BIO4HUMAN

Humanitarian sector needs assessment report

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5Ws	Who, What, Where, When and Why
AALI	African Agriculture Leadership Institute
AIMPLAS	Asociación de Investigación de Materiales Plásticos y Conexas
ASOV	Action Solitaire aux Vulnérables
BHA	Bureau for Humanitarian Assistance
BK	Briquette du Kivu
BSF	Black soldier flies
CFRM	Community Feedback and Response Mechanism
CHS	Core Humanitarian Standards
DRC	Democratic Republic of the Congo
ECHO	European Commission Humanitarian Aid
EHA Connect	Connecting Environment and Humanitarian Action
FAPROS	Femme en Action pour le Progres Social
FCDO	Foreign, Commonwealth and Development Office
FGD	Focus Group Discussion
GA	Grant Agreement
GESI	Gender Equality and Social Inclusion
GH	General Hospital
GHA	Global Humanitarian Assistance
GLC	Global Logistics Cluster
HC	Health Center
HDPE	High-density polyethylene
HF-AFRICA	Held Food Security & Livelihood Africa
HNPW	Humanitarian Networks and Partnerships Weeks
HOs	Humanitarian Organizations
HPC	Humanitarian Procurement Center
HSC	Humanitarian Supply Chain
HUB	Bioeast Hub CR, Z. U.
IAPSO	Inter-Agency Procurement Services Office
IASC	Inter-Agency Standing Committee
IBF	Irish Bioeconomy Foundation
ICRC	International Committee of the Red Cross
IDP	Internally Displaced People
IFRC	International Federation of Red Cross and Red Crescent Societies
IHO	International Humanitarian Organization
IITA	International Institute of Agriculture
ISWA	International Solid Waste Association
ISWM	Integrated Solid Waste Management
ITENE	Instituto Tecnológico del Embalaje, Transporte y Logística

JEU	Joint Environment Unit
JI	The Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management
JICA	Japan International Cooperation Agency
KII	Key Informant Interview
LCA	Life Cycle Assessment
MEAL	Monitoring, Evaluation, Accountability, and Learning
MERS	Minimum Environmental Recommendations and Requirements
MONUSCO	The United Nations Organization Stabilization Mission in the Democratic Republic of the Congo
MRF	Material Recovery Facility
MSF	Doctors Without Borders (*Médecins Sans Frontières*)
NGO	Non-Governmental Organizations
NHO	National Humanitarian Organization
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PAH	Polish Humanitarian Action
PDM	Post-Distribution Monitoring
PET	Polyethylene terephthalate
PF-EHA/GIE	Platform - Water, Hygiene, Sanitation/Economic Interest Grouping (*Plateforme – Eau, Hygiene, Assainissement/Groupement d'intéret économique*)
PIN	People in Need
POPs	Persistent Organic Pollutants
PP	Polypropylene
PPP	Public-Private Partnership
PROCVIS	Fundacja Edukacji i Dialogu Spolecznego PRO CIVIS
PSEA	Protection from Sexual Exploitation and Abuse
RC	Red Cross
REH	Réseau Environnement Humanitaire
RLH	Réseau Logistique Humanitaire
RUTF	Ready-to-Use Therapeutic Food
SK	South Kivu (province in DRC)
SOA	Synergy of Sanitation Organizations in DRC (*Synergie des Organisations Assainissant la RD Congo*)
SOPs	Standard Operating Procedures
SWM	Solid waste management
UC	Universidad de Cantabria
UN	United Nations
UNEP	United Nations Development Programme
UNGM	United Nations Global Marketplace
UNHCR	United Nations High Commissioner for Refugees
UNIGOM	University of Goma

UNOPS	United Nations Office for Project Services
UOB	Official University of Bukavu
USAID	United States Agency for International Development
WASH	Water Supply, Sanitation, and Hygiene Promotion
WFP	World Food Programme
WIR	World Institute Research
WHO	World Health Organization
WMA	Waste Management Area (*zone de déchet* in DRC health facilities)
WP	Work Package
WREC	Waste management & measuring, Reverse logistics, Environmentally sustainable procurement & transport, and Circular economy project

Executive Summary

This Bio4HUMAN project public deliverable D3.3 - *Humanitarian Sector Needs Assessment Report* presents the findings from the needs assessment prepared and conducted from March 2024 – July 2024 by People in Need (PIN) and Polish Humanitarian Action (PAH) in Democratic Republic of the Congo (DRC), South Sudan, and in Europe. D3.3 expands upon the deliverables D3.1 (Stakeholder Analysis) and D3.2 (Scoping Plan). In D3.1, the Bio4HUMAN stakeholders were identified, and strategies for engaging them were devised. D3.2 detailed the plan for the scoping exercise, encompassing both the first and second phases. In D3.3, the identified stakeholders participated as respondents in quantitative and qualitative surveys, and secondary data were gathered according to the plan outlined in D3.2. The goal of D3.3 is to feed into the process of identification of bio-based solutions, which will be conducted under the WP4. The identified bio-based solutions will then be assessed through the environmental life cycle assessment (LCA) in WP5, and their socio-economic and governance aspects will be evaluated through a feasibility study and innovation test bed in WP6.

This document outlines firstly the qualitative and quantitative methodologies used for the humanitarian sector needs assessment, incorporating both primary and secondary data. Secondly, the findings are presented, focusing on the types of waste present in humanitarian settings, solid waste management (SWM) standards and sustainable models, and the current state of SWM in these settings. Lastly, the main challenges related to SWM in humanitarian settings are identified, and opportunities, including the potential use of bio-based solutions, are described.

The D3.3 is under the Work Package 3 of the Horizon Europe-funded Bio4HUMAN project: *Identifying Bio-Based Solutions for Waste Management Applicable to the Humanitarian Sector*. Bio4HUMAN, coordinated by Enspire Science Ltd., aims to provide stakeholders in the humanitarian and bio-based sectors with science-based information on the application potential, sustainable performances, and circularity of bio-based products and systems suitable for humanitarian purposes. Bio4HUMAN is an interdisciplinary project bringing together experts from the bio-based, circular economy, and humanitarian sectors. The project includes bio-based sector actors

such as the following manufacturers and processors: Instituto Tecnológico del Embalaje, Transporte y Logística (ITENE) and Asociación de Investigación de Materiales Plásticos y Conexas (AIMPLAS); bio-based and circular economy experts from Fundacja Edukacji i Dialogu Spolecznego PRO CIVIS (PROCIVIS), Irish Bioeconomy Foundation (IBF), WeLOOP and Bioeast Hub CR, Z. U. (HUB); academia represented by Universidad de Cantabria (UC); and humanitarian aid operators PIN and PAH.

1. Introduction

Humanitarian action and environment

Humanitarian assistance, guided by the principles of humanity, impartiality, neutrality, and independence, intends to save lives, alleviate suffering and maintain human dignity during and after man-made crises and disasters caused by natural hazards. Driven by the humanitarian imperative, an absolute moral obligation to save lives and alleviate human suffering based on need, without discrimination[1], humanitarian sector focuses on people affected by conflict and disasters, looking in particular at their needs related to health, food, shelter and education.[2] In line with the "Do No Harm" (DNH) principle, the humanitarian sector should ensure that it does not unintentionally contribute to environmental degradation or worsen existing environmental vulnerabilities, which could result in additional harm to affected communities. Nevertheless, the impacts on the environment - either related to the disaster itself, or to the ensuing humanitarian activity – are often viewed as secondary to the humanitarian imperative.[3]

Since 2005 when the environment was recognized as an integral cross-cutting issue in the humanitarian cluster approach (as part of the Humanitarian Reform Agenda[4]), there has been a growing recognition of the importance of addressing the environmental impacts of humanitarian aid. Consequently, more humanitarian organisations (HOs), donors and initiatives started to focus on so-called greening of humanitarian assistance. Additionally, there has been an increasing awareness of the need to incorporate environmental protection and sustainability into humanitarian responses. *The Climate and Environment Charter for Humanitarian Organizations*[5] (the Climate Charter), officially launched in May 2021, has sent a clear signal that humanitarian actors have a key role to play in addressing both humanitarian and environmental crisis. More than 400 organisations (together with donors, relevant government agencies and foundations) have already signed the charter, recognizing that humanitarian organization must increase their environmental sustainability.[6] Despite these efforts, the environment has not been

[1] Humanitarian Congress. (2024). The humanitarian imperative is non-negotiable. Retrieved from https://humanitariancongress.at/event/the-humanitarian-imperative-is-non-negotiable/.
[2] Brangeon, S. A., & Crowley, F. (2020). Environmental footprint of humanitarian assistance: Scoping review (p. 5). URD. Retrieved from https://reliefweb.int/report/world/environmental-footprint-humanitarian-assistance-scoping-review.
[3] Ibid.
[4] Inter-Agency Standing Committee (IASC). IASC transformative agenda. Retrieved from https://interagencystandingcommittee.org/iasc-transformative-agenda.
[5] Climate Charter. Retrieved from https://www.climate-charter.org/.
[6] Brangeon, S. A., & Crowley, F. (2020). Environmental footprint of humanitarian assistance: Scoping review (p. 5). URD. Retrieved from https://reliefweb.int/report/world/environmental-footprint-humanitarian-assistance-scoping-review.

fully mainstreamed in humanitarian response.[7] Moreover, recent carbon accounting exercises led by humanitarian organizations have confirmed that supply chains and procurement (e.g. packaging, transportation, energy use, materials sourcing) contribute significantly to their overall environmental footprint.[8] Nevertheless, the appetite for environmental sustainability including innovative approaches amongst HOs (both local and international) is growing as confirmed by the Waste management & measuring, Reverse logistics, Environmentally sustainable procurement & transport, and Circular economy project (WREC) baseline study (2022) that showed that 86% of HOs are looking into the environmental impacts of humanitarian logistics, and only 5% responded 'no'. [9] Moreover, 44% of the respondents (47) indicated that green procurement represents the most relevant area to reduce the environmental impacts associated with their operations.[10]

In response to this need, Bio4HUMAN aims to introduce innovative bio-based solutions, systems, and technologies for HOs to enhance the environmental sustainability of their interventions. This deliverable is intended for the non-humanitarian Bio4HUMAN partners as well as representatives of bio-based industry and bioeconomy field interested in the topic of solid waste management in humanitarian settings as it includes a description of humanitarian SWM concepts and standards, and knowledge known to humanitarian practitioners as well as overview of the general environment and context of SWM in South Sudan and DRC that influences humanitarian SWM.

The humanitarian sector needs assessment with regards to SWM consisted of the following steps:

1. A detailed literature on waste and SWM in humanitarian settings
2. Field assessment in DRC and South Sudan

2. Methodology

The preparation, conduct and report writing of the D3.3 took place from March 2024 to July 2024 by PIN and PAH. The methodology of the T3.3 was developed and described in D3.2 (Scoping Plan), while the primary data was collected from stakeholders identified in D3.1 (Stakeholder Analysis). In the initial phase of T3.3, PIN reviewed and analysed global secondary data. In parallel, a detailed methodology for primary data collection was designed in collaboration with PAH and with inputs (comments) from other Bio4HUMAN partners, including PROCIVIS, ITENE and Enspire. The field data collection was carried out by PIN MEAL Global Advisor and the PIN national team in DRC, and by PAH Senior Humanitarian Manager and the PAH national team in South Sudan. The process followed all the ethics requirements of Horizon Europe, as specified in the deliverable D9.6 (Summary of

[7] Joint UNEP/OCHA Environment Unit (JEU). (2014). Environment and humanitarian action: Increasing effectiveness, sustainability, and accountability (p. 6). Retrieved from https://preparecenter.org/wp-content/uploads/2021/03/Environment-in-Humanitarian-Action-2014-1.pdf.
[8] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Multi-donor policy landscape analysis (p. 3). Retrieved from https://eecentre.org/wp-content/uploads/2023/01/Multi-Donor-Policy-Landscape-Analysis.pdf.
[9] Ibid. (p.6).
[10] Ely, K., Insabato, F., Kucharski, M., Balzino, M., Bassel, M., & Rocheteau, M. (2023). Baseline and Mid-term Survey Report: WREC Survey Report (p. 1). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-08/WREC_Surveyreport%20240823_FINAL.pdf.

compliance with Ethics Requirements), including measures to be undertaken in case of encounter with ethics issues related to Human (D9.1), Personal Data (D9.2), non-EU countries (D9.3) and Environment, Health, and Safety (D9.4 & D9.5), which were identified in the Ethics Summary Report. Finally, all the collected primary and secondary data was analysed and compiled into this deliverable D3.3.

The main research questions this deliverable seeks to answer are as follows:

I. What types and quantities of waste exist in humanitarian settings?
II. What is the current state of SWM (infrastructure and systems) in humanitarian settings?
III. What are the challenges and opportunities for SWM in humanitarian settings?
IV. What are the main needs of HOs regarding SWM?

2.1 Secondary data

2.1.1 Literature review

The literature review was conducted by PIN through keyword search (e.g. a combination of the following: solid waste in humanitarian settings, SWM in humanitarian settings, humanitarian packaging, environmental impact of humanitarian waste, etc.) on Scopus, Google Scholar, ReliefWeb, and ScienceDirect. Furthermore, the WREC's *Literature Review: Waste management and reverse logistics in the humanitarian context*[11] served as a resourceful guidance.
The main topic explored during the 1st phase of the scoping exercise (T3.3) – the biggest challenges that the humanitarian sector is facing with regard to SWM – is relatively new to the academic research and thus the inclusion of grey literature was necessary and crucial in order to cover the subject of the inquiry. The sourced grey literature explored e.g. the following:

- HOs (international HOs, ICRC, IFRC, RC, UN agencies, clusters, donors) reports (annual, research, technical, project);
- SWM manuals, guidance, standards, and toolkits;
- Donors' environmental requirements and recommendations documents;
- Recordings and transcripts from different environmental sessions and meetings (e.g. the HNPW Green Procurement session, Waste Management working group meetings etc.);
- Data from global and national clusters (e.g. WASH, Logistics and Health - 5Ws);
- Already defined and articulated internal needs of HOs regarding SWM, analysed and summarized mainly in baselines published by WREC and Joint Initiative on Sustainable Humanitarian Assistance Packaging Waste Management (JI);
- National, provincial, and local legislation, including bills and by-laws, regulating SWM in South Sudan and DRC – published by the office of the

[11] Tuomala, V., Aminoff, A., & Kovacs, G. Literature review. Waste management and reverse logistics in the humanitarian context. (2022). Hanken School of Economics, HUMLOG Institute. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-08/WREC%20literature%20review%20Nofoma.pdf.

president, national ministries, and provincial governorate office (Provincial sub-law).

The following repositories focused on SWM in humanitarian settings were used:

- JI[12] repository;
- WREC Environmental Sustainability in Humanitarian Logistics Resources[13];
- EHA Connect[14] - the first comprehensive online repository of environment in humanitarian action (EHA) tools and guidance (developed by JI);
- The Climate Action Accelerator[15];
- Elrha - A global organization that finds solutions to complex humanitarian problems through research and innovation[16];
- UNEP – UN Environment programme[17];
- Réseau Environnement Humanitaire (REH) resources[18] ;
- The International Solid Waste Association (ISWA)[19].

Regarding the case studies' legislation, the information was collected from **government representatives** on national and provincial level (DRC Ministry of Environment and Sustainable Development, DRC Ministry of Public Health, South Sudan Ministry of Environment and Forestry, South Sudan Ministry of Water Resources and Irrigation) and local level (municipalities, county and payam [20] representatives and administrations, local leaders' groups, communities).

2.2 Primary data

Preparation for and collection of primary data took place between April and July 2024 and comprised of three exercises – a) quantitative survey with International HOs (based in Europe, and in DRC and South Sudan) and National HOs from DRC and South Sudan [21], b) qualitative KIIs and FGDs with representatives of 5 stakeholder groups (DRC, South Sudan, global), and c) solid waste observations[22] in DRC and South Sudan. All used primary data collection tools are included as Annexes 1-12 of this deliverable and are disponible to be used[23] by other HO when conducting SWM or similar assessments in humanitarian locations.[24] PIN research team in DRC consisted of Global MEAL Advisor, Coordinator of Climate Resilience Activities, Junior Country Program Coordinator, and MEAL Manager. PAH research

[12] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2019). Sustainable humanitarian packaging waste management. Retrieved from https://eecentre.org/2019/07/15/https-www-eecentre-org-2019-07-15-sustainable-humanitarian-packaging-waste-management/.
[13] https://logcluster.org/en/green-logistics-resources
[14] https://ehaconnect.org/
[15] https://climateactionaccelerator.org/who_we_are/
[16] https://www.elrha.org/about-us/
[17] https://www.unep.org/ietc/
[18] https://www.environnementhumanitaire.org/en/ressources/
[19] https://www.iswa.org/?v=928568b84963
[20] A payam is a second-lowest administrative division in South Sudan with the minimum population of 25,000 habitants.
[21] https://www.kobotoolbox.org/ used as data collection tool
[22] KoboToolbox used as data collection tool.
[23] Also, in adaptable versions.
[24] For guidance and information on primary data collection tools, please contact info@bio4human.eu or kld@peopleinneed.net

team in South Sudan included Project Implementation and Quality Coordinator (South Sudan), Program Implementation and Quality Coordinator (global), Security Officer, and MEAL Coordinator.

All respondents were explained the goals of the Bio4HUMAN[25] project and asked for consent to participate in the research before the interviews. As name, institution and job position were collected from the KII participants, the researchers first read or let the participants read the prepared privacy notice (explaining storage, handling, and deletion of their data, as well as their rights) and asked them to provide written consent with the personal data collection. Since no personal data was collected from the FGD participants, no written consents were signed. The consent forms and interview transcripts are stored in hard and electronic copies in secured locations with limited access and their handling will be managed by PIN and PAH and follow the project's Data Management Plan (D1.2). On 27th May 2024, PIN and PAH signed a data sharing agreement that allows them to share and jointly analyse the collected information, including the personal identifying data.

KIIs and FGDs were conducted in the language of choice of the respondents, including Arabic, Juba Arabic, English, French, Swahili, Kifuliro, Kakwa, and Mashi. Where necessary, translators were engaged either from within the field staff or community. Each KII and FGD was conducted by at least two researchers – one interviewer and one note taker – to record accurate and full accounts. Where possible, researchers ensured gender balance of the respondents (FGDs with communities and RECOs[26]).

