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What drives agroecological transitions in Africa? A systematic review

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Systematic Review

Keywords: agroecology, social movements, policies, research, Africa

Posted Date: August 4th, 2025

DOI: https://doi.org/10.21203/rs.3.rs-6886777/v1

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Additional Declarations: No competing interests reported.

Abstract

Food systems in Africa face complex and interconnected challenges whose promising solution is agroecological transformation. A variety of actors support the transition, yet significant impediments exist among agroecology actors and stakeholders in African contexts. We systematically reviewed 70 studies to examine the impediments to agroecological transitions in Africa. Our results show that for successful transitions, participatory research methods, inclusive policies and robust market systems are critical for driving adoption of agroecological practices. Farmer organizations and their participatory models like farmer field schools and alternative food networks, are effective in promoting inclusivity and scalability. However, our analysis reveals that fragmented policies, socioeconomic inequalities and knowledge asymmetries are constraints onto meaningful progress. These challenges are further exacerbated by low awareness, constraints in funding and inadequate policy oversights. Results of our analysis propose long-term engagement in agroecology interventions, context-specific solutions, inclusive policies and equitable market access as well as interdisciplinary collaboration which are vital for unlocking the potential of agroecology in Africa.

1. Introduction

In Africa, food systems face an array of challenges such as climate change, food insecurity, environmental degradation as well as biodiversity loss, pandemics, and political instability. Conventional approaches like genetic modification and industrial agriculture have inadequately addressed these issues often exacerbating environmental damage and social inequalities (Bezner & Wynberg, 2024). Agroecology has emerged as a promising alternative, offering a holistic framework that integrates ecological, social, economic and political dimensions to build resilient and sustainable food systems (Bezner & Wynberg, 2024). Unlike industrial agriculture which relies on chemical inputs and monocultures, agroecology emphasizes regenerative practices, participatory approaches, and community-driven solutions making it uniquely suited to address Africa's complex agricultural challenges (Anderson et al., 2019; Jones et al., 2022). Industrial agriculture has contributed to soil degradation, biodiversity loss and climate vulnerability (Ouko et al., 2024; Tapsoba et al., 2020), while agroecology promotes practices that enhance soil health, biodiversity, and climate resilience while addressing socioeconomic inequalities. Despite its potential, agroecology faces many challenges such as under-explored market systems, limited involvement of Farmer Organizations and insufficient communication by development agencies (Darmaun et al., 2023; Einbinder et al., 2021). Hence, transitioning to agroecology requires systemic changes including supportive policies, multi-actor collaborations and robust market systems.

Scaling agroecology in Africa demands shifts in sound frameworks, increased research investment, and the active engagement of diverse stakeholders, including farmers, policymakers, researchers, and civil society organizations (Greenberg et al., 2023; Ouko et al., 2024). Key drivers for expanding agroecology include social organization, constructivist learning processes, effective agroecological practices, and favorable market and policy environments (Mier y Terán Giménez Cacho et al., 2018). Multi-stakeholder

collaborations and network linkages are critical for fostering broader adoption. Context-specific research and holistic assessment frameworks are needed to capture agroecology's multifaceted impacts from ecological benefits to social empowerment and economic resilience (Prost et al., 2023). Cohesive policies, robust market mechanisms, and effective knowledge-sharing systems are lacking. This hinders widespread adoption and scalability of agroecology.

This paper systematically reviewed the drivers, challenges and opportunities for agroecological transitions in Africa. While previous research examined aspects of agroecology, significant gaps remain in understanding how agroecology can be effectively scaled, integrated and sustained across diverse African contexts. This study aimed at filling these gaps by providing a systematic synthesis of existing literature, offering new insights and deeper understanding of the pathways that could unlock agroecology's potential to build sustainable and resilient food systems across Africa.

2. Methodology

2.1 Literature search strategies

We systematically studied peer-reviewed articles to examine the agroecology transitions in Africa, employing the Preferred Reporting Items for Systematic reviews and meta-analyses (PRISMA) methodological framework (Sachet et al., 2021; Vu-Ngoc et al., 2018). We employed five electronic databases (Scopus, Dimensions, Google Scholar, Elicit, and Web of Science) for articles with data from Africa published between 2019 and October 2024. We employed Boolean operators (AND/OR) and truncation to capture variations of key terms, with two distinct search strings: one focusing on agroecological initiatives for climate adaptation in Africa, and the other on agroecological networks, partnerships, and collaborations (See supplementary materials 2).

