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RESEARCH REPORT

Deliberating Policy Coherence in Kenya's Agricultural Input Systems: The Case of Biofertilizers

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Front cover photo: Fermenter of a biogas plant (*photo:* Shutterstock)
Back cover photo: Rice farmers divide young rice plants and replant in flooded rice fields (*photo:* Shutterstock)

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Contents

Abbreviations

ABS – Access and Benefit Sharing

AfDB – African Development Bank

AGRA – Alliance for a Green Revolution in Africa

AFA – Agriculture and Food Authority

BETA – Bottom-Up Economic Transformation Agenda

CAK – Competition Authority of Kenya

CSA – Climate-Smart Agriculture

FAO – Food and Agriculture Organization of the United Nations

GEO – Global Environment Outlook

GIZ – Deutsche Gesellschaft für Internationale Zusammenarbeit

GoK – Government of Kenya

HLPE – High-Level Panel of Experts on Food Security and Nutrition

IBP – International Budget Partnership

ICT – Information and Communication Technology

IFAD – International Fund for Agricultural Development

IFDC – International Fertilizer Development Center

IFPRI – International Food Policy Research Institute

ILO – International Labour Organization

IWMI – International Water Management Institute

KEBS – Kenya Bureau of Standards

KEPHIS – Kenya Plant Health Inspectorate Service

KIPPRA – Kenya Institute for Public Policy Research and Analysis

MoALD – Ministry of Agriculture and Livestock Development

MSME – Micro, Small and Medium Enterprises

NCPB – National Cereals and Produce Board

NEMA – National Environment Management Authority

NGO – Non-Governmental Organization

NPK – Nitrogen-Phosphorus-Potassium

OECD – Organisation for Economic Co-operation and Development

PCPB – Pest Control Products Board

PPP – Public-Private Partnership

SDG – Sustainable Development Goal

SME – Small and Medium Enterprise

UNEP – United Nations Environment Programme

WFP – World Food Programme

WLE – Water, Land and Ecosystems (CGIAR program)

Summary

Kenya's agricultural input system remains heavily skewed toward chemical fertilizers despite the mounting evidence of the long-term damage they cause to soil health, nutrient cycles, and water quality. Biofertilizers—organic inputs containing living microorganisms that enhance nutrient uptake and rebuild soil structure—have been increasingly acknowledged in policy documents, such as the National Soil Fertility Management Policy (2023), the Climate-Smart Agriculture Strategy (2017–2026), and the National Agricultural Sector Growth and Transformation Strategy (ASTGS 2019–2029), as essential for sustainable land management and climate resilience. However, this policy-level recognition has not translated into concrete support mechanisms such as regulatory standards, public funding, or inclusion in national input distribution and subsidy programs. This paper applies a political economy and policy coherence lens to examine why biofertilizers remain structurally excluded from Kenya's agricultural input regime, despite the recognition of their agronomic and environmental benefits. It analyzes three core dimensions of policy incoherence hindering the scaling of biofertilizers nationally: (1) horizontal fragmentation between agriculture, environment, and water agencies; (2) vertical misalignment between national policy ambitions and subnational implementation capacities; and (3) internal inconsistency within policies that advocate for sustainable inputs but allocate funding and delivery exclusively to chemical fertilizers. Moreover, through stakeholder mapping, policy document review, and interviews with two Kenya-based biofertilizer enterprises—EcoRich Solutions and Rebug2Debug—this paper also integrates empirical findings.

This analysis reveals that the absence of a dedicated regulatory framework for biofertilizers—combined with subsidy schemes that prioritize chemical fertilizers, fragmented institutional mandates, and weak cross-sectoral coordination—has produced a policy environment where biofertilizers are neither legally recognized nor practically accessible. Despite formal mentions in national strategies, their continued exclusion from regulatory, financial, and distribution systems raises critical questions about the depth and intent of policy commitments to sustainable and climate-resilient agriculture. Although referenced in several strategies, including the National Soil Fertility Policy and the Climate-Smart Agriculture Strategy, regulatory agencies currently lack the legal authority and technical standards to classify, certify, or monitor organic products. As a result, biofertilizer producers remain excluded from national distribution systems, public subsidy schemes, and extension programs. County governments, though constitutionally responsible for input delivery and farmer outreach, lack the technical capacity and fiscal autonomy needed to support alternative input strategies. At the same time, water and environment agencies acknowledge worsening soil degradation and watershed stress but are not engaged in input reform processes, reflecting a narrow framing of fertilizer policy as the exclusive domain of the Ministry of Agriculture. The analysis further finds that this institutional gap erodes farmer trust, discourages private sector investment, and weakens national efforts to restore soils, reduce input-related water pollution, and enhance climate resilience.

The paper concludes that the most urgent reform is the development of a dedicated regulatory framework for biofertilizers, comprising national classification systems, performance standards, and biosafety protocols. In the absence of legal recognition, credible organic inputs remain excluded from formal markets and ineligible for public support. In parallel, a targeted subsidy sandbox in collaboration with NEMA and relevant ministries can enable the controlled inclusion of approved biofertilizers within the national e-voucher system. This approach can enable real-time evaluation of farmer uptake, agronomic outcomes, and water-related benefits across diverse agroecological zones. Additional measures include strengthening extension systems to support organic input use, revising procurement eligibility criteria to accommodate smaller suppliers, and establishing joint budgeting mechanisms that link agriculture, water, and environment mandates. By identifying the institutional, regulatory, and political drivers of exclusion, the paper outlines a pathway for aligning Kenya's input system with broader national objectives on soil regeneration, water resources management, and climate action in agriculture. In the absence of such structural reform, biofertilizers will remain policy aspirations without operational traction—perpetuating input systems that compromise long-term resilience and may introduce additional biohazards into food supply chains due to unregulated production and use.

Introduction

In recent years, Kenya's agricultural input system has come under growing scrutiny due to mounting evidence of the environmental and agronomic limitations associated with widespread chemical fertilizer use. While access to chemical fertilizers has contributed to higher yields in maize and other staples, their long-term application has led to serious soil degradation in intensively farmed areas such as the Central Highlands and the western maize belt (Figure 1). Continuous chemical application has depleted soil organic matter, caused nutrient imbalances, and increased soil acidity—ultimately reducing the effectiveness of fertilizers themselves. Simultaneously, nitrogen leaching and runoff have polluted surface and groundwater in many high-input regions (FAO, 2021; UNEP, 2019; Nziguheba et al., 2020). These soil and water challenges are increasingly interlinked: as soils lose organic content, they retain less moisture, making crops more vulnerable to dry spells and reducing resilience in rainfed systems. Addressing this dual crisis requires input strategies that rebuild soil structure and improve water retention. Biofertilizers—organic inputs containing living microorganisms that enhance nutrient uptake and support root development—present one such option. Biofertilizers have been recognized in several national strategies, including Kenya's National Soil Fertility Policy (2023) and the Climate-Smart Agriculture Strategy (2017), as critical to restoring degraded soils, improving nutrient efficiency, and enhancing climate resilience. These priorities are echoed in international frameworks such as the FAO's Global Soil Partnership and International Code of Conduct for the Sustainable Use and Management of Fertilizers (FAO, 2019), UNEP's Global Chemicals Outlook II (UNEP, 2019), IFAD's 2022 Climate Action Plan, and IWMI's applied research in West Africa on circular organic inputs and biosolids, which highlights scalable business models for organic fertilizer adoption among smallholders (Drechsel et al., 2020). Yet despite these policy signals, adoption of biofertilizers remains extremely limited due to high costs, regulatory uncertainty, and lack of integration into mainstream input programs. The structural and political drivers of biofertilizer exclusion, ranging from entrenched agrochemical lobbies to legacy policy biases, remain insufficiently analyzed in both scholarship and policy discourse.

