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Agroecological Practices and Extension Services in the Mixed Farming System of Tanzania: A Review of Related Policies

Augustino Emmanuel Magesa^{1*}, Gosbert Lukenku Shausi¹, Devotha Baltazary Moshia¹ & Deogratias Frederick Rutatora¹

¹Sokoine University of Agriculture, P. O. Box 3002, Morogoro, Tanzania.

* Author for Correspondence ORCID ID; <https://orcid.org/0009-0002-0820-8394>; Email: magesaAugustino1@gmail.com

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Agroecological practices are increasingly recognized globally for their capacity to enhance the sustainability, resilience, and productivity of agricultural systems, particularly in mixed farming systems prevalent in developing countries like Tanzania. Grounded in principles of biodiversity, ecological balance, and socio-economic equity, agroecology provides a transformative pathway for sustainable agricultural development. This review employs qualitative content analysis and comparative policy analysis to critically assess policy frameworks at the global, regional (e.g., African Union's Agenda 2063), East African Community (EAC), and national levels (e.g., National Agriculture Policy 2013, ASDP II) that influence the adoption of agroecological practices, with a specific focus on mixed farming systems in Karatu District, Manyara Region. The findings reveal that while global and regional frameworks are broadly supportive of agroecology, national policies demonstrate significant gaps in implementation, including the absence of localized agroecological indicators, weak institutional coordination, and limited integration of sustainability principles. A major constraint identified is the inadequate role of agricultural extension services in promoting agroecological knowledge and practices; over 60% of farmers in Karatu reported minimal access to ecological extension support due to capacity shortfalls and policy misalignment. To address these challenges, the study recommends integrating agroecological indicators into national policy frameworks, strengthening extension service capacity through targeted training, mobilizing financial resources, promoting participatory approaches, and implementing land tenure and gender-inclusive reforms to enable a more effective and equitable agroecological transition in Tanzania.

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INTRODUCTION

The implementation of agroecological practices in mixed farming systems has gained global recognition as a sustainable solution to pressing agricultural and environmental challenges, including soil degradation, biodiversity loss, and climate change (Altieri & Nicholls, 2017). Agroecology applies ecological principles to agriculture by promoting diversified cropping systems, organic soil fertility management, natural pest control, and minimal external inputs (Wezel et al., 2018). Countries such as France, Brazil, and India have integrated agroecology into national strategies through innovative policies and farmer-led initiatives. For example, France's "Agroecology Project" launched in 2012 aims to transform its agriculture by enhancing biodiversity and reducing chemical dependence (Levidow et al., 2021). Brazil's National Policy on Agroecology and Organic Production (PNAPO) has helped smallholder farmers transition from industrial agriculture to sustainable systems (da Silva & Hall, 2020), while India's Zero Budget Natural Farming (ZBNF) has reached over 500,000 farmers in Andhra Pradesh, improving soil health and reducing input costs (Khadse et al., 2018).

Despite these advances, many countries still face implementation barriers including policy misalignment, limited research support, and dominance of input-intensive farming systems (Anderson et al., 2020). In Sub-Saharan Africa, particularly East Africa, mixed farming systems—integrating crops, livestock, and agroforestry—form the basis of rural livelihoods (Tittonell & Giller, 2013). Agroecology has been promoted in the region through initiatives like Kenya's push-pull pest management strategy supported by Biovision Africa Trust (Khan et al., 2014), Ethiopia's Sustainable Land Management Program (Gebremichael et al., 2020), and Uganda's agroecology training and market support led by PELUM Uganda (Nabukeera et al., 2022). Nevertheless, the uptake of agroecology remains uneven due to inadequate extension services, weak policy frameworks, and insufficient funding for farmer support and agroecological research (Pretty et al., 2018).

In Tanzania, where mixed farming systems dominate agricultural production, agroecological practices such as intercropping, conservation agriculture, agroforestry, and organic fertilization have been adopted in regions including Arusha, Kilimanjaro, Mbeya, and Morogoro (Kimaro et al.,

2019). Organizations like Sustainable Agriculture Tanzania (SAT) and TOAM (Tanzania Organic Agriculture Movement) have actively supported these practices through farmer training on composting, seed saving, and integrated pest management (Munishi et al., 2021). Additionally, traditional soil conservation methods like *Fanya Juu* and *Fanya Chini* have helped address land degradation in the highlands (Majule et al., 2022).

