



Existing and Emerging Green Technology Solutions for Food waste Prevention In Uganda. 2021

Contents

Abstract.....	2
1 Role of Green Technology Solutions in Tackling Food Waste.....	4
2 How Green Technology Solutions have been used to prevent food waste in Uganda	5
3 Traditional and Ingenious technology used in Uganda to preventing food waste.....	7

4	New opportunities for green technology Solutions to drive transformational change in preventing food waste in Uganda	8
5	Challenges for up-take of Green technology solutions to prevent food waste in Uganda	11
6	Key Policy Considerations	12

Abstract

Communities around Uganda have been employing Green technologies for centuries in order to prolong their shelf life by using tradition and indigenous techniques. These tradition and indigenous techniques are reported have been Cost-free technology, Safe, Affordable, Reliable and effective way of saving food. The traditional and indigenous techniques include smoke coating, Sun drying of beans with covers, and roasting. Green and digital technologies are increasingly being used in Uganda to address food waste, including in storage, recycling and preservation. Aseptic packaging is widely used in the food and beverage industry to extend shelf life. Micro-cold transportation is used to provide cold chain solutions to small business holders. Hotels are using mobile phone applications (Jumia Foods and Glovo) to allow customers to pre-order their meals, helping hotels better predict or estimate food demand for a given day. Hotels are also using

QR code-based applications to allow customers to make orders directly to chefs. The 2020 lockdown due to the COVID-19 pandemic led to an expansion of urban farming (which now accounts for about 35% of food in Kampala). Urban farmers have embraced the use of improved varieties of vegetables with extended shelf life, which minimize food waste. With support from the European Union, KCCA launched the “Farm to Plate Virtual Market” (K-Smart Market, a digital mobile phone application) to facilitate urban farmers and food vendors to sell directly to consumers. This shortens the food supply chain and eliminates associated waste and loss. Middle- and high-income earners are increasingly using home appliances with micro-computers or digital controllers to minimize food waste in the kitchen and during storage. The inevitable food waste, such as fruit and vegetable peelings, can be converted to energy through waste-to-energy technologies. The Kampala City Abattoir, for example, uses blood, fat and carcass waste to generate biogas for electricity. There are also emerging projects in Kampala that are converting organic waste, including food waste, to produce briquettes for cooking and compost for urban farming. The storage unit is detachable and can be used in the local market by vendors to preserve their produce for up to five days.. Scaling up such technologies can open up new opportunities for preventing and reducing food waste by informal retailers who lose about 30% to 40% of food they stock for sale. Challenges have been identified for further uptake of such technologies, including poor infrastructure (transport, electricity, ICT), lack of tech design and productive capacity, and shortage of experienced professionals with technical skills to harness green technologies for food waste management

1 Background

This study is funded under the project Building Back Better; using Green and Digital Technologies to Reduce Food Waste at Consumer level. The project aims at contributing to the following Sustainable Development Goals (SDGs): SDG target 12.3 (halving food waste), SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Sustainable Consumption and Production), SDG 13 (Climate Action) and SDG 17 (Partnerships). It will also support countries in harnessing green and digital technologies to reduce food waste at consumer level; contribute to the attainment of the SDGs and climate goals; support countries in Building Back Better from the COVID-19 pandemic. This project brings together different knowledge groups of United Nations Environment Programme (UNEP) for an

integrated approach cutting across Economic and Trade Policy, Food and Food Waste, Consumer Information, Sustainable Lifestyles, and the International Resource Panel (IRP). This is combined with case studies of 5 cities in 5 regions, including: Doha (Qatar), Bogotá (Colombia), Belgrade (Serbia), Kampala (Uganda) and Bangkok (Thailand).

The objective of this report is to identify existing and emerging green technologies for preventing food waste in Uganda. For Purposes of this report green technology are products/goods or services whose application and use can conserve the natural resources and environment, and can curb the negative impacts of human activities. These identifies technologies that include, Efficient technologies, Low carbon technologies, Recovery Recycling technologies applied at food retail stage, in food service sector or household to prevent food waste, or repurpose food waste to keep it in food productive cycle.

