The Second State of the 3Rs and Resource Circulation and Circular Economy in Asia and the Pacific

Thematic Sub-section:
Assessment of world cases and best practices on circular economy utilization of food waste
at
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Introduction

- Circular economy is usually seen with applications of principles acquired from natural systems: production out of waste, resilience through diversity, reapplication of renewable energy sources, systems thinking, and cascading flows of materials and energy (Jurgilevich, et al., 2016).

- Social benefits of circular economies for food include improve access to nutrition, supporting local communities, and creating value (Robertson-Fall, 2021).

Introduction

- A systemic vision that considers a holistic perspective of the diverse nature of the system and their relationships with other stakeholders is essential for the integration of sustainability into business models of food systems (Hamam, et al., 2021)
- Success criteria including deliberate interaction, formations of partnership, networking, and learning from many and diverse stakeholders are required to achieve a balanced system when it comes to obtaining stakeholder acceptance of circular economy (Hamam, et al., 2021)
- Furthermore, transition into circular economy models require consumers to take circular economy as their moral project and a conscious decision, and that wasting food is immoral (Lehtokunnas, Mattila, Naervaenen, & Mesiranta, 2020).

Introduction

- Current researches of circular economy of food waste has been paying more attention to the technicality of applications, while less attention has been paid to consumer behaviour shifts and consumption patterns

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Policies and systems that enable best practices

- Australia
- Hong Kong, SAR, China
- Japan
- Cambodia
- Singapore

Legislation on Agriculture Biomass Waste since the *Ha Noi 3R Declaration* in 2013

- In member countries of the *Ha Noi 3R Declaration*, there has been notable changes in legislations on agriculture biomass since the Declaration's implementation in 2013, explained by the expert panel at The 2nd State of 3R and Circular Economy in Asia and the Pacific virtual meetings.
- Most legislative implementational changes in India, Indonesia, Japan, Myanmar, and Viet Nam.

Types of circular economic applications of food

Objectives	Strategies	Practices	
Reduced resource consumption	Ecodesign	Agroecology	Zero waste grocery delivery
		Zero waste grocery stores	Energy efficiency
	Process optimization	Shorter supply chains	Agrimetrics yield tracking
		Digital food waste tracking	Quality control
	Responsible consumption and procurement	Consumer awareness	Discounting soon-expiring food
		Sustainable food choices	Sustainable procurement
Intensified product use	Sharing economy	Cooperative supermarket	Food sharing
	Short-term renting	-	

Types of circular economic applications of food

Objectives	Strategies	Practices	
Extending life of products and components	Maintenance and repair	-	
	Donating and reselling	Surplus food recovery	Re-appropriation of surplus food
	Refurbishing	-	
	Performance economy	Meal subscription service	
Giving products new life	Industrial ecology	Agricultural industrial eco-park	
	Recycling and composting	Green bins	Nutrient recovery
		Re-appropriation of food waste	
	Energy recovery	Biogas and electricity	Biofuel

Case studies: Circularity with bread

Beer-making with bread

Toast Ale, a startup that collects surplus bread from delis, bakeries, and sandwich makers, incorporates the bread to be brewed with malted barley, hops, yeast and water to create beer (Ellen MacArthur Foundation, 2021).

Coffee husks into tea

Dried coffee husks are not fit for human consumption as a part of the beverage. Cascara is a type of tea that is made by brewing the otherwise discarded dried coffee husks collected from the process after the usable parts of the coffee bean is extracted [Vuong, 2017]. The resulting tea contains a high amount of caffeine and imparts a fruity taste. Cascara tea is now available at global chain coffee shops [Vuong, 2017].

Targeted valorization of food waste

- Organic matter contains nutrients that can be used for various purposes, including nurturing people and animals and fostering growth of crops and consumable organisms. While food waste in general can be excellent fertilizers, different types of food waste have profiles of organic matter and nutrients that are more valuable and feasible for recovery than others (Cecilia, García-Sancho, Maireles-Torres, & Luque, 2019)
- Target ingredients have an overall higher ecological and economic value than general food waste valorization.

Case studies: Upcycling inedible food waste into valuable material

Bean shells and radish peels into high-value products

King's Ground from Pingtung County, Taiwan, Province of China, valorizes inedible parts of food products, such as radish peels, into a fermented food that is traditionally costly to produce and purchase (Cirular Taiwan, 2021). Not only are otherwise unused parts of the vegetable full utilized, the final product of fermented radish peels is also a shelf-stable, high-value merchandise (Cirular Taiwan, 2021).

Furthermore, the biotech company adopts a series of advance technological processes such as bio-stress, bio-collision, the Hurdle Technique, the Vortex Ring Effect, and nanotechnology to segregate useful components from agricultural by-products and waste that would be incorporated into health supplements, medicinal, and livestock feed products (Cirular Taiwan, 2021).

