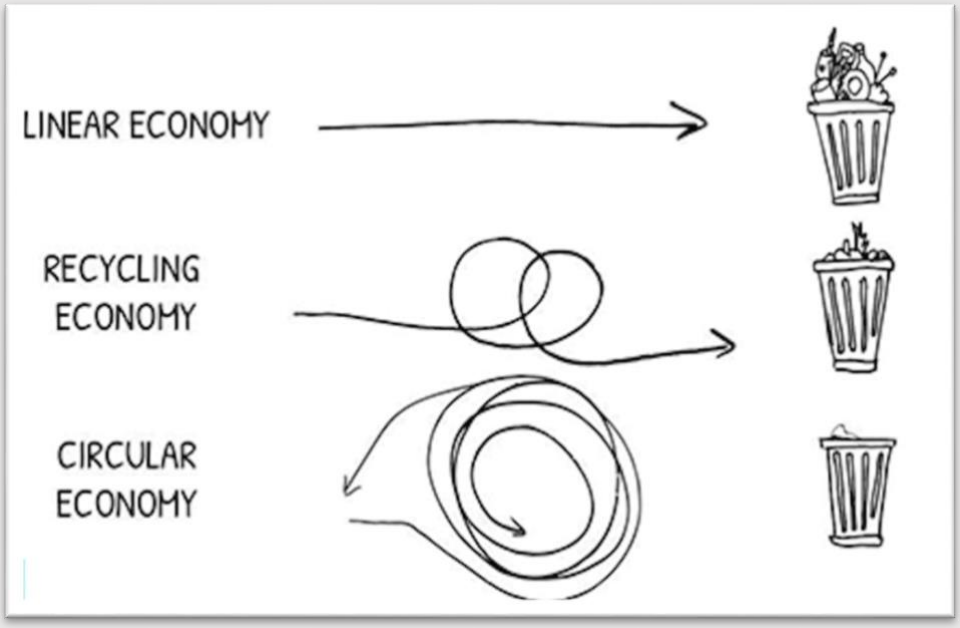
Towards circular food production systems in East Africa

What are the barriers, drivers, and solutions to implement a circular economy in the agricultural sector in East Africa in order to meet the challenges of the Sustainable Developments Goals (SDGs) 2, 12 and 13?



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Abstract

The African continent is under great pressure to solve the increasing need for food security due to an explosive increase in the population combined with additional challenges from climate change. Furthermore, with the current linear system that is focused on 'take-make-dispose', agricultural emissions are even increasing and contributing further to climate change. Taking these concerns seriously, the agricultural sector should be completely re-designed in a way that it will fulfill the demand of food security in a sustainable manner, while it enhances waste valorization to reduce waste accumulation towards sustainable environmental development.

An alternative to the linear system is a circular economy which seeks to close the loop of resources through the establishment of restorative and regenerative systems. The circular economy is a new concept, which acknowledges that there is limited academic research available, especially in its implementation in agriculture in East Africa. Some studies provide six different typologies of determinants towards the circular economy, namely technical, financial/market, institutional/regulatory, organizational, social/cultural, and environmental determinants. However, there is a lack of understanding of how these determinants are relevant and applied in the circular economy of agriculture in East Africa.

Therefore, this research aims to identify and understand the 'barriers, drivers and solutions to implement a circular economy in the agricultural sector in East Africa with the intention to meet the challenges of the Sustainable Developments Goals (SDGs) 2 (food security), 12 (sustainable consumption and production patterns) and 13 (climate change actions)'. This research intends to provide an in-depth understanding of circular economy determinant(s) and solutions that are relevant and apply to agriculture in East Africa.

This research seeks to cover the 'formal' and the 'informal' agriculture sectors in East Africa. Since this research covers two different target groups with significantly different educational backgrounds and business professionalism, the research approach uses mixed data which can be considered as complementary. Therefore, this research applies two different methods including interactive field observation and a formal survey in multiple East African countries. First, an interactive field observation with a guiding questionnaire was conducted in Rwanda mainly focused on the actors of the 'informal' cassava value chain, which includes input suppliers, farmers, collectors, processors and retailers. The interactive field observations sought to determine the implementation status of the circular economy in

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the ‘informal agricultural sector’ in Rwanda. Furthermore, the implementation barriers of circular economy are identified in the field. Secondly, a survey is conducted with ‘formal’ agricultural circular and non-circular companies in East Africa, which includes medium to large scale input suppliers, farmers, and agro-processors. The survey has the objective to identify which determinants and interventions are relevant to accelerate the transition towards a circular agriculture in three different countries in East Africa, namely Rwanda, Tanzania and Kenya. The analysis of the interactive field observations of the ‘informal agricultural’ follows a matching-pattern method to identify circular economy principles and barriers, in which a theoretical framework is utilized to map empirical patterns. Furthermore, coding strategies are used the analyze open questions of the questionnaire of the interactive observations, while closed questions are presented in percentages in tables and charts. A similar strategy is used for the survey, although the survey mostly analyzed the data by percentages in tables and charts.