2 Role of Green Technology Solutions in Tackling Food Waste

The food consumption market is already embracing digital innovation. Today, consumers are making use of smartphone applications to record purchases, monitor their consumption patterns and plan meals with tailored recipes. By installing smart reusable sensors for food containers, people can also track food freshness. Other examples include smart cameras for food storage organization and smart bins for waste classifications. One major benefit of digitalization is to make consumer waste traceable and measurable, thus allowing the problems to become visible. This in turn can help change behaviour. Together with artificial intelligence, producers and consumers alike would be equipped with information that far exceeds what traditional waste collection measurements and survey methods currently offer. The resulting quantity and quality of data also enables a market that goes beyond the dimensions around buying and selling food, fuelling the participation of multiple players connected to each other by data. In this multi-sided market, aggregated records of consumer waste can provide a clear reference within the food supply chain on future consumer preference. This is useful for companies when it comes to adjusting their business strategies. New business models based on such data have emerged, which in turn serve consumers. For instance, food takeout platforms have relied on food consumption data to come up

with such solutions as designing smaller dish portions to tackle food waste, while bringing cost savings and satisfaction to both sides. In addition, personalized cooking recipes are incentivizing a content creation market. By matching information of food surplus at businesses and home with charity schemes – such as food banks – food waste can be avoided, allowing more fairness in food distribution. Consumers can modify their behaviors for the promise of cost savings from better planning, attractive rewards, or improved purchasing experiences. Smart device or application developers can attract investment or profit by networking all stakeholders in the digital platform. Classifying waste one step closer to its source, the deployment of smart bins can bring life to waste management specialization, adding another dimension to the market. Such win-win solutions rely on an exponential growth of data on consumer food waste, which in turn could reinforce those emerging business models. Digital applications at the consumption level can have a profound implication for the agri-food value chain by redefining the meaning of consumer preference. Often, the market relies on data of transactions, such as the price and quantity of purchase to evaluate consumer preference and predict the demand. Without taking into consideration consumer waste, the market signal is incomplete and delayed – retailers and farmers maximize the profit by overselling a product in the short term while risk losing customer loyalty and causing wrong production plans in the long term. Overall, wasted food represents resources that ultimately exit the food supply chain and the loss is borne across the entire supply chain. Through real-time data collection – pooling of data from various dimensions such as the supply chain, transactions and domestic food waste – insights generated through artificial intelligence-fueled algorithms can help uncover hidden behavior patterns. This can redefine consumer preference with a new formula that sends timelier and more accurate signals to the market regarding demand. The value of information of food consumption after its purchase is the disruption potential associated with better consumer predictability for the food industry. It provides an opportunity to alter the business model from simply producing more to producing wisely tailored to the demand. This model contributes to food waste avoidance at the full value chain level.

3 How Green Technology Solutions have been used to prevent food waste in Uganda

Technologies have been widely used in Uganda to address food waste. The technologies applied in improved storage, food recycling and use of preservatives are as indicated below;

- i. Hotels are using mobile phone applications (Jumia Foods and Glovo) to allow customers to pre-order their meals. This enables the hotels to predict or estimate food demand for a given day. Hotels are also using QR Code based applications to allow customers make orders directly to chefs. This eliminates information flow distortion from Customer to waiters and then to the chef.
- ii. Piloting use of Farm to plate digital mobile application. Under urban farming, KCCA has developed and launched a mobile phone application (K-Smart Market) to support urban farmers sell directly to consumers thus eliminating food waste associated with middle men
- iii. Urban farming scattered around Kampala and its suburbs is growing. During the period of national lockdown in 2020 due to COVID 19 pandemic, urban farming contributed to around 35% of the food in Kampala City. The restriction in movement of people provided households more time to engage in growing of foods such as vegetables around their homes. The urban farmers have also embraced use of improved varieties of vegetables with extended or long shelf life which minimize food waste during storage.
- iv. Household's especially middle- and high-income earners are increasingly using home appliances with micro computers or digital controllers to allow automatic cooking and conditioned storages. This has minimized food waste in the kitchen and during storage.
- v. Aseptic packaging finds extensive use in the food and beverage industry, and its popularity is driven by the desire to achieve long/extend shelf life. In Uganda Aseptic packaging is widely used in dairy industry to produce long life which shelf life of about 90 days without conditioned storage.
- vi. Air tight grain bags-double layer bags consist of a gas-proof inner bag placed inside a much tougher open weave polypropylene (PP) bag for protection against physical damage. After filling they are tightly closed with a string. The bags are air-tight (hermetic) so that some weeks after being filled with grain and tightly closed, a modified atmosphere is created that will kill pests. The double bags usually have a capacity of 50 or 100kg. At least two types of double bags are available on the market. The application of these technologies have proved to have a life span of about 2-3 seasons or (1.5 years).

