Novel approaches to manage consumer food waste for sustainability

A perspective from Asia

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25 mins
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Scope

1. Managing food waste for food security and sustainability
2. Novel approaches: Changing mindsets and Harnessing technology
1. Managing food waste for food security and sustainability

- Food security
- Sustainability
- “The right thing to do”; (Savings)
Food Security requires a balance between food production and food loss/waste.

- Losses occur at every stage of the supply chain that typifies modern food systems. Some losses are avoidable but some result from wastage.
- Estimates by the Food and Agriculture Organization (FAO) and seminal research projects like WRAP show losses in supply chains range from 30-50%.
- Surveys have not shown that consumers link food waste to sustainability.
- To increase the level of circularity and sustainability in food systems requires that FW be addressed.
• Food systems may be described by their supply chains
• Supply chains start at the input and production (agriculture) end, and commonly finish with consumers

Sustainability of production systems and supply chains are continually challenged

Losses and Waste occur along supply chains

>400 Million Smallholder farms in Asia
Developed countries: Low Loss, High Waste
Developing countries: High Loss, Low Waste

“....on average, each person in Singapore generated about 155kg of food waste in 2017”


Main drivers and sources of food waste

Manufacturing:
• Over production, Appearance quality standard, Damaged products, Cheap disposal alternatives, Inedible parts of produce

Wholesale & Retail:
• Temperature changes leading to spoilage, Aesthetic standards, Packaging defects, Over-supply, Over-stocking

Food Services:
• Lack of flexibility in portion sizes, Insufficient planning to forecast and order ingredients, Consumer attitudes towards taking leftovers home, Refused food

Households:
• Buying too much, Bad storage, Discarding edible parts, Discarding leftovers, Large portion sizes

SDG 12.3 aims to cut the global food waste in half at the retail and consumer levels by 2030
Incentivise the development and use of improved food storage, transport and packaging in traditional supply chains.

Modify policies to reduce and prevent retail and consumer food wastage in urban environments.

Enhance government support for innovative means of using food that is wasted in urban environments.
Magnitude of food waste and lost opportunities

- A third of the food produced for human consumption globally, about 1.6 billion tonnes per year, is lost or wasted.
- The cost of food waste globally is estimated at around USD 2.6 trillion – of which USD 1 trillion is incurred from greenhouse gas (GHG) emissions, water scarcity, biodiversity loss, increased conflicts and loss of livelihood due to issues such as soil erosion, nutrient loss, reduced yields, wind erosion and pesticide exposure.
- Food waste accounts for 4.4 giga-tonnes (Gt) of CO₂ eq. per year, which represents 8% of global anthropogenic GHG emissions. In comparison, the overall emissions from China, USA and India are 12.45, 6.34 and 3.00 Gt of CO₂ eq. per year.

<table>
<thead>
<tr>
<th>ASPECT</th>
<th>COST (US DOLLARS)</th>
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<tbody>
<tr>
<td>Economic</td>
<td>1 trillion</td>
</tr>
<tr>
<td>Environmental</td>
<td>700 billion</td>
</tr>
<tr>
<td>Social</td>
<td>900 billion</td>
</tr>
<tr>
<td>Total</td>
<td>2.6 trillion</td>
</tr>
</tbody>
</table>


2018

GLOBAL FOOD WASTE MANAGEMENT: AN IMPLEMENTATION GUIDE FOR CITIES

Full Report
Concerns for food waste link to concerns about the sustainability of food systems

• At its simplest, a food system covers “end-to-end” activities, from production to consumption, and even disposal. More broadly, it also covers “…the governance and economics of food production, its sustainability, the degree to which we waste food, and how food production affects the natural environment” (EIU, 2018. SEPARATE TABLES: BRINGING TOGETHER ASIA’S FOOD SYSTEMS)

• “A sustainable food system is a food system that delivers food and nutrition security for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised.”—U.N. Task Force on Global Food and Nutrition Security, 2015.

http://www.un.org/en/issues/food/taskforce/pdf/All%20food%20systems%20are%20sustainable.pdf
2. Novel approaches: Changing mindsets and Harnessing technology

- Changing mindsets and attitudes
- Prevention technology
- Re-Use approaches
- Recycling technologies and approaches
- Recovery
- Circularity approaches
Changing mindsets and attitudes

Ecoponics school FW program
Singapore

Education and awareness building starts in schools
NEA to launch campaign to reduce food waste next week

SINGAPORE - The National Environment Agency (NEA) is launching a new campaign to tackle food wastage here, on the back of a survey that found that consumers here, while concerned about wasting food, had poor habits which could exacerbate the problem.

