



*International Scientific Conference on “Sustainable and Efficient
Use of Energy, Water and Natural Resources”
Wednesday 21 April 2021 (Online)*

Valorisation of Food Waste to Compost for Soil Enrichment

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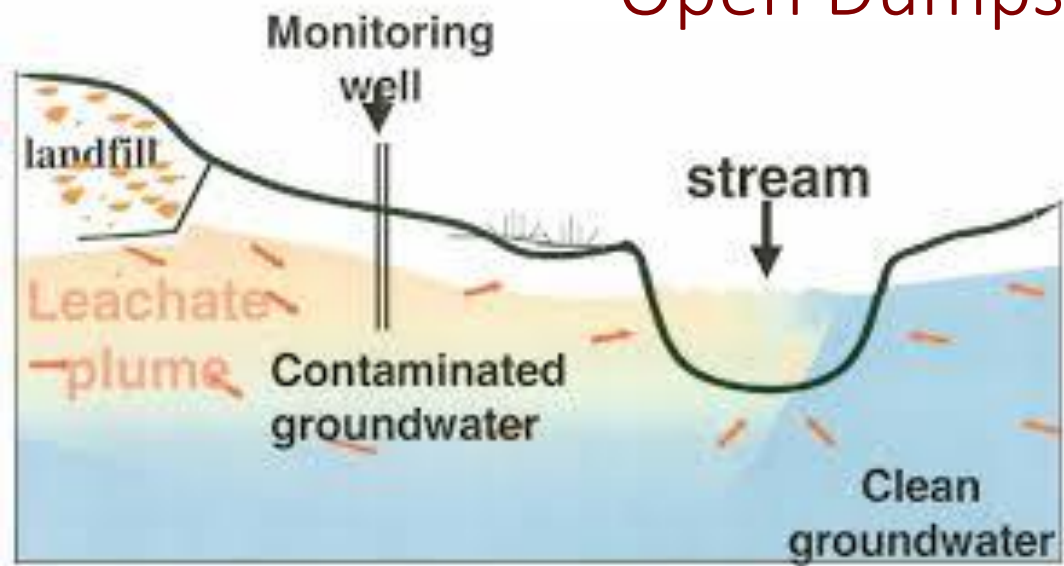
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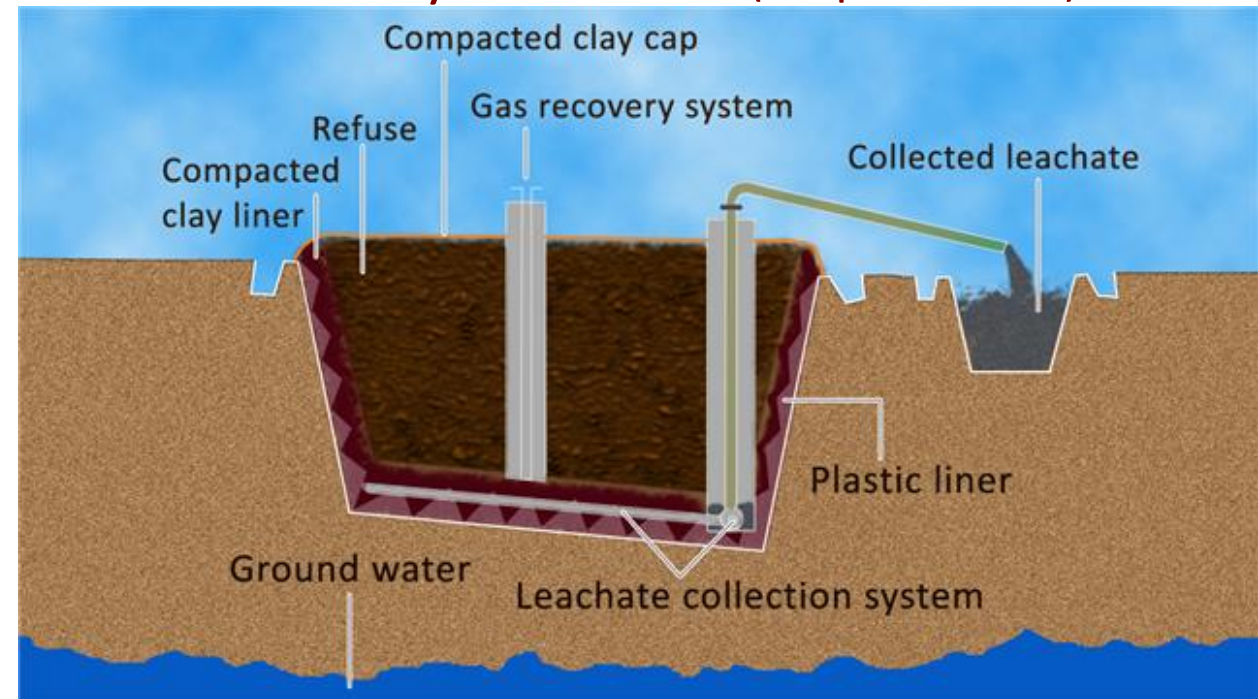
Open Dumps



