



Agriculture, Nutrition and Health Academy Week

30 JUNE 2022

Assessing the human health effects of recycling and reusing plastic packaging in the food system

A systematic review and meta-analysis of life cycle assessments

immana

Innovative Methods and Metrics for
Agriculture and Nutrition Actions

Presenter: Megan Deeney

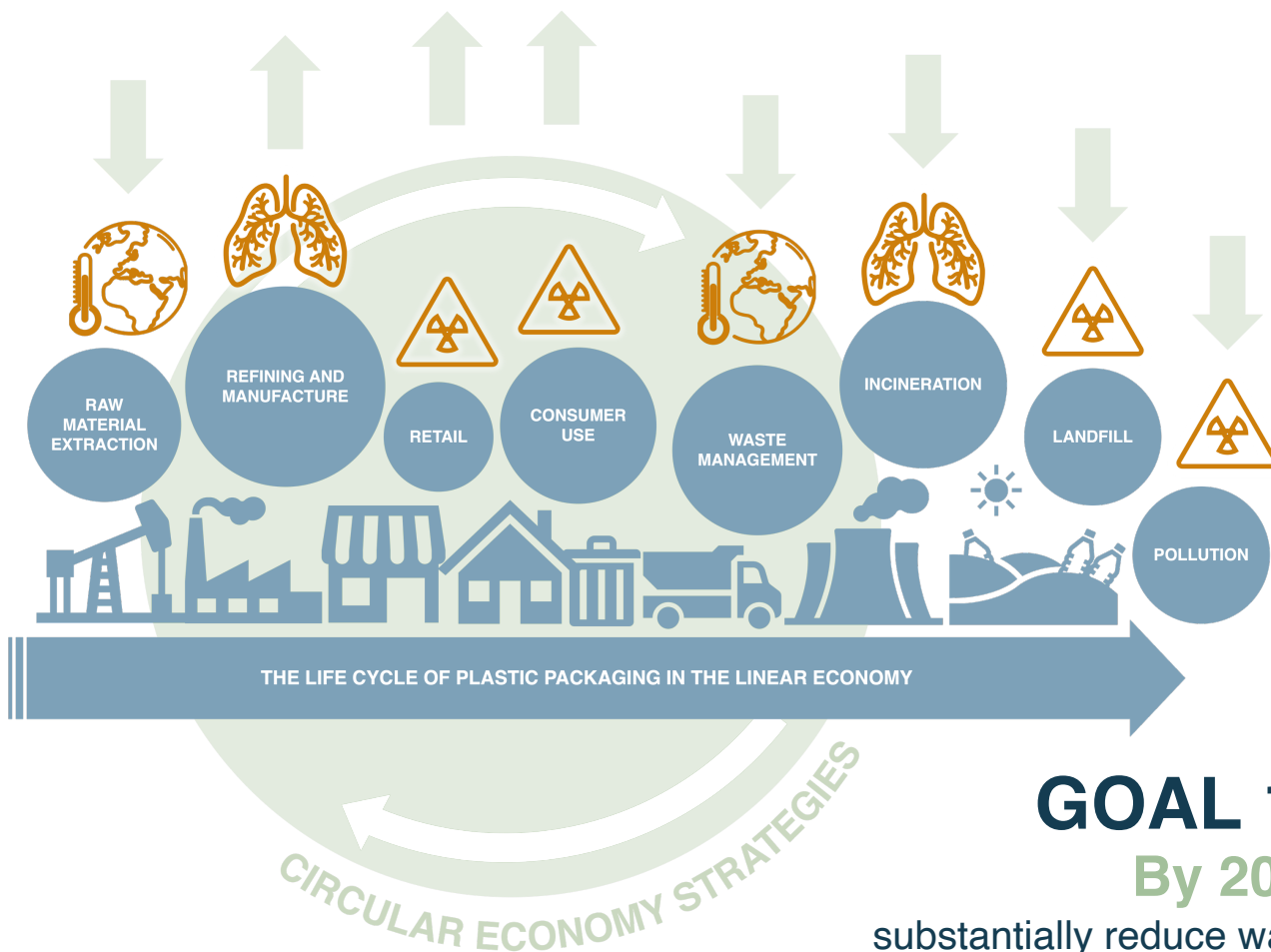
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Background