2.2.1 Quantitative survey with International and National HOs

Originally, PIN planned to conduct Key Informant Interviews (KIIs) with HOs to gain a deeper understanding of their needs concerning SWM. However, when looking for participants, we received only two positive responses. Therefore, the strategy for collecting data from HOs, particularly international ones,[27] was changed and a quantitative survey designed, using Kobo Toolbox. The survey focuses on identifying the primary needs and challenges of the humanitarian sector in SWM (see Annex 1). Despite the concerted efforts of both PIN and PAH to engage more humanitarian actors, the response rate to the online survey, which required approximately 20 minutes to complete, was quite low. Those efforts involved requests for dissemination of the survey through the following:

- REH's e-mail contact list and through a post on their webpage[25];
- Global WASH and Logistics cluster's mailing lists (the latter through WREC);
- DRC's South Kivu provincial WASH and Logistics clusters' mailing lists;
- South Sudan's national WASH, S/NFI, Health, Protection, Nutrition, Logistics, FSL, Education and CCCM clusters' mailing lists;
- South Sudan national WASH, S/NFI, Health, Protection, Nutrition, Logistics, FSL, Education and CCCM clusters mailing lists;
- WREC and JI contacts;

[25] Either verbally or verbally with an addition of Bio4HUMAN project leaflet wherever possible.
[26] RECO stands for in French 'relais communautaire' which means a community relay or community health worker. RECOs are the primary community health workers who play a crucial role in delivering health services at the community level in DRC.
[27] This is still in line with the T3.3 description and planning in the Bio4HUMAN Grant Agreement.

- Personal contacts of both PIN and PAH humanitarian advisors (via e-mail), including Alliance 2015 members[28];
- Bio4HUMAN social media (LinkedIn, Instagram, X).

A total of 34 HOs began the survey, but 5 organizations declined to sign the mandatory consent form. As a result, 29 responses were received from HOs, 10 international and 19 nationals. Follow up verifications were still conducted with 5 national HOs in DRC and South Sudan, that complemented the survey findings. Among the international HOs that participated in the survey were Acted, ACF, CRS, Christian Aid, Malteser International, MONUSCO, PIN, PAH, Save the Children, and Tearfund. Table 1 provides a breakdown of the survey respondents.

Table 1: Identification of needs of humanitarian sector in SWM survey respondents

	DRC	South Sudan	EU-level	Total
National	10	9	-	**19**
International	3	2	5	**10**
Total	**13**	**11**	**5**	**29**

2.2.2 Quantitative PDM surveys with distribution beneficiaries

During the research data collection, PIN DRC MEAL team was conducting two PDM (post-distribution monitoring) surveys, which were also utilized to contribute to this Bio4HUMAN needs assessment. PDM of the ECHO-funded *Integrated emergency Health, Nutrition, Protection, WASH action targeting the most vulnerable conflict-affected communities, South Kivu, DR Congo* project (ECHO Kimbi-Lulenge project) implemented in Hauts Plateaux d'Uvira and Kimbi-Lulenge health zones took place in May 2024. This PDM collected data on how WASH kit's packaging was used by beneficiaries. PDM of the BHA-funded *Multi-sectoral emergency assistance to vulnerable populations affected by the conflict* project (BHA Lemera project) implemented in Lemera and Nyangezi health zones in South Kivu was conducted in July 2024. This PDM provides an insight into the types of items purchased by beneficiaries and potential resulting waste that may be associated with humanitarian cash distributions, as waste created through humanitarian cash assistance can also be considered as humanitarian waste. The sampling of these surveys used the standard 95% confidence level and 5% margin of error.

2.2.3 Qualitative KIIs and FGDs with identified stakeholders

As a part of the Stakeholder Analysis (results in D3.1), representatives of the following stakeholder groups were identified: academia, community, government/policy makers (national/provincial and local level), humanitarian actors (INGOs, LNGOs, clusters, donors), and industry/businesses – to include into the qualitative part of the research. DRC and South Sudan data collection teams then identified key representatives in each group for data collection. As shown in Table 2, 44 KIIs and 9 FGDs with the 5 groups' representatives were conducted in total either in person (50) or online (3). The number of KIs participating in the interviews varied between 1 and 4 depending on their availability to participate and ability to respond to the research questions.

[28] https://www.alliance2015.org/who-we-are/members/

Table 2: Bio4HUMAN qualitative KIIs and FGDs respondents per location (1)

Method & respondent	DRC	South Sudan	Global	Total
KIIs with academia	4	2	-	**6**
FGDs with communities	7	1	-	**8**
KIIs with local leaders	4	1	-	**5**
KIIs with local government	3	5	-	**8**
KIIs with national/provincial government	3	2	-	**5**
KIIs with humanitarian actors	5	6	2	**13**
KIIs with businesses	6	1	-	**7**
FGDs with businesses	-	1	-	**1**
Total	**32**	**19**	**2**	**53**

The respondents were selected from five different settings – global, urban, semi-urban, rural, and Internally Displaced People (IDP) camps – to ensure all types of environments were included in the study. The urban setting included Bukavu (provincial capital of South Kivu) and Goma (provincial capital of North Kivu) in DRC as well as Juba in South Sudan. Semi-urban setting comprised Kamanyola (*groupement* in South Kivu) in DRC and Yei (Central Equatoria State) in South Sudan. Lemera (*groupement* in South Kivu) in DRC was selected as rural setting, while Bulengo (near Goma) in DRC and Way Station (in Juba) in South Sudan represent the IDP camp setting. These locations were selected based on three criteria – a) representation of all types of setting, b) accessibility (distance and transportation infrastructure) to data collection teams, and c) security situation.

Table 3: Bio4HUMAN qualitative KIIs and FGDs respondents per location (2)

Method & respondent	Global	Urban	Semi-urban	Rural	IDP camp	Total
KIIs with academia	-	6	-	-	-	**6**
FGDs with communities	-	-	3	2	3	**8**
KIIs with local leaders	-	-	2	1	2	**5**
KIIs with local government	-	3	4	1		**8**
KIIs with national/provincial government	-	5	-	-	-	**5**
KIIs with humanitarian actors	2	10	1	-	-	**13**
KIIs with businesses	-	5	1	-	1	**7**
FGDs with businesses	-	-	1	-	-	**1**
Total	**2**	**29**	**12**	**4**	**6**	**53**

Table 4 below provides a list of all the institutions participating in the qualitative KIIs and FGDs organized based on the type of actor.

Table 4: Bio4HUMAN institutions participating in KIIs and FGDs

Actor	DRC	South Sudan
Academia	• International Institute of Tropical Agriculture (IITA) • Evangelic University of Bukavu, FabLab • Official University of Bukavu • University of Goma (UNIGOM)	• University of Juba • University Innovation POD (UNIPOD), University of Juba
Community (incl. local leaders)	• Women and men • Female and male RECOs (*relais communautaires* – community volunteers) • Health staff in Kamanyola Health Centre • Health staff in Lemera General Hospital • Bulengo Camp management • Bulengo WASH committee	• IDP camp representatives (male and female) – Juba Way Station IDP camp • Health staff in Yei Hospital
Government (incl. national, provincial, local)	• Coordination Provinciale de l'Environnement et Developpement Durable, Bureau de l'Assainissement et salubrité du milieu South Kivu • Bureau en Charge de l'eau, Hygiène et assainissement, Division provinciale de la santé, South Kivu • Service d 'Environnement, Coordination Provincial, North Kivu • Bukavu Townhall • Bureau central de la zone de santé, Lemera • Groupement de Kamanyola	• Ministry of Water Resources and Irrigation • Ministry of Environment and Forestry • Juba County • Juba City Council • Yei River County • Payam Yei Health Inspector
Humanitarian actors	• Caritas, Goma • FAO, Goma • GIZ, Bukavu • Logistics cluster in South Kivu, DRC (IOM) • WASH cluster in South Kivu, DRC (UNICEF)	• Yei Across (National NGO) • Shelter/NFI Cluster in South Sudan (NRC) • Core Pipeline in South Sudan (IOM) • WASH Cluster in South Sudan (UNICEF) • Japan International Cooperation Agency - JICA
	Global HAs: • ECHO • Global WASH cluster (The Nederlands Red Cross)	
Businesses	• Briquette du Kivu • PlastyCor • Resilience for Development Group (RDG) in Goma	• Dar Salam Market – Business Committee representatives • Carnak Tobacco Company Ltd.

	• PF-EHA/GIE (Plateforme – Eau, Hygiene, Assainissement/Groupement d'intéret économique), platform grouping SWM businesses in Goma • SOA (Synergie des Organisations Assainissant la RD Congo), platform grouping SWM businesses in Bukavu	

2.2.4 Observations of solid waste

PIN and PAH teams conducted together 19 solid waste observations, including observations of 6 official landfills (Musigiko in DRC; Jansuk, Rwonyi, Yei road and Nimule road in South Sudan), 6 unofficial landfills/accumulated waste (Bulengo IDP camp, Juba Way Station IDP camp, Yei), 2 observations of WMA (waste management area / *zone de déchet*) in health facilities (Kamanyola HC, Lemera GH), 3 humanitarian waste collections (Juba, Yei), 1 observation of waste from a distribution located at HO premises, and 1 observation of plastic transformation business located in an IDP camp. As already suggested, these observations took place at all identified settings, including 5 in urban, 8 in semi-urban, 1 in rural, and 5 in IDP camp setting. The locations included Bukavu, Goma, Kamanyola, Lemera, and Bulengo IDP camp in DRC, as well as Juba, Yei, and Juba Way Station IDP camp in South Sudan.

Table 5: Bio4HUMAN solid waste observation sessions' locations

	Urban	Semi-urban	Rural	IDP camp	Total
DRC	2	1	1	4	**8**
South Sudan	3	7		1	**11**
Total	**5**	**8**	**1**	**5**	**19**

2.3 Limitations

2.3.1 Literature review

- Many HOs are at various stages of incorporating greening initiatives and policies; however, research and documentation of specifically humanitarian waste (quantity, volume, quality) and its management is scarce. To at least partially fill this gap, the research design included primary data collection methods.

2.3.2 Quantitative survey with International and National HOs

- The response rate of HOs was very low despite the adjustment of the data collection method (from KIIs to online survey) to make the exercise less time-demanding, and despite the survey dissemination efforts and outreach (more details above in *2.2.1 Quantitative survey with International and National HOs*).

- In most cases, HOs do not have a dedicated person/position that would encompass the full SWM agenda, including all the relevant environmental aspects, and would have all the data and information collected during the survey available. The nature of the questionnaire was cross-cutting through many topics (internal policymaking; logistics/procurement; programmatic; environmental) that are being handled by many departments across different organizational levels. However, the survey approach provided time and space to gather the missing information from the relevant colleagues.
- The survey shows very optimistic and sometimes inconsistent responses for national HOs, which suggests that either some of the questions were not fully understood or the respondents wanted to shed positive light on their organization. The team addressed this issue by a) reaching out to the respondents to clarify certain responses, yet only 5 HOs provided additional feedback; b) cleaning the dataset maintaining the same logic of the answers; and c) interpreting the results with the support of the knowledge of the local context and capacities.

2.3.3 Qualitative KIIs and FGDs with identified stakeholders

- Most respondents were not able to distinguish between humanitarian and other waste and their management, as, according to them, both types of waste end up being mixed. Gathering information specific to humanitarian waste thus proved often difficult and all waste had to be considered during discussions.
- Due to educational, technological, and cultural background as well as different areas of specializations and professions, many respondents had different understanding of some of the research concepts, such as “good SWM”, “recycling” or “bio-based solutions”, as compared to the researchers. This required thorough explanations and clarifications from the data collection teams.
- Language was also part of the challenge. The English or French level of respondents and knowledge of specific technical words may have been lacking. However, the research team included local language speakers and when needed other translators were engaged to ensure good communication and minimize misunderstanding.
- The respondents may not have always had the full understanding or knowledge of the discussed topics; hence their responses may not have been accurate. Especially in the case of HOs, there is often no single person/position responsible for the full SWM agenda, but different parts of this agenda are responsibilities of several positions across different organizational levels. Furthermore, country programme staff were not always aware of policies and initiatives carried out at the HQ level. As such, the HO KIs often did not have the full institutional knowledge of the SWM situation and agenda.
- Although the researchers provided full explanation of the research goals and its potential impact on local communities in long-term, respondents may have given answers under the impression of receiving immediate support. This was addressed by repeated explanation of the research goals and impact and management of expectations.
- Many respondents indicated they would provide written reports, policies, or quantitative figures to support the Bio4HUMAN research. However, most of these documents have not been obtained by PIN and PAH team yet despite

follow ups. Nevertheless, the teams will continue their efforts to gather these supporting materials.

- Although the team planned to conduct separate FGDs with community women and men, this could not be achieved in Lemera in DRC due to the late arrival of the first (female) group, which interfered with the agreed meeting time of the following (male) group. As the team wanted to respect the time availability of all participants, joint FGD of women and men was conducted in Lemera. Nevertheless, the team ensured equal participation of both women and men by encouraging respondents from both gender groups to share opinions.
- Many of the initially mapped stakeholders did not answer invitation emails, phones, nor reached back after in-person inquiries.

2.3.4 Observations of solid waste

- While observing Musigiko landfill, toxic smoke from fires that occur during the dry season complicated the visit. Before the visit, the landfill management was consulted about the situation at the site. During the observation, the staff was wearing a face mask and protection glasses and kept to the areas least affected by smoke.
- Observation of solid waste, especially taking photos, was often triggering interest of the population and military. The team, whenever possible was requesting for official letters/approvals from respective authorities, inviting community leaders/administration representatives to accompany the team and facilitate any challenging encounters, but not always such requests were fulfilled, and team was sometimes facing access limitations. Limitations were related to access only and did not have impact on the safety and security of the team.

3. Waste in Humanitarian settings

Global solid waste

According to the World Bank, the world produced 2.24 billion tons of solid waste in 2020, resulting in an average footprint of 0.79 kilograms per person per day. UNEP estimates that every year 11.2 billion tons of solid waste are collected globally, and the decomposition of the organic portion of this waste contributes to approximately 5% of global greenhouse gas emissions.[29] It is expected that, with rapid population growth and urbanization, annual waste generation will increase by 73% to 3.88 billion tons in 2050.[30] Equally, it is anticipated that the waste generation will grow significantly faster than the population – by more than double by 2050 and solid waste-related emissions will increase to 2.6 billion tons of CO2-equivalent by 2050. For example, in 2016, the region of Sub-Saharan Africa produced 174 million tons of waste, averaging 0.46 kilograms per person per day and this amount is expected to

[29] United Nations Environment Programme (UNEP). Solid waste management. Retrieved from https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/solid-waste-management.

[30] World Bank. (2021). Bridging the gap in solid waste management: Governance requirements for results (p.5). © World Bank, Washington, DC. Retrieved from http://hdl.handle.net/10986/35703. License: CC BY 3.0 IGO.

quadruple by 2050.[31] See the percentage increase of projected waste from 2016 to 2050 per regions bellow.

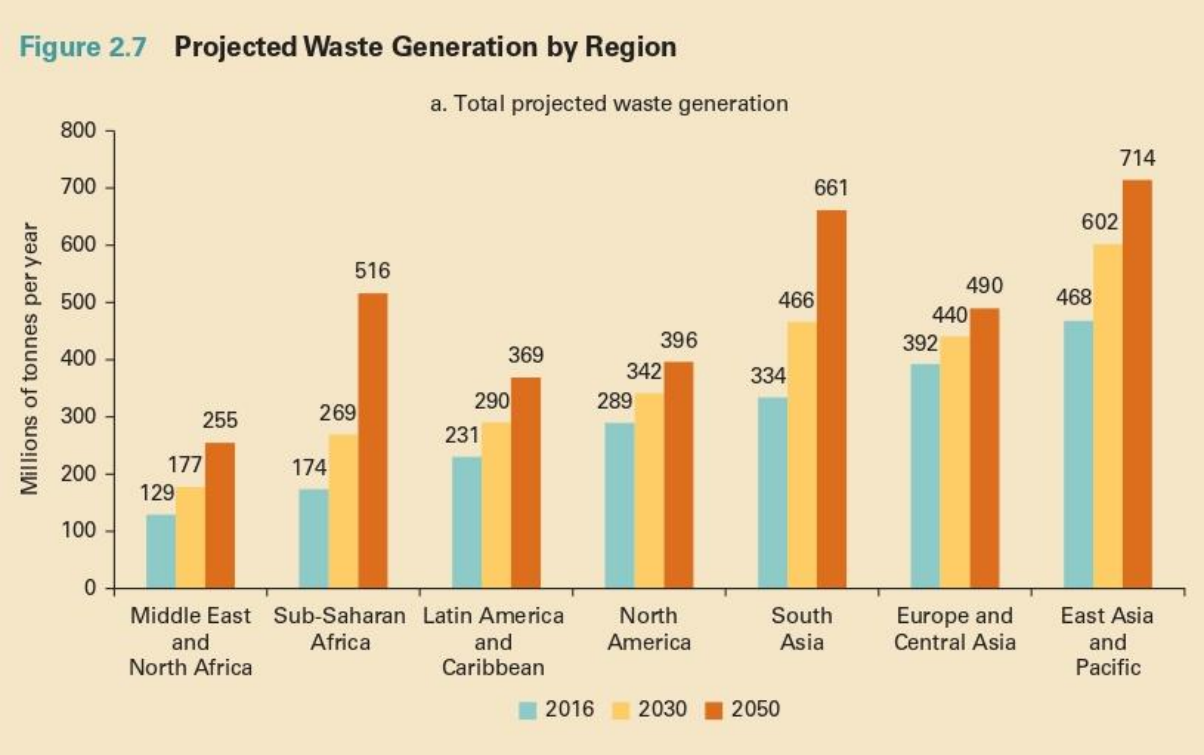

Figure 1: Projected waste generation by region (millions of tons) from 2016 to 2050

Source: World Bank, 2018, p. 28

3.1 Waste in humanitarian settings vs. humanitarian waste

Bio4HUMAN, as specified in the Grant Agreement (GA), focuses on solid waste.[32] We refer to all non-liquid wastes;[33] any type of garbage, trash, refuse or discarded material (end-of life products[34]). Humanitarian settings include conflict-affected areas (such as Yemen, the Central African Republic, and Mali), natural disaster zones, complex emergencies (e.g. Syria, Yemen or Afghanistan), and refugee or IDP camps/settlements in protracted crises or urban environments.[35] Bio4HUMAN targets two countries in Sub-Saharan Africa – DRC and South Sudan,[36] both considered as protracted crisis, and characterized by recurrent natural disasters and/or conflict, longevity of food crises, breakdown of livelihoods, and insufficient institutional capacity to react to the crises.[37] While we can describe humanitarian waste (such as its source and packaging details), we cannot differentiate it from

[31] Kaza, S., Yao, L. C., Bhada-Tata, P., & Van Woerden, F. (2018). What a Waste 2.0: A global snapshot of solid waste management to 2050 (p. 76). Urban Development. © Washington, DC: World Bank. Retrieved from http://hdl.handle.net/10986/30317. License: CC BY 3.0 IGO.
[32] Some documents (e.g. WREC quick guide) refer to end-of-life relief items instead of waste or interchangeable with waste, in line with the terminology used in the GA, we use waste.
[33] European Commission. (2005). Environmental sanitation (p. 105). Retrieved from https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/es/ES07CD.pdf.
[34] WREC. (2023). Quick Guide. Solid Waste Management (SWM) Guide (p. 2). Retrieved from https://d10.logcluster.org/en/document/wrec-quick-guide-waste-management-august-2023.
[35] Elrha. HIF Glossary. Retrieved from https://www.elrha.org/support/hif/hif-glossary/.
[36] In this report, in addition to global data, we focus mainly on the context of solid waste in Sub-Saharan Africa to complement the data from the DRC and South Sudan. Exploring other continents in detail is beyond the scope of this report.
[37] Inter-agency Network for Education in Emergencies (INEE). Protracted crisis. Retrieved from https://inee.org/eie-glossary/protracted-crisis.

general waste present in humanitarian settings unless it is specifically marked as humanitarian waste (e.g., WFP-branded flour bags). After humanitarian waste enters the waste stream and decays, it blends indistinguishably with general waste. Moreover, the use of branded items will significantly decrease in the future, due to the implementation of two emerging trends: *a)* cutting the use of HOs' logos on aid supplies and infrastructure[38]; and replacing distribution of non-food items by cash, wherever possible[39]. The latter is widely recognised by EU and other major humanitarian donors as the most efficient and effective way of getting assistance to people affected by conflicts or disasters[40]. In the case of cash modalities (cash and voucher distributions), the waste generated by the purchases at local markets can also by extension be considered as humanitarian waste; yet such waste is not distinguishable from the typical humanitarian one. For this reason, we focus on both types of waste in this report.

