutional, policy, and environmental factors. Socioeconomic determinants include age, education, household size, gender, farm size, land tenure, and livestock ownership. Education, secure land tenure, and livestock ownership generally support adoption, whereas gender inequalities and limited financial capacity constrain it.

Institutional factors, such as access to extension services, farmer training, group membership, weather information, and agricultural credit, significantly enhance adoption. Market participation also plays a key role by providing incentives to invest in improved practices. At the policy level, subsidies and land tenure security encourage adoption, whereas weak policy implementation and institutional coordination limit impact. Environmental factors, including climate shocks, soil degradation, and land characteristics, further shape adoption decisions.

2.2.2 Institutional Barriers, Facilitators, and Stakeholder Perspectives

Key facilitators of RA adoption include extension services, farmer organisations, NGO support, and access to credit. However, major barriers persist, including limited extension coverage, weak institutional coordination, insecure land tenure, and insufficient linkages among research, advisory services, and farmers.

Stakeholder perspectives reinforce these findings. Farmers recognise the benefits of sustainable land management but face constraints in accessing land, finance, training, and technology. Government actors highlight gaps in policy effectiveness, particularly regarding youth engagement, while extension agents emphasise the need for improved training and outreach to farmers. Notably, private-sector perspectives remain underrepresented in the literature, creating a critical gap given their role in scaling both RA and PURE solutions.

2.3 PURE Adoption and Evidence

While Kenya has made significant progress in renewable energy generation at the national level, the productive use of renewable energy in agriculture remains uneven, particularly among smallholder farmers. Adoption is constrained by high upfront costs, limited access to finance, weak maintenance ecosystems, and low awareness of available technologies.

PURE technologies in Kenya are most commonly used in:

Solar-powered irrigation systems

Biogas digesters for household and dairy energy

Solar dryers and cold storage for horticulture and fish value chains

Despite these applications, multiple gaps limit wider adoption. Policy and regulatory constraints remain significant. The diffusion of renewable energy continues to depend heavily on government policies and regulatory conditions, with evidence pointing to implementation weaknesses, inconsistent policy support, and limited incentives for integrated systems (Blohmke et al., 2013; Acker et al., 1996). More recent studies also highlight gaps in programmes and regulatory frameworks needed to support agroforestry and integrated energy solutions (Booth et al., 2018; Ndung'u et al., 2023; Farthing et al., 2023).

Institutional capacity constraints further limit progress. These include weak technical capacity in the renewable energy sectors, limited training and support systems, and inadequate capacity within financial institutions to support technology adoption. In addition, gaps in data, technical expertise, and system integration, particularly in microgrid development and productive energy use, constrain effective implementation.

Market-related barriers persist. Studies highlight poor access to finance, insecure business environments, and high tariffs as key constraints, alongside unmet demand for solar technologies, modern energy solutions, and productive-use applications in rural areas. At the same time, these challenges present clear opportunities to expand energy access, support rural enterprise development, and strengthen value chains through energy-enabled production and processing.

Investment opportunities are increasingly centred on integrated service delivery models, including bundling technologies and services, expanding training programmes, and supporting community-level initiatives. There is also growing interest among development partners and private investors in scaling renewable energy solutions, particularly through innovative financing models and localised production systems.

Overall, the literature highlights that while the potential for PURE in agriculture is significant, adoption remains constrained by policy, institutional, financial, and technical barriers.

Addressing these challenges will require stronger coordination among stakeholders, improved access to finance, enhanced technical capacity, and the development of business models that support the integration of energy technologies into agricultural systems (Ngowa et al., 2024).

Table 2.1 summarises the current use and distribution of productive renewable energy technologies across the seven study counties. The evidence indicates that solar irrigation and biogas systems are the most commonly observed applications, although uptake remains uneven and often small-scale. In contrast, technologies for post-harvest value addition, such as solar drying, cold storage, and solar-powered processing, are less widely documented and largely limited to pilot initiatives or localised deployments. The overall pattern shows uneven, fragmented uptake of PURE technologies across counties.

Table 2.1 Renewable Energy Solutions Used by Farmers or Cooperatives in each County.

County	Solar Irrigation	Solar Dryers	Solar Cold Storage	Solar Milling/ Processing	Biogas / Biodigesters
Busia	Irrigation expansion projects; some solar pumps through national programs	Limited documented evidence; possible small pilots	Limited public evidence	Not documented in available sources	Limited documented uptake
Bungoma	Smallholder solar pumps used regionally	Yes, documented installations, incl. coffee solar dryers	Limited public evidence	Not widely reported	Limited data, possible household biodigesters
Uasin Gishu	Some farms using solar water pumps (largely small-scale)	Limited published evidence	Limited evidence	Possible small solar-powered processing tools	Yes, strong biodigester adoption (Sistema. bio, NGOs)
Nakuru	Solar pumping/ solar irrigation	Some usage, though less reported	Yes, pilots of solar cold rooms and PURE cold storage models	Yes, solar-powered chaff cutters and milling documented	Yes, household-level biodigesters reported
Nandi	Solar irrigation demos and events reported	Limited documentation	Limited public evidence	Not widely reported	Possible smallholder biodigesters (not fully documented)
Kericho	Limited county-specific evidence	Yes, solar dryers in coffee cooperatives	Limited data	Limited evidence	Yes, biodigester suppliers active, farm installations
Kakamega	Some solar pumping regionally, not well documented	Yes, Solar bubble dryers distributed to cereal community-based organisations (CBOs)	Limited data	Not widely reported	Limited documented evidence

Table 2.2 provides an overview of key suppliers, technologies, and financing mechanisms supporting the productive use of renewable energy in the study areas. The ecosystem comprises a mix of private companies, development partners, and public actors that provide solar irrigation, drying, cold storage, and biogas solutions. Financing models range from pay-as-you-go (PAYGO) systems and commercial bank loans to donor-funded pilots and county-level subsidies. While this reflects a diverse and active market, support remains fragmented across technologies and actors, with limited integration of services into bundled RA-PURE solutions.

Table 2.2 Current suppliers and financiers of renewable energy

Solution	Supplier / Brand	Coverage	Financing Partner
Solar irrigation systems (solar pumps, solar boreholes, smallholder drip kits)	SunCulture	Kenya-wide; strong presence in Western and Rift Valley; Pay-as-you-go (PAYGO) solar pumps	KCB, Equity Bank, Cooperative Bank – Agri-finance loans for solar pumping and irrigation FAO, SNV, GIZ, USAID - Kenya Crops and Dairy Market Systems Activity (KCDMS), AGRA – Grants/ pilots for smallholder irrigation MFI PAYGO models (e.g., SunCulture) PAYGO via mobile money County governments and constituency development fund (CDF)- Occasional subsidies or group purchases
	Futurepump	Manual and solar surface pumps are widely used by smallholders	
	Davis & Shirtliff	Largest installer nationwide; borehole pumps, solar pumping systems	
	SolarGen Technologies	Provides pumps and off-grid solar for irrigation	
	Lorentz (via distributors)	Premium solar pump systems used by	
	Sunking / Greenlight Planet	Entry-level solar pumps for individual smallholders	
Solar dryers (tunnel dryers, cabinet dryers, solar bubble dryers)	Sun-dried Africa	Operates in Bungoma, Kakamega, Nandi: coffee and horticulture dryers	County governments (especially Bungoma and Kakamega) NGOs (SNV, VI Agroforestry, USAID Kenya Crops and Dairy Market Systems (KCDMS), World Vision) Cooperative self-financing through member contributions Private buyers/exporters supporting quality improvement (coffee/tea sectors)
	MCopper Ltd	Fabricates metallic and ultra-violet (UV) tent dryers	
	University-based innovators (Egerton University, Jomo Kenyatta University of Science and Technology	Promotes community solar dryers	
	Dryland Natural Resource Center (DNRC)	Provide low-cost solar dryer prototypes to cooperatives	
	County governments	Often procure from local fabricators (Bungoma, Kakamega)	
Solar cold storage (cold rooms, milk coolers, packhouse cooling)	Solar Freeze	Popular small-scale mobile cold rooms; strong in Western and Rift	Village Capital, Shell Foundation, Mercy Corps Agrifin (pilots and grants) County governments (Nakuru, Uasin Gishu) IFAD, WFP, FAO (packhouse and cold-chain projects) Pay-as-you-store models (ColdHubs: farmers pay per crate per day)
	ColdHubs	Large solar cold rooms for cooperatives and markets	
	Savanna Circuit Technologies	Solar-powered milk coolers used in Nakuru, Uasin Gishu	
	Aceleron and Powerhive-integrated solutions	Solar- and battery-refrigerated rooms	
	Davis & Shirtliff	Integrated solar refrigeration for markets and cooperatives	

2.4 RA-PURE Nexus: Evidence, Gaps, and Opportunities

The literature indicates that RA and PURE initiatives are often implemented in parallel rather than in an integrated manner. Few studies document the deliberate bundling of regenerative farming practices with renewable energy solutions. When integration occurs, such as biodigesters producing bioslurry for soil fertility or solar irrigation supporting diversified cropping, it is typically driven by externally funded pilot projects rather than by systemic adoption.

The RA-PURE nexus remains nascent: there is clear potential for renewable-energy-enabled RA to raise productivity, reduce post-harvest losses, and restore soils, yet current integration is low. Empirical evidence points to very limited RA uptake overall (only ~0.5% of farms in the sampled population by Mulupi et al. (2025) achieving high RA implementation), and PURE technologies such as solar irrigation and biodigesters exist mostly as isolated pilots rather than as scaled, integrated solutions. Structural constraints, including technical, financial, and institutional factors, are the primary reasons for the gap between potential and practice. Nonetheless, targeted interventions (subsidies, blended finance, capacity building, and business model innovation) can unlock rapid progress (Ngowa et al., 2024; Silva et al., 2019).

Low RA uptake: Quantitative studies by Mulupi et al. (2025) show that only a very small share of farms implement multiple RA practices (cover cropping, crop rotation, composting, integrated livestock-crop systems) at scale. This weak uptake reduces the absorptive demand for PURE technologies that would amplify RA benefits (e.g., biodigester bioslurry used as a fertiliser). Existing PURE pilots: Field evidence shows solar pumps, solar dryers, small solar cold rooms, micro solar mills, and biodigesters being trialled in counties such as Nakuru, Uasin Gishu, Kericho, Bungoma, and Kakamega. However, these projects rarely link explicitly to RA practices or soil-health interventions.

Technology promise: Solar irrigation can enable timely water delivery for diversified cropping and reduced-tillage systems. Biodigesters convert livestock waste into energy while producing bioslurry for organic soil fertility, with high synergy potential documented by Silva et al. (2019). Policy and programme guidance: Recent analyses (Ngowa et al., 2024) recommend integrated, context-specific packages that combine training, finance, and market linkages to scale RA-PURE.

The literature indicates that RA and PURE are largely implemented in parallel rather than as integrated systems. When integration occurs, such as biodigesters producing bioslurry for soil fertility or solar irrigation supporting diversified cropping, it is typically driven by externally funded pilot projects rather than by widespread, system-level adoption. Overall, the RA-PURE nexus remains nascent. While renewable-energy-enabled RA has clear potential to improve productivity, enhance soil health, and reduce post-harvest losses, current levels of integration and adoption remain low. Empirical evidence indicates limited uptake of comprehensive RA practices, with only a small proportion of farms implementing multiple practices at scale (Mulupi et al., 2025). Similarly, PURE technologies such as solar irrigation and biodigesters are often deployed as standalone interventions rather than as part of integrated systems (Silva et al., 2019; Ngowa et al., 2024).

This gap between potential and practice stems from structural constraints, including limited technical capacity, weak extension systems, inadequate financing mechanisms, and fragmented policy and institutional frameworks. Consequently, farmers lack the skills, resources, and coordinated support required to adopt and sustain integrated RA-PURE solutions at scale.

Table 2.3 illustrates how these dynamics manifest across the study counties, highlighting variations in integration levels, existing practices, technologies in use, and key constraints. While regenerative agricultural practices are relatively more established in several counties, integration with renewable energy technologies remains limited and uneven, with common barriers including high costs, limited technical capacity, weak extension support, and financing gaps.

Despite these challenges, the literature highlights clear opportunities to accelerate integration. Targeted interventions, including blended finance models, capacity building for farmers and service providers, and the development of integrated delivery models, can help bridge the gap. In particular, demonstration-based approaches, strengthened local service ecosystems, and improved alignment between agricultural and energy policies are critical to unlocking the full potential of the RA-PURE nexus.

Table 2.3 RA-PURE County Matrix

County	Status of RA-PURE Integration	Current RA Practices	PURE Technologies in Use	Key Constraints	Opportunities
Nakuru	Early but growing; <1% high RA adoption	Conservation tillage, agroforestry, manure use	Solar pumps, dryers, biogas, cold storage	Low skills, high cost, limited extension	High solar potential, dairy/ horticulture value chains
Nandi	Low integration; moderate biogas	Intercropping, rotational grazing, organic inputs	Household biogas, limited solar dryers	Low awareness, weak cooperative investment	Tea/dairy waste-to-energy, RA soil training
Kericho	Low RA adoption; estates use some RE	Contour farming, agroforestry, soil conservation	Solar (photovoltaic) PV, biogas, limited dryers	High cost, weak farmer RA skills	Strong cooperatives, hybrid tea factory systems
Uasin Gishu	Low RA; PURE limited to dairy/ horticulture	Crop rotation, manure incorporation	Biogas, solar irrigation, dryers	Mechanization reliance, low RE investment	Biogas scaling, solar milling
Busia	Active pilots but fragmented	Agroecology, mulching, indigenous crops	Solar irrigation, cold storage, dryers	Maintenance issues, low financing	Solar fish value chain, youth agribusiness
Bungoma	Moderate RA and PURE uptake	Agroforestry, compost, indigenous seeds	Solar dryers, biogas, milling	Poor servicing, limited financing	Solar dryers, dairy cooperative biogas
Kakamega	Strong RA networks, low PURE	Conservation agriculture, agroforestry	Solar dryers, cold rooms, pumps, biogas	Weak value chains, lack of incentives	Solar cooling/ drying, strong groups

2.5 Regional and County-Level Analysis

Distinct regional patterns in the adoption and integration of RA and PURE across the Rift Valley and Western Kenya, reflecting differences in institutional capacity, dominant value chains, and infrastructure development.

