Regional Policy Guide

ON

AGROECOLOGY, CIRCULAR ECONOMY AND CLIMATE ACTION IN AFRICA

GUIDING COUNTRIES TOWARD ECOSYSTEM SERVICES AND SUPER POLLUTANTS MITIGATION IN AGRICULTURE AND WASTE SECTORS

SUPPORTED BY:

REGIONAL POLICY GUIDE

ON

AGROECOLOGY, CIRCULAR ECONOMY, AND CLIMATE ACTION FOR ECOSYSTEM SERVICES FOR SUB-SAHARAN AFRICA

Prepared By

The ACE4ES Consortium
(Council for Scientific and Industrial Research – Crops Research Institute, Africa Rice Center, Peasant Farmers Association of Ghana, Agency for Health, Food Security, Youth Initiative for Land in Africa, University of Energy and Natural Resources)

For Endorsement By

Hon. Dr. Godfred Seidu Jasaw
Chairman, Parliamentary Select Committee on Food, Agriculture and Cocoa Affairs, Ghana

Foreword

By the Honourable Minister for Food and Agriculture, Republic of Ghana

Agriculture remains the backbone of many economies in Sub-Saharan Africa, providing livelihoods for millions, ensuring food security, and sustaining rural communities. However, the sector also faces mounting challenges—land degradation, climate change, declining biodiversity, and unsustainable input dependence—that threaten both productivity and the environment. Addressing these challenges calls for a transformative shift in how we produce, manage, and govern food systems.

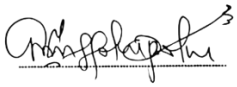
The Regional Policy Guide on Agroecology, Circular Economy, and Climate Action for Ecosystem Services offers a timely and compelling framework to support this transformation. By integrating the principles of agroecology and circular economy into our agricultural development strategies, the guide helps lay the foundation for building resilient, inclusive, and sustainable food systems across Africa.

For Ghana, this policy guide aligns with our national priorities under the Medium-Term Agriculture Sector Investment Plan (METASIP), the Feed Ghana programme, and our updated Nationally Determined Contributions (NDCs). It presents actionable pathways to enhance soil fertility through organic inputs, improve biodiversity and pollinator health, and reduce emissions from agricultural systems—particularly methane, black carbon, and nitrous oxide.

The Ministry of Food and Agriculture fully endorses the vision advanced in this guide. We see it as an important tool to support knowledge-based policymaking, foster inclusive value chains, and unlock climate-smart innovations that empower our farmers, especially women and youth.

As Ghana commissions the ACE4ES Multicultural Technology Park (MTP)—a regional hub for agroecological and circular economy innovations—we affirm our commitment to working with stakeholders across the region to mainstream these approaches into national and continental agricultural development agendas.

Let this guide inspire bold action, renewed collaboration, and shared responsibility in building a food system that nourishes people, restores ecosystems, and strengthens resilience for generations to come.



Hon. Eric Opoku
Minister for Food and Agriculture
Republic of Ghana

Acknowledgments

The development of this *Regional Policy Guide on Agroecology, Circular Economy, and Climate Action for Ecosystem Services in Sub-Saharan Africa* represents a collective effort shaped by rigorous scientific inquiry, policy dialogue, and multi-country collaboration aimed at transforming food systems toward resilience, equity, and climate sustainability.

We are deeply grateful to Dr. Kwaku Onwona-Hwesofour Asante, Principal Investigator of the ACE4ES Project at the CSIR-Crops Research Institute, for his visionary leadership in coordinating this initiative from conception to finalization. He was joined in the core drafting process by Dr. Eric Owusu Danquah of CSIR-CRI, Dr. Anthony Baidoo of the University of Energy and Natural Resources in Ghana, Dr. Isaiah Adeyemi of the Olusegun Agagu University of Science and Technology in Nigeria who led the compilation of stakeholder contributions from Nigeria, and Mr. Antoine Innocent Houedji of the Youth Initiative for Land in Africa (YILAA) who played a critical role in coordinating country-level consultations in Benin. The guide benefited greatly from early policy contributions and technical inputs from Dr. Jihane El Goauzi, Dr. Samson Ogallah, Fatou Diabete, and Sadiki Laiser of the Global Climate Change Alliance (GCCA) Programme under the Department of Agriculture, Rural Development, Blue Economy and Sustainable Environment (DARBE) of the African Union Commission. Their continental perspectives helped shape the document's alignment with Africa-wide climate and development frameworks.

We extend special appreciation to Mr. Gregory Kohler, Agriculture Expert at the Climate and Clean Air Coalition (CCAC), and Prof. Maxwell Darko Asante, Director, CSIR – Crops Research Institute, for this technical insights and constructive feedback during the drafting process, and to Mr. James Dahlgreen of SRI-2030 for his invaluable contributions on sustainable rice systems and mitigation pathways. Dr. Godfred Seidu Jasaw, Chairperson of the Parliamentary Select Committee on Food, Agriculture and Cocoa Affairs, is warmly acknowledged for his phenomenal contribution to strengthening the policy relevance, institutional coherence, and national alignment of this guide.

The visual presentation and layout of this document were significantly enhanced through the creativity and design skills of Mr. Godfred Dadzie Mensah, whose infographics and formatting brought clarity to complex ideas.

We also recognize the vital contributions of the ACE4ES Consortium and Implementation Team, comprised of researchers and practitioners from the CSIR-Crops Research Institute and CSIR-Soil Research Institute in Ghana, the Africa Rice Center in Côte d'Ivoire, the Peasant Farmers Association of Ghana, the Agency for Health and Food Security, the Youth Initiative for Land in Africa in Benin, and the Tanzania Organic Agriculture Movement. Their interdisciplinary knowledge, field experiences, and institutional engagements enriched the policy substance and contextual relevance of this guide.

The technical quality and integrity of the content were further ensured through the expert oversight of the Technical Review Team led by Dr. Raphael Kwame Bam, with review support from Drs. Ernest Baafi, Clement Oppong Preprah, Felix Frimpong, Priscilla Francisco Ribeiro and other team members whose meticulous assessments greatly improved the final output.

We are profoundly thankful to the Climate and Clean Air Coalition (CCAC) for the funding support that enabled the work of the ACE4ES Consortium and for its enduring commitment to science-based, cross-sectoral action on super pollutants and sustainable food systems in Africa. Above all, we express our gratitude to the farmers, youth groups, civil society actors, researchers, and public institutions across Ghana, Nigeria, Benin, and Tanzania who participated in consultations and shared their lived experiences, policy insights, and priorities. Their voices form the foundation of this policy guide and its call to action for agroecological transformation and circular economy transitions across the region.

Table of Contents

Foreword II
Acknowledgments III
Executive Summary 1
Background 2
Problem Overview 6
1. Agricultural Challenges 6
2. Environmental and Climate Challenges 7
3. Circular Economy and Resource Efficiency 10
4. Gender and Youth Inclusion 11
5. Policy and Investment Gaps 11
Purpose of the Policy Guide 12
Scope of the Policy Guide 13
Target Stakeholders: 15
II. Agroecology 16
A. Agricultural Practices and Sustainability 16
Promoting Sustainable Farming Techniques: 16
Reducing Reliance on Chemical Inputs and Promoting Organic Farming: 17
Research and Development of Agroecological Practices: 18
B. Farmer Engagement and Participation 20
Strengthening Farmer Cooperatives and Grassroots Networks: 20
Incentivizing Farmers who Adopt Agroecology: 21
Policies to Overcome Adoption Barriers: 22
C. Gender and Youth Inclusion 22
Equal Access to Resources and Decision-Making: 22
Gender-Sensitive and Youth-Targeted Training Programs: 22
Encouraging Youth-Led Innovation: 23
III. Circular Economy 23
A. Resource Efficiency and Waste Management 23
Circular Waste Management Practices: 23
Waste-to-Resource Opportunities: 24
Developing Waste Management Infrastructure: 25
B. Value Chain Analysis 25

Integration of Circular Economy Principles: 25
Implementing Closed-Loop Systems: 26
Value Addition Through Sustainable Practices: 26
C. Policy and Regulatory Environment 26
Identifying Policy Gaps: 26
Creating Incentives and Regulatory Frameworks: 27
Engaging the Private Sector: 27
IV. Ecosystem Services 28
A. Ecosystem Health and Services 28
Enhancing Ecosystem Services through Agricultural Practices: 28
Policy Support for Agroecological Practices: 29
Developing Metrics to Measure Ecosystem Services: 29
B. Land and Water Use 30
Sustainable Land and Water Management Practices: 30
Water-Efficient Systems and Soil Conservation Techniques: 31
Integrating Land and Water Use Planning with Climate Adaptation: 31
A. Super Pollutants and GHG Emissions 32
Mitigating Short-Lived Climate Pollutants (SLCPs): 32
Promoting Climate-Smart Agricultural Practices: 33
Ensuring Alignment with Nationally Determined Contributions (NDCs): 33
B. Climate-Smart Agriculture 34
Supporting the Adoption of Climate-Smart Agriculture (CSA): 34
Policies to Incentivize Agroforestry, Crop Diversification, and Improved Soil Management: 34
Integration of Climate Action and Food Security: 35
VI. Policy and Institutional Frameworks 49
A. Existing Policies and Frameworks 49
Review of National and Regional Policies: 49
Identifying Policy Gaps and Inconsistencies: 51
Encouraging Coherence Between Sectoral Policies: 51
B. Funding and Investment 53
Mobilizing Public and Private Investments: 53
Facilitating Access to International Development Funding: 53
Promoting South-South and Triangular Cooperation: 54
IX. Recommendations and Implementation Framework 60

A. Recommendations for Member States 60
Develop National Strategies: 60
Policy Alignment with Regional Frameworks: 60
Financial Incentives and Capacity Building: 61
B. Monitoring and Evaluation 62
Establish a Regional Monitoring and Evaluation Framework: 62
Encourage Regular reporting and data sharing. 63
C. Stakeholder Involvement 63
Ensure the Participation of Key Stakeholders: 63
Foster Partnerships Between Research Institutions and Governments: 64
X. Conclusion 64
References: 67

Executive Summary

The Regional Policy Guide for Agroecology, Circular Economy, and Climate Action aims to provide a coherent framework for Sub-Saharan African countries to enhance ecosystem services, improve food security, and build climate resilience through sustainable agricultural practices. This guide is the result of extensive needs assessments and consultations with a wide range of stakeholders, including policymakers, research institutions, civil society, farmer networks, and private sector actors. Its purpose is to align national strategies with regional frameworks such as the Comprehensive Africa Agriculture Development Programme (CAADP), AU Agenda 2063, and the Paris Agreement, while addressing policy gaps and inconsistencies in agriculture, waste management, and climate action.

The guide is structured around five key pillars:

1. Agroecology: Encouraging the adoption of sustainable agricultural practices that improve biodiversity, soil health, and crop productivity, while reducing reliance on chemical inputs. It emphasizes the importance of farmer engagement and participation, with special focus on gender and youth inclusion in the agroecological transition.

2. Circular Economy: Promoting the efficient use of resources through sustainable waste management practices, such as composting, biochar production, feed production and bioenergy. The guide also stresses the need for value chain analysis to integrate circular economy principles across agricultural systems, reducing waste and encouraging resource recovery.

3. Ecosystem Services: Focusing on enhancing ecosystem health through sustainable land and water use practices. The guide advocates for the adoption of agroecological practices that restore degraded ecosystems and improve natural resource management.

4. Climate Action: Providing strategies for mitigating Short-Lived Climate Pollutants (SLCPs), super pollutants and their precursors, and strengthening resilience through climate-smart agricultural practices like System of Rice Intensification (SRI) and the use of biochar and composting. The guide ensures alignment

with member states' Nationally Determined Contributions (NDCs) under the Paris Agreement.

5. Policy and Institutional Frameworks: The guide calls for policy coherence across sectors such as agriculture, environment, and energy to promote the adoption of sustainable practices. It advocates for increased public and private investment in agroecological and circular economy initiatives, while also encouraging south-south cooperation and triangular partnerships to drive investment in climate resilience.

Recommendations include the development of national strategies that integrate agroecology, circular economy, and climate action, aligned with regional frameworks. Furthermore, a regional monitoring and evaluation framework is proposed to track progress and ensure alignment with international climate targets.

Background

The development of this policy guide is the result of an elaborate process that engaged diverse stakeholders across Sub-Saharan Africa. Through a series of physical and virtual meetings, needs assessments, and consultations, key insights were gathered from regional and national stakeholders representing various sectors. Participants included government agencies, academic and research institutions, civil society organizations, the private sector, farmer cooperatives, youth and women's networks, and international development partners.

These engagements were designed to ensure that the policy guide reflects the real challenges and opportunities faced by stakeholders at all levels. From local farmers to regional policymakers, stakeholder inputs were considered to foster an inclusive and participatory approach to policy formulation. The discussions were grounded in the need for vertical and horizontal policy coherence—ensuring that agroecology, circular economy, and climate action are aligned across different sectors and governance levels to maximize the impact on ecosystem services and sustainable agricultural development.

The insights gained from these collaborative efforts highlighted the urgent need for a framework that supports national and regional transitions toward sustainable farming, resource efficiency, and climate resilience. The diverse contributions informed the recommendations outlined in this policy guide, which serves as a comprehensive roadmap for fostering agroecological transitions, promoting circular economy principles, and integrating climate action into agricultural systems. This policy guide seeks to drive harmonized action across member states, ensuring the alignment of national priorities with regional and global sustainability goals.

Through the implementation of the recommendations outlined in this guide, it is expected that Africa will make significant progress toward enhancing ecosystem services, improving food security, and building climate resilience, while promoting inclusive and sustainable economic growth.