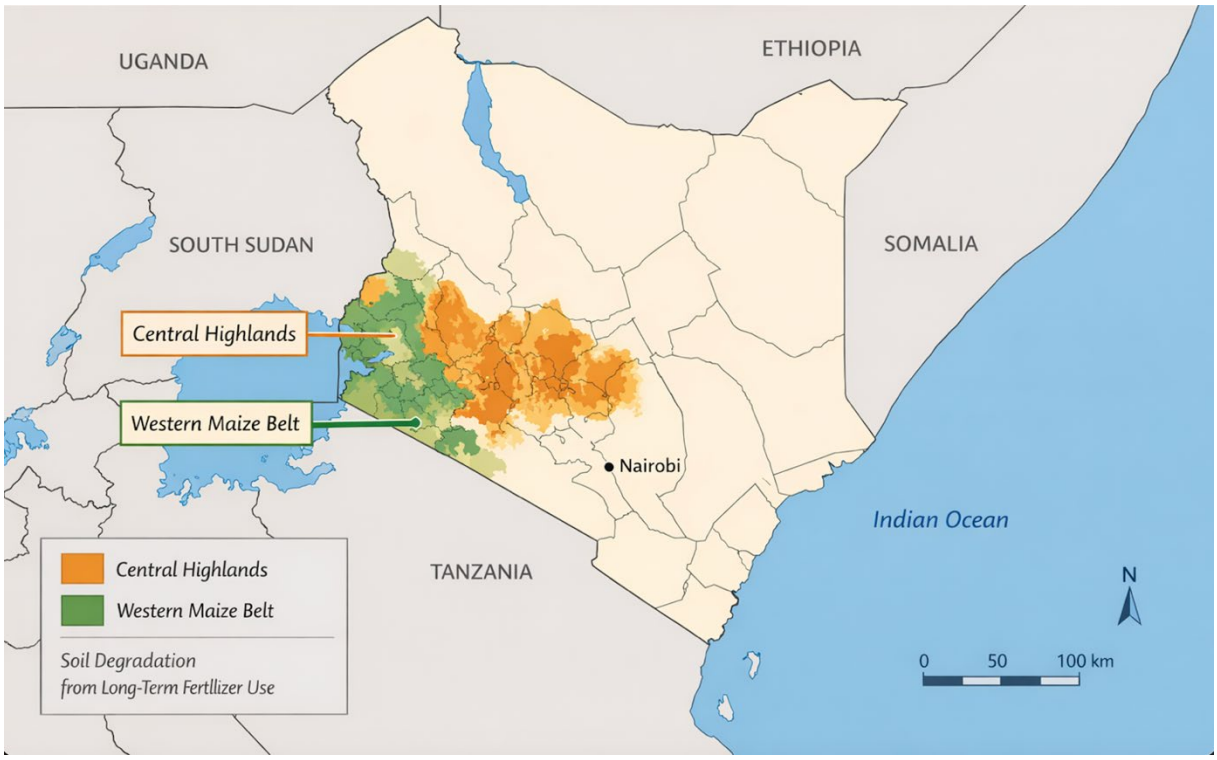

Figure 1. Soil Degradation in Intensively Farmed Regions of Kenya
Source: Author's creation

In Kenya, as in many parts of Africa and globally, public agricultural input systems have historically prioritized chemical fertilizers, while largely overlooking biological alternatives such as biofertilizers. Although recent policy documents, including the National Soil Fertility Policy and the Climate-Smart Agriculture Strategy, acknowledge the need for improved soil health and more diverse input strategies, these references are rarely accompanied by concrete regulatory measures, dedicated funding, or implementation plans (Mucheru-Muna et al., 2022; Ministry of Agriculture and Livestock Development [MoALD], 2023). Field trials conducted across various agro-ecological zones, especially in central and western Kenya, have shown that biofertilizers containing nitrogen-fixing bacteria and phosphate-solubilizing microbes can improve soil structure, increase moisture retention, and raise yields in nutrient-depleted soils (Ondieki et al., 2019; Gweyi-Onyango et al., 2020). Despite these benefits, farmer uptake

remains minimal. Key barriers include limited market availability, lack of quality assurance mechanisms, and weak technical capacity among agricultural extension agents. Kenya currently lacks a clear regulatory framework for biofertilizers: there are no national standards for product registration, efficacy testing, quality control, or biosafety. This discourages private investment and restricts adoption. Yet there is growing evidence that biofertilizer use could offer competitive advantages in export-oriented horticulture, particularly for producers targeting the European Union (EU), where both sustainability certifications and stringent food safety standards, such as maximum residue limits, are becoming prerequisites for market access (FAO, 2019; Kesse-Guyot et al., 2020). These policy and market dynamics suggest that biofertilizers sit at the intersection of national goals for soil and water restoration and shifting global standards, but remain poorly integrated into Kenya's formal agricultural input system.

This paper examines the political and institutional factors shaping the integration and scaling of biofertilizers within Kenya's agricultural input system. Using political economy and policy coherence lenses, the analysis investigates how biofertilizer-related objectives are framed, supported, and implemented across different levels and sectors of government. It evaluates three dimensions of coherence: vertical coherence (the alignment between national policies and county-level implementation), horizontal coherence (the alignment between agriculture, water, and environmental policy domains), and internal coherence (the consistency between stated goals and the instruments used to deliver them). The core research question guiding this analysis is: What political and institutional dynamics shape incoherence in Kenya's agricultural input policies, and how do these dynamics affect efforts to mainstream biofertilizers? Particular attention is paid to how political incentives, input structures, and competing interests among state agencies, fertilizer suppliers, and donors contribute to the gap between policy commitments and operational practice.

While the primary focus of this analysis is on national policy dynamics, the biofertilizer agenda must also be understood through the lens of water resource management, climate adaptation and mitigation, and broader environmental sustainability. Biofertilizers are increasingly recognized not only for their role in improving nutrient delivery but also as low-emission, climate-adaptive technologies that contribute to soil carbon restoration, reduced nitrogen losses, and improved water retention (FAO 2019; Lal 2004; Jones et al. 2013; Adediran et al. 2022; Sanginga and Woolmer 2009). As part of the broader waste-into-use agenda, composting—arguably the earliest form of circular agriculture—embodies this logic, having been practiced for thousands of years to recycle organic waste into productive soil amendments. Studies from Africa demonstrate that organic fertilizers enhance soil structure, increase moisture-holding capacity, and contribute to carbon sequestration by building soil organic matter—benefits that help buffer crops against drought stress and reduce irrigation frequency in water-scarce regions (Lal, 2004; Jones et al., 2013; Gweyi-Onyango et al., 2020). These soil-water interactions have important implications for sustainable irrigation development and catchment-level resilience—core adaptation goals identified in Kenya's National Climate Change Action Plan (NCCAP 2018–2022) and the National Irrigation Sector Investment Plan (NISIP 2020–2030). These benefits are especially relevant for Kenya's semi-arid regions, where degraded soils and unreliable rainfall limit agricultural productivity. From a climate mitigation perspective, biofertilizers also reduce the release of harmful gases linked to chemical fertilizer use and water pollution, aligning with Kenya's goals under its Nationally Determined Contribution to lower emissions from the agriculture sector (Government of Kenya, 2020). These combined advantages suggest that biofertilizers should not be treated solely as an agricultural input, but as part of a wider environmental and water strategy. However, unlocking this potential requires deliberate policy coherence and institutional coordination between agriculture, environment, and water agencies, which this paper finds is currently weak in Kenya's policy landscape.

This paper contributes to a growing body of scholarship on fertilizer subsidy reform, soil and water management, and agricultural policy transformation in low- and middle-income countries. It offers a detailed, Kenya-specific case study of how public input programs, often shaped by entrenched political incentives, legacy institutional structures, and external donor prescriptions, can be assessed and potentially reoriented to accommodate biofertilizer adoption. By analyzing the interaction between policy design, institutional fragmentation, and competing actor interests, the paper advances understanding of why reform efforts succeed or stall in complex policy environments. While grounded in Kenya, the analysis speaks to broader questions of how governments globally can reconcile agronomic goals with environmental constraints, and how input systems can evolve to meet both domestic production needs and external market standards. In doing so, it contributes to ongoing debates on the political and institutional conditions necessary for credible, implementable, and coordinated transitions toward more climate-resilient forms of agriculture.

Analytical Framework and Methods

This study employs a political economy and policy coherence lens to investigate why biofertilizers—despite increasing rhetorical prominence in Kenya's agricultural discourse—remain structurally excluded from national input support systems. The analytical framework draws on the premise that agricultural input reform is not solely a technical or agronomic process, but a politically negotiated one, shaped by institutional mandates, sectoral boundaries, and the distribution of power and incentives among state and non-state actors. Building on Candel

and Biesbroek (2016) and recent contributions by Sanchez Ramirez, Nicol, and Eldabbagh (2024), policy coherence is conceptualized along three interrelated dimensions: horizontal coherence, referring to alignment between sectors or ministries at the same level of governance (e.g., agriculture, environment, and water); vertical coherence, denoting the degree to which national policy ambitions are translated into subnational implementation structures (e.g., counties and extension systems); and internal or implementation coherence, assessing whether individual policies are consistent in their objectives, delivery mechanisms, and institutional mandates. These dimensions are not independent; weaknesses in one area often reinforce fragmentation across others. The coherence literature underscores that alignment of goals is a necessary but insufficient condition for reform—effective coherence requires institutionalized mechanisms for joint planning, cross-sector budgeting, and shared accountability (Candel & Biesbroek, 2016; Sanchez Ramirez et al., 2024). In complex policy domains such as climate-resilient agriculture, coherence acts as a precondition for system-wide uptake of innovations that straddle sectoral mandates. For instance, the OECD-FAO (2023) review of Nigeria's food, land, and water systems highlights how interministerial disjuncture, especially between agriculture and environment ministries, are perpetuated by fragmented funding streams, bureaucratic turf politics, and the absence of formal coordination platforms. These findings point to the structural nature of incoherence, which, in Kenya's case, continues to marginalize biofertilizers as policy aspirations without operational leverage.