The Circular Economy and Human Health



TRADE-OFFS BETWEEN SDGs

10 REDUCED INEQUALITIES =	12 RESPONSIBLE CONSUMPTION AND PRODUCTION ∞
1 NO POVERTY 👤👤👤👤	12 RESPONSIBLE CONSUMPTION AND PRODUCTION ∞
6 CLEAN WATER AND SANITATION 💧	12 RESPONSIBLE CONSUMPTION AND PRODUCTION ∞
3 GOOD HEALTH AND WELL-BEING ❤️	12 RESPONSIBLE CONSUMPTION AND PRODUCTION ∞
4 QUALITY EDUCATION 📖	12 RESPONSIBLE CONSUMPTION AND PRODUCTION ∞

GOAL 12

By 2030

substantially reduce waste generation through prevention, reduction, **recycling** and **reuse**

United Nations (2015)

Image: Pradhan et al. 2017

Aims and objectives

To quantitatively meta-analyse the possible human health effects of increased recycling and reuse



Climate Change	Morbidity and mortality due to increase in malnutrition, malaria, diarrhoea and flooding
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Stratospheric Ozone Depletion	Morbidity and mortality due to Increase in skin cancers including malignant melanoma, basal cell carcinoma and squamous cell carcinoma due to UVB exposure
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Fine Particulate Matter Formation	Mortality due to increase in cardiopulmonary disease and lung cancer
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Human Toxicity Cancer Effects	Morbidity and mortality due to increase in cancer incidence
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Human Toxicity Non-Cancer Effects	Morbidity and mortality due to increase in non-cancer disease incidence
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Water Use	Morbidity and mortality due to increase in malnutrition and vulnerability of population
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Methods

Systematic search, appraisal and meta-analysis

PEER REVIEWED LCA

-  HUMAN HEALTH
-  GLOBAL WARMING
-  OZONE LAYER DEPLETION
-  PHOTOCHEMICAL OZONE CREATION
-  IONISING RADIATION
-  PARTICULATE MATTER FORMATION
-  HUMAN TOXICITY
-  CARCINOGENS
-  NON-CARCINOGENS
-  WATER USE

RECYCLED
PLASTIC



VIRGIN
PLASTIC

REUSABLE
PLASTIC



SINGLE-USE
PLASTIC

END-OF LIFE
RECYCLING



INCINERATION
LANDFILL



Results

Evidence Mapping



49 LIFE CYCLE ASSESSMENTS

15 RECYCLED CONTENT

36 END-OF-LIFE RECYCLING

17 REUSE

		LCA ENDPOINT	LCA MIDPOINT HEALTH - RELATED IMPACT CATEGORIES								
		Human Health	Climate Change	Stratospheric Ozone Depletion	Photo-chemical Ozone Formation	Ionizing Radiation	Fine Particulate Matter Formation	Human Toxicity	Human Toxicity Cancer Effects	Human Toxicity Non-Cancer Effects	Water Use
Recycled vs virgin material content	Bottles	0	7	3	3	0	2	3	2	1	1
	Cups	0	2	0	0	0	0	1	0	0	0
	Primary packaging	0	3	1	2	1	1	1	0	0	1
	Grocery bags	0	2	0	1	0	0	1	0	0	1
	Service ware	0	2	0	1	0	1	0	1	0	0
	Total	0	16*	4	7*	1	4	6*	3	1	3
End-of-life recycling vs landfill or incineration	Bottles	1	12	2	4	0	2	2	1	1	0
	Cups	0	7	5	5	1	1	4	0	0	2
	Primary packaging	0	11	4	4	3	3	2	1	1	3
	Grocery bags	0	3	1	2	1	1	1	1	1	1
	Service ware	0	5	1	1	0	0	1	1	1	0
	Total	1	37*	13	16*	5	7	10*	4	4	6
Reusable vs single-use by design and number of uses	Bottles	0	3	0	0	0	0	0	0	0	0
	Cups	0	4	2	2	0	0	2	0	0	2
	Primary packaging	0	0	0	0	0	0	0	0	0	0
	Grocery bags	0	5	1	5	1	1	2	1	1	4
	Service ware	0	5	1	1	0	0	1	0	0	2
	Total	0	17	4	8	1	1	5	1	1	8