Case studies: Upcycling inedible food waste into valuable material

Durian husk applications by the Nanyang Technological University

The Nanyang Technological University of Singapore has discovered ways to successfully repurpose pectin extracted from durian husks, an inedible part of the tropical fruit, into biodegradable packaging materials (Teh, 2019). Durian husks are cut, grounded, then shredded to yield cellulose powder, which is molded into a sheet form that would be shaped into the packaging form (Teh, 2019). Biodegradable packaging is especially applicable to short shelf-life products such as fresh food.

Aside from packaging material, cellulose from durian husks can also be made into a soft gel that resemble silicon sheets that can be trimmed into medical bandages of varying sizes and shapes [NTU, 2021].

With the addition of organic molecules made from baker's yeast known as natural yeast phenolics, the product can be resistant to bacteria, rendering the final product a non-toxic hydrogel bandage that can help skin wounds heal faster and prevent infections [NTU, 2021].

Assessment of value of utilization practices

- Regardless of the prioritized goal of any theoretical circular food system, there are several criteria that need to be considered when judging whether the system is in fact circular (PBL, 2017):
  - Natural resources must be utilized and managed effectively;
  - Food material usage is optimized; and
  - The system results in optimum use of residual streams to minimize biomass loss.

Case studies: Decentralized food waste circular economies in city schools

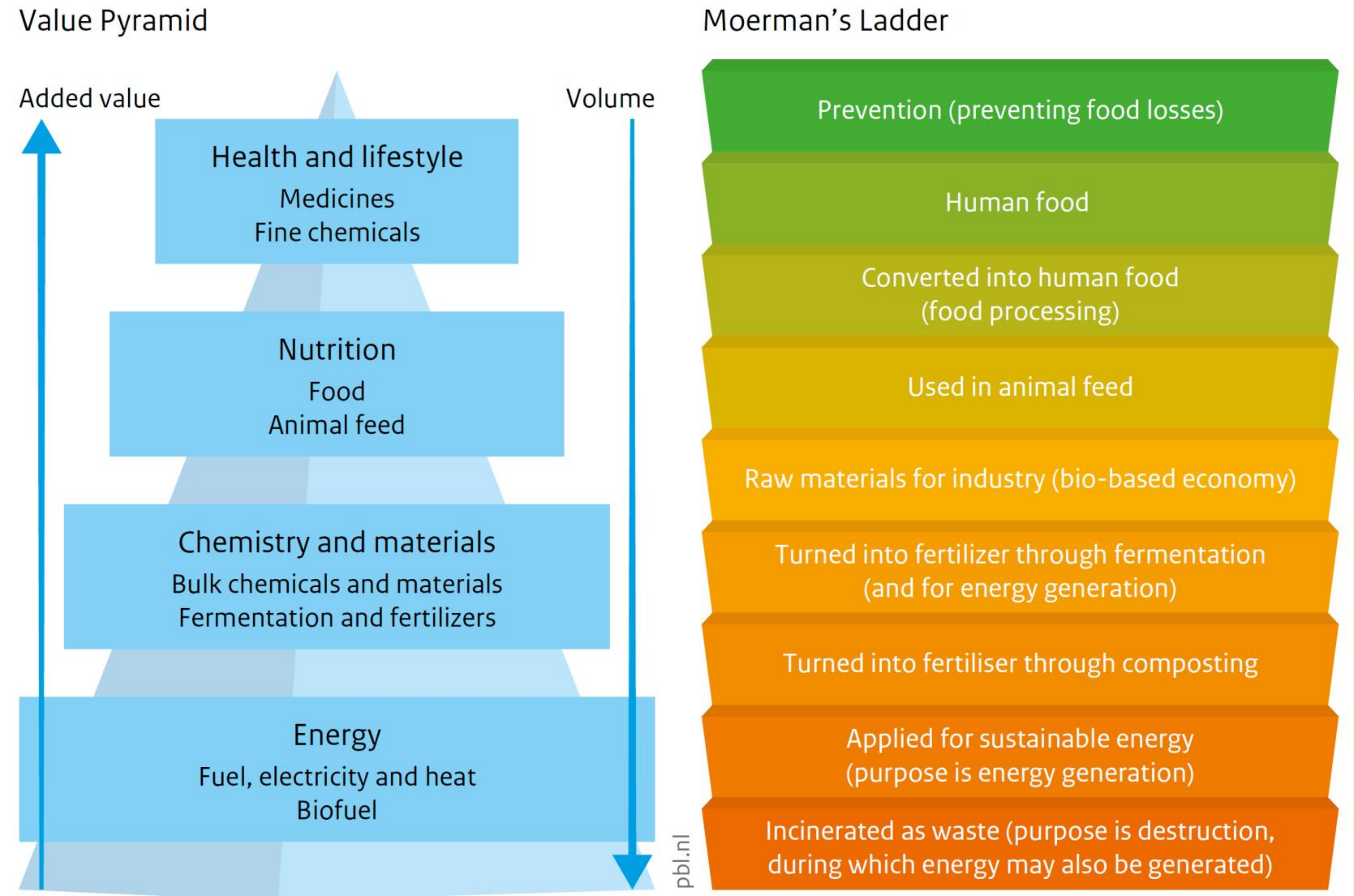
Sapporo City elementary and junior high schools