3.2 Waste in humanitarian settings

Solid waste present in humanitarian settings is categorized according to its origin and its nature. The source of waste in humanitarian settings are as follows:

Table 6: Sources of waste in humanitarian settings

Domestic/household waste	Waste from food preparation, packaging, cleaning, fuel burning, old clothing, furnishings, appliances, and reading materials.	It may also include human excreta in cases where e.g. disposable nappies and bucket latrines are used.
Commercial waste	From markets, shops, stores, offices, hotels, restaurants etc.	Typically, it consists largely of packaging materials, used office supplies, and food waste.
Institutional waste	From schools, hospitals, government offices etc.	Generally, it contains more paper than food. It can contain hazardous waste and chemicals (hospitals).
Industrial waste	Includes packaging materials, food waste, metal, plastic, textiles, fuel burning residues (e.g., ash), and used processing chemicals.	It may also contain hazardous chemicals. When industrial wastewaters are treated to reduce water pollution, the hazardous substances become concentrated in sludge, which is sometimes also classified as solid waste.
Agricultural waste	Can be included in industrial waste or be a separate category.	
Abattoir waste	This is mainly organic but often very socially	

[38] Loy, I. (2024). Inklings | The new push for 'no logo' aid. Retrieved from https://www.thenewhumanitarian.org/newsletter/2024/04/03/inklings-new-push-no-logo-aid.
[39] European Commission. (2021). Communication from the Commission to the European Parliament and the Council on the EU's humanitarian action: new challenges, same principles (p. 7). Retrieved from https://ec.europa.eu/echo/files/aid/hacommunication2021.pdf.
[40] Ibid. (p.6).

	objectionable and attracts vermin.	
Street sweepings	Includes dirt and litter, animal excreta, dead animals, and spilled loads.	It may also encompass other types of waste, such as household and commercial waste, that are dumped in the street. In areas with inadequate sanitation services, street sweepings may also contain human excreta.
Construction and demolition waste	It mostly consists of soil and masonry.	It can also include residues of paints and other chemicals, as well as wood, metal, plastic, and other materials.

Furthermore, waste is classified according to its nature and content (which is linked to its source), into the following categories[41]:

- Construction waste;
- Organic waste;
- Combustibles;
- Non-combustibles;
- Bulky waste;
- Ashes/dust;
- Hazardous waste — such as: Chemical waste: including oil, battery acid;
- Sanitation waste;
- Medical or clinical waste;
- Radioactive waste.

In Sub-Saharan Africa for example, organic waste constitutes 57% (higher in the low- and middle-income cities) and plastic waste 13% of municipal solid waste; both figures are considerably higher than the global trend.[42] See figure 2 bellow for comparison of municipal solid waste composition in Sub-Saharan Africa and globally.

[41] Reed, B. (2016). Solid Waste Management: WASH in Emergencies HIF Problem Exploration Report (pp. 19-21). Retrieved from https://www.researchgate.net/publication/313550238_Solid_Waste_Management'_WASH_in_Emergencies_HIF_Problem_Exploration_Report.

[42] UNEP. (2018). Africa Waste Management Outlook (p. 26). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.

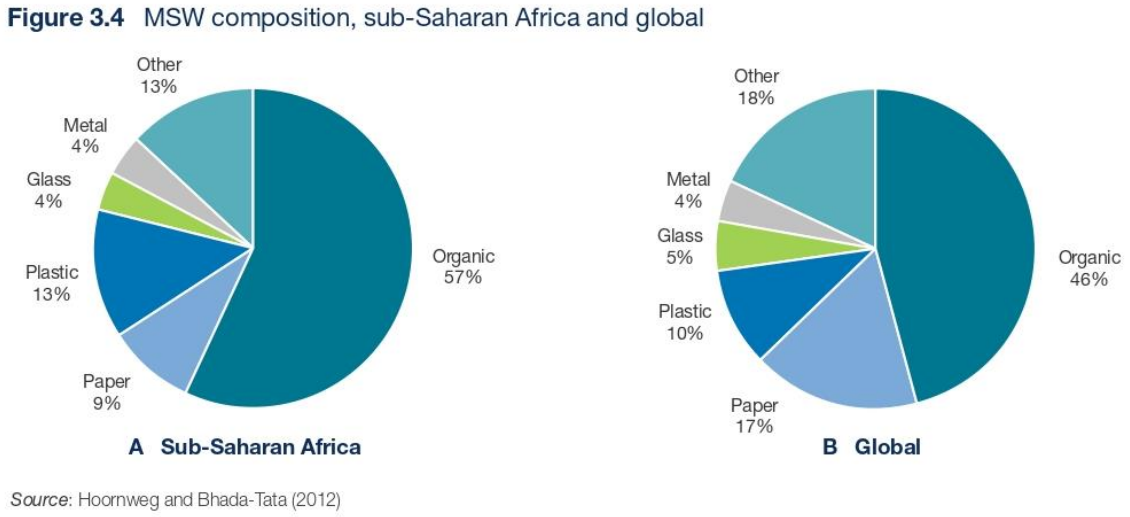

Figure 2: Municipal solid waste composition, sub-Saharan Africa and global

Source: UNEP, 2018, p. 26

Each type of waste in humanitarian settings (including humanitarian waste) requires different treatment and disposal methods, such as for example:

- Organic Waste: Composting or anaerobic digestion to convert organic waste into useful products like compost or biogas;
- Recyclable Waste: Recycling programs to process materials like plastics, paper, metal, and glass;
- Hazardous Waste: Safe handling and disposal of hazardous waste, such as medical waste, chemicals, and e-waste, through incineration or specialized facilities;
- Non-recyclable Waste: Safe landfill practices to minimize environmental impact. In emergency situations, temporary pits or trenches may be used.[29]

3.3 Humanitarian waste

In this report, within the literature review findings, we refer to different phases of humanitarian response (such as rapid response, protracted emergencies, and acute emergencies), different sites (such as IDP camps and urban areas), geographical contexts, environmental conditions, and types of humanitarian crises (including natural disasters, conflicts, or complex emergencies) at regional, national, or subnational levels within lower- or middle-income countries.[43] The type of crisis/disaster and other factors such as type of geographical region, socio-cultural practices, material levels amongst populations, and seasonal variations largely influences the humanitarian action carried out (including types of the packaging of humanitarian goods)[44] and consequently the type and quantity of solid waste produced.

3.3.1 Humanitarian waste classification

Humanitarian solid waste can be divided into organic (e.g. food waste, vegetable waste, etc.) and inorganic (e.g. plastics, metals, glass, carboard, paper, textile, etc.).

[43] Elrha. (2022). Solid Waste Management Problem Exploration Report (p. 4). Retrieved from https://www.elrha.org/wp-content/uploads/2022/10/Elrha_SWM-PE-Report_Final.pdf.
[44] DG ECHO. Chapter 7, Solid Waste Management (p. 106). Retrieved from https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/WEDC/es/ES07CD.pdf.

We can also divide humanitarian solid waste into relief supplies packaging (boxes, plastic wraps, and other packaging materials from food, medical supplies, and other relief items[45]), medical waste, non-food items (e.g. no longer used blankets or tarpaulins) and food waste (spoiled or excess food).

WREC classifies humanitarian waste into the following two categories, see the figure bellow [46]:

a) non-hazardous (e.g. plastics, cardboard, food waste, etc.);
b) hazardous waste (e.g. expired medicines, used oil and filters from vehicles, e-waste, etc.).

[45] See examples of relief items here: https://itemscatalogue.redcross.int/relief--4.aspx; including so called green items: https://itemscatalogue.redcross.int/green--2.aspx
[46] WREC. (2023). Quick Guide. Solid Waste Management (SWM) Guide (p. 9). Retrieved from https://logcluster.org/en/document/wrec-quick-guide-waste-management-august-2023.

Non-hazardous waste	Hazardous waste
Plastic waste (mostly from packaging) 1 PET (Polyethylene Terephthalate) (e.g. oil, water bottles, packing strap) 2 HDPE (High-Density Polyethylene) (e.g. milk bottle, detergent recipient, buckets, plastic pallet) 3 PVC (Polyvinyl Chloride or Vinyl) (e.g. window frames, pipes, cables) 4 LDPE (Low Density Polyethylene) (e.g. shopping bags) 5 PP (Polypropylene) (e.g. woven bags, bins, brooms, cables, plastic pallet, packing straps, bottle tops) 6 PS (Polystyrene) (e.g. cups and plates, egg cartons) and EPS (Styrofoam or extended polystyrene) (e.g. plates and cup containers, trays, packaging bubble wrap) 7 OTHER (Miscellaneous) (e.g. DVDs, computer cases, nylon, car parts) Aluminium laminate plastics (e.g. sachets) *In the absence of plastic numbers, better to check the recyclability of plastics with the local waste collectors or recycling companies.* Metal waste • Aluminium (e.g. drink cans, food cans, aluminium tray and foil) • Steel (e.g. Vehicle Spare Parts • Tin • Copper Glass waste • Bottles and jars • Auto glass • Window glass Paper& Cardboard: • Cardboard (e.g. packaging boxes, eggs tray) • Paper (e.g. office paper, paperbags, envelopes, newspaper) Organic waste • Food waste (e.g. peelings, food scraps) • Vegetation waste (e.g. branches, leaves, scrap wood) Wood • Broken pallets (wood) • Furniture • Bamboo scraps	E-waste: • IT Hardware (e.g. servers, routers, external drives, CPUs) • Telecoms equipment (e.g. deskphones, radios, mobile phones, computers, laptops, monitors, keyboards, Scanners, printers, copiers, toner cartridges) • Household/office appliances (e.g. Air conditioners, fridges, generators) • Lighting equipment (light bulbs, switches, fluorescent lamps) • Electrical and electronic equipment (e.g. cameras, smoke detectors, drills, medical devices) • Solar Photovoltaic equipment (e.g. PV panels, inverters) Batteries of different types (e.g. lithium ion, lead acid) Medical Waste: • Pharmaceutical products (e.g. expired and unused medicines and vaccines, pills, creams) • Used sharps (e.g. needles, razors, scalpels) • Infectious items (e.g. Infected with body fluids) • Etc. Fleet management waste: • Used engine oil • Oil Filters • Lubricants • Tyres Chemicals: • Solvents • Acids • Detergents • Paints • Varnishes • Inks • Glues • Non-empty packaging waste that contains hazardous substances Pesticides Asbestos

Figure 3: Non-hazardous and Hazardous Waste classification

Source: WREC, 2023, p. 9

According to the June 2022 questionnaire developed by French independent think tank - Groupe URD and disseminated among HOs in Europe, the highest concern for the humanitarian sector when it comes to solid waste constitutes packaging, followed by e-waste, followed by organic waste, sanitation, construction, and medical waste.

3.3.2 Packaging waste

When a disaster or crisis occurs anywhere in the world, large quantities of food and essential relief supplies are transported to remote areas. These supplies are meticulously packaged to ensure they promptly reach those in need, in good condition. However, once urgent assistance has been delivered, the packaging

generates unintended waste in affected communities, refugee or IDP camps.[47] The most commonly used packaging of relief items is plastic packaging (44%), used mainly for food conservation:

- Polyethylene terephthalate (PET) – used for oil/water bottles;
- High-density polyethylene (HDPE) – used in vegetable oil containers;
- Polypropylene (PP) – used in woven bags for commodities such as rice and sorghum.[48]

The plastic packaging was followed by paper and cardboard (43%).[49] As many as 81% of HOs consider packaging and/or plastic as the biggest problem in terms of waste streams, followed by medical waste (in the wake of the Covid-19 pandemic).[50]

Packaging[51] can be divided into primary, secondary, and tertiary, as shown in the box below[52].

Box 1. Packaging Definitions

In humanitarian assistance, packaging can be understood and defined at three distinct levels:

- ***Primary packaging*** is understood as the packaging components in direct contact with the products at the smallest unit of distribution (e.g., a single bag of grain).
- ***Secondary packaging*** contains multiple primary packaged products together (e.g., a crate of six bags of grain).
- ***Tertiary packaging*** is the freight and logistics packaging used to facilitate shipping and storage (e.g., a stretch-wrapped pallet of 16 crates of bags of grain).

Figure 4: Packaging Definitions In humanitarian assistance

Source: USAID, 2020, p.6

3.4 Quantities of waste present in humanitarian settings

Across countries and regions, significant challenges exist regarding waste data and availability. One major issue is the lack of standardization in measurement and reporting. Additionally, many countries, including the two case studies – DRC and South Sudan, lack well-developed monitoring systems, resulting in inadequate estimates for basic indicators such as total collected waste and the proportion of

[47] USAID. Three Ways the Humanitarian Community is Going Green While Saving Lives. Retrieved from https://usaidsaveslives.medium.com/three-ways-the-humanitarian-community-is-going-green-while-saving-lives-3318362edb6.
[48] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2019). Alternatives to Conventional Plastics in Packaging (p. 3). Retrieved from https://eecentre.org/wp-content/uploads/2019/07/Alternatives-To-Conventional-Plastics-in-Packaging.pdf.
[49] WREC. (2022). Sustainable Supply Chains Baseline Study (p. 1). Retrieved from https://logcluster.org/en/document/wrec-baseline-survey-results?language=es.
[50] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context (p.20). Hanken School of Economics, Supply Chain Management and Social Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.
[51] For details, see packaging specification of relief items: https://reliefweb.int/report/world/packaging-specifications-fcdo-core-relief-items-2023.
[52] USAID, (2020). Sustainability in Humanitarian Supply Chains. A Preliminary Scoping of Improvements in Packaging. (p.6) Retrieved from https://eecentre.org/wp-content/uploads/2022/03/Packaging_Waste_Management_Scoping_Statement_508_-_update_9.9.pdf.

collected waste deposited in controlled landfills. Some countries lack official waste data entirely, or the available data may be incomplete or inaccurate.[53]

There are few theoretical guidance sources[54] for measuring waste in humanitarian settings (e.g. waste audits or waste composition analysis), mostly focusing on estimating the types and quantities of waste (either generated by HOs or general waste in humanitarian settings). The first comprehensive guidance [55] *Waste or Material Characterization Exercise Guidance* developed by WREC was published only in June 2024. This guidance will allow HOs to understand better their overall waste and identify better the alternative options to waste landfilling, as well as to develop the SWM plan and define the necessary activities and budget to manage the waste or material responsibly. The guidance describes two main methods of measuring waste:

- Quantification Method:

This method involves segregating waste by type and manually counting (weighing the quantities) the waste generated over 5 working days from offices, warehouses, and fleet workshops. It is suitable for smaller amounts of waste. For larger quantities (such as in project areas), WREC recommends taking representative samples (e.g., from households or market shops) to analyse the waste/material generated over seven consecutive days.

- Estimation method:

Potential waste is estimated at the procurement phase, based on the procurement plans and information on the packaging and the relief items' material characteristics.[56]

While it is acknowledged by the humanitarian sector that accurate waste measurements help in effective planning, resource allocation, and implementation of appropriate waste management strategies, in practice, the characterization and quantification of (humanitarian) waste remains one of the biggest challenges for the humanitarian sector. This is because the waste quantification process is time-consuming, needs financial and human resources, and is often competing with other emergency priorities.

[53] United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource (p.17). Nairobi. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.

[54] CIWM & WasteAid UK. (2017). Making Waste Work: A Toolkit (p. 30). Retrieved from https://wasteaid.org/wp-content/uploads/2022/06/CIWM_WAUK_MWM-Toolkit-Vol-I_FINAL-151017.pdf.

[55] WREC. (2024). Waste or Material Characterization Exercise Guidance. Retrieved from https://logcluster.org/en/document/wrec-waste-or-material-characterization-exercise-guidance.

[56] WREC. (2024). Waste Characterization Process (p. 4). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2024-03/Logistics%20Cluster_WREC%20Waste%20Characterization%20Process_2024.pdf.

Very few sources of global numbers of humanitarian waste or general waste in humanitarian settings[57] exist. JI's packaging baseline from 2023[58] is the only one, to our knowledge, providing some concrete global data on humanitarian packaging quantities. This baseline collected data from humanitarian organizations, corresponding to the packaging of 6.77 million metric tons of food and non-food items (NFIs) procured by nine humanitarian organizations in 2021, included 6.73 million metric tons of food and 36,000 metric tons of NFIs. JI analysed that for the 6.77 million tons of food and NFIs, 33,000 metric tons of primary and 35,600 metric tons of secondary packaging were used. Therefore, packaging represents on average 1% of the total weight of an item.[59] The JI baseline further analysed that corrugated cardboard boxes were the most commonly used material for primary and secondary packaging of food and NFIs, accounting for 50% of the total packaging weight. Other materials included plastic packaging (32%), tin cans (10%), and metallized laminated sachets[60] (8%). Vegetable oil was responsible for 43% of all primary and secondary packaging (by weight), with super cereal, LNS and rice representing 14%, 13%, and 6%, respectively. The remaining 24% was spread among other items (*see Figure 5)*. Different types of plastic materials are used as primary and secondary packaging to deliver food and NFIs.[61] When comparing packaging weight per metric ton of the packaged product, JI found that aluminium-based packaging, such as used for water-purifying tablets, uses the most packaging per metric ton of items. Specifically, 0.6 metric tons of packaging is needed for every metric ton of water purification tablets. When analysing the packaging waste data in terms of the number of packaging units, JI found that approximately 3 billion packaging units (mainly lightweight materials like sachets) were required to deliver 6.77 million metric tons of food and NFIs.[62]

3.5 Humanitarian and general solid waste in DRC and South Sudan

Most needs assessment respondents found it difficult to distinguish between humanitarian and general waste, as all of them end up mixed together in the same places once they enter the waste stream and start to decay. The only research environments where some distinctions could be made were IDP camps and health facilities, as these are settings with limited sources of waste where humanitarian actors usually distribute items, which fill in the usual supply gaps and as such can be distinguished, at designated spaces. For example, RUTF (ready-to-use therapeutic food) used to treat acute malnutrition is mostly obtained only through humanitarian nutrition interventions at supported health facilities and the used

[57] A good example of localised quantification waste exercise conducted by the United Nations Population Fund, Humanitarian Office: United Nations Population Fund, Humanitarian Office, & Kühne Logistics University, Center for Humanitarian Logistics and Regional Development. (2022). Measuring and reducing the environmental impact of UNFPA's humanitarian supply chain: Analysis and recommendations. Retrieved from https://www.help-logistics.org/fileadmin/user_upload/Dateien_HELP/documents/report/Sustainability_Report_UNFPA_Reducing_Environmental_Impact.pdf.