2.2 Eligibility and screening process

The initial search yielded 488 articles focusing on agroecology, social movements and climate change (see Figure 1). The retrieved studies were imported into Excel and duplicates were removed, reducing the pool to 375. All co-authors independently screened the titles and abstracts against the inclusion criteria, narrowing the selection to 263 and 96 articles respectively (see Figure 1). Divergence of views about eligibility were resolved by discussion in Zoom meetings. The remaining 96 articles were downloaded and divided among the co-authors, with each article reviewed by at least two independent reviewers. Disagreements or uncertainties about eligibility were again resolved by Zoom discussions.

Through a participatory, multi-stage process involving all co-authors, 26 articles were excluded after full-text screening, resulting in a final selection of 70 articles for data extraction (supplementary material 3). The PRISMA workflow in the supplementary materials provides a more detailed overview of the methodological process for the inclusion and exclusion of articles.

2.3 Data extraction and analysis

A standardized data extraction form (See supplementary material 3) was developed capturing metadata such as name of the author, year of publication, DOI, keywords, key findings. Multiple reviewers were involved in the data extraction process to ensure consistency and accuracy. The extracted data was analyzed and synthesized to identify common themes and trends (See Supplementary material 4.

3. Results and Discussion

3.1 Background of the Results

3.1.1 Geographical Distribution of Research

The distribution of the 70 articles revealed coverage across 25 African countries, representing approximately 46% of the continent. We grouped the countries into four regions, namely Northern, Southern, Eastern and western Africa (Figure 2) and identified several articles in each country as presented in Figure 3.

3.1.2 Temporal Distribution of Research Articles

The highest number of publications occurred in 2021 (n=18), followed by 2022 (n=12), 2024 (n=11), and 2020 (n=11). The years 2023 and 2019 each contributed 9 articles *(Figure 4).* A steady upward trend in publications was observed from 2019 to 2021.

3.2 Thematic Analysis of Agroecological Research

The extracted data (supplementary material 3) was analyzed and categorized into five major themes, namely: Farmer Organizations and social movements, policy integration and institutional support, market dynamics and economic viability and agroecological practices for climate change adaptation.

3.2.1 Role of Farmer Organizations and social movements in advancing agroecology

Our analysis showed that Farmer organizations (FOs) and social movements play a pivotal role in advancing agroecology by promoting sustainable practices, empowering communities and influencing policy. They challenge the dominant industrial agriculture model and advocate for participatory approaches that amplify marginalized voices (Gliessman, 2020; Iyabano et al., 2022, 2023; Bottazzi & Boillat, 2021). For instance, La Via Campesina promotes inclusivity and equity in agroecological transitions. However, FOs and social movements face challenges such as limited technical capacity, financial constraints, and reliance on foreign funding, which can hinder their effectiveness (Bottazzi & Boillat, 2021; Kampmann & Oliver, 2021). Donor dynamics often restrict local empowerment, as seen in Senegal (Boillat et al., 2022; Tapsoba et al., 2020). To address these challenges, participatory methods, institutional support, and long-term engagement are crucial for measuring the impact of FO and social movements (Anderson et al., 2019).

FOs facilitate agroecology adoption by supporting farmers through gender sensitive programs and institutional support, as seen in Burkina Faso and Zimbabwe (Iyabano et al., 2023; Soussi et al., 2024; McAllister & Wright, 2019). Social movements also enhance resilience, improve livelihoods, and promote social equity. In South Africa, social movements improved community health and market power, while in Malawi FOs foster knowledge sharing and gender equality (Chanyau & Rosenberg, 2024; Kansanga et al., 2020). Social movements promote agrobiodiversity as seen in Morocco and Ghana, whereas farmer organizations advocate for food sovereignty and biodiversity (Zimmerer et al., 2024Nyantakyi-Frimpong et al., 2021).

Participatory model promoted by FOs such as farmer field schools (FFS), alternative food networks (AFNs) and farmer research networks (FRNs) are critical for agroecological transitions. They empower farmers, promote trust and encourage sustainable practices as seen in Burkina Faso and Togo (Bakker et al., 2021; Richardson et al., 2022). However, AFNs like Participatory Guarantee Systems (PGS) in Senegal face criticism for excluding marginalized groups and reinforcing social inequalities (Boillat et al., 2023; Marfurt et al., 2023). FOs and social movements influence systemic change, contributing to resilient, equitable food systems when supported by targeted polices and institutional collaboration, as seen in Mali's cotton farming and Ethiopia's coffee and conservation initiative (Nicolay, 2019; Jiren et al., 2020).

