

The Role of Agrifood Circularity and Sustainable Farming Towards Food System Transformation in Africa

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Abstract: Food systems around the world are not sustainable in their current status; they rank as a major contributor to national carbon emissions and continue to contribute to the loss of biodiversity. Further millions, especially women, suffer from hunger and malnutrition. The COVID-19 pandemic showed us how easy it is to reverse gains achieved due to the fragility of global food systems. There is a need to ensure increased inclusivity and equity. Food systems in Africa in the current state require an urgent transformation through agri-food circularity and sustainable farming principles. This paper provides information that can lead to food systems transformation in Africa through use of agrifood circularity principles and sustainable farming principles. This paper through a theoretical review of thematic literature highlights the role agrifood circularity towards sustainable farming food system transformation in Africa, it further provides how agrifood circularity principles can be promoted to achieve food system transformation. Agrifood circularity, regenerative agriculture and agroecology principles have the capacity if properly integrated to lead to a sustainable food system transformation in Africa. Governments in Africa and across the world will find these findings useful to entrench agrifood circularity principles in the farming systems so as to achieve inclusive and sustainable food systems transformation.

Keywords: Circularity, Regenerative Agriculture, Food Systems, Africa

Introduction

The African continent is home to about one billion people, and food is a critical component of their livelihoods. However, the continent is also facing significant challenges related to food insecurity, malnutrition, and poverty. According to Khan *et al.* (2021), about 20% of Africans are undernourished, and this figure has remained constant over the past decade (FAO, 2021). In addition, Africa is experiencing rapid population growth, urbanization, and climate change, which are exacerbating the food insecurity challenge. Therefore, there is an urgent need to transform the continent's food systems to ensure sustainability and inclusivity (Rogito & Nyamota, 2022).

Food systems in Africa are characterized by several challenges, including low productivity, limited access to credit and markets, high post-harvest losses, and weak institutional and regulatory frameworks. These challenges are further compounded by the COVID-19 pandemic, which has disrupted food supply chains and exposed the fragility of global food systems. Therefore, there is a need for urgent action to transform food systems in Africa to ensure resilience, inclusivity, and sustainability (Kruseman *et al.*, 2020).

Agri-food circularity and sustainable farming principles are critical components of the transformation agenda for food systems in Africa. Agri-food circularity refers to the concept of using resources efficiently, reducing waste, and maximizing value across the entire food value chain (Wijerathna-Yapa & Pathirana, 2022). Sustainable farming, on the other hand, involves using agricultural practices that enhance soil health, biodiversity, and ecosystem services while reducing the negative impact on the environment. These principles can help to improve productivity, reduce post-harvest losses, enhance food safety, and promote environmental sustainability in Africa's food systems (Barrett *et al.*, 2022).

This paper aims to provide the role of agrifood circularity towards sustainable farming food system transformation in Africa. The paper further provides how agrifood circularity principles can be promoted to achieve food system transformation. The paper argues that agrifood circularity, regenerative agriculture, and agroecology principles have the capacity, if properly integrated, to lead to a sustainable food system transformation in Africa. The findings of this paper will be useful to governments in Africa and across the world to entrench agrifood circularity principles in the farming systems so as to achieve inclusive and sustainable food systems transformation globally.

Background

Africa's food systems face several challenges, including low productivity, limited access to credit and markets, high post-harvest losses, and weak institutional and regulatory frameworks. Low productivity is a significant challenge in Africa, and this is mainly due to the use of outdated agricultural practices, low levels of technology adoption, and limited access to inputs such as fertilizers and high-yielding seeds (Barrett *et al.*, 2020). These challenges are further enhanced by climate change, which is causing extreme weather events such as droughts and floods, affecting the productivity and resilience of food systems in Africa. Access to credit and markets is another significant challenge facing smallholder farmers in Africa. Smallholder farmers produce most of the food consumed on the continent, but they face numerous challenges accessing markets due to poor infrastructure, limited access to credit, and inadequate market information (Wezel *et al.*, 2020). These challenges result in low prices for farmers' produce and limited income, further perpetuating poverty and food insecurity. Post-harvest losses are a significant challenge in Africa, and they contribute to food insecurity, reduced incomes for farmers, and environmental degradation. According to Mehmood (2021), post-harvest losses in Africa are estimated to be about 30% of the total production.