[58] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Packaging Baseline Assessment Based on Humanitarian Emergency Responses 2021-May 2023. Retrieved from https://reliefweb.int/report/world/joint-initiative-sustainable-humanitarian-assistance-packaging-waste-management-packaging-baseline-assessment-based-humanitarian-emergency-responses-2021-may-2023.

[59] Ibid. (p.8).

[60] Metallized laminated sachets are the most used packaging in terms of number of individual packaging units.

[61] Ibid. (p.2).

[62] Ibid. (p.9).

packaging is usually required to be brought back by patients to the issuing health facility for accountability and monitoring of correct usage.

Based on the qualitative KIIs and FGDs as well as observations, the type of waste (both humanitarian and general) that is found to be most ubiquitous in all four environments – camp, rural, semi-urban, urban – is primarily plastic waste, especially plastic sachets and bottles, followed by organic waste from humanitarian distributions, fields, gardens, and markets. Metal (tins, cans, car parts, needles, razors), cartons, paper and medical waste are present but in comparatively lesser amounts than plastic and organic waste. The least cited and observed type of waste was glass and textile in all researched settings.

The most often mentioned type of humanitarian items and packaging in the research locations is, not surprisingly, plastic, which is used for food and nutrition supplies packaging and other relief items. Humanitarian plastic packaging includes sachets (LDPE or aluminium laminate plastics), bottles (PET and PP), disinfectant and liquid soap recipients (HDPE), woven bags or sacs (PP), while distributed plastic items listed are usually made of HDPE, such as jerrycans, bins, basins, cups, spoons, tarpaulin (can be also made of nylon, PP, canvas, or polyester), and watering cans. Organic items provided during distributions are usually part of food security and livelihood assistance and respondents mostly mentioned flour and oil but also vegetable seeds and lentils. These can develop into organic waste if they expire, are contaminated by pests, or exposed to external conditions. Humanitarian metal waste comprises of metal containers (usually used to conserve oil), as well as cooking tools, including plates and casseroles, and some farm tools or their parts. Carton boxes are usually used to package soap bars or aquatabs, RUTF sachets and other items, while flour is often distributed in paper sacks. Humanitarian medical waste usually consists of packaging (paper, plastic, aluminium foil), sharps and expired pharmaceutical products. Rather few interviews and observations encountered construction waste. Respondents were not specific as to what type of construction waste is generated by humanitarian activities, but Lemera GH observation confirmed mostly plasterboard and some brick waste.

Photo 1: Waste in Way Station IDP camp, Juba, South Sudan

Photo 2: Construction waste in Lemera GH, Lemera, DRC

The survey with international and national HOs provides information on humanitarian waste from HOs' perspective. Figure 5 shows all waste produced both through HOs' operations (office waste) and humanitarian aid and, overall, confirms the qualitative findings. Most participating international NGOs tend to produce organic, packaging, and plastic waste, followed by construction, electronic, sanitation and medical waste. Few indicated producing paper, household, and hazardous waste, such as batteries. Most participating national NGOs claim to produce organic waste, followed by sanitation, packaging, construction, plastic, and household waste.

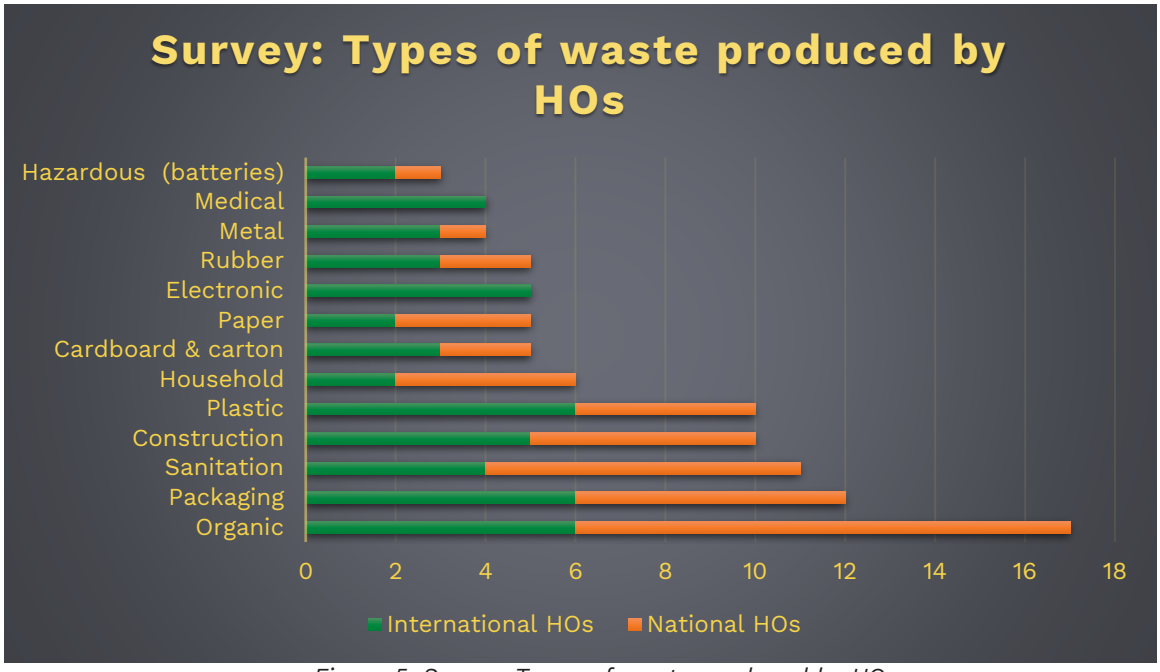

Figure 5: Survey: Types of waste produced by HOs

Although the surveyed HOs could identify types of waste they produced, only 1 international and 9 national HOs responded they could measure the volume of their waste, while 17 HOs (8 I, 9 N) admitted they were not able to do so. The reasons for the international HOs' inability included:

- Lack of intention and initiative
- No system or mechanism is put in place
- The task is challenging, as accessibility to, and time to reach the waste locations are limited
- HOs can potentially measure waste through subscription to waste collection company; however, opportunities to subscribe to waste collection are available only in few countries

The national HO respondents cited lack of tools and support, lack of priority, and small amounts of waste generated.

When asked if HOs had their packaging data available, most (15) NHOs admitted not having such figures available, but 3 said they had all the data and 1 had some data available. On the other hand, 3 IHOs had all and 2 IHOs had some packaging data, while the remaining 6 had no such information, but 3 indicated it could be possible to produce the figures.

Figure 6: Survey: Availability of HOs' packaging data

The PDM results of PIN's BHA Lemera project also provides an insight, albeit limited, into waste generated by cash modalities, which have been more and more popular in the humanitarian interventions to support local markets and give recipients agency to purchase what they really need. The two most popular items purchased by the cash beneficiaries were foodstuff (99% of respondents) and clothing and shoes (83%). These were followed by NFIs, such as WASH items or cooking tools) with 54%, paying off debt (52%), other (usually purchase of domestic animals and in smaller measure of mattresses, land/field, and construction materials; 20%), transport (13%), and agricultural inputs, such as seeds and tools (11%). Given these figures, the solid waste that can be eventually generated by cash humanitarian intervention includes especially organic waste from food and agricultural inputs, as well as textile waste (clothing and shoes), plastic (NFI items, shoes, medicine, and other packaging), metal (NFIs and agricultural tools), and carton and paper (packaging of foodstuffs and medicines).

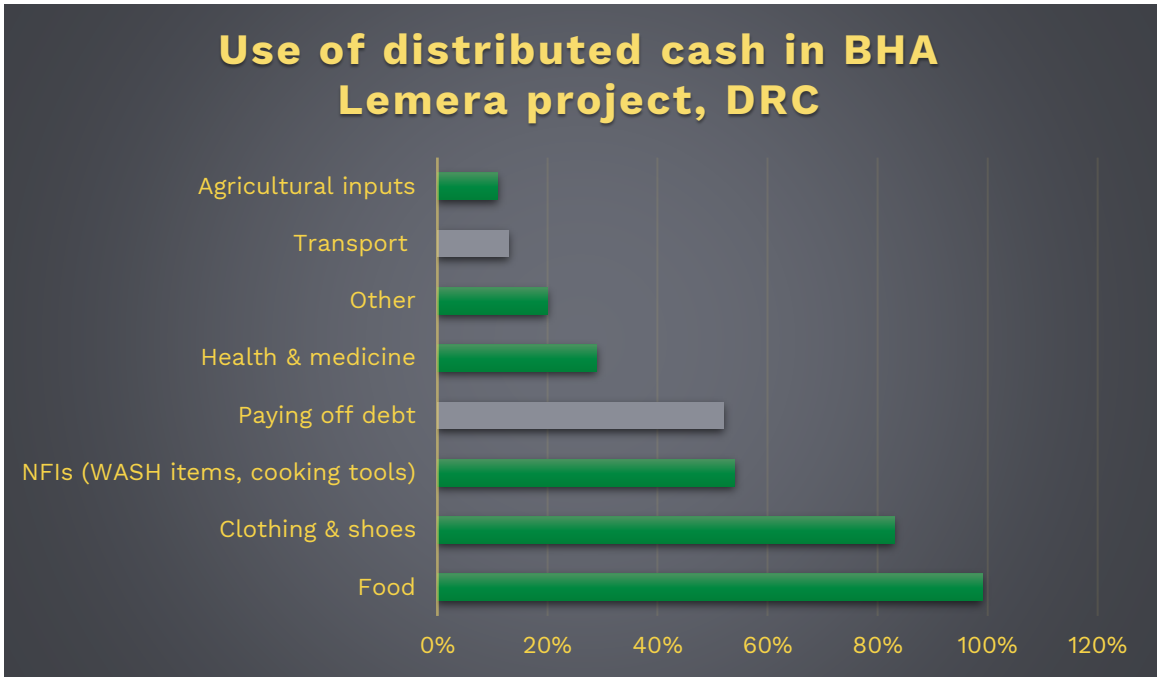

Figure 7: Use of distributed cash in BHA Lemera project, DRC

Table 7 below summarizes the types of waste identified in DRC and South Sudan through KIIs, FGDs, observations and PDM survey.

Table 7: Types and sources of waste in humanitarian settings identified in DRC and South Sudan

Type of material/waste	Packaging	Items
Plastic	• Sachets, e.g. RUTF sachets (LDPE or aluminium laminate plastics) • Bottles, e.g. for oil (PET and PP) • Recipients, e.g. for disinfectant and liquid soap (HDPE) • Woven bags or sacs, e.g. for food items (PP)	• Jerrycans and basins (HDPE) • Bins (HDPE) • Cups and spoons (HDPE) • Watering cans (HDPE) • Tarpaulin (HDPE, PP, nylon, canvas, PL)
Organic matter	• N/A	• Foodstuffs and agricultural inputs, e.g. flour, oil, legumes, vegetable seeds etc. (become waste if expired or contaminated)
Metal	• Containers and tins, e.g. to conserve oil	• Cooking tools, e.g. plates and casseroles • Farming tools or their parts

Carton	• Boxes used as primary (e.g. soap, Aquatabs[63]) or secondary packaging (e.g. RUTF)	• N/A
Paper	• Sacks for food items, e.g. flour	• N/A
Medical	• Medicament's packaging, e.g. blister packs (paper, plastic, aluminium foil etc.)	• Pharmaceutical products (expired) • Sharps
Textile	• N/A	• Clothing and shoes • Mattresses
Construction materials	• N/A	• Bricks • Plasterboard

4. Solid Waste Management in humanitarian settings

SWM is a set of practices, processes, and policies aiming at preventing, measuring, reducing, reusing, recycling, or properly disposing of items which are no longer useful for an organization. [64] Emergency SWM is a critical component of humanitarian response, ensuring that waste generated during and after emergencies is handled safely and efficiently to protect public health and the environment.[65] However, once humanitarian waste enters the general waste streams in humanitarian settings, it becomes indistinguishable from regular waste unless specifically marked. Therefore, in this report, we consider both types of waste (humanitarian and general present in humanitarian settings).

Humanitarian assistance is provided to affected countries and communities where the existing SWM systems are broken or overloaded while receiving more or new types of waste. Existing systems are owned by the host communities and only partly operational; for example, regular waste collection is impossible because roads or paths are blocked, or access is not possible due to conflict. [66] The disaster/humanitarian waste adds to the already present unmanaged waste,[67] left for local authorities who lack proper SWM infrastructure and equipment, and communities to deal with it. The accumulated waste that often remains in communities or is disposed inappropriately causes considerable adverse impacts on the environment, public health, and climate as shown in figure 8 below.

[63] Aquatab is a water purification tablet, which when added to water kills certain bacteria and viruses.
[64] WREC. (2023). Quick Guide. Solid Waste Management (SWM) Guide (p. 2). Retrieved from https://logcluster.org/en/document/wrec-quick-guide-waste-management-august-2023.
[65] UNOCHA. (2011). Disaster Waste Management Guidelines (p. 5). Retrieved from https://www.unocha.org/publications/report/world/disaster-waste-management-guidelines.
[66] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 19). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.
[67] International Federation of Red Cross and Red Crescent Societies. (2020). Managing Solid Waste (p. 3). Retrieved from https://ehaconnect.org/wp-content/uploads/sites/2/2020/08/Managing-solid-waste.pdf.

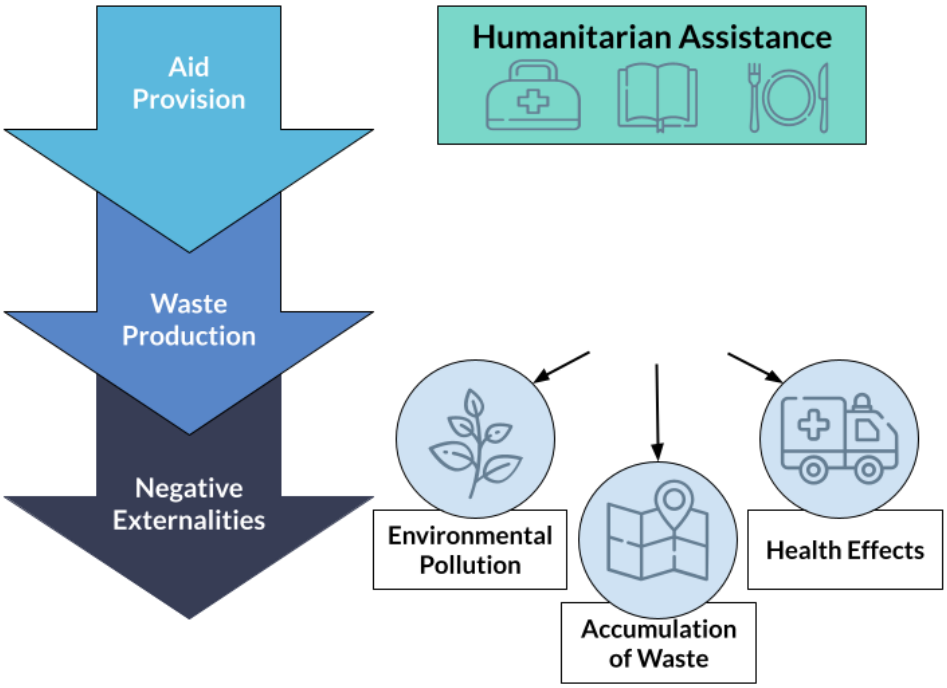

Figure 8: Waste Production in the Humanitarian Sector

Source: LSE, 2021, p.3

Moreover, accumulated waste can hinder relief and recovery efforts. Some types of waste bring chemical risks (e.g. pesticides, products of incomplete combustion including dioxins/furans, poly aromatic hydrocarbons (PAH), volatilized heavy metals from uncontrolled waste burning); biological risks (e.g. faecal matter/body fluids, healthcare waste), physical risks (e.g. collapse of waste piles, uncontrolled fires in piles of waste, vehicle accidents from trucks picking up) and local environmental risks (e.g. soil contamination, landfill gas from decomposing organic waste).[68]

If not properly managed, waste negatively impacts public health in already vulnerable communities, hinders relief and reconstruction efforts, damages the environment, and affects the climate, as illustrated in the figure below.

[68] UNOCHA. (2011). Disaster Waste Management Guidelines (p. 7). Retrieved from https://www.unocha.org/publications/report/world/disaster-waste-management-guidelines.