Policy Framework Alignment

The Regional Policy Guide on Agroecology, Circular Economy, and Climate Action, developed by the ACE4ES Consortium and partners, is strategically aligned with both global and regional frameworks, ensuring its relevance and effectiveness in guiding sustainable agricultural transformation in Sub-Saharan Africa. This policy guide adopts a vertical and horizontal coherence approach, valuing community engagements as well as high-level political engagements and ensuring global commitments are well aligned with regional frameworks, demonstrating coherence and integration across multiple governance levels.

Global Policy Alignments

At the global level, the policy guide aligns with key frameworks such as the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 13 (Climate Action), and SDG 15 (Life on Land). By promoting sustainable agricultural practices, climate-smart farming, and ecosystem restoration, the guide supports the achievement of these targets, ensuring that agricultural systems contribute to food security, emission reductions, and biodiversity conservation.

The policy guide also integrates principles from the Paris Agreement, ensuring that agricultural practices align with the Nationally Determined Contributions (NDCs) of African countries and focuses on the reduction of short-lived climate pollutants (SLCPs) like methane and black carbon, and other emissions like nitrous oxide.

Additionally, the guide aligns with the Convention on Biological Diversity (CBD) and the Kunming-Montreal Global Biodiversity Framework which places emphasis on biodiversity conservation and sustainable use of natural resources within agricultural landscapes. This alignment ensures that agroecological practices protect and enhance biodiversity, supporting ecosystem services critical for agriculture. The guide also reflects the objectives of the UN Convention to Combat Desertification (UNCCD) by promoting land management strategies that restore degraded lands, prevent soil erosion, and enhance soil fertility.

Moreover, the ACE4ES policy guide supports initiatives such as the Global Methane Pledge, targeted at methane emission reductions, and the United Nations Decade on Ecosystem Restoration (2021-2030), which prioritizes sustainable agriculture and ecosystem restoration. The policy guide's emphasis on practices that restore soil health, protect biodiversity, and improve ecosystem services ensures alignment with these global frameworks.

Regional Policy Alignments

At the regional level, the guide aligns with the Comprehensive Africa Agriculture Development Programme (CAADP), which is Africa's principal framework for agricultural transformation. CAADP focuses on sustainable land management and climate-smart agriculture, which are central themes in the policy guide, emphasizing ecosystem services and agroecological practices to boost agricultural productivity and resilience.

The policy guide also supports the objectives of the Malabo Declaration on Accelerated Agricultural Growth and Transformation (2014), which promotes inclusive and climate-resilient agricultural growth. Through the promotion of agroecology and sustainable farming practices, the ACE4ES policy guide contributes directly to the Malabo targets, building resilient food systems and improving livelihoods across Sub-Saharan Africa.

The guide further aligns with the African Union Climate Change and Resilient Development Strategy and Action Plan (2022-2032), which emphasizes climate-smart agriculture and ecosystem-based adaptation. The ACE4ES project's focus on emission reductions and promoting resilient agroecosystems mirrors these priorities, supporting Africa's broader climate adaptation and mitigation goals.

Moreover, the policy guide is designed to support the African Continental Free Trade Area (AfCFTA) by enhancing sustainable agricultural productivity. It contributes to the development of

regional value chains and food security under this economic integration framework. It also contributes to Agenda 2063: The Africa We Want, aligning its strategies with Africa's long-term vision for socioeconomic and environmental transformation.

The guide's alignment extends to several climate Initiative, which focuses on climate resilience through improved climate information services. The ACE4ES project's emphasis on data-driven monitoring and emissions measurement supports this initiative to produce the data necessary for informed climate-smart agricultural strategies.

Lastly, the guide syncs with the African Union Environmental Action Plan (2021-2030), in support of its commitment to ecosystem protection, biodiversity conservation, and sustainable water and land use.

Dr. Kwaku Onwona-Hwesofour Asante,
Coordinator, ACE4ES Consortium,
CSIR-Crops Research Institute, P O Box 3785, Kumasi-Ghana.
Email: asante.kwaku@gmail.com / k.asante@cropsresearch.org

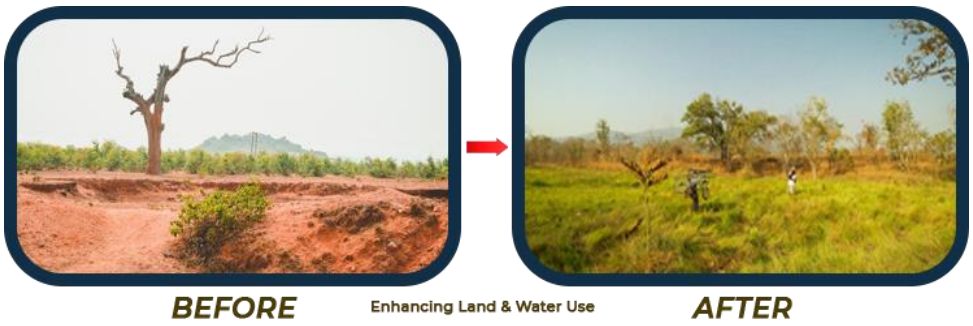
Problem Overview

The potential for Africa to produce nutritious food enough to meet its growing population and export excesses to the global market is uncontestable given its natural resource endowments. In spite of this, Africa is experiencing critical environmental and socio-economic challenges that necessitate urgent action for its food systems and climate constraints. With the continent's population projected to reach 2.5 billion by 2050 (Lam, 2024), there is a corresponding increase in food demand and pressure on natural resources. This has exacerbated environmental degradation, including loss of biodiversity, deforestation, and soil degradation. The implementation of a regional policy guide that integrates agroecology, circular economy, and climate action is not only timely but essential for achieving sustainable development.

1. Agricultural Challenges

Agriculture forms the backbone of Africa's economy, employing more than 60% of the population (Kubik, 2022; Magoma, 2024). However, the sector faces a variety of systemic issues, including:

i. Land Degradation: More than 65% of Africa’s land is affected by degradation (Lakew Tefera et al., 2024). This undermines food security, reduces agricultural productivity, and makes communities more vulnerable to climate change.

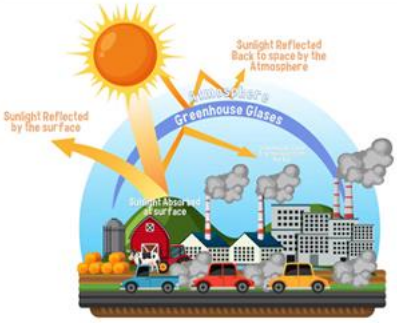


ii. Food Insecurity: Despite agriculture's central role, 282 million Africans are undernourished (de Haas & Giller, 2025). Over-reliance on unsustainable farming methods like monocropping and heavy dependence on external inputs including imported hybrid seeds and agrochemicals has further stressed the land, leading to soil erosion and reduced fertility.

2. Environmental and Climate Challenges

Africa is disproportionately affected by the global climate crisis. The continent contributes only 3% of global greenhouse gas (GHG) emissions, yet it faces severe impacts of climate change, including extreme weather events like droughts, floods, and rising temperatures (Omotoso & Omotayo, 2024). These climate impacts further reduce agricultural productivity and threaten food security, especially as agriculture is largely rain-fed and climate-sensitive.

a) **Super-Pollutant Emissions:** Short-lived climate pollutants (SLCPs), particularly methane and black carbon, are major contributors to climate change. Methane emissions from rice paddies and livestock, as well as black carbon from biomass burning, significantly contribute to both climate warming and public health risks. Agriculture accounts for 56% of methane emissions in Africa making it a key area for intervention (Hui et al., 2024). Nitrous oxide emissions from excessive fertilizer use and carbon monoxide from biomass burning continue to add to the pool of climate pollutants



and GHG emissions. Other emerging climate constraints from scientific studies is agriculture's contribution to tropospheric ozone emission which poses both health risks and increased warming.

b) High Vulnerability of Climate Change: Africa's Agriculture is highly vulnerable to the impacts of climate change. With only 6% of Africa's cultivated area under irrigation, agriculture within the region remains extremely vulnerable to climate stressors (Higginbottom et al., 2021).

c) **Biodiversity Loss:** Africa is losing biodiversity at an alarming rate. The continent has already lost 20-30% of its mammal, bird, and amphibian species (Cappa et al., 2022; Nath et al., 2023). Biodiversity loss undermines ecosystem services such as pollination, water regulation, and soil fertility, all of which are critical for agriculture. Particularly, pollinators, including bees, butterflies, birds, and other insects, play a critical role in both agricultural production and biodiversity. The widespread use of pesticides, particularly neonicotinoids and other harmful agrochemicals, has significantly impacted pollinator populations, resulting in notable declines in species critical to food production and ecosystem balance. Approximately 75% of the world's food crops depend on pollination services (Ara & Haque, 2021), making the decline of pollinators a direct threat to food security and biodiversity.

Key Facts:

✓ **Bee Population Decline:** According to a global assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), nearly 40% of invertebrate pollinator species are at risk of extinction (Deynze et al., 2022). Pesticide exposure is one of the key drivers of this decline, contributing to

colony collapse disorder (CCD) in managed bee populations (Goulson et al., 2015).

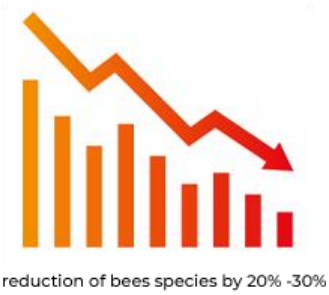
✓ **Pesticide Exposure Impact:** Research highlights that neonicotinoid pesticides, widely used across agricultural landscapes, are responsible for the loss of up to 40% of honeybee colonies in several regions, particularly in Europe and North America arising from misuse and misapplication (Van Deynze et al., 2024a).

✓**Economic Losses:** The Food and Agriculture Organization (FAO) estimates the economic value of pollination services provided by ecosystems to be between $235 and $577 billion USD annually (Khalifa et al., 2021). Pollinator declines from pesticide use threaten the productivity of crops such as fruits, vegetables, nuts, and seeds, leading to substantial economic consequences (Khalifa et al., 2021).

✓ **Butterfly Population Trends:** In spite of the data paucity on Africa's butterfly population trends, case study data from Europe present butterfly populations to have declined by 49% over the past decade (Van Deynze et al., 2024b), with the leading cause being pesticide use in agricultural systems. In North America, monarch butterfly populations have decreased by more than 80% in the last 20 years due to pesticide-related habitat loss and food source degradation (Chakuya et al., 2022).

✓ **Wild Pollinators:** Wild pollinators, such as solitary bees and bumblebees, are also severely impacted by pesticide use. Studies show that fields treated with pesticides have 50% fewer wild pollinators than those managed organically or without synthetic chemicals (Cappa et al., 2022; Smith et al., 2022).

✓ In regions such as South Africa and Ghana, pesticide use in agriculture has been shown to reduce native bee species populations by 20-30% (Quandahor et al., 2024).



3. Circular Economy and Resource Efficiency

The concept of a circular economy, where resources are reused, recycled, and repurposed, is not widely implemented across African agriculture. Most agricultural systems are still linear, leading to massive waste, resource depletion, and environmental damage.

a) **Agricultural Waste:** Africa generates an estimated 35 million tons of agricultural waste annually (Awogbemi & Kallon, 2022; Herath et al., 2024), most of which is underutilized. Only a small fraction is converted into valuable by-products like compost or biochar, while the rest is either burned (leading to emissions) or discarded (adding to landfill challenges) (Kataya et al., 2023).

b) **Waste Management Infrastructure Gaps:** In many African countries, especially in rural areas, waste management infrastructure is weak or non-existent. The inability to process agricultural waste efficiently leads to lost economic opportunities and exacerbates environmental degradation.

4. Gender and Youth Inclusion

Women and youth are underrepresented in agriculture's decision-making processes despite their crucial roles. Women contribute up to 50% of agricultural labor in Sub-Saharan Africa (Buehren, 2023), yet they have limited access to land, resources, and agricultural inputs. According to the World Bank, women own less than 20% of land in Africa due to discriminatory inheritance and property laws (Nchanji et al., 2023). Africa has the world's fastest-growing youth population, yet youth unemployment remains a severe problem, with 12 million young Africans entering the labor market annually, and only 3 million formal jobs created each year (Kubik, 2022). Agriculture could provide a viable opportunity for youth employment if supported by modern agroecological practices and innovation.

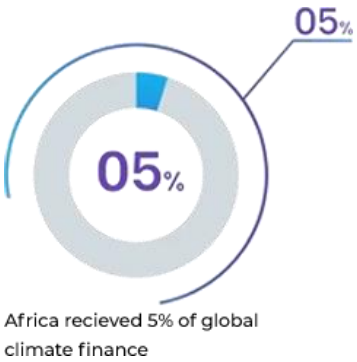
Upto 50% women contribute to agricultural labor in Sub-Saharan Africa.

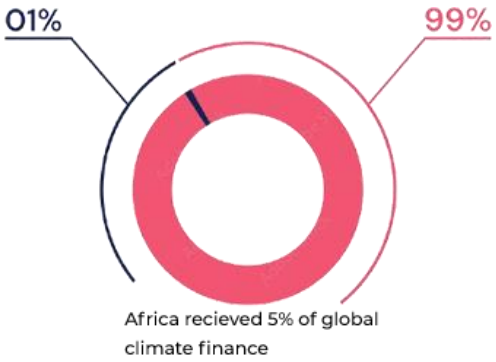
Women own less than 20% of land in Africa.

5. Policy and Investment Gaps

Despite the clear need for agroecological and circular economy practices, Africa's policy and investment landscape remains fragmented. Most national policies do not adequately promote agroecology or circular economy principles. There is also limited coherence between agricultural, environmental, and climate action policies, which hampers the implementation of sustainable agricultural practices (Baker et al., 2019; Shawoo et al., 2020).

