



BIO-BASED TECHNOLOGIES FOR SOLID WASTE MANAGEMENT IN HUMANITARIAN OPERATIONS. A CASE STUDY FOR BIO4HUMAN

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CONTEXT

Waste Management Issue in Humanitarian Operations

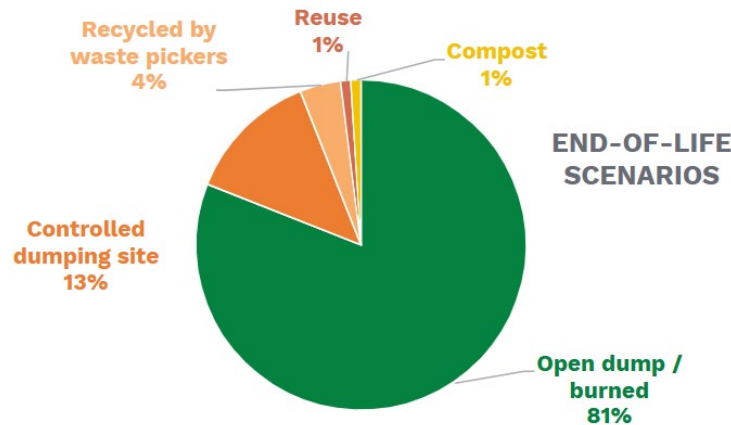
Humanitarian Aid



Natural disasters



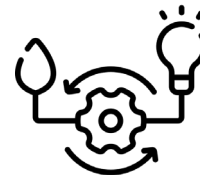
Human-made disasters



End-of-life scenarios considered for reference scenarios in DRC and South Sudan



in May 2021, The Climate and Environment Charter for Humanitarian Organizations



BIO4HUMAN

Addressing the challenge brought by the solid waste management crisis in humanitarian settings by deploying innovative bio-based solutions, systems, and technologies.

METHODOLOGY

Identification of Bio-Based Technological Solutions



Surveys with the Bio-Based Industry Consortium



Literature review



The bio – based solutions delivered by CBE JU projects



Analysis of EUIPO and EPO patent databases

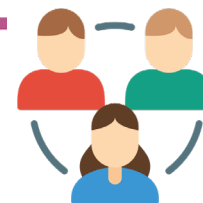
Challenges of Bio-Based Solutions in Humanitarian Operations