Methods used for data collection and analysis include secondary and gray literature review, stakeholder mapping, and semi-structured interviews. The qualitative policy and document analysis of Kenya's core policy frameworks shaping the agricultural input landscape include the National Soil Fertility Policy (2023), the Climate-Smart Agriculture Strategy, the Agricultural Sector Transformation and Growth Strategy, the National Fertilizer Policy, the Water Act (2016), the National Water Master Plan (2014), and the National Irrigation Sector Investment Plan 2020–2030. These documents were reviewed for explicit references to biofertilizers, organic inputs, and soil health restoration, as well as the clarity of implementation instruments, institutional mandates, and coherence across sectors and scales. The study also incorporates stakeholder mapping of key actors involved in fertilizer policy design, regulation, and distribution. This includes government agencies such as the Ministry of Agriculture and Livestock Development, the National Environment Management Authority, the National Treasury, and regulatory bodies like the Kenya Plant Health Inspectorate Service and the Pest Control Products Board.

Finally, semi-structured interviews were conducted with two Kenya-based biofertilizer enterprises—Rebug2Debug and EcoRich Solutions—to capture firm-level perspectives on regulatory, operational, and institutional barriers shaping the biofertilizer sector. Rebug2Debug, a climate-tech enterprise operating across East Africa, emerged from a collaboration between WFP Rwanda and the agri-biotech company PROTEEN as part of the Rebug2Debug Solution, which uses Black Soldier Flies to rapidly convert post-harvest food crop residues and other biodegradable waste streams into organic fertilizer (Joly and Nikiema, 2019; WFP Innovation Accelerator, 2024). The approach aims to simultaneously tackle food waste management and soil degradation by producing regenerative inputs from circular economy models. According to WFP reports, the initiative established a production facility in Rwanda with a monthly capacity exceeding 200 metric tons of organic fertilizer, with active plans to scale operations into Kenya and Uganda (WFP Innovation Accelerator, 2024). EcoRich Solutions, established in Nairobi in 2013, produces organic fertilizer through decentralized composting technologies that transform urban food market waste into nutrient-rich soil inputs for smallholder and peri-urban farmers. Its flagship product, "EcoRich Gro+," is now used in Nairobi's peri-urban horticultural zones and has received positive feedback from farmer associations.

Overall, the analytical framework and methods offer a consistent approach for examining how policy design, institutional incentives, and stakeholder power dynamics shape the marginalization of biofertilizers within Kenya's agricultural input system. By combining policy coherence analysis with qualitative document review, institutional mapping, and enterprise-level interviews, the study seeks to uncover the concrete administrative, regulatory, and political conditions that determine which inputs are formally recognized, publicly supported, and widely distributed. This approach provides the foundation for the next section, which maps the institutional landscape governing input policy and explores how responsibilities, incentives, and authority are distributed across agencies in ways that systematically constrain the integration of biofertilizers into Kenya's agricultural programs.

Mapping Policy (In)Coherence and Institutional Constraints in Scaling Biofertilizers

As biofertilizers gain rhetorical traction in Kenya's agricultural policy discourse, the extent to which these commitments are embedded in institutional arrangements, regulatory instruments, and financing structures remains limited. While organic inputs appear across strategies related to agriculture, environment, and climate resilience, the operationalization of these commitments varies considerably across sectors and levels of government. Applying a policy coherence lens—distinguishing among horizontal (across ministries and sectors), vertical (between national and subnational levels), and internal (within individual policies)—reveals that coherence is not simply a matter of shared objectives but of functional alignment between mandates, regulatory clarity, and resource allocation. Weaknesses across these dimensions reinforce one another, constraining the integration of

biofertilizers into national input systems. The analysis below illustrates how Kenya's fragmented policy architecture, institutional silos, and ambiguous regulatory environment continue to limit the mainstreaming of biofertilizers.

A review of Kenya's core agricultural and climate policies shows growing rhetorical interest in transitioning toward sustainable intensification, input diversification, and ecological restoration. However, they do not outline consistent implementation instruments to achieve this, with explicit mandates regarding which agency is responsible for developing or enforcing standards for biofertilizers, budget lines, or institutional structures for execution, raising **internal incoherence**. Their implementation instruments still prioritize chemical fertilizers. The National Soil Fertility Policy (2023) provides the most explicit reference, positioning biofertilizers alongside compost and manure within an integrated soil management strategy aimed at reversing nutrient depletion and rebuilding organic matter. However, this recognition remains largely rhetorical within implementation instruments, which continue to prioritize chemical fertilizers—often reinforced by national seed strategies focused on hybrids and genetically modified crops, as well as by global philanthropic and development actors, including AGRA and the Gates Foundation.[1] Moreover, this policy provides no regulatory framework for biofertilizers, no resources for quality assurance, and no mandate for their inclusion in public extension or subsidy programs. The Climate-Smart Agriculture Strategy identifies biofertilizers as "low-emission alternatives" to chemical nitrogen fertilizers, linking them to soil carbon restoration and reduced emissions. However, it lacks detail on how biofertilizers or other low-emission inputs will be promoted or scaled, and its monitoring framework fails to disaggregate indicators by input type, leaving their role in adaptation or mitigation unclear. Moreover, the Agricultural Sector Transformation and Growth Strategy (ASTGS) (2019–2029) presents a vision of sustainable agriculture driven by innovation and climate resilience, yet its operational focus is almost entirely on expanding private-sector-led fertilizer blending and digital e-voucher systems for synthetic inputs. It proposes infrastructure upgrades and distribution improvements for chemical fertilizers, while organic alternatives receive minimal attention and no budgetary support. As a result, business-as-usual input distribution persists even amid worsening environmental degradation.

Beyond the agricultural sector, Kenya's environmental and climate frameworks provide even less operational support for biofertilizers. The National Climate Change Action Plan (NCCAP 2018–2022) identifies soil health as a priority and references organic agriculture, but does not specify particular input categories or link soil restoration goals to subsidy reforms or investment priorities. Likewise, the Ministry of Water, Sanitation, and Irrigation, through the National Irrigation Policy (2017) and the National Water Master Plan 2030 (2014), highlights land degradation and declining soil structure as key challenges undermining water retention and irrigation efficiency, especially in semi-arid regions. The Water Act (2016) and Water Master Plan raise concerns about watershed degradation and agrochemical runoff, yet offer no reference to alternatives such as biofertilizers. This omission is also seen in the National Irrigation Sector Investment Plan (NISIP) 2020–2030. While it highlights the urgency of sustainable land and water management, its focus remains on irrigation infrastructure, scheme modernization, and service delivery—without considering how biofertilizers could support long-term water conservation and alleviate water stress. This lack of integration is notable given clear agronomic evidence: a 1% increase in soil organic matter can boost water-holding capacity by over 20,000 liters per hectare (Lal, 2004), and studies from Africa show that organic inputs reduce irrigation frequency and improve drought resilience (Jones et al., 2013; Gweyi-Onyango et al., 2020). Without aligning soil and water policy instruments, Kenya risks missing key synergies vital to climate-resilient agriculture.

One of the most fundamental regulatory barriers to the mainstreaming of biofertilizers in Kenya is the absence of an official set of technical standards to define what qualifies as a biofertilizer, creating a foundational internal incoherence barrier to their integration into public programs and regulated markets. While chemical fertilizers are governed by established nutrient composition standards, moisture levels, and packaging requirements under the Fertilizers and Animal Foodstuffs Act (Cap 345), no equivalent frameworks currently exist for organic inputs. As a result, biofertilizers lack formal recognition in Kenya's regulatory framework. As observed in broader African assessments (FAO 2019; Jayne and Sanchez 2021; Vanlauwe et al. 2019), this gap makes it impossible to evaluate or register them according to clearly defined criteria. This gap extends to key dimensions of product quality: there are no established benchmarks for microbial composition, no efficacy thresholds tied to soil or crop performance, and no biosafety protocols to ensure that live microbial agents do not pose environmental or health risks. Without such standards, regulatory agencies, including the Kenya Bureau of Standards (KEBS), the Kenya Plant Health Inspectorate Service (KEPHIS), and the Pest Control Products Board (PCPB), lack the legal mandate or technical reference points to certify organic inputs. Besides certification, the regulatory system also lacks basic monitoring and enforcement mechanisms needed to inspect the quality and safety of biofertilizers once they are on the market. This means no government agency is responsible for checking whether the information on a biofertilizer label is accurate, whether the product still works effectively by the time it reaches farmers, or whether it meets basic safety and performance requirements. As a result, poor-quality and misrepresented products can easily circulate, with no penalties and sanctioning mechanisms in place. This

[1] These productivity-focused approaches depend on proprietary seed and input packages, reinforcing a path dependency around synthetic fertilizers and limiting space for biofertilizers within mainstream agricultural support systems.

absence of market-level oversight mirrors findings from Ghana, where IWMI-led research has shown that regulatory institutions lack the technical capacity, laboratory infrastructure, and institutional clarity to monitor biofertilizer quality, leading to a proliferation of ineffective or adulterated products in the market (Drechsel et al., 2015; Danso et al., 2019). The Ghana experience highlights the need not only for certification protocols, but for robust systems of post-market surveillance and enforcement—an area that also remains underdeveloped in Kenya.