Research Gate (2019) https://www.google.com/search?q=landfill+underground+contamination&source=lnms&tbm=isch&sa=X&ved=0ahUKEwit4o_Ow_TiAhUCOY8KHUnHDBYQ_AUIECgB&biw=1162&bih=585#imgrc=0rsCCMhbHfcEHM (accessed June 2019)



Sanitary Landfill (Expensive)



Help Save Nature, (2019) <https://helpsave nature.com/difference-between-sanitary-landfills-open-dumps> (accessed June 2019)

WHAT A WASTE 2.0

A Global Snapshot of Solid Waste Management to 2050



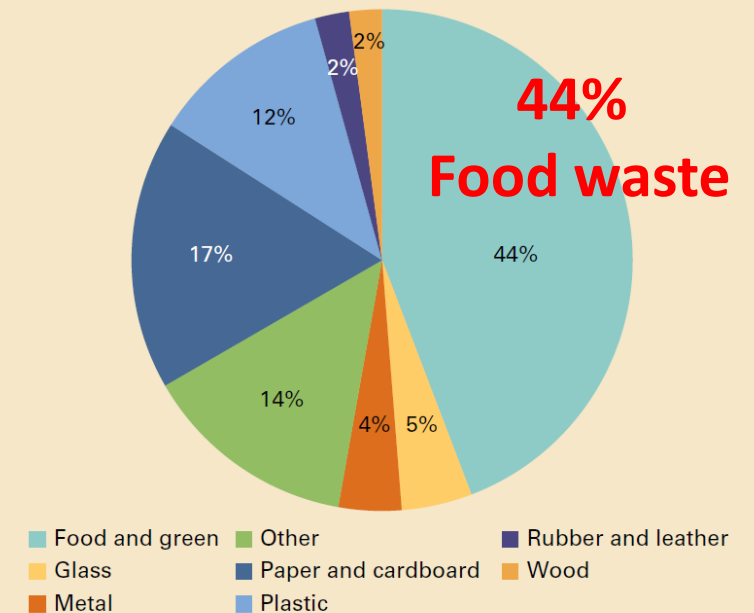
Silpa Kaza, Lisa Yao, Perinaz Bhada-Tata, and Frank Van Woerden

2×10^9 t (2016)

70%

3.4×10^9 t (2050)

Figure O.5 Global Waste Composition
percent



What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050 (2018)