3.2.2: Policy integration and institutional support for agroecology

Our analysis showed that despite its transformative potential, agroecology faces challenges of inconsistent policy support, insufficient funding, and uncoordinated interventions which hinder its scaling and implementation (Tapsoba et al., 2020). We identified that in Kenya's Vihiga County, overlapping national and county policies and inadequate funding undermine the agroecology strategy, questioning its long-term efficacy (Chumba et al., 2024). Effective agroecology transitions require multi-stakeholder cooperation, coordinated institutions, and local actor participation to develop coherent policies (Chevallier, 2024; Ewert et al., 2023; Tataridas & Freitas, 2024). Strong policy support is vital for integrating agroecology into broader frameworks (Darmaun et al., 2020; Ouko et al., 2024).

Initiatives like Ethiopia's "coffee and conservation", enhance climate resilience and policy effectiveness (Jiren et al., 2020), while advocacy in Senegal faces challenge from NGO dependence and policy conflicts. (Bottazzi & Boillat, 2021). In Mali, addressing soil degradation requires tackling institutional weaknesses, education gaps, and property rights issues (Nicolay, 2019). Urbanization in South Africa and Tunisia threatens small-scale agroecology, highlighting the need for policies to guide participatory planning (Hamrita & Jiménez, 2022; Rudolph et al., 2020). Agroecology's diverse interpretations complicate policy development (Bellwood-Howard, 2020). A unified conceptualization and context-specific solutions are vital to align policy (Tittonell et al., 2022). Institutional and structural transformations, including education, resource availability, and governance, are crucial to scaling agroecology for resilient and fair food systems (Kansanga et al., 2020; Mapfumo et al., 2022; Tataridas & Freitas, 2024).

3.2.3. Market dynamics and economic viability of agroecology

Our analysis showed that the adoption of agroecology, while promising for sustainable agriculture and rural development, faces significant constraints related to economic sustainability and socioeconomics (Ewert et al., 2023). Socioeconomic factors play a critical role in determining the adoption of agroecological practices, with market factors driving scalability. While economic growth can spur agroecological research (Wyckhuys et al., 2022), its impact on the adoption of agroecological values remains limited. For instance, pesticide use varies by socioeconomic class, with emerging economies showing minimal reduction, as predicted by the Environmental Kuznets Curve (EKC) theory. In contrast, high-income countries maintain pesticide use through mechanized agriculture. This indicates a need for market-driven interventions, farmer education, and agroecological solutions to bridge the gap between scientific progress, economic growth, and sustainability (Ewert et al., 2023).

Labour dynamics, including exploitative conditions and hidden labour expectations, further constrain agroecology, especially for smallholder farmers in regions like Zimbabwe (Mouratiadou et al., 2024; Mapfumo et al., 2022). Despite these challenges, some farmers derive fulfillment from agroecological practices, a phenomenon termed as the “farmers’ paradox” (Connor et al., 2024). Medium-sized agroecological farms report better work satisfaction and shorter hours than smaller or conventional farms, though issues like gender equality and mental health remain unaddressed in the agroecology-labour debate (Bezner, Liebert, et al., 2022).

Environmental benefits, such as reduced emissions from agroecological practices like agroforestry and sustainable land use, coexist with economic viability (Rakotovao et al., 2021), but scaling them requires addressing barriers like market access certification systems, particularly in Sub-Saharan Africa (Schader et al., 2021). Market reforms and strengthened institutional frameworks are essential to overcome resource inequities and industrial agriculture co-optation (Matt, 2023; Leakey, 2020). Economic challenges, including price variability, require a multiscale strategy to ensure agroecology aligns with environmental, social, and economic goals (Ewert et al., 2023; Dosso et al., 2024).

3.2.4 Climate change resilience and adaptation practices in agroecology

Our analysis showed that agroecological practices offer a promising framework for addressing climate change, resilience, and sustainability of agriculture in Africa. These practices enhance climate resilience, food security, and community empowerment through ecosystem restoration, crop diversification, and nutrition-sensitive approaches (Dagunga et al., 2023; Darmaun et al., 2020; Rakotovao et al., 2021). These practices improve soil health, biodiversity, and water retention, bolstering resilience to climate extremes. For instance, agroforestry and contour hedgerows in arid regions like the Sahel enhance water retention and biodiversity, while Push-Pull Technology (PPT) in Ethiopia has enhanced climate resilience indicators for maize, albeit its focus remains on fodder production over yield acquires (Sinclair et al., 2019; Gugissa et al., 2022). These practices demonstrate that agroecological systems can exceed conventional methods of fostering social and ecological resilience (Darmaun et al., 2020).