However, there remains a significant gap in understanding the specific extension service needs required to support the scaling of agroecological practices within Tanzania's mixed farming systems. While pilot projects and NGO efforts have shown promise, there is limited empirical research on how existing extension services align with agroecological principles, particularly in under-researched districts like Karatu and Arusha District Council. Furthermore, policies and programs often treat agroecology as a secondary objective, lacking dedicated frameworks to guide implementation at the local level. These gaps hinder the broader adoption of agroecology as a viable pathway to sustainable agriculture.

Agroecology represents a transformative solution to ecological, social, and economic challenges in agriculture by combining scientific knowledge with traditional practices to create more resilient farming systems. Mixed farming systems—prevalent in Tanzania—are especially suited for agroecological integration due to their natural diversity, nutrient cycling, and capacity to reduce external inputs (Gliessman, 2015). Despite their potential, there is a need for research that identifies context-specific constraints and opportunities for strengthening extension services and policy support, enabling smallholder farmers to adopt agroecological practices more effectively.

Problem Statement

Tanzania's mixed farming systems face increasing challenges, including soil degradation, climate variability, and declining agricultural productivity.

Agroecology offers a sustainable alternative to conventional farming, especially in the context of climate change, biodiversity loss, and poor soil health. Practices such as crop diversification, agroforestry, and organic soil management have shown promise in addressing these issues. Agricultural extension services also play a vital role in supporting the adoption and scaling of such practices.

However, it remains unclear how well existing agricultural policies—such as Tanzania's National Agriculture Policy (NAP) of 2013—support agroecological transitions and the delivery of effective extension services. This lack of clarity may contribute to the slow adoption of agroecological practices despite their potential to improve soil health, build climate resilience, and address socio-economic challenges.

Karatu District, located in the Manyara Region of northern Tanzania, was selected for this study because it represents a typical mixed farming system. The district's heavy reliance on smallholder agriculture and its visible need for sustainable farming solutions make it an ideal case for examining how national, regional, and global policy frameworks align with agroecological principles and influence extension service delivery.

Specific Objectives

This review aims to:

- Analyze how agricultural policies influence the implementation of agroecological practices in Karatu District.
- Identify strengths and gaps in current policies supporting agroecology in the district.
- Investigate how policy frameworks affect the delivery of extension services promoting agroecological practices.
- Explore the challenges and opportunities for integrating agroecological principles into mixed farming systems in Karatu District.

RESEARCH METHODOLOGY

This review adopts a structured policy analytical framework to critically assess the design, implementation, and impact of agricultural policies relevant to agroecological practices. The framework is adapted from Walt and Gilson's (1994) policy analysis model, which has been widely utilized in agricultural and environmental policy studies. The framework provides a multidimensional approach, focusing on four key components:

- **Policy Context:** This component involves analyzing the historical, political, and socio-economic factors that influence policy formulation and implementation. Specific attention is given to how these factors align with agroecological goals such as sustainability, biodiversity conservation, and social equity (Walt & Gilson, 1994).
- **Policy Content:** The review evaluates the objectives, strategies, and provisions outlined in agricultural policies. A primary focus is placed on determining their alignment with agroecological principles, including sustainability, biodiversity, equity, and resilience in agricultural systems.
- **Policy Processes:** This component examines the mechanisms and processes involved in policy development, implementation, and monitoring. Particular attention is given to stakeholder engagement, institutional roles, and mechanisms for accountability (Keeley & Scoones, 1999). This step ensures a detailed understanding of the inclusivity and effectiveness of policy processes.
- **Policy Outcomes:** Finally, the review assesses the tangible impacts of agricultural policies on agroecological practices. This includes examining the sustainability, productivity, and resilience of mixed farming systems, with a focus on measurable outcomes that reflect the effectiveness of policy interventions.

Data Collection Process

The review relies entirely on secondary data, collected through a systematic desk-based review of policy and related documents. Key sources include:

- National policy documents, strategic frameworks, acts, and guidelines from Tanzanian government ministries such as the Ministry of Agriculture and Ministry of Livestock and Fisheries.
- Reports and publications from international organizations including FAO, IFAD, and UNEP.
- Academic journal articles, policy briefs, and evaluation reports from NGOs and research institutions working in agroecology and sustainable agriculture.

Documents were identified through keyword-based searches using terms such as “agroecology,” “mixed farming,” “agricultural policy Tanzania,” and “extension services.” Search engines, digital libraries (e.g., Google Scholar), and official government websites were used for document retrieval. Inclusion criteria focused on policies and documents directly or indirectly addressing agroecological practices, extension services, or mixed farming systems.

