Circular Food Systems in Tanzania:

Enhancing Rural Development through Sustainable Land and Water Use

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Background

Circular Food Systems (CFS) encompass sustainable food production, consumption, and waste management. In Tanzania, current CFS efforts integrate efficient irrigation, smallholder farming, post-harvest loss management, food waste reduction, and dryland agriculture. These integrations foster rural development and resilient food systems, enhancing water, carbon, and nutrient cycling without increasing greenhouse gas emissions. Efficient use of land and water resources supports smallholder farmers, reduces post-harvest losses, and minimizes food waste, contributing to food security and economic growth. Tanzanian policies like KILIMO KWANZA and SAGCOT aim to modernize agriculture and reduce post-harvest losses through improved practices and infrastructure (Sgroi, 2023; Bisheko & Rejikumar, 2024).

Relevance

Tanzania has always faced significant challenges in land and water use, which have adversely affected its agricultural productivity and sustainability. Droughts, land degradation, and inefficient water use are prevalent issues, leading to reduced crop yields and increased food insecurity (Kimaro & Hieronimo, 2014). Over-reliance on rain-fed agriculture and inadequate irrigation infrastructure exacerbates these problems, making smallholder farmers vulnerable to climate variability (Kajembe et al., 2010). Additionally, post-harvest losses due to poor storage and transportation infrastructure further diminish food availability and economic returns (Bisheko & Rejikumar, 2024). Inefficient land use has led to conflicts over resources and hindered the adoption of sustainable agricultural practices (Kimaro & Hieronimo, 2014). These issues contribute to economic instability, increased rural poverty, and environmental degradation, highlighting the urgent need for policy interventions to address these challenges and promote sustainable agricultural practices in Tanzania.

The Current State of Agriculture in Tanzania

Tanzania's agricultural sector is dominated by smallholder farmers who contribute about 70% of the national food supply (FAO, 2022). However, these farmers face numerous challenges, including inadequate irrigation infrastructure, leading to over-reliance on rain-fed agriculture. Only about 1.6% of Tanzania's arable land is irrigated, leaving crops vulnerable to climate variability (FAO, 2022). Post-harvest losses are significant, with estimates indicating that up to 30% of produce is lost due to poor storage and handling facilities (Bisheko & Rejikumar, 2024). The government has implemented various policies and programs to address these issues, such as the KILIMO KWANZA initiative and the Agricultural Sector Development Programme (ASDP II), which aim to modernize agriculture, improve irrigation, and reduce post-harvest losses (Tanzania Investment Centre, 2024). FAO's Country Programming Framework 2022-2027 also supports sustainable land and water use to enhance agricultural productivity and food security (FAO, 2022).

Comparative Policy and Gap Analysis

Tanzania's agricultural policies demonstrate both alignment with and divergence from Circular Food Systems (CFS) principles. The National Agricultural Policy (NAP) of 2013 emphasizes sustainable agricultural development, inclusive growth, and climate resilience, aligning with CFS by promoting sustainable practices and empowering smallholder farmers. However, it lacks explicit mention of CFS and its integration with irrigation schemes, indicating a gap in holistic system approaches.

The National Irrigation Policy (2009) focuses on developing and managing irrigation infrastructure to reduce reliance on rain-fed agriculture, promoting water efficiency and land use optimization. While this aligns with CFS goals, it does not explicitly address broader circular practices, such as nutrient cycling and waste reuse. The Agricultural Sector Development Program (ASDP II) (2017/2018-2027/2028) aims to enhance agricultural productivity and commercialization, emphasizing sustainable land and water management. Despite its focus

on productivity and sustainable practices, ASDP II lacks specific integration of CFS principles, particularly in nutrient cycling and waste management.

Moreover, the National Postharvest Management Strategy (NPHMS) 2019-2029 aims to reduce postharvest losses and improve food security, aligning with CFS by addressing food waste. However, it requires significant scaling up for national impact and lacks the necessary infrastructure for effective waste management. On the environmental front, the National Environment Policy (2021) emphasizes sustainable management and conservation of natural resources. While it promotes environmental protection, it does not explicitly encourage circular practices, highlighting a need for policy amendments to support integrated and sustainable agricultural practices.

Overall, while Tanzania's policies lay a strong foundation for sustainable agriculture, there are significant opportunities to enhance their alignment with Circular Food Systems (CFS) principles through targeted policy amendments and holistic agricultural development programs. Despite the National Agricultural Policy (2013) and the National Irrigation Policy (2009) promoting sustainable agriculture and water use, they lack explicit incorporation of CFS principles such as nutrient cycling and waste reuse. The inadequate infrastructure for post-harvest management leads to significant food losses, negatively impacting food security and farmer income. Additionally, current waste management policies fail to address agricultural waste valorization, resulting in missed opportunities for resource recovery. Financial support mechanisms are insufficient, limiting smallholder farmers' ability to invest in sustainable practices and technologies. Fragmented initiatives and lack of policy cohesion further hinder the effective implementation of CFS. Addressing these gaps requires comprehensive policies, enhanced financial mechanisms, and integrated approaches to land and water management to promote sustainable agricultural practices and resilience.