Food waste from leftover lunch catering in schools are converted on-site as fertilizers for participating schools in Sapporo City, Japan (ICLEI, 2021). Within the school grounds and leveraging the fertilizer made from food waste, students participate in the cultivating of vegetables which are then procured by local caterers. The full cyclical model is in turn allowing for first-hand education of food system circular economics (ICLEI, 2021).

Smart Food Waste Recycling Bin in university canteens

As a form of decentralized waste treatment in the ‘City University of Hong Kong’, Smart Food Waste Recycling Bins that composts food waste into energy using bio-catalysis with fermentation microorganisms were employed in the university’s canteens (Yeo, Chopra, Zhang, & An, 2019). A life-cycle analysis (LCA) approach was used to evaluate the entire system’s environmental impact. Results showed that at full capacity, a significant reduction of GHG emissions was achieved when the system was compared with centralized waste treatment systems (Yeo, Chopra, Zhang, & An, 2019).

Conceptual frameworks for comparing the value of food waste diversion/utilization



Case studies: Artificial intelligence in industrial kitchens

Orbisk

Artificial intelligence (AI) has been increasingly incorporated into food circular economy solutions. Orbisk, a technology startup based in the Netherlands, is also on a mission to reduce food waste in the food service industry (eit Food, 2021). By linking up smart cameras, weighing scales and waste bins to calculate food being discarded with analysis to the ingredient level, Orbisk applies AI technology to food circularity. Food service businesses can hence make informed decisions guided by the analysis from the AI system in order to better optimize food use, when to purchase the appropriate amount of food to reduce the amount of food wasted and increase the margin of profit for the business (eit Food, 2021).

Winnow

Winnow's AI tool, Winnow Vision, enables kitchens to enable circularity for food and even food trimmings by maximizing product yield, repurposing high value ingredients, and managing inventory more effectively with more visibility (Hill, 2021). Capable of recognizing 65 types of food trimmings that include fruit and vegetable trimmings, meat and fish, and bakery items, the tool allows for repurposing certain ingredients into other dishes (Hill, 2021).

It is said that kitchens can save 3-8% of food cost by optimizing production and reducing overproduction. Reduction and circularity of food trimmings is an additional savings opportunity that kitchens can benefit from (Hill, 2021).

Frontier technologies towards food waste management

- State-of-art technologies such as blockchain, IoT, AI and other smart systems and devices can greatly assist the efficiency of food circular economies, also allowing traceability, transparency, big data analytics, and systemic studies of food circularity (de Souza, et al., 2021).
- Coupled with LCA and holistic considerations of food waste utilization solutions, these technologies enable the optimization of the utility of food materials.

Conclusions and way forward

- In the Asia Pacific region, best practice examples bearing innovative and technologically-advanced approaches to circularity for food waste are abundant.
- Trends and developments on relevant Ha Noi 3R Declaration goals and SDGs, People's Republic of China, Japan, Viet Nam, Malaysia, and Australia developed targets aligned with SDG 12.3, while Japan, Australia, and New Zealand measure food loss and waste.
- An astounding majority of initiatives implemented for the reduction or circularity of food waste use the Ha Noi 3R Declaration goal indicators such as goal 2's indicator of "organic waste landfilled" and goal 10's "percentage of food loss at each stage of food supply chain". Increased practice of composting, or increased in organic waste management, have not been widely discussed in published plans, reports or researches of food waste initiatives of Ha Noi 3R Declaration countries.
- There is an urgent requirement for dedicated legislations for the management of agricultural biomass waste, and as of early 2022, only relatively developed countries of the Asia Pacific have specific laws for agricultural biomass waste.
- Moving forward, after the Ha Noi 3R Declaration's time frame ends in 2023, panel experts recommend several clear goals or targets to be set for agriculture biomass waste, including: 1) data collection, 2) quantitative targets of utilization, 3) quantitative targets of increase in installed capacity for bioenergy, and 4) encouragement of technology-sharing and capacity-building between developed and developing countries of the Asia Pacific.