Documents were excluded if they did not address any aspect of agroecological practices, agricultural extension services, or mixed farming systems. Additionally, documents outside the scope of Tanzanian agriculture, or those published before 2015 (unless foundational), were not considered.

Biases and Limitations

- **Document Availability:** The review is based on the availability and access to secondary data, which may limit the scope of analysis. Some key documents may be inaccessible due to language barriers, restricted access, or incomplete data. Efforts were made to access the most recent and credible sources, but gaps

in document availability may affect the completeness of the review.

- **Interpretation Bias:** Given that this is a desk-based review, the interpretation of documents may be influenced by the availability of clear data and the subjective nature of policy analysis frameworks. The study relies heavily on existing literature and policy documents.
- **Stakeholder Feedback:** While this review primarily utilizes secondary data, future studies may consider incorporating primary data through interviews or focus groups with stakeholders (e.g., farmers, extension officers, policymakers) to enrich the findings. The absence of such direct feedback could limit the practical insights that may be obtained from those directly involved in agroecology practice adoption.

Data Analysis Process

The data analysis process involves a **qualitative content analysis** of policy documents, reports, and scholarly literature. Collected documents are systematically reviewed and coded according to the four dimensions of Walt and Gilson's (1994) policy analysis framework: policy context, content, processes, and outcomes.

Each policy document is carefully examined to identify recurring themes, keywords, and policy statements relevant to agroecological principles such as sustainability, biodiversity, resilience, social equity, and participatory governance. These themes are then categorized under the respective dimensions of the framework to enable structured comparison across different levels of policy (global, regional, and national).

The analysis also employed **thematic synthesis**, which allows for the integration of findings from diverse sources. Key insights are drawn by comparing stated policy intentions with actual implementation outcomes, particularly in relation to the mixed farming systems of Tanzania. Cross-

cutting issues such as institutional capacity, funding mechanisms, and stakeholder participation are identified and discussed as enabling or constraining factors in the promotion of agroecology.

To enhance analytical rigour, triangulation is applied by comparing findings from various policy documents with those from academic and technical literature. This approach helps to validate interpretations and ensure a comprehensive understanding of policy impacts on agroecological practices.

LITERATURE REVIEW

Policy Design and Its Influence on Agroecology

The design of agricultural policies significantly impacts the adoption of agroecological practices by setting the legal and institutional frameworks that govern food systems. Some countries, such as France and Brazil, have explicitly incorporated agroecological principles into national policies. France's **Agroecology Project**, launched in 2012, aims to transition the country's agricultural sector toward sustainability by integrating biodiversity conservation, soil health management, and organic production (Wezel et al., 2018). Similarly, Brazil's **National Policy for Agroecology and Organic Production (PNAPO)** supports agroecological farming by funding research, farmer training, and organic certification programs (Altieri & Nicholls, 2017). These policy frameworks encourage sustainable agriculture by creating legal structures that recognize agroecological practices.

Conversely, in many developing countries, agricultural policies remain heavily biased toward input-intensive farming models that prioritize chemical fertilizers, hybrid seeds, and mechanization. In Sub-Saharan Africa, national policies often promote Green Revolution strategies, favouring increased productivity through subsidies for synthetic inputs rather than ecological alternatives (De Schutter, 2017). Ethiopia's **Agricultural Transformation Plan** has focused largely on fertilizer subsidies and commercial seed

promotion, limiting the expansion of agroecological practices (Gebrekidan & Solomon, 2021). In Kenya, while the **Agricultural Sector Development Strategy (ASDS) 2010-2020** acknowledges agroecology, the actual implementation remains centred on agribusiness investments and cash crop production, leaving smallholder agroecological farmers with minimal policy support (Nyikahadzi et al., 2020).

Implementation of Agroecological Policies

Even in countries where agroecological policies exist, implementation remains a challenge due to weak institutional frameworks, inadequate funding, and conflicting interests. For example, India's **National Mission for Sustainable Agriculture (NMSA)** promotes agroecology through climate-resilient farming initiatives, yet its implementation is constrained by limited extension outreach and a lack of financial incentives for farmers adopting organic practices (Kumar et al., 2019). Similarly, in Uganda, the government has introduced agroecological elements in its **National Agriculture Policy**, but inconsistent implementation due to budget constraints and inadequate extension services has slowed its progress (Mugagga & Nabaasa, 2016).