Conclusions

The circular economy concept rests on three principles: design out waste, keep products and materials in use (re-use and recycle), and regenerate natural systems. Research findings have shown that some circular economy practices are already implemented in Rwanda’s food production system.

A circular economy in agriculture in East Africa is mostly visibly implemented by using organic waste of compost as fertilizer. In addition, farmers use organic waste residues of processing activities as animal feed. The technique to store, collect and separate different crops and waste materials is applied by the reuse of containers, baskets and equipment by different actors. Recycling practices are applied by using agricultural bags and jerry cans in daily agricultural activities. Input suppliers recycle old papers into paper bags for selling products to consumers. It is rare that respondents surveyed reported the use of renewable resources in their business activities, such as the use of solar lights or the use of waste to generate energy. Consequently, a circular economy in agriculture in Rwanda is mostly focused on the first (design out waste) and second principle (keep products and materials in use) based on the circular economy principles.

About 37.5 percent of all respondents of the ‘informal sector’ already work together with other actors in the food value chain related to their waste, especially towards organic

waste. Collaborations related to waste are mostly seen by input suppliers and retailers providing waste for free to customers, informal waste collectors and processors selling (organic) waste to farmers and recyclers (e.g. waste of processing activities is sold to farmers), or use of organic waste by actors themselves as compost or as animal feed.

Despite the circular economy practices in place, there is still great potential for further improvements. Improvements in the use of circular economy practices suggested by the actors of the surveys and interviews include the use of compost or human waste as natural fertilizers to increase the yield. Furthermore, actors of the informal sector suggest the potentials of gathering dumped waste of the village or (organic) waste from the farmers together including manure to produce compost. In addition, processors stress that they could process organic waste into animal feed or other respondents stress that they could sell organic waste of their business activities as animal feed.

This research has uncovered that circular economy practices are also applied in the 'formal agricultural sector' in East Africa. It can be concluded of the results that a circular economy in the 'formal sector agricultural sector' in East Africa is implemented at higher level, since 81 percent of the actors work together with other parties related to their waste versus 37.5 percent of the respondents of the 'informal agricultural sector' in Rwanda. In contrast to the 'informal sector' circular economy collaborations in the 'formal sector' are more focused on active waste collection as input of new business activities rather than selling or providing waste for free.

Furthermore, the survey from the 'formal agricultural sector' show that a significant number of actors are not only focused on the utilization of organic waste as compost and animal feed (first principle) and the re-use and recycling of materials (second principle), but also have implemented or plan to implement circular economy practices through regenerative farming. For instance, some actors implement aquaponics, agroforestry or multi-species systems, which is the third circular economy principle. About 81 percent of the respondents have 'some form' of a circular economy business model that applies in-house circularity, work with companies related to residues or the actors' company produce circular innovations. For example, in-house circularity is applied through the use of organic waste as compost or energy for an actor's own company, while other companies produce a circular economy product at commercial scale (e.g. compost or insect-based animal feed). Despite the existing circular economy practices in place, there is still great potential for further improvements.

The identified barriers of implementing a circular food system in Rwanda are found to be in all of the six typologies of determinants. For instance, there is a great lack of technical support, since only 9 percent of the respondents receive support from government institutions or development agencies to enhance their business activities through training, information or technologies. However, all actors report receiving technical support that is not related to circular economy practices. This can also be explained by the fact that farmers stated their lack of knowledge of organic waste to produce high-quality compost. Furthermore, there is a lack of understanding and awareness about the term "recycling" by the respondents. Many respondents even stressed, that it was their first time that they are approached to discuss waste and recycling topics. This indicates that there is a lack of awareness about the circular economy concept and it's potential. Other implementation barriers include the current limited financial support, since only 37.5 percent of the actors receive financial support which makes it even more challenging to invest in implementing circular economy practices through purchases of technologies and required equipment. There is an acute lack of financial support for farmers and collectors. Furthermore, there are very few existing policy frameworks related to waste management, recycling or renewable resources. In addition, there is an institutional barrier towards the lack of support in interconnecting actors for circular economy practices. Moreover, there are almost no community activities related to organic waste-management, recycling or the use of renewable resources, since only 5 percent of all actors are impacted by communities that are related to a circular economy. The current community activities are mostly focused on gathering plastics, hygiene and construction of the roads. Other relevant implementation barriers include the influence of the seasons in the quantity of organic waste and the need for animal feed during raining seasons. Further, transport barriers play a role since the transport of organic waste or manure can be challenging given limited transportation options.