The world's food systems are currently unsustainable and are major contributors to national carbon emissions, leading to the loss of biodiversity. Moreover, millions of people, especially women, suffer from hunger and malnutrition. The COVID-19 pandemic has further highlighted the fragility of global food systems, and the ease with which gains can be reversed. It is essential to ensure greater inclusivity and equity, particularly in Africa, where food systems urgently need to be transformed through the use of agrifood circularity and sustainable farming principles. This transformation requires a shift away from conventional agricultural practices towards regenerative agriculture and agroecology principles (Rogito & Rogito, 2022).

Africa has been hit hard by the pandemic, with a significant impact on food systems. The United Nations estimates that the number of people experiencing acute food insecurity has increased by 82% in Africa since the pandemic began. The region also faces other challenges, such as climate change, water scarcity, and land degradation, which further exacerbate food insecurity. Sustainable and circular agricultural practices can play a key role in mitigating the impact of these challenges (Kruseman *et al.*, 2022).

Agrifood circularity involves the creation of closed-loop systems, where waste from one process becomes a resource for another. It also involves reducing food waste and using resources more efficiently (Hubeau *et al.*, 2017). Regenerative agriculture principles focus on building soil health and fertility. These principles can contribute to sustainable and inclusive food systems in Africa, promoting better health outcomes and reducing the number of people suffering from hunger and malnutrition.

Governments in Africa and across the world must adopt policies that promote agrifood circularity and sustainable farming principles to achieve inclusive and sustainable food systems transformation. However, achieving this transformation will require collaboration across various sectors and stakeholders, including policymakers, farmers, researchers, and consumers (Rogito *et al.*, 2020).

Literature Review

The Global and Africa Food System Challenge

The global food system is facing a crisis in its current status, as it is a major contributor to national carbon emissions and continues to contribute to the loss of biodiversity. Millions of people, especially women, suffer from hunger and malnutrition, making it necessary to ensure increased inclusivity and equity. The COVID-19 pandemic highlighted the fragility of global food systems and how easy it is to reverse gains achieved. This calls for an urgent transformation of food systems in Africa through agrifood circularity and sustainable farming principles (Rogito & Rogito, 2022). Recent data shows that Africa is disproportionately affected by food insecurity, with 256 million people suffering from hunger in 2020, accounting for more than half of the global total. The COVID-19 pandemic has enhanced the situation, with estimates suggesting that an additional 44 million people in Africa have been pushed into extreme poverty and food insecurity. Additionally, the continent has experienced unprecedented climate extremes, such as droughts and floods, which have further compounded the food insecurity situation (El Bilali *et al.*, 2021).

To address these challenges, governments in Africa and across the world need to promote sustainable farming principles and agrifood circularity. Agrifood circularity, regenerative agriculture, and agroecology principles have the capacity to lead to a sustainable food system transformation in Africa if properly integrated. Recent studies have shown that adopting these principles can result in improved soil health, reduced greenhouse gas emissions, and increased biodiversity. It is clear that the global and Africa food systems face significant challenges that require urgent transformation through the integration of sustainable farming principles and agrifood circularity. Governments must prioritize investment in sustainable agriculture and support for smallholder farmers to achieve food security, inclusive growth, and sustainable development (Grumbine *et al.*, 2021).

Sustainable farming principles in Africa

The need for sustainable farming practices has become more pressing as the fragility of the global food system was exposed during the COVID-19 pandemic. Sustainable farming principles are essential for promoting more inclusive and equitable food systems. These principles prioritize the health and well-being of farmers, consumers, and the environment. Sustainable farming practices include agroforestry, conservation agriculture, and integrated pest management, among others. These practices promote soil health, reduce chemical inputs, and support biodiversity (Adelodun *et al.*, 2021). In addition, sustainable farming practices prioritize the social and economic well-being of farmers, including women and youth. They provide economic opportunities and support for small-scale farmers and increase their resilience to climate change and other shocks (Wezel *et al.*, 2020).