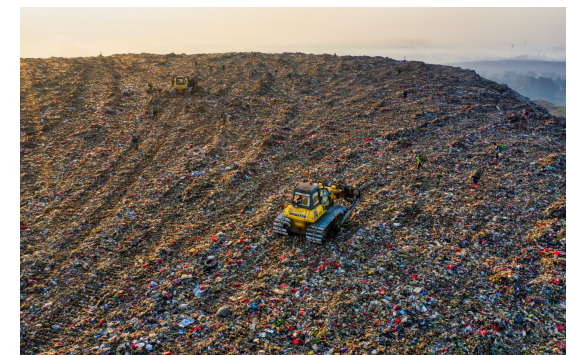
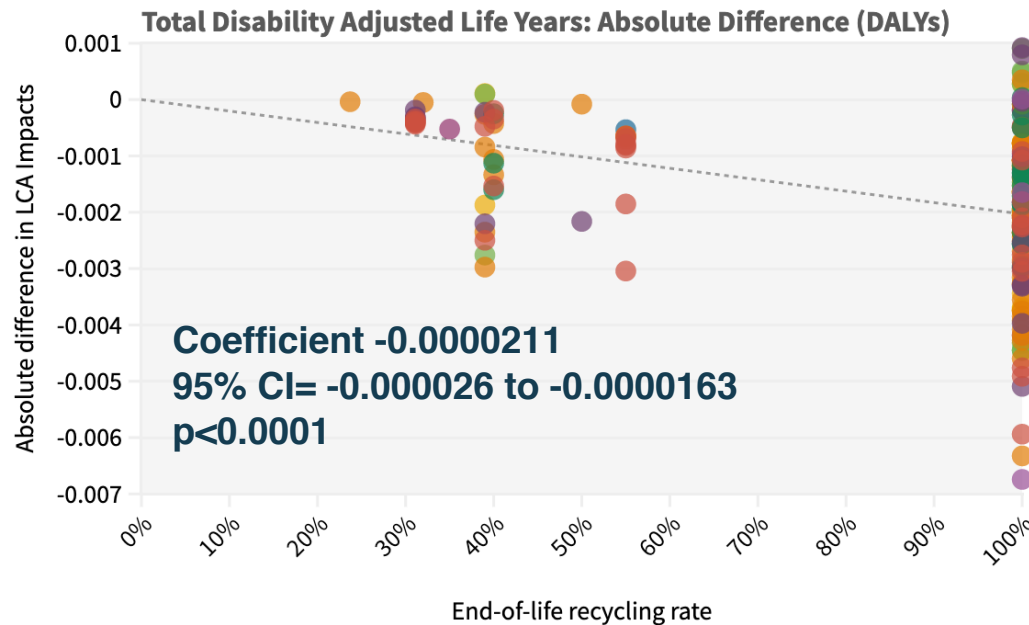
* Total across packaging types exceeds total number of studies as two studies included multiple product categories

