



Integrated mushroom, biogas and bio-fertilizer production from coffee and sisal processing waste innovations

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## Background

As African countries strive to shift from primarily agrarian economies to industrial-based bio-economies as the engine for growth, underpinned by value addition, environmental management will be key for sustainable development. The eastern African region generates huge amounts of agro-waste from agricultural activities that are typically underutilized, untreated and in most cases disposed-off in environmentally unfriendly manner that contribute to the emission of greenhouse gases (GHG) and consequently climate change. Bio-refining of waste biomass involving the integrated production of chemicals, bio-energy and other value added products is a potential alternative for adding value to this waste as a bio-resource.

The coffee and sisal industries for example contribute significantly to the agricultural sector in the eastern African region but also generate huge tonnage of agricultural waste annually. For example only 2% of the sisal plant is converted to sisal fibre with the rest of the plant considered waste. In the case of coffee, 99% of the biomass generated by the coffee plant is discarded at various stages of processing from harvest to consumption. Innovative technologies are therefore necessary to not only manage the disposal of the agricultural biomass but add value to produce products such as food, feed, bioenergy, bio-fertilizer and other bio-based products.

## The Project goal

This consortium aims at demonstrating and pilot-testing an integrated approach that combines the production of edible mushrooms,



biogas and its conversion to electricity, and bio-fertilizer from sisal and coffee waste in collaboration with the industrial partners in Kenya, Ethiopia and Tanzania. More specifically the project will:

- 1 establish technologies for integration of mushroom cultivation with biogas production from coffee and sisal processing and sisal post-harvest waste
- 2 evaluate techno-economic feasibility of the developed technologies
- 3 assess the fertilizer value of the biogas manure
- 4 disseminate the results of the established technologies

## The Innovation

Integrated approach for utilizing sisal and coffee waste that combines oyster mushroom production, biogas and electricity generation and bio-fertilizer production.



*“Kilifi Plantations Limited fully supports the partnership with project 4 as it offers opportunities for more efficient land use while finding alternative use of sisal waste in an environmentally sustainable way. The waste generated from the sisal decorticating process is used to generate biogas. The biogas generated is converted to electricity to augment the energy needs for the farm. The growing and production of the mushrooms is envisaged to add another revenue stream to our operations and create more employment opportunities.”* **Betty Bundotich** *Banana Investments Limited*

### **Achievements**

- i Auditing and characterization of sisal and coffee waste completed.
- ii Process and protocol for oyster mushroom production from saline sisal decortication, sisal boles and coffee processing waste developed.
- iii Process and protocols for biogas production from spent mushroom substrates of coffee and sisal post-harvest waste developed.
- iv A license for approval of the waste treatment pilot by the environmental regulatory authority issued in Kenya.
- v A comprehensive idea feasibility and pre-techno-economic analysis for the technologies.

### **Future Prospects**

Once the pilot-testing is optimized and feasibility and techno-economic analysis conducted to evaluate the business viability of the innovations, the next step will be to disseminate the innovations to industrial stakeholders in the region generating similar waste. This will be followed by up-scaling of technologies in partnership with interested industrial partners to fully manage their waste and convert it into value added products that not only impact their profitability but also solve an environmental problem.

### **Participating Countries, institutions and organizations**

#### **Research organizations**

- University of Dar es Salaam (UDSM), Tanzania
- Addis Ababa University (AAU), Ethiopia
- Pwani University College (PUC), Kenya
- Brandenburg University of Technology, and Germany
- Technical University of Denmark

#### **Private sector partners**

- Coffee Plantations Development Enterprise, Ethiopia
- Mohammed Enterprises Tanzania Ltd (Sisal Plantations), Tanzania
- Kilifi Plantations, Kenya





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