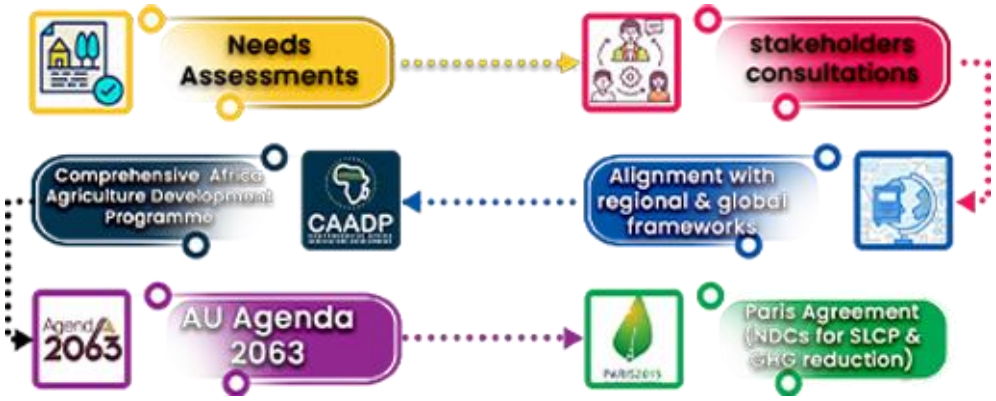
Africa is one of the least funded regions in terms of climate finance. In 2020, Africa received only 5% of global climate finance. Additionally, less than 1% of international development funding is allocated to air pollution control and even far less for agriculture-associated air pollution, despite the devastating health and economic impacts of air pollution in Africa (Bhandary et al., 2021; Bhattacharya, 2022).





Given the above challenges, the proposed Regional Policy Guide is essential for aligning agroecological practices, circular economy principles, and climate action across member states in Sub-Saharan Africa. Through the adoption of this guide, Africa can address food insecurity, improve natural resource management, reduce emissions, and foster resilience to climate change. The policy guide provides an opportunity for coordinated action that aligns national policies with regional and global frameworks, such as the Comprehensive Africa Agriculture Development Programme (CAADP), Agenda 2063, and the Paris Agreement.

This policy guide, developed through extensive multi-stakeholder consultations, offers a framework for member states to promote sustainable agriculture, improve resource efficiency, and integrate climate-smart solutions, ensuring Africa's environmental and economic sustainability for generations to come.



Purpose of the Policy Guide

This policy guide has been developed to offer a coherent framework for member states across the African region to implement strategies that integrate agroecology, circular economy, and climate action to enhance ecosystem services. It aims to align national policies with regional and global sustainability goals by promoting the following:

✓ Agroecology: Encouraging sustainable farming practices that restore soil health, preserve biodiversity, and ensure long-term food security by minimizing external inputs and maximizing ecological functions. Agroecology seeks to create resilient agricultural systems capable of withstanding climate variability and protecting ecosystems.

✓ Circular Economy: Facilitating the transition from linear to circular economic models in agricultural value chains. This involves closing resource loops through waste reduction, recycling or repurposing by composting, pyrolyzing and facilitating the efficient use of by-products such as crop residues and livestock waste to improve resource efficiency and reduce environmental impacts.

✓ Climate Action: Aligning agricultural practices with national climate goals and international climate agreements, such as the Paris Agreement, to ensure that agriculture contributes to both mitigation (reducing greenhouse gas emissions) and adaptation (building resilience against climate shocks).

The key objectives of this policy guide include:

1) To foster environmentally sustainable agricultural practices that contribute to soil regeneration, biodiversity conservation, and sustainable water use while reducing pollution and harmful emissions.

2) To facilitate the promotion of agroecology and circular economy practices towards the long-term contribution to food security by improving yields, soil health, and resilience to climate variability.

3) To provide member states with actionable strategies to build resilience to climate change through sustainable land management, conservation practices, and the integration of climate-smart agriculture.

Scope of the Policy Guide

The scope of this policy guide extends across multiple dimensions of sustainable development and agricultural systems within Sub-Saharan Africa, with a primary focus on the following areas:

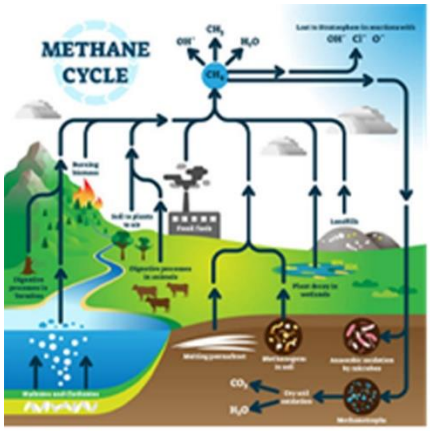
i. Agricultural Systems: The guide addresses the promotion of agroecology as a pathway to achieve sustainable food systems, resilient crop and livestock production, and a reduction in short-lived climate pollutants (SLCPs) and long-lived climate pollutants (LLCPs). It includes frameworks for integrating biodiversity conservation, soil health restoration, water management, and sustainable input use into national and regional agricultural policies.

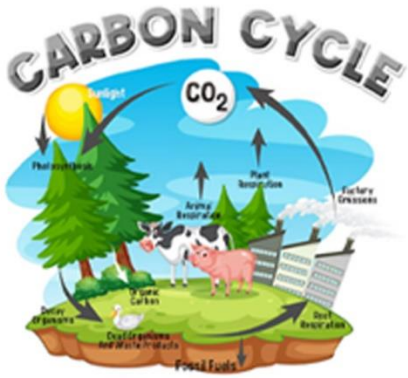
ii. Waste Management: Circular economy principles are applied to agricultural value chains, focusing on sustainable waste management strategies. This includes policies on composting, bioenergy production, and the reuse of agricultural by-products, such as crop

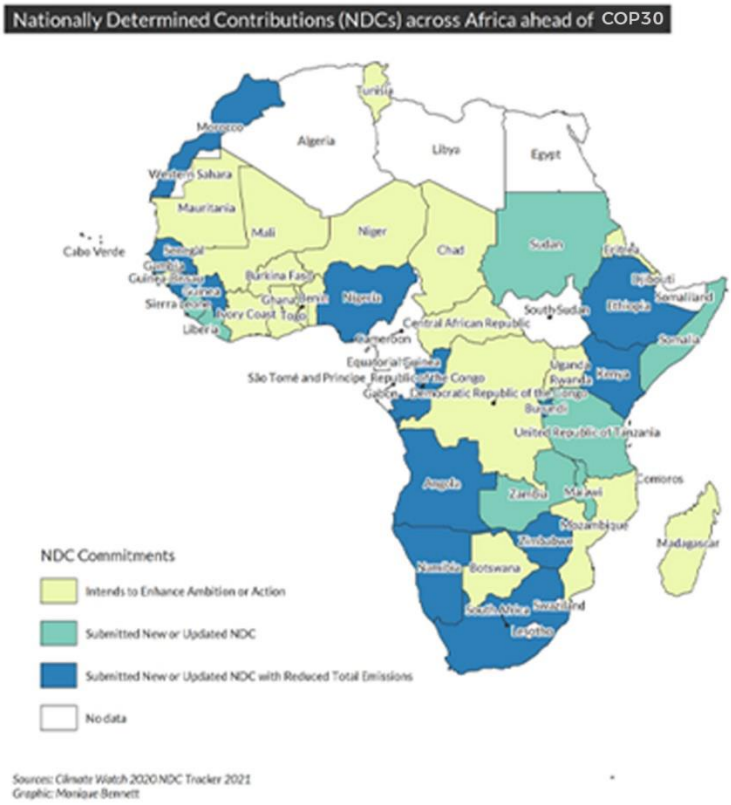
residues, livestock waste, and agro-processing waste, to reduce environmental pollution and improve resource efficiency.

iii. Biodiversity Conservation: This is critical for conserving ecosystem services through agroecological practices. It emphasizes biodiversity as a key element of sustainable agricultural systems, aiming to increase crop diversity, protect wildlife corridors, and support ecosystem resilience in farming landscapes.

iv. Climate Mitigation and Adaptation Strategies: Alignment of national agricultural systems with regional and international climate goals, including Nationally Determined Contributions (NDCs) under the Paris Agreement needs to be prioritized. Strategies for mitigating greenhouse gas (GHG) emissions from agriculture, such as zero burning of biomass, promoting alternative wetting and drying (AWD) in rice production, and increasing carbon sequestration through agroforestry and sustainable land management can make a great change in air quality, climate metrics and crop productivity.







In alignment with the policy guide, the anchoring of policies and practices in key international and regional frameworks are promoted through the following:

a) Comprehensive Africa Agriculture Development Programme (CAADP): Aligning agroecological and circular economy strategies with the goals of increasing agricultural productivity, food security, and poverty reduction across Africa.

b) Paris Agreement: Ensuring that agricultural practices contribute to climate mitigation and adaptation targets, particularly in the reduction of SLCPs such as methane and black carbon.

c) African Union Agenda 2063: Contributing to the broader goals of sustainable development, including economic transformation, environmental protection, and inclusive growth within the agricultural sector.

d) Nationally Determined Contributions (NDCs): The policy guide supports the alignment of national agricultural systems with country-specific NDCs, providing a roadmap for how agroecological and circular economy principles can contribute to achieving these targets.

e) Sustainable Development Goals (SDGs): The policy guide aligns with the Sustainable Development Goals (SDGs), specifically SDGs 2 (Zero Hunger), 12 (Responsible Consumption and Production), 13 (Climate Action), and 15 (Life on Land). By integrating agroecological and circular economy principles, it accelerates progress on these goals, promoting sustainable food production, reducing waste, and enhancing climate resilience. The guide encourages countries to leverage these approaches to drive economic, social, and environmental sustainability, positioning Africa as a leader in advancing the SDGs through innovative agricultural policies.

Target Stakeholders:

Regional entities, coalitions, research organisations have greater need to engage a broad spectrum of stakeholders to ensure its implementation of policy coherence initiatives within the agriculture, environment and energy sector is holistic and impactful. The primary target groups include:

i. National and Regional Policymakers: Government ministries and regional bodies responsible for agriculture, environment, waste management, and climate action will use this guide to shape policy development and implementation. These stakeholders are crucial for ensuring the alignment of national policies with regional frameworks like the Comprehensive Africa Agriculture Development Programme (CAADP) and AU Agenda 2063.

ii. Private Sector: Agribusinesses, agro-processors, and other private sector entities involved in agriculture and food production are essential partners for integrating circular economy principles and sustainable practices into agricultural value chains. Their role will be vital in advancing innovations in waste-to-resource initiatives, sustainable packaging, and green technologies that contribute to climate action and ecosystem restoration.

iii. Civil Society Organizations (CSOs): CSOs, particularly those advocating for environmental sustainability, food security, and climate resilience, will play a key role in monitoring policy implementation and facilitating farmer and community engagement. They will help ensure the inclusivity of policies and amplify the voices of marginalized groups, such as smallholder farmers and rural communities.

iv. Research Institutions and Universities: Academic and research institutions are vital for driving research, innovation, and capacity-building initiatives around agroecology, circular economy, and climate-smart agriculture. They provide the technical expertise to evaluate policy impacts and develop solutions that enhance ecosystem services.

v. Farmer Networks: Farmer associations, cooperatives, and grassroots organizations will be central to the implementation of agroecological practices on the ground. Their participation in policy dialogues ensures that policies are farmer-led and responsive to the real challenges faced by agricultural communities.

vi. Youth and Women Groups: Given their critical role in the agricultural labor force, youth and women must be included in policy formulation and implementation processes. The guide promotes gender-sensitive and youth-targeted approaches to foster inclusivity, ensuring that these groups have equitable access to resources, training, and leadership opportunities in the agroecological and circular economy transition.

II. Agroecology

A. Agricultural Practices and Sustainability

Promoting Sustainable Farming Techniques:

i. Crop Diversification: Encouraging the use of diverse crop varieties in farming systems to enhance productivity, soil health, and ecosystem resilience. Crop diversification helps reduce the risk of crop failure, enhances biodiversity, and improves food security by providing multiple sources of income and nutrition for farmers.

ii. Agroforestry: Integrating trees and shrubs into agricultural landscapes to improve soil fertility, sequester carbon, and enhance water conservation. Agroforestry also supports

biodiversity by providing habitats for different species while protecting the land from erosion. Commitments to afforestation and the prevention of deforestation and forest degradation are key to preventing super pollutant production like soot (particulate matter 2.5) and its associated elemental and volatile organic compounds and harmful metallic elements. These elements and compounds serve as precursors to other harmful GHGs like tropospheric ozone,




iii. Soil Management: Implementing practices such as crop rotation, cover cropping, and conservation tillage to maintain soil fertility, improve water retention, and prevent soil degradation. Healthy soils are essential for sustainable agriculture and can reduce the need for synthetic inputs. Additionally, protecting soils with cover crops, compost and organic manure is a better substitute for agriculture burning during post-harvest and pre-planting land preparation during which black-carbon is produced extensively-polluting the air and extensively warming the atmosphere simultaneously.



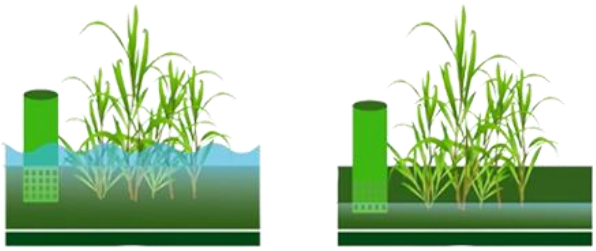

Reducing Reliance on Chemical Inputs and Promoting Organic Farming:

i. Organic Farming: Encouraging farmers to adopt organic farming techniques that minimize the use of synthetic fertilizers and pesticides. Organic farming prioritizes the use of natural inputs like compost and biofertilizers to improve soil health and boost crop yields without harming ecosystems and polluting the atmosphere with super pollutants. Farmers who deploy organic production practices also commit to biomass incorporation instead of biomass burning resulting in a significant reduction in black carbon and super-pollutant emissions.

ii. Integrated Pest Management (IPM): Utilizing biological control methods and crop rotations to manage pests and diseases, reducing the reliance on chemical pesticides. IPM promotes the health of the ecosystem while ensuring crop productivity.