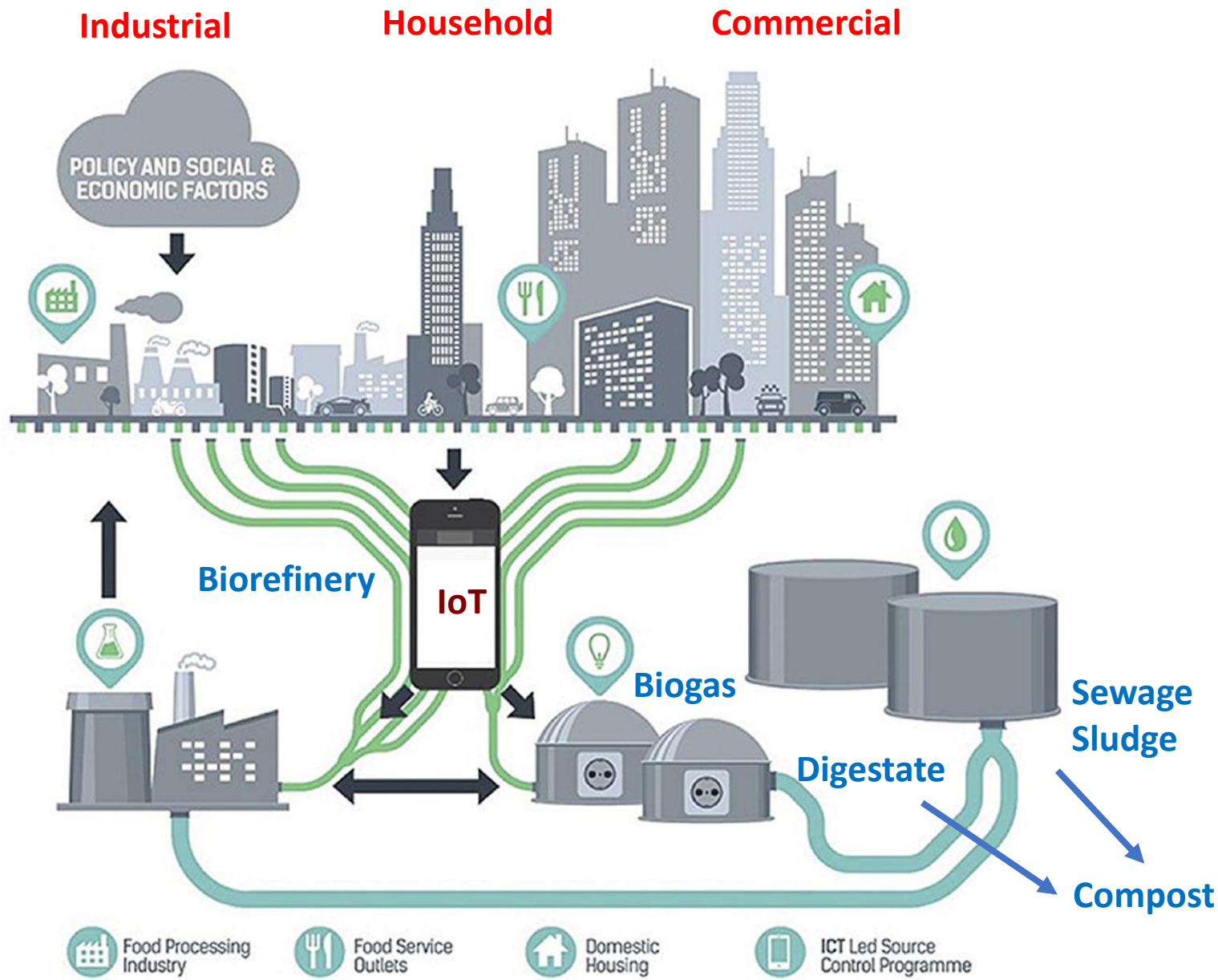
<https://openknowledge.worldbank.org/handle/10986/2174>

Towards Zero-waste?

RESOURCE RECYCLING



Food Waste generation



The Future

- Sisticmic Solutions
- IoT
- Multi-stakeholders
- Supply-Demand Chain
- Database management
- Mass Balance Modeling for nutrients
- Product Quality
- Process Integration
- Optimisation
- Economic Feasibility
- Mitigation of GHG
- Socio-economic impacts

