Comparative Life Cycle Assessment of Hygienic Pads | Review

Project: Accelerating the Reduction of the Environmental Impact of Humanitarian Action

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Authors: Ashima Rajput, Dr Cara Tobin Greene, Sonja Schmid

Science and Technology for Humanitarian Action Challenges (HAC)

Project website: https://climateactionaccelerator.org/accelerating-the-reduction-of-the-environmental-impact-of-humanitarian-action/

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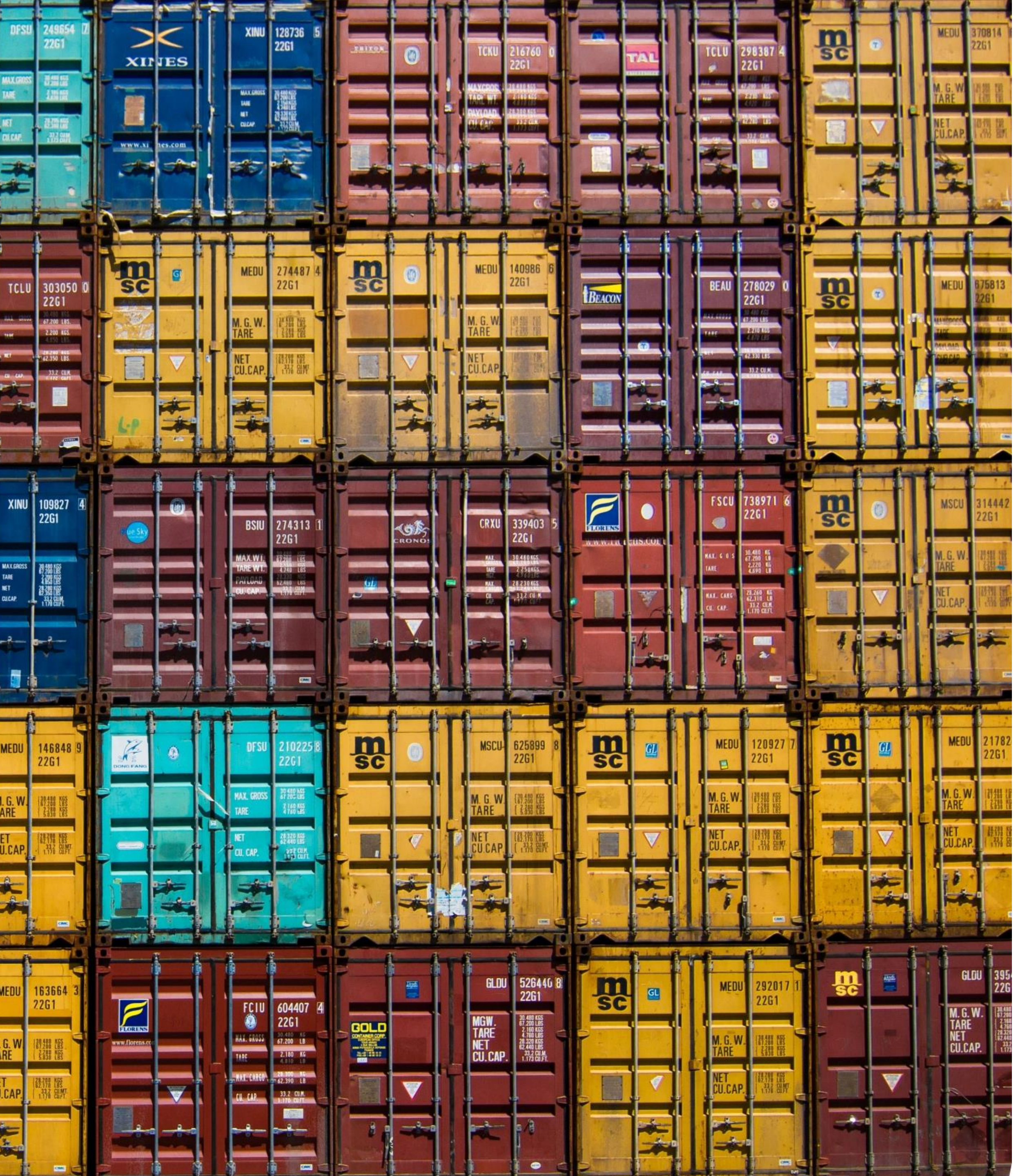


Acknowledgement

The findings from this analysis are based on an earlier study on the environmental impact of menstrual products conducted by *Fourcassier et al*. The data was reviewed and adapted in order to align with the streamlined methodology as developed as part of this project.

The content of this document is the sole responsibility of the project team.

Contents

Introduction

Objectives and scope

This analysis aims to enhance understanding of the item's impacts on climate, human health, and plastic leakage. It also identifies potential levers to reduce these impacts. However, assessing the feasibility of implementing these levers falls outside the scope of this project.