Research and Development of Agroecological Practices:

i. Innovative Research: This involves promoting research into agroecological practices that enhance crop productivity and resilience. It includes breeding drought-resistant crop varieties, developing natural soil amendments (like biochar), and improving water management techniques such as alternate wetting and drying (AWD) in rice fields. The conversion of biomass to char instead of ash holds a lot of promise in preventing black carbon production. Similarly, AWD practices save the atmosphere from excessive methane production.



Alternate wetting and drying (AWD)

Biochar

ii. Biodiversity and Ecosystem Health: Fostering biodiversity within farming systems supports ecosystem services like pollination, pest regulation, and nutrient cycling. Research should focus on enhancing biodiversity in agroecosystems, making them more resilient to environmental changes and climate impacts.

Distinguishing Between Food Security and Food Sovereignty in Agroecological Transitions

A key consideration in promoting sustainable agricultural transformation is the distinction between food security and food sovereignty. While both concepts are critical to ensuring that populations have access to sufficient food, food sovereignty aligns more closely with agroecology and circular economy principles due to its emphasis on local self-sufficiency, environmental sustainability, and reduced dependency on external inputs.

1. **Food Security:**

Food security is traditionally defined as ensuring that all individuals have reliable access to sufficient, safe, and nutritious food to meet their dietary needs. However, achieving food security in many African countries has often relied on intensive industrial farming, including monocropping, synthetic fertilizers, and imported agricultural inputs. This approach, while addressing immediate food supply challenges, has led to soil degradation, biodiversity loss, and vulnerability to global supply chain disruptions. Land preparation has often been tied to biomass burning producing huge tons of black carbon and other particulate matter constituents.

2. **Food Sovereignty and Agroecology:**

In contrast, food sovereignty goes beyond food security by emphasizing local control over food production systems, favoring agroecological farming practices that use indigenous knowledge, biodiversity conservation, and locally available inputs. This approach:

- Reduces dependency on imported chemical fertilizers by promoting the use of organic manure, compost, and biofertilizers.
- Strengthens resilience against external shocks, such as trade restrictions and global price volatility.
- Encourages diversified farming systems that integrate agroforestry, crop rotation, and intercropping to improve soil fertility and productivity sustainably.
- Supports smallholder farmers by ensuring they have decision-making power over agricultural policies and market structures, aligning with rights-based approaches to farming.
- Reduce the production of black carbon and nitrous oxide as biomass incorporation in soil is prioritized over burning and lesser inorganic fertilizers such as ammonia are replaced with nitrogen-fixing legumes as cover crops or intercrops.

Policy Implications for Agroecological Transitions

To fully integrate food sovereignty into agroecology and circular economy policies, the following strategies should be prioritized:

- Promoting local input production by scaling up organic manure, composting programs, and biopesticides.
- Strengthening farmer-led seed systems to reduce reliance on imported genetically modified seeds.
- Developing national strategies for soil fertility management based on locally sourced organic amendments.
- Reforming trade policies to prioritize domestic and regional food markets over dependency on external food imports.
- Ensuring farmer participation in policy decisions to align agricultural priorities with community needs and ecological sustainability.





B. Farmer Engagement and Participation

Strengthening Farmer Cooperatives and Grassroots Networks:

i. Knowledge Dissemination: Empowering farmer cooperatives and grassroots organizations to serve as platforms for the dissemination of agroecological knowledge. These networks play a vital role in peer-to-peer learning, sharing best practices, and enabling collective action toward sustainable farming.

ii. Capacity Building: Offering training and education on agroecological practices through farmer cooperatives and community groups, ensuring that knowledge is effectively passed on at the local level.

Incentivizing Farmers who Adopt Agroecology:

i. Access to Organic Inputs: Providing farmers with easier access to organic inputs such as biofertilizers, compost, and natural pest control solutions. This can be achieved through subsidies, public-private partnerships, and local production of organic inputs.

ii. Market Opportunities: Creating and promoting market access for sustainably produced products, such as organic food, fair-trade goods, and climate-smart commodities. Policies should ensure that farmers benefit from price premiums and certification schemes for eco-friendly products.

iii. Capacity Building: Developing programs that focus on building the capacity of farmers to adopt agroecological practices. Training on organic farming, water conservation, soil management and the relationship between sustainable production practices and super-pollutant prevention can enhance their ability to transition to sustainable farming systems.

Policies to Overcome Adoption Barriers:

i. Access to Resources: Implementing policies that address resource constraints faced by farmers, such as limited access to land, water, and financing. Policies should focus on improving land tenure security for smallholders and providing financial support through loans, grants, or microcredit schemes.

ii. Knowledge Gaps: Promoting extension services that focus on agroecological principles, ensuring farmers are aware of the benefits and methods of sustainable agriculture. Strengthening partnerships between research institutions and farmer networks can help bridge these knowledge gaps.

iii. Financial Constraints: Developing financial mechanisms that incentivize the adoption of agroecology, such as subsidies for organic inputs, reduced interest rates for green investments, or grants for sustainable land use practices.

C. Gender and Youth Inclusion

Equal Access to Resources and Decision-Making:

i. Land and Other Resources Access: Ensuring that women and youth have equal access to land, financial resources, and agricultural inputs such as seeds, fertilizers, and technology. Policies should support equitable land ownership rights and remove barriers that prevent marginalized groups from fully participating in agriculture.

ii. Inclusive Decision-Making: Promoting the active involvement of women and youth in decision-making processes, both at the household and community levels, especially regarding agricultural practices and land management. This can be achieved through reforms in agricultural governance structures to ensure fair representation.

Gender-Sensitive and Youth-Targeted Training Programs:

i. Training in Agroecological Practices: Developing training programs specifically designed for women and youth to equip them with the knowledge and skills needed to adopt agroecological practices. These programs should be accessible and tailored to meet the unique challenges faced by these groups, such as time constraints or lack of formal education.

ii. Capacity Building: Training programs should also focus on leadership and entrepreneurship, enabling women and youth to take on leadership roles in farmer cooperatives, agribusinesses, and community organizations, contributing to greater inclusivity in agricultural development.

Encouraging Youth-Led Innovation:

i. Innovation in Sustainable Agriculture: Creating avenues for youth to engage in agriculture through innovation and technology, particularly in climate-smart and digital farming solutions. Youth-led initiatives in areas like precision agriculture, mobile farming applications, and sustainable energy solutions like solar-powered irrigation systems can drive agricultural transformation.

ii. Entrepreneurship Opportunities: Supporting youth in agribusiness through access to capital, mentorship programs, and incubation centers that focus on sustainable agriculture and the circular economy. This can foster the development of youth-led businesses in areas like organic farming, agro-processing, and renewable energy solutions for rural agriculture.

III. Circular Economy

A. Resource Efficiency and Waste Management

Circular Waste Management Practices:

i. Composting: This involves promoting the use of crop residues, animal manure, and organic waste for compost production to enhance soil fertility while reducing waste. Composting organic material reduces reliance on synthetic fertilizers and can significantly improve nutrient cycling in agricultural systems. Very importantly, the composting process takes away the need for biomass burning and prevents super-pollutant emissions associated with burning.

ii. Biochar Production: Supporting the conversion of agricultural waste into biochar, which enhances soil health by improving water retention, increasing microbial activity, and sequestering carbon. Biochar also offers a way to recycle waste while contributing to carbon sequestration efforts and prevents biomass burning-associated black carbon production

iii. Bioenergy Generation: Encouraging bioenergy production from agricultural waste, such as the use of crop residues and animal manure for biogas generation or biofuel

production. This provides renewable energy sources for rural farming communities while reducing emissions from waste burning.

Waste-to-Resource Opportunities:

i. Turning Agricultural By-Products into Valuable Inputs: Policies should focus on promoting waste-to-resource initiatives that transform agricultural by-products such as rice husks, maize stalks, fruit peels etc. into valuable products such as biofertilizers, organic compost, or bioenergy. By adopting waste reuse strategies, farmers can increase their income, reduce environmental waste to prevent or reduce the production of super-pollutants such as black carbon, methane, tropospheric ozone and nitrous oxide among others.

ii. Local Market Integration: Facilitating the creation of local markets for products derived from agricultural waste, such as compost, biochar, or renewable energy, will provide farmers with additional income streams and help to close the resource loop in farming communities.

Developing Waste Management Infrastructure:

i. Rural Waste Management Systems: Building infrastructure for composting facilities, biogas digesters, and biochar kilns, particularly in rural areas, will enable farmers to process and reuse agricultural waste on a larger scale. This will also help reduce reliance on open burning, which contributes to black carbon emissions.

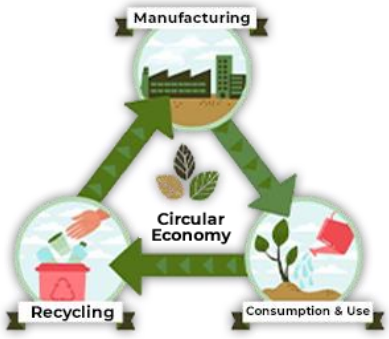
ii. Public-Private Partnerships (PPPs): Governments should incentivize the private sector to invest in rural waste management infrastructure through public-private partnerships (PPPs). These partnerships can accelerate the adoption of circular economy practices by providing financial and technical support for the development of waste processing facilities.

B. Value Chain Analysis

Integration of Circular Economy Principles:

i. Maximizing Resource Efficiency: Integrate circular economy principles throughout agricultural value chains to reduce waste and optimize resource use, such as water and nutrients. This involves encouraging practices like recycling by-products, recovering energy, and reusing outputs within the system to maintain sustainability and minimize environmental degradation.

ii. Sustainable Production Processes: Circular production methods, such as renewable energy use and resource recovery, should be promoted to reduce waste and support ecosystem resilience. These closed-loop processes allow agricultural systems to reuse and recycle resources at each stage of production, reducing external resource dependency.



Implementing Closed-Loop Systems:

i. Recycling Outputs as Inputs: Policies should facilitate the transformation of agricultural outputs like crop residues and livestock waste into valuable resources for reuse within the system. For example, composting organic waste, converting residues into biochar, or using livestock waste for biogas generation can improve soil health and resource availability.

ii. Minimizing Environmental Impact: Closed-loop systems reduce reliance on external inputs such as synthetic fertilizers and fossil fuels, making agricultural production more environmentally friendly while maintaining or improving productivity.

Value Addition Through Sustainable Practices:

i. Efficient Processing and Packaging: Encourage the use of energy-efficient and water-saving technologies in food processing to minimize resource consumption. Additionally, sustainable packaging solutions, such as biodegradable or recyclable materials, should be promoted to reduce packaging waste.

ii. Developing Circular Economy Markets: Foster market opportunities for circular products like organic fertilizers, biochar, and eco-friendly packaging materials. Creating incentives for private-sector participation in these markets will further encourage the adoption of sustainable practices within the value chain.

C. Policy and Regulatory Environment

Identifying Policy Gaps:

i. National and Regional Gaps: Circular economy remains underrepresented in many national and regional agricultural policies. Existing regulations often focus on

conventional waste management strategies and fail to promote resource efficiency or circular approaches in agriculture. Identifying and addressing these policy gaps is crucial for creating an enabling environment for circular economy practices, such as waste recycling and resource reuse.

ii. Sector-Specific Reforms: Tailored policy reforms should target specific agricultural sectors such as rice, maize, and cassava that generate significant waste and have the potential to adopt circular practices. This will help in aligning national policies with regional frameworks and global sustainability targets.

Creating Incentives and Regulatory Frameworks:

i. Incentives for Waste Management and Resource Efficiency: Governments should introduce subsidies, tax breaks, and grants for farmers and agro-industries that adopt circular economy practices, such as composting, biochar production, and water recycling. Such incentives will encourage investment in sustainable agricultural practices that reduce waste and promote resource efficiency.

ii. Strengthening Regulations: In addition to incentives, robust regulations need to be developed and enforced to ensure compliance with circular economy principles. This may include penalties for non-compliance with waste management regulations or mandatory recycling and resource recovery practices in agricultural production and processing.

Engaging the Private Sector:

i. Public-Private Partnerships (PPPs): PPPs can mobilize resources, technologies, and expertise to scale up circular economy innovations, such as the development of biogas plants, composting facilities, and sustainable packaging solutions. Engaging the private sector through these partnerships can lead to the successful implementation of large-scale circular economy projects in agriculture.

ii. Corporate Social Responsibility (CSR): Many agribusinesses are increasingly integrating sustainability into their CSR initiatives. Promoting circular economy practices, such as reducing packaging waste or converting agricultural by-products into valuable products, can be part of these efforts. Encouraging agribusinesses to align their CSR initiatives with national and regional circular economy goals will help promote sustainable agricultural systems.

IV. Ecosystem Services

A. Ecosystem Health and Services

Enhancing Ecosystem Services through Agricultural Practices:

I. Soil Health: Agricultural practices such as crop rotation, cover cropping, agroforestry, and organic farming can significantly enhance soil fertility, improve water retention, and reduce erosion. These practices also contribute to higher levels of organic matter and microbial activity in the soil, leading to long-term improvements in soil productivity and overall agriculture sustainability. Through sustainable agricultural practices, super pollutant emissions such as methane, black carbon and nitrous oxide are significantly reduced. Carbon sequestration is intensified leading to better provisioning, regulatory and supportive ecosystem services.