This regulatory gap creates uncertainty not only for suppliers but also for farmers, government actors, and donors, who are reluctant to fund or scale fertilizers that lack official verification. Suppliers developing credible biofertilizers have no pathway to formal recognition or public procurement. The absence of monitoring and sanctioning mechanisms rewarding quality and punishing fraud discourages credible firms from entering the market. Unlike synthetic fertilizers, which undergo batch testing and must meet minimum nutrient content thresholds, biofertilizers in Kenya are not subject to any mandatory quality assurance checks. As a result, even well-formulated products struggle to gain trust among extension officers, agrodealers, and farmers. Indeed, scholars have shown that in the absence of certification protocols, markets for organic inputs often become flooded with low-quality or unverified products, further eroding farmer trust and diminishing demand (Rao, 2020; FAO, 2019). Farmers and extension officers cannot be assured of product safety and performance. The lack of standards also weakens donor alignment, as international partners are hesitant to co-finance inputs not recognized by the national regulatory system (IFDC, 2021a). This gap has created a credibility deficit that undermines investment, crowds out innovators, and deters the formation of a robust commercial ecosystem for organic inputs (FAO, 2019; Rao, 2020; Raviv et al., 2022). Moreover, in the absence of specific inspection frameworks guiding routine inspections during biofertilizer use, even quality products developed by local firms or research institutes remain excluded from mainstream subsidy and procurement systems. Unless Kenya adopts a legally binding standard for biofertilizer classification and evaluation, there is no pathway for credible market entry and weak incentives for producers to invest in improving the quality. The sector will remain informal, fragmented, and excluded from the country's public input distribution schemes, including extension demonstrations and the national e-voucher system, and lack formal institutional credibility.

Horizontal incoherence similarly remains a central obstacle to the mainstreaming of biofertilizers in Kenya. Agricultural, environmental, and water agencies continue to operate in silos, with little coordination on input reform or soil health strategies. The Ministry of Agriculture and Livestock Development (MoALD), which oversees the National Fertilizer Subsidy Program, digitized through e-vouchers, manages this flagship intervention independently, with an operational focus mainly on chemical fertilizers.[2] The program is structured to deliver chemical fertilizers through targeted e-vouchers, with no provision for organic alternatives. There are no established procedures for including biofertilizers in subsidy programs, public procurement channels, or extension curricula. Besides, no directorate or technical unit within MoALD is tasked with developing, procuring, or regulating organic inputs. In the meantime, the fertilizer subsidy program design involves limited formal engagement from other ministries whose mandates are directly affected by fertilizer use. For example, the Ministry of Environment, Climate Change and Forestry and its implementing agency, the National Environment Management Authority (NEMA), have repeatedly warned of the environmental risks linked to synthetic fertilizer use, including nitrate leaching, eutrophication, and soil biological depletion (MoE, 2021; NEMA, 2022). Yet these agencies are not systematically involved in input policy design, regulation, or standard setting for alternatives. Studies (IFDC 2021b; Mucheru-Muna et al., 2022) consistently argue that the absence of defined standards for microbial efficacy, safety, and labeling remains one of the most significant constraints to developing a credible biofertilizer market in Kenya. Without deliberate coordination structures, biofertilizers will remain institutionally peripheral and excluded from systemic uptake.

Donor-funded projects and private sector actors occupy important but highly siloed roles in Kenya's fertilizer landscape, underscoring horizontal incoherence between state and non-state initiatives. International organizations such as the International Fertilizer Development Center (IFDC), the Alliance for a Green Revolution in Africa (AGRA), and the African Development Bank (AfDB) have supported pilots introducing biofertilizers, strengthening local manufacturing, or promoting microbial inoculants through demonstration plots and farmer trainings (AGRA 2019; IFDC 2021b). Similar regional programs, such as the Gates-funded N2Africa project, which scaled rhizobial inoculants for grain legumes in countries including Kenya, Rwanda, Ghana, and Nigeria, demonstrate that donor-led biofertilizer initiatives can achieve agronomic gains and build farmer awareness, but often remain weakly connected to core public input systems and national regulatory reforms (Ronner et al. 2016; Vanlauwe et al. 2019). This raises broader questions about the long-term institutional embedding of such innovations, and whether external investments are reinforcing parallel delivery channels rather than driving systemic reform. In Kenya, most such pilots sit outside the National Fertilizer Subsidy Program and are not institutionally linked to MoALD's e-voucher schemes, to NEMA's soil and water quality mandates, or to KEPHIS and PCPB's emerging discussions on microbial standards.

[2] While the subsidy scheme itself is publicly financed, donors such as the African Development Bank have supported complementary interventions—co-financing fertilizer value chain infrastructure, credit schemes, and procurement systems to enhance supply and delivery (AfDB, 2023).

Private suppliers, for their part, interact primarily with donors and NGOs rather than with coordinated public procurement or extension channels, and face opaque approval processes and uncertain routes into government-supported distribution networks (Mucheru-Muna et al. 2022; IFDC 2021b). For example, companies like MEA Ltd—one of Kenya's leading fertilizer manufacturers—have produced rhizobial inoculants such as Biofix, originally developed by the University of Nairobi's MIRCEN center and scaled through collaborations with the International Center for Tropical Agriculture (CIAT) and N2Africa, a Gates-funded initiative promoting biological nitrogen fixation in grain legumes (Ronner et al., 2016; Vanlauwe et al., 2019). However, biofertilizers remain a marginal and under-supported segment of these firms' portfolios. Similarly, SMEs, such as EcoRich and Rebug2Debug, which produce compost-based and insect-derived fertilizers respectively, report barriers in navigating licensing, certification, and subsidy systems, often relying instead on fragmented NGO partnerships or informal distribution networks (interview data, 2025). Even larger firms such as KEL Chemicals, while expressing interest in organic input markets, have yet to bring major biofertilizer products to market, underscoring the limited commercial incentives under Kenya's current regulatory framework. The result is a fragmented field in which biofertilizers circulate through project-based, geographically limited interventions while national subsidy programs, environmental agencies, and commercial distributors largely continue to operate around chemical fertilizers. This lack of structured forums, joint investment frameworks, or shared monitoring arrangements across government, donors, and industry exemplifies horizontal incoherence: actors work in parallel on soil health and microbial inputs, but without the coordination needed to move biofertilizers from small-scale pilots into Kenya's mainstream input architecture.[3]

Devolution introduces a further layer of fragmentation through vertical incoherence: national strategies articulate diversification toward organic inputs, but counties, responsible for delivery, lack the mandates, budgets, and technical capacity to implement these ambitions. Although policies such as the National Soil Fertility Policy 2023 and the Climate-Smart Agriculture Strategy (2017–2026) refer to sustainable input transitions, they provide no conditional grants, regulatory guidance, or performance incentives to steer counties away from chemical fertilizer procurement. County agriculture budgets, as shown in recent analyses by the International Budget Partnership (IBP) and Kenya Institute for Public Policy Research and Analysis (KIPPRA), remain dominated by recurrent costs, leaving little fiscal space for piloting biofertilizers or conducting demonstrations (IBP 2021; KIPPRA 2023). Extension systems mirror this gap: extension staff are rarely trained on biofertilizers, lack protocols for handling or assessing organic products, and have no directives to incorporate them into routine advisory services. Devolution has been shown to create opportunities for local experimentation, but uneven capacity, political patronage, and weak planning frameworks shown in the literature (Boone et al. 2019; Wanyama 2022) mean that most counties default to the inputs supplied through national procurement systems —raising questions about how political incentives and pressures shape these choices behind the scenes.

This institutional fragmentation is echoed across many African countries, where coherence failures—horizontal, vertical, and internal—undermine the integration of sustainable inputs into national agricultural systems. Horizontally, agricultural ministries in African countries, including Ghana, Zambia, and Nigeria, tend to dominate fertilizer subsidy design, with limited input from environment or health agencies, leading to siloed policies that prioritize short-term yield gains over long-term ecological outcomes (Jayne & Sanchez, 2021; Duden & Zegzouti, 2024). Vertically, national commitments to agroecological transition often fail to trickle down to subnational implementation, as seen in Ethiopia's attempts to scale rhizobial inoculants, where lack of coordination with regional governments and extension systems stalled uptake (Raimi, 2021). Internally, inconsistencies between policy objectives and delivery instruments are common—for instance, Nigeria's agricultural frameworks reference organic fertilizers in principle, yet actual subsidy disbursements remain dominated by chemical inputs due to procurement bottlenecks and supplier interests (FAO, 2019). In contrast to countries such as India and Brazil, which have taken deliberate steps to build coherence across ministries of agriculture, environment, science, and rural development, other governments, such as Sri Lanka, have faced major disruptions after abrupt policy shifts, such as the now-infamous 2021 ban on chemical fertilizers, which led to widespread yield declines and food insecurity, as addressed by the World Bank (2022). These efforts produced unified regulatory frameworks, national awareness campaigns, and dedicated public funding streams that catalyzed biofertilizer adoption (Mahapatra et al., 2020; FAO, 2019). For Kenya, the lesson is clear: addressing policy fragmentation will require not just rhetorical alignment but the deliberate restructuring of institutional responsibilities, funding mechanisms, and regulatory mandates to ensure biofertilizers are supported as part of a coordinated and credible agricultural transition.

