Circular economy in Africa: examples and opportunities

FOOD AND AGRICULTURE

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This article is part of a collection of insights on the circular economy in Africa. The goal of this collection is to explore the potential of the circular economy in a selection of key economic sectors in African countries and highlight examples of the circular economy in action. The sectors explored in this study are: food and agriculture; fashion and textiles; plastics; e-waste; automotive; and the built environment. The collection also considers the key role of public policy and the financial sector in creating the conditions for the transition to a circular economy.

The collection is the result of a joint effort led by four organisations: Chatham House; the Ellen MacArthur Foundation; ICLEI Africa; and the University of Lagos, who worked closely to combine their complementary knowledge and expertise on this broad topic. While the collection was curated by the Ellen MacArthur Foundation, it reflects a plurality of views and analyses.

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ICLEI Local Governments for Sustainability AFRICA

CHATHAM HOUSE

UNIVERSITY OF LAGOS IN DEED AND IN TRUTH

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Betty Kibaara, Director, Rockefeller Foundation

Jonathan Muriuki, Country Representative for Kenya, ICRAF

Dr. Chrysanthus Tanga, Research Scientist, ICIPE

Talash Huijbers, Founder, Insectipro

Michael Lwoyelo, Managing Director, Sanergy

Francis Okot, Field Co-ordinator, Agricycle

Carla Mucavi, FAO Representative to Kenya

Samuel Rigu, CEO and Founder, Safiorganics

Emma Naluyima, Farmer/ Veterinarian, One Acre Farm

Andrew Wallace, Co-founder and CEO, Chanzi

Elke Nijman, Founder, Circular Africa

Lead writer

Nick Jeffries, Senior Expert, Ellen MacArthur Foundation

Core project team

PROJECT MANAGEMENT

Jocelyn Blériot, Executive Lead, Institutions, Governments and Cities, Ellen MacArthur Foundation

Sarah O'Carroll, Cities Lead, Ellen MacArthur Foundation

Dr Amelia Kuch, Policy Research Manager, Ellen MacArthur Foundation

EDITORIAL

Ian Banks, Editorial Lead, Ellen MacArthur Foundation

Lena Gravis, Senior Expert - Editorial, Ellen MacArthur Foundation

Dale Walker, Freelance Editor

PRODUCTION

Sarah Churchill-Slough, Illustrator & Designer at squigglers & sarah nicole design

COMMUNICATION

Maha Daouk, Senior Communications Executive, Ellen MacArthur Foundation

Gabriella Hewitt, Media Relations Senior Executive, Ellen MacArthur Foundation

Lou Waldegrave, Senior Writer, Media and Messaging, Ellen MacArthur Foundation

EXTERNAL CONTRIBUTORS

Joanna de Vries, Conker House Editor

Introduction

Agriculture is the mainstay of Africa's economy, employing more than half the population and contributing to roughly 23% of GDP.[1] African farmers, businesses, and food entrepreneurs are at the forefront of food production and the backbone of many African economies. As the many case studies included in this article show, some are already reaping the benefits of a shift to a circular economy for food. However, in many parts of the continent, agriculture fails to provide either sufficient nutrition to its citizens or a decent livelihood to its farmers.

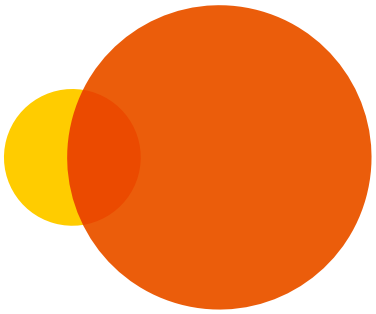
At the same time, African cities represent one of the fastest-changing demographics in the world. Africa's urban population is set to double in the next 30 year, and the affluence of African citizens is also increasing.[2] As a result, each year African cities require a greater overall volume of food and will in turn produce more organic waste.

Ensuring a secure and healthy supply of food to African cities and managing flows of urban organic waste in a way that preserves the continent's food cultures, diversity of ingredients and rich biodiversity, will be one of the major challenges in the decades ahead. There is an opportunity for African governments to develop policies and work with supply chains and citizens to address this challenge. ▶

▶ Besides these general challenges, there are also significant external threats, which include the impacts of climate change, locust swarms, and pandemics – all of which are exacerbating an already fragile and complex situation.