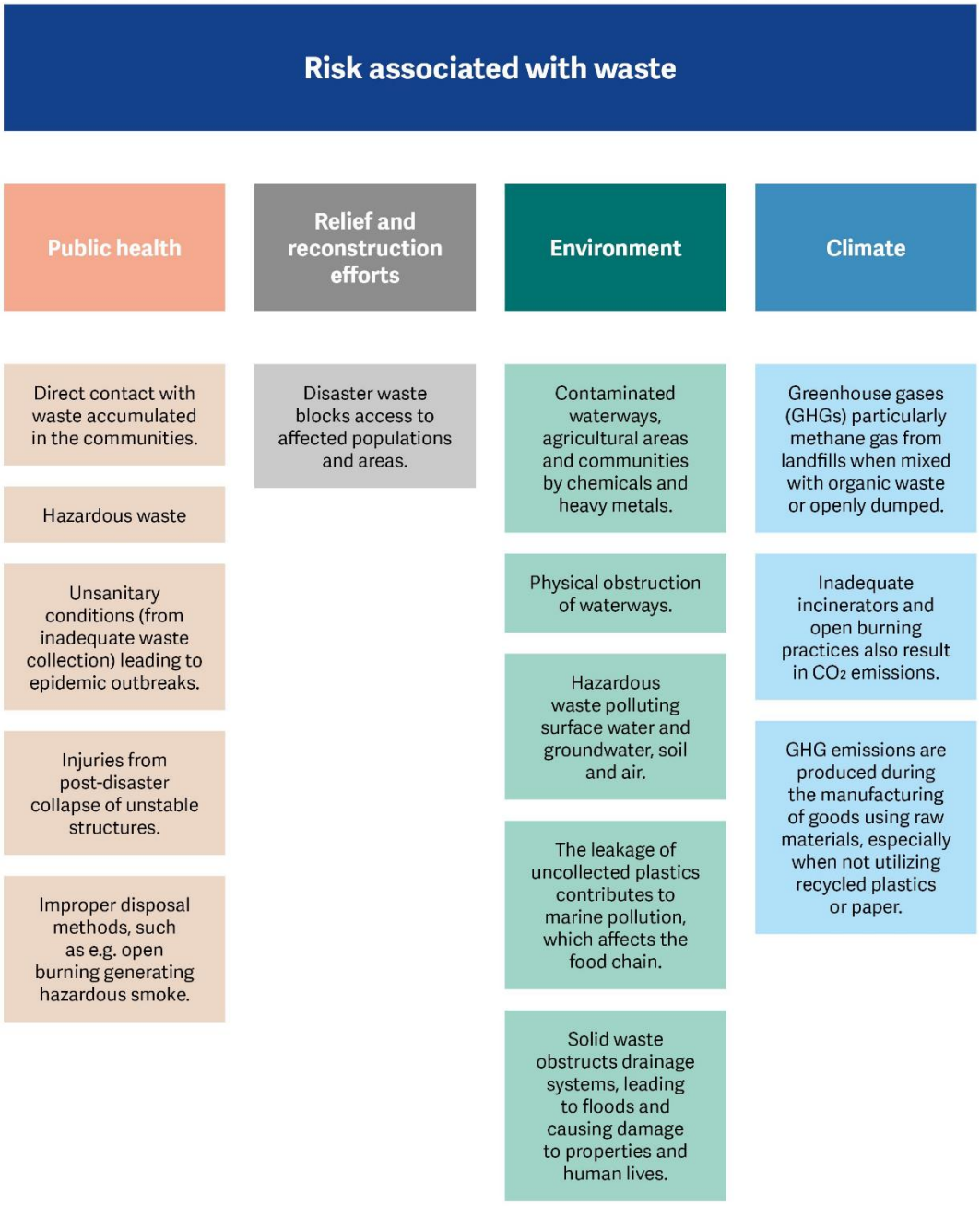

Figure 9: Risks associated with mismanaged waste in humanitarian settings

Risks associated with waste identified by DRC and South Sudan respondents

FGD and KII respondents observed most of the public health and environmental risks associated with inadequate SWM as presented in figure 9 above. Furthermore, they often linked the environmental hazards to their livelihoods and listed additional risks that concern them, including children's exposure and conflict with neighbours.

Public health

The biggest concern associated with improper SWM included illnesses and injuries that affect adults but especially children who were said and observed to play with and in waste as well as pick waste to later sell it. Illnesses, according to

respondents' observation, can be transmitted in several ways. First, waste, e.g. plastic or metal containers, accumulates rainwater, which then attracts mosquitos that can increase the risk of malaria transmission. Similarly, when organic waste accumulates in markets, waste pits or water passages, and decomposes, it attracts mosquitos, flies and other insects that can transmit diarrhoea or malaria. Lemera respondents emphasized that contaminated organic waste that is consumed by unknowing or poor community members, concretely contaminated putrid mangoes found on the ground and in the market that has no toilets, cause annual cholera outbreaks. People can also contract diseases from contaminated water, which had been in contact with waste either on the ground or deposed in water channels, which is a common SWM practice in the case study areas. Another common local SWM practice – re-use of deposed plastic bottles for milk, juice and alcohol, and sachets – can be a source of disease, such as diarrhoea, because of improper sanitation of these containers. In Bulengo IDP camp, the observed practice of using composted organic waste mixed with other types of waste (plastic, metal, textile, sanitation), constitutes similar health risks. Another common SWM practice – burning of solid, e.g. plastic waste – can produce toxic fumes detrimental to health. Scavenging for food in landfills observed e.g. in Yei and Bulengo brings different sorts of risk, such as consumption of contaminated or expired food, exposure to hazardous waste and toxic fumes, and injuries. Injures were also said to be caused by sharp objects, including metal (tins, needles) and glass (bottles) waste found in public but also at homes and own plots where waste is often deposed. The resulting wounds can be infected and cause severe health problems, including handicaps. The last health concern caused by bad SWM brought up in discussion was the possibility of HIV or other viruses' transmission from infected and incorrectly deposed needles and other medical waste.

Environment and livelihoods

The negative environmental impacts of bad SWM practices mentioned by respondents included water systems, land, atmosphere, and animals, and were often linked with people's livelihoods. The most often discussed environmental impact was contamination of water, which starts with waste being thrown into water channels and waste deposited on steep slopes transported into water ways by rainwater. In the areas heavily affected by waste, this can take form of waste slides and soil erosion that can also damage houses located on steep slopes, such as those around Lake Kivu or in Lemera. On the other hand, waste deposited in water channels can accumulate and block water flow, causing flooding of houses or fields. When waste continues from water channels further down the water stream, it accumulates in lakes and rivers, examples given include White Nile, Rusizi river, and Lake Kivu. Once waste enters rivers, they can become shallower and their carrying capacity can diminish due to waste sedimentation, which can lead to floods. Fishing, a common livelihood in the sampled areas, is also impacted because plastic and other waste affects fish in rivers and lakes. Another challenge is waste blocking hydroelectric dams, such as the Rusizi hydroelectric dam, that can affect electricity production and cause electricity cuts, impacting livelihoods. Official University of Bukavu (UOB) and World Institute Research (WIR) are currently conducting the *Baseline Study to Assess the State of Sedimentation and Solid Waste Deposits in the Rusizi 1 and 2 Hydroelectric Dams and Their Impact on Power Generation* to explore this issue.

Another environmental impact concerns soil, and especially arable land, which is a major source of livelihood for the local communities. Respondents observed that

land degrades with the presence especially of plastic waste. Moreover, seeds deteriorate and do not sprout if covered by plastic. Waste can also affect animals, as livestock can consume it and suffocate. If waste is deposited near forests and rain forests, it likewise affects animals living there. Pollution of the atmosphere from fumes produced by burning waste either at the household level or, as observed in Musigiko, Juba and Yei, in unprotected landfills was another concern. Lastly, having a dirty environment was surprisingly cited by only one key informant, yet it was observed during the whole data collection process.

Photo 3: Atmosphere pollution caused by ongoing fire in unprotected Musigiko landfill near Bukavu, DRC

Children's exposure

Children's exposure to solid waste is highlighted as a separate topic because it was one of the major respondent's concerns in terms of risks associated with SWM, and children's exposure to solid waste was also observed on several occasions, especially in IDP camp setting but, overall, in all of the researched settings. Children are the most likely to contract diseases or injure themselves due to their frequent exposure and lack of understanding of the associated risks. Respondents provided many examples of children using waste found outside as toys, while toys assembled from textile (ball) and plastic waste (car) were also observed by the researchers. Furthermore, children were said and observed to enter landfills to scavenge for food and play in them as well as to collect waste in order to generate income.

Conflict with neighbours

One of the SWM challenges reported by the respondents was the impact on neighbour relations. When the waste stored on the ground and in water channels starts decomposing, the bad smell and increased mosquito presence bothers

neighbours. Furthermore, fumes and smell caused by burning of waste can also be a source of annoyance and even lead to conflicts.
In South Sudan the KIs also mentioned the issue of waste reaching the Nile River, which is transboundary and affects other countries down the stream.

4.1 SWM framework (standards, guidelines)

The framework for humanitarian SWM comprises various standards and guidelines established by donors, humanitarian community, and national regulators in the operational country, as well as some international agreements.

4.1.1 Climate charter

Climate charter's Commitment 2 *Maximize the environmental sustainability of our work and rapidly reduce our greenhouse gas emissions*[69] stipulates that HOs should responsibly manage and use natural resources, including water, and reduce and properly manage waste generated on their premises and by humanitarian programmes; and systematically evaluate, avoid and mitigate the negative environmental impacts of their programs as much as possible, and use their influence to push for more environmentally sustainable humanitarian action, notably when it comes to supply chains and logistics.[70] This includes focusing on (ideally sustainable) waste management, tailored to the specific context and needs of the affected population, to mitigate significant environmental, health and climate impacts.

4.1.2 SPHERE

The *Sphere standards* (Sphere) provide a framework to ensure that humanitarian responses meet the basic needs of affected populations in all sectors. Water Supply, Sanitation, and Hygiene Promotion (WASH) sector covers also the SWM, and aims to ensure that populations affected by disaster or conflict have access to sufficient, safe, and affordable water, adequate sanitation, and appropriate hygiene facilities and practices. See the main SWM standards below.[71]

Solid waste management standard 5.1:
Environment free from solid waste
Solid waste is safely contained to avoid pollution of the natural, living, learning, working and communal environments.

Solid waste management standard 5.2:
Household and personal actions to safely manage solid waste
People can safely collect and potentially treat solid waste in their households.

[69] Ibid.
[70] IFRC & ICRC. (2021). Climate and Environment Charter for Humanitarian Organizations (p. 3). Retrieved from https://www.climate-charter.org/wp-content/uploads/2022/05/ClimateEnvironmentCharter-EN.pdf.
[71] Sphere Association. (2018). Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response (pp. 126-129). Retrieved from https://spherestandards.org/wp-content/uploads/Sphere-Handbook-2018-EN.pdf.

Figure 10: SWM SPHERE standards

Source: Sphere, 2018, pp. 126-129

Moreover, the Sphere´s *Reducing environmental impact in humanitarian response* stipulates that programmes should minimise their environmental impact and consider how procurement, transport and choice of materials, or land and natural resource use may protect or degrade the environment further.[72]

4.1.3 Core Humanitarian Standards (CHS)

Under the CHS Commitment 9 - People and communities can expect that resources are managed ethically and responsibly. Requirement 9. 4 stipulates that humanitarian organizations need to "*Manage and use resources to achieve their intended purpose, minimising waste and the impact on the environment".*[73]

4.1.4 Inter-Agency Standing Committee (IASC)

The IASC brought the so-called cluster approach in 2005 as a key component of humanitarian reform. The aim was to improve the coordination, predictability, accountability, and effectiveness of humanitarian responses. The reform designated the environment as one of the four major cross-cutting humanitarian issues. The OCHA is responsible for mainstreaming the environment in humanitarian action and the Joint Environment Unit (JEU) OCHA-UNEP leads the operationalization with support for the roles and responsibilities of Global Cluster Lead Agencies in relation to the environment at field level.[74]

4.1.5 Donors

The *Humanitarian Aid Donors' Declaration on Climate and Environment* (Declaration), launched at the first European Humanitarian Forum held in Brussels in March 2022, aims to mobilize governments and donors to collectively address climate and environmental risks in humanitarian efforts. The declaration has been endorsed by the 27 Member States of the European Union. Under Commitment 4 of the Declaration, donors commit to "Foster the creation of the conditions required for international humanitarian organizations and local partners to adopt environmentally friendly practices, to e.g. adopt an environmentally friendly

[72] Sphere. (2019). Reducing environmental impact in humanitarian response (p.1). Retrieved from https://spherestandards.org/wp-content/uploads/Sphere-thematic-sheet-environment-EN.pdf.
[73] CHS Alliance. (2024). Core Humanitarian Standard on Quality and Accountability (p. 12). Retrieved from https://www.corehumanitarianstandard.org/_files/ugd/e57c40_f8ca250a7bd04282b4f2e4e810daf5fc.pdf.
[74] WREC. (2023). Mapping SWM Standards (p. 4). Retrieved from https://d10.logcluster.org/libraries/pdf.js/web/viewer.html?file=https%3A%2F%2Fs3.eu-west-1.amazonaws.com%2Flogcluster-web-prod-files%2Fpublic%2F2023-08%2FMapping%2520SWM%2520standards%2520and%2520guidelines_WREC_FINAL.pdf.

approach to management of natural resources and waste, and use nature-based solutions and the circular economy where possible."[75]

Donors have been thus increasingly requesting HOs to demonstrate that their projects consider environmental degradation and climate change, including SWM. Concretely, they are encouraging HOs to actively promote SWM and take more sustainable approaches, such as harmonization of processes for humanitarian SWM; better communication to change perceptions and behaviour around the ownership of public space and the related waste; and innovative approaches and technology to reduce waste volumes, especially related to packaging.[76]

While all major humanitarian donors (e.g. BHA, GAC, FCDO) encourage HOs applying for their funding to demonstrate how they will reduce their climate and environmental footprint across the projects, including the focus on SWM, the only donor that requires this is DG ECHO (ECHO).[77] As ECHO's contribution to the European Green Deal, ECHO published in 2022 the *Guidance on the operationalization of the minimum environmental requirements and recommendations for EU-funded humanitarian aid operations* (MERS). The core principle of MERS is to avoid negative environmental impacts associated with humanitarian responses. When avoidance is not feasible, mitigating measures should be implemented to reduce potential negative environmental impacts, adhering to a precautionary approach. MERS represent criteria that ECHO's humanitarian partners need to address in a humanitarian response, which since 2023 became mandatory.

Waste management is one of seven guiding principles of the MERS, as shown below.

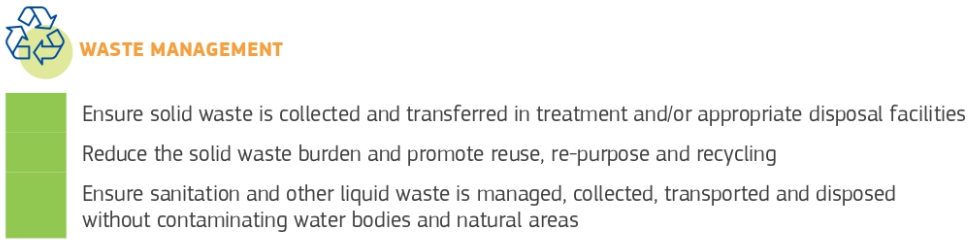

Figure 11: Waste management principle

Source : ECHO, 2022, p. 11

4.1.6 International agreements

Key international agreements related to waste management include:

[75] European Commission. (2022). Humanitarian Aid Donors' Declaration on Climate and Environment (p. 3). Retrieved from https://civil-protection-humanitarian-aid.ec.europa.eu/document/download/8928aae4-4e2c-44d6-bbed-34d8cfdb90a9_en?filename=Donor%20declaration%20on%20climate%20and%20environment_ENG.pdf.

[76] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO). (2022). Guidance on the operationalization of the minimum environmental requirements and recommendations for EU-funded humanitarian aid operations (p. 23). Publications Office of the European Union. Retrieved from https://data.europa.eu/doi/10.2795/467817.

[77] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management & Climate Action Accelerator. (2024). Operationalizing and Scaling-up Donors' Climate and Environmental Commitments: An Analysis of Progress, Gaps, and Opportunities (p. 9). Retrieved from https://climateactionaccelerator.org/wp-content/uploads/2023/11/CAA_MApping-Analysis_EN_V11.pdf.

***Basel Convention on the control of transboundary movements of hazardous wastes and their disposal*, 1992**[78]

- To minimize hazardous waste generation.
- To treat hazardous waste as close as possible to where it was generated.
- To reduce transboundary movement of hazardous waste.

***Stockholm Convention on Persistent Organic Pollutants*, 2004**[79]

The Convention identifies several processes linked to waste as responsible for releasing comparatively high quantities of POPs into the environment:

- Open burning of waste, including burning of landfill sites.
- Waste incinerators, including co-incinerators of municipal, hazardous, or medical waste.[80]

4.1.7 SWM guidelines

There are several guidelines focusing on SWM in humanitarian settings, developed mainly by humanitarian actors, such as:

- *Solid Waste management in Emergencies* (WHO);
- *Disaster Waste Management Guidelines* (OCHA);
- *Handbook for Emergencies* (UNHCR);
- *Guidance Note : Débris Management* (UNDP);
- *Managing Solid Waste: Sector-specific guidelines for the Red Cross Red Crescent* (IFRC);
- *Compendium of WHO and Other UN Guidance on Health and Environment* (WHO);
- *Green Response: Environmental Quick Guide* (IFRC);
- *Domestic and Refugee Camp Waste Management Collection and Disposal* (Oxfam);
- *Guidelines for the Safe Disposal of Solid Waste in Humanitarian Context* (UNHCR).

4.1.8 SWM national and local regulations

Across countries and regions, significant challenges exist regarding waste data and availability. One major issue is the lack of standardization in measurement and reporting. Additionally, many countries lack well-developed monitoring systems, resulting in inadequate estimates for basic indicators such as total collected waste and the proportion of collected waste deposited in controlled landfills.

HOs must comply with the national waste management regulations and standards of the country where they intervene. Those are usually overseen by the Ministry of Environment and/or Ministry of Health and focus on the collection, transportation,

[78] UNEP & Basel Convention. (2019). Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal: Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and Their Disposal: Texts and Annexes. Retrieved from https://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx.

[79] UNEP & Stockholm Convention. (2019). Stockholm Convention on Persistent Organic Pollutants (POPs): Text and Annexes. Retrieved from https://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx.

[80] International Federation of Red Cross and Red Crescent Societies. (2020). Managing Solid Waste (p. 59). Retrieved from https://ehaconnect.org/wp-content/uploads/sites/2/2020/08/Managing-solid-waste.pdf.

recovery, and disposal of waste.[81] In some countries, there can be a specific legal framework for e.g. hazardous waste, medical waste and/or plastic waste (such as Rwanda that banned single use plastics in 2008). The SWM regulatory frameworks usually cover the following:

- Compliance with Local Laws: HOs comply with the host country's SWM laws, including regulations about waste segregation, recycling protocols, disposal methods, and treatment facilities;
- Collaboration with Municipalities: Effective SWM often requires close collaboration with local municipal authorities who are usually in charge of local waste collection services, waste treatment facilities, and waste disposal sites;
- Permits and Licenses: in some countries/regions some SWM activities require permits or licenses, especially for operations like large-scale waste collection, transport, and disposal;
- Public Health and Environmental Regulations**:** HOs need to comply with local health and environmental regulations (e.g. specific requirements for the handling and disposal of hazardous waste such as medical and electronic waste).

4.1.9 SWM regulations in DRC and South Sudan

Both DRC and South Sudan have some legislation regulating SWM but, while Congolese SWM legislation is more complete, that of South Sudan is still evolving. The two case studies offer an insight into the types of challenges countries supported with humanitarian aid face when establishing and enforcing their SWM legislation.

In the case of DRC, a mix of national laws, policies, and international commitments (party of e.g. Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, 1992) regulates waste management and environmental protection. The *Environmental Protection Law (Law No. 11/009 of July 9, 2011)*, *Hygiene Code of the Democratic Republic of the Congo (2015)* and *Biomedical Waste Management Plan (2016)* form the backbone of the national SWM legislation. Local governments, including provinces and municipalities, have the authority to issue by-laws and regulations concerning SWM in their jurisdiction. An example is the *Provincial By-law n° 19/040/GP/SK from 28th August 2019 Modifying and Completing By-law n° 11/006/GP/SK from 20th January 2011; Carrying out Sanitation of Urban and Rural Areas in the Province of South Kivu*. Such local regulations often address specific issues related to waste collection, disposal sites, and recycling.