II. Water Conservation: Sustainable water management practices like rainwater harvesting, alternative wetting and drying (AWD) in rice production, and the use of drought-resistant crops can help conserve water resources and reduce methane emissions. These measures are critical in maintaining water cycles, especially in regions prone to water scarcity.

III. Carbon Sequestration: Agroecological approaches such as agroforestry, biochar application, and no-till farming can increase carbon sequestration in soils and vegetation. These practices help mitigate climate change by capturing carbon from the atmosphere and storing it in plants and soils.

IV. Biodiversity: Agroecology promotes biodiversity by integrating multiple plant and animal species into farming systems. This diversity enhances ecosystem resilience, supports pollinators, controls pests through natural predators, and increases productivity by fostering healthy ecological interactions.

Policy Support for Agroecological Practices:

i. Restoring Degraded Ecosystems: Policies should promote agroecological practices that regenerate degraded ecosystems, such as reforestation, wetland restoration, and soil regeneration techniques. By incentivizing practices that restore ecosystem functions, governments can support long-term environmental and agricultural sustainability.

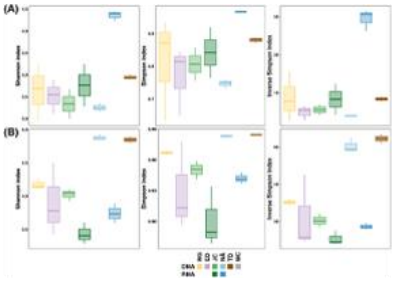
ii. Natural Resource Management: Agroecological policies should be aligned with broader natural resource management strategies. This includes creating supportive frameworks for sustainable land use, water conservation, and biodiversity protection at local, national, and regional levels. Policy interventions should also ensure equitable access to these resources, particularly for marginalized farming communities.

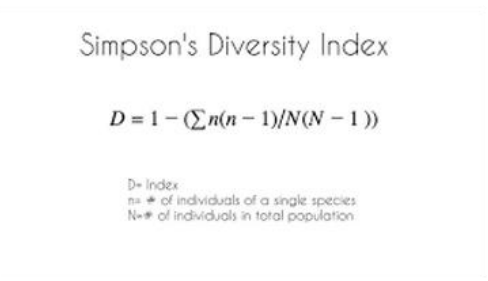
Developing Metrics to Measure Ecosystem Services:

i. Biodiversity Indexes: Metrics such as the Shannon, Simpson and Species Richness (S) among several other biodiversity indexes can be used to measure species diversity within agricultural systems. These metrics help assess the effectiveness of agroecological practices in promoting biodiversity and ecosystem resilience.

ii. Carbon Capture Potential: Developing standardized methods to measure carbon sequestration in agricultural systems specific to agroclimatic landscapes is critical. This includes quantifying carbon stored in soils and biomass, as well as calculating the long-term benefits of practices like agroforestry and no-till farming.

iii. Soil Health Indicators: Metrics such as soil organic matter (SOM) levels, nutrient balances, and microbial activity can provide insights into the health of soils under different agricultural practices. Governments and research institutions should develop frameworks for regularly assessing these indicators to track ecosystem health and guide policy decisions.





B. Land and Water Use

Sustainable Land and Water Management Practices:

i. Land Use for Ecosystem Services Protection: Effective land management is critical for maintaining ecosystem services such as carbon sequestration, water filtration, and biodiversity conservation. Practices like agroforestry, mixed cropping, and conservation tillage promote soil health, prevent erosion, and enhance the land's resilience to climate variability.

ii. Water-Smart Agriculture in Water-Scarce Regions: Water scarcity is an increasing concern in many parts of Sub-Saharan Africa. Sustainable water management practices such as rainwater harvesting, efficient irrigation systems, and soil

moisture retention techniques are vital to protecting water resources while maintaining agricultural productivity. Promoting water-use efficiency in agricultural systems will ensure that ecosystems remain functional while meeting the needs of farmers.

Water-Efficient Systems and Soil Conservation Techniques:

i. System of Rice Intensification (SRI) and Alternate Wetting and Drying (AWD): These innovative practices in rice farming have proven to significantly reduce water use, increase crop yields, and lower methane emissions. SRI emphasizes reducing water usage and increasing spacing between plants, while AWD allows rice fields to be alternately flooded and dried, promoting water efficiency and improving soil conditions. Through AWD, water is provided to rice only when physiologically required. This way, the waterlogged conditions resulting in methane production is avoided during the drying period when flooding is not require for improved rice performance.

ii. Soil Conservation Techniques: Approaches like contour farming, which involves plowing along the contour of the land to minimize water runoff, and agroforestry, which integrates trees into farming systems, are key soil conservation strategies. These techniques prevent soil erosion, maintain soil fertility, and protect watersheds, which are essential for long-term agricultural sustainability.

Integrating Land and Water Use Planning with Climate Adaptation:

i. Land Use Planning: Integrated land-use planning involves considering how land can be used efficiently to balance agricultural production with environmental protection. Policies that promote sustainable land use must be aligned with broader climate adaptation goals, ensuring that land

management strategies enhance ecosystem resilience and reduce vulnerabilities to climate change impacts, such as droughts or floods.

ii. Water Use Policies in Climate Adaptation: Effective water governance is essential for regions facing water stress due to climate change. Policies should promote the use of water-efficient technologies, improve irrigation infrastructure, and ensure equitable access to water resources, particularly for marginalized farming communities. By aligning water use policies with climate adaptation strategies, governments can support both agricultural productivity and ecosystem sustainability in the face of increasing climate variability.

A. Super Pollutants and GHG Emissions

Mitigating Short-Lived Climate Pollutants (SLCPs):

a) Methane Reduction in Agriculture: Methane, one of the most potent SLCPs, is primarily emitted from rice paddies and livestock. In flooded rice fields, anaerobic conditions promote the production of methane. Livestock farming, especially ruminant animals like cattle, also contributes significantly to methane emissions. Effective mitigation strategies include:

i. System of Rice Intensification (SRI): By reducing water usage in rice fields, SRI practices limit the anaerobic conditions that produce methane. Additionally, the alternate wetting and drying (AWD) method in rice farming has been shown to reduce methane emissions while maintaining or increasing rice yields.

ii. Improved Livestock Management: Reducing methane emissions from livestock can be achieved through better feed management, rotational grazing, and livestock breeding programs and animal health initiatives.

b) Black Carbon from Biomass Burning: Soot or black carbon, another major SLCP, results from incomplete combustion of biomass ie burning crop residues or wood for fuel). Mitigation efforts should focus on:

   i. Promoting alternatives to biomass burning: These include using agricultural waste for bioenergy production, composting, and biochar generation.

   ii. Adoption of cleaner cookstoves and fuels: Particularly in rural areas, where traditional biomass stoves are a significant source of black carbon, transitioning to clean energy sources can dramatically reduce emissions.



Promoting Climate-Smart Agricultural Practices:

c) System of Rice Intensification (SRI) and Alternate Wetting and Drying (AWD): These methods not only reduce methane emissions but also improve water use efficiency and increase yields. SRI and AWD can be scaled in regions where rice farming is prominent, contributing to both climate mitigation and food security.

d) Composting and Biochar: Organic waste and crop residues can be composted or converted into biochar, which reduces emissions, improves soil health, and sequesters carbon. Biochar production has the added benefit of capturing carbon that would otherwise be released through the burning of residues.

e) Agroforestry and Agroecology: Integrating trees into farming systems (agroforestry) can enhance carbon sequestration, reduce soil erosion, and improve biodiversity. Agroecological practices that prioritize natural nutrient cycling and biodiversity can simultaneously enhance resilience and reduce GHG emissions.

Ensuring Alignment with Nationally Determined Contributions (NDCs):

f) NDC Integration: The policy guide should support countries in aligning their agroecological and circular economy strategies with their NDCs under the Paris Agreement. This can ensure that agricultural practices not only contribute to food security but also help achieve climate targets.

   i. SLCP Mitigation: Many African countries have included SLCPs like methane and black carbon in their NDCs, but further alignment with agroecological and circular economy principles can enhance the implementation of these targets.

ii. Carbon Sequestration Goals: Practices like agroforestry and biochar application should be integrated into national climate action plans to increase the carbon sequestration potential of agricultural systems.

B. Climate-Smart Agriculture

Supporting the Adoption of Climate-Smart Agriculture (CSA):

Resilience to Climate Stresses: Climate-smart agriculture (CSA) is essential for enhancing resilience in agricultural systems, particularly in regions vulnerable to climate variability such as Sub-Saharan Africa. The guide should promote the adoption of CSA practices that help farmers cope with extreme weather events like droughts, floods, and shifting growing seasons. These practices could include water-efficient farming methods, conservation agriculture, and soil moisture retention strategies.

i. Water-Efficient Practices: Techniques like alternate wetting and drying (AWD) in rice farming, rainwater harvesting, and drip irrigation are vital for conserving water resources in regions prone to droughts.

ii. Drought-Resilient Crop Varieties: Encouraging the use of drought-tolerant and climate-resilient crops will help farmers maintain productivity in adverse conditions. Crop diversification is a key strategy in reducing vulnerability to climate shocks.

Policies to Incentivize Agroforestry, Crop Diversification, and Improved Soil Management:

a) Agroforestry: Agroforestry, which integrates trees into farming systems, not only enhances carbon sequestration but also improves soil health, provides shade for crops, and protects against soil erosion. Policies should support the expansion of agroforestry practices across different agro-ecological zones, offering incentives such as grants or subsidies for farmers adopting these methods.

b) Crop Diversification: Diversified farming systems are less vulnerable to climate risks compared to monoculture systems. Policies should promote the diversification of crops, particularly focusing on intercropping and polyculture systems, which provide both food security and ecological stability.

c) Soil Management for Carbon Sequestration: Practices like conservation tillage, organic farming, and the use of cover crops can enhance soil organic carbon levels, improve fertility, and contribute to carbon sequestration. Financial incentives, such as subsidies for organic inputs (e.g., compost, biochar), should be introduced to encourage farmers to adopt sustainable soil management practices.

Integration of Climate Action and Food Security:

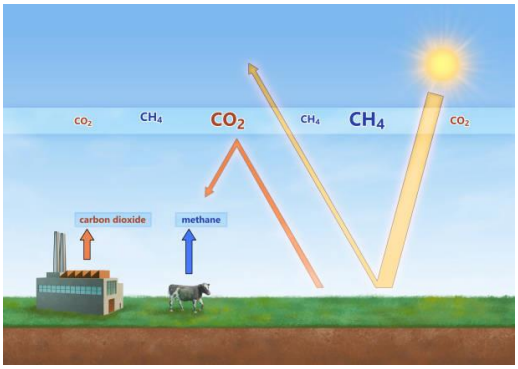
a) Agroecological Practices and Climate Goals: Agroecological practices, which emphasize ecological balance, resource efficiency, and biodiversity, should be prioritized as part of climate-smart agriculture policies. These practices help build climate resilience while ensuring food security, addressing both environmental and socio-economic challenges in agricultural systems.

b) Aligning Agroecology with NDCs: Agroecological practices should be integrated into Nationally Determined Contributions (NDCs) to ensure that countries are aligning food security and agricultural productivity with their climate action goals. This alignment will allow for a holistic approach to climate resilience and sustainable development.

c) Food Security and Climate Adaptation: Policies that integrate food security with climate adaptation strategies should be developed. This includes ensuring that climate-resilient agricultural practices are accessible to smallholder farmers, who are often the most vulnerable to climate change. Capacity-building initiatives, access to climate-resilient seeds, and improved agricultural extension services will be key in achieving this goal.

Methane Mitigation through Agroecology

Methane (CH_4) is a potent short-lived climate pollutant with a global warming potential (GWP) approximately 28–34 times greater than CO_2 over a 100-year period, but approximately 84–86 times greater over a 20-year period. This underscores methane's significant near-term impact on global warming, making rapid reductions critical for climate action.



In Sub-Saharan Africa, agriculture is the largest source of methane emissions, largely from enteric fermentation in livestock and flooded rice cultivation. While alternate wetting and drying (AWD) and System of Rice Intensification (SRI) for rice is discussed, it is essential to further emphasize the link between agroecology and methane mitigation in livestock systems.

Strategies for Methane Reduction in Livestock Systems

Agroecology provides an integrated suite of practices that can reduce methane emissions intensity (emissions per unit of product) from livestock while enhancing productivity, ecosystem health, and farmer resilience.

a) **Improved Pasture and Grazing Management**

Rotational and adaptive grazing: Improves pasture quality and soil carbon sequestration while preventing overgrazing, which can exacerbate methane emissions from livestock.

Agro-silvopastoral systems: Integrating trees and shrubs into grazing lands enhances forage diversity, provides shade, improves microclimates, and reduces emissions intensity through healthier, more efficient livestock.

b) Enhanced Feed Quality and Diet Optimization

Protein-rich, digestible forages: Inclusion of high-quality forages such as legumes like clover, leucaena, brachiaria, and super napier reduces methane yield per kilogram of milk or meat by improving rumen function.

Local feed additives: Agroecological additives such as tannin-rich plants and oilseeds are known inhibitors of methanogenesis in the rumen, lowering methane production naturally.

c) Integration of Crop-Livestock Systems

Manure management and biogas production: Processing manure in biogas digesters reduces methane emissions from open decomposition, produces renewable energy, and returns nutrient-rich slurry to fields.

Crop residues as feed: Using residues instead of burning reduces emissions of methane and black carbon, supports nutrient recycling, and enhances livestock diets.

d) Animal Health and Genetic Improvements

Improved herd health: Healthier animals have better feed efficiency and lower methane emissions per unit of output.

Selective breeding: Utilizing locally adapted, more productive breeds can improve overall efficiency and reduce methane intensity.

Expected Benefits

✓ Reduced methane emissions intensity, contributing to NDC targets and the Global Methane Pledge to reduce methane emissions.