In addressing these interconnected issues, there is an opportunity for African countries to follow a different trajectory and establish a food system that can help tackle some of the biggest food security and economic challenges the continent is facing. Underpinning this path must be the right for people to define their own healthy and culturally appropriate food and to determine their own agricultural systems.

The circular economy provides a potential for a system-level solutions framework that lays the foundation for a thriving food system. Although not a silver bullet for all food system challenges, in many other regions of the world – such as Europe,[3] India[4], and China[5] – the circular economy has been shown to offer great potential economic opportunities, at the same time as helping to address significant societal and environmental issues.



What impact is this sector having and why is it critical to shift to a circular economy?

Agricultural productivity. Since the 1960s, agricultural productivity has steadily increased across the African continent. However, this increase has been achieved through the expansion of land under cultivation, rather than improvements in per hectare yields, and this expansion is constituting a threat to biodiversity.

Food security. Over the last decades, population growth has outpaced food production and the frequency of extreme weather events has increased due to climate change. These factors contribute to hunger and malnutrition and impact hundreds of millions of people, particularly in the sub-Saharan region. Food losses contribute directly to food insecurity, reducing the amount, quality, and accessibility of food, as well as indirectly as lost food means farmer revenues are reduced, so there is less money to buy food.[6] Limited infrastructure, refrigeration, and storage systems mean that up to 40% of food that is grown is lost before even arriving at the point of sale.[7]

Food safety. In cities, current processing and handling practices can mean that much of the food that enters markets is contaminated and unsafe. One survey in Arusha, Tanzania, that sampled 600 fruits and vegetables found that almost 60% had evidence of bacterial contamination.[8]

Dealing with growing volumes of urban organic waste. Collection, processing and sanitation systems only serve a small proportion of the population. The result is that organic waste is often just dumped and left to rot. As well as being a lost opportunity, this also leads to pollution, pest issues, and methane emissions.

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CIRCULAR ECONOMY STRATEGIES

A circular economy for food strives to have a positive impact on people, planet, and business through the application of three principles:

The following section describes how these principles are applied in the African context.

1

Reducing food loss to improve livelihoods

Reducing food losses could address two of the biggest challenges affecting African countries today, namely food security and the livelihoods of smallholder farmers. Due to a variety of factors – including the quality of and access to storage containers, poor transport systems, and lack of refrigeration – food losses in Africa remain significant. For example, Nigeria, the second largest tomato producer on the continent, loses up to 50% of tomatoes after harvest.[9] Improving roads and other infrastructure will be key in addressing this issue, however with an almost USD 50 billion infrastructure gap each year between what is needed and what is available,[10] other options need to be explored.

By bringing production and consumption centres closer together, for example by increasing urban and peri-urban farming and food processing, food loss could be significantly reduced. Shortening and simplifying supply chains, by creating more direct connections between growers and their markets using digital innovation can also contribute to reducing food losses and increasing income for farmers. Taimba, a mobile-based cashless platform that connects farmers to retailers, and Twiga, a B2B food distribution platform, offer concrete examples from East Africa of food supply chain innovation that can reduce food losses.

Increasing the amount of on-farm processing and transforming perishable fruits and vegetables into long-lasting, higher value products, is another promising approach. Examples of this include Agricycle, a network of farmers in Uganda and Kenya supported by solar hydrating technology and market linkages. The Ketchup Project in Kenya,[11] which supports farmers to grow tomatoes and sun-dry them on site, helps reduce the proportion of fruit that would normally rot and be thrown away. The dehydrated tomatoes are exported to the Netherlands where they are converted to low-sugar ketchup, with associated health benefits. Through this scheme, the farmers involved achieve greater financial security by earning a more stable income, and gain knowledge and certification that enables them to enter European markets.

Photo credit:
The Ketchup Project

2

Keeping materials in use to create new value opportunities

Organic material makes up to 60% of the waste fraction of municipal solid waste flows in African cities, and this is set to double in the next 30 years.[12] Allowing this material to be buried in landfill or rot away represents a depletion of soil fertility – an economic loss as well as a cost to cash-strapped municipalities.

Reimagining urban organic waste streams as feedstock for a low-carbon bioeconomy or as nutrients to support healthy soils, means that the costly problem of organic waste could be turned into profitable enterprises as well as support nature-positive agriculture. For example, the demand for insect feed for fish farming in Kenya is estimated at 100,000 tonnes,[13] but currently less than 10% of this demand is met. Cultivating insect larvae on discarded organic waste offers a profitable way of addressing this shortfall, as well as contributing to more local employment and resilient supply chains.