Rift Valley: Among Rift Valley counties, Nakuru shows relatively stronger engagement with renewable energy applications in agriculture, including solar irrigation, cold storage, and energy-enabled processing linked to horticultural and dairy systems. This suggests a comparatively enabling institutional environment for advancing integrated RA-PURE approaches.

In Uasin Gishu, PURE adoption is more moderate and concentrated around biogas systems in dairy production. While integration of regenerative practices remains limited, ongoing training and extension initiatives provide entry points to strengthen the RA-PURE nexus through cooperative-based models.

Nandi and Kericho show comparatively lower adoption of integrated systems. Renewable energy use exists but is largely concentrated at institutional or commercial scales, such as tea estates, with limited diffusion to smallholder farming systems.

Western Kenya: Busia, Bungoma, and Kakamega show stronger engagement with agroecological and soil conservation practices, often driven by NGOs and CBOs. Practices such as composting, agroforestry, and conservation agriculture are relatively widespread. However, PURE technologies, including solar dryers and small-scale irrigation, remain fragmented and largely confined to pilot initiatives, with limited integration into broader farming systems.

The regional analysis highlights uneven progress in integrating RA-PURE, underscoring the need for context-specific strategies that build on existing institutional and technological strengths while addressing local constraints.

2.6 Value Chains and Market Systems Analysis

Table 2.4 presents the dominant agricultural value chains across the study counties, illustrating the economic context in which RA-PURE integration can be developed. The data show clear variation in production systems, ranging from cereal-dominated systems in Uasin Gishu and Bungoma, to tea-based economies in Kericho and Nandi, to more diversified mixed-farming systems in Kakamega and Busia.

These differences have important implications for the adoption of RA-PURE. Value chains such as dairy, horticulture, and tea offer stronger opportunities for integrating renewable energy technologies, particularly irrigation, processing, and cooling, while staple crop systems may require different entry points focused on soil health, water access, and post-harvest management.

Table 2.4 Dominant agricultural value chains by county

County	Value Chains
Kakamega	• Mixed food and cash crops: maize, sugarcane, beans, cassava, bananas, and vegetables dominate smallholder systems. • Livestock, especially dairy and poultry, integrated with crop farming. • The National Agricultural Value Chain Development Project (NAVCDP) also highlights dairy, indigenous chicken, avocado, bananas, and apiculture as priority value chains.
Nakuru	• Diverse cropping including maize, beans, Irish potatoes, horticulture (tomatoes, vegetables), and fruit trees. • Dairy and aquaculture value chains (fish) are noted in prioritisation frameworks like the Agricultural Sector Development Support Programme (ASDSP). • Recent NAVCDP rollouts target poultry, fruits (banana, avocado, and mango), vegetables, coffee, cotton, and apiculture.
Kericho	• Tea is the dominant cash crop with substantial processing infrastructure and export orientation. • ASDSP data shows cow milk (dairy), indigenous chicken, and tomato as prioritised value chains. • Livestock production (dairy, goats, poultry) is also significant.
Uasin Gishu	• A national breadbasket: maize and wheat dominate. • Dairy and horticultural produce (vegetables and fruits) are also significant. • Fish farming is present through pond production.
Nandi	• Tea and maize are the dominant crops, supported by significant dairy production. • Upgraded dairy processing infrastructure (ultra-high temperature [UHT] milk processing) and poultry slaughter capacity add value-chain potential.
Bungoma	• Maize is the key staple (one of the top maize-producing counties nationally) with beans, cassava, and vegetables. • Cash crops include sugarcane, coffee, cotton, and sunflower. • Livestock (dairy, poultry) complements crop production.
Busia	• Mixed farming with fish (tilapia, Nile perch), poultry, indigenous chicken, groundnut, maize, beans, and livestock. • Fish and poultry feature prominently as priority chains in national programmes (e.g., ASDSP).

2.7 Energy Bottlenecks Addressable with PURE Technologies

Across the seven counties, energy-related constraints significantly limit agricultural productivity, value addition, and resilience. These bottlenecks occur at multiple stages of the agricultural value chain and present clear entry points for deploying PURE technologies. Irrigation constraints are particularly pronounced, with most staple and horticultural crops still reliant on rain-fed systems. This leaves farmers exposed to high climate risk and yield variability. Solar-powered irrigation offers strong potential to stabilise production and extend growing seasons, especially in counties such as Nakuru, Uasin Gishu, Bungoma, and Kakamega. However, limited mechanisation and access to reliable water sources continue to constrain uptake.

Post-harvest losses represent another critical bottleneck, particularly in dairy, fish, and horticultural value chains. In counties such as Nakuru, Nandi, Kakamega, Kericho, and Uasin Gishu, the lack of cold storage and chilling infrastructure leads to significant spoilage. Similarly, fish value chains in Busia and Nakuru and horticultural systems across multiple counties face losses due to inadequate drying and cooling facilities. Solar-powered cold storage, milk chillers, and dryers offer viable alternatives to improve product quality and marketability.

Constraints on processing and value addition further limit income generation. Key value chains, including maize, groundnuts (Busia), and tomatoes (Kericho and Bungoma), face shortages of affordable processing infrastructure. Renewable energy technologies, such as solar- and biogas-powered systems, can support decentralised milling, oil pressing, and processing, reducing reliance on costly or unreliable grid electricity.

2.8 Value Chains Most Responsive to RA-PURE Integration

Certain value chains align well with regenerative agriculture and the integration of renewable energy. Soil-intensive systems, such as maize and legume crops, benefit from improved soil health through rotational cropping and organic inputs. Diversified horticultural systems are highly responsive to both soil management and irrigation, making them well-suited for integrated RA-PURE approaches.

Livestock-crop systems, particularly dairy systems, offer strong synergies. Manure from dairy systems can support biogas production, while bioslurry enhances soil fertility, creating circular nutrient and energy flows. Aquaculture systems similarly benefit from renewable energy, using solar-powered aeration, pumping, and cold storage to support more efficient and sustainable production.

2.9 Gender, Equity, and Social Inclusion (GESI)

GESI is critical cross-cutting dimensions shaping the adoption and scalability of RA-PURE systems across the study counties. While these approaches are promoted as pathways to climate resilience and productivity, evidence shows that women, youth, and other marginalised groups face persistent structural barriers that limit their effective participation.

Most RA and PURE interventions are not explicitly designed to be inclusive systems. Gender and youth are often treated as beneficiary categories rather than as economic actors within agri-energy value chains. As a result, participation tends to be concentrated among male-headed households and better-resourced farmers, while women, youth, and land-poor households remain marginalised.

2.9.1 Women and Youth in the RA-PURE Economy

Women play a central role in agricultural production, particularly in food crops, horticulture, dairy, and post-harvest handling, yet face constraints in decision-making, asset ownership, and access to finance. Female-headed households are significantly less likely to adopt capital-intensive technologies, such as solar irrigation, biodigesters, and cold storage, due to limited access to credit and insecure land tenure (Mugure et al., 2013; Musafiri et al., 2021). By contrast, women are more likely to adopt low-cost regenerative practices, such as composting and intercropping, which require less capital but increase labour burdens (Mulupi et al., 2025).

Land tenure insecurity further limits women's adoption of long-term practices, such as agroforestry (Ndung'u et al., 2023). Although women dominate post-harvest activities, they rarely control the energy infrastructure, such as dryers, milling equipment, or cold storage, that underpins these value chains. This disconnect between labour contribution and asset ownership constrains their ability to benefit from RA–PURE systems.

Youth participation in agriculture is declining, driven by perceptions of low profitability, limited access to land, and limited exposure to modern technologies (Musundi et al., 2021). However, RA-PURE integration offers opportunities to reposition agriculture as a technology-enabled and commercially viable sector. Despite this potential, youth engagement remains constrained by limited access to land, finance, and skills development pathways, as well as weak linkages to agribusiness and energy-enabled value chains.

2.9.2 Inclusion Gaps and Systemic Barriers

Across counties, inclusion challenges affect land-poor households, informal MSMEs, and other vulnerable groups, who face compounded barriers in finance, skills, and infrastructure access. Informal women- and youth-led enterprises, particularly in processing and trading, continue to rely on biomass energy and manual labour, with limited access to solar-powered technologies due to high upfront costs and a lack of tailored financing.

Institutional and policy gaps further entrench exclusion. Although national frameworks emphasise gender and youth inclusion, implementation at the county level remains uneven.

Key gaps include:

- Limited gender- and youth-responsive financing mechanisms.
- Weak integration of youth into cooperative ownership and governance.
- Lack of disaggregated data to track inclusion outcomes.
- Extension systems that are not tailored to women- and youth-led enterprises.
- Limited incentives for private-sector actors to develop inclusive business models.

2.9.3 Implications for RA-PURE Integration

Without deliberate inclusion strategies, RA-PURE systems risk reinforcing existing inequalities and limiting their scalability. Addressing these gaps requires targeted financing, inclusive co-operative models, tailored extension services, and stronger integration of women and youth as asset owners, entrepreneurs, and decision-makers within value chains.

3 Methodology

3 Methodology

The RA-PURE gap analysis used a mixed-methods approach, combining quantitative and qualitative methods to assess adoption levels, system functionality, and integration gaps across the target counties.

3.1 Study Design and Data Collection

Primary data was collected through:

- Structured household surveys to assess adoption levels, farm characteristics, and access to RA-PURE-related services;
- Key informant interviews (KIIs) with service providers (extension officers, NGOs, government agencies, and development partners) to understand institutional support and service delivery mechanisms;
- KIIs with input and technology suppliers to assess availability and accessibility of RA-PURE inputs and technologies;
- Focus group discussions (FGDs) with farmers to capture perceptions, experiences, and support systems.

Secondary data were drawn from peer-reviewed studies, policy documents, programme reports, and grey literature, focusing on RA and PURE initiatives in Kenya (2015-2025).

3.2 Sampling Approach

A purposive sampling approach was applied, focusing on farmers participating in farmer field schools under the Power for Food Partnership project. Data collection was conducted in selected sub-counties across the seven target counties to ensure alignment with programme geographies. Respondents were identified through learning partners and county focal persons.

For KIIs, a snowball sampling approach was used to identify additional stakeholders engaged in RA, PURE, or both.

3.3 Data Collection and Processing

Data collection was conducted in February-March 2026 using digital tools hosted on KoboToolbox. Enumerators were trained to ensure consistency, accuracy, and ethical compliance. Data was uploaded in real time or near real time, followed by validation and cleaning processes, including consistency checks and removal of incomplete or duplicate entries.

3.4 Data Analysis

Quantitative data from household surveys were analysed using descriptive statistics (frequencies, percentages, and cross-tabulations). Qualitative data from KIIs and FGDs were analysed thematically to identify recurring patterns, constraints, and opportunities. Integration of both datasets enabled triangulation and strengthened the robustness of the analysis.

3.5 Coverage Summary

A summary of the study coverage is presented in Table 3.1 and Figure 3.1. The study covered seven counties and 21 sub-counties, including 320 household farmers, 113 service providers, and 104 suppliers. The sample distribution was designed to capture diversity in agro-ecological conditions, service delivery systems, and market access across counties, ensuring representation of both high-performing and emerging adoption contexts.

Table 3.1 Data Collection Sample Distribution

County	Household Farmers	KII Service Providers	KII Suppliers	Total
Bungoma	45	18	17	**80**
Busia	45	13	9	**67**
Kakamega	44	13	15	**72**
Kericho	45	16	15	**76**
Nakuru	46	21	17	**84**
Nandi	50	16	16	**82**
Uasin Gishu	45	16	15	**76**
TOTAL	**320**	**113**	**104**	**537**

The sample distribution was designed to capture diversity in agro-ecological zones, service delivery systems, and market access conditions across the counties. This ensured that the findings reflect both high-performing and emerging adoption contexts within the RA-PURE ecosystem.

3.6 Data Analysis Framework

The analysis used a structured comparative framework to assess gaps between observed field conditions and benchmarks derived from the literature, programme design assumptions, and established best practices. The framework followed a three-step process: first, defining benchmarks for expected levels of RA-PURE adoption, service access, and system performance; second,

Figure 3.1 Gap Analysis Sample Data Distribution

537 Total number of respondents

320	113	104
Household Farmers	Service Providers	Suppliers

Bungoma

Household Farmers	KII Service Providers	KII Suppliers	Total
45	18	17	**80**

Busia

Household Farmers	KII Service Providers	KII Suppliers	Total
45	13	9	**67**

Kakamega

Household Farmers	KII Service Providers	KII Suppliers	Total
44	13	15	**72**

Uasin Gishu

Household Farmers	KII Service Providers	KII Suppliers	Total
45	16	15	**76**

Nandi

Household Farmers	KII Service Providers	KII Suppliers	Total
50	16	16	**82**

Nakuru

Household Farmers	KII Service Providers	KII Suppliers	Total
46	21	17	**84**

Kericho

Household Farmers	KII Service Providers	KII Suppliers	Total
45	16	15	**76**

conducting an empirical assessment using quantitative and qualitative data to establish actual on-the-ground conditions; and third, identifying gaps by comparing observed outcomes with these benchmarks.

The identified gaps were categorised into key thematic areas, including adoption, access, service delivery, market and system performance, institutional and policy alignment, and gender and inclusion. Findings were triangulated among farmers, service providers, and suppliers to ensure consistency and enhance the reliability of the analysis.

3.7 Limitations of the Study

While the RA-PURE Gap Analysis provides a comprehensive overview of the current landscape, several limitations should be considered when interpreting the findings. The study was conducted under time and resource constraints, which affected sample size and geographic coverage.

Although it covered seven counties, the sample may not fully capture micro-level variations within sub-counties or the full diversity of farming systems. In some cases, the number of respondents, particularly among suppliers and service providers, was relatively small, limiting the extent to which the findings can be generalised.