ECONOMIC VIABILITY



OPERATIONAL AND LOGISTICAL CHALLENGES

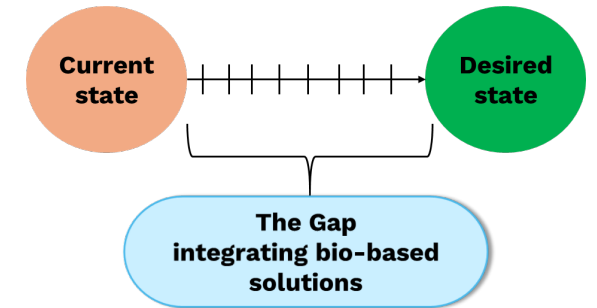


KNOWLEDGE GAPS/
SOCIAL AND CULTURAL
BARRIERS



REGULATORY HURDLES

Gap Analysis Through all Supply Chain



D3.3 Humanitarian Sector Needs Assessment Report

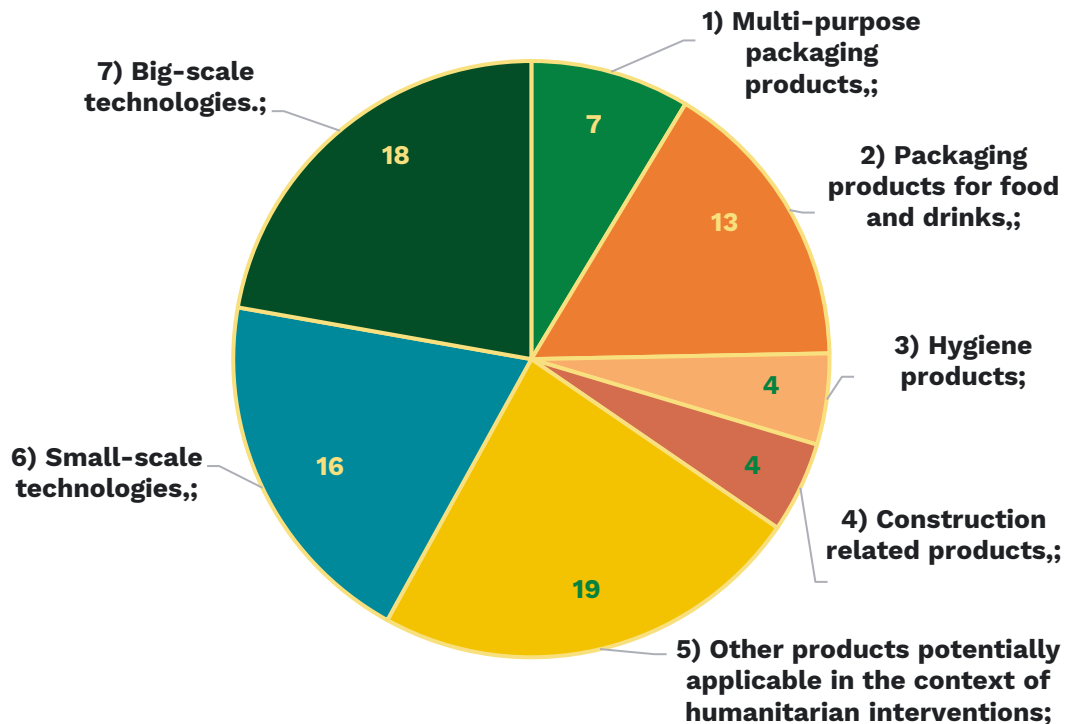
Interviewing Supply Chain Leaders

Multiple Studies

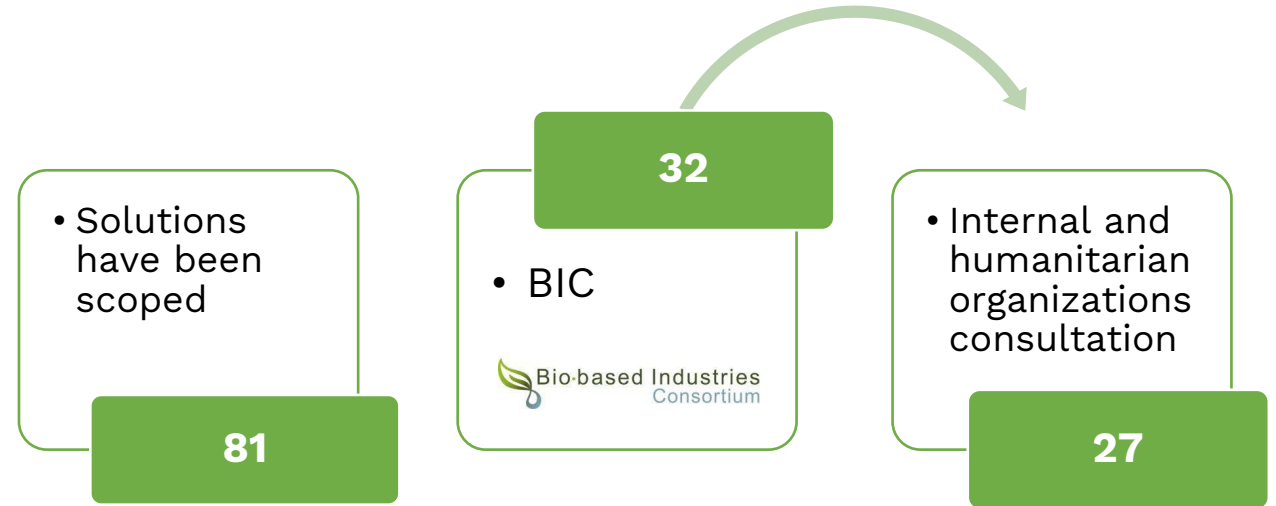
Gaps Identification

RESULTS

Clustering the 81 *bio-based Solutions* with Potential Application in the Humanitarian Settings