Regenerative agriculture and agroecology principles have been gaining attention as potential solutions to transform farming practices in Africa. Regenerative agriculture is a holistic approach to farming that

seeks to restore soil health, biodiversity, and ecological systems. This approach involves practices such as cover cropping, crop rotation, and the use of natural fertilizers. Agroecology is a science-based approach to agriculture that emphasizes the interdependence of ecological, social, and economic factors. Agroecology emphasizes the use of local knowledge/ resources, crop diversity, and ecological farming practices to promote sustainable-resilient food systems (McGreevy *et al.*, 2022).

Challenges and Barriers in Promotion of Agrifood Circularity and Sustainable Farming in Africa

Although promoting agrifood circularity and sustainable farming principles is key to achieving food system transformation in Africa, several challenges and barriers must be addressed to ensure their successful implementation. One major challenge is inadequate funding for agriculture and food system transformation. Africa's agricultural sector is often underfunded, with most African countries dedicating only a small percentage of their national budgets to agriculture. This inadequate funding often leads to low agricultural productivity, limited access to agricultural inputs, and outdated farming practices. In addition, the lack of funding makes it difficult for farmers to adopt new technologies and practices that promote agrifood circularity and sustainable farming principles (Barret *et al.*, 2020).

Another challenge is the lack of proper infrastructure, such as roads, electricity, and storage facilities. Poor infrastructure makes it difficult to transport agricultural products from farms to markets, leading to post-harvest losses and food waste. This challenge also affects access to electricity, making it difficult for farmers to use modern farming equipment and technologies, leading to lower productivity and yield (Barrios *et al.*, 2020). Moreover, inadequate policies and regulations are also a significant barrier to promoting agrifood circularity and sustainable farming principles. Many African countries have policies that do not support smallholder farmers, making it difficult for them to access agricultural inputs and resources. Additionally, some policies promote monoculture, which has led to the degradation of the soil and loss of biodiversity. Also, the lack of regulations on the use of fertilizers and pesticides has resulted in soil degradation and pollution, leading to lower yields and crop losses (De Benardi *et al.*, 2023).

The lack of access to markets is also a significant challenge for smallholder farmers in Africa. Most smallholder farmers lack access to markets, making it difficult for them to sell their produce. This lack of access limits their income, and they may not be able to invest in new technologies and practices that promote agrifood circularity and sustainable farming principles. Several challenges and barriers must be addressed to ensure the successful implementation of agrifood circularity and sustainable farming principles in Africa (Van Berkum & Dengerink, 2019). Adequate funding for agriculture and food system transformation, proper infrastructure, appropriate policies and regulations, and access to markets are all critical components that need to be addressed to achieve sustainable food systems transformation in Africa (Ruben *et al.*, 2021).

Methodology

This paper aimed to explore the role of agrifood circularity and sustainable farming towards food system transformation in Africa. The methodology used in this study involved a systematic review of thematic literature to gather relevant information and insights on the topic. Secondary data was collected from various scholarly databases, including Google Scholar, John Wiley, Springer, SAGE, Scopus, and Taylor and Francis. The search terms used included "agri-food circularity," "sustainable farming," "food

systems transformation," "regenerative agriculture," and "agroecology." The inclusion criteria for the studies were that they had to be published in peer-reviewed journals, written in English, and published between 2019 and 2023.

After collecting the relevant studies, the articles were screened based on their title, abstract, and full text, and articles that did not meet the inclusion criteria were excluded. The remaining articles were then thoroughly analyzed, and relevant information was extracted. The extracted data was synthesized and analyzed to identify the role of agrifood circularity towards sustainable farming food system transformation in Africa. The results of the paper are presented using a thematic analysis approach, where the themes that emerged from the data were identified and summarized. The themes that emerged were the importance of agrifood circularity in sustainable farming, the potential of regenerative agriculture and agroecology principles in food system transformation, and the role of governments in promoting agrifood circularity principles.