By no means is it suggested that life-saving assistance to the most vulnerable populations across the world should be reduced for decarbonisation purposes. Effective emissions and other impact reductions should not result in any reduction in the quality, quantity or timeliness of assistance, but rather should explore ways to reinforce or maintain aid, while identifying low-carbon, sustainable, and resilient alternative options.

Objectives and scope

Objectives:

- To establish GHG Emission Factors for **single-use & reusable hygienic pads** adapted to the humanitarian context
- To analyse the environmental impact of the product's life cycle and identify key levers for impact reduction through a comparison between the two products for an extended time period

Scope & System Boundary:

- **Cradle-to-grave*** system for the assessment of impact across the complete life cycle.
  - The materials, production, distribution, use and disposal of the product are in scope of the study
  - Any additional processes after production are not in scope e.g. unplanned storage, etc.
  - The procurement of the packaging is modelled, upstream activities related to the packaging are out-of-scope
  - The study focuses on one unit of the product and does not include larger-scale supply activities i.e. shipping per container, etc.

*In life cycle assessment, **cradle-to-grave** refers to evaluating a product's environmental impacts from raw material extraction through manufacturing, use, and final disposal. In contrast, **cradle-to-gate** focuses only on the stages up to the product's departure from the manufacturing site, excluding use and end-of-life phases.

Methodology

The results are calculated following the Environmental Footprint 3.1 indicator system in two categories:

- **Climate Change**: Global Warming Potential (GWP100)
- **Impact on Human Health**:
    - Human Toxicity: Carcinogenic and Non-carcinogenic
    - Ionising Radiation
    - Particulate Matter Formation
    - Photochemical Oxidant Formation
  - Weighted using the approach detailed in the EF methodology – with a percentage assigned to each sub indicator (see reference)
  - Normalized for one citizen so as to aggregate and represent as a single score for human health

Plastic leakage: Experimental projection of the amount of plastic leaked into nature via mismanagement of waste

References:
"European Platform on LCA | EPLCA.". https://eplca.jrc.ec.europa.eu/EnvironmentalFootprint.html
Joint Research Centre (European Commission), Alessandro Kim Cerutti, Rana Pant, and Serenella Sala. 2018. Development of a Weighting Approach for the Environmental Footprint. Publications Office of the European Union. https://data.europa.eu/doi/10.2760/945290

End-of-life

This study aims to model the impact differences between various waste management methods tailored closer to humanitarian contexts. The following end-of-life options were modelled in the analysis, as appropriate:

- **Open dump** (unmanaged)
- **Open burning** (unmanaged)
- **Unsanitary landfill** (minimal management)
- **Sanitary landfill** (managed site)
- **Municipal incineration** (managed plant)
- **Recycling** (as modelled)

For plastics, the differences in measured impact between each end-of-life scenario are similar. (For more info on the impacts and sources of end-of-life impact measurement please see annex.)

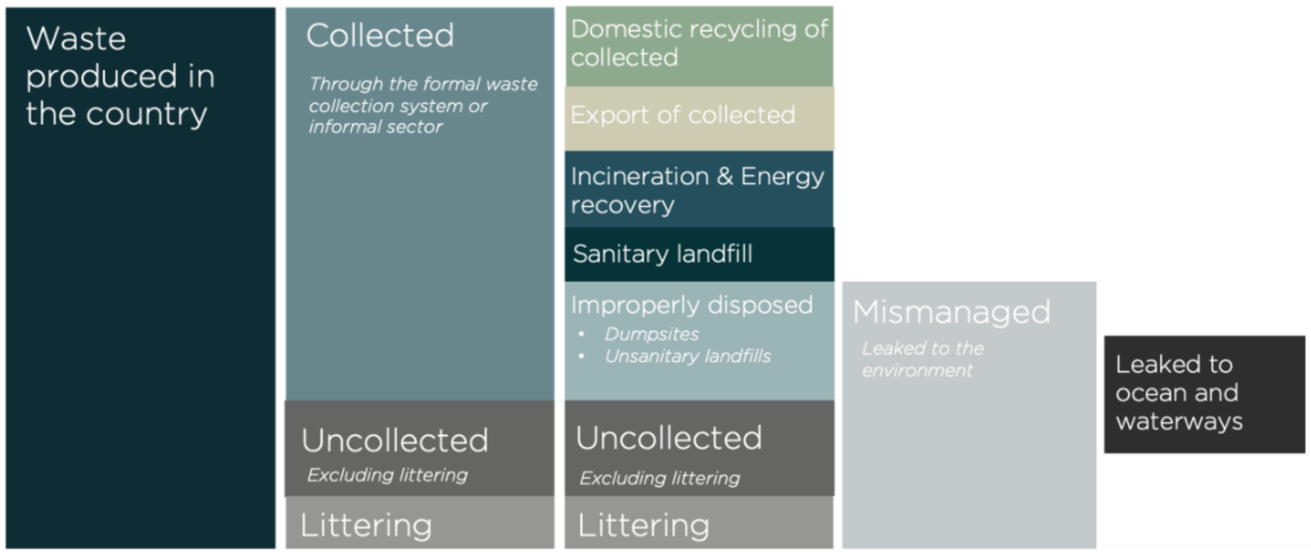
According to the LCA methodology, the analysis of greenhouse gas (GHG) emissions (Global Warming Potential)—is limited to a 100-year timeframe. As a result, any additional impact from plastic degradation in landfills occurring beyond this period is neither measured nor compared to other waste disposal methods.