The analysis also relied partly on self-reported data, which may be subject to recall and response bias. In addition, the assessment is a snapshot in time (February to March 2026), and findings may vary with seasonal conditions, market dynamics, and climatic factors.

Some system-level dynamics, such as institutional coordination and supply chain performance, were explored primarily through qualitative insights rather than fully quantified metrics. Furthermore, variations in agro-ecological conditions, infrastructure, and market access across counties limit direct comparability, necessitating context-specific interpretation of the results.

Despite these limitations, the study provides a robust, evidence-based foundation for programme design and highlights areas for further validation and adaptive learning during implementation.

Gap Analysis Findings and Discussion

4

4 Gap Analysis Findings and Discussion

4.1 Household Profile

The household survey captured a broadly representative sample across the seven target counties. In total, 320 household farmers were interviewed, comprising 62% women and 38% men, as expected, since more women than men participate in farmer groups. Table 4.1 summarises the key demographic characteristics. The respondent profile reflects a predominantly smallholder and relatively experienced farming population. Most farmers (74%) fall within the 36-64 years age range, with youth comprising only 16%, indicating limited youth participation and hence a need to intentionally craft ways to enhance their participation. Education levels are moderate, with the majority having attained primary or secondary education, which would be instrumental in supporting the uptake of improved practices.

Table 4.1 Household Demographics

Characteristic	Finding
Gender	62% Women, 38% Men
Age group (majority)	18-35 (16%), 36-45 (36%), 46-64 (38%), Above 65 (9%)
Education (majority)	Secondary (39%) or Primary (34%)
Household head	63% are household heads
Farmer group membership	76% belong to a farmer group
Land size	52% farm 1–3 acres; 35% farm less than 1 acre
Land ownership	55% own titled land, 42% use family land
Farm decision-maker	40% men, 34% joint, 26% women

Land access is relatively secure, with most farmers operating on owned or family land, which is very important for investing in RA-PURE technologies without fear of losing the established investments when leases expire. They are predominantly smallholder farmers, where 87% have land sizes below 3 acres.

87%
Farmers with less than 3 acres

Generally, in Kenya, the Ministry of Agriculture and Livestock Development classifies smallholder farmers as those working on land ranging from 0.5 to 5.0 acres, though others cite up to 10 acres. High levels of farmer group membership (76%) highlight strong social organisation, providing an important platform for extension, training, and collective action, consistent with evidence that group participation and access to information are key enablers of adoption.

Decision-making is balanced, with 40% male-led, 34% joint, and 26% female-led, indicating opportunities for gender-responsive programming. However, gender distribution varies by county, with Nandi (56% male) and Uasin Gishu (64% male), while Busia (80% female) and Nakuru (74% female).

These dynamics highlight the need to tailor engagement strategies to local gender realities, ensuring that interventions reach and influence the actual farm decision-makers and adopters.

4.2 Regenerative Agriculture (RA)

4.2.1 Farm Production Systems and RA Practice Adoption

Current RA Practice Adoption: Across all seven counties, regenerative agricultural practices are widely adopted, with less than 1% of household respondents reporting no use of RA practices (Table 4.2). This confirms that RA is not new to farmers in the study areas but rather a set of practices already embedded within existing farming systems, though applied at varying levels of intensity. Determining this intensity is important, as it affects soil conditions and, consequently, productivity. Understanding the depth and consistency of this application is therefore critical, as the intensity of RA practices directly shapes soil health outcomes and, ultimately, agricultural productivity.

>99%
Households practicing RA

While many RA practices have been adopted, three stand out as the most widely adopted: compost/manure application (79%), intercropping (74%), and crop rotation (73%). Their consistently high uptake across counties highlights their accessibility, low cost, and alignment with existing farmers' knowledge. This is particularly important for programme design, as it suggests that scaling efforts can build on practices that farmers are already familiar with and may prefer. Evidence from the literature similarly shows that farmers tend to adopt individual, low-cost practices, such as manure use and crop rotation, before transitioning to more integrated regenerative systems.

Beyond these core practices, adoption declines among more knowledge- or resource-intensive interventions. Mulching (54%), agroforestry (34%), conservation tillage (26%), and bioslurry (7%) show significantly lower uptake. This pattern reflects well-documented constraints, including labour requirements, access to inputs, and technical knowledge gaps continue to limit deeper and more integrated RA adoption. It also indicates that although awareness of RA exists, the transition towards comprehensive, system-based practices remains incomplete.

Table 4.2 Distribution of Regenerative Agriculture Practice Adoption Across Study Counties

RA Practice	Overall	Bungoma	Busia	Kakamega	Kericho	Nakuru	Nandi	Uasin Gishu
Compost / Manure	**79%**	89%	96%	95%	49%	78%	94%	51%
Intercropping	**74%**	71%	91%	80%	93%	65%	72%	47%
Crop Rotation	**73%**	96%	80%	75%	38%	61%	72%	89%
Mulching	**54%**	76%	42%	73%	27%	52%	80%	29%
Agroforestry	**34%**	44%	13%	64%	38%	33%	32%	13%
Conservation Tillage	**26%**	31%	13%	43%	22%	26%	36%	7%
Commercial Organic	**12%**	18%	2%	2%	47%	4%	4%	4%
Bioslurry	**7%**	4%	0%	5%	0%	0%	34%	0%

County-level variations further underscore the importance of context-specific programming. Kakamega, Nandi, and Bungoma show the highest RA intensity, with farmers adopting a broader mix of practices. Kakamega, for instance, has strong uptake across multiple practices, including agroforestry, while Nandi stands out for mulching and bioslurry use, likely linked to its crop-livestock systems.

By contrast, Kericho and Uasin Gishu record the lowest RA intensity, though for different reasons. Kericho farmers exhibit high intercropping and use of commercial organic inputs, reflecting tea-based systems, while Uasin Gishu farmers rely more heavily on crop rotation within relatively larger-scale production systems. These differences highlight that RA adoption is shaped by local production systems and value chains, reinforcing the need for tailored interventions rather than a one-size-fits-all approach.

Biogas adoption remains notably low across most counties, despite its strong alignment with the RA-PURE nexus. This represents a missed opportunity, as biogas systems provide a dual benefit: they generate clean energy for productive uses such as brooding, milk heating, and small-scale processing, while also producing bioslurry, a high-quality organic input that supports soil fertility and regenerative agriculture. However, purposive sampling may have influenced the results.

The finding is nevertheless consistent with the literature review, which highlights that although biogas systems are recognised for their dual benefits in energy provision and soil fertility enhancement, uptake remains limited due to high upfront costs, knowledge gaps, and weak financing mechanisms.

Strengthening uptake will therefore require targeted measures, including improved access to finance, greater farmer awareness, and integration into bundled RA-PURE solutions.

Promoting biogas as both an energy and soil health intervention could significantly enhance the effectiveness and sustainability of integrated RA-PURE systems.

Overall, the findings suggest that although most farmers already practise RA, it is largely partial or unintegrated. This aligns with broader evidence that comprehensive adoption of regenerative agriculture remains limited, even where individual practices are common. The key opportunity, therefore, lies in deepening and integrating existing practices rather than introducing entirely new ones.

This is further reflected in the variation in RA intensity across counties: Kakamega leads with an average of 4.3 practices per farmer, followed by Nandi (4.2) and Bungoma (4.1), while Kericho (2.7) and Uasin Gishu (2.4) record the lowest intensity. These patterns reinforce the need for targeted, context-specific strategies that not only increase the number of practices adopted but also strengthen their integration, particularly through complementary energy solutions under the RA-PURE approach.

Cropping Systems

Cropping systems further reinforce these entry points. Maize and beans are the dominant staple crops across all counties, complemented by vegetable, dairy, and poultry enterprises. Among vegetable growers, kale (sukuma wiki) is the most prevalent (56%), followed by black nightshade (managu) at 30%, cowpeas (18%), cabbage (16%), and spinach (13%), with others such as spider plant (sagaa) and jute mallow (mrenda) also present, particularly in Bungoma, Busia, and Kakamega.

These crops are well-suited to intercropping and soil-based regenerative practices, making them strong candidates for demonstration plots and field trials. Their widespread adoption provides a practical and scalable foundation for introducing more integrated RA-PURE interventions.

4.2.2 Agricultural Production Challenges and Implications for RA-PURE Interventions

Drought emerges as the dominant climate-related challenge across all seven counties, cited by 83% of respondents, followed by pests and diseases (58%) and erratic rainfall (53%), as shown in Table 4.3. Soil degradation is reported by 22% of households, while flooding remains a relatively minor concern (5%). These findings highlight a production environment characterised by persistent water stress, biological pressures, and increasing climatic unpredictability.

The high prevalence of drought across all counties underscores a structural dependence on rain-fed agriculture and the growing vulnerability of smallholder systems to climate variability. This aligns with existing evidence in the Kenyan context, particularly in the Rift Valley and Western regions, where prolonged dry spells and erratic rainfall patterns are consistently identified as major constraints to agricultural productivity. While RA practices such as mulching, intercropping, and soil cover management can improve soil moisture retention and enhance resilience over time, their effectiveness is inherently limited without reliable access to water.

Table 4.3 Key Agricultural Production Challenges Reported by Household Farmers

Climate Challenge	% of Household Respondents
Drought	83%
Pests and Diseases	58%
Erratic Rainfall	53%
Soil Degradation	22%
Flooding	5%

Erratic rainfall, reported by more than half of households (53%), further reinforces the limitations of rain-fed systems and the growing unpredictability of planting and harvesting cycles. Together with drought, this points to a systemic production risk that cannot be addressed by agronomic practices alone. Instead, it calls for integrating energy-enabled solutions to support water access, stabilise production, and enable more consistent crop performance.

Pests and diseases, cited by 58% of respondents, reflect the growing pressure of climate-induced biological stressors. These challenges are increasingly associated with changing temperature and rainfall patterns, which influence pest lifecycles and disease prevalence. This reinforces the need for integrated approaches that combine soil health improvement, crop diversification, and resilient farming systems, core principles of regenerative agriculture.

Although reported by a smaller proportion of respondents (22%), soil degradation remains a critical underlying constraint, directly affecting productivity, water retention, and long-term land sustainability. This aligns with broader evidence linking declining soil fertility in Kenya to continuous cultivation, inadequate replenishment of organic matter, and unsustainable land management practices. Strengthening regenerative practices is therefore essential not only for immediate productivity gains but also for restoring soil function and long-term system resilience.

These findings indicate that climate-related challenges are both immediate and systemic, requiring integrated solutions that address water access, soil health, and production stability. This provides a strong rationale for the RA-PURE approach, in which renewable energy technologies, particularly solar-powered irrigation, are critical enablers of climate-resilient regenerative agricultural systems. Solar-powered irrigation can provide reliable access to water during dry periods, reduce dependence on rainfall, support year-round production, and enhance the effectiveness of RA practices.

During programme implementation, these integrated solutions can be operationalised through structured field-based learning approaches. For example, mother-and-baby trial designs enable the evaluation of solar-powered irrigation alongside complementary RA practices such as mulching, intercropping, and soil cover management. While mother trials can generate controlled evidence on optimal water use and agronomic performance, baby trials allow farmers to test simplified versions under real-world conditions, thereby facilitating participatory learning, adaptation, and peer-to-peer knowledge exchange. Such approaches are critical for validating integrated RA-PURE solutions and accelerating their adoption at scale.

4.2.3 Perceived Impacts of Regenerative Agriculture Practices

Among farmers who practise RA, self-reported benefits are overwhelmingly positive (Table 4.4). Improved soil fertility is the most commonly reported benefit (84%), followed by increased crop yields (78%) and improved household food security (53%). These findings reinforce RA's central role in enhancing productivity and resilience at the farm level.

The 98% rate of perceived positive impact (with only 1% reporting no change and 2% not practising RA) is a significant enabler for programme design. Farmers already believe in RA. The challenge is not awareness but scaling and deepening practice, particularly in energy-enhanced combinations.

Table 4.4 Reported Benefits of Regenerative Agriculture Practices

Reported RA Benefit	% of Household Respondents
Improved soil fertility	84%
Increased crop yields	78%
Improved food security	53%
Increased incomes and profits	49%
Improved moisture retention/ drought resilience	36%
Reduced production costs	36%
No noticeable change	1%
Not applicable (do not practice RA)	2%

4.2.4 Barriers to Adoption and Scaling of Regenerative Agriculture

Despite the widespread uptake of regenerative agriculture practices, several key barriers continue to limit the depth, consistency, and scalability of adoption, as outlined in Table 4.5. Cost is the leading constraint, cited by 35% of respondents, followed by labour requirements (22%) and lack of knowledge (20%). These findings suggest that while awareness of RA is relatively high, farmers' ability to fully implement and sustain these practices remains constrained by resource and capacity limitations.

The prominence of cost as a barrier underscores the financial burden of transitioning from conventional to regenerative systems, particularly where practices require upfront investment in inputs, labour, or time before benefits are realised. This aligns with findings from the literature, which identify limited access to affordable finance and high upfront costs as key constraints to the adoption of both regenerative agriculture and associated technologies in rural Kenya.

Table 4.5 Key Barriers to Adoption of Regenerative Agriculture Practices

Barrier	Frequency
Cost	35%
Labour	22%
Knowledge	20%
Access /Availability of inputs	8%
Land	7%
Water	6%

Labour constraints further reflect the practical challenges of implementing RA practices such as mulching, composting, and agroforestry, which can be labour-intensive, particularly in smallholder systems with limited household labour. At the same time, persistent knowledge gaps, despite relatively high awareness, suggest that farmers may be familiar with RA concepts but lack the technical depth needed for effective, sustained application. The literature likewise emphasises the critical role of extension services, training, and farmer-to-farmer learning in enabling adoption and improving outcomes.

Barriers related to access to inputs, land, and water, though cited less frequently, remain important structural constraints. Limited access to organic inputs, insecure land tenure, and water scarcity can all constrain farmers' ability to invest in and sustain regenerative practices. These challenges are also reflected in broader Kenyan and regional studies, which emphasise the importance of institutional support systems, secure land tenure, and access to natural resources in shaping adoption decisions.