In South Sudan, there is no legal system that would focus specifically on solid waste management. The Ministry of Environment and Forestry is the main government body for SWM, but there are cross-cutting aspects that involve the Ministry of Water Resources and Irrigation and the Ministry of Lands, Housing and Urban Development. The laws and regulations in relation to SWM can be found in *Environmental Protection and Management Bill, 2015*, *The South Sudan Environment Bill* (that is still a draft, 2023), *Local government act, 2009*, *National Environment Policy 2015-2025*.

[81] WREC. (2023). Mapping SWM Standards (p. 4). Retrieved from https://d10.logcluster.org/libraries/pdf.js/web/viewer.html?file=https%3A%2F%2Fs3.eu-west-1.amazonaws.com%2Flogcluster-web-prod-files%2Fpublic%2F2023-08%2FMapping%2520SWM%2520standards%2520and%2520guidelines_WREC_FINAL.pdf.

According to the interviewed informants there are several documents that have been drafted by different ministries that included some aspects of SWM (or liquid WM) in 2015 and 2016. However, these have not passed through the Ministry of Justice and Constitutional Affairs to be signed by the President yet due to the war. After the war, these acts were returned by the Ministry of Justice and Constitutional Affairs to respective ministries for harmonization and alignment with the Peace Agreement and other relevant documents in 2018 but that has not been achieved to this date. Other local regulations governing some aspects of SWM have been introduced since by local governments as according to the "Local government act, 2009" SWM should be managed on local administration level, and local bodies have the authority to create ordinances in the form of by-laws or local orders.

Limitations of SWM regulations in DRC and South Sudan

Despite having SWM-related regulations, both countries face significant challenges in building the infrastructure necessary for effective waste management. Limited financial resources, lack of technical expertise, security constraints, low electricity access, and also underdeveloped road networks hinder the development of comprehensive SWM systems, especially in rural areas. Ongoing conflict in both countries and political instability especially in South Sudan have affected the countries' ability to implement and enforce SWM regulations, destroyed and stopped some of the investments. Moreover, many different actors in DRC are not aware of legislation related to SWM, as the government does not actively promote or enforce it. The informal sector also plays a role in SWM, especially recycling and reusing, in both countries; however, its integration into formal management systems remains a challenge. More challenges limiting implementation of good SWM in DRC and South Sudan can be found below (*SWM challenges identified by research participants in DRC and South Sudan*).

4.2 SWM sustainable models

There are several models and strategies (see below) employed to manage solid waste effectively. Effective waste management often involves combining elements from multiple models to create a tailored approach that fits the specific needs of a community or region. The choice of model depends on factors such as local regulations, economic conditions, technological capabilities, and community engagement levels. In practice, very little is implemented in this regard in humanitarian settings. For example, the setup of humanitarian sites and settlements is rarely accompanied by a sustainable SWM plan.[82]

4.2.1 SWM Management Hierarchy

Sustainable waste management is based on a life-cycle approach: from avoidance, reduction, reuse, repair and finally recycling, treatment and proper disposal. It is

[82] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO). (2022). Guidance on the operationalization of the minimum environmental requirements and recommendations for EU-funded humanitarian aid operations (p. 8). Publications Office of the European Union. Retrieved from https://data.europa.eu/doi/10.2795/467817.

often necessary to develop actions by type of waste because not all waste has the same specificity (food, general, electronic, garage, hazardous, medical).[83]

In line with the SWM hierarchy (see Figure 12 below) the following practices are implemented by HOs:

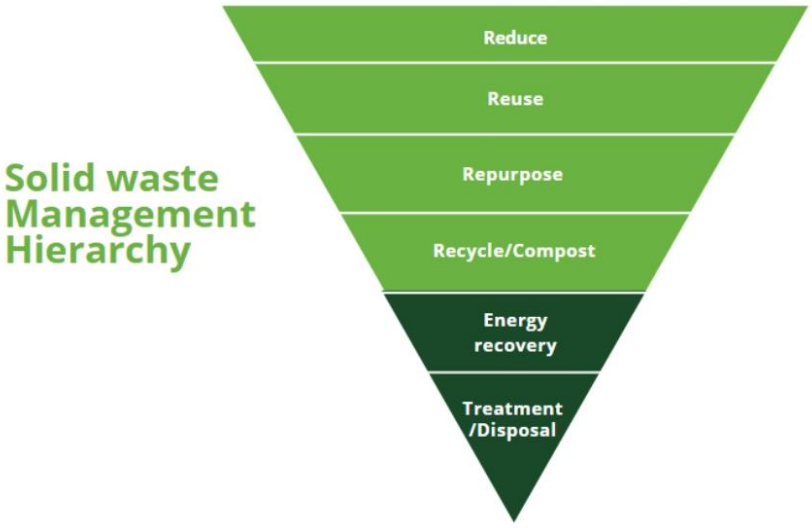

Figure 12: Solid Waste Management Hierarchy

Source: WREC, 2023, p.3

For more details, refer to the benefits of progressing up the waste prevention hierarchy below.

[83] WREC. (2023). Quick Guide. Solid Waste Management (SWM) Guide (p. 3). Retrieved from https://d10.logcluster.org/en/document/wrec-quick-guide-waste-management-august-2023.

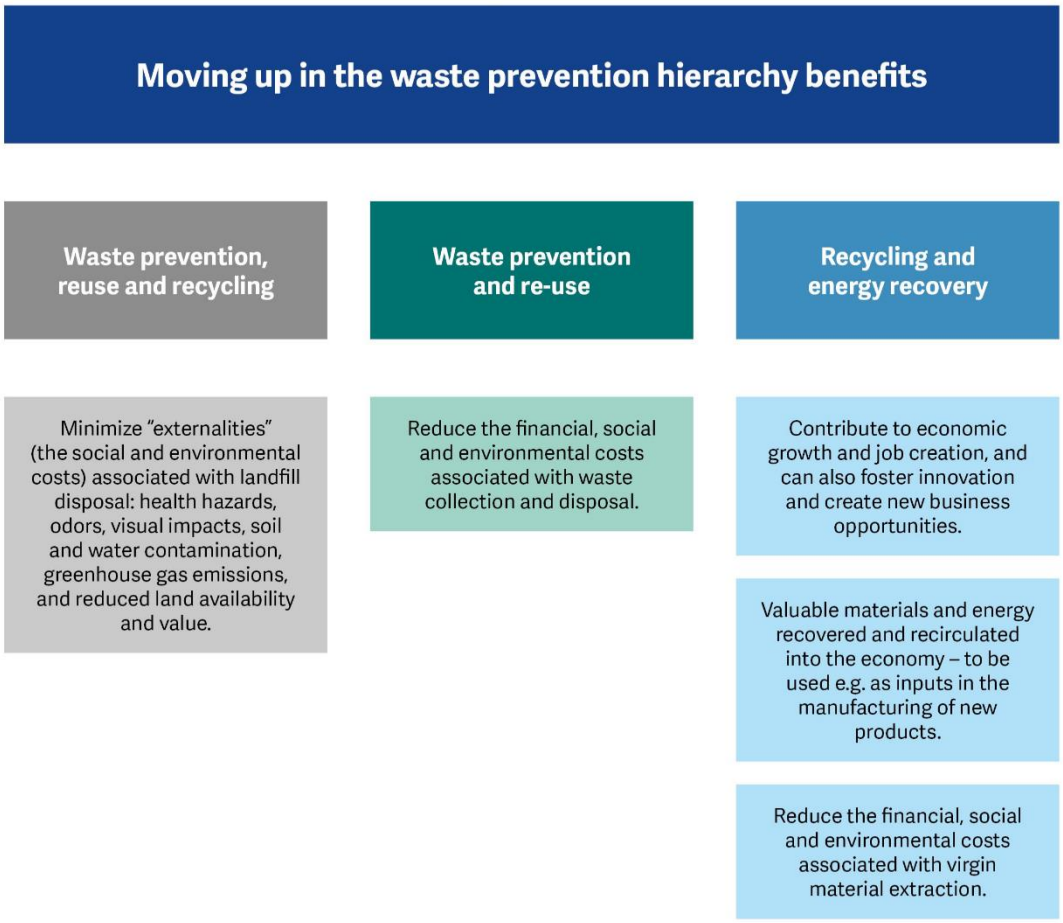

Figure 13: Benefits from moving-up the waste hierarchy system

4.2.2 Integrated SWM

Integrated Solid Waste Management (ISWM) represents a holistic approach to waste handling. It considers diverse processes and involves various stakeholders to ensure efficient, safe, and environmentally friendly practices. ISWM encompasses a range of techniques aimed at achieving environmentally, financially, and socially sustainable waste treatment. This concept aligns with the waste hierarchy model (figure 13 below[84]) and involves the following steps:

- The complete solid waste management chain, from waste generation to storage and collection, to transportation and final disposal;
- The inclusion of the reduce, reuse, recycle, recovery approach in the chain;
- Financial sustainability, linkages with policy and legislation, and stakeholder involvement (local community, private as well as public sectors and informal actors).[85]

[84] International Organization for Migration. (2021). Study on the issues and opportunities of Solid Waste Management within IDPs settings in West and Central Africa (p. 5). Retrieved from https://environmentalmigration.iom.int/sites/g/files/tmzbdl1411/files/documents/Study%20on%20the%20issues%20and%20opportunities%20of%20Solide%20Waste%20Management%20within%20IDPs%20settings%20in%20WCA%2C%202021.pdf.

[85] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO). (2022). Guidance on the operationalization of the minimum environmental

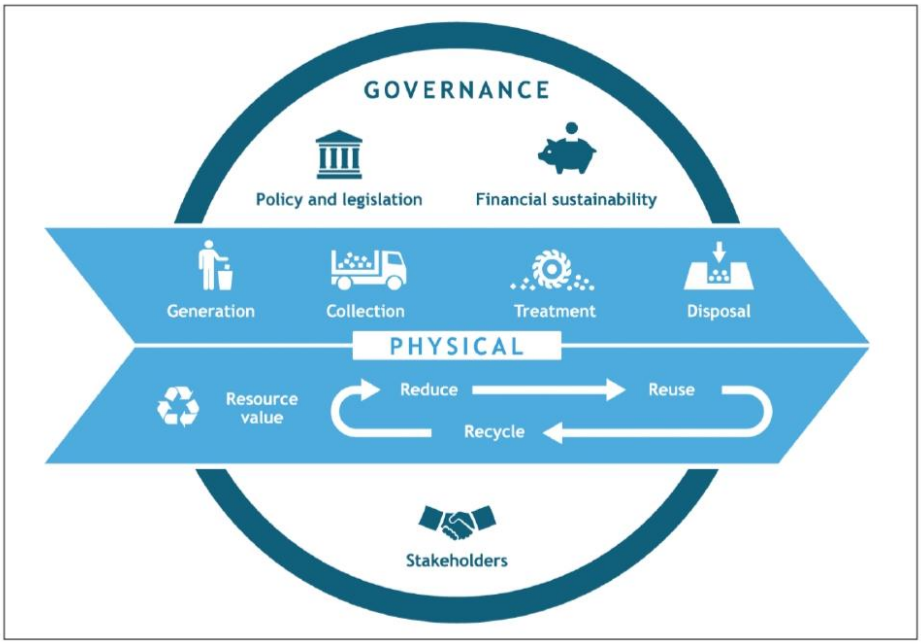

Figure 14: Overview of Integrated Solid Waste Management

Source: IOM, 2020, p.5

The first step to take when setting up an ISWM system is to conduct a Waste or Material Characterization exercise/audit to determine the quantities and type of waste material, end-of-life products, and unused items generated in the offices, warehouses, workshops of HOs and project locations.[86] This includes the assessment of the waste streams, as well as identification of local methods of management and disposal of waste and the stakeholders involved in the processes, thus defining a reliable baseline information about the quantities and types of waste being generated.[87] In humanitarian settings, various waste streams necessitate different management strategies to ensure effective and sustainable disposal. Focusing on specific waste streams is important for understanding (a) where the waste occurs and thereby, which stakeholders need to be involved in managing that waste stream, and (b) which materials are included in the waste and thereby, which waste management processes need to be followed.[88]

requirements and recommendations for EU-funded humanitarian aid operations (p. 26). Publications Office of the European Union. Retrieved from https://data.europa.eu/doi/10.2795/467817.

[86] WREC. (2024). Waste or Material Characterization Exercise Guidance (p. 1). Retrieved from https://logcluster.org/en/document/wrec-waste-or-material-characterization-exercise-guidance
[87] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO). (2022). Guidance on the operationalization of the minimum environmental requirements and recommendations for EU-funded humanitarian aid operations (p. 27). Publications Office of the European Union. Retrieved from https://data.europa.eu/doi/10.2795/467817.
[88] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context (p.21). Hanken School of Economics, Supply Chain Management and Social Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.

4.2.3 Circular economy and Life Cycle Assessment (LCA):

One of the contemporary sustainable economic models involves designing products and materials to be reusable, re-manufacturable, recyclable, or recoverable, thereby keeping them in the economy for as long as possible along with their constituent resources. This approach aims to minimize waste generation, particularly that of hazardous waste, and to prevent or reduce greenhouse gas emissions, therefore significantly contributing to sustainable consumption and production.[89] Life cycle assessments (LCA) are integrated into circular economy model in order to enhance its effectiveness by providing a robust method for assessing and optimizing the environmental performance of circular strategies.

4.2.4 Green procurement

Green procurement is a strategic approach that emphasizes environmental responsibility in purchasing decisions.[90] Green procurement is the process of acquiring goods, services, and works with a reduced environmental impact throughout their life cycle, from production to disposal. It aims to incorporate environmental considerations into purchasing decisions, thus promoting sustainability and responsible resource management. Implementing green procurement in the humanitarian sector entails incorporating environmental considerations into procurement decisions from the planning stage to the disposal stage of the procurement cycle. This approach promotes a circular economy, emphasizing waste reduction and resource efficiency, while also aiming for social improvements and economic inclusivity,[91] as shown in the figure below.[92]

[89] United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource (p.5). Nairobi. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.

[90] WREC. (2023). Quick Guide. Solid Waste Management (SWM) Guide (p. 2). Retrieved from https://d10.logcluster.org/en/document/wrec-quick-guide-waste-management-august-2023.

[91] Ibid. (p.4).

[92] There are different examples of green procurement implemented in humanitarian settings, such as: WREC. (2024). WREC Green Procurement Market Assessment: IFRC Bangladesh Pilot – Case Study (p. 1). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2024-06/Case%20Study%20-%20IFRC%20BGD%20green%20market%20assmt%20FINAL.pdf.

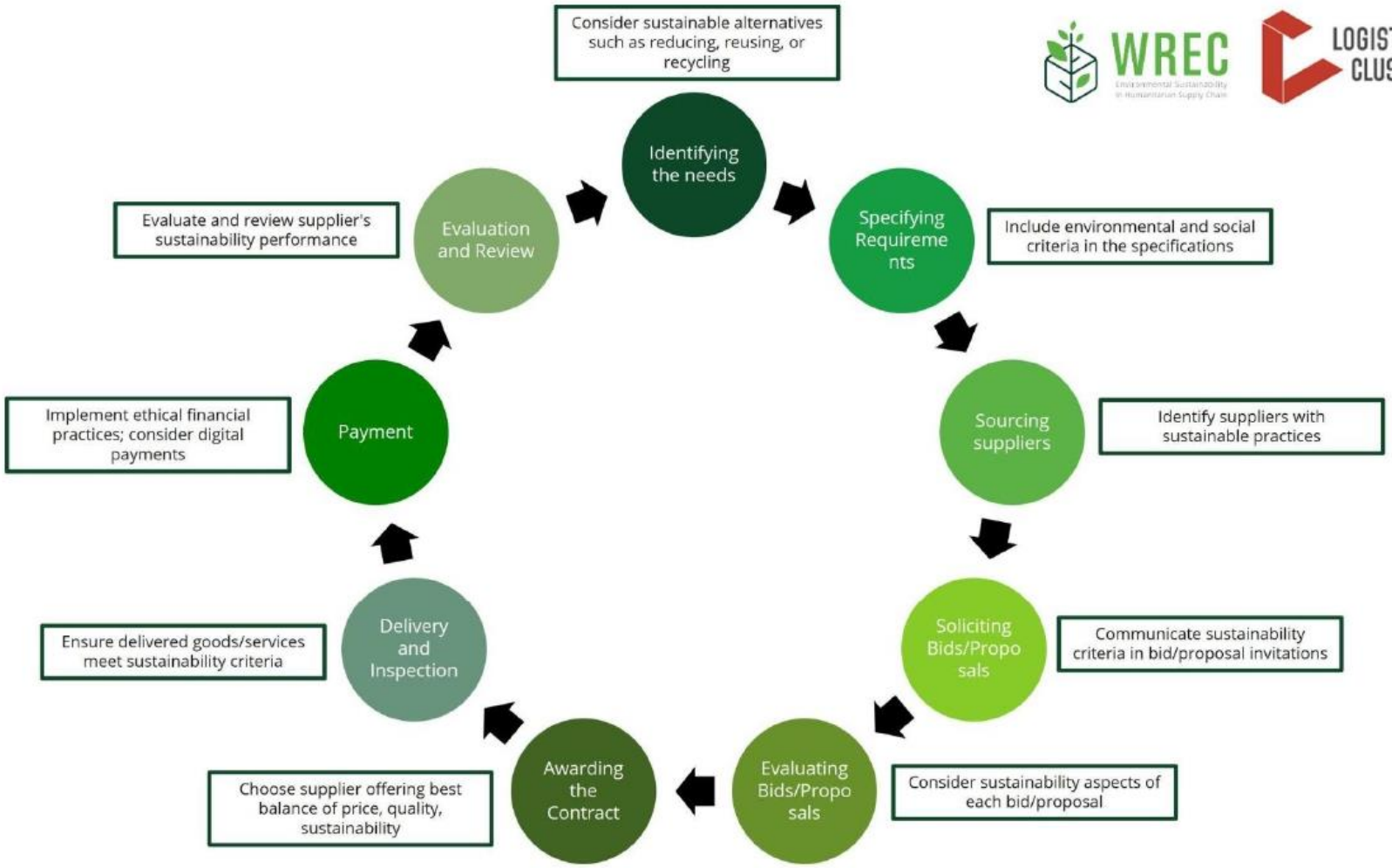

Figure 15: Procurement Cycle and how to embed sustainability in each step

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Source: WREC, 2023, p.4

4.2.5 Procurement practices of the surveyed national and international HOs

Most of the surveyed national and international HOs seem to prioritize, at least to some extent, SWM in their operations. Active prioritization seems to be stronger within national HOs; however, it is important to refer to the limitations of the survey (*2.3 Limitations* section above), as researchers' understanding of, and standards expected from SWM may differ from that of the respondents. While 4 NHOs labelled SWM as their most important issue they tackle, no such claim was made by international counterparts. There is no surveyed IHO that would not consider SWM in their operations at least to some extent, but 4 NHOs admitted that SWM was not prioritized by their organizations at all. They did not provide any explanation for that. More details are available in figure 16 below.