There are many examples of entrepreneurs already harnessing the power of insects to turn waste into profits. Insectipro farms crickets in Kenya to convert food by-products and waste into an affordable flour which can be added to porridge to fortify it with iron, zinc, and protein – exactly the nutrients that many malnourished children lack. Chanzi, a start-up in Tanzania (see case study box, p.10) have created an affordable 'vernacular' insect farm using local equipment and materials. Lowering the entry cost to insect farming is an important factor in scaling up waste valorisation in African cities.

Anaerobic digestion of food waste also offers significant benefits and is recognised as one of the most effective and profitable solutions to the issue. The method, relatively easy to set up, provides many other benefits, including the generation of biogas and rich biofertiliser, in place of fossil fuel-derived fertiliser, as well as emissions prevention, and creation of employment. For example, every tonne of food waste recycled in anaerobic digestion, as an alternative to landfill, prevents between 0.5 and 1 tonne of CO2 entering the atmosphere.

Waste Transformers is a company that sells decentralised energy and nutrient hubs packaged in standard 6 meters shipping containers.[14] The containers can process between 500–3,600kg of organic waste per day, converting it into saleable products such as liquid fertiliser, compost, and biogas. Waste Transformer units have been successfully demonstrated in South Africa and Liberia.

Valorisation of by-products can also occur further up the value chain. Farming and processing generates high volumes of organic by-products that are inedible by humans and can only be used sparingly to feed animals. These organic by-products can be turned into different revenue generating products, such as organic biochar fertiliser as Kenyan company Safi Organics has demonstrated. By reimagining rice waste as feedstock, Safi Organics has created a profitable new business – farmer yields and resilience have been improved and about 1.7 tonnes of CO2 equivalent is sequestered per acre through the use of their biochar product.

1.7

1.7 tonnes of CO_2 equivalent is sequestered per acre from using organic fertiliser

3

Regenerating natural systems for better societal and environmental outcomes

In many African traditions, regenerative agriculture is practiced by intercropping, composting, animal grazing, and various agro-ecological practices. However, with the growing population and growing food demand, many parts of the agriculture sector are seeking to increase productivity. To increase yield, the default option is to use intensive farming practices and synthetic inputs, which are associated with short-term productivity gains but long-term negative impacts to farmer health and the environment, in particular soil, biodiversity, and climate.[15]

An alternative path would seek out much-needed short-term benefits but in a way that hedges against longer term negative impacts. **Such an approach would harness traditional agro-ecological knowledge, capitalise on Africa's wide crop diversity, and would be supported by careful application of appropriate technology and the best scientific knowledge on ecosystems, soil health, nutrition, and resilience.**

The adoption of this more regenerative approach, requires a mindset shift from a single-minded focus on yields, to one that embraces a wider set of outcomes, including nutrition, the preservation of genetic biodiversity and natural capital, the protection of soils, the conservation of water, and the lowering of external inputs. In other words, an optimisation of the system. The result for farmers could be increased resilience, higher profits, and improved health.

The precise practices that deliver on these desired outcomes depend upon the specific context and geography. A poultry farming operation in Northern Kenya, called Farmer Max, has incorporated livestock into their operation, which they move ahead of the mobile coops, providing soil fertility and insects for the chickens. A fruit and vegetable farm in Kenya, called Tamalu, has integrated trees into the growing operation. This agroforestry approach creates a habitat for insects which pollinate and manage pests, but also allows stacked enterprises, so more food can be produced on a small area of land. Both approaches lead to more climate resilient farming, as well as nutritious food that farmers and their families can actually eat.

Small-scale mixed farming systems, such as Emma Naluyima's farm in Uganda (see case study box, p.9), are a particularly attractive proposition due to the prevalence of small farm plots in many African countries. This type of system increases profits by eliminating the cost of inputs and improves farm productivity by encouraging positive interconnections ('symbioses') within the farm.