✓ Improved farmer livelihoods and system productivity, through healthier animals and diversified income streams.

✓ Enhanced ecosystem resilience, via integrated, diversified landscapes and improved soil health.

✓ Synergies with biodiversity conservation, reducing land pressure and supporting multifunctional farming systems.

Policy and Supportive Actions

- ✓ Provide incentives for rotational grazing, forage crop cultivation, and agro-silvopastoral system establishment.



- ✓ Support community-led feed production initiatives to improve forage quality and reduce dependence on purchased concentrates.


- ✓ Facilitate access to small-scale biogas technologies and provide technical assistance for manure management.

- ✓ Integrate livestock methane mitigation into national agroecological transition plans and climate-smart agriculture strategies.

- ✓ Strengthen extension services to disseminate knowledge on integrated livestock-agroecological systems.

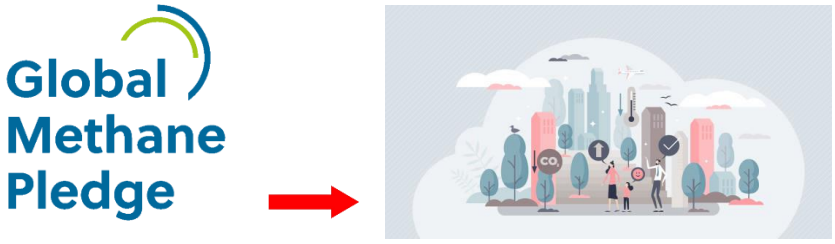
Integration into Regional and Global Frameworks

These strategies align with and reinforce:

Paris Agreement and Nationally Determined Contributions (NDCs): By addressing livestock methane, a major agricultural emission source.

CAADP and AU Agenda 2063: Advancing productivity, food security, and environmental stewardship.

Global Methane Pledge: Supporting collective action to deliver immediate climate benefits and improve air quality.



Agroecological Approaches to Nitrous Oxide Mitigation

Nitrous oxide (N_2O) is a powerful long-lived greenhouse gas, with a global warming potential approximately 273 times greater than CO_2 over a 100-year period. It is also a significant contributor to stratospheric ozone depletion. Agriculture accounts for around two-thirds of global anthropogenic N_2O emissions, primarily from synthetic fertilizer application, manure management, and nitrogen-rich crop residues. In Sub-Saharan Africa, increasing fertilizer use, coupled with inefficient nitrogen management, has exacerbated N_2O emissions and reduced nitrogen use efficiency.


Agroecological approaches offer a holistic, ecosystem-based pathway to reduce N_2O emissions while enhancing soil fertility and supporting climate resilience.

Agroecological Strategies for Nitrous Oxide Mitigation

a) Improved Soil Fertility Management

Organic amendments: Using compost, biochar, and farmyard manure instead of—or in combination with—synthetic fertilizers reduce excessive nitrogen inputs and improves nitrogen retention in soils.



Green manures and cover crops: Leguminous cover crops fix atmospheric nitrogen naturally, reducing the need for synthetic nitrogen fertilizers. When incorporated into soils, they enhance soil organic matter and improve nitrogen cycling.

b) Precision and Context-Specific Fertilizer Use

Integrated Soil Fertility Management (ISFM): Tailoring nutrient inputs to specific soil and crop needs, based on soil testing and local knowledge, minimizes excess nitrogen applications and N_2O losses.

Microdosing techniques: Applying small, targeted doses of fertilizers close to plant roots improves nitrogen use efficiency and reduces gaseous losses.

c) Diversified Cropping Systems

Crop rotations and intercropping: Diversifying cropping systems with nitrogen-fixing legumes reduces the overall demand for synthetic nitrogen inputs and enhances nutrient cycling.

Agroforestry systems: Tree species with deep rooting systems can capture leached nitrogen, reducing N_2O emissions while providing additional ecosystem services.

d) Water and Soil Management Synergies

Conservation tillage and reduced soil disturbance: Minimizing tillage maintains soil structure, reduces aeration-induced N_2O fluxes, and enhances microbial activity for better nitrogen cycling.

Improved irrigation practices: Avoiding excessive soil wetness reduces anaerobic conditions that can drive N_2O production (denitrification), especially important in upland crops.

e) Manure Management

Composting instead of raw application: Composting stabilizes organic nitrogen in manure, reducing emissions when applied to fields.

Bedding and dry litter systems: Keeping manure drier reduces microbial conversion of nitrogen to N_2O.

Expected Benefits

✓ Significant reductions in N_2O emissions, supporting national and regional climate targets and global mitigation efforts.

✓ Enhanced soil health and fertility, leading to more resilient and productive agricultural systems.

✓ Reduced reliance on costly synthetic fertilizers, improving farm profitability and reducing input dependency.

✓ Improved ecosystem services, including biodiversity support and water quality protection through reduced nitrate leaching.

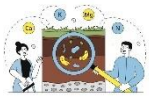


Policy and Supportive Actions

✓  Develop and implement national soil fertility strategies centered on organic inputs, leguminous cover crops, and agroecological nutrient cycling.

✓  Provide subsidies or incentives for composting facilities, biochar production, and on-farm composting practices.

✓  Strengthen extension services and farmer field schools to disseminate precision fertilization and integrated soil fertility management techniques.

✓  Promote participatory soil testing programs and local knowledge exchange on context-specific nutrient management.

✓ 

Support agroforestry integration through financial incentives and technical support.

Integration into Regional and Global Frameworks

The aforementioned actions directly support the following frameworks

Paris Agreement and Nationally Determined Contributions (NDCs) by addressing N_2O emissions as part of comprehensive GHG mitigation strategies.

AU Agenda 2063 and CAADP: Advancing sustainable intensification and climate-resilient agriculture.

Sustainable Development Goals (SDGs): Specifically, SDG 13 (Climate Action), SDG 2 (Zero Hunger), and SDG 15 (Life on Land).

Agroecology and Black Carbon Mitigation

Black carbon (BC), commonly known as soot, is a major component of fine particulate matter ($PM_{2.5}$). It is formed from incomplete combustion of biomass, fossil fuels, and waste materials. While black carbon is not a greenhouse gas, it has a global warming potential up to 3,200 times greater than CO_2 over a 20-year period, making it a potent short-lived climate forcer. In Sub-Saharan Africa, significant black carbon emissions stem from agricultural practices such as open burning of crop residues, land clearing fires, and traditional biomass cooking. Black carbon not only contributes to regional warming and glacial melt but also poses severe public health risks, contributing to respiratory diseases and premature mortality.

Agroecological Strategies for Black Carbon Mitigation

a) Elimination of Crop Residue Burning

In-situ biomass incorporation: Agroecology encourages incorporating crop residues into soils as organic amendments rather than burning them. This practice improves soil organic matter, enhances soil structure, and boosts microbial activity.

Composting crop residues: Composting transforms residues into nutrient-rich organic fertilizers, improving soil fertility and reducing dependence on synthetic inputs.

b) Promotion of Reduced and No-Till and Conservation Agriculture

Reduced soil disturbance: Avoiding tillage minimizes the need to clear land through burning and supports the maintenance of surface residues for erosion control and moisture conservation.

Permanent soil cover: Maintaining crop residues as mulch reduces weed pressure, suppresses soil evaporation, and discourages open burning for field cleaning.

c) Integration of Agroforestry Systems

Living fences and tree borders: Establishing agroforestry buffers reduces the need for land clearing fires and provides additional biomass resources that can be used sustainably (e.g., as mulch, compost feedstock).

Alternative fuelwood sources: Agroforestry offers managed sources of woody biomass, reducing pressure on forest burning and uncontrolled fuel harvesting.

d) Circular Economy Approaches to Biomass

Biochar production: Controlled pyrolysis of agricultural residues produces biochar rather than ash, capturing carbon and avoiding black carbon emissions. Biochar application also enhances soil health and nutrient retention.

Bioenergy solutions: Utilizing crop residues and manure for biogas or pellet production offers clean energy alternatives, reducing reliance on traditional biomass burning for cooking and heating.

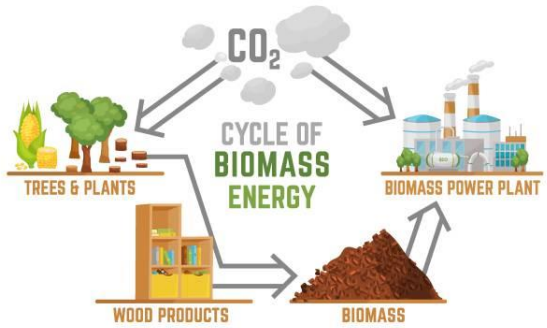
Expected Benefits

✓ Significant reductions in black carbon emissions, supporting regional and global air quality and climate mitigation goals.


✓ Improved soil health and fertility, through organic residue incorporation and biochar use.


✓ Enhanced human health outcomes, via reduced exposure to particulate pollution from burning.


✓ Support for circular economy principles, converting waste biomass into valuable soil amendments and energy sources.

Policy and Supportive Actions

- ✓ Establish and enforce regulations banning open agricultural burning, complemented by farmer support programs to adopt alternative residue management practices.
- ✓ Provide incentives and technical support for composting and biochar production facilities, including community-level units.
- ✓ Promote clean cooking initiatives, integrating agricultural waste-based bioenergy solutions and reducing reliance on open fires.
- ✓ Develop and disseminate extension materials on residue management benefits, emphasizing the links between soil health, emissions reduction, and economic gains.
- ✓ Integrate black carbon mitigation explicitly into national agroecology and climate action strategies, ensuring alignment with Nationally Determined Contributions (NDCs) and clean air programs.

VI. Policy and Institutional Frameworks

A. Existing Policies and Frameworks

Review of National and Regional Policies:

i. Agriculture and Environment Policies: A thorough review of existing national and regional policies related to agriculture, the environment, and climate action is essential to understand the current policy landscape. This review should cover frameworks such as the Comprehensive Africa Agriculture Development Programme (CAADP), the African Union's Agenda 2063, Nationally Determined Contributions (NDCs) under the Paris Agreement, and regional initiatives by bodies such as ECOWAS, SADC, and EAC.

ii. Sectoral Policies: Assess policies at the intersection of agriculture, energy, and waste management to identify how circular economy principles and agroecology are currently supported. Policies that promote organic farming, sustainable land use, and ecosystem restoration need to be highlighted and evaluated for effectiveness.

iii. International Agreements and Commitments: The review should also consider how these policies align with international agreements and commitments, such as the Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

Identifying Policy Gaps and Inconsistencies:

i. Gaps in Agroecology Promotion: While several African countries have implemented policies focused on boosting agricultural productivity, fewer have specific frameworks promoting agroecology, circular economy, or regenerative agricultural practices. This section of the guide would analyze gaps in promoting organic farming, climate-resilient crop production, and sustainable waste management practices, identifying where reforms are necessary.

ii. Inconsistencies Across Sectors: One of the major challenges in implementing sustainable practices like agroecology and the circular economy is the lack of coherence across sectoral policies. For example, agricultural policies may promote increased chemical fertilizer use to boost productivity, while environmental policies focus on reducing the environmental impact of such inputs. Identifying these contradictions is key to fostering policy alignment.

iii. Fragmentation of Policy Goals: Policies in agriculture, environment, and climate change are often developed in silos. This fragmented approach hinders the holistic adoption of circular economy practices and agroecology, which require integrated action across sectors like waste management, energy use, and biodiversity conservation.

Encouraging Coherence Between Sectoral Policies:

i. Harmonizing Agriculture, Environment, and Energy Policies: Policy coherence is vital to prevent conflicts between sectoral policies and to promote synergies. For example, policies promoting bioenergy from agricultural waste (circular economy) should align with policies for sustainable land use (agroecology) and climate action strategies (NDCs). This requires cross-sectoral coordination at both national and regional levels.

ii. Inter-Ministerial and Cross-Sectoral Collaboration: Governments should establish mechanisms for cross-sectoral collaboration between ministries of agriculture, environment, energy, and health to ensure policy coherence. These bodies should work together to develop unified strategies that align agricultural productivity goals with environmental sustainability and climate resilience efforts.

iii. Leveraging Regional Frameworks: Regional bodies like the African Union (AU), ECOWAS, and SADC should be involved in fostering policy coherence by creating

platforms for dialogue between member states. These frameworks can help ensure that national policies are harmonized with regional climate action and sustainability goals.

Integrating Non-Governmental Initiatives for Greater Policy Coherence

While government policies often operate in silos, the same challenge exists within in-country project work, where development, research, and agricultural initiatives run independently without coordination. Ensuring better coherence between government efforts and existing non-governmental initiatives can maximize impact, reduce duplication, and improve resource allocation.

Strategies for Integration:

- Mapping existing initiatives across research institutions, NGOs, and the private sector to identify synergies and gaps.
- Creating national coordination platforms where different stakeholders (government, NGOs, research institutions, private sector) align priorities and collaborate on agroecology and circular economy transitions.
- Leveraging existing project infrastructure to scale up best practices rather than duplicating efforts through separate government programs.
- Encouraging inter-ministerial collaboration to ensure agricultural, environmental, and economic policies work in synergy with ongoing development projects.

B. Funding and Investment

Mobilizing Public and Private Investments:

i. Public Investment: Governments across Sub-Saharan Africa should increase public investment in agroecological and circular economy practices by including these priorities in national budgets and development plans. Key areas for investment include sustainable land use, renewable energy, and ecosystem restoration.

ii. Private Sector Engagement: Public-private partnerships (PPPs) can be instrumental in scaling agroecological and circular economy projects. By providing incentives such as tax breaks and grants, governments can encourage the private sector to invest in green technologies, waste management systems, and sustainable agriculture initiatives.