Plastic leakage

This project aims to estimate the mismanaged waste that may occur at the end of life of products distributed by humanitarian organisations.

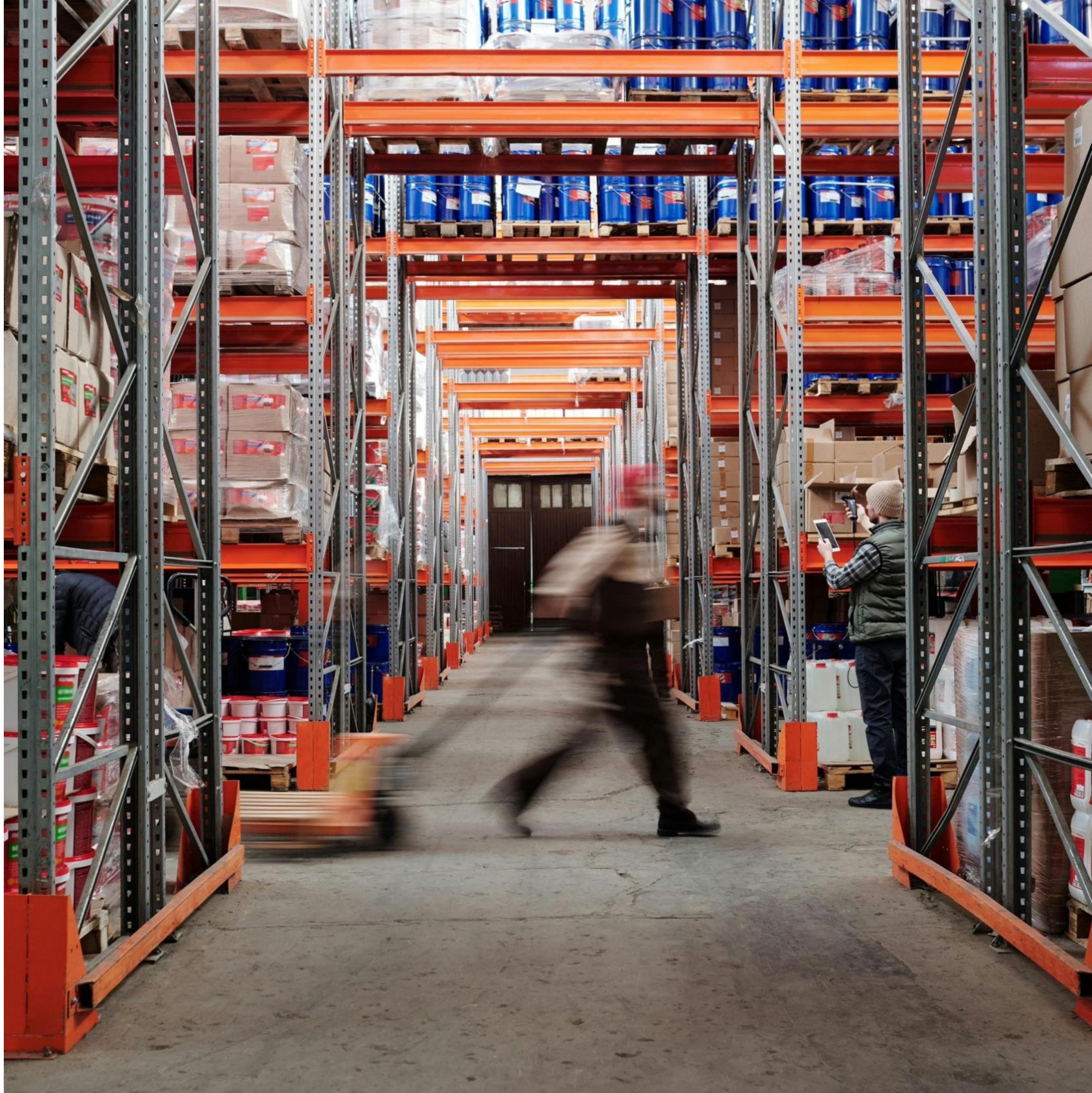
The modelled scenarios are analysed for plastic leakage by selecting the waste management method that is modelled and calculating the projected leakage (or lack thereof) due to the same.

For more information, please refer to: "Global Plastic Environmental Analytics Platform." Plasteax. https://plasteax.earth/.