Photo credit:
Farmer Max

The enabling role of design and technology: empowering food designers to support healthy diets

A number of recent studies have highlighted the criticality of shifting dietary habits for achieving a food system that enhances human health and operates within planetary boundaries.[16,17,18] A key ingredient for such a diet is variety, but this can often reduce as a food system becomes more industrialised.[19] Using a more diverse palette of ingredients benefits both human and planetary health, by providing an array of nutrients to avoid malnutrition; and because crop diversity supports soil health and biodiversity. Due to its range of different cultures as well as climate and geology, Africa already has a high level of ingredient diversity, a good proxy for a high-quality diet. A 2018 University of Cambridge research paper, that looked at diet quality around the world, ranked a number of West African country diets higher even than Japan or the Nordic countries.[20]

As African countries become urbanised and their citizens more affluent, a big challenge will be to decouple growing wealth with the increased consumption of fatty, ultra-processed food, which leads to a number of diet-related diseases such as type 2 diabetes.[21] African countries could avoid the diet-related health crisis that many countries around the world are currently having to address[22] by empowering ingredient suppliers, chefs, and other 'food designers' to be innovative in the processing and marketing of indigenous foods and thus preserve diversity and flavours in the supply chain. Such an approach would not only protect the health of citizens but also elevate the profile of African cuisines around the world.

Digital and other technology

Emerging technology innovations have the potential to enable more circularity in Africa's food systems, for example by increasing supply chain efficiency, boosting farm productivity, and even improving citizen's nutrition. Examples include:

- Renewable energy production systems such as anaerobic digesters, solar irrigation, or drying systems
- Innovative growing systems such as hydroponics, aquaponics, or vertical farms
- Mobile or digital platforms or supply chains that create better connections between producers and consumers
- Digitally enabled business models to facilitate equipment sharing or on-demand services

Alongside increasing effective resource use, emerging technologies can also reduce labour burden and make farming and food livelihoods more attractive to young people, reversing the demographic trends of an increasingly aging farming population.

The diffusion of technology in Africa's food and agricultural sector, like elsewhere, should be viewed as one component of a broader range of solutions, and in due consideration of the socio-economic context. Technology that succeeds in one context, can often fail in another, for example if there is not adequate knowledge or infrastructure to support it.

Case study

How to run a profitable 1-acre farm

Photo credit:
Emma Naluyima

An innovative farmer in Uganda has taken a circular approach to the layout and operation of her farm that has allowed her family and the surrounding environment to thrive despite the small size of her farm.

Emma Naluyima has divided her farm into four distinct zones, with many different plant and animal species supporting each other, emulating a healthy natural ecosystem. In one zone pigs are bred and their waste is used to grow insect larvae which is used to feed chickens and fish. The pig waste is further broken down by worms, which is used as fertiliser for the matoke (green bananas) – a local staple. In a different zone, cattle are raised – their waste is directed to an anaerobic digester, producing smokeless cooking gas and soil-enhancing digestate for the matoke plantation. In another zone, Emma has embraced technology, operating an aquaponics system to grow tilapia and tomatoes, as well as a hydroponics system that produced fodder for her livestock in only six days.

By taking a system approach and encouraging positive connections between zones, Emma benefits from multiple revenue streams as well as significant reductions in feed, fertiliser, and energy costs. Her farm has demonstrated that it is possible to be highly productive on a small plot, through encouraging a rich biodiversity and providing an inspirational and profitable example that other smallholder farmers could follow.

Case study

Twelve million little helpers

Photo credit:
Chanzi

Chanzi, a start-up based in Tanzania, sources food waste from farms and businesses, and uses black soldier fly larvae to convert this waste into insect feed for fish and poultry farms, and organic fertilisers to support healthy crop growing. For USD 1,000 of organic waste costs, revenues of USD 3,300 in insect feed and USD 700 in organic fertiliser are generated.

Chanzi's facilities are designed to be built and operated using local materials and equipment, meaning much lower capital costs and reduced construction times compared to other insect production systems. This makes them very cost competitive, with feed costs 25–40% lower than conventional fish meal and soya. The health and rate of growth of livestock fed on insect feed is also improved. Each Chanzi facility uses millions of larvae, generates over 20 full time jobs, processes 18,000kg of organic waste per day, converting it into 1,000kg of animal feed and 2,000kg of organic fertiliser.

The most important beneficiary of Chanzi's system could be the environment. The current linear animal feed industry is massively inefficient and nature-degrading. The production of fish feed impacts marine food chains and generates significant carbon emissions as boats have to travel further and further. Growing insects on waste brings feed production closer to consumption centres, and the by-products can help regenerate soils.

Endnotes

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