Gender dynamics also play an important role in shaping adoption. Women, who make up a significant proportion of farmer group members and are often directly involved in day-to-day farm management, may face additional constraints in accessing credit, land ownership, labour, and decision-making authority. These factors can limit their ability to adopt more resource-intensive RA practices. Addressing these disparities through targeted financing, inclusive training approaches, and engagement strategies that reach both men and women decision-makers can significantly enhance adoption and ensure more equitable outcomes in RA-PURE interventions.

Thus, the primary challenge is not whether farmers are aware of or interested in regenerative agriculture, but whether they are sufficiently supported to adopt it at scale and in an integrated manner. Addressing these barriers will require coordinated approaches that combine access to finance, technical training, availability of inputs, and enabling institutional frameworks, particularly when linking RA with energy solutions under the RA-PURE approach.

From an implementation perspective, these constraints have direct implications for the adoption of RA and PURE technologies. Cost and labour barriers, for instance, can be partially addressed by integrating labour-saving and efficiency-enhancing technologies such as solar-powered irrigation systems, which reduce manual effort for watering while improving the reliability of water access. However, such technologies also entail upfront capital costs, reinforcing the need for financial mechanisms such as subsidies, credit facilities, group financing models, or pay-as-you-go systems to improve affordability.

Knowledge-related barriers underscore the importance of hands-on, experiential learning over conventional training alone. In this context, mother and baby trials are particularly relevant. Through mother trials, farmers and extension actors can demonstrate correct RA practices, including input application, spacing, irrigation scheduling, and integration with PURE technologies, under controlled, well-managed conditions. These trials serve as learning hubs where farmers observe best practices, compare outcomes, and understand the technical aspects of implementation. In baby trials, farmers apply these practices on their own farms, adapting them to their resource constraints and local conditions. This approach helps bridge the knowledge gap through experiential learning, peer exchange, and continuous feedback. It also enables farmers to gradually build confidence and competence in managing RA systems, including the use of inputs, labour allocation, and water management technologies.

Access to inputs, land limitations, and water availability further reinforce the need for ecosystem-level interventions. These include strengthening supply chains for RA inputs (such as quality seeds, organic amendments, and biological inputs), promoting efficient land-use practices such as intercropping and intensification, and integrating water-smart solutions.

The analysis underscores that successful scaling of RA and PURE systems requires a holistic approach that integrates financial inclusion, technical capacity building, access to inputs, and appropriate technologies. Rather than focusing solely on awareness-raising, interventions should prioritise integrated support models that reduce cost burdens, alleviate labour intensity, enhance knowledge through practical learning platforms, and improve access to essential production resources.

4.3 Productive Use of Renewable Energy (PURE)

4.3.1 Energy Access and Sources Among Household Farmers

Most households across the seven counties have access to some form of energy. Grid electricity (59%) and solar (53%) are the two dominant sources, while biogas adoption remains limited overall (6%). Wind energy is almost entirely absent (0.6%), as shown in Table 4.6.

Solar energy exhibits the most pronounced geographic variation. Adoption is highest in Busia (89%), Bungoma (78%), and Kakamega (70%), indicating strong penetration in Western Kenya, where off-grid or unreliable grid conditions make decentralised solar solutions more attractive. In contrast, uptake is lowest in Uasin Gishu (18%) and relatively low in Kericho (36%) and Nandi (36%), suggesting that solar is less prioritised in areas with stronger grid connectivity or different farming system dynamics.

From an RA-PURE perspective, these patterns present a clear opportunity. High solar penetration in Western counties provides a strong foundation for scaling up solar-powered irrigation, directly addressing the widespread challenge of drought and erratic rainfall. Leveraging existing solar infrastructure for productive uses can significantly enhance the impact of regenerative agriculture by improving water access, stabilising yields, and enabling year-round production.

Table 4.6 Household Energy Access by Source and County

County	Grid Electricity	Solar	Biogas
Bungoma	36%	78%	4%
Busia	53%	89%	0%
Kakamega	59%	70%	5%
Kericho	69%	36%	0%
Nakuru	59%	48%	2%
Nandi	74%	36%	26%
Uasin Gishu	64%	18%	0%
Overall	**59%**	**53%**	**6%**

Biogas adoption remains generally low across counties, with a notable exception in Nandi (26%), which stands out as a clear outlier. In all other counties, adoption ranges from 0% to 5%, indicating minimal uptake. The relatively higher adoption in Nandi is likely linked to its livestock-based farming systems, which provide the organic feedstock required for biogas production.

This has significant implications for RA-PURE integration. Biogas systems offer a dual advantage: they provide clean energy for productive uses such as brooding, milk heating, and small-scale processing, while generating bioslurry that can serve as an organic soil input. The low uptake across most counties indicates a missed opportunity to strengthen soil fertility management alongside energy access. Expanding biogas adoption, particularly in livestock-rich systems, could therefore play a critical role in deepening the integration of energy and regenerative agricultural practices.

These patterns align with the literature, which indicates that renewable energy adoption in Kenya is shaped by infrastructure availability, agro-ecological conditions, and livelihood systems. Technologies such as solar tend to scale rapidly in off-grid contexts, whereas biogas adoption is closely linked to livestock ownership and system integration.

4.3.2 Agricultural Energy Use and Implications for RA-PURE Integration

Despite relatively widespread access to energy, the productive use of energy in agriculture remains minimal. The vast majority of households (85%) use energy primarily for lighting, while 68% use it for home appliances such as televisions and radios (Table 4.7). By contrast, energy use for agricultural production is strikingly low.

The dominant use of energy for non-productive purposes is the most critical gap in the RA-PURE landscape. Although energy infrastructure is present in many households, it is not yet oriented towards agricultural productivity. This is particularly evident with solar energy, which, despite relatively high adoption in several counties, is used primarily for basic household needs rather than for productive applications such as irrigation, processing, or cold storage.

This gap becomes even more significant when considered alongside earlier findings. While regenerative agriculture practices are widely adopted, their effectiveness, particularly in improving soil moisture and resilience, is constrained by limited access to reliable water. At the same time, 83% of farmers report drought as a major challenge, yet only 15% use energy for irrigation. This highlights a critical disconnect between available energy resources and their potential to enhance agricultural productivity and resilience.

Table 4.7 Household Energy Use by Application

Energy Use	% of Households
Lighting only	85%
Home appliances (TV, radio, etc.)	53%
Cooking	10%
Irrigation	15%
Processing	1%
Cooling / Cold storage	1%
Storage	1%

From an RA-PURE perspective, this is a substantial missed opportunity. Solar energy, already widely available, could be harnessed for irrigation to support water-smart regenerative practices, stabilise yields, and enable year-round production. Similarly, the extremely low use of energy for processing, cooling, and storage (all at 1%) indicates untapped potential for value addition, reduced post-harvest losses, and improved market access.

Biogas offers an additional opportunity for integration, particularly in livestock-based systems. Beyond energy generation, biogas systems produce bioslurry, which can enhance soil fertility and complement regenerative practices. However, given the low uptake across most counties, this potential remains largely unrealised.

System reliability also emerged as a concern; 42% of farmers reported that their energy system had broken down at least once. Of these, 91% had the system repaired, indicating that maintenance services exist but may not be consistently timely or accessible. This underscores the need to strengthen after-sales support, local technician capacity, and service delivery models as part of scaling the productive use of renewable energy.

The findings across RA adoption, energy access, and energy use point to a clear and actionable gap. While both regenerative agricultural practices and energy infrastructure are already in place, they remain largely unconnected in practice. Farmers are implementing RA, but often without the energy inputs needed to maximise productivity and resilience. At the same time, energy is widely available yet underutilised for productive agricultural purposes.

This disconnect defines the core opportunity for the RA-PURE approach. The focus going forward should therefore not be on introducing entirely new technologies or practices, but on strengthening the integration of existing ones, linking energy to agriculture in ways that enhance water access, support value addition, and improve overall system performance.

4.3.3 Energy Challenges

Energy Access Constraints and Implications for Productive Use: High cost is the dominant energy-related challenge, cited by 60% of respondents, followed by unreliable supply (33%), as shown in Table 4.8. In contrast, limited access is reported by only 3% of households, confirming that the primary constraint is not the availability of infrastructure but affordability.

Table 4.8 Key Energy-Related Challenges Reported by Households

Energy Challenge	Frequency
High cost	60%
Unreliable supply	33%
Maintenance challenges	4%
No access	3%

The high cost as a barrier highlights the financial constraints that limit the adoption and productive use of energy technologies, particularly among smallholder farmers. Even where energy infrastructure exists, high upfront investment costs can restrict its use to basic household needs rather than productive agricultural applications. This aligns with broader evidence in the literature identifying affordability and access to finance as key barriers to scaling renewable energy solutions in rural Kenya.

The relatively low proportion of households reporting no access (3%) reflects the significant progress made in expanding energy infrastructure across rural areas. However, this also reinforces that access alone is insufficient. Without affordability and productive use, the developmental impact of energy remains limited.

Only 4% of respondents report maintenance challenges, suggesting that system upkeep is not a major barrier. This may be linked to the types of energy systems in use, which generally require less maintenance. However, it may also reflect the limited use of energy for productive purposes; more complex applications, such as irrigation, processing, or cooling, could introduce higher maintenance demands that need to be considered when scaling RA-PURE interventions.

When asked about the impact of renewable energy on farming, 58% of respondents reported that it was not applicable, either because they do not use energy for agricultural purposes or because their energy use is limited to non-productive applications. Only 13% reported that renewable energy enabled irrigation, and a similar proportion reported increased income from its use.

These findings underscore the need for delivery models that reduce upfront costs, improve financing options, and strengthen service reliability, while also promoting productive applications such as irrigation, processing, and value addition. Redirecting existing energy access towards these uses will be essential to unlocking the full potential of renewable energy to support regenerative agricultural systems.

4.4 RA-PURE Integration

4.4.1 Awareness and Current Adoption of RA-PURE Approaches

RA-PURE awareness is moderately high overall (70%), but varies significantly across counties (Table 4.9). Kakamega leads with 93% awareness, while Kericho lags sharply at just 27%. Despite this relatively strong awareness, actual adoption remains low, with only 17% of households currently using any RA-PURE combination.

A key finding is the significant gap between awareness and adoption. While 70% of farmers are aware of RA-PURE concepts, only 17% have put them into practice. This suggests that the primary barriers lie not in knowledge dissemination but in the practical, financial, and systemic challenges of integrating energy and agriculture at the farm level.

At the county level, notable contrasts offer important insights. Nandi (44%) and Uasin Gishu (31%) stand out for markedly higher adoption rates. In Nandi, this appears to be driven by biogas adoption linked to livestock systems, enabling both energy use and bioslurry application.
These counties illustrate how aligning farming systems with energy technologies can drive integration and present strong opportunities for peer learning and demonstration.

Table 4.9 RA-PURE Awareness and Adoption by County

County	RA-PURE Awareness	RA-PURE Currently Adopted
Bungoma	73%	13%
Busia	62%	4%
Kakamega	93%	18%
Kericho	27%	0%
Nakuru	74%	2%
Nandi	80%	44%
Uasin Gishu	82%	31%
Overall	**70%**	**17%**

In contrast, Kericho stands out as a clear outlier requiring targeted attention. With zero adoption and only 27% awareness, the county's predominantly tea-based farming systems and reliance on commercial inputs suggest that current RA-PURE models and messaging may not align well with local realities. This indicates the need for tailored, value chain-specific approaches, such as tea-compatible regenerative practices and energy solutions to support processing and input management.

4.4.2 Information Channels and Delivery Pathways for RA-PURE

Farmer groups and cooperatives (33%), extension services (30%), and peer-to-peer learning (30%) are the most prominent sources of information on RA-PURE approaches, underscoring the importance of trusted, community-based channels for reaching smallholder farmers (Figure 4.1). Media (25%) and NGOs/projects (22%) also play a valuable role in raising awareness at scale. These channels complement one another, each playing a distinct yet reinforcing role in information dissemination and farmer engagement.

While private companies are less frequently cited (3%), this indicates a missed opportunity to link farmers to input suppliers and technology providers; their presence nonetheless signals an emerging pathway that can be strengthened. Building on this complementarity by deliberately connecting farmer groups and extension systems with private-sector actors will be critical for moving beyond awareness to adoption.

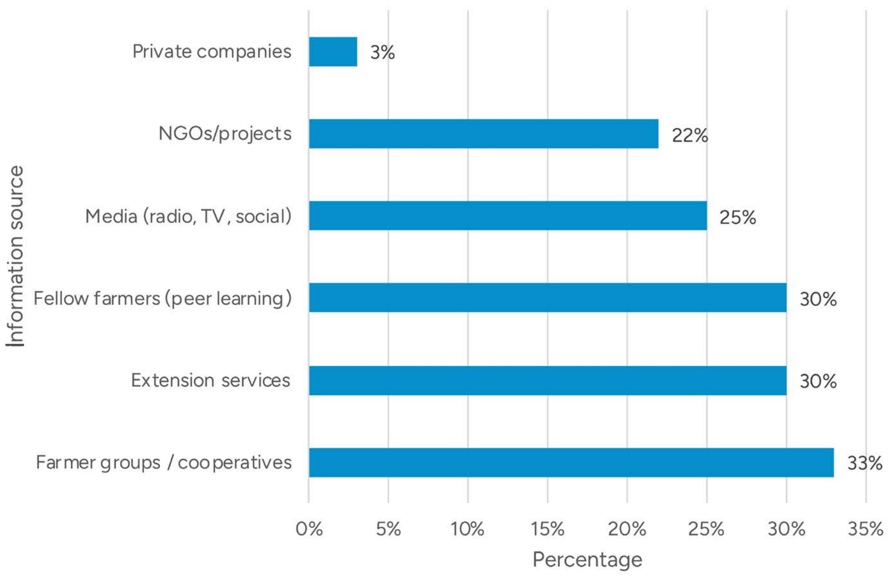


Figure 4.1 Sources of Information on RA-PURE Approaches Among Farmers

4.4.3 Farmer Preferences and Perceived Benefits of RA-PURE Integration

Perceived Benefits of RA-PURE Integration:
When respondents were asked about the perceived benefits of combining RA with energy technologies, their responses indicate a generally positive yet evolving understanding of the value of integrated RA-PURE systems (Table 4.10). The most commonly anticipated benefit was improved productivity (32%), followed by improved soil health (27%) and increased income (23%). Additional perceived benefits included reduced climate risks (19%) and reduced labour costs (10%).