Source: EA – Earth Action

LCA Results



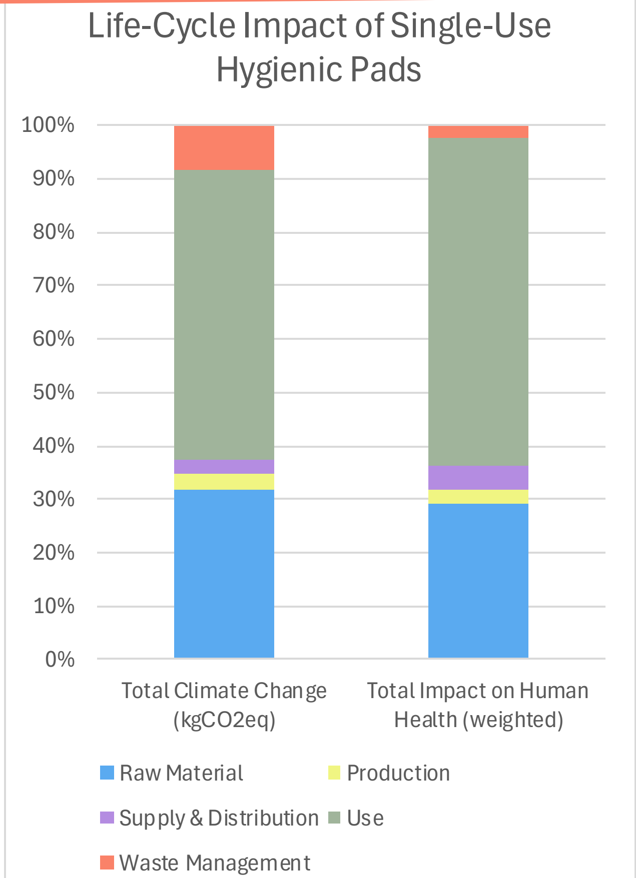
Key Product Parameters & Assumptions

LIFE-CYCLE STAGE	PARAMETER	DESCRIPTION OF MODEL
GENERAL	Field Context	11g net weight
Raw Material	Bill of Materials	Polyethylene, paper, glue, wood pulp
	Packaging	LDPE Film
Production	Manufacturing Location	Local to warehouse and distribution location (i.e. within 1,500 km)
	Manufacturing Processes	Modelled using energy and water use
Supply & Distribution	Transport Chain	TRUCK for procurement of materials (500 km) TRUCK to warehouse (1,500 km) & distribution (1,500 km)
Use	Utilization	10 pads per period (modelled low to represent scarcity)
	Usage Processes	Washing of hands after use of each pad (2L water & soap)
Waste Management	Product Disposal Method	Open Dumping + Wastewater
	Packaging Disposal Method	Open Dumping

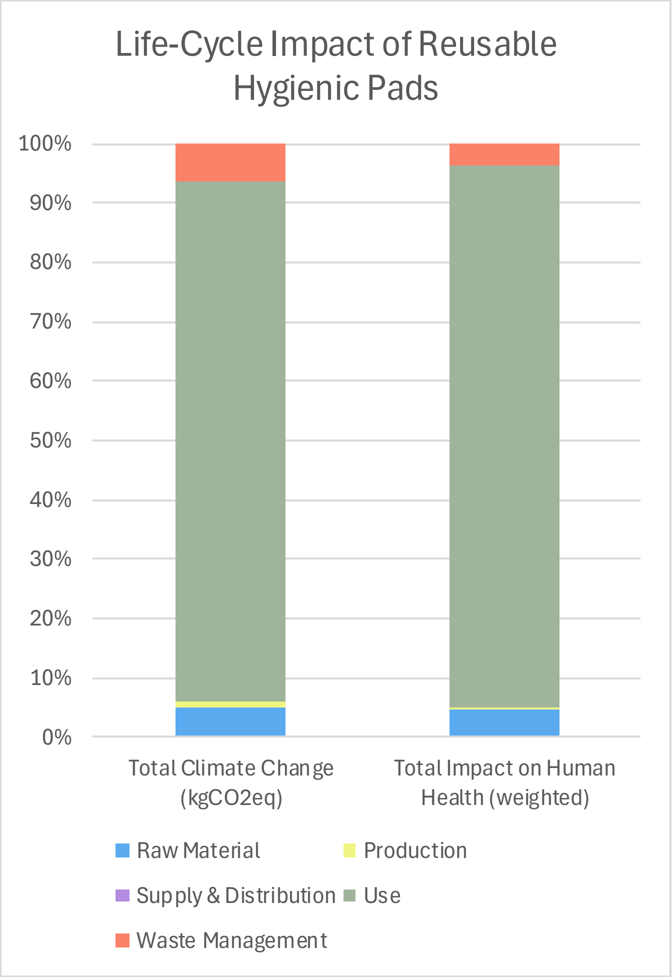
Key Product Parameters & Assumptions

LIFE-CYCLE STAGE	PARAMETER	DESCRIPTION OF MODEL
GENERAL	Field Context	43g net weight
Raw Material	Bill of Materials	Polyester, cotton
	Packaging	LDPE Film
Production	Manufacturing Location	India
	Manufacturing Processes	Modelled using energy use
Supply & Distribution	Transport Chain	TRUCK for procurement of materials (500 km) TRAIN to port (1,500 km), SEA to final location (10,000 km) TRUCK to warehouse (1,500 km) & distribution (1,500 km)
Use	Utilization	2 pads per year used interchangeably (5 times per period)
	Usage Processes	Washing of pad after each use (5L water + soap)
Waste Management	Product Disposal Method	Open Dumping + Wastewater
	Packaging Disposal Method	Open Dumping