Overall, Kenya's fertilizer policy is shaped by overlapping mandates, poor coordination, and uneven implementation, which have kept biofertilizers out of major public programs. While national strategies increasingly

[3] N2Africa was implemented in Kenya between 2009 and 2014 in counties including Kakamega, Bungoma, Siaya, and Vihiga, promoting rhizobial inoculants for grain legumes like soybean and climbing beans (Ronner et al., 2016; Vanlauwe et al., 2019). FAO's regional programs, such as the Soil Doctors Programme and Save and Grow, have supported microbial input awareness in Eastern Africa, including technical cooperation in Kenya, Uganda, Tanzania, and Ethiopia, but have not been integrated into national subsidy or regulatory systems. Similarly, IFDC's soil fertility work in Kenya's Central Highlands and Western regions has demonstrated the potential of microbial and organic inputs, but remains disconnected from formal input architecture (IFDC, 2021b).

mention organic inputs, they lack clear responsibilities, funding, and regulatory pathways to support their use. Ministries work in silos, with agriculture controlling subsidies while environment and water agencies remain excluded from key decisions. Counties, responsible for delivery, lack the resources and guidance to support alternatives. Even within policies, stated goals to reduce chemical dependency are not matched by budgets or action plans. As a result, biofertilizers remain sidelined, while conventional fertilizers continue to dominate. Unless the government reforms how responsibilities, budgets, and rules are shared across agencies, biofertilizers will not move beyond rhetoric.

Political Economy Barriers to Biofertilizer Reform in Kenya

Kenya's public spending on fertilizer support continues to overwhelmingly favor synthetic inputs, creating a structural constraint to the scaling of biofertilizers, despite their growing recognition in national policy documents. Strategies such as the National Soil Fertility Policy (2023) and the Climate-Smart Agriculture Strategy (2017–2026) explicitly reference the role of organic and microbial amendments in addressing soil degradation and boosting long-term fertility. Yet these commitments have not translated into fiscal allocations, regulatory guidance, or procurement pathways. As of 2023, Kenya's fertilizer subsidy program continues to fund only conventional chemical fertilizers, namely Diammonium Phosphate, Calcium Ammonium Nitrate, and Nitrogen-Phosphorus-Potassium blends, with no budgetary provision for biofertilizers or other regenerative soil amendments (National Treasury, 2023). While the subsidy scheme itself is publicly financed, donors such as the African Development Bank have supported complementary interventions—co-financing fertilizer value chain infrastructure, credit schemes, and procurement systems to enhance supply and delivery (AfDB, 2023). This disconnect reflects what scholars describe as a classic implementation gap, where policy rhetoric is not supported by institutional instruments or fiscal structures (Candel & Biesbroek, 2016; Nilsson et al., 2012).

This spending pattern is rooted in durable political and economic incentives that position chemical fertilizers as high-visibility tools of electoral politics and post-election political stabilization, rather than as inputs solely for boosting short-term agricultural production. Originally scaled up in response to the 2007–2008 post-election crisis, Kenya's national fertilizer subsidy program was designed not just to raise yields, but to signal government responsiveness and rebuild public trust—an approach actively supported by development partners seeking to restore political stability during a period of national fragility (Jayne & Rashid, 2013; Wanyama, 2022). Over time, this crisis-driven logic of subsidy provision has become institutionalized within Kenya's agricultural policy landscape. Fertilizer distribution now serves dual purposes: stimulating production while delivering highly visible political messaging. Successive administrations have strategically timed subsidy announcements to coincide with planting seasons and election cycles, with fertilizer bags distributed at rallies and referenced in presidential speeches as tangible proof of state commitment to rural constituencies. This dynamic reflects broader trends across the region, where input subsidies often function less as responses to agronomic priorities and more as political instruments to consolidate rural support, target key voter blocs, and demonstrate state presence through easily counted, visibly distributed goods (Poulton et al., 2006; Resnick & Mather, 2016; Jayne & Sanchez, 2021).

The 2022–2023 electoral cycle further marked a particularly sharp escalation in both fertilizer spending and political framing. Fertilizer subsidies had been present in Kenya's policy landscape since at least 2009, in response to the global food price crisis, but the 2022 budget allocations far exceeded historical norms. In September 2022, just weeks after the presidential transition, the government announced a KES 3.55 billion (about USD 30 million) fertilizer subsidy program aimed at distributing over 1.4 million 50-kg bags at a reduced price (AFA, 2022). This was followed by a much larger commitment: the FY2022/2023 national budget earmarked KES 16.4 billion (about USD 120 million) for fertilizer subsidies, making it the single largest agricultural expenditure that year (National Treasury, 2023). These allocations represented a near fourfold increase from FY2020/2021 (KES 4.2 billion) and more than double the levels observed in FY2017. Notably, 100% of these funds were dedicated to chemical fertilizers, with no fiscal support for biofertilizers or other sustainable inputs. This kind of "subsidy lock-in," as described by Druilhe and Barreiro-Hurle (2012), occurs when historically favored inputs, such as chemical fertilizers, become embedded in policy routines, procurement structures, and public expectations. The Kenyan case reflects this dynamic vividly. Despite the inclusion of biofertilizers in high-level policy frameworks, they have yet to appear in any national procurement tender, budget line, or e-voucher subsidy catalog. In contrast to Kenya's USD 120 million allocation fully committed to conventional inputs, some countries, such as Ghana and Zambia, have begun to pilot input diversification efforts. Ghana's Planting for Food and Jobs initiative allocated part of its USD 45 million fertilizer budget in 2021 to pilot organic blends, while Zambia's Farmer Input Support Program has introduced lime and microbial conditioners in regions with severe soil acidification (MOFA, 2021; IFDC, 2023).

The political influence of fertilizer suppliers in Kenya extends beyond procurement monopolies—it has demonstrable effects on subsidy program design, implementation timelines, and even public trust. Market assessments indicate that a handful of firms, such as MEA Ltd, Yara East Africa, and OCP Kenya, dominate Kenya's fertilizer supply chain through preferential access to tenders and close ties with the Ministry of Agriculture

and parliamentary committees (Competition Authority of Kenya 2015; Tegemeo Institute 2024).[4] This concentrated structure limits competition and reduces flexibility to incorporate new, smaller, or regenerative input providers (Jayne and Sanchez 2021). The consequences are visible: an evaluation by Tegemeo (2024) found that only 19% of registered farmers received subsidized fertilizer in 2023, with delays far exceeding those in commercial markets. Cases of substandard fertilizer delivered under the subsidy scheme—linked to opaque contracting and weak oversight—have also fueled public controversy (Business Daily 2024). Kenya's vulnerability to global supply shocks, such as the 2024 Middle East disruptions, further exposes the risks of dependence on a narrow set of chemical suppliers. These procurement structures disadvantage biofertilizers not only technologically but politically. Biofertilizers challenge a subsidy system built around bulk importation, standardized chemical formulas, rapid distribution metrics, and politically visible impacts, disrupting entrenched interests that benefit from the status quo. In contrast, microbial inputs are often produced by smaller domestic firms, research institutes, or university-linked ventures that lack the lobbying power and procurement readiness of large importers. This asymmetry is institutional rather than merely commercial (Druilhe and Barreiro-Hurle 2012; Poulton et al. 2006; Jayne et al. 2021).

Despite growing policy recognition of the need for regenerative and biological inputs, Kenyan biofertilizer companies, such as MazaoPlus BioAg, Agribusiness Solutions Ltd, EcoRich Solutions, and university-affiliated enterprises at KALRO and Egerton University, remain excluded from the National Fertilizer Subsidy Program catalog, the Ministry of Agriculture's e-voucher lists, and public tenders. The regulatory gap is central: Kenya lacks a legally codified framework for organic input registration under the Fertilizers and Animal Foodstuffs Act (Cap 345), which is designed around chemical fertilizers. Without national standards, certification procedures, or defined quality control mechanisms, biofertilizers cannot enter public distribution channels, regardless of field performance or cost-effectiveness. The subsidy's design (i.e., centralized procurement, high-volume supply, and short political timelines) further marginalizes local innovators who rely on decentralized production, farmer training, and adaptive use. Interviews and policy reviews (AATF 2021; KALRO 2022) indicate that biofertilizer firms are routinely absent from budget consultations and donor-supported reform discussions. Kenya's USD 120 million subsidy program thus remains inaccessible to the very firms producing inputs that its soil health and climate strategies endorse.

The exclusion of biofertilizers from public support programs is not unique to Kenya; similar patterns are evident across several African countries where vested commercial and institutional interests shape input policy design. In Ethiopia, attempts by universities and government research centers to promote locally produced biological soil enhancers were sidelined due to resistance from dominant chemical fertilizer suppliers and the absence of a regulatory framework to recognize non-traditional products (Raimi, 2021). In Ghana, early provisions to pilot organic inputs under the Planting for Food and Jobs program were reportedly withdrawn after major importers of inorganic fertilizers cited concerns about reliability and distribution complexity (Duden and Zegzouti, 2024). In Nigeria, although national agricultural strategies reference biofertilizers as part of sustainable farming goals, producers have been excluded from government tenders due to a lack of standards, certification, and procurement guidelines (FAO, 2019). These cases illustrate how subsidy systems built around chemical inputs systematically and deliberately marginalize ecological alternatives.

