A Circular Bioeconomy for the Kenyan Dairy Sector
VALORISE

A collaborative research project

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Food loss and waste in perspective

Global food system is single largest driver of environmental change

- 24% of GHGs (and increasing)
- 70% of blue water
- 60% of biodiversity since 19070s

2 billion people are still food insecure

24% of calories produced for humans are lost or wasted in the supply chain

FLW represents 3.3 billion tons of GHGs (8%) - the 3rd largest emitting 'country' in the world

New World Bank report with lots of facts on FLW

Environmental impact of food loss and waste

Food loss and waste is responsible for about **8%** of global **greenhouse gas (GHG) emissions**

Volume of **water** used to produce lost or wasted food is equivalent to three times the volume of **Lake Geneva**

Nearly **30%** of the world's **agricultural land** is currently occupied to produce food that is ultimately never consumed

If food use and **distribution** is better managed, **14%** of all **GHG emissions** from **agriculture** could be avoided by 2050

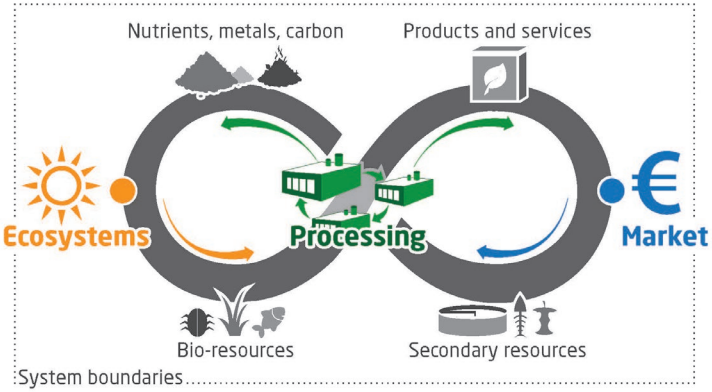
Source: https://twitter.com/faostatistics/status/920548825374298112

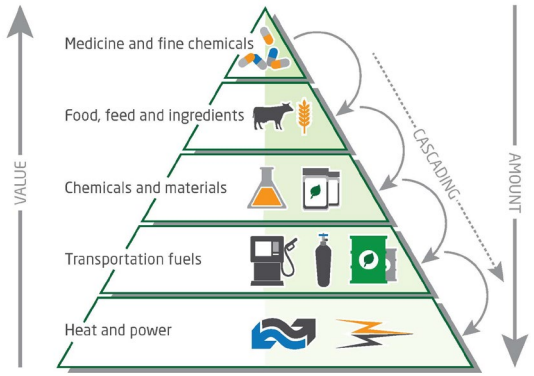
Circular bioeconomy in the food processing industry

Food-processing accounts for **39% of total materials lost** in the food and agriculture sector.

CBE is based on biobased circular models that **take advantage of organic waste and sidestreams** as a **bio-feedstock** and convert this biomass into products for various uses such as food, feed, fibres, bioenergy and industrial raw materials, **adding value** in the process.

CBE builds on the circular economy principles of the **hierarchy of resource use** - from prevention and reuse to recycling, recovery and disposal.





Our project and the partners

Research question: How can experimentation and application of CBE principles in food-processing in LMICs be understood as the result of the interaction of institutional, economic, biophysical and technical factors?

Approach: Study the valorisation pathways for sidestreams in the Kenyan dairy industry - from less to more demanding pathways

Key premise: Dairy firms are central value-chain actors and leverage points for sector-wide CBE development in LMICs.

Theory: Broad **innovation study** approach, focusing on the causal properties of firms to innovative and diversify their businesses. Other theories - **innovation systems**, **value chain studies**, **material flow analysis,** and **food technology** - to examine the specific factors affecting valorisation.

Circular bioeconomy in the Kenyan dairy sector

Kenyan dairies processes 634 million litres of milk contributing 14% of agricultural GDP and 4% of national GDP

Consumption of dairy products is 110+ litres per person and will double by 2030

Increase in **processed products** - e.g. yoghurt and cheese - that produce valuable **sidestreams** (whey) that are not valorised today

'**Lost milk**' due to substandard quality is a major sidestream - informal value-added

Modern dairy factory in Kenya

Sidestream valorisation pathways in Kenyan dairy

Prevention: **Reducing biomass (milk) waste** as the least demanding pathway.

The focus here is on reducing the amount of milk that is discarded or lost due to inefficient transport, storage and processing, including milk rejected at the gate due to low quality or glut situations. In Kenya, post-harvest losses in smallholder dairy are around 27%.

Reuse/cycle: **Processing spoilt milk, whey and other sidestreams into animal feed**:

- for dairy cows/calves, thereby increasing milk yield, farm profits, and resource efficiency
- for pigs and chickens, which utilise proteins better than cattle.

Reuse/cycle: **Processing surplus milk and whey into food ingredients** using advanced **filtering and separation technologies** (e.g. separation of proteins from lactose) and complying with high **hygienic standards** as the most demanding pathway. Less demanding products include butter flavour, potable alcohol and sweet sugars, as well as fermented dairy products.

Project research activities

Develop an **analytical framework** that integrates biophysical, technical, economic and institutional factors to understand dairy bioeconomy transitions in LMICs (WP1 and WP3)

Map key actors, activities and institutions in the dairy value chain and innovation system with a focus on sidestreams (WP1)

Analyse the flows, volume, quality and spatial distribution of dairy sidestreams and estimate the volumes available for circular utilisation (WP2)

Review relevant technical solutions and products that can match the current and future needs of a dairy CBE in LMICs (WP2)

Analyse the incentives and opportunities (capabilities), the **institutional context** and **business models** that enable dairy firms to innovate and apply biocircular principles (WP3)

Explore **future scenarios** for a dairy bioeconomy development through stakeholder engagement (WP4)

Project main outcomes

Improved knowledge of the characteristics, significance and distribution of **dairy sidestreams and of assessing dairy resource flows** in a LMIC context.

Understanding and application of the appropriate **technologies, products and business models** for valorising biomass sidestreams in the Kenyan dairy industry

Understanding the **relationship** between **firms' incentives and opportunities to innovate**, unstable and emerging **markets**, and a **regulatory set-up** with an emerging focus on food-processing, safety, and waste reduction.

Refined **methods for stakeholder scenario-building** will be applied to CBE in LMICs.

Increased **public awareness** of dairy CBE potentials and challenges in LMICs.

Increased **knowledge and capacity** in research, industry and government.