Results



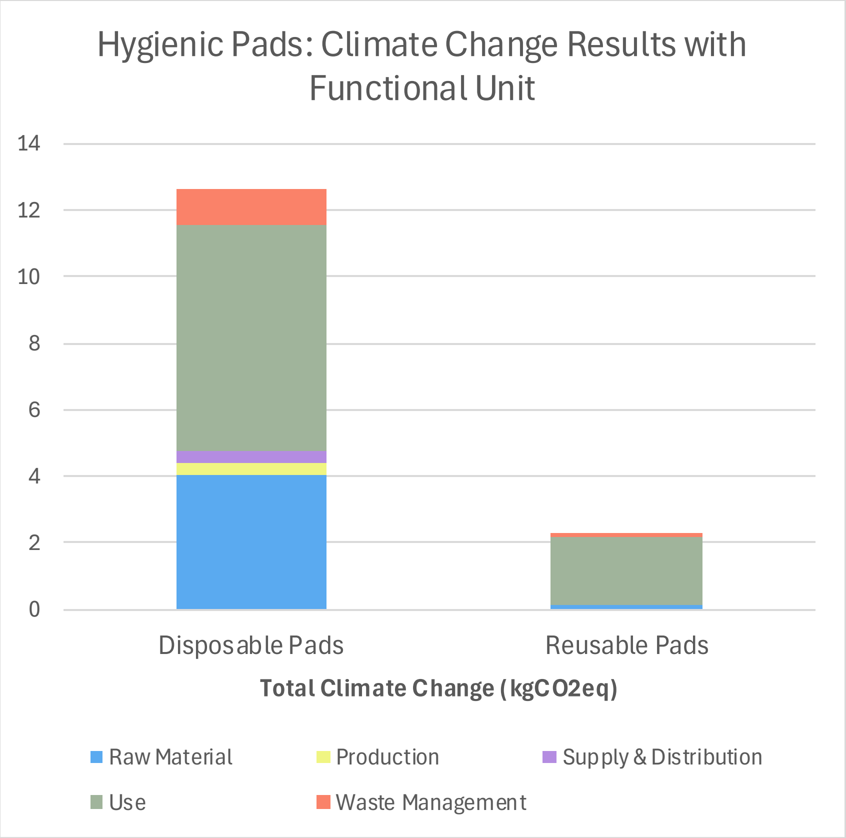
- For both types of pads, the largest share of impact is caused by the water during the use of the pads, consisting of handwashing for single-use pads and laundry for reusable pads
- For disposable hygienic pads it is **54%/61%** of GHG Emissions/impact on human health
- For reusable pads it is **88%/91%** of GHG Emissions/impact on human health
- Plastic leakage
  - All elements of this product cause plastic leakage due to the assumption of open dumping.

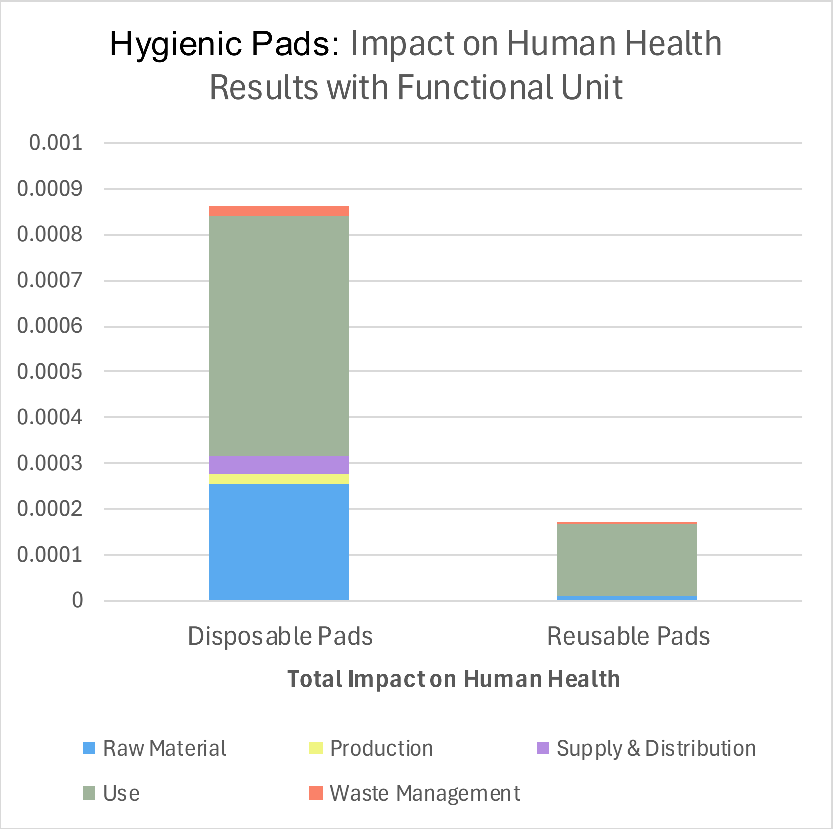


Emission factors		Unit
Cradle-to-grave	0.11	kgCO2eq/unit
Cradle-to-gate	0.04	kgCO2eq/unit

