Innovative circular economy and agribusiness models for enhancing sustainability and efficiency in Kenya's agri-food sector: Lessons from Germany

Ibrahim Macharia

Kenyatta University, Agribusiness and Trade, Kenya

Abstract

Kenya's food system faces numerous issues, including food insecurity, post-harvest losses, inefficient resource utilisation, and climate change. This study looks into innovative, cost-effective circular economy and agribusiness ideas from Germany's agrifood sector and evaluates their applicability in Kenya. A mixed-methods approach was used, including a comprehensive literature review, 45 key informant interviews, 16 case study analyses, 20 structured surveys, field observations, expert consultations and stakeholder workshops.

The study analysed key circular economy and agribusiness models

The findings show that biogas production from agricultural waste decreased farm energy expenses by 43 %, while solar dryers cut post-harvest losses by 67 %. Precision agriculture increased crop yields by 86 % while optimising resource consumption. Food rescue systems successfully repurposed 36 % of extra food. Closed-loop supply chains reduced packaging waste by 98 %. Aquaponic systems, which combine fish and vegetable production, used 92 % less water and had a 78 % nutrient recycling efficiency, resulting in 34 % higher yields than soil-based systems. Solar-powered cold storage reduced post-harvest losses for perishable items by 55 %, prolonging shelf life and enhancing market access. Blockchain-based traceability systems improved transparency and trust in value chains, reducing fraud and post-harvest losses. Contract farming models ensured stable markets and price security for smallholder farmers. Digital agricultural platforms provided farmers with real-time data on market prices, weather forecasts, and agronomic practices, improving productivity and profitability. Organised cooperatives in improved value chain efficiency and smallholder resilience, as seen in Germany's BayWa AG model. While the initial investment expenditures and training for these technologies remain a barrier, the long-term advantages make them economically viable in Kenya. Multi-stakeholder engagement, targeted policy assistance, infrastructure investment, and farmer training programmes are all required for successful implementation. The study offers pilot projects, policy frameworks, public-private partnerships, and capacity-building initiatives to help these models adapt and scale in Kenya's agrifood sector.

Keywords: Agribusiness models, agricultural innovation, aquaponics, blockchain traceability, circular-economy, food security, Germany, Kenya, post-harvest loss

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Contact Address: Ibrahim Macharia, Kenyatta University, Agribusiness and Trade, Thika Road, 254 Nairobi, Kenya, e-mail: macharia.ibrahim@ku.ac.ke