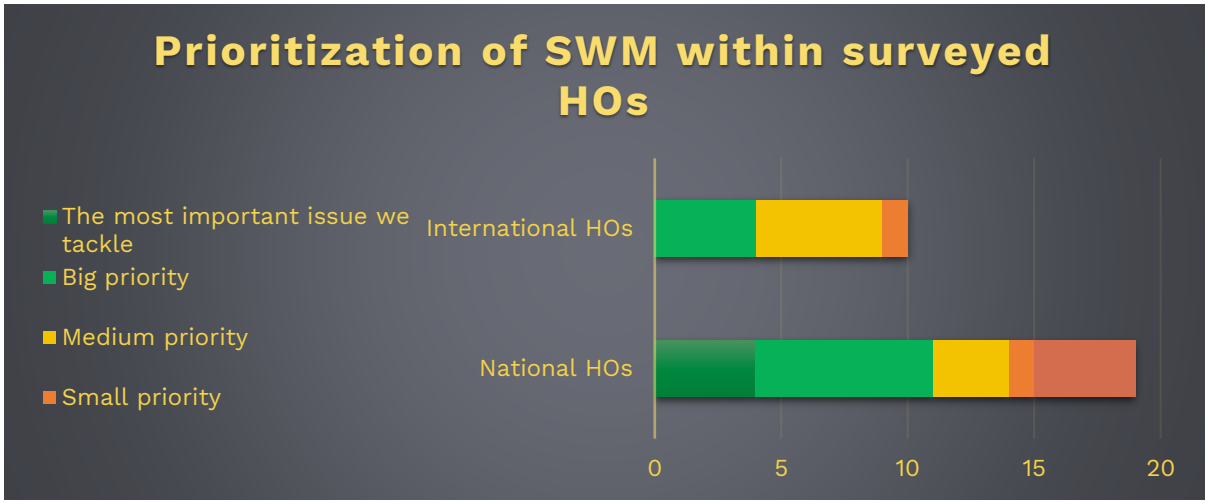

Figure 16: Prioritization of SWM within surveyed HOs

The SWM prioritization figures correspond with the numbers of HOs – 4 IHOs and 10 NHOs – claiming to have SWM guidance, including framework, policy, or standard operating procedures (SOPs). Moreover, 1 IHO and 2 NHOs informed being in the process of drafting and reviewing SWM-related guidance. All these also confirmed their HO was implementing the adopted or draft SWM guidance.

It is difficult to assess the proportion of procurement done by the surveyed HOs locally and internationally, as the figures they indicated either covered the full scale from procuring most items locally to procuring everything internationally, or the respondents (5 IHOs, 7 NHOs) did not have such information available. The responses regarding employment of environmental criteria during supplier selection were more clear-cut. In total, 2 IHOs and 8 NHOs confirmed using some environmental criteria when selecting suppliers, with another 2 HOs being in the process of establishing such rules. The rest of HOs did not apply environmental criteria during supplier selection process or did not know if such regulations existed within their organizations.

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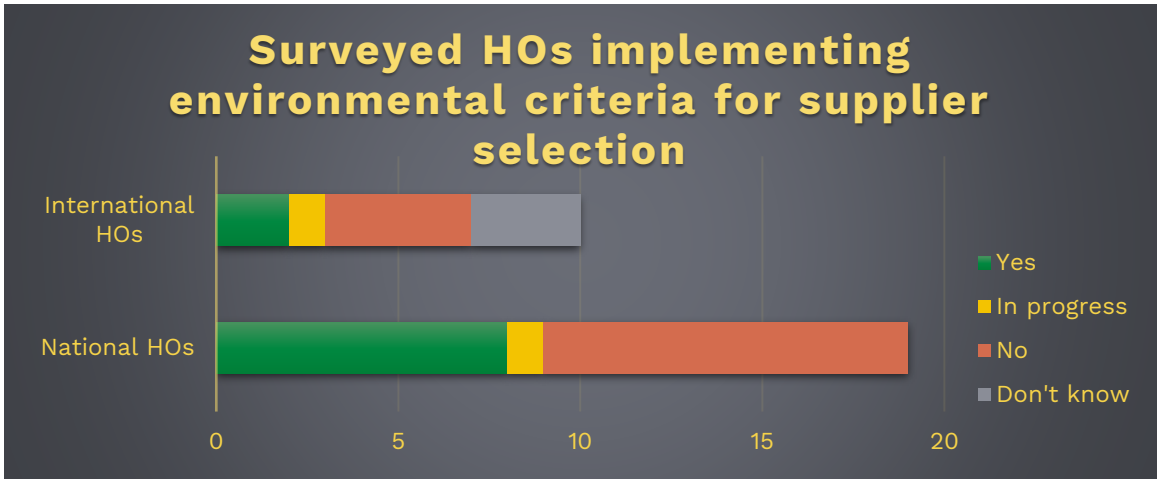


Figure 17: Surveyed HOs implementing environmental criteria for supplier selection

During the procurement process, most (7) of the 10 surveyed IHOs carry out the practice of technical specifications of items in terms of materials, including sustainable criteria. On the contrary, only 1 IHO carries out LCA for the procured items. Centralized supply chain is applied by 4 IHOs, whereas 3 IHOs practice environmental supplier screening.

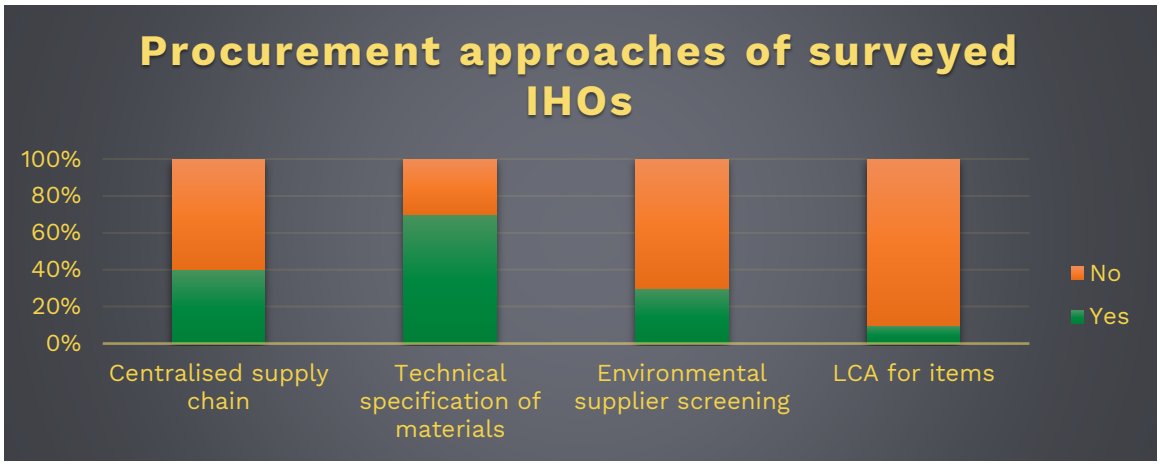


Figure 18: Procurement approaches of surveyed HOs

Half (5) of surveyed IHOs have requirements on the disposal, reuse, repurposing of packaging waste. Two IHOs specified that recycling concerned waste produced within the offices and one also highlighted it dependent on the government's/authorities' recycling capacity of the separated waste. One respondent specified such a requirement applied to medical waste, while another IHO follows ECHO requirement and recommendations where feasible. One respondent admitted that although such requirements existed within the organization, they were not fully known and used. Information on repurposing of packaging waste by NHOs is difficult to interpret due to misunderstanding of the question. However, 1 IHO and 6 NHOs gave examples of packaging types they tried to avoid. These included especially plastic packaging, aluminium and plastic sachets, and wooden pallets with metallic edges. From the remaining 9 IHOs, 1

indicated that related training took place only in pilot countries and that alternative was not always available, 1 said such practice was not yet formalized, 1 did not know the answer, 2 claimed not having capacity, and 1 re-iterated SWM was not their focus. Several NHOs admitted they lacked knowledge on the subject.

4.2.6 Reverse logistics

Reverse logistics refers to the process of returning, donating, or reselling packaging waste to individuals, groups, or businesses that can safely reuse, repurpose, or recycle packaging materials. Reverse logistics involves coordination among humanitarian organizations, logistics providers, government agencies, and local communities.[93] It thus represents an additional step to be incorporated into the waste hierarchy.

The following are the examples of implemented reverse logistics:

- Returning packaging waste

Humanitarian organizations return packaging waste to their manufacturer or supplier for responsible recycling or disposal. For example, empty sachets of RUTF or Plumpy'Nut used as nutritional input for malnourished children, are collected, transported, and either recycled or disposed of properly, minimizing environmental impact and promoting sustainability in humanitarian efforts.

- Donating/reselling packaging waste

Donating or reselling the material to organizations, individuals, or businesses that can reuse or repurpose it. E.g.:

- Cardboard boxes and Polypropylene (PP) woven bags to local shops or households for use in storage;
- High-density polyethylene (HDPE) containers (jerrycans) to transport water;
- Donating packaging material to a recycling centre that accepts specific materials and can recycle them properly;
- Return of medical supplies and equipment.

Health and environmental risks related to packaging use need to be assessed before implementing the reverse logistics.[94]

4.3 SWM innovations and solutions for humanitarian sector

HOs have been trying to find more green/sustainable alternatives to the plastic (petroleum-based plastics—also referred to as “conventional” or “virgin” plastic) and carboard and paper packaging for relief items.

4.3.1 Alternative to Plastic Packaging

The most used alternatives to conventional plastic packaging are as shown below.

[93] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Multi-donor policy landscape analysis (p. 10). Retrieved from https://eecentre.org/wp-content/uploads/2023/01/Multi-Donor-Policy-Landscape-Analysis.pdf.
[94] Ibid. (pp.9-10).

Figure 19: Most commonly used alternatives to conventional plastics in packaging

Source: Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management, 2023, p. 4

In humanitarian contexts, some plastic packaging is more recyclable than other, such as the polyethylene terephthalate (PET) or high-density polyethylene (HDPE). Plastic packaging is more recyclable if made from one material, mixing different materials makes thus recycling less feasible because of the need to separate the materials (e.g., metalized laminated sachets or pouches used for ready-to-use therapeutic foods or high-energy biscuits). Including information on the type of plastic in the packaging (using e.g. Resin Identification Code) helps ensure that the packaging will be collected separately and recycled. Packaging made from "alternative plastics" (biodegradable, compostable, bio-based, etc.) is not necessarily more environmentally sustainable and is often not adapted to humanitarian contexts.[95] According to JI, those sustainable solutions may help reduce the plastic pollution problem linked to poor end-of-life management, but

[95] ACTED, IOM, Joint Initiative on Sustainable Humanitarian Assistance Packaging Waste Management. (2019). Procurement Decision Tree to Reduce the Environmental Impact of Humanitarian Packaging (p. 2). Retrieved from https://eecentre.org.

they should not be considered quick-fix solutions or “silver bullets."[96] It is still necessary to focus on the packaging's role, especially for food items (e.g., protection from rain, UV, hygiene, shelf-life), and consider whether a more sustainable material can fulfil the same purpose. JI recommends to HOs to think on a bigger scale and make systemic shifts, by reflecting carefully on the “use case” for plastics packaging, i.e., what is its function? Is it necessary? and can the same result be achieved using a different type of packaging?[97]. The WREC waste management facilities mapping[98] provides information on which plastics can be recycled in different humanitarian settings. JI recommends using the “% of recycled content” information for plastic packaging to keep materials in circulation. However, for packaging food items, this can cause health hazards if the packaging is not approved as food-grade.[99]

4.3.2 Alternative to Carboard and Paper Packaging

According to JI's recommendations, recycled cardboard/paper should:

- Be prioritized over non-recycled cardboard/paper to keeps materials in circulation;
- Brown cardboard should be prioritized over white, bleached cardboard because of the chemicals used, which can create contamination during the recycling process;
- Wet or dirty cardboard is difficult to recycle and is likely to be sent to landfills;
- When storing cardboard to be recycled it should be protected from the rain;
- Cardboard and paper that has a coating, a plastic liner, or is laminated is difficult to recycle and should be avoided if possible.

While cardboard is advantageous due to its biodegradability and recyclability, it emits significantly more greenhouse gases compared to plastic. [100]

From a waste management perspective, unbleached cardboard (when brown) is better than plastic as it helps reduce air pollution (when plastic is burnt), as well as soil and water contamination (plastic particles which take thousands of years to decompose). Shifting away from plastic to cardboard presents opportunities for humanitarian organizations to reduce their environmental footprint caused by poor waste management practices. Nevertheless, this shift comes at a cost and covering this cost is only possible for organizations which have some level of financial autonomy or those which have anticipated these costs in their budgets. While a “good enough” approach is most suitable in difficult humanitarian contexts such as Afghanistan, it is important to keep in mind that cardboard is not the “perfect” solution and can generate other environmental impacts: the transport of cardboard is often more carbon intensive (as much heavier than plastic for the same functional unit) and the use of cardboard from non-sustainably managed forests can also have an impact on biodiversity and land use. If possible, humanitarian organizations

[96] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Alternatives to conventional (petroleum-based) plastics in packaging (p. 4). Retrieved from https://eecentre.org.
[97] Ibid.
[98] https://logie.logcluster.org/?op=wrec
[99] ACTED, IOM, Joint Initiative on Sustainable Humanitarian Assistance Packaging Waste Management. (2019). Procurement Decision Tree to Reduce the Environmental Impact of Humanitarian Packaging (p. 2). Retrieved from https://eecentre.org.
[100] Ibid.

should adopt a holistic approach and analyze various environmental impacts to be able to make informed choices when comparing different options.

4.3.3 Examples of HOs initiatives towards sustainable packaging

In March 2024, JI published a compendium of case studies[101] of eight HOs who have tried to reduce the environmental footprint of their packaging by testing solutions that are both upstream and downstream in the supply chain. See the examples below.

Table 8: Managing Packaging Waste Sustainably – examples of Good Practices from HOs

Initiative	Main Lessons Learnt
ShelterBox reduction of plastics packaging[102]	• The solutions must be adapted to local contexts, considering community perspectives and reuse practices. • Target primary and secondary packaging for sustainable changes as they are more manageable and within the organization's direct influence. • Engage suppliers from the outset to ensure their buy-in and participation in reducing plastic usage. This collaboration often aligns with their own sustainability goals. • Understand that decision-making involves trade-offs between different environmental impacts. Prioritizing changes that have the most significant positive impact is crucial. • Establish a working group and secure management support to sustain progress and distribute the workload across the organization. • Adapt approaches for regional suppliers considering cultural and operational differences, ensuring effective communication and implementation. • Incorporating sustainable practices enhances the organization's value, potentially attracting additional funding and improving employee engagement.

[101] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2024). Managing Packaging Waste Sustainably – Lessons from Humanitarian Organizations. Retrieved from Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management.
[102] ShelterBox. (2022). Managing Packaging Waste Sustainably – Lessons from Humanitarian Organizations: ShelterBox's Success in Eliminating Single Use Plastic. Retrieved from https://shelterbox.org/wp-content/uploads/2022/09/MANAGING-PACKAGING-WASTE-SHELTERBOX-low.pdf.

ICRC Afghanistan's Pilot: Replacing Plastics with Carboard in NFI Distributions[103]	• From a waste management perspective, unbleached cardboard (when brown) is preferable to plastic because it reduces air pollution (when plastic is burnt) and decreases soil and water contamination (plastic particles take thousands of years to decompose). • This transition incurs additional costs. • Cardboard is not a perfect solution. It can have other environmental impacts: transporting cardboard is often more carbon-intensive due to its heavier weight, and using cardboard from non-sustainably managed forests can negatively affect biodiversity.
World Food Programme's (WFP) Plastic Free E-voucher Shops in Cox's Bazar, Bangladesh[104]	• Alternatives to conventional plastics, such as wax-coated paper bags and jute bags, are not straightforward to implement. These substitutes come with their own environmental challenges, such as difficulty in recycling mixed materials and high water and carbon dioxide consumption for jute production. Raising awareness and providing information to beneficiaries is necessary for successful implementation. • Suppliers, especially established private sector companies, are generally flexible and capable of adjusting their practices. WFP's strong purchasing power in Cox's Bazar allowed it to leverage this influence to encourage suppliers to adopt sustainable practices. Small measures, like recycling plastic packaging, can result in significant waste reduction. • Encouraging beneficiaries to consistently bring back reusable packaging (like rice sacks and jute bags) is challenging. It requires substantial changes in knowledge, attitudes, and practices, which can take time to develop. The harsh and humid conditions in Cox's Bazar further complicate this effort, as keeping reusable bags clean and dry is difficult.

[103] ICRC. (2022). Managing Packaging Waste Sustainably – Lessons from Humanitarian Organizations: ICRC Afghanistan's Pilot: Replacing Plastic with Cardboard in NFI Distributions. Retrieved from https://eecentre.org/wp-content/uploads/2022/11/ICRC-Afghanistan-Case-Study_ENG_508.pdf.
[104] World Food Programme. (2022). Plastic-Free E-Voucher Shops in Cox's Bazar. Retrieved from https://resources.eecentre.org/wp-content/uploads/sites/6/2022/10/WFP-Plastic-Free-E-Voucher-Shops-in-Coxs-Bazar_ENG_508.pdf.

	• Shifting to alternatives to plastic involves higher costs. For instance, paper bags are 1.7 times more expensive, and jute bags are 3.5 to 4 times more expensive than plastic bags. These costs need to be anticipated and subsidized to ensure initial buy-in from local retailers. • The e-voucher assistance program facilitated the transition away from single-use plastics more effectively than in-kind distributions would have. Working with a set of specific retailers made it easier to influence practices positively, a change likely to continue beyond the program.
Acted Lebanon: A Holistic Approach to Reducing and Managing Waste[105]	• ACTED found that anticipating additional costs for sustainable packaging and waste collection in project budgets is crucial. They fostered supplier buy-in by explaining the benefits of environmentally sustainable materials and including sustainability requirements in their agreements. This approach facilitated a smoother integration of environmental considerations into their supply chains. • The gradual implementation of sustainable practices has enhanced the quality of ACTED's work. Staff members are motivated and have become ambassadors for environmentally sustainable practices. Beneficiaries have also responded positively to changes, such as the transition from plastic to jute bags, which has strengthened awareness-raising efforts. • ACTED's strategy included implementing easy, short-term changes ("quick wins") to maintain motivation while working on longer-term, more complex challenges. For instance, replacing secondary packaging was relatively straightforward, but addressing primary packaging for food items remains a challenge. This approach allows for significant progress in reducing environmental footprints while continuously exploring further improvements.