This study has uncovered that the identified barriers of the implementation of 'formal' circular food systems in East Africa can be found in all of the six typologies of determinants, which is similar to the 'informal sector'. Although, it can be concluded from the research findings that the 'formal agriculture sector' in East Africa has significant more access to technical, financial and institutional support in interconnecting actors for circular economy practices than the 'informal sector'. Furthermore, the 'formal' sector is more affected by policies and regulations related to circular economy practices than the 'informal' sector in

Rwanda. Therefore, it could be suggested from the research findings that the 'informal agricultural sector' faces higher barriers towards the implementation of circular economy in the agricultural sector than the 'formal agricultural sector', which can be explained in part by the differences in the level of education of the various actors.

The most important implementation barriers toward circular 'formal' food systems in East Africa include the lack of skilled workers, technical support and knowledge, large capital requirements, and high initial cost to establish a circular economy business model. Other important implementation barriers include the current implementation and enforcement failures related to waste, recycling and renewable energy, which is line with the barrier of the lack of proper waste collection and separation infrastructure/insufficient goods. Furthermore, the respondents also mentioned other barriers such as long administrative procedures to register circular economy innovations for circular food systems and the lack of alternatives for plastics after the introduction of bans for certain types of plastics, which hampers agro-processors in their business activities.

Policy implications

Since the research findings suggest that there is a lack of appropriate policy frameworks and proper interventions related to waste, recycling and renewable resources in the agricultural sector in East Africa, there is a great potential for possible interventions.

Similar to the implementation barriers, solutions are found in all six typologies that are described in the existing literature. It is suggested that the most important technical solutions are in encouraging, incentivizing, and establishing pilot projects in companies; collaboration platforms in order to share knowledge and solutions e.g. through public-private partnerships'; and facilitation of research to develop and improve (new) technologies and business practices through research experiments locations and research budget. Furthermore, training for professionals that work in or around agriculture circular economy concepts and circular food systems and other technical solutions are highly valued. The need for training about value addition to waste and circular economy practices is also stressed by the 'informal sector'. Other significant important solutions include initiation of industry collaboration platforms (industrial symbioses programmes) that have the purpose to develop cooperation in an industry where unused or residual resources are used by another; business competitions; and business support schemes to support circular business initiatives. Consequently, there is a

need for budgets of the public sector to invest in circular economy activities; to introduce fiscal instruments to encourage circular activities; to improve waste collection infrastructure; and institutional and regulatory framework with common ambition towards a circular economy'.

In conclusion, a holistic approach is needed that combines technical, financial/market, institutional/regulatory, social/cultural solutions, which could be done through and circular economy institution with a national fund for circular economy initiatives. Solutions should include all six typologies of the determinants, since solutions can be found in all typologies. Circular economy is an approach that requires a common ambition of the government, private sector and research institutions. In order to establish a circular food system there is a need for central coordination within the government to achieve a successful transition. Therefore, this study concludes that there is a need for national programs for circular food systems and circular economy-focused institutions.

It is suggested that national programs for circular food systems should implement the following interventions:

- Establish industry and collaboration platforms to share knowledge and solutions. For example, public-private partnerships between universities, knowledge institutions, and government in order to support research questions of the private sector. In addition, a national program should facilitate private sector cooperation where unused or residual resources of one company can be used by another company. These collaborations can either be achieved at (cross) value or at industry level.
- Support research programmes and pilot projects for companies. In East Africa the circular economy is an approach that is not studied in-depth. Research should focus on the design and improvement of technologies and business practices through research experiments. In order to test and improve circular technologies and business practices, there is a need for pilot projects inside companies.
- Financial support for new businesses, industry initiatives and test pilot projects in companies through a special fund. A circular economy focused investment fund could also encourage companies to develop circular food systems initiatives by organizing business competitions.

- Introduce fiscal instruments (VAT) to encourage companies to develop circular business activities rather than taxes that discourage non-circular economy activities in lieu of waste or other social externalities. This is especially important since not all non-circular economy companies have immediate access to knowledge, technologies and resources to implement circular economy activities.
- Improve and enforce waste collection and separation infrastructure, since there is a lack of separation at the source, during transportation and handling of the waste. An improved waste collection infrastructure results in greater potentials to add value to waste and remove costs for circular business models.

National programs for circular food systems should consider the difference between the 'informal' and 'formal' agricultural sector in East Africa especially since the 'informal' sector face significantly higher barriers to achieve a successful transition.

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