The NEA will also partner food retail businesses such as supermarkets and food outlet Subway to place posters and table-top stickers at their premises to remind and encourage consumers not to waste food. Community Development Councils (CDCs), grassroots leaders, partners and stakeholders will also step in organise initiatives related to reducing food wastage, such as in the form of an educational skit.

The campaign will be expanded to schools in early 2016.

Food accounts for one-tenth of all waste produced in Singapore. About 788,600 tonnes of food were thrown away in 2014. Only 13 per cent of last year's food waste was recycled.
Singapore Food Waste Management Hierarchy
(National Environment Agency) 2018

**Year** | **Food Waste Disposed of (tonne)** | **Food Waste Recycled (tonne)** | **Total Food Waste Generated (tonne)** | **Recycling Rate (%)**
---|---|---|---|---
2017 | 676,800 | 133,000 | 809,800 | 16%

Prevention technology

1. How big is the problem/ opportunity? E.g. Winnow system

2. Packaging

1. Internet of Things (IoT)
Quantifying waste: Defining the size of the problem

The biggest savings opportunity lies in overproduction

Prepared in Advance

- 1% (3-5%)
- 1-5% (5-15%)
- 1-15% (1-5%)

Cook to Order

- 1% (2-20%)
- 1-6% (1-10%)
- 1-5% (1-5%)

*Data collected from over 700 kitchens using Winnow

Courtesy: Mark Zornes, Winnow
Introducing the Winnow system

Throw food waste in the bin
Every time you throw food in the bin, the connected scale automatically registers the weight of the waste.

Categorize waste in three taps
Using the tablet, you categorize the wasted item, capturing key data, such as cost, reason for wastage and time of day.

Receive instant feedback
Instant feedback to drive immediate behavioural change; understand the value and environmental impact of waste.

Analyze daily & weekly trends
Data is processed in the cloud; you receive daily, weekly & cross-site reports in your inbox, with actionable data to drive change.

 Courtesy: Mark Zornes, Winnow
Overview of technological innovations in food packaging to prevent food waste

- Improved packaging properties: mechanical, thermal, barrier properties
- Biodegradability: enhanced biodegradation
- Active packaging: shelf life extension, oxygen scavenger, antimicrobial
- Intelligent packaging: interaction with the environment, self-cleaning, self-healing, indication of deterioration
- Delivery and controlled release: nutraceuticals, bioactive compounds (such as essential oils)
- Monitoring product conditions: time temperature indicator (TTI), freshness indicator, leakage indicator, gas detector


“Slippery” packaging

06 Aug 2018 -- Researches at Virginia Tech have created innovative “slippery” plastic packaging designed to minimize the food waste commonly left behind in condiment, dairy and beverage packaging. The study, which was published in Scientific Reports and has yielded a provisional patent, establishes a method for wicking chemically compatible vegetable oils into the surfaces of common extruded plastics. While cutting down on food waste, the “slippery” packaging also helps combat the frustration felt by consumers when they are unable to squeeze the last drop of sauce from small packets.

There have also been innovations in the transit of foodstuffs. For instance, a team from the Federal Laboratories for Materials Science and Technology in Switzerland have developed sensors to monitor the state of fruit as it travels from farm to store. The sensor is designed to record the experience of the fruit in the pallet as closely as possible, so is the same size and composition as a fruit. The sensor provides constant feedback on the temperature in the container, because even minute changes are capable of significantly changing the speed at which picked crops ripen. This not only influences food wastage, but also creates variance in the use-by date on the produce.

Disruptive technologies: Drones, Satellite photography and sensors, IoT-based sensor networks, Phase tracking, Weather forecasts, Light and heat control, and Intelligent software analysis for pest and disease prediction, environment management and other involved analytical tasks.