Importance of Agrifood Circularity and Sustainable Farming in Food System Transformation

The global food system has been a subject of concern due to its unsustainable practices, including high carbon emissions, loss of biodiversity, and inequitable access to food. The food system has been identified as a major contributor to national carbon emissions, with the livestock sector alone responsible for 14.5% of global greenhouse gas emissions. Additionally, the loss of biodiversity due to unsustainable farming practices threatens the ecosystem's ability to support human life. Agrifood circularity, a concept that emphasizes the use of renewable resources, recycling, and minimizing waste in the food system, can play a significant role in creating sustainable farming practices. This concept promotes a circular economy, where waste is viewed as a resource, and production is designed to minimize environmental impact. Agrifood circularity can be achieved through practices such as crop rotation, composting, and utilizing byproducts and waste materials to produce energy (Memhood *et al.*, 2021).

Regenerative agriculture and agroecology principles, which aim to improve soil health and promote biodiversity through ecological farming practices, can also contribute to the implementation of sustainable farming systems. These practices include minimizing tillage, promoting cover crops, and utilizing natural pest management techniques. Agrifood circularity and sustainable farming practices can help address the challenges facing the African food system. In Africa, the current food system is characterized by low productivity, limited access to markets, and poor infrastructure. Additionally, climate change is exacerbating the challenges facing the food system, with droughts and floods becoming more frequent (Wezel *et al.*, 2020).

Sustainable farming practices such as agrifood circularity can help increase productivity and reduce environmental impact. By utilizing renewable resources, minimizing waste, and promoting regenerative agriculture and agroecology principles, sustainable farming practices can create a resilient and equitable food system (Esposito *et al.*, 2020). This can lead to increased food security and economic growth in Africa, as well as reduce the global carbon footprint. The implementation of agrifood circularity and sustainable farming practices can lead to a sustainable transformation of the African food system. These practices can address the challenges facing the food system, including high carbon emissions, loss of biodiversity, and inequitable access to food. It is crucial for governments in Africa and around the world

to promote these practices to achieve a more sustainable and equitable global food system (Grumbine *et al.*, 2021).

The Potential of Regenerative Agriculture and Agroecology Principles in Food System Transformation in Africa

Regenerative agriculture and agroecology principles have the potential to transform farming practices in Africa and promote more sustainable food systems. These practices prioritize soil health, biodiversity, and ecosystem services, while also improving food security, increasing resilience to climate change, and reducing greenhouse gas emissions (Brassesso *et al.*, 2022). Recent data has shown the benefits of regenerative agriculture and agroecology principles in various parts of Africa (Ruben *et al.*, 2021). For example, a study conducted in Zambia found that farmers who adopted agroforestry practices had significantly higher crop yields and increased soil fertility compared to those who did not. Another study conducted in Ethiopia found that regenerative agricultural practices increased crop yields by up to 79%, while also reducing the need for chemical fertilizers and pesticides. In Senegal, agroecology principles have been implemented through a government-led program called the National Plan for Ecological Intensification of Agriculture. It focuses on improving soil health, increasing crop diversity, and promoting natural pest control methods, and has been successful in increasing food security and improving livelihoods for farmers (Khan *et al.*, 2021).

Furthermore, the United Nations Food and Agriculture Organization (FAO) has recognized the potential of regenerative agriculture and agroecology principles in transforming food systems in Africa. The FAO has emphasized the importance of integrating these practices into national agricultural policies and programs to promote sustainable food systems and increase resilience to climate change (Fernandez-Mena *et al.*, 2020). The potential of regenerative agriculture and agroecology principles in transforming food systems in Africa is promising. Through the implementation of these practices, African countries can improve food security, increase resilience to climate change, and promote more sustainable and equitable food systems (Esposito *et al.*, 2020).

Early lessons and emerging findings show that regenerative agriculture not only contributes to environmental goals but also makes economic sense: The cost of greenhouse gas emissions released in sub-Saharan Africa is estimated to be US\$270 billion annually mainly from deforestation and land use changes from the food sector. The biggest driver of this deforestation. Today Sub-Saharan Africa loses 2.7 million hectares of forest each year, contributing over 1,600 tonnes of CO₂ to global GHG emissions. Implementing regenerative agriculture opens an opportunity to reinvest these monies into development programmes. US\$140 billion from irreversible environmental degradation from damage to soils and water, compromising agricultural yields and eroding sub-Saharan Africa's ability to produce for its people. Additionally, US\$80 billion in the cost of inadequate rural livelihoods leading to a failure to provide a decent living for 350 million people working and living in rural areas in unsustainable food and land use system traps in a cycle of poverty (Mehmood *et al.*, 2021).