Emission factors		Unit
Cradle-to-grave	1.15	kgCO2eq/unit
Cradle-to-gate	0.07	kgCO2eq/unit

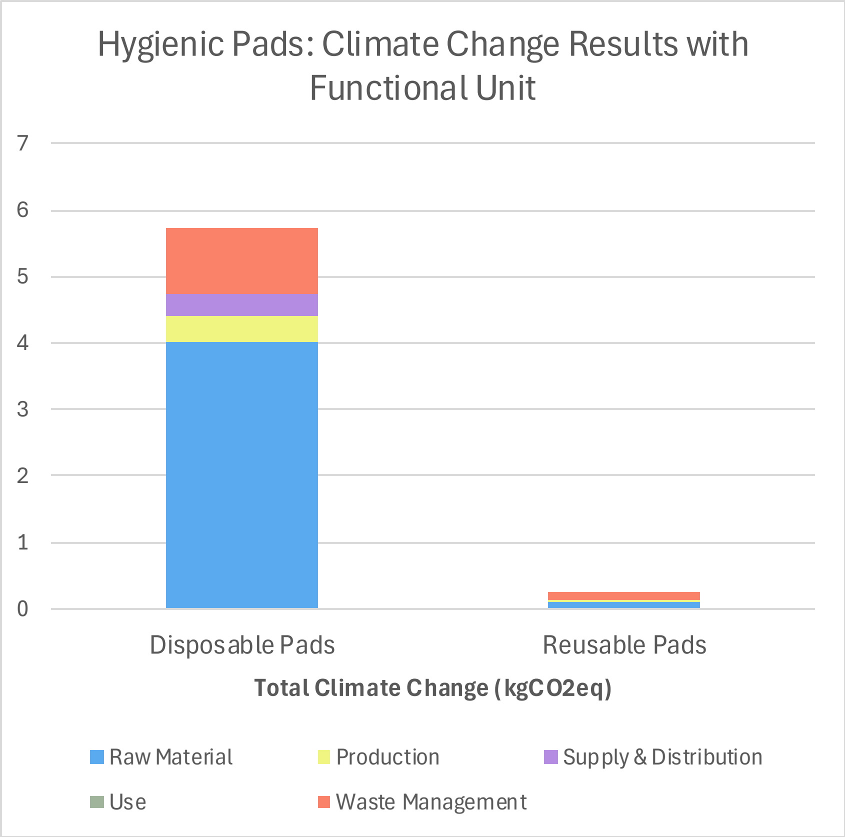
Comparative Results

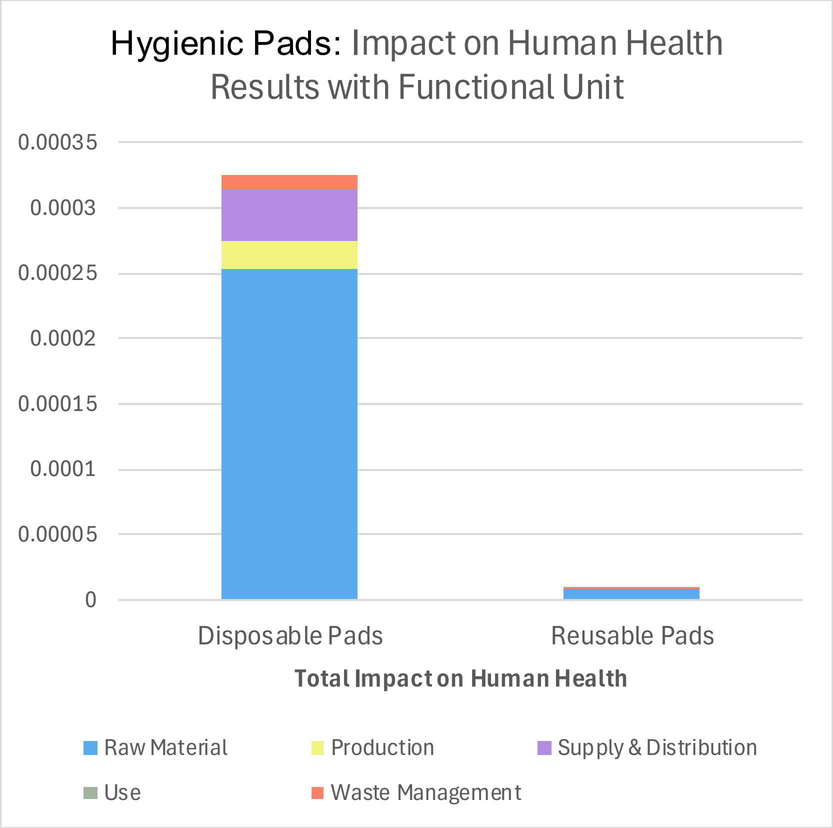




- The functional unit of this study is 12 periods. It was assumed that 120 disposable pads and 2 reusable pads are needed to fulfil this function.
- As a result, the comparative impact for 12 periods is significantly lower for reusable pads due to the lower amount of items needed, reducing the climate change impact by 82% and impact on human health by 80% for one year, primarily due to the water use