Californian startup Zest Labs are bringing a similar technology to market. Their solution provides real-time data on the pallet to help people make smarter logistics decisions. For instance, if the contents are ripening quicker than expected, that produce can be re-routed to a nearer store to retain a good shelf life.
Disruptive Innovations to reduce waste

GM Technologies not fully utilized but with high potential impact on food production in ASEAN

Controlled-environment Plant Factories using hydroponics

- Hundreds of PFALs operating in China, Japan, Korea and Singapore

Delayed ripening papaya

- High potential to reduce wastage in supply chains in the tropics; prolong shelf life for consumers

High potential to reduce “cosmetic” wastage
Marina Bays Sands Integrated Resort, Singapore

<table>
<thead>
<tr>
<th>Year</th>
<th>Food Donated to FFTH (Kg)</th>
<th>Food Donated to Food Bank (Kg)</th>
<th>TOTAL (Kg)</th>
</tr>
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<tbody>
<tr>
<td>2012</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2013</td>
<td>618</td>
<td>-</td>
<td>618</td>
</tr>
<tr>
<td>2014</td>
<td>1,852</td>
<td>-</td>
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<tr>
<td>2015</td>
<td>3,301</td>
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<td>3,301</td>
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<tr>
<td>2016</td>
<td>6,217</td>
<td>1,077</td>
<td>7,294</td>
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<tr>
<td>2017</td>
<td>8,437</td>
<td>2,773</td>
<td>11,210</td>
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<tr>
<td>2018</td>
<td>7,348</td>
<td>1,473</td>
<td>8,821</td>
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ReUSE approaches

Sustainability Policy Statement
At Marina Bay Sands, sustainability defines the way the integrated resort does business. Its global sustainability programme, Sands ECO360, guides the company in responsible operations to reduce its carbon footprint and overall environmental impact.
Re-Use approaches

27 December 2018, Sunday Star, Malaysia

Food Bank goes nationwide

Plan aims to stop 15,000 tonnes of food wastage every day

By ARNOLD LOH
arnold.loh@thestar.com.my

GEORGE TOWN: Malaysians are just too wasteful – throwing away about 15,000 tonnes of excess food every day. But this will not be an utter waste soon. Plans are afoot to avoid such perfectly edible food from going to the landfills. Instead, it will provide sustenance for the underprivileged, arrest methane emissions and slash carbon footprint.

Called the Malaysia Food Bank Foundation, it will be an extensive network of hypermarkets, hotels, food producers and volunteers to make sure that excess food – from fruits and vegetables to bread and even a five-star resort’s mutton curry – will go to the poor.

Modelled after Penang’s successful Mutia Food Bank, Domestic Trade and Consumer Affairs
## Recycling technologies and approaches

<table>
<thead>
<tr>
<th>Year</th>
<th>Food Placed in Digestor (Kg)</th>
<th>Used cooking oil (Kg)</th>
<th>ReUsed + ReCycled TOTAL (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2013</td>
<td>3,680</td>
<td>5,285</td>
<td>9,583</td>
</tr>
<tr>
<td>2014</td>
<td>330,452</td>
<td>22,176</td>
<td>354,480</td>
</tr>
<tr>
<td>2015</td>
<td>338,955</td>
<td>16,575</td>
<td>358,831</td>
</tr>
<tr>
<td>2016</td>
<td>508,668</td>
<td>38,500</td>
<td>554,462</td>
</tr>
<tr>
<td>2017</td>
<td>518,258</td>
<td>38,705</td>
<td>568,173</td>
</tr>
<tr>
<td>2018</td>
<td>579,389</td>
<td>34,300</td>
<td>622,510</td>
</tr>
</tbody>
</table>

**Food waste** is managed through five *anaerobic* digesters. In 2016, the integrated resort diverted a total of 521 tonnes of food waste. It also carried out food donation programmes with local charities, contributing 6.2 tonnes of bread to Food from The Heart and 6.5 tonnes of hot food to Food Bank Singapore.

*In July 2016, Marina Bay Sands rolled out an innovative condensate water recovery project to collect and recycle water that drips from the 3,000 air-conditioning units across its three hotel towers. The project saves an average of 60,000 liters of water a day. The recycled condensate water is used for the water features around the property, exterior landscaping and to irrigate plants at the hotel.*
The integrated resort has its own Herb Garden located outside of Hotel Tower 1. Measuring 170 square metres, the garden supplies approximately 50 types of herbs, to restaurants owned and operated by Marina Bay Sands. A drip irrigation system, powered by solar panels, is used to water plants and shrubs, thereby avoiding wasteful spraying. Every day, 800 - 1,200 g of herbs are harvested at the Herb Garden and used in restaurants owned and operated by Marina Bay Sands.
Our Waste-To-Fertiliser technology reduces, converts and recycles these wastes into much more manageable and eco-friendly fertiliser. We ferment and decompose food waste using microorganisms in order to produce high-quality fertiliser.