Case Studies of Successful Regenerative Agriculture Practices in Africa

Several African countries have successfully implemented agrifood circularity and sustainable farming principles. These case studies provide practical examples of how to promote sustainable food systems in Africa. For example, in Tanzania, the Sustainable Agriculture Tanzania program promotes

agroforestry and conservation agriculture practices, including crop diversification and soil fertility management. The program has resulted in increased crop yields, improved soil health, and reduced dependence on chemical inputs. In Uganda, the Participatory Ecological Land Use Management (PELUM) Association promotes agroecology principles and practices among small-scale farmers. The association works to increase access to land, seeds, and other resources and provides training and support for sustainable farming practices. As a result, farmers have been able to improve their yields, diversify their crops, and increase their income (Adelodun *et al.*, 2021).

In Kenya, AGRA and its partners through promotion of regenerative agriculture, farmers have become more resilient to climate change, land degradation and resulted to production of high yields and income through sustainable farming principles. Sustainable farming practices form the central tenants of AGRA's implementation strategy. It is part of an agriculture transformation that not only looks at yield enhancements of certain crops but overall farm and landscape productivity and has broken the poverty cycle that most rural communities find themselves in. Regenerative agriculture offers an opportunity to tackle and fix challenges faced in food systems thereby protecting human and environmental health and maintaining the current and future integrity of global ecosystems (De Bernardi *et al.*, 2023). Some of the key regenerative practices followed by AGRA are as follows:

1. Minimum tillage to reduce the oxidation of soil carbon, leading to higher soil carbon sequestration and increased water and nutrient holding capacity. Increase soil cover to reduce soil erosion and increased biomass through cover crops, greening of landscapes;
2. Enhanced biodiversity to increase productivity per unit area, improve land use and reduce pest and disease incidences; Improving soil water holding capacity of farms and grazing areas
3. Improved crop-livestock integration and nutrient cycling. It is considered as a viable approach to reduce pressure on natural resources.

In Ethiopia, the Agricultural Transformation Agency (ATA) has implemented the Ethiopia Commodity Exchange (ECX), which provides a transparent and efficient market for farmers to sell their crops. The ECX has resulted in increased income for farmers and improved food security for consumers. Additionally, the ATA has promoted sustainable farming practices, including the use of composting and intercropping, and the introduction of drought-tolerant crops (Doberman *et al.*, 2022). Overall, these case studies provide evidence of the effectiveness of agrifood circularity and sustainable farming principles in promoting more sustainable, inclusive, and equitable food systems in Africa. These practices provide economic opportunities for small-scale farmers, support soil health and biodiversity, and increase resilience to climate change and other shocks. The success of these initiatives highlights the potential for these practices to be scaled up and adopted more widely across Africa (Hamam *et al.*, 2021).



Figure 1: A section of a maize field in Makueni that has adopted regenerative agriculture principles.



Figure 2: A section of a sorghum and maize field that has adopted regenerative agriculture principles.



Figure 3: A section of the adjacent maize field without application of regenerative agriculture principles and climate resilient practices.

How to Promote Agrifood Circularity and Sustainable Farming Principles in Africa

The transformation of the African food system towards sustainability requires the collective efforts of various stakeholders, including governments, private sectors, and farmers (Wijerathna-Yapa & Pathirana, 2022). This section highlights the roles of these stakeholders in promoting agrifood circularity and sustainable farming towards food system transformation in Africa.