Comparative Results





- If water was not considered, the reduction would be even higher, amounting to a net 96% reduction in both categories due to a switch from 120 single-use pads to only 2 reusable pads

Key conclusions of comparative analysis

- Changing the type of hygienic pad used can significantly lower the impact of the item, when assuming effective reuse of the pad, in this case for 12 periods:
  - ▼ 82% climate change
  - ▼ 80% impact on human health
- The impacts to local ecosystems and water systems must be studied to expand on this result.

Email address contact@climateactionaccelerator.org

LinkedIn linkedin.com/company/theclimateactionaccelerator

Website climateactionaccelerator.org

Thank you!

Fourcassier, S. *et al.* (2022) 'Menstrual products: A comparable Life Cycle Assessment', *Cleaner Environmental Systems*, 7, p. 100096. Available at: https://doi.org/10.1016/j.cesys.2022.100096.

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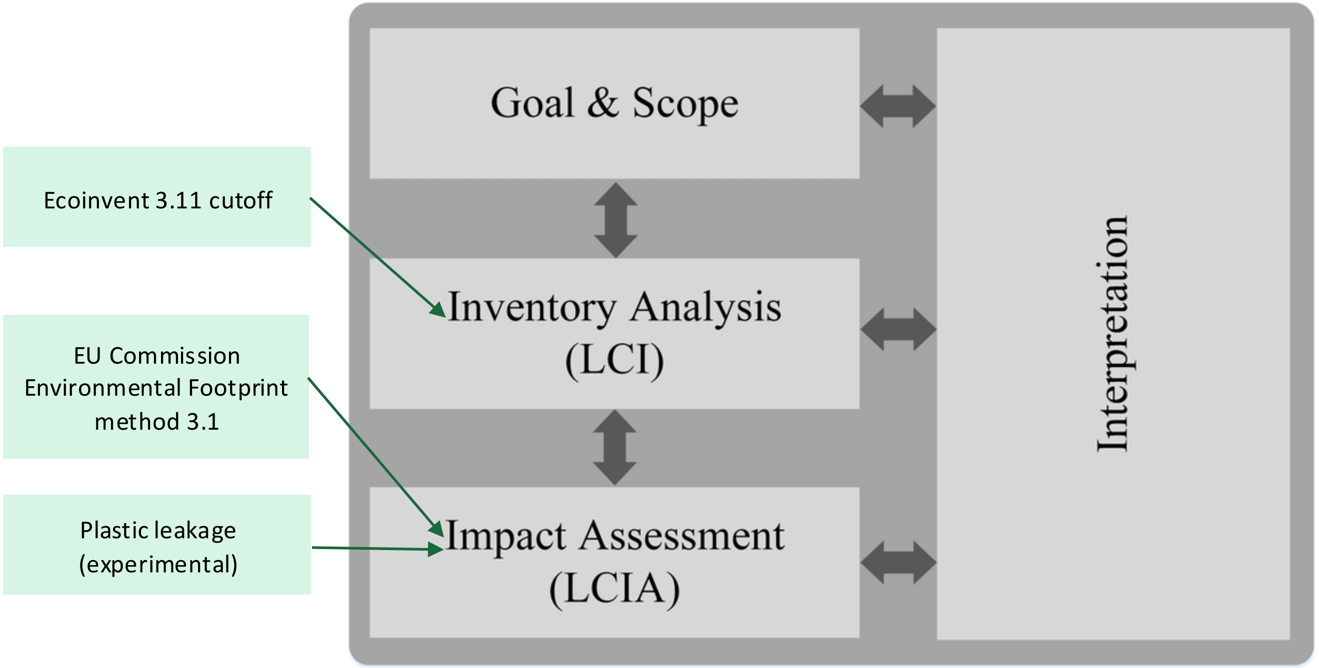
Methodology

The primary database used is Ecoinvent 3.11

The studies utilize the data from the **cut-off system model which allocates the entire impact of the material to its primary user** without any ‘rewards’ for its potential for being recycled.

Consequently, any recycled materials do not carry the burden of the impact of the primary use of the material and rather track the impacts from the recycling process onward.



Life cycle assessment (LCA) steps according to ISO 14040, 14044, and 14067.