Closing the Loop

Supply- Demand Chain Management

1. Composting

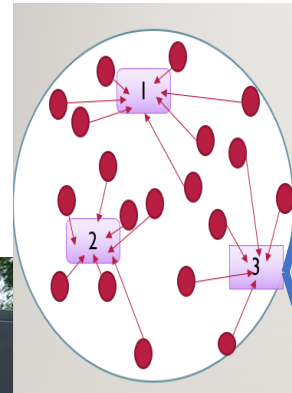
Segregation/
Training



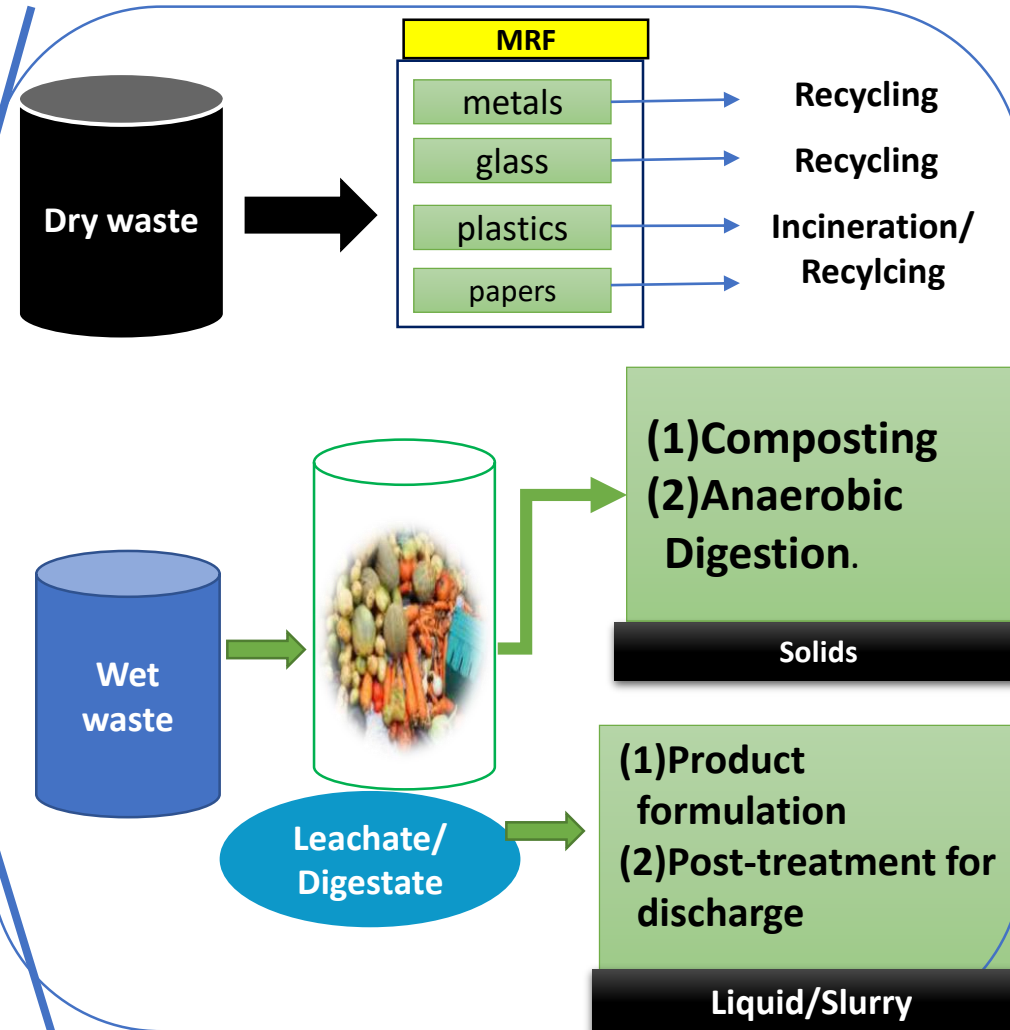
Collection -Treatment



Agriculture Use



Transfer station
Waste collection site



Sistemic Solutions: Multiple- stakeholder Collaborations

Public/Gov.

Local Authorities

Public Health
Landscape Unit
Environment Unit

Policy Makers

Environmental Authorities

Policy Makers

Private

Waste Company

Investor

Financing

Entrepreneur

Community

Residential Council

Schools

NGOs

University

Questionnaire
Multiple-Objective Mapping
Priority Analysis
Interest Mapping

Leadership /Academic/ Government

Focus Group Discussion (FGD)



Composting

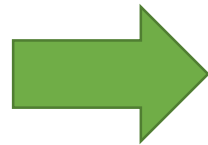
Reduce 50 - 80 % food waste volume

PRODUCTS

- Compost & Leachate -as **organic soil amendment**.
- **Nutrient characterization** of the food waste compost and leachate is crucial for enhancing the economic food waste valorization impact.



