

Integrating Social Value into Circular Waste-to-Energy Strategies for Humanitarian Settings: A Life Cycle Sustainability Approach

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Background

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



Poor Waste Management



Lack of priority



Hard-to-reach locations



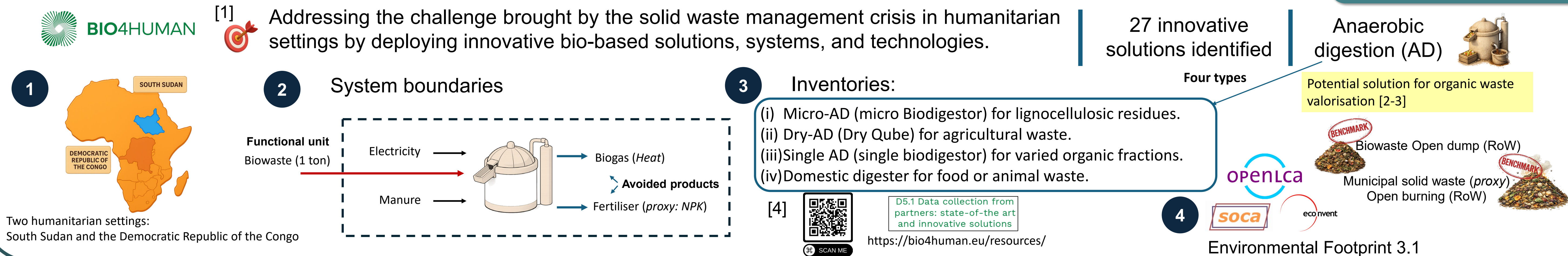
Financial constraints

- ❑ Inadequate waste management: 81% 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.
- ❑ Minimal 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 evaluate the environmental and socio-economic implications of circular waste-to-energy strategies identified within the framework of the Bio4HUMAN project using a life cycle assessment (LCA) perspective.

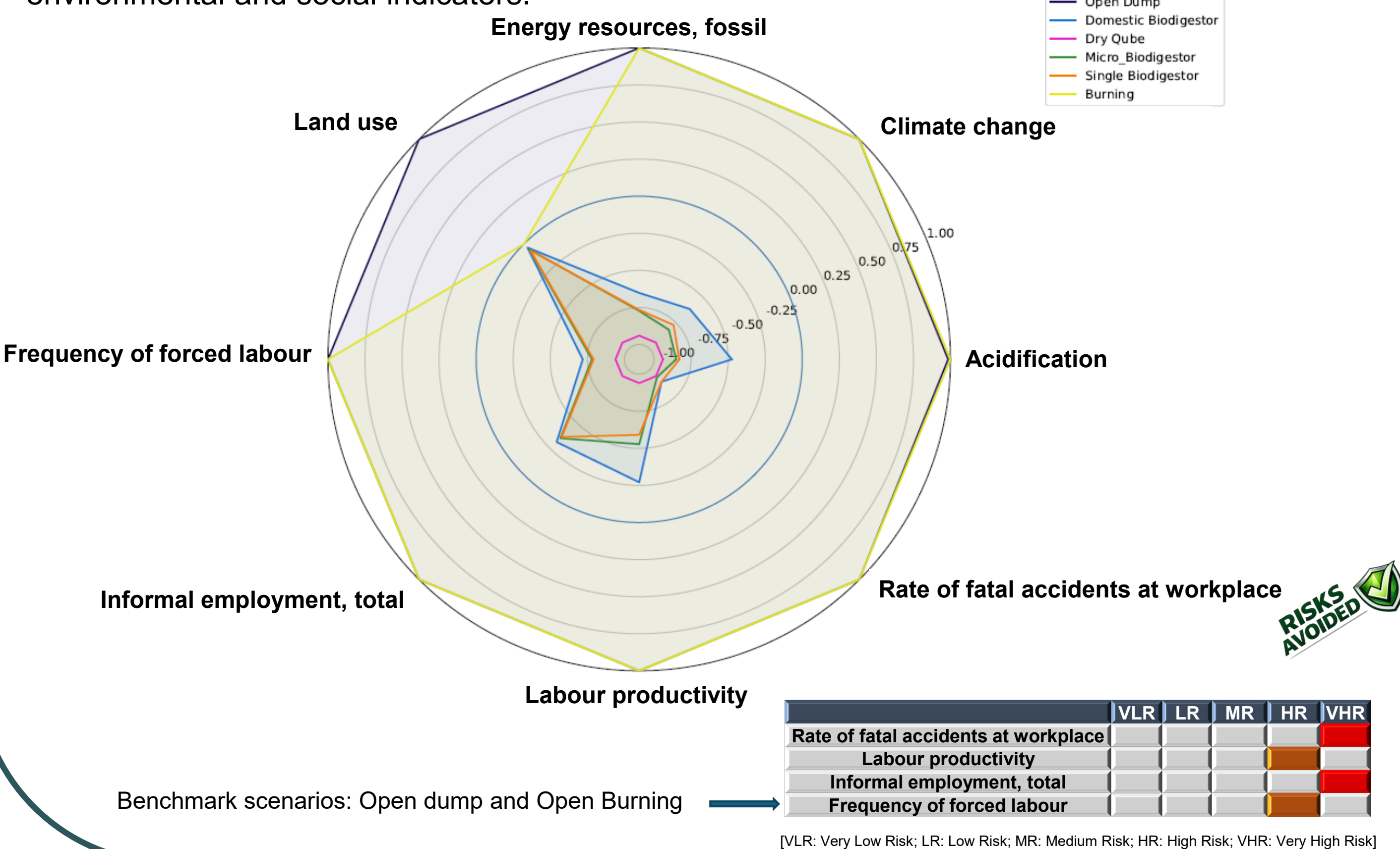
Methodology



Results

Normalised environmental and social performance of biowaste management scenarios in humanitarian settings

A relative min-max normalisation was applied to each indicator, scaling results between -1 (best performance) and +1 (worst performance) for a better comparison of heterogeneous environmental and social indicators.



❖ All anaerobic digestion scenarios outperform conventional disposal practices, with Dry Qube achieving the best overall performance across all environmental and social indicators.



- ❑ Up to -13,200 MJ energy resources per ton of waste.
- ❑ Strong reduction in land use impacts (~300,000 units of improvement).
- ❑ Net reduction of greenhouse gas emissions (up to -1300 kg of CO₂eq).



- ❑ Up to ~12,000 risk hours reduction in workplace accidents.
- ❑ Improved labour productivity through reduced risk exposure.
- ❑ Lower levels of informal employment and forced labour risk.

❖ Biodigestion systems show improved performance by **recovering energy** (heat) and **nutrients** (fertiliser), while simultaneously **mitigating the environmental and social impacts associated with open dumping and burning**.

❖ Dry Qube achieves the **best performance** due to **higher process efficiency, maximised resource recovery, and reduced environmental and social risks**.

Conclusions

- ✓ Developed within the Horizon Europe project Bio4HUMAN, this study assessed circular Waste-to-Energy solutions for humanitarian settings.
- ✓ All anaerobic digestion scenarios outperformed conventional practices, with Dry Qube achieving the best overall performance across all indicators.
- ✓ Biodigestion systems enhanced sustainability by producing heat and fertiliser while avoiding the impacts of conventional practices such as open dumping and open burning.

References

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Partner Institutions