Table 4.10 Perceived Benefits of RA-PURE

Perceived Benefit	% of Respondents
Improved productivity	32%
Improved soil health	27%
Increased income	23%
Reduced climate risks	19%
Reduced labour costs	10%
Not sure	51%

Despite this range of expected benefits, a significant proportion of respondents (51%) were unsure of the advantages of integrating RA and energy technologies. This reflects the relatively low levels of current adoption and limited direct exposure to integrated RA-PURE systems among farmers.

The findings suggest that although there is clear recognition of the potential gains in productivity, soil health, and income, farmers' confidence remains largely based on expectations rather than lived experience. The high level of uncertainty underscores the importance of practical demonstration, experiential learning, and evidence generation to validate these benefits, strengthen farmers' understanding, and support more informed adoption decisions.

4.4.4 Preferred RA-PURE Combinations

Farmer preferences clearly point to a small number of high-potential entry points for RA-PURE integration (Table 4.11). The majority of respondents (69%) prefer combining RA practices with solar-powered irrigation, followed by RA practices combined with biogas (28%). In contrast, very few respondents expressed interest in RA combined with solar drying (2%) or cold storage (<1%).

Table 4.11 Preferred RA-PURE Combinations

RA-PURE Combination	Frequency
RA practices + Solar irrigation	69%
RA practices + Biogas	28%
RA practices + Solar drying	2%
RA practices + Cold storage	<1%

The strong preference for solar irrigation reflects its direct relevance to addressing key production constraints, particularly water access. This aligns closely with the earlier finding that drought affects 83% of households, reinforcing irrigation as a critical intervention for stabilizing production, reducing reliance on rainfall, and enabling year-round cultivation when combined with RA practices.

Interest in biogas highlights its dual role within farming systems. Beyond providing a renewable energy source, biogas systems contribute to soil fertility through bioslurry, making them particularly relevant in livestock-integrated systems and helping to reduce dependence on external inputs.

In contrast, the very low preference for solar drying and cold storage suggests that farmers prioritise solutions addressing production-stage constraints over post-harvest value addition. This may reflect both limited awareness and prevailing market dynamics. In many of the study areas, fresh produce is widely available and preferred by consumers, whereas processed alternatives such as dried vegetables often face limited demand and higher costs. As a result, post-harvest energy solutions may require stronger market linkages, consumer awareness, and viable business models to drive uptake.

Importantly, service providers across all counties independently corroborate these patterns, consistently identifying solar irrigation and biogas as the most viable and demand-driven RA-PURE combinations.

4.4.5 Barriers to RA-PURE Adoption and Implications for Scale

The barriers to RA-PURE adoption are overwhelmingly financial (Table 4.12). High technology costs (71%) and limited access to finance (54%) far outweigh other constraints, indicating that affordability is the primary limiting factor in the uptake of integrated RA-PURE systems.

Lack of technical knowledge (46%) and limited access to energy technologies (34%) are significant constraints. These gaps suggest that even where farmers are willing to adopt, they may lack the practical skills, information, and access needed to implement and sustain integrated systems effectively.

Table 4.12 Key Barriers to RA-PURE Adoption Among Household

Barrier	% of Households
High cost of technologies	71%
Limited access to finance	54%
Lack of technical knowledge	46%
Limited access to energy technologies	34%
Land or water constraints	17%
Not convinced of the benefits	7%

High upfront costs and limited access to finance further reinforce these barriers. For smallholder farmers with constrained cash flows, the capital required for technologies such as solar irrigation or biogas systems can be prohibitive. The absence of accessible financing mechanisms, such as credit, savings groups, or cooperative models, limits farmers' ability to spread costs over time, thereby restricting entry into RA-PURE adoption.

Limited access to technologies also reflects supply-side challenges, including weak distribution networks, inadequate last-mile delivery, and limited availability of after-sales services. Strengthening these systems will be critical to ensuring that interested farmers can access and maintain appropriate technologies. Land and water constraints, cited by 17% of respondents, further affect the feasibility of adoption in certain contexts, particularly where landholdings are small or water resources are scarce.

Notably, only 7% of respondents were unconvinced of the benefits of RA-PURE systems. This confirms that scepticism is not a major barrier; rather, there is strong latent demand that is currently constrained by financial, technical, and access-related challenges. In effect, farmers are willing to adopt, but are unable to do so at scale under existing conditions.

Thus, there is a need for integrated interventions that address affordability, strengthen access to finance, build technical capacity, and improve the availability and delivery of RA-PURE technologies. Given the high level of willingness to adopt, removing these practical constraints will be key to translating demand into sustained uptake.

4.4.6 Farmer Demand and Support Needs for RA-PURE Systems

Despite the barriers identified, demand for RA-PURE systems is exceptionally high. An overwhelming 97% of respondents indicated they would be interested in adopting an RA-PURE system if appropriate support were available. This is one of the strongest signals in the analysis, indicating that willingness to adopt is not the constraint, but rather the enabling conditions are.

When asked about the changes they would most like to see on their farms in the next three to five years, farmers consistently pointed to increased yields and productivity as their primary aspiration. This is closely linked to strong demand for access to solar energy, particularly for solar irrigation pumps and solar panels. Reliable irrigation, biodigesters, access to affordable financing, and stronger market linkages were also frequently cited.

These aspirations reinforce earlier findings on preferred RA-PURE combinations and energy-use gaps. In particular, they confirm that solar-powered irrigation, supported by accessible financing, is the most demand-aligned entry point for the RA-PURE programme. At the same time, interest in biogas signals opportunities for integrated solutions in livestock-based systems, while calls for market linkages indicate the need to strengthen value chains alongside production interventions.

Financing is identified as the most critical support need, cited by 84% of respondents (Table 4.13). This underscores the central role of affordability in enabling adoption, particularly given the high upfront costs of RA-PURE technologies such as solar irrigation systems and biogas digesters. Farmers require access to flexible financing options, including grants, subsidised loans, and PAYGO models, to overcome capital constraints and invest in productive assets.

Table 4.13 Farmer Support Needs for Adoption of RA-PURE Systems

Support Need	% of Interested Respondents
Financing (grants, loans, PAYGO)	84%
Training and extension services	62%
Access to energy technologies	35%
Market linkages	6%

Training and extension services are the second-most-cited need (62%), highlighting the importance of building technical capacity to support proper adoption and sustained use of RA-PURE systems. Farmers require guidance not only on how to operate specific technologies but also on how to integrate them effectively with RA practices. Continuous advisory support is essential to ensure that technologies are used efficiently and deliver the expected benefits.

Access to energy technologies (35%) indicates that availability and distribution remain key considerations. Despite high interest and awareness, adoption can be constrained if appropriate technologies are not accessible via local markets or service providers. Strengthening supply chains, improving last-mile distribution, and expanding partnerships with private-sector actors will be key to addressing this gap. The systems transformation approach will be critical here.

Market linkages, though cited by a smaller proportion of respondents (6%), remain an important enabler of long-term sustainability. The relatively low emphasis suggests that farmers are currently more focused on production constraints than on downstream market opportunities. This may also reflect low current production levels, which limit surplus and associated losses, or farming systems that are not yet strongly market-oriented. As production increases through RA-PURE interventions, the importance of market linkages is likely to grow.

4.5 RA-PURE Supply-Side Landscape

A total of 104 input and technology suppliers were interviewed across the seven counties, providing a complementary perspective on market readiness, product availability, and integration gaps within the RA-PURE ecosystem. While household data highlight strong demand and adoption constraints, the supply-side perspective reveals the market's structure, maturity, and limitations required to meet that demand. This perspective sheds light on market readiness, the availability of technologies and inputs, business models, and existing gaps that may constrain the adoption and scaling of integrated solutions.

4.5.1 Supplier Profile and Business Types

The supplier landscape is dominated by actors focused on RA inputs, with 66% of suppliers dealing in products such as organic fertilisers, compost, and bio-inputs. This reflects a relatively strong and established market for soil health and agronomic inputs, aligning with the widespread adoption of basic RA practices among farmers.

In comparison, only 32% of suppliers offer PURE technologies, including solar systems, biogas units, and agro-processing equipment. This indicates that while the RA input market is relatively mature, the energy technology segment remains underdeveloped and less penetrated. The limited presence of PURE technology providers helps explain the limited integration of energy into agricultural systems, despite reasonable levels of energy access at the household level. Additionally, 44% of suppliers provide advisory or technical services, suggesting that nearly half of the supply ecosystem is engaged not only in product delivery but also in knowledge transfer and farmer support. This is an important enabler, as adopting RA-PURE systems requires access to technologies and the technical capacity to use them effectively.

However, the fact that fewer than half of suppliers provide such services indicates room to strengthen bundled service models that combine inputs, technologies, and advisory support. Notably, fewer than 10% of suppliers offer financing or PAYGO services directly. This represents a critical gap, given that financial constraints are the leading barrier to RA-PURE adoption among farmers. The limited integration of financing within supplier offerings suggests that most businesses operate on a traditional sales model, which may not be accessible to smallholder farmers with limited liquidity.

4.5.2 Supplier Business Maturity and Market Structure

The supplier ecosystem appears active and growing, but it remains evolving in terms of maturity and institutional depth. The largest share of suppliers (36%) has been in operation for between two and five years, indicating a relatively young and dynamic market. This is followed by 27% with 6 to 10 years of experience and 21% with more than 10 years in business, suggesting the presence of some established players with greater experience and stability. Meanwhile, 16% of suppliers are new entrants with fewer than 2 years of operation, indicating continued market entry and expansion.

This distribution reflects a supply-side landscape that is expanding but not yet fully mature. The relatively high proportion of younger businesses suggests innovation and responsiveness to emerging opportunities, particularly in the RA and renewable energy sectors. However, it also implies potential limitations in scale, capitalisation, operational capacity, and long-term sustainability.

Many suppliers may require support to strengthen business operations, expand their reach, and improve service delivery.

4.5.3 Financing Models and Accessibility

Cash transactions dominate the supplier market, with 76% of suppliers relying primarily on upfront payments. This reflects the prevailing market structure but also highlights a key constraint on adoption, as many farmers cannot afford lump-sum payments for technologies such as solar irrigation systems or biogas units. PAYGO models are used by 32% of suppliers and are widely recognised as one of the most accessible and inclusive financing mechanisms. PAYGO allows farmers to make incremental payments over time, reducing the burden of upfront costs. This model is particularly beneficial for women and youth, who often face greater financial constraints and limited access to formal credit but can manage smaller, periodic payments.

Partnered financing arrangements, used by 23% of suppliers, typically involve collaborations with NGOs, cooperatives, or development programmes. These models are particularly effective in group-based contexts, where farmers can pool resources, access subsidised financing, or benefit from collective guarantees. This approach aligns with the prevalence of farmer groups and cooperatives as key institutions in rural areas. Lease and hire-purchase models are currently underutilised, with only 14% of suppliers offering such options. However, these models offer significant opportunities, particularly for higher-cost technologies such as solar-powered irrigation systems, agro-processing equipment, and cold storage solutions. Models that allow farmers to pay for assets over time while using them can bridge the affordability gap and accelerate adoption.

4.5.4 Key Implications

The supply-side analysis highlights several critical insights for programme design. First, there is a clear imbalance between RA inputs and PURE technologies. While RA inputs such as organic fertilisers and bio-inputs are widely accessible, energy technologies remain scarce, limiting the effective integration of energy into agricultural production systems.

Financing remains insufficiently integrated into supplier offerings. The dominance of cash-based transactions constrains adoption, particularly for capital-intensive technologies such as solar irrigation systems and biogas units, which require significant upfront investment. The supplier ecosystem, while active and expanding, is still maturing. Many businesses are relatively young and may lack the capacity, scale, and operational resilience needed to support widespread, sustained adoption of RA-PURE solutions. This points to the need for targeted business development and capacity-strengthening support. At the same time, there are clear opportunities to enhance inclusivity and access through alternative financing models. Mechanisms such as PAYGO, group-based financing, and lease or hire-purchase arrangements offer practical pathways to reduce affordability barriers, particularly for women and youth who often have limited access to upfront capital.

The analysis underscores the importance of delivering bundled solutions. Integrating inputs, energy technologies, advisory services, and financing into comprehensive, coordinated packages can significantly improve adoption rates, ensure the proper use of technologies, and enhance overall impact. Addressing these gaps will be essential to unlocking the full potential of RA-PURE systems and ensuring that farmers' demand is met with accessible, reliable, and well-supported solutions.

4.5.5 Market Trends in Top-Selling RA and PURE Products

The supply-side data reveal clear patterns in the types of products most widely sold across both RA and PURE categories (Table 4.14). On the RA side, organic fertilisers are the leading product (54%), followed by biofertilisers (42%) and biopesticides (35%). On the PURE side, solar irrigation pumps dominate the market (44%), with energy-efficient processing equipment (14%) and biogas digesters (11%) trailing.

Table 4.14 Top-Selling RA and PURE Products among Suppliers

Product Category	Top RA Product	Top PURE Product
Top seller	Organic fertilisers (54%)	Solar irrigation pumps (44%)
2nd seller	Biofertilisers (42%)	Processing equipment (14%)
3rd seller	Biopesticides (35%)	Biogas digesters (11%)

These trends reflect both the current level of market maturity and the immediate priorities of farmers. The dominance of organic fertilisers and biofertilizers on the RA side suggests that soil fertility management remains the primary entry point for regenerative agriculture. These products are relatively accessible, familiar to farmers, and directly linked to improved yields, making them easier to adopt compared to more complex or system-based RA practices. The strong presence of biopesticides further indicates growing awareness of sustainable pest and disease management approaches, particularly in response to increasing pest pressures.