Donor and private sector actors add another layer of political economy dynamics. Across Africa, donors have historically supported fertilizer subsidies as vehicles for yield increases, traceability, and rapid program delivery (Jayne et al. 2018; Mather & Jayne 2016). These systems, including e-vouchers, centralized procurement, and market efficiency initiatives, align poorly with decentralized production models of biofertilizers. In Kenya, partnerships such as the African Fertilizer and Agribusiness Partnership (AFAP) and Sustain Africa, supported by AGRA, GIZ, and the African Development Bank, prioritize chemical fertilizer market efficiency but seldom integrate organic inputs. While these actors are increasingly engaged in dialogues on soil health and climate-smart agriculture, their operational footprints remain closely tied to chemical inputs. At the same time, the donor landscape is fragmented. While some climate adaptation and agroecology portfolios (e.g., FAO soil health frameworks, Green Climate Fund pipeline proposals) are beginning to support organic inputs, these remain peripheral relative to mainstream agricultural development assistance. This asymmetry reinforces a system in which performance is measured through volumes delivered, hectares covered, and political visibility—metrics that favor chemical fertilizers. These indicators align closely with the interests of large importers, commercial farms, and export-oriented value chains, further marginalizing regenerative alternatives that offer long-term sustainability but fall outside conventional performance benchmarks.

[4] Yara East Africa Ltd and MEA Ltd together account for an estimated 70–80% of Kenya's fertilizer supply and have served as the principal contractors under the national subsidy program, largely due to their ability to procure large volumes and manage complex logistics—capabilities that create structural entry barriers for smaller competitors (Competition Authority of Kenya, 2015).

Empirical Insights from Biofertilizer Enterprises

Interviews with two biofertilizer enterprises—EcoRich Solutions and Rebug2Debug—provide empirical support for the structural and regulatory exclusion patterns identified in this paper. Both companies report significant barriers to formal market entry, despite demonstrable success in producing effective biofertilizers from organic waste streams. In Kenya, EcoRich has pioneered a "waste-to-fertilizer" system that converts municipal food market waste into biofertilizer, targeting affordability for smallholder farmers. Despite recycling over 4,000 tons of waste and distributing 12,000 units of fertilizer to more than 7,000 farmers, the company remains excluded from formal subsidy schemes, procurement tenders, and regulatory recognition due to the absence of certification procedures for its production process. The core regulatory barrier behind this exclusion lies in the absence of a legal framework for certifying waste-conversion technologies or standardizing biofertilizer outputs—a gap similarly documented in Ghana and other West African countries, where IWMI-led research (Cofie et al., 2014; Nikiema et al., 2020) has emphasized the need for cross-sectoral collaboration, simplified quality standards, and clearer institutional mandates to integrate waste-based fertilizers into national input systems. While EcoRich has received provisional endorsements from relevant authorities, such as the Kenya Bureau of Standards (KEBS), the National Environment Management Authority (NEMA), and soil laboratories under the Ministry of Agriculture, the lack of formally codified standards for organic composition, process validation, and environmental safety has delayed full certification. As the founder notes, "There is no policy framework that supports circular economy innovators… we are still navigating approvals because there is no regulation for our kind of process." This institutional void not only limits market access but also deters investment and inhibits the formalization of new technologies.

Moreover, the interviews with EcoRich point to a deeper problem of institutional fragmentation. Regulatory authorities NEMA and KEBS were described by EcoRich as supportive in principle but slow, inconsistent, and uncoordinated in practice. While KEBS approved the nutrient quality of EcoRich's fertilizer, it has not issued certification for the waste-conversion machine called "waste pod" due to the absence of a defined standard for such a process. Meanwhile, NEMA initially opposed the establishment of EcoRich's first plant on the grounds that waste must be processed in remote, non-residential areas—a stipulation based on outdated assumptions about emissions and health risks. Only after repeated inspections and demonstrations did NEMA tacitly approve the plant's operation, though no formal certification was granted. This bureaucratic ambiguity common in many emerging bioeconomy sectors produces an institutional gray zone where enterprises are neither fully regulated nor fully supported. As scholars have observed in similar settings, such "liminal regulation" generates compliance uncertainty, deters investors, and stifles innovation (Ahlborg and Nightingale, 2018; Stirling, 2014). As the founders emphasize, they are "still waiting for final certification" even after years of compliance, due to the absence of codified standards for their model.

Rebug2Debug, which operates across Rwanda, Uganda, and Kenya, reports similar bottlenecks in regulatory ambiguity and bureaucratic delay. The company uses insect bioconversion (black soldier flies) to turn food processing waste into organic fertilizer. Despite producing over 200 metric tons per month in Rwanda, the enterprise remains trapped in regulatory limbo due to slow-moving and fragmented certification processes. In Uganda, the company succeeded in obtaining a trading license from the Uganda National Bureau of Standards after rounds of testing and appeals and extensive lobbying to persuade the Uganda National Bureau of Standards to revise their testing protocols to suit bio-based formulations, during which authorities were reportedly unsure how to evaluate their product using conventional synthetic fertilizer benchmarks. Rebug2Debug's Uganda operations now have partial permits, but a key export license from the Ministry of Agriculture and Animal Industry remains pending, restricting cross-border trade.

In Rwanda, Rebug2Debug continues to face long certification delays due to limited technical capacity, inconsistent communications, and institutional confusion about how to assess organic fertilizers made from insect-based compost. The enterprise reports having spent months navigating between regulatory agencies without clarity on testing criteria, licensing requirements, or the responsible authority for organic input registration. As one team member explained, "the people testing our products do not even know what they are testing for," indicating a significant institutional knowledge gap. Moreover, delays from agencies, including the Rwanda Bureau of Standards (RBS) and the Rwanda Inspectorate, Competition and Consumer Protection Authority (RICA), have left the company operating in a legal gray zone. "Even when samples are taken, results take four months… moisture levels change and invalidate the tests," noted another member, highlighting how current procedures fail to accommodate the biological properties of organic inputs.

Both cases of EcoRich and Rebug2Debug illustrate how biofertilizer firms are systematically excluded not only by gaps in policy design, but also by institutional practices that reflect and reproduce the dominance of chemical input regimes. While there is little evidence of overt lobbying conflict, interviewees consistently emphasized their exclusion from procurement frameworks, lack of consultation in national budget processes, and absence from donor-aligned programs. As one EcoRich founder explained, "We are still selling… but the only certificate we don't have is for our machine, because it's the first of its kind. There is simply no regulatory platform to classify it under." These findings point to the urgent need for regulatory reform, starting with the development of clear standards, time-bound certification pathways, and cross-agency coordination mechanisms. Without these, Kenya

and its neighbors risk continuing to marginalize enterprises that are developing precisely the kinds of decentralized, low-emission, and water-efficient solutions needed for long-term soil health and climate resilience.

The interviews also reveal how biofertilizer enterprises must navigate not only regulatory uncertainty but also informal political and economic constraints that are rarely acknowledged in policy discourse. For instance, EcoRich reported informal competition over waste sourcing, including pushback from vested interests and "waste cartels" operating in Nairobi's food markets. These cartels—informally organized networks deriving income from traditional landfill-based waste flows, informal hauling contracts, and the extraction of resaleable materials, including plastics and organics—view circular economy innovations as threats to their business models. In the early stages, EcoRich was unable to secure a consistent waste supply for its waste-to-fertilizer process due to active resistance from these actors. According to EcoRich, local cartels "fought us back" when the company attempted to source clean organic waste directly from markets, at times obstructing collection routes and undermining negotiations with vendors.

This pattern reflects broader political economy dynamics observed in Nairobi's waste management sector, where informal actors have long operated in regulatory grey zones and developed vested interests in maintaining control over resource flows (Aligula et al., 2019; Mitullah & Oucho, 2018). Scholars have noted that while informal waste collectors play a vital role in service delivery, especially in underserved neighborhoods, their role in obstructing formal circular innovations—whether out of economic competition or lack of policy integration—poses a governance dilemma (Samson, 2015; Githuku & Rotich, 2022). These findings from Kenya also align with broader findings in the literature on informal political economies of waste in urban Africa, where entrenched actors often act as "gatekeepers" to material flows and actively resist interventions that alter revenue streams (Myers, 2005; Simone, 2004). The politics of waste has direct implications for African bioeconomy agendas: without confronting these informal power dynamics, even the most technically sound biofertilizer innovations may fail to scale.

To circumvent these blockages, EcoRich began working directly with women's groups and neighborhood households, offering small incentives, including cash, vegetables grown on a demonstration plot using their fertilizer, and other forms of in-kind compensation, in exchange for clean, source-separated organic waste. This approach not only reduced dependence on contested municipal market access but also created localized ownership over the waste diversion process. As emerging literature suggests, such hybrid models that blend community organizing with enterprise-led innovation may be more effective in navigating the contested terrain of urban resource systems (Schindler, 2017; Njenga et al., 2020). Although EcoRich's workaround by mobilizing community-based waste collection and sorting demonstrates resilience, it also underscores the state's failure to provide an enabling ecosystem for regenerative inputs—whether through protected access agreements, waste zoning reforms, or integrated licensing regimes.