However, the adoption of agroecological practices faces challenges influenced by economic and social factors. In sub-Saharan Africa, energy limitations hinder soil nutrient recycling, as biomass is often diverted to cooking rather than farm use (Amede et al., 2023). Land tenure, gender dynamics, and resource access in regions like Western Kenya affect the distribution of organic nutrient sources for soil improvement (Nyamasoka-Magonziwa et al., 2021). Addressing these barriers requires integrated rural energy solutions and equitable resource allocation to unlock agroecology's transformative potential.

Social-biophysical interactions also play a critical role in climate adaptation. In Malawi and Ghana, historical and cultural factors influence climate sensitivity, highlighting the need for context-specific practices that integrate indigenous knowledge and address sociopolitical challenges (Bezner, Otto, et al., 2022). Agroecology's success in empowering smallholder farmers in Zimbabwe and Senegal, through local knowledge integration and social networks, underscores its potential for fostering resilience (Mapfumo et al., 2022). Nutrition-sensitive agroecology in Tanzania has improved dietary diversity, reduced food insecurity, and empowered women. This signifies agroecology's holistic benefits for social, nutritional, and environmental well-being (Santoso et al., 2021).

Agroecology also addresses global warming-related challenges, like food and water security. In Tunisia's Merguellil plain, agroecological practices complement conventional methods in irrigated agriculture, though full transition remains complex due to localized differences (Akakpo et al., 2021; Shah et al., 2021). While agroecological practices can reduce greenhouse gas emissions and increase farmer incomes, data variability complicates these assessments (Rakotovao et al., 2021). Agroecology offers transformative potential to climate resilience and sustainable agriculture, but requires policy alignment, equitable resources and collaboration to overcome barriers and drive systemic change for sustainable, inclusive development and climate adaptation in Africa.

3.2.5 Research and knowledge sharing for agroecology

Our analysis showed that the adoption of agroecological practices, as highlighted in Theme 4, hinges on robust research, knowledge exchange and participatory learning. These elements are critical for advancing farming systems, food security, sustainability, and climate resilience. This theme underscores the importance of participatory action research, information sharing, experiential learning, interdisciplinary collaboration in addressing the politics of knowledge transfer (Akanmu et al., 2023; Ouko et al., 2024; Jones et al., 2022; Sachet et al., 2021). Long-term studies and building trust between academic researchers and farmers are critical for understanding agroecological transitions and overcoming barriers (Middendorf & Prasad, 2020; Sachet et al., 2021). Additionally, multinational organizations and civil society play a critical role in shaping global agroecology through knowledge transfer (Loconto & Fouilleux, 2019).

Effective communication and farmer-to-farmer learning are pivotal for agroecological transitions. Horizontal learning and co-designing context-specific solutions, such as through photovoice, empower farmers and bridge knowledge gaps (Bezner et al., 2021; Enloe et al., 2021). In Senegal, agroecological Farmer Field Schools (FFS) and institutional partnerships help to develop sustainable agroecological

businesses, highlighting the need for systems thinking, lifelong learning, and networking (Graeuwe & Maréchal, 2024; Sørensen et al., 2021). Scaling agroecology requires integrating local knowledge into policy and enhancing agricultural extension services (Isgren et al., 2023).

Participatory action research (PAR) fosters community involvement and combines technical knowledge with sustainability. Involving smallholders in market supply chains and developing tailored solutions through field trials, reduces poverty and improves resource management (Sachet et al., 2021; Mazibuko et al., 2023). However, limited use of participatory research methods hinders the co-creation of locally adapted solutions, causing the need for expanded efforts (Sachet et al., 2021).

Inclusive tools and metrics are vital for agroecology research. Socioeconomic impact measurement and replicating agroecological reforms require robust frameworks (Nikiema et al., 2023). Interdisciplinary research integrating social, political, and ecological dimensions is crucial for scaling agroecology (Mason et al., 2020). Tools like FAO's TAPE, which assesses agroecological principles, support evidence-based transition models (Snapp et al., 2021; Gliessman, 2020b). Further research is needed to explore the social, economic, cognitive, and ecosystem impacts of agroecological practices, as well as multi-scale policies and farming solutions (Oteros-Rozas et al., 2019).

Investments in infrastructure, capacity building, and education are necessary to address knowledge and resource gaps (Johansson et al., 2024). Aligning agroecological research with national and international policies can help eliminate systemic inequities (Tataridas & Freitas, 2024). Despite its transformative potential, agroecology faces challenges, such as institutional resistance, limited understanding, and financial constraints for smallholder farmers. Collaborative efforts among governments, NGOs, and corporations are essential to develop a robust agroecology research policy framework that addresses Africa's food security and environmental challenges (Côte et al., 2022). By promoting local knowledge systems, participatory research, and community networks, agroecology can empower farmers and drive sustainable agricultural transformation.