Case Examples: Countries such as Kenya have mobilized private investment in renewable energy projects and circular economy initiatives, demonstrating the potential for collaboration between governments and businesses to drive environmental sustainability.

Facilitating Access to International Development Funding:

i. Climate Finance Mechanisms: International development funding sources, such as the Green Climate Fund (GCF), the Global Environment Facility (GEF), and the Adaptation Fund among others, offer financial support for projects that mitigate and adapt to climate change. Member states can access these funds to support agroecology and circular economy initiatives that contribute to climate resilience.

ii. Blended Finance: Blended finance approaches that combine public, private, and philanthropic resources can also be useful. This allows member states to de-risk investments in agroecological projects, thereby attracting private sector capital.

Examples of Funded Projects: GCF-funded projects in Africa have supported climate-smart agriculture, ecosystem-based adaptation, and renewable energy development, all of which align with agroecological and circular economy goals.


Promoting South-South and Triangular Cooperation:

i. South-South Cooperation: Member states should prioritize South-South cooperation to share knowledge, technology, and resources between countries in the Global South. Countries like Ethiopia and Senegal have successfully shared agroecological best practices with their peers, promoting knowledge exchange and innovation.

ii. Triangular Cooperation: Triangular cooperation involving collaboration between or among a number of developing countries with support from a developed country or international organization need to be strengthened. This cooperation model can be crucial for scaling agroecology and circular economy practices, especially in addressing transboundary challenges such as climate change, land degradation, and biodiversity loss.

Examples: The African Union's Comprehensive Africa Agriculture Development Programme (CAADP) promotes regional cooperation, which can be expanded to include agroecology and circular economy initiatives under triangular cooperation agreements.


VIII Incorporating Disaster Risk Reduction (DRR) in National Policies in Sync with the Sendai Framework for Disaster Risk Reduction (2015-2030)

The ACE4ES consortium and partners recognize the importance of integrating Disaster Risk Reduction (DRR) into national policies to enhance resilience, mitigate risks, and promote sustainable agricultural practices across member states. The following guidelines provide a holistic approach for member states to incorporate DRR through agroecology, circular economy, and climate action initiatives:

1. Integration of Agroecology for Disaster Resilience

1.1. Promote Climate-Smart and Resilient Farming Practices

1) Crop Diversification: Encourage the adoption of diversified cropping systems to reduce dependency on monocultures, thus enhancing resilience to droughts, floods, and pests.
2) Agroforestry: Incorporate trees and shrubs into farmlands to improve soil fertility, provide windbreaks, enhance water retention, and sequester carbon. These systems act as buffers against extreme weather and mitigate soil erosion.
3) Conservation Agriculture: Implement practices such as no-till farming, cover cropping, and crop rotation to improve soil health, enhance water retention, and reduce erosion, thereby reducing vulnerability to extreme weather events.



1.2. Develop National Agroecology Policies and Programs

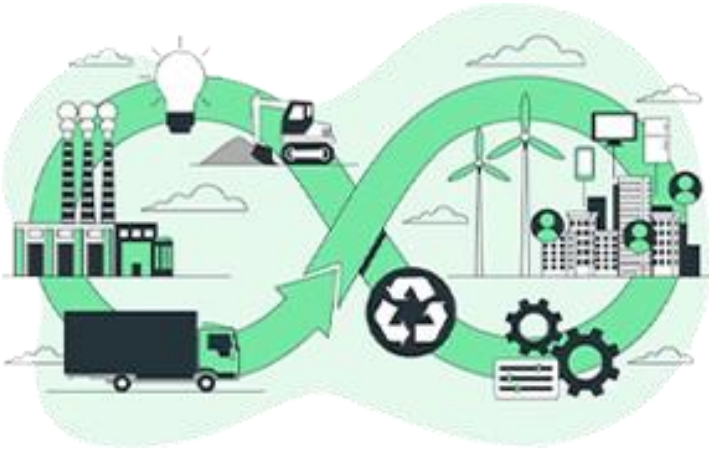
1) Establish policies that support the adoption of agroecological practices, offering incentives such as subsidies, grants, and technical assistance for farmers implementing these methods.
2) Integrate agroecology within national agricultural extension services to build farmers' capacities for implementing sustainable practices that increase resilience to climate-related disasters.

2. Embedding Circular Economy Principles for DRR

2.1. Implement Sustainable Waste Management Systems

1) Develop national frameworks for transforming agricultural by-products and waste into resources, such as compost and biochar, to improve soil health and carbon sequestration while reducing the need for synthetic inputs.
2) Invest in waste processing infrastructure to convert organic agricultural waste into renewable energy (e.g., biogas), enhancing energy security and reducing environmental pollution.

2.2. Promote Resource Efficiency and Recycling in Agricultural Value Chains



1) Encourage policies that incentivize the use of organic inputs and the recycling of agricultural residues, contributing to soil fertility and ecosystem resilience while minimizing environmental degradation.

2) Establish public-private partnerships (PPPs) to mobilize resources for building sustainable agricultural waste management systems, ensuring that such systems are accessible to rural and marginalized communities.

3. Advancing Climate Action for DRR in Agricultural Systems

3.1. Align Agricultural Policies with Nationally Determined Contributions (NDCs)

1) Ensure that agroecological practices and circular economy principles are integrated into NDCs, promoting emission reductions and sustainable land management strategies in agriculture.

2) Support national adaptation plans that incorporate climate-resilient agricultural practices, such as drought-resistant crop varieties, rainwater harvesting systems, and efficient irrigation technologies.

3.2. Enhance Early Warning Systems and Risk Monitoring

1) Invest in technology and infrastructure to establish early warning systems for droughts, floods, and extreme weather events. These systems should provide farmers and communities with timely information to implement adaptive measures.
2) Develop risk monitoring mechanisms, such as soil and water quality assessments, to inform policymakers and stakeholders about the conditions of ecosystems and agricultural lands. This data-driven approach ensures that DRR measures are effective and continuously improved.

4. Promoting Cross-Sectoral and Multi-Stakeholder Collaboration

4.1. Foster Cross-Sectoral Policy Coherence

1) Ensure coherence between agricultural, environmental, and climate policies by creating inter-ministerial task forces or working groups focused on integrating agroecology, circular economy, and climate action for DRR.
2) Align national policies with regional and international frameworks like the CAADP, the Paris Agreement, and the Sendai Framework to ensure that agricultural practices contribute to broader resilience and sustainability goals.

4.2. Engage Local Communities, Farmers, and the Private Sector

1) Strengthen partnerships with civil society organizations (CSOs), farmer networks, and the private sector to co-create and implement DRR strategies at the community level. These collaborations ensure that local knowledge and practices are integrated into national policies.
2) Provide platforms for participatory decision-making, ensuring that marginalized groups, including women and youth, are actively involved in policy formulation and implementation processes related to disaster resilience in agriculture.

5. Developing Financial Mechanisms and Incentives for DRR

5.1. Establish National DRR Funds and Incentive Programs

1) Develop dedicated DRR funds to support the implementation of agroecological and circular economy projects that enhance climate resilience in agriculture. These funds can be sourced from national budgets, international climate finance, and public-private partnerships.

2) Offer incentives such as tax breaks, grants, and loans for farmers and agribusinesses that adopt sustainable agricultural practices, invest in renewable energy solutions, and engage in biodiversity conservation efforts.

5.2. Facilitate Access to International Climate Finance

GREEN CLIMATE FUND

1) Align national policies with international funding mechanisms like the Green Climate Fund (GCF) and the Adaptation Fund, ensuring that member states can access financial resources for building resilient agricultural systems and integrating DRR measures.

2) Collaborate with development partners and regional organizations to leverage blended finance models that combine public, private, and philanthropic resources for scaling DRR initiatives in agriculture.

6. Capacity Building and Training Programs

6.1. Strengthen Agricultural Extension Services

1) Equip national agricultural extension services with knowledge and tools on agroecological practices, circular economy principles, and climate adaptation strategies to support farmers in implementing DRR measures.

2) Develop training programs tailored to different stakeholders (e.g., farmers, community leaders, youth groups) to build their capacity in climate-resilient farming techniques, disaster preparedness, and sustainable land management.

6.2. Establish Knowledge-Sharing Platforms

1) Create platforms for exchanging best practices and lessons learned across member states and regions, enabling policymakers and practitioners to learn from successful DRR strategies.
2) Foster South-South and Triangular cooperation to enhance regional collaboration on agroecology, circular economy, and climate-smart agricultural solutions that reduce disaster risks.

7. Monitoring, Evaluation, and Policy Adaptation

7.1. Develop Comprehensive Monitoring and Evaluation Frameworks

1) Implement frameworks that track the effectiveness of DRR measures, assessing how agroecological and circular economy practices contribute to risk reduction, ecosystem health, and climate resilience.
2) Ensure data collection systems are integrated across sectors, providing accurate and timely information to policymakers for making informed decisions.

7.2. Policy Adaptation and Continuous Improvement

1) Regularly review and adapt policies based on monitoring outcomes, ensuring that DRR strategies are responsive to emerging risks, climatic variations, and evolving local contexts.
2) Foster a culture of continuous learning and improvement by conducting periodic evaluations and engaging stakeholders in the review process.

In summary, member states are encouraged to adopt this holistic approach, integrating agroecology, circular economy, and climate action into national DRR policies. By doing so, they can build resilient agricultural systems, protect communities from climate-related disasters, and ensure sustainable development and food security for future generations. The alignment of these measures with regional and international frameworks will enhance coherence, mobilize resources, and facilitate collective action across Sub-Saharan Africa.

IX. Recommendations and Implementation Framework

A. Recommendations for Member States

Develop National Strategies:

i. Integration of Agroecology, Circular Economy, and Climate Action: Member states are encouraged to develop comprehensive national strategies that integrate agroecology, circular economy principles, and climate action. These strategies should focus on enhancing ecosystem services such as soil health, water conservation, and biodiversity protection, while also addressing short-lived climate pollutants (SLCPs) and long-term climate resilience.

ii. Collaboration with Regional Bodies: National strategies should be developed in coordination with regional bodies, such as the African Union and Regional Economic Communities (RECs), to ensure that local efforts align with regional priorities and commitments.

Policy Alignment with Regional Frameworks:

i. Coherence with CAADP and AU Agenda 2063: National policies should be aligned with regional frameworks like the Comprehensive Africa Agriculture Development Programme (CAADP) and the African Union's Agenda 2063. These frameworks provide strategic guidance for sustainable agricultural growth, environmental protection, and climate action in Africa.

ii. Monitoring and Reporting: Countries should establish robust monitoring and evaluation mechanisms to track the implementation of these policies and ensure that they meet national targets and regional obligations. Reporting to regional bodies will foster accountability and shared progress.

Financial Incentives and Capacity Building:

i. Incentivizing Agroecological Adoption: Governments should create financial incentives, such as grants, subsidies, or tax breaks, to encourage the adoption of agroecological practices. These could support farmers in transitioning from conventional to sustainable farming methods, such as organic farming, crop diversification, and agroforestry.

ii. Capacity Building and Farmer Engagement: Training programs for farmers, extension workers, and policymakers should be developed to build knowledge and technical skills in agroecological practices. Farmer networks and cooperatives can play a crucial role in the dissemination of knowledge and best practices.

iii. Encouraging Private Sector Engagement: Governments should work closely with the private sector to mobilize investments in sustainable farming technologies, waste management infrastructure, and renewable energy solutions.

Catalyzing Short-Term Action While Developing Long-Term Strategies

Rather than waiting for the full development of comprehensive national strategies, governments should be encouraged to take immediate, high-impact actions that build momentum for long-term agroecological and circular economy transitions.

Key Short-Term Focus Areas:

- Scaling up existing successful initiatives in agroecology, organic input production, and sustainable waste management without waiting for new funding cycles.

- Providing low-cost incentives (e.g., tax exemptions for sustainable agribusinesses, public procurement of organic products) to stimulate market-driven change.
- Leveraging existing policies to introduce quick regulatory adjustments that promote resource efficiency (e.g., bans on open burning of crop residues, promoting composting incentives).
- Utilizing existing financial mechanisms, such as climate adaptation funds, to provide immediate support to smallholder farmers transitioning to sustainable agricultural practices.
- Encouraging pilot projects in circular agriculture and agroecology that can serve as proof-of-concept for future large-scale national programs.

B. Monitoring and Evaluation

Establish a Regional Monitoring and Evaluation Framework:

i. Tracking Policy Implementation: Develop a robust regional framework for monitoring and evaluating the implementation of agroecology, circular economy, and climate action policies. This framework should include key performance indicators (KPIs) that measure progress towards enhancing ecosystem services, improving resource efficiency, reducing greenhouse gas emissions, and building climate resilience in agricultural systems.

ii. Impact on Ecosystem Services: The monitoring system should focus on tracking the impact of implemented policies on critical ecosystem services, such as soil health, water management, biodiversity conservation, and carbon sequestration. It should assess how agroecological practices are improving the overall health and productivity of ecosystems.

Encourage Regular reporting and data sharing.

i. Data Exchange Among Member States: To ensure coherence across the region, member states should regularly report their progress on policy implementation and the impacts on ecosystem services. This data sharing will enable cross-country learning, allow for the identification of best practices, and help address challenges that hinder effective implementation.

ii. Alignment with Global Climate Targets: Reporting frameworks should align with international climate commitments, including the Nationally Determined Contributions (NDCs) under the Paris Agreement. Member states should integrate agroecological and circular economy measures into their NDCs and report progress to regional bodies like the African Union, as well as global organizations such as the United Nations Framework Convention on Climate Change (UNFCCC).

iii. Periodic Review Mechanisms: Establish periodic review mechanisms to evaluate the success of policy implementation, identify gaps, and recommend adjustments based on lessons learned and changing environmental or socio-economic conditions.