Food waste



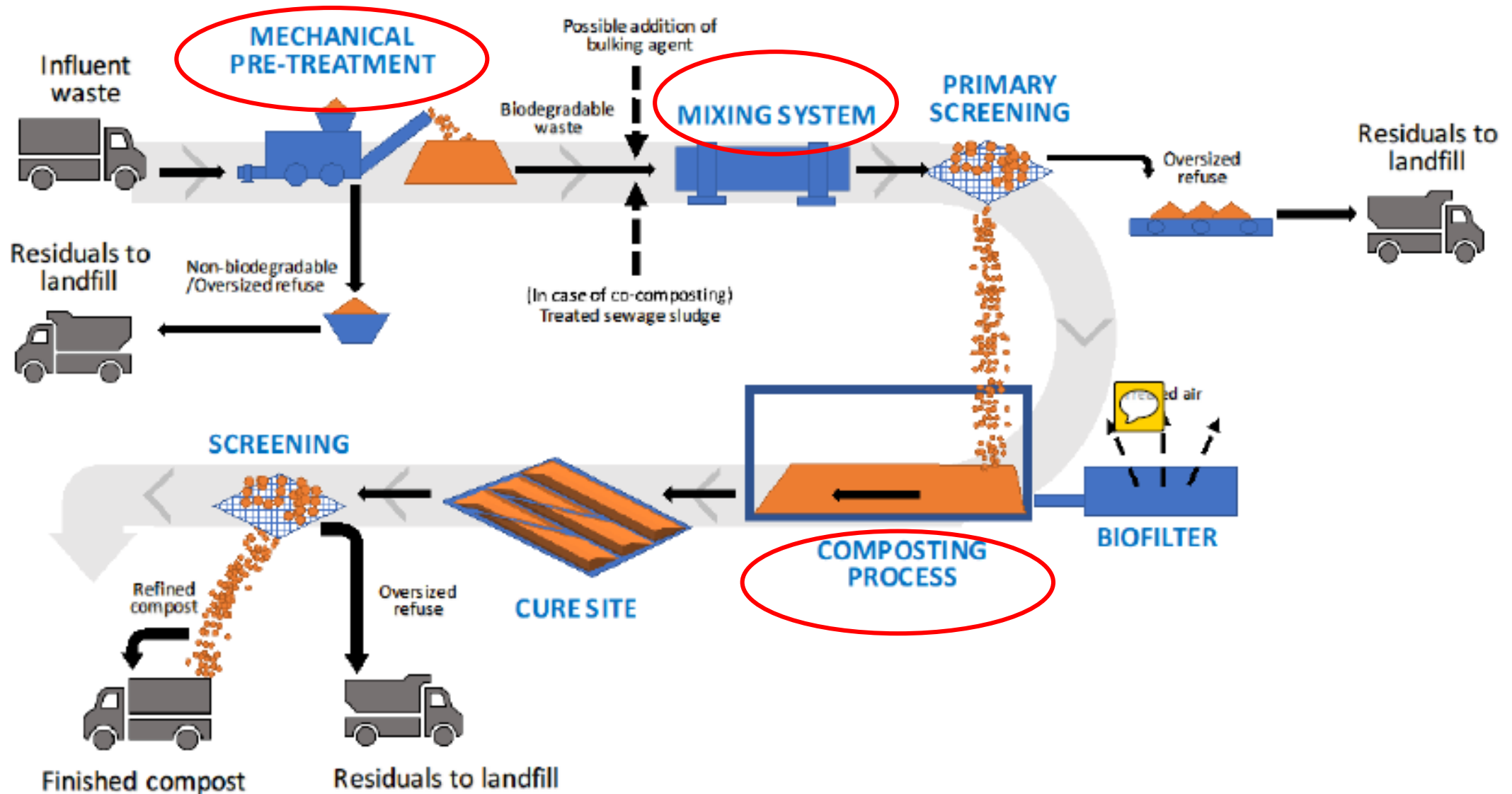
**Compost
(Organic
Fertilizer)**



**Leachate
(Liquid Organic
Fertilizer)**

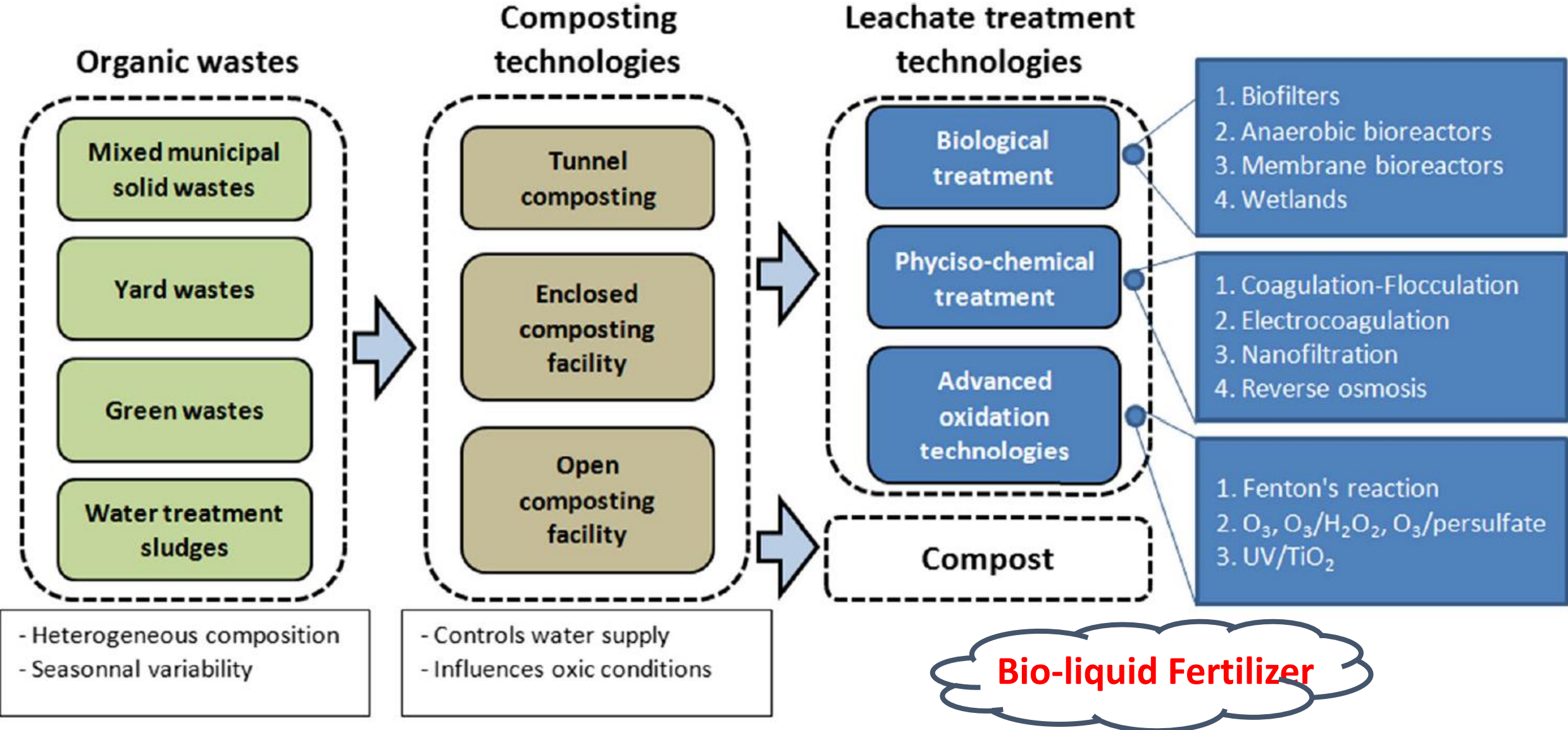
Large Scale Composting

1. Composting



Composting & Leachate Treatments

1. Composting



Compost- Not Just N:P:K

GHG Mitigation: 0.4 kg CO₂eq./t



Strengthens Community Bonds

Physically connects people to each other and the places they live.



Reduces Vehicle Emissions

Cuts transportation distances between material generators & compost producers.



Improves Soil Quality

Adds nutrients back into the soil that are essential for plant growth.



Supports Local Food Production

Reduces fertilizer costs and increases crop yield.



Builds Local Economy

Keeps resources and money circulating within the local community.



Reduces Water & Pesticide Use

Compost can hold an amount of water equal to 200% it's dry weight.