3.3 Discussion

This review synthesizes evidence from 70 peer-reviewed articles published between 2019 and 2024 across 25 African countries, highlighting the critical role of agroecology in enhancing sustainability, resilience, and equity within food systems. Agroecology, which integrates ecological principles, traditional knowledge, and scientific innovation, provides a multifaceted approach to addressing interconnected challenges such as food security, environmental sustainability, and social equity (Altieri & Nicholls, 2020; Bezner et al., 2023). Despite its transformative potential, the widespread adoption and scaling of agroecological practices face significant barriers, including financial constraints, institutional inertia, and socio-cultural challenges.

As shown in Fig 3, Senegal, Kenya, Tanzania, and Burkina Faso have made notable progress in advancing agroecology likely through supportive institutions, policies, and funding mechanisms (Ouko et al., 2024). These nations have robust frameworks that integrate agroecological research, practice, and policy,

attracting both national and international resources. In contrast, countries such as Chad, Benin, and Angola lag because of limited institutional support and weak research capacity, hindering widespread adoption of agroecology (Dagunga et al., 2023). This disparity underscores the need for inclusive research and capacity-building initiatives that ensure agroecological innovations are accessible and applicable across diverse African contexts (Cooper et al., 2020; Wyckhuys et al., 2022).

. For our analysis we observed a steady upward trend in publications from 2019 to 2021. This surge in interest may be attributed, in part, to the COVID-19 pandemic, which disrupted global food supply chains. These disruptions likely prompted increased attention to agroecology as more people turned to local food production systems during lockdowns, sparking greater research focus on sustainable and resilient agricultural practices. The limitations of industrial food systems during global lockdowns prompted renewed interest in agroecology to enhance local food security and climate resilience (Isha et al., 2021; Mason et al., 2020). Scholars and practitioners explored agroecology's potential to mitigate global shocks, including health pandemics (Dagunga et al., 2023).

FOs and social movements are pivotal in facilitating the transition to agroecology. These movements empower farmers, influence policy frameworks, and provide institutional support, fostering the adoption of agroecological practices (Iyabano et al., 2023; Loconto & Fouilleux, 2019). Initiatives such as farmer field schools and participatory guarantee systems have been instrumental in building local innovations, enhancing knowledge exchange, and improving market access for agroecological produce (Richardson, 2022; Bezner et al., 2021). However, challenges remain in ensuring inclusivity and addressing socio-economic inequalities. In some instances, the benefits of agroecological initiatives are disproportionately accessible to educated elites in these institutions, exacerbating existing disparities within rural communities (Rosset & Martínez-Torres, 2012; Tapsoba et al., 2020). The theoretical framework of participatory governance and social capital aligns with these findings, emphasizing the importance of inclusive and community-driven approaches in sustainable agriculture (Anderson et al., 2019). However, power struggles and elite capture pose significant barriers to the effectiveness of FOs and social movements, particularly in donor-driven initiatives (Boillat et al., 2022). To address these challenges, more participatory approaches that prioritize community agencies and inclusivity are needed. Long-term evaluations of the impact of these organizations on community transformation are essential to better understand their role in fostering resilience and sustainability (Boillat et al., 2023).

Policy integration and institutional support are essential for scaling agroecology, yet implementation gaps persist due to inconsistent government backing, inadequate funding, and policy overlap (Jiren et al., 2020; Chumba et al., 2024). Multi-stakeholder coalitions and participatory governance are needed to align policies with agroecological principles and address structural barriers (Tataridas & Freitas, 2024). Countries like Kenya, Uganda, and Tanzania have developed national agroecology policies, while others, such as Rwanda and Burundi, argue that existing agricultural policies already encompass agroecological principles (Tataridas & Freitas, 2024). However, many of these existing policies were initially designed with an industrial agricultural orientation, raising questions about their alignment with agroecological principles (Ouko, 2024). Financial constraints and institutional capacity gaps remain a major barrier to

the successful implementation of agroecological policies. African governments must prioritize mobilizing local resources and reducing reliance on external funding to ensure policy ownership and sustainability (Tapsoba et al., 2020). Multi-stakeholder coalitions involving farmers, researchers, policymakers, and civil society organizations are essential to develop and implement policies that address the diverse challenges of agroecology, including gender equity, market access, and climate adaptation (Altieri & Nicholls, 2020; Nicholls & Altieri, 2018).