Key Challenges in Implementing Circular Food Systems in Tanzania

Implementing Circular Food Systems (CFS) in Tanzania faces several key challenges. Policy coherence remains a significant issue, with fragmented policies across agriculture, irrigation, and waste management, leading to inefficient resource use and limited integration of circular principles. Financial constraints are also prevalent, with limited access to funding and investment for CFS initiatives, especially for smallholder farmers and SMMEs. Technical support is inadequate, as there is insufficient infrastructure and technology for effective resource recovery and waste management. Additionally, low awareness among stakeholders about the benefits and practices of CFS hampers adoption and implementation efforts. Addressing these challenges requires cohesive policy frameworks, improved financial support mechanisms, enhanced technical infrastructure, and comprehensive stakeholder education and engagement programs.

Case Studies and Best Practices

TISA Project:

The Transforming Smallholder Irrigation into Profitable and Self-Sustaining Systems (TISA) project by FANRPAN has significantly enhanced smallholder farmers' livelihoods in Tanzania by integrating adaptive management and Agricultural Innovation Platforms (AIPs). By monitoring soil moisture and nutrients, farmers have achieved substantial increases in crop yields and incomes even before infrastructure investments. The project supports over 15,000 farmers across 38 irrigation schemes, demonstrating the scalability and impact of innovative water management techniques. The collaboration between farmers, government agencies, and businesses has been crucial in making irrigation schemes more self-sustaining and equitable (ACIAR, 2017).

Towards Circular Food Production Systems in East Africa:

This initiative focuses on integrating circular practices in agricultural production, such as recycling organic waste and improving soil health. Implemented in East Africa, it has shown significant improvements in crop yields and environmental conservation. For example, recycling organic waste has led to a 30% increase in soil

fertility, and farmers have reported a 20% boost in crop yields. The initiative emphasizes the importance of sustainable farming methods and highlights the potential of circular systems to enhance food security and ecological balance. By transforming agricultural waste into valuable inputs, the initiative supports the development of resilient and productive farming systems.

Circular Bioeconomy in African Food Systems:

This study, conducted in Rwanda, DRC, and Ethiopia, provides comprehensive insights into the status quo of circular bioeconomy practices. It highlights how communities practice composting and recycling organic waste to close nutrient loops, thereby enhancing soil fertility and food security. In Rwanda, composting practices have led to a 25% reduction in chemical fertilizer use, while in Ethiopia, organic waste recycling has improved food security by 15%. The research emphasizes the need for supportive policies and quality scientific evidence to guide the development of African circular food systems. Findings suggest that awareness, knowledge, and support for circular bioeconomy practices are high among communities, indicating a strong foundation for scaling such practices (Sekabira et al., 2022).

FANRPAN's and Circular Food Systems

The Food, Agriculture, and Natural Resources Policy Analysis Network (FANRPAN) has been a crucial player in advancing Circular Food Systems (CFS) across Africa. FANRPAN's initiatives focus on integrating climate-smart agriculture (CSA) and nutrition-sensitive agriculture (NSA) to enhance food security, sustainability, and resilience against climate change. Operating through established national nodes in 18 African countries, including Tanzania, FANRPAN involves diverse stakeholders such as government departments, parliamentarians, research organizations, and the private sector (FANRPAN, 2023).

In Tanzania, FANRPAN's work emphasizes supporting smallholder farmers by promoting sustainable agricultural practices aligned with CFS principles. These practices include reducing post-harvest losses, improving water and nutrient use efficiency, and enhancing overall agricultural productivity. Key initiatives include the Climate Smart Agriculture Programme, which aims to build resilience against climate variability, and the Nutrition Sensitive Agriculture Initiative, which focuses on ensuring agriculture delivers positive nutrition outcomes (FANRPAN, 2023).

FANRPAN's strategy involves conducting collaborative research, providing technical support, organizing training and workshops, and facilitating policy dialogues. This holistic approach is designed to generate evidence-based policies and practices that can be scaled across Tanzania and other African countries. The implementation of these projects provides a significant opportunity for Tanzania to leverage FANRPAN's expertise and resources to advance its agricultural sector sustainably, contributing to national goals of food security and rural development (FANRPAN, 2023).

Stakeholder Support and Policy Amendments

Various stakeholders, including governments, NGOs, and private sector entities, can play a pivotal role in effectively supporting and building upon FANRPAN's work. Policymakers should focus on creating enabling environments by amending agricultural policies to promote sustainability and resilience in food systems. This includes integrating climate-smart agriculture practices, enhancing access to quality seeds, and ensuring fair market access for smallholder farmers. Holistic agricultural development programs are essential and should aim at boosting productivity and sustainability while considering nutrition-sensitive approaches to address malnutrition.