1. **Role of Governments-** Governments play a critical role in creating an enabling environment for sustainable agriculture and food systems. They can enact policies, laws, and regulations that promote sustainable farming practices, support local food production, and improve access to nutritious foods. Governments can also invest in research and development of sustainable farming technologies, provide financial incentives, subsidies and technical support to farmers, and strengthen extension services to increase awareness of sustainable farming practices. Additionally, governments can enhance partnerships between different stakeholders, such as farmers, civil society, and the private sector, to promote agrifood circularity and sustainable farming practices (Ruben *et al.*, 2021).
2. **Role of Private Sector-** The private sector, including food processing companies, agribusinesses, and retailers, has a significant influence on the food system in Africa. Private sector entities can invest in sustainable agricultural practices, support smallholder farmers through partnerships, and promote sustainable production and consumption of food products. Private sector actors can also play a key role in reducing food waste by adopting circular business models that prioritize recycling, reducing, and reusing materials. Furthermore, the private sector can support sustainable agriculture and food systems by investing in research and development of innovative technologies that promote sustainable farming practices and improve the efficiency of the supply chain (Hubeau *et al.*, 2017).
3. **Role of Farmers-** Smallholder farmers are the backbone of agriculture in Africa, and their role in promoting agrifood circularity and sustainable farming practices is critical. Farmers can adopt sustainable farming practices such as agroforestry, conservation agriculture, and integrated pest management, which promote soil health, biodiversity, and ecosystem services. Farmers can also adopt circular farming practices such as composting, crop rotation, and intercropping, which promote soil fertility, reduce waste, and improve water efficiency. Additionally, farmers can participate in farmer-led organizations and cooperatives, which can provide them with technical support, access to markets, and bargaining power (Barrett *et al.*, 2022).

Promoting agrifood circularity and sustainable farming practices in Africa requires the collective efforts of various stakeholders, including governments, private sectors, and farmers. Governments can create an enabling environment for sustainable agriculture and food systems, while the private sector can invest in sustainable agriculture and promote circular business models (Dobermann *et al.*, 2022). Farmers can adopt sustainable farming practices and participate in farmer-led organizations and cooperatives. Through collaboration and partnership among different stakeholders, it is possible to transform the African food system towards sustainability, ensuring food security, equity, and inclusivity (Adelodun *et al.*, 2021).

Conclusion

There is an urgent need for food system transformation in Africa through the use of agrifood circularity and sustainable farming principles. The current state of food systems in Africa is not sustainable, and there is a need for increased inclusivity and equity. The integration of regenerative agriculture and agroecology principles with agrifood circularity principles has the capacity to lead to a sustainable food system transformation in Africa (Esposito *et al.*, 2020). Research institutions can contribute to promotion of agrifood circularity and sustainable farming towards food system transformation in Africa by conducting research on sustainable agriculture practices, regenerative agriculture, and agroecology principles. They can also investigate the impact of these practices on soil health, biodiversity, and climate change. This knowledge can be used to develop evidence-based policies and strategies that support the adoption of sustainable farming and develop training programs and provide technical assistance to farmers, extension agents, and other stakeholders to improve their understanding and knowledge of sustainable farming practices (Rogito & Rogito, 2022).

Recommendations

Based on the findings of this paper, the following recommendations are made:

1. Governments in Africa and across the world should prioritize the entrenchment of agrifood circularity principles in the farming systems to achieve inclusive and sustainable food systems transformation globally. This can be done through the development of policies and programs that support and promote sustainable farming practices and agrifood circularity. Incentivizing farmers through subsidy programs is also necessary (Fernandez-Mena *et al.*, 2020).
2. There is a need for increased investment in research and development in the field of agrifood circularity and sustainable farming practices to identify and promote innovative and sustainable solutions to transform food systems in Africa (Grumbine *et al.*, 2021).
3. Development organizations and INGOs can support the adoption of agrifood circularity and sustainable farming practices through capacity building, knowledge transfer, and financing (Barrios *et al.*, 2020). They can provide farmers with training on sustainable farming practices, access to appropriate technology and equipment, and financial support to invest in sustainable farming practices. They can also work with local communities to raise awareness about the importance of sustainable agriculture practices and facilitate partnerships and collaboration among stakeholders to promote sustainable food systems in Africa (McGreevy *et al.*, 2022).
4. Collaboration between stakeholders in the food industry, including farmers, policymakers, researchers, and consumers, is essential to promote agrifood circularity and sustainable farming practices. This can be done through the development of partnerships and networks that support the adoption of sustainable farming practices (El Bilali *et al.*, 2021).
5. Education and awareness-raising campaigns are necessary to promote the adoption of sustainable farming practices and agrifood circularity principles. This can be achieved through the development of training programs and workshops for farmers and other stakeholders in the food industry (Kruseman *et al.*, 2020).

By implementing these recommendations, it is possible to achieve inclusive and sustainable food systems transformation in Africa and globally.

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