- vii. Improved varieties of food crops. With life science innovation in Uganda especially in fruits, retailers have opted to buy crops with quality properties like long shelf life. The retailers in fresh fruit market for example prefer to stock Open-field tomato with good transportation resistance and long shelf life.
- viii. There is increased use of micro-cold transportation that provides cold chain solutions to smallholders to Distribute products in stable conditions. These technologies are widely used in distribution of dairy products. Fruiti-Cycle designed, an electric motorized tricycle mounted with a refrigerated storage unit for conveniently distributing fresh fruits and vegetables, while reducing the 50% loses to 10%. Fruiti-Cycle, for example, uses manual peddling energy to generate electricity then converts it up to 50km/hr motorized system. This energy allows a famer to carry 5 times more produce (up to 300kg) every time than the current normal bicycles with 60kg carrying capacity. The energy also allows a farmer to reach far markets in a radius of 100km without getting exhausted unlike the normal bicycles that can only travel as far as 30km before a farmer gets very exhausted. Unlike other motor tricycles in the market, Fruiti-Cycle has a refrigerated storage unit which uses evaporative cooling system powered by solar to prolong the shelf-life of the produce during distribution and to reduce mechanical damages due to poor packaging. The storage unit is also detachable to be used within the market-by-market vendors to preserve their produce up to five days, significantly reducing the total post-harvest losses from 50% to only 10%

4 Traditional and Ingenious technology used in Uganda to preventing food waste

Communities around Uganda have been employing tradition and indigenous techniques for centuries in order to prolong their shelf life. These tradition and indigenous techniques are reported have provided cheaper in terms of time and labor, Cost-free technology, Safe, Affordable, Reliable and effective way of saving food and preventing it from being wasted or lost. However, nowadays Traditional and indigenous ways of preserving are not considered a priority after years of dependence on commercially produced high-yielding varieties and therefore have been largely ignored. The following technologies are reported to be use in a number of households in Uganda to prevent food waste.

- Smoke coating: This technique widely used in household is outskirts of Kampala to preserve food and preventing from being waste. Meat, fishing millet and sorghum seeds

tassels are cut, dried and smoked coated and simply hung in kitchen. Smoke produces a bitter taste, which deters pests.

- Sun drying of beans with covers leguminous beans such as cowpeas, beans and groundnuts are left with covers, stored in sacks, clay pots and drums and they last for one to two years.
- The Ankole people in western Uganda Chun milk in season of plenty into regular butter with a long shelf and doesn't require conditioned storage. Ghee from Ankole can last more than one year under room temperature storage.

5 Opportunities for green technology Solutions to drive transformational change in preventing food waste in Uganda

The food market is already embracing digital innovation. Today, consumers are making use of smartphone applications to record purchases, monitor their consumption patterns and plan meals with tailored recipes.

The government planning in Uganda is shifting towards evidence-based policy. For example, in the agriculture sector plan 2015/16-2019/20 the government allocated 19.43 billion to the development of an efficient food and Agriculture statistic system that is at concept level. The food waste online databases and hubs allows the possibility to support flow and exchange of information and give direction to government planning and policy development. For example, Rethink Food Waste through Economics and Data (ReFED) launched online the Innovator Database and the Policy Finder (ReFED 2018); Similar digital applications and platforms, for instance, in Uganda can allow food value chain players such as retailers, hotels and distributors to share information on shortcomings within the food value chain, including delays and unforeseen costs such as food waste due to load shedding, breakdown of vehicles due to poor road conditions. This information can then be used to demand improvements to infrastructure, help traders project demand, and provide more accurate data on food waste.