On the PURE side, the prominence of solar irrigation pumps aligns closely with the major climate challenge identified by farmers, drought, and the need for reliable water access. Solar irrigation is a high-impact, productivity-enhancing technology that directly addresses water scarcity while reducing reliance on costly or unreliable energy sources. Its position as the top-selling PURE product suggests that, where energy technologies are adopted, they are driven primarily by immediate production needs rather than post-harvest or value-addition considerations.

The relatively low uptake of processing equipment (14%) and biogas digesters (11%) indicates that energy use beyond primary production remains limited. Processing technologies, while important for value addition and income diversification, may require higher capital investment, stronger market linkages, and more advanced operational capacity. Similarly, biogas adoption often depends on specific conditions such as livestock ownership, availability of organic waste, and technical know-how, which may not be uniformly present across all households.

The product landscape reveals a clear pattern: farmers and markets prioritise solutions that deliver immediate, tangible productivity gains, particularly in crop production and water management. However, the divide between top-selling RA inputs and PURE technologies also reinforces the broader integration gap across the supply chain. Although both categories are active, they are not yet combined into cohesive solutions that maximise synergies among soil health, water management, and energy use.

This presents an opportunity to build on existing market demand by linking high-performing products, such as organic fertilisers and solar irrigation pumps, into integrated packages that address multiple constraints simultaneously. By aligning soil fertility improvements with reliable irrigation, such combinations can enhance productivity, resilience, and resource efficiency, while also creating clearer value propositions for both farmers and suppliers.

4.5.6 Integration Gap and Barriers to Bundled RA-PURE Solutions

The most critical supply-side finding is the near-total absence of integrated RA-PURE product bundles. A majority of suppliers (60%) offer RA and PURE products separately, operating in silos, whereas only 3% regularly provide integrated solutions. This highlights a significant structural gap in the market.

Suppliers cite several reasons for this separation, including differences in customer segments, the technical complexity of integrating systems, and limited internal capacity to design and deliver bundled solutions. This indicates that the challenge is not only market-driven but also rooted in supplier capabilities and business model limitations. Strengthening supplier capacity to develop, package, and deliver integrated RA-PURE offerings is therefore a high-leverage opportunity for intervention. Further insights from suppliers indicate that the barriers to offering integrated solutions closely mirror those reported by farmers.

The most commonly cited constraints include a lack of farmer awareness (72%), high upfront costs (71%), and limited access to financing (60%). Skills and maintenance challenges are reported by 39% of suppliers, while fragmented supply chains are noted by 13%.

The strong convergence of these barriers among farmers, service providers, and suppliers confirms that constraints to RA-PURE integration are systemic rather than isolated. They are driven primarily by affordability, financing gaps, technical capacity, and weak coordination.

4.5.7 Market Uptake and Scale Readiness of Suppliers

On the supply side, the primary reasons for low product uptake closely mirror the barriers identified on the farmer side, reinforcing the systemic nature of the constraints within the RA-PURE ecosystem. Suppliers report that products are often perceived as too expensive (44%), limiting affordability for smallholder farmers and reducing purchase volumes. In addition, 34% of suppliers note that farmers do not fully recognise the value of these products, indicating a gap in awareness, understanding, and demonstrated benefits. This perception challenge is further compounded by a lack of skills and after-sales support (29%), which affects the proper installation, use, and maintenance of technologies, particularly for more complex PURE systems. Limited access to finance on the demand side is also highlighted by 23% of suppliers, underscoring the role of financial constraints in suppressing effective demand.

Despite these challenges, the supply side shows strong readiness to scale. A significant proportion of suppliers (63%) report strong capacity to scale their operations, while a further 32% indicate moderate capacity. This suggests that the majority of suppliers have the infrastructure, networks, or operational capability to expand their reach if market conditions become more favourable. Furthermore, 83% of suppliers describe their businesses as profitable or very profitable, indicating that current operations are financially viable and that there is a commercial incentive to grow. The presence of profitability, combined with stated scale capacity, suggests that the supply side is not a bottleneck in terms of willingness or ability to expand, but rather is constrained by demand-side limitations.

Collaboration also appears to be a key feature of the supply ecosystem. Approximately 63% of suppliers report partnerships with county governments, cooperatives, or non-governmental organisations (NGOs) to promote their products. These partnerships are important channels for market access, trust-building, and farmer engagement. They also provide a platform for bundling services, coordinating outreach, and aligning with broader development programmes.

Such collaborations can help bridge awareness gaps, facilitate demonstrations, and support distribution in areas that may otherwise be hard to reach through purely commercial channels. Product performance in the market is primarily driven by clear economic benefits. Suppliers report that products sell well when farmers can clearly see income gains (61%) or when products are perceived as affordable (56%). This underscores a fundamental principle for RA-PURE adoption: farmers are more likely to invest in technologies and inputs when the return on investment is tangible, immediate, and easy to understand. It also highlights the importance of framing RA-PURE solutions not only in environmental or sustainability terms, but as productivity-enhancing and income-generating investments.

When asked what would make offering integrated RA-PURE solutions commercially attractive, suppliers consistently identified three key enabling conditions. First, increased farmer awareness and demand are essential to create market pull for bundled solutions. Without sufficient understanding of how integrated systems work and the benefits they deliver, farmers are unlikely to demand or invest in such packages. Second, accessible financing for farmers through grants, subsidies, or affordable credit was highlighted as a critical enabler, given the high upfront costs of integrated solutions. Financing mechanisms that reduce initial capital barriers can significantly expand the customer base and improve uptake.

Third, suppliers emphasised the importance of formal partnerships with NGOs and government programmes. Such partnerships help de-risk market entry by providing access to organised farmer groups, co-funding opportunities, and institutional support for outreach and implementation. They also facilitate trust-building and coordination, which are particularly important in rural and emerging markets. In addition, suppliers pointed to demonstrated farmer success stories as a powerful lever for generating demand. Visible, verified examples of successful adoption serve as proof of concept and help overcome scepticism among potential adopters.

Looking ahead, suppliers identified several broader system-level changes that would enable the sustainable scale-up of RA-PURE solutions. These include improved market access, access to affordable credit, and supportive policy frameworks that promote organic farming and regenerative practices. Suppliers linked these enabling conditions directly to improved cash flows, expanded market opportunities, and the overall viability of offering integrated product bundles. Together, these insights suggest that while the supply side is structurally ready to scale, unlocking its full potential will require coordinated efforts to stimulate demand, improve access to finance, and strengthen institutional partnerships that support the delivery of integrated RA-PURE solutions.

4.6 Service Provider Perspectives

A total of 113 service providers, including extension officers, NGO staff, cooperative leaders, and researchers, were interviewed across seven counties. Their perspectives offer an institutional and systems-level understanding of RA-PURE readiness, complementing farmer- and supplier-side insights by highlighting constraints, priorities, and gaps in service delivery, coordination, and resource allocation.

4.6.1 Key Constraints to Productivity and RA-PURE Adoption

Service providers consistently identify a set of cross-cutting constraints that affect both smallholder productivity and the adoption of RA-PURE systems.

Climate variability and drought are the most pressing challenges across all counties, consistent with household findings in which 83% of farmers cited drought as a key constraint. Increasing rainfall variability and prolonged dry spells continue to undermine rain-fed systems, reinforcing the need for water-smart, energy-enabled solutions such as solar irrigation.

High production costs, particularly for inputs and energy technologies, are also widely cited. This reflects broader affordability challenges across households and suppliers, indicating that access to finance and cost reduction will be central to enabling adoption at scale.

Soil health degradation is particularly pronounced in Bungoma, Busia, and Kakamega, where continuous cultivation has reduced soil fertility. This underscores the need to strengthen regenerative practices, particularly organic soil management, to restore productivity.

Market access and price volatility are reported in Bungoma, Nandi, and Nakuru, limiting farmers' willingness to invest in productivity-enhancing technologies. Improving market linkages and price stability will be important as production increases.

Water scarcity, particularly in Kericho and Uasin Gishu, further constrains production during dry periods. Expanding access to reliable irrigation, especially through solar-powered systems, offers a clear pathway to improved resilience and productivity. Service providers' perspectives strongly align with findings from households and suppliers, with climate risk, high costs, limited financing, and technical capacity emerging as shared constraints. This convergence confirms that barriers to RA-PURE adoption are systemic, pointing to the need for integrated solutions that address affordability, access, and capacity simultaneously.

4.6.2 Promoted RA Practices and Priority RA-PURE Pathways

Service providers confirm strong alignment with household data on the most commonly promoted regenerative agriculture practices. Organic soil inputs (74%), crop rotation (74%), and intercropping (78%) are the most widely encouraged practices across the counties. These practices are foundational for improving soil fertility, enhancing biodiversity, and increasing resilience to climate variability. More advanced or less widely adopted practices, such as conservation tillage (37%) and cover cropping (49%), are promoted at lower rates.

This suggests that while awareness of RA principles is relatively high, adoption of more system- or knowledge-intensive practices remains limited. The lower promotion rates may reflect gaps in technical capacity, limited demonstration of benefits, or higher perceived complexity in implementing these practices.

The alignment between service provider promotion and farmer adoption indicates that extension systems are effectively transmitting basic RA knowledge, but there remains an opportunity to deepen adoption of more comprehensive regenerative practices through targeted capacity building and demonstration.

4.6.3 Energy and RA-PURE in Agriculture

From the service provider perspective, energy use in agriculture is primarily concentrated in irrigation and livestock-related applications. Irrigation is the most commonly cited use of energy (63%), reflecting its central role in addressing water constraints and stabilising production, particularly in areas with seasonal droughts. Livestock-related energy uses (44%), such as milk cooling and processing, also feature prominently, especially in mixed farming systems. Despite these applications, 35% of service providers report that PURE uptake remains minimal in their areas. This indicates that, while energy is used in agriculture, its productive and integrated application remains limited, and the transition towards renewable, productivity-oriented energy systems is in its early stages.

When asked to recommend suitable RA-PURE combinations, service providers across all counties show strong convergence on two primary models. The first is solar-powered irrigation combined with RA soil practices, such as organic inputs, mulching, and crop rotation. This combination addresses water scarcity while improving soil health and crop productivity. The second is biogas systems integrated with livestock production, supported by the use of bioslurry as an organic fertiliser. This model creates a closed-loop system that addresses energy needs and soil fertility. The consistency of these recommendations across counties aligns closely with farmer preferences and supplier offerings, indicating a shared understanding among stakeholders of the most viable and impactful RA-PURE integration pathways. These combinations, therefore, represent strong candidates for prioritisation in programme design and implementation.

4.6.4 Institutional Support and Budgetary Allocation

A key structural constraint identified by service providers is the limited institutional funding allocated to RA and PURE activities (Table 4.15). While half of the institutions (50%) report having some budget dedicated to RA promotion, only 20% allocate resources to renewable energy in agriculture, and a mere 14% have budgets specifically for integrated RA-PURE pilots. Notably, 41% of institutions report having no dedicated budget for either RA or PURE activities.

Table 4.15 Institutional Budget Allocation for RA, PURE, and RA-PURE

Budget Area	% of Service Provider Institutions
Budget for RA promotion	50%
Budget for renewable energy in agriculture	20%
Budget for integrated RA-PURE pilots	14%
No dedicated budget	41%

The low level of funding for integrated RA-PURE initiatives highlights a significant institutional gap. While individual service providers may recognise the value of integrating regenerative agriculture with renewable energy, this recognition has not yet translated into formal institutional priorities or budget allocations. As a result, efforts to promote RA-PURE integration are often fragmented, project-based, and reliant on external funding rather than being embedded within institutional programming. This lack of dedicated resources limits service providers' ability to design, test, and scale integrated solutions. It also constrains their capacity to support farmers through demonstrations, training, and follow-up services that are essential for successful adoption.

Without institutional backing, RA-PURE initiatives remain peripheral rather than mainstream within agricultural support systems.

The service provider perspective underscores several key implications for programme design and policy engagement. First, the consistency of constraints across counties, particularly climate variability, high costs, and water scarcity, confirms that RA-PURE solutions must be positioned as resilience-enhancing and cost-reducing interventions. Second, alignment among service providers, farmers, and suppliers on preferred RA-PURE combinations provides a strong evidence base for prioritising solar irrigation and biogas-livestock systems as entry points.

Third, limited institutional budgeting for integrated approaches highlights the need for advocacy and policy engagement at both the county and national levels. Strengthening institutional commitment will be critical to embedding RA-PURE within extension systems, development programmes, and public investment frameworks. Service providers occupy a pivotal role as intermediaries within the ecosystem. Enhancing their technical capacity, providing them with adequate resources, and aligning institutional incentives will be essential to bridging the gap between farmer demand and supply-side capabilities, thereby enabling more effective scaling of integrated RA-PURE solutions.

4.7 Gender and Social Dynamics

4.7.1 Gender Representation and Dynamics

The survey reveals a notable gender imbalance in the farming population, with women comprising 62% of respondents compared with 38% of men. This indicates that women play a central, often primary, role in agricultural production across the surveyed regions. In practical terms, this means that many day-to-day farming decisions, particularly regarding crop production, soil management, and household food security, are largely influenced by, or directly managed by, women

However, this overall trend masks significant county-level variation. In Nandi (56% male) and Uasin Gishu (64% male), men are more prominently represented, suggesting farming systems that may be more commercially oriented, mechanised, or linked to larger landholdings, where male participation tends to be higher. In contrast, counties such as Busia (80% female) and Nakuru (74% female) are heavily skewed towards women, reflecting contexts in which women are the primary custodians of smallholder production, particularly of food crops and subsistence-oriented farming.

These variations have important programme design implications. In female-dominated contexts, interventions must be tailored to address barriers that disproportionately affect women, including limited access to finance, land ownership constraints, and time burdens related to unpaid care work.

Technologies such as solar irrigation or biogas systems should therefore be designed with usability, affordability, and labour-saving benefits in mind. In male-dominated areas, strategies may need to focus more on commercial viability, scale, and integration with market systems. Across all counties, gender-responsive approaches, such as targeted training, inclusive financing models, and support for women-led farmer groups, will be critical to the equitable adoption of RA-PURE systems.