Stakeholders should also support initiatives like the Women Accessing Realigned Markets (WARM) project, which empowers women farmers, and the Harmonized Seed Security Project (HaSSP), which improves seed

variety access. Building capacity for policy monitoring and implementation, as well as fostering multi-stakeholder dialogues, are crucial for the effective translation of research into actionable policies. Through collaborative efforts and focused strategies, stakeholders can significantly enhance the impact of FANRPAN's initiatives across the region.

Recommendations

To advance Circular Food Systems (CFS) in Tanzania, it is imperative to implement policy amendments and holistic agricultural development programs that promote sustainable land and water use. These recommendations aim to enhance rural development by integrating CFS principles into agricultural policies and practices, ensuring economic growth, food security, and environmental sustainability.

- Policy Amendments - Revise and enhance existing agricultural, water, and environmental policies to better support the principles of circular food systems (CFS), ensuring that policy frameworks are conducive to integrated and sustainable agricultural practices.
    - **National Irrigation Policy:** Incorporate efficient water use practices, such as water recycling and rainwater harvesting. Integrate irrigation management with eco-friendly practices that minimize water runoff and increase water retention in soils. *Justification:* These practices align with CFS principles by promoting resource efficiency and reducing environmental impact.
    - **National Agricultural Policy:** Explicitly integrate circular economy principles, such as nutrient recycling, organic farming, and sustainable land management. Policies should also promote diversified cropping systems that support soil health and reduce dependency on chemical fertilizers. *Justification:* This fosters sustainable agricultural production and soil health, key components of CFS.
    - **Environmental Management Act:** Extend provisions to cover the management of agricultural byproducts, promoting their use as inputs in other agricultural processes or as raw materials in other industries. Establish guidelines for the conversion of agricultural waste into bioenergy. *Justification:* Utilizing waste products for bioenergy exemplifies CFS by closing nutrient loops and reducing waste.
    - **Livestock Policy:** Include strategies for integrating livestock with crop production to enhance nutrient cycling (e.g., using manure as fertilizer and rotational grazing to improve soil health). Promote climate-resilient livestock practices that reduce greenhouse gas emissions. *Justification*: This integration supports nutrient recycling and enhances ecosystem resilience, aligning with CFS goals.
    - **Land Use Policy:** Encourage land use practices that support CFS objectives, such as agroforestry and integrated farming systems. Provide incentives for maintaining and enhancing biodiversity and ecological functions. *Justification:* Agroforestry and integrated systems foster biodiversity and sustainable land use, core tenets of CFS.
    - **Food Security Policy:** Update to promote post-harvest technologies that reduce losses, improve food processing efficiency, and extend the value chain to include circular economy concepts. Justification: Reducing post-harvest losses and improving food processing efficiency directly support CFS by enhancing food security and minimizing waste.

- Holistic Agricultural Development Programs - Implement comprehensive development programs that not only support policy objectives but also empower smallholders and agri-entrepreneurs through innovative practices, business development, and resource management training.
    - **Integrated Resource Management Program:** This program aims to optimize the use of water, land, and nutrients through holistic management practices. It involves the development and deployment of dual-purpose water systems that serve both irrigation and livestock. These systems include water catchments and constructed wetlands to enhance water efficiency and quality, benefiting both crop production and livestock management.

- **Circular Agri-Enterprise Accelerator:** Designed to foster the growth of small and medium-sized enterprises (SMMEs) that adopt and promote circular economy principles in agriculture. The program will establish incubation centers for agri-based SMMEs, focusing on processing agricultural products locally, and encouraging innovations that lead to waste reduction and value addition.

- **Community-Based Composting and Bioenergy Solutions:** Enhance waste management and nutrient recycling within agricultural communities. The program partners with technology providers to establish biogas installations at community or cooperative levels that use agricultural waste to generate energy. This reduces reliance on non-renewable energy sources and minimizes greenhouse gas emissions.

- **Sustainable Irrigation and Dryland Farming Systems:** Implement a program that integrates advanced irrigation systems and dryland farming techniques to support CFS. This includes efficient drip irrigation systems for water conservation in irrigated areas and conservation agriculture practices for dryland farming to improve soil health and water retention.

Conclusion

Adopting Circular Food Systems (CFS) in Tanzania is essential for sustainable rural development. By integrating CFS principles into policies and practices, Tanzania can enhance land and water resource efficiency, support smallholder farmers, and reduce post-harvest losses and food waste. Comprehensive policy amendments and holistic agricultural development programs will foster resilient food systems, promote economic growth, and ensure environmental sustainability. These efforts will contribute significantly to achieving food security and sustainable agricultural practices in Tanzania.

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