Market dynamics and economic viability are central to the adoption and scalability of agroecology. While agroecological practices offer environmental and social benefits, their economic viability is often constrained by labor demands, market access barriers, and price volatility (Ahmad & Köpke, 2024; Dosso et al., 2024). Certification systems, such as PGS, are important tools for ensuring quality and facilitating market access. However, these systems face challenges, including accessibility, cost, and corruption, which must be addressed to improve their effectiveness (Boillat et al., 2023; Shader, 2021). Territorial markets, which prioritize short value chains and local food systems, offer a promising alternative by reducing transportation emissions and enhancing food sovereignty (Vignola et al., 2022). These markets provide economic benefits to farmers while promoting ecological and social values, making agroecological produce more accessible to consumers. However, labor-intensive practices during the initial transition to agroecology pose challenges, particularly for female farmers. Governments and civil society organizations must provide support during this transition period. This support should include training, equipment and financial assistance to ensure farmers overcome initial yield penalties and labor costs (Bezner et al., 2023).

Agroecological practices such as crop diversification, agroforestry, and ecological nutrient management enhance climate adaptation and build resilience within farming systems (Amoak et al., 2022; Dittmer et al., 2023). These practices stimulate biological processes, improve soil health, and reduce reliance on chemical inputs, mitigating the environmental impacts of conventional agriculture (Altieri & Nicholls, 2020). However, socio-economic barriers such as energy limitations, land tenure issues, and gender dynamics continue to hinder the widespread adoption of agroecological practices (Amede et al., 2023; Nyamasoka-Magonziwa et al., 2021). Scaling these practices requires context-specific research and interdisciplinary collaboration to tailor solutions to the unique ecological and socio-economic conditions of different regions (Vignola et al., 2022). Research and knowledge-sharing mechanisms, such as participatory action research and farmer-to-farmer learning, have proven effective in promoting agroecological practices and fostering social networks (Bezner et al., 2021; Enloe et al., 2021). However, limited funding, capacity gaps, and inadequate participatory research methods often hinder knowledge co-creation and sustainable transitions (Sachet et al., 2021; Johansson et al., 2024).

Agroecology presents a promising pathway for building resilient and sustainable food systems in Africa. However, its full potential can only be realized through inclusive policies, robust market systems, and long-term investments in research and capacity-building. Farmer organizations and social movements must be supported to address issues of inclusivity and governance, while governments and international partners must prioritize mobilizing local resources and developing context-specific policies. By fostering

multi-stakeholder collaborations and promoting participatory action research, Africa can overcome the challenges of agroecology and harness its benefits for climate adaptation, food security, and social equity.

The findings of this study contribute to the growing body of knowledge on agroecology. They identify power struggles, elite capture, and socio-economic barriers as significant challenges to the effectiveness of FOs, social movements, and agroecological practices. Future research should prioritize longitudinal studies, interdisciplinary approaches, and participatory engagement in addressing these challenges and ensure the equitable and sustainable scaling of agroecology. By fostering inclusive policies, equitable market access, and collaborative governance structures, agroecology can play a pivotal role in building resilient and equitable food systems that address the dual challenges of climate change and food insecurity in Africa.

Declarations

4. Ethical Considerations

Ethical approval for the study was granted by the Uganda Christian University Research Ethics Committee (approval number UCUREC-2024-772), and the research was registered with the Uganda National Council for Science and Technology (UNCST) under registration number A409ES.

5. Statements and Declarations

The authors declare that they have no known competing financial or personal relationships that could have influenced this work.

6. Funding Declaration

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

7. Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this paper.

8. **Clinical trial number:** Not applicable.

9. **Consent to Publish declaration:** Not applicable.

10. **Consent to Participate declaration:** Not applicable.