The food waste assessment in the informal food retailers shows that short self-life of fresh food produces accounts for about 34% of food waste in informal food retail markets. Technologies and innovations have been developed to extend shelf life of fresh produce ranging from packing innovations to bio technology. Mitsubishi, for example, has developed NutraSave, a resin that can be layered onto flexible packaging such as pouches and films to reduce oxygen absorption, thereby preserving. Innovations to postpone spoilage are emerging. Companies such as Nanology, FreshPaper, and Bluapple have started manufacturing discs and pods that go inside refrigerators or fruit bowls and absorb the gases that accelerate ripening, keeping fresh produce fresher for longer. In Uganda, Makerere University in Partnership with National Agriculture Research Organization project to extend shelf life of fresh cassava roots by Waxing and high relative humidity storage whose economic evaluation showed it was an economically viable technology. Technologies and innovations for extending product self-life can contribute to food waste that occurs in storage at household, food service sector and retail markets.

Apps for redistributing surplus food from food service and restaurants are becoming more widespread. Restaurants in Uganda are faced with challenges of unsold food, left overs or vegetables and fruits in storage which are close to end of life. The Food redistribution app provides hotels an opportunity to minimize costs associated with waste handling. Such Apps connect restaurants and food service companies with unsold or leftover food to customers who want. Globally food redistribution apps are emerging across the globe. No Food Waste, operating in India, rescues food from weddings, parties, and other functions and redistributes this food to the needy (No Food Waste 2019). Apps 11th Hour, operating in Singapore, and Too Good To Go, operating in nine European countries, enable customers to pick up meals that are near their expiry from restaurants and food stalls at a discount. Use of food redistribution apps is hindered by absence of standards and regulations for unsold food or leftovers.

The Small and Micro-conditioned technologies to reduce food waste during distribution of fresh produce are emerging. The China North machine has developed a tricycle with conditioned storages powered by rechargeable Lithium batteries which is ready for commercial scale. In Uganda, the Fruti-Cycle Project provides biogas-powered tricycles with cold storage units able to carry 300 kg the Low cost Micro-conditioned distribution technologies provides possibility to

allow the informal food retailers distribute with low investment and operating cost and minimum food waste generation.

Unsold produce is being turned into upcycled products. A growing number of start-ups are turning leftover produce into juices, soups, sauces, and other “upcycled” food products. For instance, 24-year-old Lawrence Okettayot is tackling food waste, Uganda, with his Sparky Dryer, an eco-friendly dehydrator built with steel and wood. The Sparky Dryer runs on biofuel and burns with zero-carbon emissions to dry fruits, vegetables, cereals and grains. One dryer costs 450,000 to 900,000 UGX (\$120 – \$240) and dehydrates foods five times faster than electric dryers and 10 times faster than open sun drying. The Sparky Dryer can dehydrates up to 100 kg of produce in five hours running on two kilograms of biofuel. Scaling up such technologies provides opportunity for the food sector especially the informal retailers who lose about 30 to 40% of food they stock for sale. There are further opportunities, especially with the government programme of agro-industrialization where provision can be made to establish standards and regulations of processing unsold food or food that is close to end of life.

Waste to energy innovations are emerge from the informal sector especially in Kampala slums often referred to as slum labs. One example from Kampala is the Luchacos cooperative, which uses organic waste to produce biomass briquettes – an energy source for cooking. Municipalities continuously fail to collect and manage waste, authorities tend to concentrate their efforts in areas with clear access routes. Informal settlements remain under-served or are not served at all. Waste to energy technologies provides opportunities to slum areas in Kampala to address the problem of uncollected waste by energy recovery which can provide clean cooking solutions. In Kampala, organic materials thrown away by residents include food waste, plant leaves and stems. The waste-to-energy technologies including biogas, briquettes, and pyrolysis technologies further provide an opportunity to recover energy from food waste collected by KCCA and waste handling company that end up in landfills.

Unplanned shopping and meal preparation are one of the major causes of food waste at household level. A number of mobile digital applications for food shopping and meal planning are available on google play store (Uganda version). Such applications include Weekly Meal Planner which allows users to take control of meal scheduling by adding recipe to the planner, to adjust portions,

reschedule meals and plan left over nights and track extra food portions in the freezers. This also includes a shopping list and food inventory tracker. Use of such digital applications is emerging and still limited to the people who read English and the data base lacks Uganda food recipes.