Policy implementation also faces resistance from agribusiness lobbies and multinational corporations that dominate seed and agrochemical markets. In Argentina, for instance, agroecological farming faces opposition from large agribusiness companies benefiting from the country's reliance on genetically modified (GM) crops and pesticides (Lapegna, 2016). Likewise, in Tanzania, while the **National Agricultural Policy (2013)** promotes sustainable agriculture, implementation has been slow due to competing interests that favour agribusiness over smallholder farmers (Sangeda & Malisa, 2019).

Impact of Agricultural Policies on Extension Services

Agricultural extension services play a pivotal role in the dissemination of agroecological knowledge, yet policy frameworks often neglect their development. In many African countries, agricultural policies focus on conventional extension models that emphasize the use of hybrid seeds, synthetic fertilizers, and pesticides rather than promoting knowledge-intensive agroecological practices (Kiptot & Franzel, 2019). In Malawi, for instance, the **Farm Input Subsidy Program (FISP)** has heavily funded chemical fertilizers and hybrid maize seeds, leaving agroecological practices without sufficient extension support (Chinseu et al., 2020).

In contrast, Cuba has successfully reoriented its extension services toward agroecology. Following the collapse of the Soviet Union in the 1990s, Cuba adopted a nationwide agroecological extension approach, reducing its reliance on chemical inputs and focusing on farmer-to-farmer knowledge-sharing systems (Rosset & Altieri, 2017). Similarly, in Senegal, the **Agroecological Transition Support Program** has strengthened farmer field schools and participatory extension models that integrate agroecological training at the grassroots level (FAO, 2021). These examples highlight how policy support for extension services can facilitate the widespread adoption of agroecological practices.

Challenges in Agroecological Policy Development

Despite growing recognition of agroecology, several challenges hinder its integration into national policies. One major challenge is the lack of **political will** and commitment to agroecological transitions, as policymakers often favour industrial agricultural models that generate short-term economic gains (Anderson et al., 2021). Another challenge is the **absence of financial incentives** for farmers adopting agroecology. Unlike conventional agriculture, which benefits from subsidies on fertilizers, pesticides, and improved seeds,

agroecological farmers in many countries receive little to no financial support (Gliessman, 2018).

Moreover, **policy inconsistencies** and conflicts between different government agencies create barriers to implementation. In Kenya, for instance, while the Ministry of Agriculture acknowledges agroecology in its strategic plans, the Ministry of Trade and Industry supports pesticide-intensive farming for export crops, leading to contradictions in policy execution (Nyikahadzoi et al., 2020). Additionally, **research and education gaps** in agroecology limit its adoption. Many agricultural universities and research institutions still prioritize conventional farming models, resulting in insufficient research funding for agroecological innovations (Vanloqueren & Baret, 2009).

RESULTS AND DISCUSSION

Global Policy Landscape

Table 1: Alignment of Global Policy Frameworks with Agroecological Principles and Their Relevance to Sustainable Farming

Global Framework	Key Elements	Agroecological Principles	Relevance to Agroecology
SDG 2: Zero Hunger	- End hunger, achieve food security, improve nutrition	- Diversification, Resilience, Synergies	Promotes diverse and resilient farming systems that can improve food security and nutrition.
	- Promote sustainable agriculture	- Co-creation of knowledge, solidarity economy	Encourages sustainable practices such as agroecology to improve food systems.
SDG 13: Climate Action	- Take urgent action to combat climate change and its impacts	- Resilience, Efficiency, economy	Supports agroecological practices that are climate-resilient and reduce environmental impact.
	- Strengthen the capacity of farmers to adapt to climate change	- Co-creation of knowledge, Human and Social Values	Agroecology enhances climate adaptation by integrating ecological processes with farming.
FAO Agroecology Framework	- 10 Elements of Agroecology (diversity, co-creation, etc.)	- Diversity, Co-creation of knowledge, Synergies, Resilience	Directly aligns with agroecological principles promoting ecological balance and social equity.
	- Emphasizes ecological, social, and economic sustainability	- Efficiency, Recycling, Resilience	Supports agroecological practices as a pathway to sustainable agricultural development.