The finding that 54% of respondents have practised regenerative agriculture for three or more seasons further strengthens this outlook. It suggests that farmers, including a significant proportion of women, already possess foundational knowledge and experience in RA practices. Programme interventions can therefore build on existing capacities rather than introducing entirely new concepts, focusing on deepening the quality of practice and integrating energy solutions to enhance impact.

4.7.2 Age and Education Profile

The age distribution of respondents shows that the majority of the farming population (74%) falls within the 36-64 age bracket, indicating an experienced but gradually ageing workforce. Younger farmers (18-35 years) account for only 16% of respondents, while those aged 65 and over represent 9%. This demographic structure suggests that while there is a strong base of farming experience, generational renewal may be limited within the sector.

From a technical perspective, this has implications for the adoption of new technologies. Older farmers may be more risk-averse and less inclined to adopt unfamiliar systems without clear evidence of benefits. At the same time, their experience can be leveraged through demonstration and peer-learning models, in which trusted farmers showcase successful RA-PURE applications. The relatively low youth participation also highlights an opportunity to position RA-PURE systems, particularly those involving renewable energy and value addition, as attractive entry points for youth engagement in agriculture.

Regarding education, most respondents have completed either secondary (39%) or primary (34%) education. This suggests moderate literacy levels and underscores the need for practical, user-friendly training approaches. Technical information on RA practices, solar irrigation systems, or biogas technologies should be delivered through simplified, visual, and demonstration-based methods rather than overly technical formats. Extension services should emphasise hands-on training, field demonstrations, and peer-to-peer learning to ensure effective knowledge transfer.

4.7.3 Household and Farm Management

The survey also offers important insights into household structure and farm management dynamics. A majority of respondents (63%) identify as household heads, indicating that many farmers have direct authority over farm-level decision-making. This is a positive factor for programme implementation, as it reduces the complexity of intra-household decision-making and can accelerate adoption when farmers are convinced of the benefits.

Farmer group membership is notably high, with 76% of respondents belonging to a group. This is a significant institutional asset for programme delivery. Farmer groups provide established platforms for collective training, information dissemination, demand aggregation for inputs and technologies, and access to financing. From a technical and operational standpoint, group-based approaches, such as collective solar irrigation schemes, group financing models, and shared learning platforms, can significantly reduce costs and improve adoption rates.

Landholding patterns further highlight the smallholder nature of the farming systems. The majority of farmers operate on small plots, with 52% cultivating between 1 and 3 acres and 35% farming less than 1 acre. Such small land sizes necessitate technologies and practices that are scalable, modular, and resource-efficient. For example, solar irrigation systems may need to be designed as small-scale or shared systems, while RA practices should focus on intensification and soil productivity rather than expansion. Land ownership patterns also influence investment decisions. While 55% of respondents hold title deeds, a substantial proportion (42%) farm on family land. This can create uncertainty about long-term investment, particularly for capital-intensive technologies such as irrigation systems or biogas digesters. Farmers without secure land tenure may be less willing to invest in infrastructure with long payback periods.

The demographic and socio-economic profile of respondents provides important context for designing RA-PURE interventions. The strong representation of women in farming, high participation in farmer groups, and the fact that many farmers already have experience with RA practices are key enabling factors that can support programme uptake and scaling. These elements indicate an existing foundation of knowledge, social organisation, and engagement that can be leveraged to accelerate adoption. At the same time, several structural constraints must be carefully addressed. Small land sizes limit the scale at which technologies can be deployed, while land tenure arrangements, particularly where farmers operate on family land without formal ownership, can reduce incentives to invest in long-term improvements. Limited access to finance remains a major barrier to the adoption of capital-intensive technologies, and the ageing farming population may slow the uptake of new, more technical solutions.

In practical terms, interventions need to be deliberately tailored to these realities. Approaches should be gender-responsive and inclusive, ensuring that women, who constitute the majority of farmers in many areas, have equitable access to technologies, training, and financing. Leveraging farmer groups as entry points for delivery and financing can enhance reach, reduce costs, and strengthen peer learning. Technologies promoted under the programme should be scalable and appropriate for smallholder contexts, enabling modular adoption and efficient use of limited land and resources.

Training and extension should prioritise practical, demonstration-led approaches that translate technical concepts into clear, actionable practices that farmers can readily adopt. At the same time, financing mechanisms must be flexible and aligned with farmers' cash flows, enabling investment without being constrained by high upfront costs. By aligning with these socio-economic dynamics, RA-PURE interventions are more likely to achieve higher adoption rates, deliver stronger productivity and resilience outcomes, and ensure long-term sustainability across the target counties.

4.8 County-Level Profiles

This section presents concise profiles of each county, drawing on insights from all three data sources: household surveys, key informant interviews with service providers, and supplier interviews. Each profile highlights the county's unique characteristics, its readiness for RA-PURE integration, and the key implications for programme design and targeted interventions.

4.8.1 Bungoma County

The County has a strong foundation for RA, characterised by relatively high practice intensity and widespread adoption of core soil management techniques. Households apply an average of 4.11 RA practices (the third-highest among counties), with crop rotation (96%), compost/manure use (89%), and mulching (76%) the most common practices (Table 4.16). These practices improve soil fertility, moisture retention, and overall farm resilience.

Table 4.16 Household-Level RA-PURE Profile and Adoption Indicators, Bungoma County

Key Indicator	Summary Value
Household respondents	45
RA intensity (avg. practices)	4.11 (3rd highest)
Dominant energy source	Solar (78%), Grid (36%)
RA-PURE awareness	73%
RA-PURE current adoption	13%
Dominant RA practices	Crop rotation (96%), Compost/manure (89%), Mulching (76%)

Energy access is largely driven by solar systems (78%), with limited reliance on grid electricity. This high penetration of solar energy creates a favourable environment for expanding its use beyond basic needs into productive agricultural applications, such as irrigation and processing.

RA-PURE awareness is relatively high at 73%, but adoption remains low at 13%, indicating a clear gap between awareness and implementation. This suggests that although farmers are familiar with both RA practices and renewable energy, constraints such as affordability, access to technology, and technical capacity continue to limit integration.

Bungoma's strong adoption of RA and widespread use of solar power position it as a high-potential county for scaling integrated RA-PURE solutions. In particular, solar-powered irrigation aligns well with existing soil management practices, offering an opportunity to address water constraints and enhance productivity gains from regenerative agriculture.

The presence of early adopters (13%) provides a foundation for demonstration and peer learning. Interventions can therefore focus on deepening integration by linking existing RA practices to productive solar applications, with targeted financing and technical support.

4.8.2 Busia County

Busia County provides a strong foundation for RA-PURE integration, marked by very high solar adoption (89%) and solid engagement in core RA practices. Households report an average of 3.36 RA practices (ranked 4th), with compost/manure use (96%), intercropping (91%), and crop rotation (80%) the most common (Table 4.17). These practices reflect a system grounded in soil fertility management and crop diversification.

Despite these strengths, RA-PURE adoption remains very low at 4%, while awareness stands at 62%, indicating a significant gap between knowledge and implementation. Although solar energy is widely used, its application remains largely non-productive, with limited use for irrigation, processing, or post-harvest management. This points to the underutilisation of existing renewable energy infrastructure.

Table 4.17 Household-Level RA-PURE Profile and Adoption Indicators, Busia County

Key Indicator	Summary Value
Household respondents	45
RA intensity (avg. practices)	3.36 (4th)
Dominant energy source	Solar (89%), Grid (53%)
RA-PURE awareness	62%
RA-PURE current adoption	4%
Dominant RA practices	Compost/manure (96%), Intercropping (91%), Crop rotation (80%)

Busia's moderate RA intensity suggests scope to deepen and diversify regenerative practices, while its strong reliance on locally available inputs provides a solid foundation for integrating energy-enabled solutions. However, a relatively weak supplier ecosystem, reflected in the low number of technology providers, may constrain access to RA-PURE technologies and related services.

From a programme perspective, Busia is a high-potential yet underdeveloped integration context. Interventions should focus on linking existing RA practices to productive solar applications, particularly irrigation and post-harvest technologies, while strengthening supply chains, financing options, and technical support systems. Leveraging the high penetration of solar energy will be key to driving adoption.

4.8.3 Kakamega County

Kakamega County stands out as the top performer in RA adoption and awareness across all surveyed counties. With the highest RA intensity (4.34 practices per household), farmers engage in a diverse set of practices, including compost/manure use (95%), intercropping (80%), agroforestry (64%), and conservation tillage (43%), as shown in Table 4.18. The presence of agroforestry and conservation tillage indicates a more advanced and integrated RA system compared with other counties.

Table 4.18 Household-Level RA-PURE Profile and Adoption Indicators, Kakamega County

Key Indicator	Summary Value
Household respondents	44
RA intensity (avg. practices)	4.34 (highest)
Dominant energy source	Solar (70%), Grid (59%)
RA-PURE awareness	93% (highest)
RA-PURE current adoption	18%
Dominant RA practices	Compost/manure (95%), Intercropping (80%), Agroforestry (64%), Conservation tillage (43%)

Kakamega County stands out as the strongest performer across all surveyed counties in terms of energy access, characterised by strong solar use (70%), supporting the feasibility of decentralised renewable energy applications. RA-PURE awareness is the highest among all counties at 93%, with a relatively high adoption rate of 18%, indicating that the county is already transitioning from awareness to implementation.

This combination of strong RA practices, high awareness, and emerging adoption positions Kakamega as a leading county for scaling integrated RA-PURE systems. Unlike other counties, the focus here is less on raising awareness and more on deepening integration and improving system efficiency.

Priority entry points include biogas-linked RA systems and solar-powered irrigation, both of which align well with existing farming systems. Biogas complements the widespread use of organic inputs by converting waste into energy and enhancing soil fertility through bioslurry. Solar-powered irrigation addresses water variability and, when combined with practices such as mulching and agroforestry, can significantly improve water use efficiency and productivity.

From a programme perspective, Kakamega can serve as a reference and demonstration hub, demonstrating how mature RA systems can be strengthened through renewable energy integration. Interventions should therefore focus on scaling proven models, strengthening technical capacity, and expanding access to financing and to appropriate technologies.

4.8.4 Kericho County

Kericho County stands out as a clear outlier, with the lowest levels of RA-PURE awareness and adoption across all counties. Households report low RA intensity (2.67 practices, second lowest), with practices largely limited to intercropping (93%) and the use of commercial organic inputs (47%), as shown in Table 4.19. These practices are often embedded within the dominant tea-based farming system rather than reflecting a fully developed regenerative approach.

Table 4.19 Household-Level RA-PURE Profile and Adoption Indicators, Kericho County

Key Indicator	Summary Value
Household respondents	45
RA intensity (avg. practices)	2.67 (2nd lowest)
Dominant energy source	Grid (69%), Solar (36%)
RA-PURE awareness	27% (lowest)
RA-PURE current adoption	0% (lowest)
Dominant RA practices	Intercropping (93%), Commercial organic inputs (47%)

In Kericho, energy access is relatively strong, with moderate solar use (36%) and broader energy availability. However, RA-PURE adoption remains at 0%, and awareness is the lowest at 27%, indicating that integration has not yet taken root. This suggests that the primary constraint is not energy availability but limited awareness and weak alignment between existing farming systems and RA-PURE concepts.

Kericho's highly specialised, tea-dominated production system differs markedly from the mixed smallholder systems found in other counties. As a result, standard RA-PURE approaches, particularly those focused on staple crops, are less applicable. Instead, interventions must be tailored to the realities of tea-based farming systems and the constraints farmers face, including water management and productivity pressures.

From a programme perspective, Kericho requires a context-specific, adaptive approach. Initial efforts should focus on raising awareness and demonstrating relevant use cases, while gradually introducing renewable energy applications that complement existing systems. For example, solar-powered irrigation or water pumping can support intercropped food production on tea farms, improving household resilience without disrupting the primary enterprise.

Overall, Kericho is a low-readiness context in which scaling RA-PURE will depend on aligning interventions with existing value chains and demonstrating practical, system-compatible benefits.

4.8.4 Nakuru County

Nakuru County offers a moderately developed yet underutilised landscape for RA and renewable energy integration. Households report an average RA intensity of 3.15 practices (5th), with compost/manure use (78%), intercropping (65%), and mulching (52%) forming the core practices (Table 4.20). These figures indicate a foundational but not yet deeply embedded adoption of regenerative approaches.

Table 4.20 Household-Level RA-PURE Profile and Adoption Indicators, Nakuru County

Key Indicator	Summary Value
Household respondents	46
RA intensity (avg. practices)	3.15 (5th)
Dominant energy source	Grid (59%), Solar (48%)
RA-PURE awareness	74%
RA-PURE current adoption	2%
Dominant RA practices	Compost/manure (78%), Intercropping (65%), Mulching (52%)

Nakuru Energy access includes substantial solar use (48%), providing a strong basis for expanding renewable energy into productive agricultural applications. However, despite relatively high RA-PURE awareness (74%), adoption remains extremely low at 2%, indicating a significant gap between knowledge and implementation. This suggests constraints related to affordability, access to technologies, and practical integration into farming systems.

A key strength of Nakuru is its robust institutional ecosystem, comprising government agencies, NGOs, and cooperatives that support agricultural development. However, persistent challenges, particularly climate variability and limited market incentives for sustainable produce, continue to hinder productivity and adoption.

From a programme perspective, Nakuru is a high-potential, institution-driven context. Interventions should focus on translating awareness into practice by leveraging existing institutional networks to promote practical, demonstrable RA-PURE applications. Strengthening links between renewable energy use and agricultural production, particularly through solar-powered irrigation and value chain support, will be critical to unlocking adoption.

4.8.6 Nandi County

Nandi County is the strongest example of integrated RA-PURE systems, with the highest adoption rate at 44%. Households report a high RA intensity of 4.2 practices (second highest), with widespread use of compost/manure (94%), mulching (80%), intercropping (72%), and, notably, bioslurry (34%), as shown in Table 4.21.