Scoping the Bio-Based Technological Solutions



Products:

Compostable and / or biodegradable



Technologies:

Suitable for rural and low-resources settings



RESULTS

27 bio-based Innovative Technological Solutions



**21
PRODUCTS**

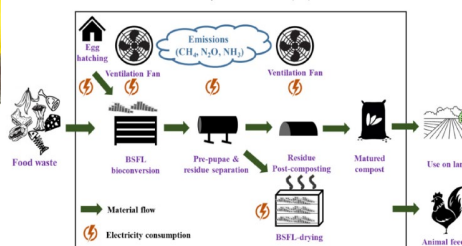
**6
TECHNOLOGIES**

Bio-Based Technological Products



Small – Scale Bio-Based Technologies

- Black soldier fly (BSF) Technologies (waste to compost)



- Biodigesters (waste to energy)

1. Modular micro AD system – Qube Renewables
2. Single Stage Biogas Digester
3. Micro Biogas Digester
4. Domestic biogas technologies



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SUSTAINABLE SOLUTIONS FOR THE CHALLENGES OF SOLID WASTE MANAGEMENT IN HUMANITARIAN CONTEXTS

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Background

Humanitarian organizations face missing tools and inefficient support to improve sustainable waste management.

Poor Waste Management

Hard-to-reach locations

Lack of priority

Financial constraints

- ❑ Inadequate waste management: 87% of waste is either openly dumped or burned.
- ❑ Limited controlled disposal: 13% of waste ends up in controlled dumping sites, which, while better, still falls short of sustainable management.
- ❑ Informal recovery and valorization: Recycled by waste pickers (4%). Reuse (1%), Compost (1%).
- ❑ The overwhelming majority of waste is not adequately managed, emphasizing a critical need to improve solid waste systems and promote circular economy strategies.

Objective

To identifying bio-based solutions for sustainable waste management applicable to the humanitarian sector

Results

Case-study: Valorization of organic waste through Black soldier fly (BSF)

Goal and scope: To evaluate the environmental benefits of treating 1 kg of organic waste by BSF compared with BSF from a cradle-to-grave perspective in comparison with a treatment mix.

System boundaries: Inventory from literature[†]

Methodology: EP 3.1

Methodology

1. Setting up the problem: Two locations + humanitarian Aid Life Cycle
2. Then humanitarian aid kits (Zemchuk) settings
3. Step - Assessment
4. 27 innovative solutions identified

The integrating the based solution

Life cycle assessment

(Lower impacts than conventional products / treatment technologies)

Impact results (per kg):

Metric	Treatment mix	BSF
GWP (kg CO ₂ e/kg)	~0.8	~0.15 (97% reduction)
ADP (MJ/kg)	~0.8	~0.15 (97% reduction)
Energy demand (MJ/kg)	~0.8	~0.15 (97% reduction)

BSF may be considered a potential bio-based solution:

- Global warming potential is sharply reduced in BSF in comparison with the reference treatment mix.
- BSF demonstrates a much lower dependence on fossil fuels.
- Land use is substantially reduced with BSF treatment, allowing nearly no land demand, in contrast to the treatment mix.

Conclusions

- ❖ Biohuman is currently identifying potential bio-based solutions to substitute conventional products in humanitarian-aid contexts.
- ❖ A case study based on a circular supply chain using BSF larvae can produce high-value bioproducts, reducing global warming, fossil energy and land occupation categories.
- ❖ This study has demonstrated that the valorisation of organic waste through BSF outperforms traditional composting.

References

[†] M. Rumayor, R. Pérez, J. García-González, et al., "Improving the sustainability of humanitarian aid: A life cycle assessment of the waste management of the Spanish humanitarian aid organization," *Journal of Cleaner Production*, vol. 304, p. 127044, 2022.

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