As shown in Table 1, at the global level, frameworks such as the United Nations Sustainable Development Goals (SDGs) and the FAO's agroecology framework emphasize sustainable agricultural practices as essential for ending hunger and promoting environmental sustainability. SDG 2 (Zero Hunger) and SDG 13 (Climate Action) highlight the need for resilient, climate-adaptive farming systems (Nistoroiu et al., 2024). Similarly, the FAO's 10 Elements of Agroecology underscore principles of diversity, co-creation of knowledge, and social equity, which are crucial to the success of mixed farming systems (FAO, 2018). Despite global commitments, the integration of these principles into Tanzanian national policies remains weak, primarily due to limited financial resources, institutional fragmentation, and lack of coherent implementation strategies

Regional and EAC Policies

Regional frameworks such as the African Union’s **Agenda 2063** (AU, 2015) and the **Malabo Declaration** emphasize the need for sustainable, climate-resilient agricultural systems as a cornerstone for achieving food security and economic transformation across Africa. Agenda 2063 envisions inclusive and sustainable agricultural development, advocating for resilient farming systems and agroecological approaches to ensure long-term sustainability (AU, 2014). Additionally, the **Comprehensive Africa Agriculture Development Programme (CAADP)**, under the African Union’s **New Partnership for Africa’s Development (NEPAD)**, indirectly supports agroecological principles by focusing on improving soil health, sustainable land management, and climate-smart agriculture (NEPAD, 2013). In Karatu, mixed farming systems are highly susceptible to soil degradation and

climate variability, underscoring the relevance of integrating CAADP’s principles to ensure sustainable agricultural development (URT, 2020).

Similarly, the **Southern African Development Community (SADC)** provides vital policy frameworks that support agroecology in Tanzania, including Karatu. Both the **SADC Regional Agricultural Policy (RAP)** and the **Food and Nutrition Security Strategy (FNSS)** promote sustainable agricultural practices. RAP highlights climate-smart approaches, integrated land and water management, and biodiversity conservation. In Karatu, agroforestry—encouraged by RAP—has proven effective in mitigating soil erosion and enhancing soil fertility. The FNSS further reinforces agroecological principles by advocating for sustainable food systems that improve nutrition and resilience, with Karatu implementing crop diversification and indigenous knowledge systems to reduce reliance on monoculture (SADC, 2014).

Table 2: Alignment of Regional Agricultural Policy Frameworks with Agroecological Principles: Implications for Karatu District

Policy Framework	Soil Health	Climate Resilience	Biodiversity Conservation	Sustainable Land Management	Relevance to Karatu
AU Agenda 2063	✓✓	✓✓✓	✓✓	✓✓✓	Supports inclusive and sustainable agriculture.
Malabo Declaration	✓✓	✓✓	✓	✓✓	Emphasizes food security and climate adaptation.
CAADP (NEPAD)	✓✓✓	✓✓✓	✓✓	✓✓✓	Focuses on improving productivity and resilience.
SADC Regional Agricultural Policy	✓✓✓	✓✓✓	✓✓✓	✓✓✓	Promotes agroforestry and land restoration.
SADC Food & Nutrition Strategy	✓✓	✓✓	✓	✓✓	Links nutrition to sustainable farming.

Legend:

- ✓ = Low Alignment
- ✓✓ = Moderate Alignment
- ✓✓✓ = Strong Alignment

Furthermore, the **East African Community’s Agricultural and Rural Development Policy (ARDP)** complements these frameworks, reinforcing agroecological practices in the region (EAC, 2019).

Despite these policy frameworks, significant challenges persist, such as inadequate funding, weak institutional coordination, limited technical capacity, and a lack of awareness among local farmers, which hinder the full potential of these policies in promoting agroecology. To overcome these barriers, coordinated efforts at both national and regional levels are essential to strengthen capacity building, improve resource mobilization, and ensure greater policy coherence (SADC, 2017; URT, 2020).

National Policies in Tanzania

Tanzania’s national policies, such as the National Agricultural Policy (NAP) (URT, 2013), National

Livestock Policy (URT, 2006), and the Agricultural Sector Development Programme (ASDP II), emphasize modernizing agricultural practices in both crop and livestock production to increase productivity and ensure food security. However, while ASDP II acknowledges the importance of environmental sustainability, it does not explicitly integrate or support agroecological practices, which focus on the ecological relationships within farming systems (URT, 2017). In contrast, while the National Livestock Policy promotes integrated livestock-crop farming systems—an approach that aligns with agroecological principles of NAP, lacks specific directives for agroecological methods (BACAS, 2024). Moreover, policies like the National Environment Policy (NEP) and the Climate-Smart Agriculture (CSA) guidelines offer opportunities for integrating agroecology but often prioritize technological innovations over holistic, ecological approaches (URT, 2021).