A*Star, Singapore firm develop system that turns food waste into odourless fertiliser in 24 hours

The patented microbe treatment breaks down local food waste including bones, dough, tofu and sugar cane safely and effectively.

Westcom’s microbial treatment has another benefit — it has a low operating temperature of about 40°C, unlike others which may operate at 80°C to 120°C.
China’s domestic and commercial kitchens produced 120 million tons of food waste in 2017: Ministry of Ecology and Environment

Food waste is collected from restaurants around Jinan and delivered to the warehouse. The waste is sorted, blended into mush, and used to feed the cockroaches, which consume around 60 tons of food waste each day.

Once the cockroaches die — usually when they’re around 1-year-old — the protein-rich critters are crushed up and made into chicken feed.
Insects: Food of the future?

According to the Food and Agriculture Organization of the United Nations (UN), insects that are edible "contain high quality protein, vitamins and amino acids for humans."
As well as their nutritional value, eating insects has less of an impact on our planet than more conventional sources of protein. The FAO states that they possess a "high food conversion rate," citing the example of crickets, which require "six times less feed than cattle."


Entomophagy (ˌɛntəˈmɒfədʒi/, from Greek ἔντομον, "insect", and φαγεῖν phagein, "to eat") is the human use of insects as food. The eggs, larvae, pupae, and adults of certain insects have been eaten by humans from prehistoric times to the present day.
GOODDOCTOR, XICHANG, SICHUAN

A giant indoor farm in China is breeding 6 billion cockroaches a year. Here's why

The Post turns a spotlight on the ‘disgusting’ insect with apparently remarkable medicinal qualities at the world’s largest breeding facility, where the bugs outnumber the planet’s human population

PUBLISHED : Thursday, 19 April, 2018, 9:02am
UPDATED : Thursday, 26 April, 2018, 3:17pm


The world’s largest cockroach farm is breeding 6 billion adult cockroaches a year and using artificial intelligence to manage a colony larger than the world’s human population – all for medicinal use.

Cockroach has been an ingredient in traditional Chinese medicine for thousands of years.

Cockroach milk is one of the world’s most nutritious and calorie-rich substances.
Recovery (for energy)

Biogas production for domestic and other uses from farm manure, esp. poultry manure, and other biowaste. Common in China.

Circularity approaches

Courtesy of Darren Yeo, Citizen Farm, Singapore
WE SEE A REAL FARM-TO-TABLE OPPORTUNITY, WHERE OTHERS SEE CHEAP & CONVENIENT FOOD

OUR MODEL  At Citizen Farm, we aim to change the way people eat and live. Instead of consuming industrially-produced food shipped halfway across the globe, we want our community to thrive on sustainable, safe, and locally-grown fresh food. Our model exhibits an array of different farming systems which closes the loop, grows the best quality produce but with the least amount of waste. This circular economy is robust, sustainable and what we believe, the future of farming.

https://www.ediblegardencity.com/
SILOS BEACH RESORT
SENTOSA

a TÜV Rheinland (TÜV) certified Eco Hotel

ECOLOGICALLY CONSCIOUS DINING
- food is first sourced from local and nearby countries.
- a special machine uses bacteria to convert unused food into fertilized water.
- meals and events are well planned to minimize food wastage.

VERMICULTURE

Biodiversity Beachfront Al fresco Cafe

Our beachfront café provides guests with a sustainable dining experience by using food sources from nearby countries, taking measures to reduce excess food, and not serving any meat from endangered species like shark and blue fin tuna.
Full circle

- How will technology innovations contribute to sustainable food and nutrition systems which reduce waste and stabilize food supply?
- Resource use efficiency
- Stability of production
- Consistency in produce quality
- Desired, engineered nutrition and agronomic traits
Some “Take-home” Points

• Novel approaches and technologies are being developed and trialled in many countries but have to make financial sense if they are to be mainstreamed

• Mindset changes are key to the public accepting innovations to deal with food waste.

• Educating the urban public on where food comes from, how it is produced, and how it can be lost is important to create awareness about the role of the consuming public in reducing food waste and contributing to a more food secured and sustainable future