References:
“Ecoinvent v3.11.” n.d. Ecoinvent. https://ecoinvent.org/ecoinvent-v3-11/

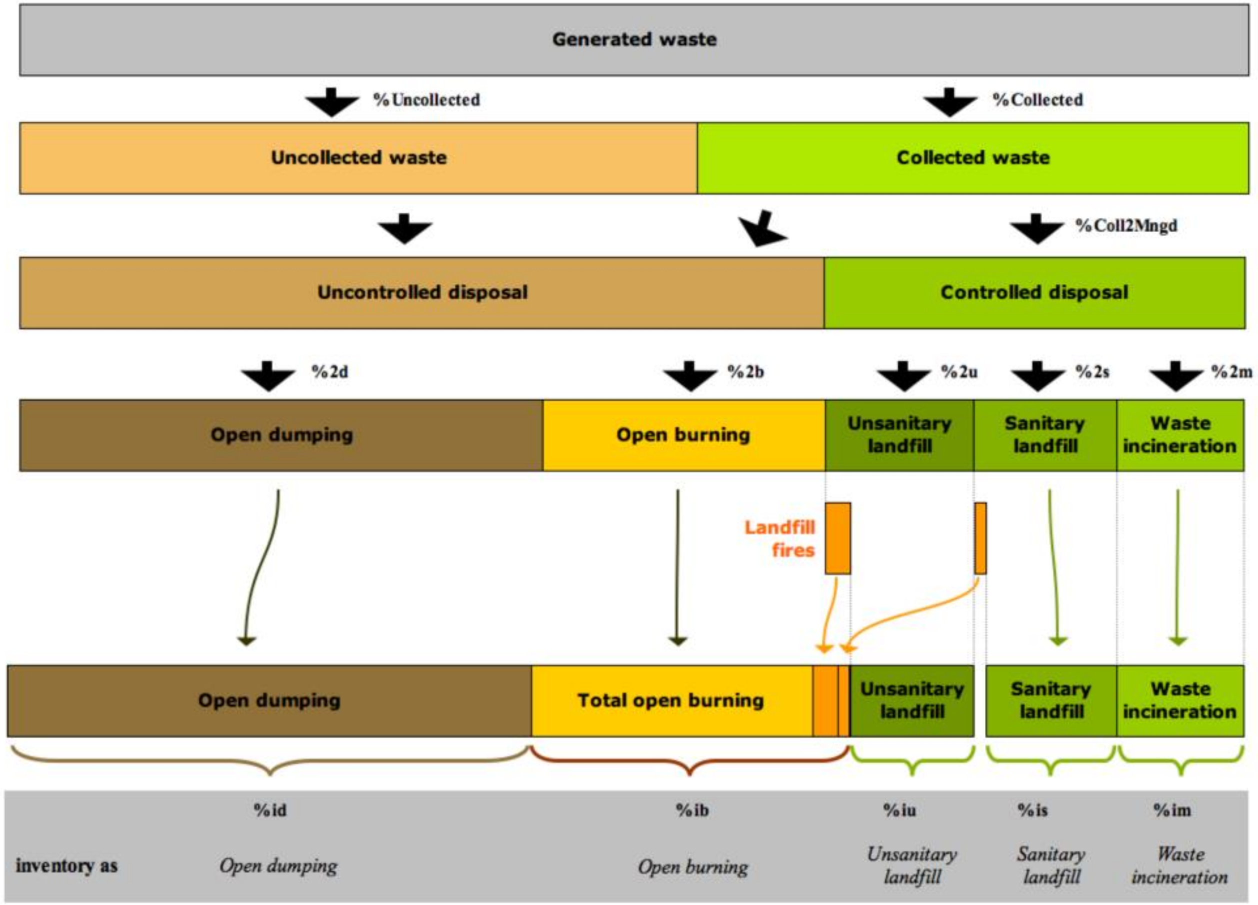
End-of-life waste management

This study aims to model the impact differences between **managed and mismanaged** waste tailored closer to humanitarian contexts.

The end-of-life impact for *a mix of plastic waste* reduces as below:

Method	GHG Emissions	Impact on Human Health
Open Burning	~HIGHEST~	~HIGHEST~
Municipal Incineration	-2.60%	-96.03%
Unsanitary Landfill	-93.80%	-99.40%
Open Dumping	-95.50%	-99.87%
Sanitary Landfill	-96.22%	-99.06%

Open burning creates maximum impact for both categories, but beyond that there are differences between climate change and human health on the specific magnitude of reduction.



Doka, G., 2018, Inventory parameters for regionalised waste disposal mixes

This study uses values for specific types of plastic wherever necessary, however the proportions of impact follow similar trends across the types of plastic product. This is therefore the standard impact implication for plastic products at end-of-life. Whenever possible, recycling is also modelled as a waste treatment option within the scope of the study.

NOTE: The methods listed above have differences in how long it takes for the plastic to be removed. It is part the LCA methodology that measurements are limited to a 100 years, therefore any further impact due to the degradation of plastic in landfills is not measured or compared with other methods of disposal.