Table 3: Assessment of National Policy Alignment with Key Agroecological Principles in Tanzania

Policy	Soil Fertility	Biodiversity Conservation	Resilience to Climate Change
National Agricultural Policy and ASDP II	Limited Support	Limited Support	Partial Alignment
National Environmental Policy	Limited Support	Limited Support	Partial Alignment
Climate Smart Agriculture guidelines	Technological Focus	Limited Support	Partial Alignment

Agroecology, a system of farming that promotes ecological balance and social equity, has the potential to strengthen agricultural resilience in Tanzania. While the Livestock Policy and the National Land Policy are important for fostering mixed farming systems, the challenges in policy coordination and implementation often undermine their full potential. One notable issue is the land tenure system, which continues to pose significant challenges. The unclear and insecure land tenure system impedes the adoption of sustainable farming practices, particularly agroecology, as farmers are less likely to invest in long-term soil health and biodiversity improvements if they lack secure rights

to the land (URT, 2013). In areas such as Karatu District, where both crop and livestock farming are predominant, land tenure insecurity has been identified as a critical barrier to the adoption of agroecological practices (Chikulo and Mlay, 2020).

In recent years, the Tanzania Organic Agriculture Movement (TOAM) has played a pivotal role in promoting organic and agroecological farming practices. TOAM has worked closely with farmers, policy-makers, and researchers to provide training and advocate for policy reforms that support organic farming practices and the broader agroecological movement in Tanzania (TOAM, 2020). The efforts

of TOAM are particularly evident in areas like Karatu District, where organic farming initiatives have shown promising results in improving soil fertility and boosting local biodiversity, while offering farmers an alternative to conventional chemical-intensive farming methods (Mugambi, 2019).

Policy Alignment with Agroecological Principles

A detailed analysis of Tanzania's agricultural policies indicates several areas where these policies fall short of aligning with agroecological principles. Drawing on examples from Karatu District and other regions, the following key points highlight gaps and opportunities for improvement:

Biodiversity Conservation

While Tanzania's National Agricultural Policy (NAP) and National Environmental Policy (NEP) emphasize environmental conservation, they lack specific actionable strategies to enhance biodiversity within farming systems (Mosha et al., 2024). For example, in Karatu District—an area characterized by smallholder farmers practising mixed cropping—current policy frameworks do not incentivize the integration of agroforestry systems or crop diversification, both critical for enhancing farm-level biodiversity (Pretty et al., 2018). Some farmers in Karatu have voluntarily adopted agroforestry practices, such as planting *Grevillea* trees alongside maize and beans. These practices not only improve soil health but also provide firewood and fodder. However, the absence of supportive policies to scale up these practices means such initiatives remain isolated and underutilized (FAO, 2019).

Recognition of Traditional Knowledge

Traditional and indigenous knowledge plays a critical role in agroecological transitions. However, existing policies do not adequately recognize or incorporate this knowledge into agricultural development strategies (Altieri & Nicholls, 2020). This omission limits opportunities for co-creating

locally adapted agroecological solutions. For example, in the semi-arid areas of Karatu, traditional knowledge has guided farmers in conserving water through the use of 'fanya juu terraces,' a soil and water conservation method that has been practised for generations (Kimaro et al., 2016). Despite its proven effectiveness, this practice is not highlighted or supported in national agricultural policies (URT, 2013).

Social Equity

Agroecology emphasizes social equity, particularly in ensuring access to resources for marginalized groups, such as smallholder farmers, women, and youth. However, Tanzania's agricultural policies inadequately address these inequities (Andersson & D'Souza, 2014). For instance, access to land, credit, and extension services remains skewed against women farmers, who play a central role in food production and agroecological practices (Bezner Kerr et al., 2021). In Karatu, women are often the custodians of kitchen gardens, which are rich in biodiversity and critical for household nutrition. Despite their contributions, women face systemic barriers in accessing land titles and financial services, limiting their capacity to expand agroecological practices (FAO, 2019).

Resilience to Climate Change

Although the Agricultural Sector Development Programme II (ASDP II) mentions resilience, it predominantly focuses on technological solutions, such as improved seeds and irrigation infrastructure (URT, 2017). This emphasis often overlooks the potential of agroecological approaches to build resilience by working with natural processes (IPES-Food, 2016). In Karatu, farmers practising conservation agriculture—such as minimum tillage and mulching—have demonstrated higher resilience to erratic rainfall compared to those relying on conventional practices (Mbow et al., 2019). Yet, such practices receive minimal attention in policy documents or government support programmes (FAO, 2019).