Impact of Compost & Bio-Liquids on Soil Fertility

Physical properties

- ↑water holding capacity, ↓bulk density & ↑porosity
 - ↑soil structure & ↓soil drainage problem

Chemical properties

- ↑OM & humus contents in soil
 - ↑nutrient fixation
 - ↑soil macro- & micro-nutrients
 - Stabilising soil pH and ↑CEC
 - ↓nutrients leaching

Biological properties

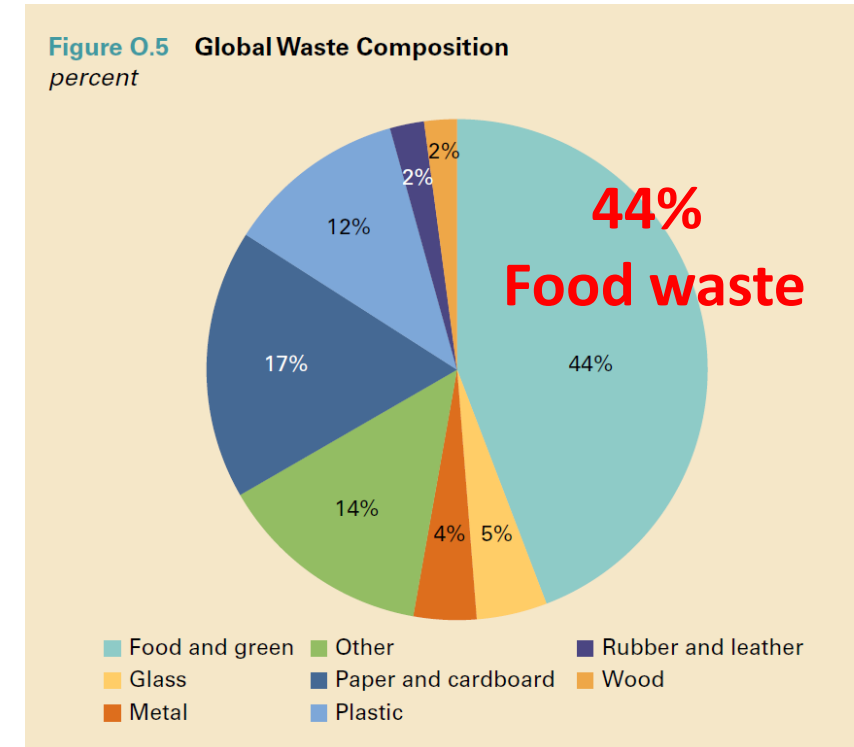
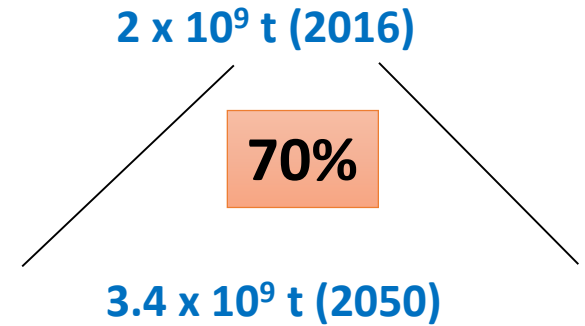
- ↑microbial population in soil
 - Microbial diseases suppression
 - ↑nutrient fixation and availability

Soil remediation

- Heavy metals & toxic substances immobilisation

Problem Statement

- Why **Food Waste** still HAS NOT been capitalized as a Resources for conversion to Compost?
- ❖ Potential contamination/mixed waste (**need proper segregation**)
- ❖ Variation in Nutrients composition based on feedstock (**Need characterization by type of inputs**)
- ❖ Variation in Nutrients based on composting formulation (**Need to standardize % of bulking agent**)
- ❖ Variation in Nutrients due to Processing and Storage



Field Research: Compost & Bio-liquid Fertilizer



Bioliquid fertilizer.



Final Compost

The mixture of food waste and green waste are stored in the fabricated bin for 1 month before being dried for 1-2 week before ground to final product.

Community Composting site

NUTRIENT COMPOSITION OF FOOD WASTE COMPOST & LEACHATE

Composition	Nutrient composition in Leachate (mg/L)			Nutrient composition in Compost (g/kg)			Reference
	N	P	K	N	P	K	
Food waste	1,800	594	2350	4.69	9.47	5.96	Sanadi et al. (2019)
-	400	320	1.03	0.10	4.16	Jarecki et al. (2012)	
-	-	-	37.2	2.9	30.9	Adhikari et al. (2009)	
-	-	-	33.8	71.6	11.2	Guo et al. (2018)	
630	1780	640	-	-	-	Romero et al. (2013)	
331	67.55	529.45	-	-	-	Kucbel et al. (2019)	

- **Variation of food waste composition** resulted in inconsistent nutrient composition in food waste compost.
- **Proper segregation of food waste based on type** (meat, vegetables, grain, etc.) can minimise the nutrient range of the compost and leachate.
- Studies on characterising the nutrient content of compost and leachate **from different types** of food waste is **limited**.