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Figures

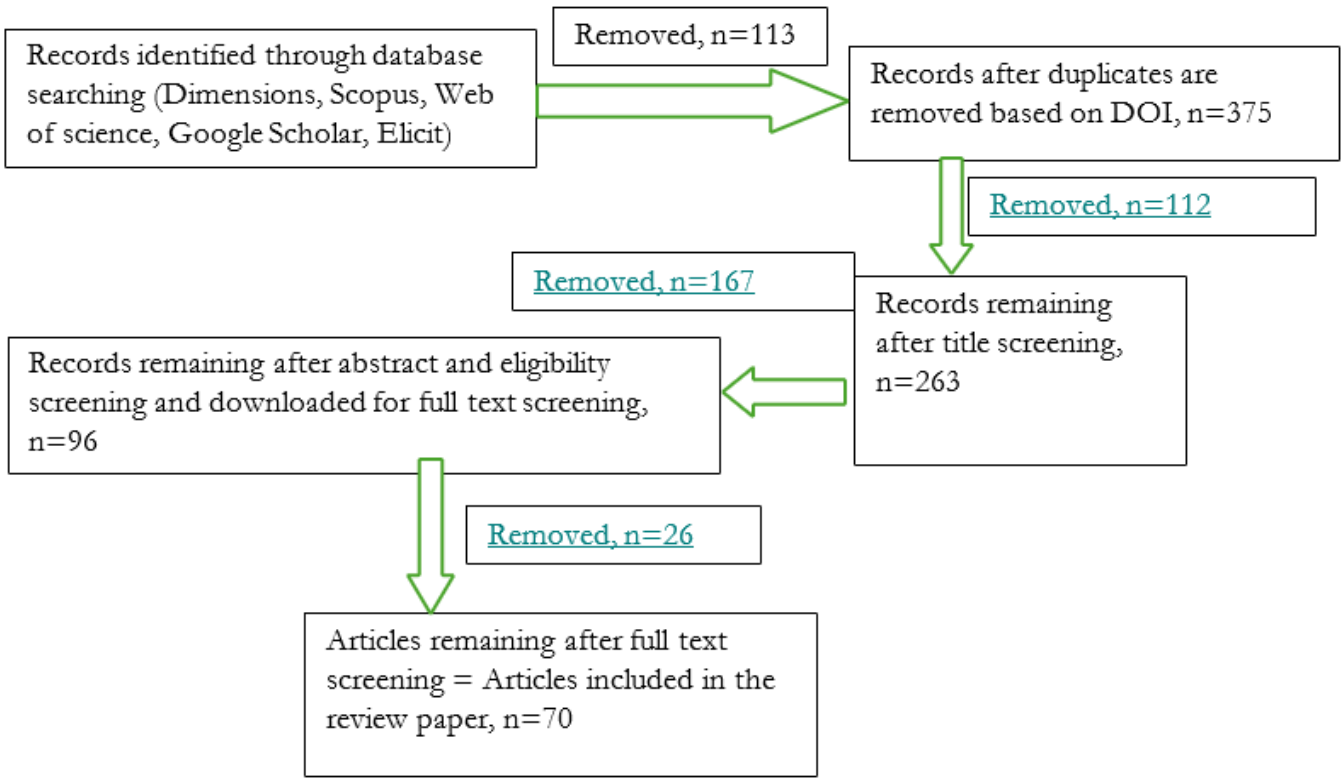


Figure 1

PRISMA flow diagram illustrating the research methodology



Figure 2

Geographic distribution of included articles into four African regions; North, South, East and West Africa.