C. Stakeholder Involvement

Ensure the Participation of Key Stakeholders:

i. Inclusive Policy Development: Promote a participatory approach in policy formulation that includes diverse stakeholder groups such as government bodies, private sector entities, civil society organizations, farmer networks, and youth and women groups. This will ensure that policies are representative, equitable, and address the needs of all actors in the agroecology, circular economy, and climate action sectors.

ii. Multi-stakeholder Collaboration: Encourage collaboration across different sectors to facilitate knowledge sharing, capacity building, and joint implementation of agroecological and circular economy strategies. This collaboration should involve key actors in agriculture, waste management, resource efficiency, and ecosystem services.

Foster Partnerships Between Research Institutions and Governments:

i. Data-Driven Policy Guidance: Leverage the expertise of research institutions to generate scientific data, best practices, and evidence-based insights that can inform policy development. Governments should work closely with academic and research institutions to ensure policies are grounded in science and tailored to the specific ecological and socio-economic contexts of member states.

ii. Applied Research for Policy Support: Support applied research initiatives that focus on the real-world application of agroecological and circular economy practices, ensuring that findings from research translate into actionable policy recommendations and implementation strategies.

iii. Capacity Building and Technical Assistance: Research institutions should provide technical support to governments, civil society, and the private sector by developing guidelines, frameworks, and toolkits to assist in the implementation of agroecological, circular economy, and climate action strategies.

X. Conclusion

This regional policy guide serves as a framework for member states to enhance their agricultural systems through agroecology, circular economy, and climate action strategies, with the ultimate goal of improving ecosystem services, food security, and climate resilience. By integrating these approaches, the guide offers solutions to address environmental degradation, unsustainable

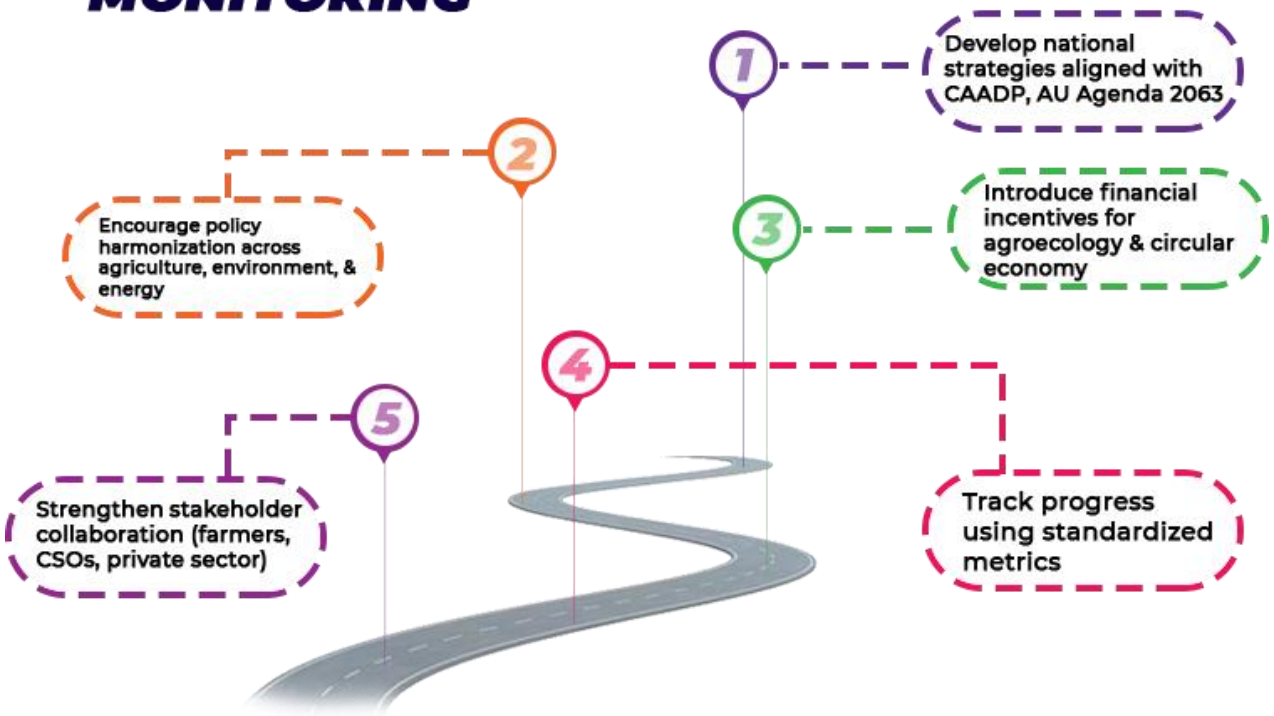
farming practices, and the pressing need for climate adaptation in the region. It provides clear pathways for transitioning towards sustainable agricultural practices, promoting resource efficiency, and aligning national policies with international and regional frameworks such as CAADP, the SDGs, Paris Agreement, and AU Agenda 2063.

The potential impact of this policy guide is significant. Agroecology can help improve soil health, water conservation, and biodiversity, while the circular economy will reduce waste and increase resource efficiency. These interventions, combined with climate-smart agriculture, will strengthen food systems and enhance the livelihoods of millions of smallholder farmers in Sub-Saharan Africa. Furthermore, this guide places a strong emphasis on the inclusion of marginalized groups—particularly women and youth—in the transition towards sustainable agriculture, ensuring that policy solutions are inclusive and equitable.

Regional collaboration is key to the success of this policy guide. Addressing shared challenges such as climate change, land degradation, and food insecurity requires coherent policies across borders, sectors, and stakeholder groups. The guide highlights the importance of coordination among national governments and regional institutions such as ECOWAS, SADC, EAC, private sector actors, civil society organizations, and research institutions. By fostering horizontal and vertical policy coherence, this guide supports integrated solutions that will not only enhance national and regional resilience but also contribute to global efforts to combat climate change and protect ecosystems.

Overall, this policy guide serves as a roadmap for sustainable agricultural transformation across Sub-Saharan Africa, promoting resilience, inclusivity, and long-term sustainability. Through coordinated regional action and commitment from all stakeholders, the vision of a more sustainable, equitable, and climate-resilient future can be realized.

IMPLEMENTATION AND MONITORING



THE PATH FORWARD

STAKE HOLDERS ROLES

CALL TO ACTION

References:

Ara, Z. G., & Haque, A. R. (2021). A Comprehensive Review on Synthetic Insecticides: Toxicity to Pollinators, Associated Risk to Food Security, and Management Approaches. In *Journal of Biosystems Engineering* (Vol. 46, Issue 3, pp. 254–272). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s42853-021-00104-y

Awogbemi, O., & Kallon, D. V. Von. (2022). Valorization of agricultural wastes for biofuel applications. In *Heliyon* (Vol. 8, Issue 10). Elsevier Ltd. https://doi.org/10.1016/j.heliyon.2022.e11117

Baker, P., Friel, S., Gleeson, D., Thow, A. M., & Labonte, R. (2019). Trade and nutrition policy coherence: A framing analysis and Australian case study. *Public Health Nutrition*, *22*(12), 2329–2337. https://doi.org/10.1017/S1368980019000752

Bhandary, R. R., Gallagher, K. S., & Zhang, F. (2021). Climate finance policy in practice: a review of the evidence. *Climate Policy*, *21*(4), 529–545. https://doi.org/10.1080/14693062.2020.1871313

Bhattacharya, A. (2022). *Finance for climate action Scaling up investment for climate and development Report of the Independent High-Level Expert Group on Climate Finance*.

Buehren, N. (2023). *Gender & Agriculture in Sub-Saharan Africa: Review of Constraints and Effective Interventions 1*.

Cappa, F., Baracchi, D., & Cervo, R. (2022). Biopesticides and insect pollinators: Detrimental effects, outdated guidelines, and future directions. In *Science of the Total Environment* (Vol. 837). Elsevier B.V. https://doi.org/10.1016/j.scitotenv.2022.155714

Chakuya, J., Gandiwa, E., Muboko, N., & Muposhi, V. K. (2022). A Review of Habitat and Distribution of Common Stingless Bees and Honeybees Species in African Savanna Ecosystems. In *Tropical Conservation Science* (Vol. 15). SAGE Publications Inc. https://doi.org/10.1177/19400829221099623

de Haas, M., & Giller, K. E. (2025). *Pathways to African Food Security; Challenges, Threats and Opportunities towards 2050*. https://www.routledge.com/Earthscan-Food-and-

Deynze, B. Van, Swinton, S. M., Hennessy, D. A., Haddad, N. M., & Ries, L. (2022). *Insecticides, more than herbicides, land use, and climate, are associated with declines in butterfly species richness and abundance in the American Midwest*. https://doi.org/10.1101/2022.07.29.502042

Herath, H. M. T. C., Udayanga, W. D. C., Dunusinghe, D. N. L., & Vidusanka, K. D. (2024). Sustainable Solid Waste Management in Developing Countries: Converting Urban Wood, Garden, Food, and Cardboard Waste Into Biochar Using Pyrolysis. *Journal of Desk Research Review and Analysis*, *2*(1), 92–109. https://doi.org/10.4038/jdrra.v2i1.28

Higginbottom, T. P., Adhikari, R., Dimova, R., Redicker, S., & Foster, T. (2021). Performance of large-scale irrigation projects in sub-Saharan Africa. *Nature Sustainability*, *4*(6), 501–508. https://doi.org/10.1038/s41893-020-00670-7

Hui, D., Ray, A., Kasrija, L., & Christian, J. (2024). Impacts of Climate Change and Agricultural Practices on Nitrogen Processes, Genes, and Soil Nitrous Oxide Emissions: A Quantitative Review of Meta-Analyses. In *Agriculture (Switzerland)* (Vol. 14, Issue 2). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/agriculture14020240

Kataya, G., Cornu, D., Bechelany, M., Hijazi, A., & Issa, M. (2023). Biomass Waste Conversion Technologies and Its Application for Sustainable Environmental Development—A Review. In *Agronomy* (Vol. 13, Issue 11). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/agronomy13112833

Khalifa, S. A. M., Elshafiey, E. H., Shetaia, A. A., El-Wahed, A. A. A., Algethami, A. F., Musharraf, S. G., Alajmi, M. F., Zhao, C., Masry, S. H. D., Abdel-Daim, M. M., Halabi, M. F., Kai, G., Al Naggar, Y., Bishr, M., Diab, M. A. M., & El-Seedi, H. R. (2021). Overview of bee pollination and its economic value for crop production. *Insects*, *12*(8). https://doi.org/10.3390/insects12080688

Kubik, Z. (2022). *The challenges of rural youth employment in Africa: A literature Review*. https://hdl.handle.net/10419/264365

Lakew Tefera, M., Carletti, A., Altea, L., Rizzu, M., Migheli, Q., & Seddaiu, G. (2024). Land degradation and the upper hand of sustainable agricultural intensification in sub-Saharan Africa-A systematic review. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, *125*(1), 63–83. https://doi.org/10.17170/kobra-202403129757

Lam, D. (2024). The Next 2 Billion: Can the World Support 10 Billion People? *Population and Development Review*. https://doi.org/10.1111/padr.12685

Magoma, R. J. (2024). Harnessing the Untapped Potential of Youth Agripreneurship in Creating Employment and Food Security in Africa. *Journal of Academics Stand Against Poverty*, *4*(Special), 50–57. https://doi.org/10.5281/zenodo.11035080

Nath, R., Singh, H., & Mukherjee, S. (2023). Insect pollinators decline: an emerging concern of Anthropocene epoch. In *Journal of Apicultural Research* (Vol. 62, Issue 1, pp. 23–38). Taylor and Francis Ltd. https://doi.org/10.1080/00218839.2022.2088931

Nchanji, E. B., Kamunye, K., & Ageyo, C. (2023). Thematic evidencing of youth-empowering interventions in livestock production systems in Sub-Sahara Africa: a systematic review. In *Frontiers in Sustainable Food Systems* (Vol. 7). Frontiers Media SA. https://doi.org/10.3389/fsufs.2023.1176652

Omotoso, A. B., & Omotayo, A. O. (2024). The interplay between agriculture, greenhouse gases, and climate change in Sub-Saharan Africa. In *Regional Environmental Change* (Vol. 24, Issue 1). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s10113-023-02159-3

Quandahor, P., Kim, L., Kim, M., Lee, K., Kusi, F., & Jeong, I. H. (2024). Effects of Agricultural Pesticides on Decline in Insect Species and Individual Numbers. In *Environments - MDPI* (Vol. 11, Issue 8). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/environments11080182

Shawoo, Z., Dzebo, A., Iacobuta, G., Chan, S., Muhoza, C., Osano, P., Francisco, M., & Vijge, M. J. (2020). Increasing policy coherence between NDCs and SDGs : a national perspective. In *Stockholm Environment Institute*. https://www.jstor.org/stable/resrep25056

Smith, M. R., Mueller, N. D., Springmann, M., Sulser, T. B., Garibaldi, L. A., Gerber, J., Wiebe, K., & Myers, S. S. (2022). Pollinator Deficits, Food Consumption, and Consequences for Human Health: A Modeling Study. *Environmental Health Perspectives*, *130*(12). https://doi.org/10.1289/EHP10947

Van Deynze, B., Swinton, S. M., Hennessy, D. A., Haddad, N. M., & Ries, L. (2024a). Insecticides, more than herbicides, land use, and climate, are associated with declines in butterfly species richness and abundance in the American Midwest. *PLoS ONE*, *19*(6). https://doi.org/10.1371/journal.pone.0304319

Van Deynze, B., Swinton, S. M., Hennessy, D. A., Haddad, N. M., & Ries, L. (2024b). Insecticides, more than herbicides, land use, and climate, are associated with declines in butterfly species richness and abundance in the American Midwest. *PLoS ONE*, *19*(6). https://doi.org/10.1371/journal.pone.0304319