Results

Meta-analysis of increasing recycling relative to incineration and landfill

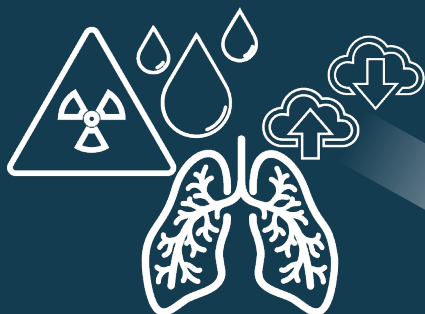


1 DAY
HEALTHY LIFE
GLOBALLY



Results

Pathways to human health

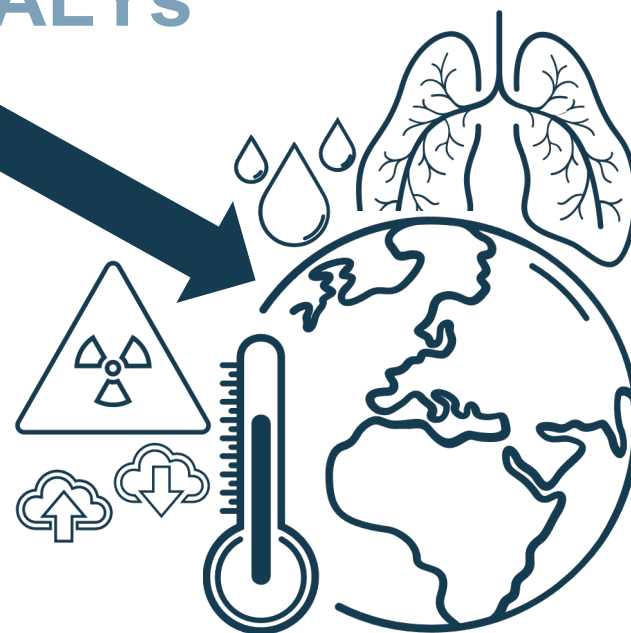
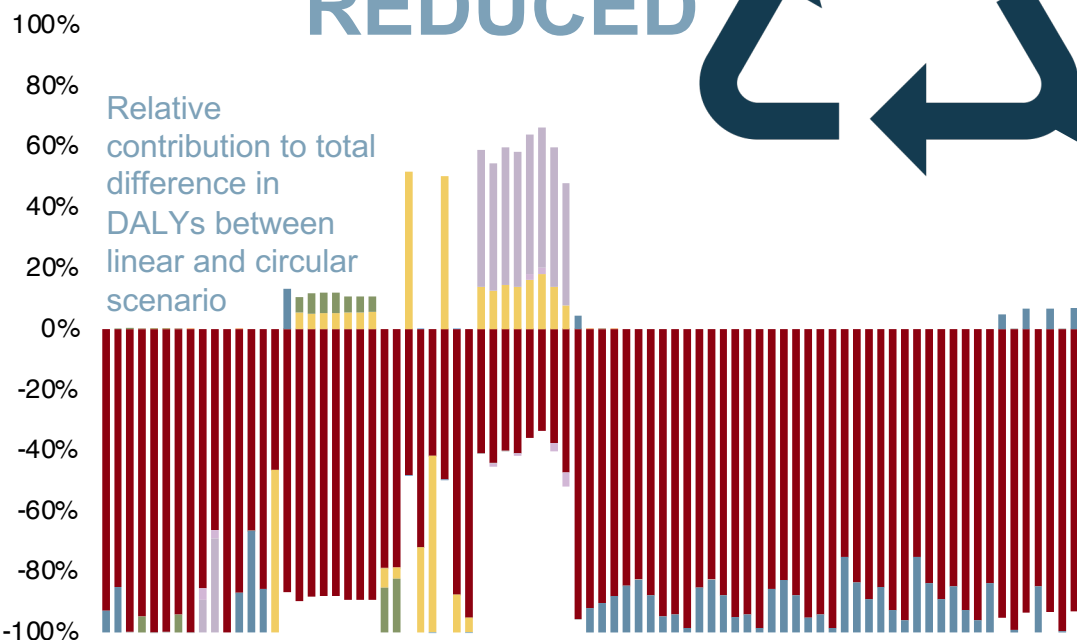


Evidence for co-benefits of **increasing recycling** mainly from **reducing health risks** associated with **climate change** impacts of landfill and incineration

Some possible trade-offs that are highly underexplored

REDUCED

DALYs



Results

Meta-analysis of reuse
vs single-use



On average

30 uses

to break-even with

**CLIMATE
IMPACTS**

of single-use

Reusable products
could increase health-
related impacts
substantially if not
actually reused

+850% Climate Change
+700% Ozone Depletion
+1000% Ozone Formation
+500% Human Toxicity
+5000% Water Use



Interpretation




Evidence for possible **health co-benefits** of **circular strategies** but many health considerations **unaccounted** for

Some evidence of **increased health risks** but **critically underexplored** in this literature



Future Research

Capitalising on the LCA framework for public health



Open burning of plastic could reach 144 million metric tons a year by 2040

PEW Charitable Trusts and SYSTEMIQ (2020)


The image shows a large fire burning in a field, with thick black smoke rising into the sky. The fire is consuming a large amount of material, likely plastic, as indicated by the text overlay.



12,000 million metric tons of plastic landfill and environmental pollution by 2050

R. Geyer et al. (2017)

The image shows a large pile of plastic waste, including bottles, bags, and other debris, scattered on the ground. The waste is piled up against a wall, and the ground is covered in a thick layer of plastic trash.



Mismanaged waste leads to between 400,000 to 1 million deaths per year in LMICs

Tearfund, Flora & Fauna International, WasteAid, IDS (2019)

The image shows a large pile of waste, including plastic bottles, bags, and other debris, scattered on the ground. The waste is piled up against a wall, and the ground is covered in a thick layer of plastic trash.

THANK YOU

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