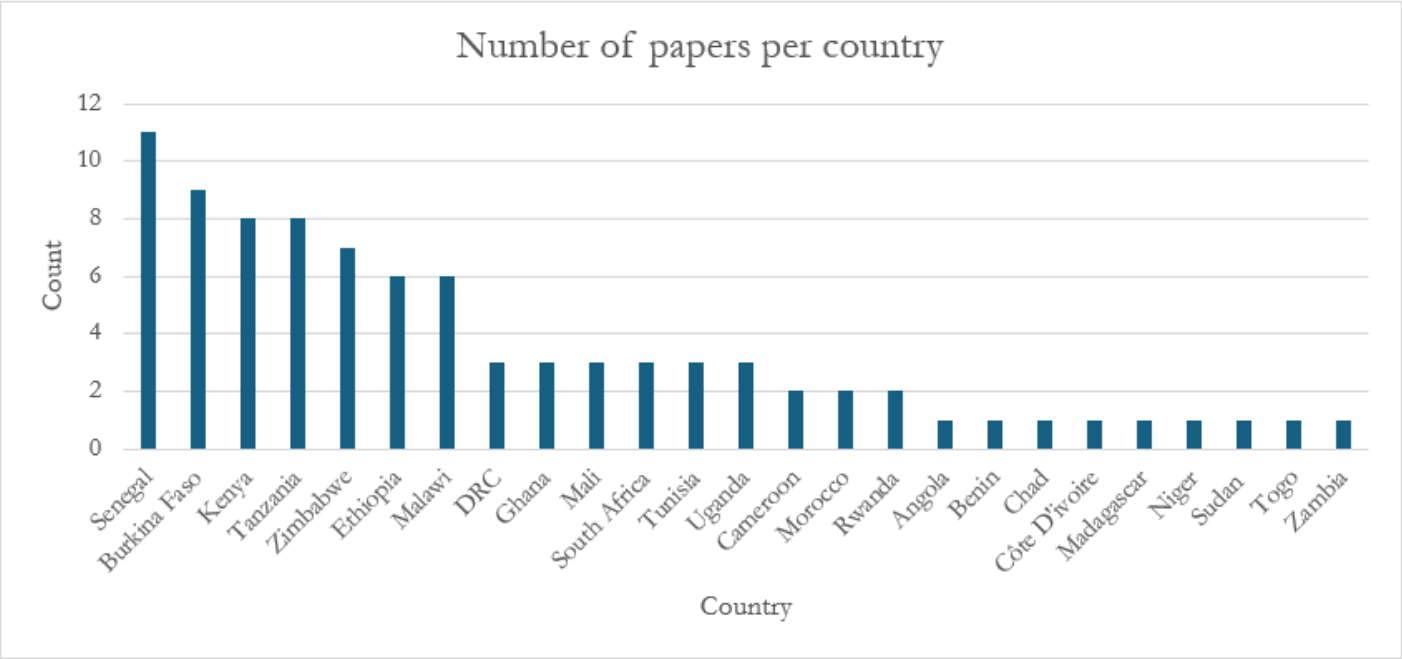


Figure 3

Country-level contributions to the included articles.

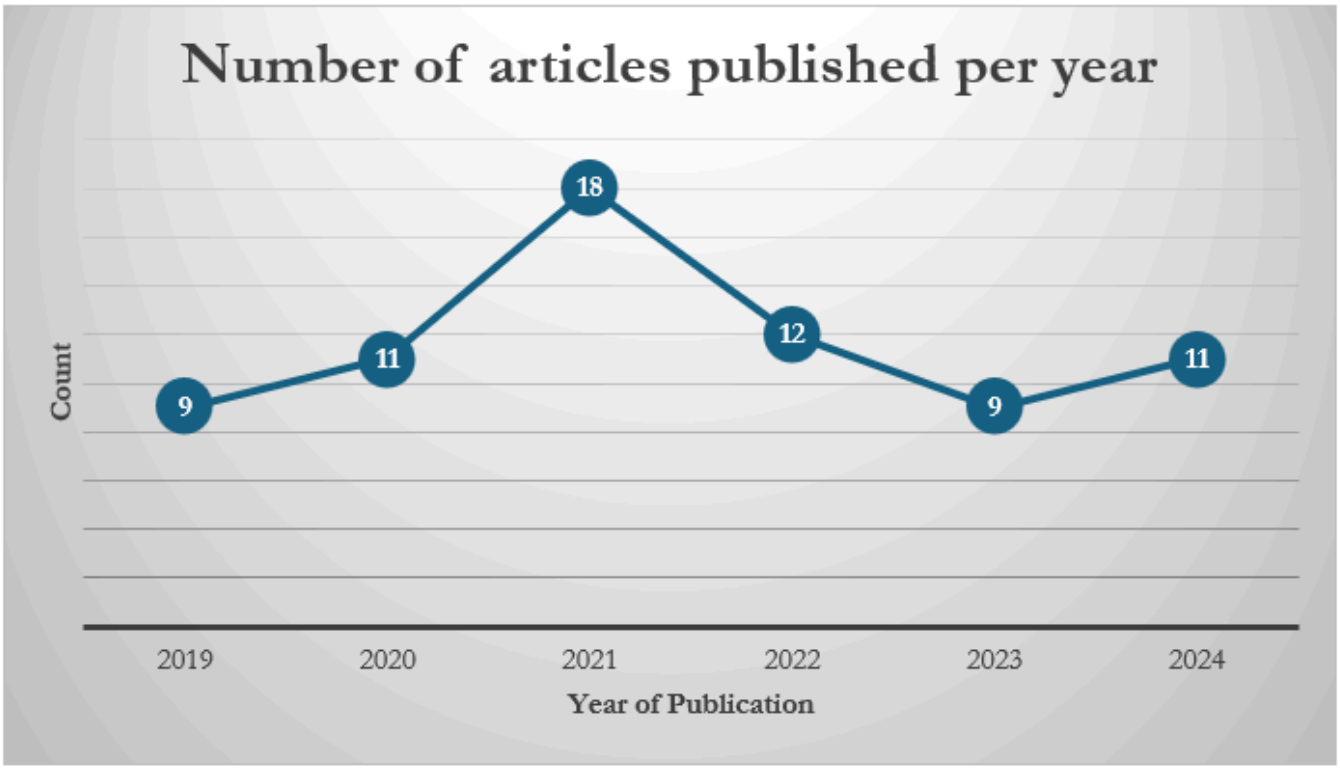


Figure 4

Temporal distribution of the articles.

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