Conclusions & Way Forward

- **Composting** should be regarded as a promising and viable method to valorise food waste (*Compost ≠ Chemical Fertilizer*) (*Not just NPK*)
- **Systemic Close-the Loop Solutions for Food Waste Composting :**
 1. Top-down approach (Enabling Policy)
 2. Upstream activities (segregation & collection) facilitated by local government
 3. Economy scale and viability invested by public-private partnership
 4. ***Product formulation (Standardisation) & quality control by Researchers***
 5. ***Nutrient characterization based on Types of biowaste***
 6. Marketing and application of compost in agriculture land
 7. *Supply and Demand Chain Management for waste and products by Expert and local government with multiple stakeholder*
- **Way Forward**
 1. **Modeling and Prediction of Compost Nutrient range based on Composition and Type of biowaste inputs**
 2. **Application of FW Compost on different crop** and long-term soil analyse



7TH INTERNATIONAL CONFERENCE ON LOW CARBON ASIA [VIRTUAL CONFERENCE]

Circular Economy towards Sustainable Development



CALL FOR PAPERS

Authors wishing to present a contribution would prepare a **one-page abstract** and a **6-page full paper**.

CEt All accepted full papers will be published in **Chemical Engineering Transaction** (SCOPUS CiteScore:1.3)

Submission Link:

<http://registration.sdewes.org/iclca21>

IMPORTANT DATE



CONFERENCE FEES

Category	STUDENT	NORMAL RATE
Early Bird (Before 31 August)	USD 260	USD 320
Normal (After 31 August)	USD 300	USD 380

TOPICS OF INTEREST

- Urban Planning and Smart Cities
- Sustainable Energy Systems
- Sustainable Waste and Water Management
- Sustainable Agriculture and Food Supply
- Nexus and Circular Economy
- Cleaner Technology

POTENTIAL SPECIAL ISSUES



ORGANIZER



CO-HOSTS



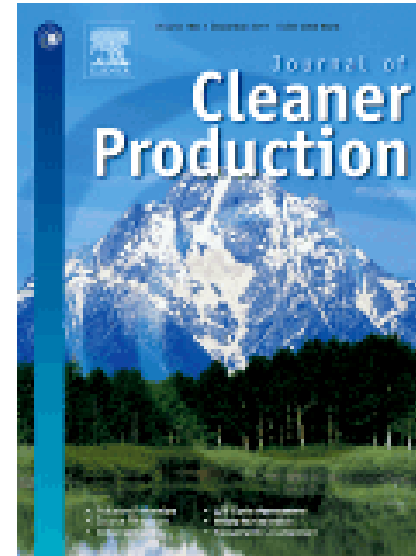
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Potential/Past Special Issues



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TOWARDS ZERO WASTE~ Leaving NO ONE BEHIND



UTM BIO-RECYCLING STATION

UTM Sustainable Campus Flagship Project



COMPOSTING PILOT PLANT



SCHOOL



SCHOOL



COMMUNITY



FGD- LOCAL AUTHORITIES

“WE DON'T INHERIT
THE EARTH FROM
OUR ANCESTORS,
WE BORROW IT FROM
OUR CHILDREN.”

- NATIVE AMERICAN PROVERB

Towards Zero-Waste

Leaving No One Behind



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ACCELERATING
GREEN
DEVELOPMENT
IN ASIA



UTM Summer School SS14

ACKNOWLEDGEMENTS



- Jiří Jaromír Klemeš
- Pei Ying Ong
- Norahim Ibrahim
- Yee Van Fan
- Nur Farzana Ahmad Sanadi
- Cassandra Bong Phun Chien
- Chee Woh Leow
- Li Yee Lim
- Huiyi Tan
- Mirza Hussin Sabki



Fundamental Research Grant Schemes
(FRGS) (R.J130000.7809.5F147)



Sustainable Process Integration Laboratory
(SPIL) (CZ.02.1.01/0.0/0.0/15_003/0000456)

Czech Republic Operational Program
Research and Development under
Collaboration with
Universiti Teknologi Malaysia (UTM)