Water and Soil Policy Linkages

Biofertilizers are not only nutrient inputs—they are critical tools for strengthening the soil–water interface, yet this dimension remains largely absent from Kenya's agricultural and water policy frameworks. By increasing soil organic matter, biological amendments improve soil structure, porosity, infiltration, and moisture retention, thereby enhancing resilience to both drought and excessive rainfall. Degraded soils with low organic carbon store less moisture, absorb rainfall poorly, and are more prone to erosion, undermining the performance of rainfed and irrigated systems alike. Empirical studies show that a 1% increase in soil organic carbon can raise water-holding capacity by over 20,000 liters per hectare (Lal, 2004), while research from Kenya demonstrates that organic inputs reduce water stress and improve infiltration (Mugwe et al., 2009; Jones et al., 2013; Gweyi-Onyango et al., 2020). Despite this evidence, Kenya's water-sector strategies, such as the National Irrigation Policy (2017), the Water Act (2016), and the National Water and Sanitation Investment Plan (2020), do not integrate soil input reform or biofertilizers into watershed management, irrigation planning, or land restoration priorities. This omission reflects weak cross-sectoral coordination, where agricultural and water institutions continue to operate in silos—preventing the integration of soil health and organic inputs into water policy, despite clear evidence of their role in enhancing water productivity and climate resilience.

A growing body of global literature increasingly frames organic inputs as cost-effective strategies for climate adaptation, especially in semi-arid regions where water scarcity constrains productivity. Biofertilizers and other biological inputs rebuild soil structure, reduce surface runoff, and improve root-zone moisture availability, thereby lowering drought-related crop failure (FAO, 2019; Yadav et al., 2017; Abukari & Maiga, 2020). Yet Kenya lacks empirical studies that systematically assess how biofertilizers influence water retention, runoff, or watershed health. Research institutions such as the Kenya Agricultural and Livestock Research Organization (KALRO) and Egerton University have carried out work on soil fertility and organic inputs, but these efforts remain siloed within the agricultural sector and are not integrated with water resource management research. The absence of cross-sectoral evidence diminishes the visibility of biofertilizers in climate adaptation programs, natural resource management strategies, and water-focused donor initiatives.

Despite the strong ecological rationale for integrating soil and water management, Kenya's policy framework does not translate this relationship into coordinated action. The National Irrigation Policy (2017), the Water Act (2016), the National Water and Sanitation Investment Plan (2020), and the National Irrigation Sector Investment Plan (NISIP 2020–2030) all identify land degradation, low soil water retention, and declining watershed performance as major constraints to irrigation efficiency and agricultural productivity. Yet none of these instruments link these challenges to declining soil organic matter or recognize soil input reform, such as scaling biofertilizers, as part of the solution. Although the Ministry of Water, Sanitation, and Irrigation acknowledges that improved land and water use efficiency underpins drought resilience and irrigation performance, it plays no role in shaping soil fertility policy, which sits solely under the Ministry of Agriculture and Livestock Development. This institutional separation exemplifies horizontal incoherence as previously discussed: sectoral policies are developed independently despite overlapping objectives. As a result, biofertilizers remain absent from water-sector planning, and Kenya misses a clear opportunity to advance both soil restoration and water-use efficiency in climate-vulnerable farming systems.

The consequences of such institutional fragmentation are significant. First, Kenya misses opportunities to leverage biofertilizers to reduce chemical nutrient runoff into rivers and lakes, enhance soil moisture capacity, and improve watershed resilience. Second, because benefits span multiple sectors, no single institution assumes responsibility for promoting or financing biofertilizers, reducing incentives for coordinated investment. As the policy coherence literature points out, shared objectives alone are insufficient; meaningful policy alignment requires joint budgeting mechanisms, cross-ministerial implementation structures, and clearly defined institutional mandates (Nilsson et al., 2012; Candel & Biesbroek, 2016). In Kenya, the absence of such mechanisms confines biofertilizers to farm-level soil fertility debates rather than situating them within broader hydrological and climate-resilience strategies.

Kenya lacks evidence on how soil inputs like biofertilizers affect water retention, use, and quality, limiting coordinated policy action. Although national institutions like the Kenya Agricultural and Livestock Research Organization (KALRO) and Egerton University have conducted studies on soil fertility and promoted the use of organic inputs, these efforts remain largely confined to the agricultural domain. There is little empirical research that systematically examines how biofertilizers contribute to improved water retention, reduced runoff, or broader watershed health—gaps that are especially glaring in semi-arid and degraded landscapes. This lack of cross-sectoral evidence reduces the visibility of biofertilizers in climate adaptation initiatives, natural resource management strategies, and water-focused donor programs. As a result, regenerative inputs remain absent from the design of multi-sectoral investment frameworks, despite their potential to generate shared environmental and economic benefits. The structure of Kenya's research and policy institutions—organized along narrow sectoral lines—thus contributes to a self-reinforcing cycle: because soil and water benefits are not jointly studied, they are not jointly funded or implemented, which in turn limits incentives for the kind of innovation needed at the intersection of land restoration and water resilience.

Discussions of soil water retention and fertility are inherently linked to agricultural productivity and income generation, positioning biofertilizers not only as environmental sustainability tools but also as critical instruments within broader poverty alleviation and rural development strategies. Growing evidence from Kenya and the wider region shows that biofertilizers can match or even exceed the yield performance of chemical fertilizers on smallholder farms, while simultaneously improving soil structure, organic carbon, and water-holding capacity (Mugwe et al., 2009; Gweyi-Onyango et al., 2020; Lal, 2004; Jones et al., 2013). Long-term trials in Kenya's Mbeere and Meru South regions found that compost and manure-based inputs delivered maize yields of 2–4 tons per hectare—equivalent to or higher than chemical fertilizers—while enhancing resilience to drought and improving nitrogen use efficiency (Mucheru-Muna et al., 2010; Otinga et al., 2013). These agronomic gains are not marginal: they directly translate into food security, income diversification, and reduced vulnerability to climatic shocks for smallholder households, many of whom rely on rainfed plots below 3 acres in size (Sheahan et al., 2014; IFAD, 2022). Once legally and politically supported, these inputs have the potential to not only drive Kenya's agricultural transformation agenda, but to address the enduring policy trade-offs between natural resource sustainability, climate resilience, and rural poverty. Their exclusion from current input support systems is therefore not only an environmental oversight, but a missed economic and social opportunity to advance production, resilience, and equity in combination.

Integrating biofertilizers into Kenya's water and soil policy frameworks offers a strategic entry point to address intertwined challenges of water and soil resources sustainability, climate adaptation, and rural poverty alleviation. By explicitly recognizing their hydrological functions, such as enhancing infiltration, reducing surface runoff, and increasing soil moisture retention, biofertilizers could be positioned as nature-based solutions within watershed restoration, irrigation efficiency, and drought resilience programs. This would not only justify their inclusion in climate adaptation financing and integrated land management strategies but also strengthen the public policy rationale for supporting them through input subsidy schemes and extension services. Such cross-sectoral alignment is essential to break down existing institutional silos and to build broader support for regenerative soil inputs. Without these linkages, the multifunctional potential of biofertilizers will remain underleveraged, and Kenya's efforts to promote sustainable, climate-resilient agriculture will continue to fall short of their transformative potential.

Discussion

This paper has examined the institutional, political, and regulatory factors that shape how biofertilizers are treated within Kenya's fertilizer policy regime. The findings reveal that despite growing rhetorical support in national strategies, biofertilizers remain functionally excluded from the country's mainstream agricultural input systems. This exclusion reflects deeper structural patterns embedded in how agricultural support programs are financed, regulated, and implemented—patterns that continue to prioritize large-scale procurement and distribution of chemical fertilizers to the neglect of biologically based alternatives. At the core of this dynamic is a lack of policy coherence: across sectors (horizontal), between national commitments and county-level implementation (vertical), and within individual policies that fail to align objectives with delivery mechanisms and institutional mandates (internal coherence).

Horizontally, the ministries responsible for agriculture, environment, and water operate largely in isolation when it comes to fertilizer policy. While environmental agencies like NEMA recognize the harm caused by nutrient runoff and soil degradation, they have no formal role in shaping or approving the inputs distributed under national subsidy programs. Similarly, water management policies acknowledge declining water retention and degraded catchments but fail to incorporate soil restoration inputs such as biofertilizers into irrigation planning or watershed rehabilitation strategies. As a result, biologically derived fertilizers are treated as marginal to both environmental sustainability and agricultural productivity, even though international evidence consistently shows their capacity to improve soil moisture retention, reduce runoff, and enhance drought resilience—critical outcomes in water-stressed regions like Kenya's ASALs (Lal, 2004; Jones et al., 2013; Gweyi-Onyango et al., 2020).

Vertically, the translation of national policy goals into subnational action is weak. Kenya's counties, despite being tasked with extension services and local distribution, receive little technical guidance or financial support to promote organic inputs. They operate under tight fiscal constraints, often lacking the resources to pilot new input strategies or train extension officers on organic soil inputs. This disconnect is exacerbated by the absence of conditional grants or intergovernmental coordination mechanisms that would allow counties to implement soil health programs in line with national strategies. As a result, even when national policies such as the National Soil Fertility Policy (2023) call for a transition toward integrated soil management, county governments remain locked into the distribution of chemical fertilizers—driven not only by ease of procurement and the absence of viable alternatives, but also by the political utility of fertilizers as visible, distributable goods during electoral cycles.

