Rethinking food production

Opportunities and barriers for circular agriculture

This is an executive summary of the article 'Opportunities and barriers for Circular Agriculture'. The article was published as part of the synthesis study of the Food & Business Research programme led by **Daniëlle de Winter** and **Ellen Lammers**.

Global agriculture is facing a major challenge: feeding a growing world population while keeping its footprint within planetary boundaries. Those seeking solutions to restructure our food system are looking for answers to some challenging questions: How can we combine technological innovation while maintaining -or even enhancing- our ecological values? How can we improve agricultural efficiency to feed a growing population without damaging the environment or raising production costs? And, are there ways to combat or mitigate the climate change impacts that affect the reliability of our harvests? Circular agriculture can provide answers to some of these questions. Yet, there is no blueprint to adopting such an approach. A collective pursuit by farmers, citizens, businesses, researchers and policymakers is needed to find the right combination of technological, ecological, social and economic principles.

Circular agriculture is an ecological concept based on the principle of optimising the use of all biomass. Circular agriculture aims at closing the loop of materials and substances, and reducing both resource use and discharges into the environment.

(Berkum 2019)

Key Question 1: How can we preserve and enhance our natural resources?

To manage our natural resources in a sustainable way, it is becoming increasingly important to capitalise on natural processes and services that are innate to the ecosystem so that we can reduce non-renewable or hazardous inputs. These processes and services include the inherent capacity of ecosystems to deal with pests, diseases and weeds, to maintain soil functions, and to improve resilience against unfavourable weather conditions.

The synthesis study showed that a variety of circular approaches can achieve such a robust ecosystem,

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while providing promising results in terms of productivity and nutritional value. Innovations were introduced and tested with (new) crops or plants that tolerate particular harsh weather conditions or that have the natural capability of giving life back to formerly depleted soils (*Acacia saligna* in Ethiopia). Other research focused on treating crop pests and soil-borne diseases without using chemicals and succeeded in producing higher yields and thus higher income for smallholder farmers (tomato production in Kenya). Finally, systems were introduced that focused on the regenerative capabilities of nature by carefully exploring how different components of the system interact. A system was developed that tested how fish feed and fish waste interacted with aquatic life in fish ponds in order to reduce disease outbreaks and lower the need for inputs (shrimp farms in Viet Nam). Each of these circular approaches comes with its own set of challenges, such as a lack of capacity, risk-averse attitudes of farmers, and a lack of trust in the unfamiliar. A common challenge for smallholders across the projects is limited access to knowledge of tried-and-tested circular approaches.

Key Question 2: Is it possible to use resources more efficiently?

An ecosystem is most efficient when it nurtures a dynamic cycle of nutrients, energy and water. The circular hypothesis is that the more self-reliant and efficiently the natural system can function, the higher its potential to produce stable yields at lower costs in a more environmentally sustainable way.

WOTRO-funded research projects have tested this premise for both livestock and crops. In Brazil, ongoing research shows that context-specific breeding programmes can potentially improve productivity at a lower cost. Another approach involved the introduction of species that have higher resource use efficiency. For example, the Black Soldier Fly proves to be a promising alternative in animal and fish feed, as it has shown to enhance the growth rate of fish in less time and at lower costs compared to standard feed. Projects have also shown how 'closing the nutrient loop' can work effectively, as in the case of aquaponics approaches in Ethiopia. There, a symbiosis is created between fish breeding, soil fertility and crop growth in a closed system that shows potential for application in urban areas and drought-prone regions. However, scaling the technical know-how of such technologies and processes beyond the field test farms and their direct beneficiaries comes at a cost. Government support is indispensable if wide-scale adoption is the goal.

Key Question 3: How can we add value to waste?

Waste is the new gold. At least, that is a growing belief among supporters of a circular economy and a circular food system. In a world faced with growing food shortages, it does not make economic sense to accept the high losses that mainstream food systems suffer at practically all stages of the value chain, from harvesting, to processing and consumption. Circular agriculture principles move away from the 'take-produce-consume-discard' model and seek to create a system that builds on the 3Rs: reuse, recycle and reduce of existing or used materials and products.

The synthesis study showed how waste streams can be turned into valuable resources in LMICs, when appropriately managed and if commercial and public institutions provide the necessary logistical support and investments. A Ghanaian research team pioneered the possibilities of valorising organic waste collected at local markets by turning it into compost (youth waste collection and composting in Ghana). Interestingly, another project has shown that organic waste can even be upgraded to a higher protein content. By feeding organic waste to Black Soldier Flies, smallholders can create a more efficient and affordable fishmeal or animal feed for their livestock (BSF in Kenya). Even human waste has seen repurposing in Bangladesh, where urine is collected and converted into valuable and perhaps more importantly, affordable, organic fertilisers (manure as fertilizer component in Bangladesh). For waste to become financially valuable, further streamlining of technologies needs to happen, together with efficient organisation of the separation and collection of waste streams, greater market demand and cultural acceptance of seeing waste as a valuable product. However, there is also a potential downside to the increasing economic value of waste, as this might limit the opportunities for smallholders and poor and marginalised groups who traditionally often make good use of waste streams as a cheap resource for their agri-businesses.

How can we make it all happen?

The research shows that there are trade-offs to be accounted for when applying circular approaches to agricultural practices. The key question is who will benefit from these circular processes? Can we expect smallholders to make similar investments in time and knowledge as larger commercial farmers?

The findings emphasise that context-specific results cannot be expected to apply to the realities of farmers across the board. Circular practices should not be promoted blindly, as they can lead to unmanageable increases in workload, especially when the food system does not yet support the new approaches. Such support might entail the need for product quality guarantees through certification and guaranteed commercial offset and market demand. Supportive government regulations and by-laws are also required to enable necessary logistical or infrastructural changes that allow new circular approaches to be introduced at scale. Above all, in LMICs the new technologies, markets and products that circularity introduces need to be accessible, affordable, and culturally acceptable to the small-holders and marginalised consumers it seeks to serve.

Weblinks

- Full article 'Opportunities and barriers for Circular Agriculture'
- Food & Business Research programme
- Food & Business Global Challenges Programme project overview
- Food & Business Applied Research Fund project overview
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The Food & Business Research (F&BR) programme aims at addressing persistent food security challenges in low and middle income countries. A total of 75 projects have been funded under two instruments:

- The Global Challenges Programme (GCP), which promotes research-based advanced understanding of emerging key issues in global and regional food security and their impact on local food security and the role of private sector development.
- The Applied Research Fund (ARF), which promotes research-supported innovations that contribute to food security and private sector development in the partner countries of Dutch development cooperation.

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