Table 4.21 Household-Level RA-PURE Profile and Adoption Indicators, Nandi County

Key Indicator	Summary Value
Household respondents	50
RA intensity (avg. practices)	4.20 (2nd highest)
Dominant energy source	Grid (74%), Solar (36%), Biogas (26%)
RA-PURE awareness	80%
RA-PURE current adoption	44% (highest)
Dominant RA practices	Compost/manure (94%), Mulching (80%), Intercropping (72%), Bioslurry (34%)

A defining feature of Nandi is the strong integration of livestock systems with renewable energy through biogas. With 26% biogas adoption, the highest across all counties, farmers have established a functional livestock-biogas-bioslurry nexus. This circular system converts organic waste into energy and returns bioslurry to the soil, enhancing fertility and reducing reliance on external inputs.

Energy access is relatively diversified, with solar (36%) complementing biogas use and offering additional potential to expand productive applications. RA–PURE awareness is also high at 80%, and the strong alignment among knowledge, resources, and farming systems has enabled practical adoption at scale.

From a programme perspective, Nandi offers a mature and replicable model for RA-PURE integration. Interventions should focus on deepening and optimising existing systems, such as improving biogas efficiency and bioslurry utilisation, while introducing complementary renewable energy solutions, particularly solar-powered irrigation, to further enhance productivity and resilience.

Nandi provides a clear proof of concept for how integrated RA-PURE systems can deliver tangible benefits when aligned with local farming systems, offering a strong foundation for peer learning and replication in other counties.

4.8.7 Uasin Gishu County

Uasin Gishu County presents a distinctive profile, with the lowest RA intensity (2.4 practices) but the second-highest RA-PURE adoption (31%). This suggests that energy use in agriculture is advancing ahead of the full establishment of an RA system (Table 4.22). The dominant practice is crop rotation (89%), with less widespread adoption of compost/manure (51%) and intercropping (47%).

Table 4.22 Household-Level RA-PURE Profile and Adoption Indicators, Uasin Gishu County

Key Indicator	Summary Value
Household respondents	45
RA intensity (avg. practices)	2.36 (lowest)
Dominant energy source	Grid (64%), Solar (18%)
RA-PURE awareness	82%
RA-PURE current adoption	31% (2nd highest)
Dominant RA practices	Crop rotation (89%), Compost/manure (51%), Intercropping (47%)

Energy use is characterised by relatively low solar adoption (18%), indicating an opportunity to expand renewable energy solutions. RA-PURE awareness is high at 82%, and adoption appears to be driven by practical productivity needs, particularly irrigation, rather than by a fully integrated RA approach.

Service provider insights highlight irrigation as a key driver, especially during dry periods when access to water becomes critical. This reinforces the role of energy-enabled irrigation as a primary entry point for RA-PURE in the county. From a programme perspective, Uasin Gishu is an energy-driven adoption context. The priority is to strengthen integration by linking existing energy use with regenerative practices, such as soil fertility management and diversification. Expanding solar-based solutions, particularly for irrigation, offers an opportunity to improve cost efficiency and sustainability while supporting long-term productivity.

Overall, Uasin Gishu shows that energy adoption can outpace RA development, highlighting the need to align renewable energy use with stronger regenerative agricultural practices to achieve more sustainable outcomes.

4.9 County Typologies and Targeting Implications for RA-PURE

4.9.1 County Segmentation by RA-PURE Readiness

Based on the combined analysis of RA adoption, energy access, and RA-PURE integration, the seven counties can be grouped into distinct typologies that reflect their readiness levels and the most appropriate entry points for intervention (Table 4.23).

Table 4.23 County Typology and Targeting Implications for RA-PURE

Typology	Counties	Key Characteristics	What Stands Out	Programme Implication
High Integration (Mature RA-PURE Systems)	Nandi	High RA intensity, strong biogas and bioslurry use, highest RA-PURE adoption (44%)	Functional livestock-biogas-bioslurry nexus already in place	Use as learning and demonstration hub; deepen and diversify (e.g. add solar irrigation)
High Potential (RA + Energy Present, Low Integration)	Bungoma, Busia, Kakamega	Strong RA adoption and high solar access, but low RA-PURE integration	Clear disconnect between energy access and productive agricultural use	Focus on integration-solar irrigation + RA bundling; strong opportunity for rapid scale
Emerging Integration (Energy Use Driving Adoption)	Uasin Gishu	Low RA intensity but relatively high RA-PURE adoption (31%); strong grid reliance	PURE adoption occurring independently of comprehensive RA systems	Strengthen RA practices to complement existing energy use; promote integrated systems
Low Readiness/ System Mismatch	Kericho	Low RA intensity, lowest awareness (27%), zero RA-PURE adoption; tea-dominant system	Existing RA-PURE models poorly aligned with local production systems	Develop tailored, value chain-specific RA-PURE models (e.g. tea-compatible interventions)
Moderate Potential with Strong Institutional Presence	Nakuru	Moderate RA adoption, strong institutional ecosystem, low RA-PURE adoption (2%)	High awareness but very low uptake	Leverage institutions to drive demonstrations and coordinated scaling

4.9.2 Interpretation and Strategic Insights

The typology highlights that RA-PURE adoption is not uniform and is strongly influenced by local production systems, resource endowments, and the existing levels of integration between agriculture and energy. A key insight is that the greatest opportunity lies not in the weakest systems, but in the building blocks that already exist yet remain unconnected. Counties such as Bungoma, Busia, and Kakamega demonstrate this clearly: both RA practices and solar energy are already widely adopted, yet integration remains low. These counties therefore present the most immediate opportunities for rapid scaling through targeted RA-PURE bundling.

At the same time, Nandi stands out as a proof-of-concept system in which biogas, livestock, and bioslurry already function as an integrated RA-PURE model. This offers a valuable real-world example for peer learning, demonstration, and replication. In contrast, counties such as Kericho highlight the limitations of applying standardised approaches across diverse contexts. The tea-based production system and reliance on commercial inputs suggest that RA-PURE interventions must be adapted to local value chains and farming systems. Uasin Gishu presents a different dynamic, with energy adoption, particularly for irrigation, appearing to outpace the adoption of regenerative practices.

Key Conclusions and Programme Implications

5

5 Key Conclusions and Programme Implications

5.1 Demand is High, Finances Constrain Adoption

Demand for RA-PURE systems is exceptionally strong, with 97% of farmers willing to adopt if supported. Across households, suppliers, and service providers, the dominant constraint is affordability, driven by high upfront costs and limited access to finance. The challenge is therefore not behaviour change, but enabling adoption through accessible and appropriate financing mechanisms.

97%
Farmers willing to adopt RA-PURE if supported

5.2 Solar Irrigation is the Primary Entry Point, Anchored on Key Crops

Across all three data sources (households, service providers, and suppliers), solar-powered irrigation combined with RA practices is the most preferred and recommended RA-PURE combination. This directly addresses the dominant climate challenge (drought) and the current productive energy gap (15% irrigation use despite widespread energy access). Solar irrigation trials should anchor the RA-PURE field trial programme. The four priority crops preferred by farmers are maize, beans, kale and black nightshade, which are not only widely grown but also compatible with regenerative practices and responsive to irrigation.

5.3 Biogas-Bioslurry Systems are a High-Potential Secondary Pathway

The livestock-biogas-bioslurry system, particularly evident in Nandi, shows strong potential for integrated RA-PURE application, offering dual benefits of energy generation and improved soil fertility. However, adoption remains limited in most counties, indicating the need for targeted approaches that align with livestock systems, improve affordability, and strengthen technical support.

5.4 The Core Gap is Practical Integration, Not Awareness

RA practices and energy access are both present across counties, but largely operate independently. While awareness of RA-PURE is relatively high, adoption remains low due to the difficulty of integrating systems at the farm. There is a need to connect existing practices and technologies into practical, farm-level applications that directly address water, soil, and productivity constraints.

5.5 Counties Require Differentiated Approaches

Readiness varies significantly across counties. Nandi and Uasin Gishu provide strong foundations for scaling, while Bungoma, Busia, and Kakamega offer high potential due to existing RA and solar adoption. However, with zero RA-PURE adoption and 27% awareness, Kericho will not be effectively reached by a one-size-fits-all programme, requiring tailored approaches to sensitisation and adoption.

5.6 Supply Systems are Fragmented and Favour Specialisation

The supply ecosystem is active yet largely specialised, with most actors focusing on either RA inputs or energy technologies rather than integrated solutions. This reflects differences in technical expertise, customer segments, and business models. Rather than forcing integration at the supplier level, there is a stronger case for coordinated delivery models that leverage specialised actors within a connected ecosystem.

5.7 Trusted Information Channels are Key to Adoption

Farmer groups, extension services, and peer learning are the most effective and trusted channels for disseminating information. These channels complement one another and provide a strong foundation for scaling awareness and adoption. However, weak linkages with private-sector providers limit farmers' access to technologies and services, underscoring the need to strengthen these connections.

5.8 Institutional Support Remains Limited

Despite active field-level engagement, institutional investment in RA-PURE integration remains low, with limited budget allocation and weak policy alignment. Stronger integration into county planning, budgeting, and policy frameworks will be necessary to support sustained scale-up.

5.9 Gender and Youth Inclusion are Critical

Women play a central role in farming systems but face constraints in access to finance, land, and decision-making. Youth participation remains limited despite their potential to adopt new technologies. Addressing these gaps will be important for equitable and accelerated adoption of RA-PURE systems.

5.10 Demonstration and Evidence will Drive Scale

A significant proportion of farmers remain uncertain about the benefits of RA-PURE due to limited direct experience. Across stakeholders, demonstration sites and visible success stories are identified as the most effective drivers of adoption. Well-designed, crop-based demonstration plots, particularly around solar irrigation and biogas systems, will be essential for building confidence and stimulating demand.

6 Programme Recommendations

6.1 Establish Accessible Financing Models for RA-PURE Adoption

Develop and deploy blended financing mechanisms that reduce upfront costs for farmers. This should include PAYGO models for solar irrigation, cooperative-based lending, targeted subsidies, and grant support for initial adoption. Special attention should be given to women and youth, who face greater financial barriers.

6.2 Anchor Field Trials on Solar Irrigation and Priority Crops

Prioritise solar-powered irrigation as the main entry point for RA-PURE field trials. Demonstration plots should focus on maize, beans, kales, and black nightshade, integrating irrigation with regenerative practices such as composting, intercropping, and mulching. These crops offer quick, visible results and strong scalability.

6.3 Scale Biogas-Bioslurry Systems in Livestock-Based Areas

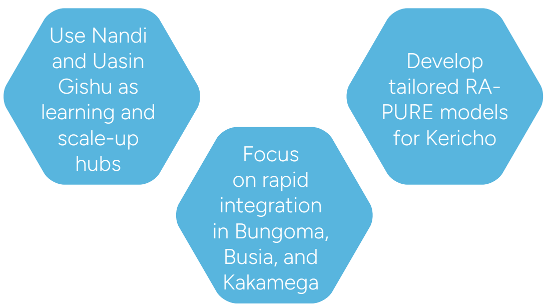
Promote the livestock-biogas-bioslurry model in counties with strong livestock systems such as Nandi, Nakuru, and Bungoma. Support should include financing for biodigesters, technical training, and integration with soil fertility programmes to maximise both energy and agricultural benefits.

6.4 Promote Practical Integration at the Farm Level

Design and implement simple, farm-level RA-PURE packages that connect existing practices and technologies. Focus on linking water access (irrigation), soil health (RA practices), and productivity outcomes, rather than introducing complex or entirely new systems.

6.5 Apply Differentiated County-Level Implementation Strategies

Adopt a targeted rollout approach:



6.6 Strengthen Coordinated Delivery Across Specialised Suppliers

Support coordination among specialised RA and PURE suppliers rather than forcing integration within single businesses. Facilitate partnerships, joint delivery models, and shared service platforms to improve farmer access to complete RA-PURE solutions.

6.7 Leverage Trusted Information and Delivery Channels

Scale dissemination through farmer groups, extension systems, and peer learning networks. Strengthen linkages between these channels and private sector providers to improve access to technologies, services, and after-sales support.

6.8 Strengthen Institutional Integration and Policy Support

Advocate for the inclusion of RA-PURE approaches in county development plans, budgets, and agricultural strategies. Support public institutions in allocating resources for integrated pilots and aligning policies with climate-smart, energy-enabled agriculture.

6.9 Mainstream Gender and Youth Inclusion

Design targeted interventions that address barriers faced by women and youth. This includes inclusive financing models, tailored training programmes, and engagement strategies that ensure both participation and influence over decision-making.

6.10 Invest in Demonstration, Evidence, and Learning Systems

Establish well-designed demonstration sites and farmer exposure programmes to showcase the benefits of RA-PURE. Strengthen monitoring, evaluation, and learning systems to generate evidence, support adaptive programming, and inform policy and scale-up.

7 References

7 References

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Appendix: Summary Data Tables

8 Appendix: Summary Data Tables

Table 8.1 A1. Household Survey: Key Indicators by County

Indicator	Bungoma	Busia	Kakamega	Kericho	Nakuru	Nandi	Uasin Gishu
Sample (n)	45	45	44	45	46	50	45
Avg. RA practices	4.11	3.36	4.34	2.67	3.15	4.20	2.36
RA-PURE awareness	73%	62%	93%	27%	74%	80%	82%
RA-PURE adoption	13%	4%	18%	0%	2%	44%	31%
Solar energy use	78%	89%	70%	36%	48%	36%	18%
Biogas use	4%	0%	5%	0%	2%	26%	0%
Energy for irrigation	11%	7%	16%	4%	11%	34%	22%
Prefers solar irrigation	71%	69%	75%	49%	65%	72%	73%

Table 8.2 A2. Data Sources

Data Source	Details
Household Farmer Survey	Household_Farmer_Survey_Cleaned.xlsx (320 respondents)
KII Service Providers	KII_Service_Providers_Cleaned.xlsx (113 respondents)
KII Suppliers	KII_Suppliers_Cleaned.xlsx (104 respondents)
Data collection platform	KoboToolbox
Data collection period	March 2026
Analysis date	March 8, 2026

Power for Food Partnership
Renewable, Regenerative, Resilient.

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