Internally, policies often articulate ecological and sustainability objectives, such as improving soil organic matter or reducing dependence on chemical inputs, but do not allocate funding, establish standards, or assign institutional responsibility to make these goals operational. For instance, while the Climate-Smart Agriculture Strategy (2017–2026) names biofertilizers as a low-emission input, it does not specify how they are to be approved, funded, or delivered. The National Fertilizer Subsidy Program has no provision for evaluating or subsidizing biologically based fertilizers, and no government procurement tender has included such products to date. These internal mismatches between vision and instrumentality mirror what Candel and Biesbroek (2016) term "symbolic coherence"—policy convergence in discourse without institutional or administrative follow-through.

The current system of fertilizer support remains dominated by large-scale procurement and centrally managed input distribution. This structure favors suppliers of standardized chemical inputs, who already possess the procurement capacity, regulatory approvals, and distribution infrastructure necessary to engage in public tenders. In contrast, most producers of biofertilizers, such as EcoRich and Rebug2Debug, are smaller, domestically embedded enterprises with limited access to certification pathways and no clear route into public subsidy programs. These suppliers face substantial barriers related to regulatory ambiguity, lack of product classification standards, and delays in certification, all of which prevent their inclusion in government procurement and restrict their ability to scale beyond niche or donor-driven projects.

Beyond institutional fragmentation, the persistence of chemical fertilizer dominance is also shaped by political and economic incentives. Fertilizer subsidies are highly visible government interventions, often deployed around planting seasons and election cycles as symbols of state support for rural constituencies (Jayne and Rashid, 2013; Poulton et al., 2006; Resnick and Mather, 2016). Because they are quantifiable, deliverable, and politically salient, synthetic fertilizers—whose nutrient content and volume can be standardized and procured in bulk—lend themselves to centralized distribution and electoral signaling. Biofertilizers, by contrast, are less easily commodified at scale, require localized production or adaptation, and involve more complex regulatory and training needs, making them less attractive within the prevailing political economy of agricultural service delivery.

The case of Kenya is not unique. As evidence from Ethiopia, Nigeria, and Ghana shows, biologically based fertilizers often receive rhetorical recognition in national strategies but remain systematically excluded from mainstream subsidy programs due to regulatory gaps, limited institutional coordination, and entrenched commercial interests in the chemical fertilizer supply chain. Major producers such as Yara International (Norway), OCP Group (Morocco), and U.S.-based Nutrien and Mosaic operate across Africa, often through local

subsidiaries or public–private partnerships, supplying the bulk of subsidized inputs and shaping national procurement and policy priorities in ways that disadvantage smaller or alternative input providers (AGRA, 2021; Benson et al., 2022; Mockshell & Kaminski, 2022). By contrast, countries like India and Brazil have achieved more balanced input systems by creating legal standards for organic inputs, establishing joint ministry platforms for soil and environmental health, and investing in decentralized composting or biofertilizer production at the local level (Mahapatra et al., 2020; FAO, 2019). In both countries, coordinated reforms enabled decentralized production through farmer cooperatives and research institutions, supported by government certification and subsidy frameworks. This has helped reduce the entrenched market power of chemical fertilizer suppliers while broadening access to regenerative inputs, especially for smallholders (Souza et al., 2018). These examples demonstrate that meaningful inclusion of alternative fertilizers requires targeted reforms to procurement rules, product registration processes, and institutional mandates, not simply high-level endorsements.

Finally, the discussion highlights a critical missed opportunity: biofertilizers are not only soil amendments—they are a key component of climate adaptation and mitigation strategies. Their use reduces environmental externalities from chemical fertilizers, restores soil carbon, enhances drought resilience, and improves water retention in rainfed and irrigated systems. Yet Kenya's climate, water, and agriculture strategies rarely link these outcomes in integrated ways, nor do they prioritize cross-sector investment or monitoring frameworks to track soil and water co-benefits. Without coordinated action and budgetary alignment across ministries, biologically based fertilizers will remain confined to policy margins, acknowledged in principle but unsupported in practice.

Overall, Kenya's fertilizer regime reflects a broader struggle to reconcile long-term sustainability goals with short-term political and administrative imperatives and interests. Reforming this system will require a shift away from input uniformity and centralized distribution, toward more decentralized, adaptive, and multi-sectoral support structures that can accommodate biologically diverse and environmentally aligned soil inputs. This shift will not occur through rhetorical inclusion alone. It requires deliberate changes in institutional coordination, fiscal design, regulatory frameworks, and political incentives—changes that, if enacted, could make Kenya's agricultural systems more resilient, ecologically balanced, and capable of meeting both food security and environmental restoration goals.

Conclusion

Despite growing policy attention to soil degradation, climate vulnerability, and the need for more sustainable agricultural inputs, Kenya's fertilizer regime remains structurally misaligned with these objectives. Biofertilizers—though acknowledged in key strategies such as the National Soil Fertility Policy and the Climate-Smart Agriculture Strategy—have not been meaningfully integrated into the country's regulatory, fiscal, or implementation frameworks. The evidence presented in this study shows that the exclusion of biofertilizers is not incidental. It reflects a deeper political economy in which long-standing subsidy systems, originally designed to ensure political stability and rural support, have become institutionalized around chemical inputs. Vested interests within fertilizer supply chains, combined with public procurement systems geared toward standardized, large-volume distribution, further entrench the dominance of inorganics. At the same time, fragmented mandates across ministries of agriculture, water, and environment prevent coordinated planning or budgetary alignment for alternatives. In this landscape, rhetorical support for soil health and regenerative inputs masks the absence of operational mechanisms to support their uptake. As a result, Kenya's input system continues to be defined by internal incoherence within policies, horizontal fragmentation across ministries, and vertical misalignment between national ambitions and county-level delivery.

The most immediate and necessary intervention is the development of a formal regulatory framework for biofertilizers. Without legal recognition, clear product definitions, and technical standards for efficacy, biosafety, and quality control, neither government agencies nor producers can reliably classify, evaluate, or certify these products. This regulatory gap creates uncertainty for suppliers, undermines farmer trust, and prevents the inclusion of biofertilizers in public procurement and subsidy programs. Establishing a dedicated regulatory framework—anchored in revisions to the Fertilizers and Animal Foodstuffs Act and supported by interagency coordination between KEBS, KEPHIS, NEMA, and MoALD—is a precondition for credible market participation and policy mainstreaming. It would also provide the basis for formal oversight, performance monitoring, and the protection of farmers against fraudulent or ineffective products.

In parallel, the Government of Kenya should pilot a targeted subsidy sandbox for biofertilizers—a time-bound, spatially limited public program that includes select biofertilizers in the national e-voucher system, with the sandbox being as a controlled policy experiment to test, adapt, and refine inclusion mechanisms before national scale-up. This sandbox can be implemented in collaboration with county governments, extension services, and regulatory agencies to evaluate distribution models, monitor farmer uptake, and assess impacts on yield, soil quality, and water retention in distinct agroecological zones. Such an approach would allow for adaptive learning and evidence-based scaling, while also testing the administrative feasibility of including biological inputs in Kenya's heavily standardized subsidy system. The sandbox could also support the development of

complementary reforms, including training modules for extension agents, adjustments to procurement protocols, and incentive structures for counties willing to diversify their input packages.

Additional reforms are needed to address systemic exclusion. Procurement eligibility criteria must be revised to allow for participation by smaller-scale, locally embedded biofertilizer producers. Extension services must be updated to reflect evolving input technologies and be resourced to provide on-farm guidance. Donor programs should shift from fragmented pilot initiatives to co-financed, institutionally embedded models that align with national soil health goals —including deliberate efforts to reorient major funding flows like the African Development Bank's fertilizer support programs, which currently prioritize chemical inputs, toward more diversified and climate-smart subsidy portfolios. Ministries must establish formal mechanisms for cross-sectoral planning, joint budgeting, and shared outcome monitoring—especially between agriculture, environment, and water. Without these shifts, biofertilizers will remain sidelined by a system built for volume, political signaling, and procurement familiarity —and in some cases, personal gain through entrenched networks and corruption tied to the chemical fertilizer value chain.

Finally, this study identifies several areas for further research. There is a critical need for empirical evidence on the agronomic, economic, and hydrological performance of biofertilizers across Kenya's key production zones. Rigorous evaluations of cost-effectiveness, environmental outcomes, and farmer adoption trajectories are essential to inform future public investments and donor alignment. Research is also needed to understand the political economy of reform at the subnational level, including the role of counties in shaping input access, extension priorities, and subsidy delivery. In the absence of such knowledge, efforts to reform Kenya's input system risk remaining aspirational, constrained by the very structures they seek to change.

Kenya's agricultural future depends not only on the availability of better inputs, but on the capacity of its institutions to recognize, regulate, and deliver them. Biofertilizers offer clear environmental, agronomic, and climate-related benefits, but realizing this potential will require deliberate regulatory action, coordinated subsidy reform, and a willingness to move beyond business-as-usual approaches to input support.

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