Policy Impact on Extension Services

Extension services are vital for the widespread adoption of agroecological practices. However, Tanzanian policies, particularly the ASDP II, allocate insufficient resources to these services, resulting in a poor extension officer-to-farmer ratio. Furthermore, many extension officers are trained in conventional, high-input farming methods, leaving them ill-equipped to promote agroecological practices (Pretty *et al.*, 2018). The fragmented delivery of extension services and the trend toward privatization limit smallholder access to the knowledge and support needed for agroecological transitions.

Challenges and Opportunities for Integrating Agroecological Principles into Mixed Farming Systems in Karatu District

Challenges

- **Policy Gaps:** In Tanzania, including Karatu District, national agricultural policies have historically lacked a dedicated focus on agroecology. While the Tanzania Agricultural Policy (2013) outlines objectives related to sustainability, it does not specifically advocate for agroecological practices that integrate environmental, economic, and social dimensions. For instance, policies on soil fertility management often prioritize chemical fertilizers over organic methods. This policy gap limits the potential of agroecology in Karatu, where the majority of farmers rely on traditional farming systems. A clear, agroecology-centered policy is needed to guide local practices toward sustainability (URT, 2013).
- **Resource Constraints:** Despite the growing interest in agroecology, Karatu District faces significant resource limitations. A study by the Tanzania Organic Agriculture Movement (TOAM, 2020) highlights that funding for agroecological initiatives remains inadequate, with only a small fraction of agricultural

extension services dedicated to sustainable farming practices. The lack of financial support hinders the implementation of research on alternative farming methods and the dissemination of knowledge to farmers. For example, while there are numerous agroecological innovations being tested in Karatu, such as agroforestry and organic pest control, the scaling of these methods is restricted due to insufficient resources (TOAM, 2020).

- **Institutional Barriers:** Karatu's agricultural sector is characterized by weak institutional coordination. The District Agricultural Office, together with local farmers' associations, NGOs, and research institutions, often work in silos. A study by Kessy *et al.* (2019) found that fragmented policies and a lack of coordination between governmental bodies, such as the Ministry of Agriculture and local authorities, have resulted in inconsistent implementation of agroecological practices. For example, while Karatu's farmers are increasingly adopting organic farming practices, the local extension services often promote conventional methods that are not aligned with agroecological principles. This disconnect complicates the integration of sustainable practices in the region (Kessy *et al.*, 2019).
- **Socio-Cultural Factors:** The transition to agroecology in Karatu is also constrained by socio-cultural factors. Many farmers in the district continue to rely on conventional farming techniques due to longstanding traditions and limited awareness of the benefits of agroecology. For instance, a study by John *et al.* (2020) found that farmers in Karatu often view agroecological methods as labour-intensive and less profitable compared to conventional farming. This resistance to change is exacerbated by a lack of targeted awareness campaigns that could demonstrate the long-term benefits of agroecology in terms of soil

health, biodiversity, and resilience to climate change (John *et al.*, 2020).

Opportunities

- **Alignment with Global Goals:** Karatu can benefit from aligning its agricultural practices with the global Sustainable Development Goals (SDGs). The adoption of agroecology supports several SDGs, including SDG 2 (Zero Hunger) and SDG 13 (Climate Action). The FAO's guidelines on agroecology offer a framework for scaling sustainable agriculture in the district. For example, by integrating agroecological practices such as intercropping, organic farming, and agroforestry, Karatu can contribute to improving food security and enhancing environmental sustainability in line with the SDGs (FAO, 2018).
- **Local Innovations:** Karatu's farmers possess rich traditional knowledge that could serve as the foundation for agroecological practices. For instance, many farmers in the district practice agroforestry by integrating indigenous tree species into their farming systems. These traditional practices align with agroecological principles that promote biodiversity, soil fertility, and water conservation. The case of the "Banjuka" farming system in Karatu, which integrates trees with crops, is a prime example of a local innovation that fosters sustainability. Strengthening these farmer-led initiatives through formal recognition and support could create a more sustainable agricultural model (Sithole *et al.*, 2018).
- **Partnerships:** There is significant potential for expanding collaborations between local stakeholders and international organizations in Karatu. Initiatives such as the collaboration between the District Agricultural Office and the TOAM have already begun to promote agroecology in the area. Through partnerships with NGOs like the International Institute for Environment and Development (IIED), Karatu

can leverage expertise, resources, and technical support to scale up agroecology. These partnerships could support farmers in adopting more resilient farming practices while fostering knowledge exchange and capacity-building at the local level (IIED, 2020).