6 Challenges for up-take of Green technology solutions to prevent food waste in Uganda

Loss of other/alternative income: A major issue with Green technologies (e.g. cold supply chain and conditioned storage) require significant change in infrastructure and the informal sector looks at this as a threat, which is likely to keep them out of business. For example, conventional transporters fear of losing their jobs to multinational corporations that afford significant infrastructure changes required in cold chain fleets required in transport and distribution

Lack of experienced professionals: Universal transition from conventional technologies to green technologies requires the solid foundation of a skilled labor force. There is huge demand for skilled professionals to design, build, operate and maintain green technology infrastructure and system.

Incompetent technical professionals and lack of training institutes prevents green technologies from scaling new heights. There is a need to teach renewable energy courses and for proper training to be conducted to develop the skills required to install and green technology infrastructure. The shortage of trained workforce to design, finance, build, operate and maintain green technology infrastructure is considered a major obstacle to the wide penetration of green technology in reducing food waste

Government grants and subsidies: The amount of government subsidies provided to technologies at food production stage is much higher than the subsidies awarded to technologies at the food consumption stages. This keeps green technologies in reducing food waste at a disadvantage. The subsidies provided by governments to prevent food loss at the primary production is overshadowing the attention given to green technologies in reducing food waste at consumption stage.

Fewer financing institutions: green technology end users face severe difficulties in securing financing for projects. There are limited financial instruments and organizations for green technologies in reducing food waste. This being a new concept, such technologies are considered risky, thus demotivating investors.

Limited availability of infrastructure and facilities: There is limited availability of advanced technologies required for green technology (data base. Information servers, smart phone, and reliable grid), especially in developing countries, which acts as a factor preventing penetration of green technology. Even if this technology is available, the cost of procuring it is very high.

Lack of operation and maintenance culture: Since green technology is comparatively new and not optimally developed, there is a lack of knowledge about operation and maintenance. Efficiency cannot be achieved if such technologies not optimally operated and if maintenance is not carried out. Lack of availability of equipment, components and spare parts will require a substantial increase in the production costs, as these items need to be imported from other countries, therefore being procured at high prices and so increasing the overall cost

Limited research and development (R&D) capabilities: Investment in research and development (R&D) is insufficient to make green technologies commercially competitive. Both governments and private firms shy away from spending on R&D, the country largely depends on foreign developed technologies.

Technology complexities: There are not enough standards, procedures and guidelines in green technologies in terms of durability, reliability, performance, etc. This prevents green technologies from achieving large-scale commercialization. A major technical issue with green technologies especially digital technologies is standardized and reliable data to support decision marking

7 Key Policy Considerations

Despite the potential offer of green and digital technologies in reducing food waste their application is major limited in the formal sector and is still fragmented., business applications still seem to be fragmented. For any change to occur, systemic approaches involving all players along the value chain and the following policy option can be considered

- i. Introduce financial product lines in commercial and development banks focused on food waste reduction technologies and programs.
- ii. Make strategic investment by governments at the cross-sector level to address digital readiness, particularly in data based, cloud computing and data processing facilities, for data to flow as inputs for the market.

- iii. Put in incentives that would be needed for small and medium-sized players to have necessary data access and be equipped with data analysis and interpretation capacities.
- iv. They should enact laws to require players in value chain to share to share information on food waste generation and development regulations and standards for technologies that can repurpose or recycle food waste
- v. Insufficient institutional and organizational capacity has been identified as one of the key challenges to the development, transfer and uptake of green technologies. To tackle this challenge, countries often report the need to enhance efficiency in government procedures and processes and to foster capacity-building for government.
- vi. Promote research on green technologies and innovations for reducing food waste.
- vii. Establish appropriate financing mechanism Introduce “pay-as-you-go” programs to make technologies marketed to largescale commercial operations affordable for smallholder operations (e.g., for solar powered refrigeration units
- viii. Little is known about the economic social and environmental implication of food waste in Uganda. To address this awareness challenge. The government and civil society organization should put up effort to make the “business case” to motivate actors (so they see reducing food waste as in their self-interest) as well as the environmental and social impart that accrue from food waste.