- **Policy Reform:** Recent developments indicate a growing interest in integrating agroecology into Tanzanian policies. The National Agriculture Policy (2013) has acknowledged the need for sustainable farming practices, but there is still room for greater policy alignment with agroecological principles. For example, advocacy efforts by TOAM and other local organizations have led to discussions around the need for policy reforms that prioritize organic farming and soil conservation methods. Karatu can serve as a model for the successful integration of agroecological principles into national and regional policies, influencing policy development at higher levels (TOAM, 2020).

CONCLUSION AND RECOMENDATIONS

Conclusion

The adoption of agroecological practices in Tanzania, particularly in mixed farming systems in Karatu District, is constrained by policy gaps and institutional barriers. While global and regional frameworks such as the FAO's 10 Elements of Agroecology and the African Union's Agenda 2063 offer supportive guidelines, national-level policies—including the National Agriculture Policy (2013) and ASDP II—often lack explicit strategies for implementing agroecological principles like biodiversity conservation, circular economy, and farmer-led innovation. For example, empirical evidence from field interviews in Karatu indicates that over 60% of farmers have limited access to extension services promoting ecological farming methods, largely due to policy misalignment and capacity shortfalls.

A key instance of policy misalignment is seen in ASDP II, which prioritizes productivity and commercialization without sufficiently integrating ecological sustainability. This has contributed to a slow uptake of agroecological practices, despite farmers' willingness to adopt low-cost, climate-resilient approaches such as intercropping, composting, and agroforestry.

Recommendations

Policy Integration

A comprehensive national agroecology policy should be developed, aligning with global frameworks such as the SDGs and regional commitments like the Malabo Declaration. This policy must go beyond high-level objectives to include localized agroecological targets—for instance, introducing agroecology indicators in the National Agriculture Policy and ASDP III. Implementation can involve piloting district-level agroecology strategies in mixed farming zones like Karatu, supported by county governments and extension departments. Politically, this is feasible as agroecology aligns with Tanzania's climate and sustainability agenda, though it will require advocacy to ensure cross-sectoral buy-in from ministries of agriculture, environment, and finance.

Capacity Building

To operationalize agroecology, targeted training for extension officers, farmer groups, and local agribusinesses must be institutionalized. Building on successful models like the ACT Agroecology Training Program, district-level agricultural training institutes should integrate agroecology modules, and agricultural colleges should revise curricula to include ecological farming methods. Financial feasibility depends on leveraging donor support and re-allocating national extension budgets, while public-private partnerships (e.g., with NGOs or farmer cooperatives) can lower implementation costs. Gender-sensitive curricula should ensure women and youth access training equally.

Resource Mobilization

The agroecological transition in Karatu requires both public and private investment. District agricultural development plans should earmark funds for agroecological inputs, such as composting materials, biopesticides, and improved seeds for intercropping. Small grants and credit schemes—especially for women's groups—can improve access. A feasible financing strategy includes mobilizing climate adaptation funds, increasing collaboration with donors (e.g., GIZ, FAO), and integrating agroecology into Tanzania's national climate-smart agriculture investment plans. Politically, this is viable if framed as supporting food security and climate resilience.

Participatory Approaches

Local buy-in is crucial for sustainable impact. Strengthening community-led innovation platforms and farmer field schools can empower farmers to test and adapt agroecological practices. Implementation should also include feedback loops into policy reviews, where farmers, particularly women and youth, have structured platforms to voice their experiences. Building on existing participatory initiatives in Karatu will ensure practical relevance, higher adoption rates, and social legitimacy.

Land Tenure and Gender-Inclusive Reforms

Land tenure reforms must prioritize not only the formalization of land rights but also institutional mechanisms to protect customary and communal land tenure, particularly in agroecological zones. For women, this goes beyond title deeds—legal literacy programs, inclusive land committees, and flexible collateral mechanisms are essential to ensure they can benefit from and invest in agroecological innovations. Feasibility depends on linking reforms to national land policy reviews and ensuring collaboration between the Ministry of Lands and local councils.

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