[105] ACTED. (2023). A Holistic Approach to Reducing and Managing Waste. Retrieved from https://eecentre.org/wp-content/uploads/2023/01/ACTED-A-Holistic-Approach-to-Reducing-and-Managing-Waste.pdf.

	• ACTED's success in sustainability is supported by strong leadership and organizational commitment. Initiatives such as carbon footprint exercises, monthly environmental sustainability reporting, and interdisciplinary working groups have been pivotal. The organization promotes innovation, collaboration with external actors, and collective learning across its offices.
UNICEF: Distributing Long Lasting Insecticidal Nets in Bulk[106]	• Engaging manufacturers who were also concerned about plastic waste was crucial. Many manufacturers supported the initiative by offering additional discounts for bulk packing, indicating their willingness to collaborate on sustainability efforts. • Bulk packing reduces both shipping costs and the carbon footprint associated with freight due to more efficient packing. The removal of plastic bags freed up extra space, allowing more long-lasting insecticidal nets to be loaded into shipping containers. • Addressing partners' concerns and justifications for individual packing helped UNICEF gather insights and shape a new narrative around the benefits of bulk packing. This advocacy was essential in changing preferences towards more sustainable options. • Important information on the use and care of long-lasting insecticidal nets is included directly on the bed nets' labels, ensuring users have access to necessary instructions even without individual packaging. • Reducing plastic waste in long-lasting insecticidal nets distribution is a significant step, but comprehensive solutions require broader thinking around waste management, recycling, social practices, and innovation. Continuous dialogue with suppliers and collaboration are key to implementing and sustaining these initiatives.

[106] UNICEF. (2019). Distributing Long Lasting Insecticidal Nets in Bulk. Retrieved from https://eecentre.org/wp-content/uploads/2019/07/UNICEF-Distributing-Long-Lasting-Insecticidal-Nets-in-Bulk-FI.pdf.

UNHCR's Greening the Packaging of Core Relief Items[107]	• Ensuring that changes to packaging do not compromise the integrity and functionality of the items is crucial. Pilot tests and laboratory results demonstrated that increasing the compression rate for thermal blankets reduced emissions and costs while maintaining their quality. • It's essential to consider the needs and context of the end users. For example, smaller and more compact solar lamps were introduced based on feedback, making them easier for refugees to carry and use. • Clear communication with end users about how to dispose of packaging is vital. Misleading terms like "biodegradable" or "compostable" can cause confusion in environments where proper disposal facilities are not available. • Engaging with suppliers to identify and implement sustainable packaging solutions proved effective. Suppliers often provided valuable feedback and suggestions for improvements, showcasing their willingness to support environmental initiatives. • Increasing the number of items packed into a bale, box, or container can significantly reduce the environmental footprint and costs. For instance, adjusting the compression rates for thermal blankets and the packaging for sleeping mats led to notable efficiencies. • Engaging with other humanitarian organizations and stakeholders, including private-sector suppliers and academics, has been beneficial. Participation in webinars and collaborative initiatives provided valuable insights and facilitated the adoption of best practices.
Save the Children's Promoting Sustainability Through Supply Chains	• Ensuring staff buy-in and commitment was crucial. The staff sustainability pledge and robust communication strategies, including webinars and videos, helped secure this. Sharing results

[107] UNHCR. (2019). Compendium of Best Practice: UNHCR Case Study. Retrieved from https://eecentre.org/wp-content/uploads/2019/07/Compendium-of-Best-Practice-UNHCR-Case-Study.pdf.

	internally further built enthusiasm and engagement in sustainability efforts. • Save the Children took a proactive approach by developing their supply chain sustainability strategy independently of donor guidance. This initiative positioned them as leaders in the humanitarian sector regarding sustainability policies for suppliers. • Achieving sustainability standards is an ongoing process. Save the Children encourages suppliers to continually improve their operations and provides support for this transition. They emphasize collaboration rather than disqualification for not meeting all standards immediately. • Linking sustainability initiatives to the organization's broader commitments and targets related to climate, localization, and social missions has strengthened engagement and ensured alignment with overall organizational goals. • The Supplier Sustainability Policy promotes the procurement of environmentally friendly products and encourages suppliers to protect children, uphold ethical standards, and promote diversity and inclusion. This approach amplifies the positive impact on the communities served by Save the Children. • The Supply Chain Team's involvement in key decision-making processes, such as the Global Climate Change Task Force and the development of environmental response plans, ensures that supply chain considerations are integral to the organization's strategies.
PALLADIUM/Foreign, Commonwealth and Development Office - Reducing single use plastics as much as possible, leaving only essential, 100% recycled, and 100% recyclable plastic behind[108]	• Merely integrating sustainability into procurement specifications is insufficient. It is crucial to inspect items upon receipt to ensure compliance with these specifications. Continuous checks and holding suppliers accountable help enforce sustainable practices. • Developing unambiguous and precise specifications is essential to avoid flexible interpretations by suppliers. Clear

[108] Palladium/Foreign, Commonwealth and Development Office. (2019). Managing Packaging Waste Sustainably – Lessons from Humanitarian Organizations: Palladium's Approach to Reducing Single Use Plastics. Retrieved from https://eecentre.org/wp-content/uploads/2019/07/Palladium-Case-Study-Managing-Packaging-Waste-Sustainably.pdf.

	instructions, such as "use 100% recyclable materials," should be stated explicitly. Any deviations should prompt discussions between buyers and suppliers to find feasible solutions. • Leveraging existing legislation can help influence suppliers to comply with sustainable practices. Palladium used the UK's Plastic Packaging Tax to stress the importance of meeting recycled content guidelines, which motivated suppliers to adhere to the new specifications. • Where possible, Palladium eliminated unnecessary plastic packaging and replaced it with sustainable alternatives. For example, cloth bags, paper bubble wrap, and paper void fill were used to replace plastic packaging. • For unavoidable plastic packaging, Palladium ensured that it was 100% recycled and recyclable. They required suppliers to use Resin Identification Codes (RICs) to facilitate the sorting and recycling process, promoting better waste management. • Finding sustainable alternatives for tertiary packaging, such as plastic wrap, remains difficult due to its effectiveness in protecting items. Palladium highlighted the need for collective solutions and increased influence over external stakeholders like transporters. • Continuous dialogue with suppliers is key. While some suppliers are advanced in their sustainability efforts, others may need guidance and support. Being critical of suppliers' suggestions ensures that proposed solutions are genuinely sustainable.

4.3.4 Bio-based solutions and the surveyed national and international HOs

The surveyed IHOs are comparatively more sceptical in terms of considering bio-based products/systems as a solution for sustainable SWM than NHOs. While 4 out of 10 IHOs viewed bio-based products as a solution and 1 IHO said it would be a solution if it were available locally and independently from international procurement, 18 out of 19 NHOs agreed bio-based products could be a solution for SWM. Additionally, 3 IHOs and 9 NHOs confirmed implementing bio-based solutions themselves; however, 5 of the 9 NHOs did not provide a correct example of bio-based solutions they implemented, which indicates a lack of understanding of bio-based products and approaches. Apart from the survey, local bio-based initiatives were also observed by the researchers in DRC and South Sudan and discussed

during FGDs and KIIs. However, such initiatives were usually on a small local and even individual scale. Most of the projects implementing some bio-based solutions and led by HOs that the research team discovered tended to be unsustainable, as they ceased after projects' end. The PIN and PAH teams asked for projects' learnings to understand the key challenges to sustainability and are currently waiting to receive the documents. On the other hand, most bio-based solutions initiated by local actors (mostly businesses) or supported by research institutes proved to be more sustainable and durable. The most commonly identified bio-based practice is compost and fertilizer production from organic waste.

Table 9: Existing bio-based solutions identified through primary data collection

Bio-based practices of surveyed HOs	Bio-based practices identified in DRC & South Sudan

International HOs
• Use of biodegradable cups and bags (PIN)
• Exploring biogas digesters (Acted)
• Bioremediation (MONUSCO)
National HOs
• Integrated soil fertility management through production of organic fertilizer from household waste and crop residues (CADIBUasbl, ASOV, LM International South Sudan, Actions des Femmes pour les Initiatives de Developpement)
• Set up of biogas digesters in camps to transform biomass into fertilizer and biogas (HF-AFRICA)
• Transformation of charcoal dust into briquettes for cooking (FAPROS)
	• Animal feed production
	  ○ Black soldier flies' larvae feeding on organic waste (IITA, UOB, AALI, BK)
	  ○ Fish feed from organic waste (household level; mode of expired food destruction by Provincial Environmental service)
	• Biogas production in biodigesters (Diobas, UOB, UNIGOM, Carnak Tobacco)
	• Bio-charcoal production from different wastes:
	  ○ Carton (BK)
	  ○ Mixed organic household or field waste (RDG, UNIGOM)
	  ○ Sugarcane husks (GIZ)
	• Fertilizer and compost from organic waste
	• Ignition stimulant produced from paper waste (BK)
	• Mushroom growing on agricultural waste. The rest of the waste is used as fertilizer (UOB, GIZ, Rikolto, UNIGOM)

5. Current state of SWM in humanitarian settings

According to UNEP, 38% of the municipal solid waste generated globally in 2020 was uncontrolled. The degree to which municipal solid waste is managed in a controlled manner varies significantly across regions; Sub-Saharan Africa and Central and South Asia have the lowest levels of controlled municipal solid waste.[30] Generally, most of the waste in humanitarian settings is mismanaged. Open dumping (uncontrolled and controlled), with associated burning of waste, is the most

common waste disposal method.[109] In many situations, there are no proper waste sorting, storage, collection, and treatment systems. This has a serious negative impact on the environment and the health of populations, such as an increase in air, land and water pollution, transmissible diseases, and respiratory infections.[110]

The negative impacts of poorly managed waste affect everyone, but mostly the vulnerable populations living in low-income countries. The improper disposal of waste puts in danger the lives and homes of the most vulnerable (landslides of waste dumps), contaminates air, water and soil and poses a serious risk to human health and ecosystems.[111] Furthermore, the waste dumping leads to environmental and marine pollution and can block water drains resulting in flooding and to increase in cholera and vector-borne diseases such as malaria and dengue.[112]

5.1 SWM Stakeholders

SWM systems in humanitarian settings consist of various stages, including generation, storage, collection, transportation, processing, recovery, and final waste disposal. [113] These complex systems involve a diverse range of stakeholders (stakeholder groups identified and described in D3.2), including e.g. donors, NGOs, national and municipal governments, SWM initiatives, academia, and the formal and informal private sector, as shown in figure 20 below.

[109] United Nations Environment Programme. (2024). Africa Waste Management Outlook (p. 74). United Nations Environment Programme. Retrieved fromhttps://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[110] UNHCR. (2023). Waste Management Concept Note (p. 2). Retrieved from https://www.unhcr.org/sites/default/files/2023-09/waste-management-concept-note.pdf.
[111] Kaza, Silpa; Yao, Lisa C.; Bhada-Tata, Perinaz; Van Woerden, Frank. (2018). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. Urban Development. © Washington, DC: World Bank. http://hdl.handle.net/10986/30317 License: CC BY 3.0 IGO.
[112] World Health Organization. (2022). Compendium of WHO and other UN guidance on health and environment (p. 69). Retrieved from https://www.who.int/tools/compendium-on-health-and-environment/solid-waste.
[113] WASH Sector Cox's Bazar. (2021). Solid Waste Management Strategy (p. 1). Retrieved from WASHCXB-Solid-Waste-Management-Strategy-31.07.21.pdf.

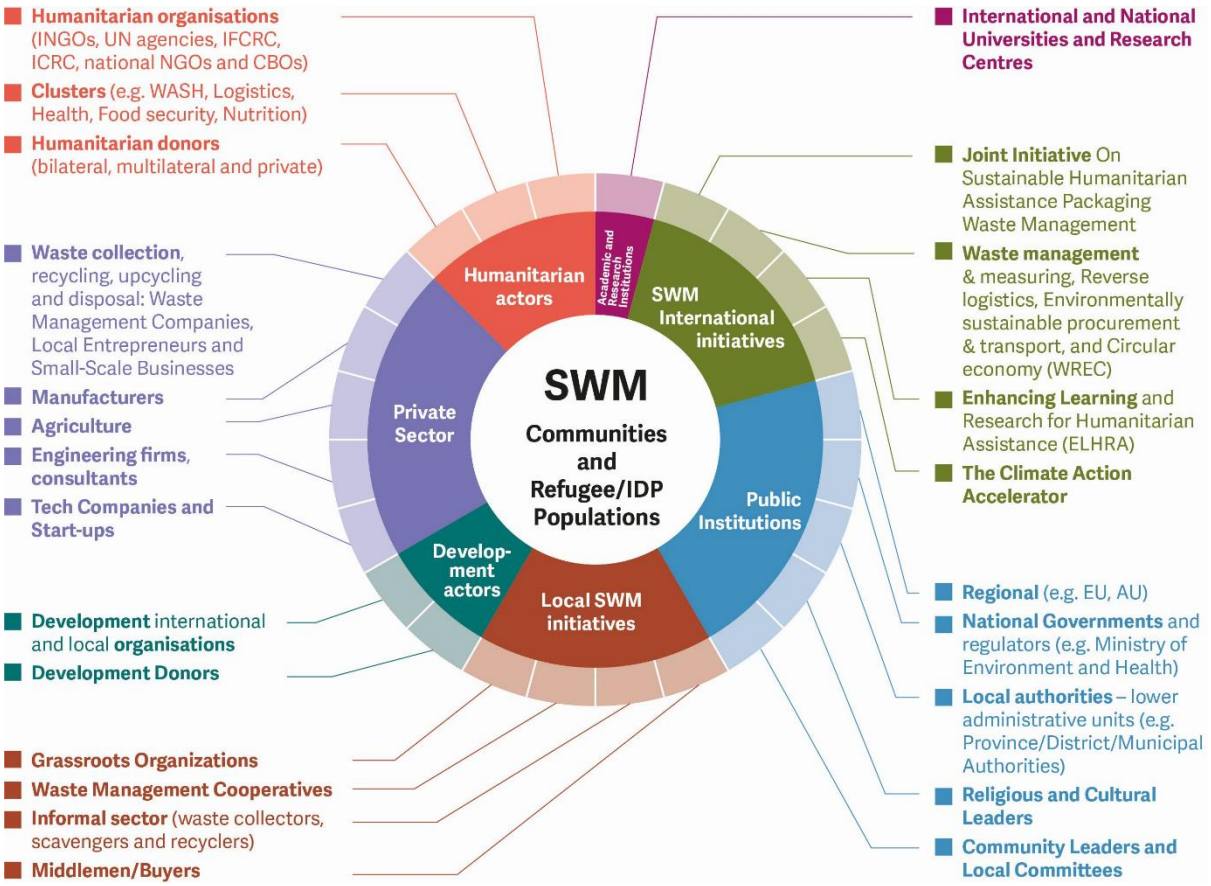


Figure 20: SWM stakeholders

5.1.1 SWM stakeholders in DRC and South Sudan

All SWM stakeholders as displayed in Figure 20 are represented in the two case study countries. However, they are not united in a joint platform and their roles and involvement differ. In South Kivu province of DRC, it is the Provincial Environmental Service that collects taxes and fees related to SWM; however, they do not provide SWM services within the province. It is the local governments, such as municipalities and chefferies, that are responsible for SWM implementation, yet they do not have sufficient budgets nor facilities to fulfil this role. As such, SWM is virtually non-existent in rural areas and camps, while in urban settings, such services are provided by private companies, which are taxed by the Provincial Environmental Service and which often enter Public-Private Partnerships (PPPs) with municipalities, as is the case of Bukavu and Goma. Such PPPs are administratively difficult to achieve but certify the private company services and as such improve the business environment in which they operate. To finance their operation and services, some SWM private companies may receive funding from the municipality for public waste collection, e.g. from the main roads, water channels and markets. This funding is sourced from fees, such as sanitation fee in Bukavu, which is imposed on market businesses by the municipality – 1,000 CDF per door and 500 CDF per table in 2024. The sanitation fee of 1,000 CDF should also be paid by taxis in Bukavu, but as taxi drivers are not keen on paying the tax, they are negotiating with the municipality to reduce the fee to 500 CDF. However, if waste is collected from households, businesses, and organizations, including HOs, SWM companies generally impose fees on their clients. Most households are not subscribed to waste evacuation due to poverty or mentality. However, in case of Bukavu, households and businesses on the main road are obliged to subscribe to waste collection. Service subscription fees are not

uniform and depend heavily on negotiations with the subscribers. Exceptionally, subscription fees can be fixed in certain location, possibly with the municipality support. Households pay in general less than businesses and organizations, while international businesses and organizations pay the most – estimations were around 25-30 USD per one collection per week. There is also an extensive network of unofficial waste pickers and collectors who sell, reuse or recycle collected waste.

The majority of SWM private businesses in Bukavu and Goma have formed a common platform to better coordinate. In Bukavu, around 30 SWM businesses (4-5 engaged in waste transformation, the rest in waste evacuation) signed partnership agreements with the municipality; around 20 of them joined the platform Synergy of Sanitation Organizations in DRC (*Synergie des Organisations d'Assainissement de la RD Congo*, SOA-RDC). These partnerships help to realize a very recent municipality's initiative of zoning, which assigns one zone to each SWM partner to manage. In Goma, 40 SWM private businesses (3 waste transformers, 38 waste collectors) form the Platform - Water, Hygiene, Sanitation/Economic Interest Grouping (*Plateforme – Eau, Hygiene, Assainissement/Groupement d'intéret économique*, PF-EHA/GIE). Despite the high number of SWM private businesses present in both provincial capitals, their capacities to manage all the waste within their cities' boundaries is limited, although the situation in Goma is significantly better. The rough estimation from PF-EHA/GIE shows that the members are able to collect app. 91 cubic meters of waste per month, or 2,736 cubic meters per month, or 32,832 cubic meters per year. Estimated figures from SOA estimate that the platform members are able to collect app 64 tons of waste per day, or 1,920 tons of waste per month, or 23,040 tons per year. This means that the waste collection capacity that SOA may have cannot compare with the estimated 898 tons of waste Bukavu generates on a daily basis.[114] The quick calculation shows that about 7% of generated waste is collected by SOA in Bukavu, which corresponds to municipality's estimation that less than 10% of waste generated is collected in the city.

The majority of waste is collected unsorted and deposited especially at private landfills, as municipalities of Bukavu and Goma do not own a landfill. As such, small private landfills are in few cases owned by SWM businesses but mostly paid for. In Bukavu, there is no state-owned landfill, and most businesses pay to depose waste in the private Musigiko landfill co-managed by SOA. One truck's discharge costs 15 to 25 USD. In Goma, 2 businesses have small private landfills, while the remaining 38 businesses pay to deposit collected waste in a private landfill outside of Goma in Nzulo, but this is near the fighting zone. There is a private landfill in Nyiragongo, but it is too far and reached by climbing steep slope.

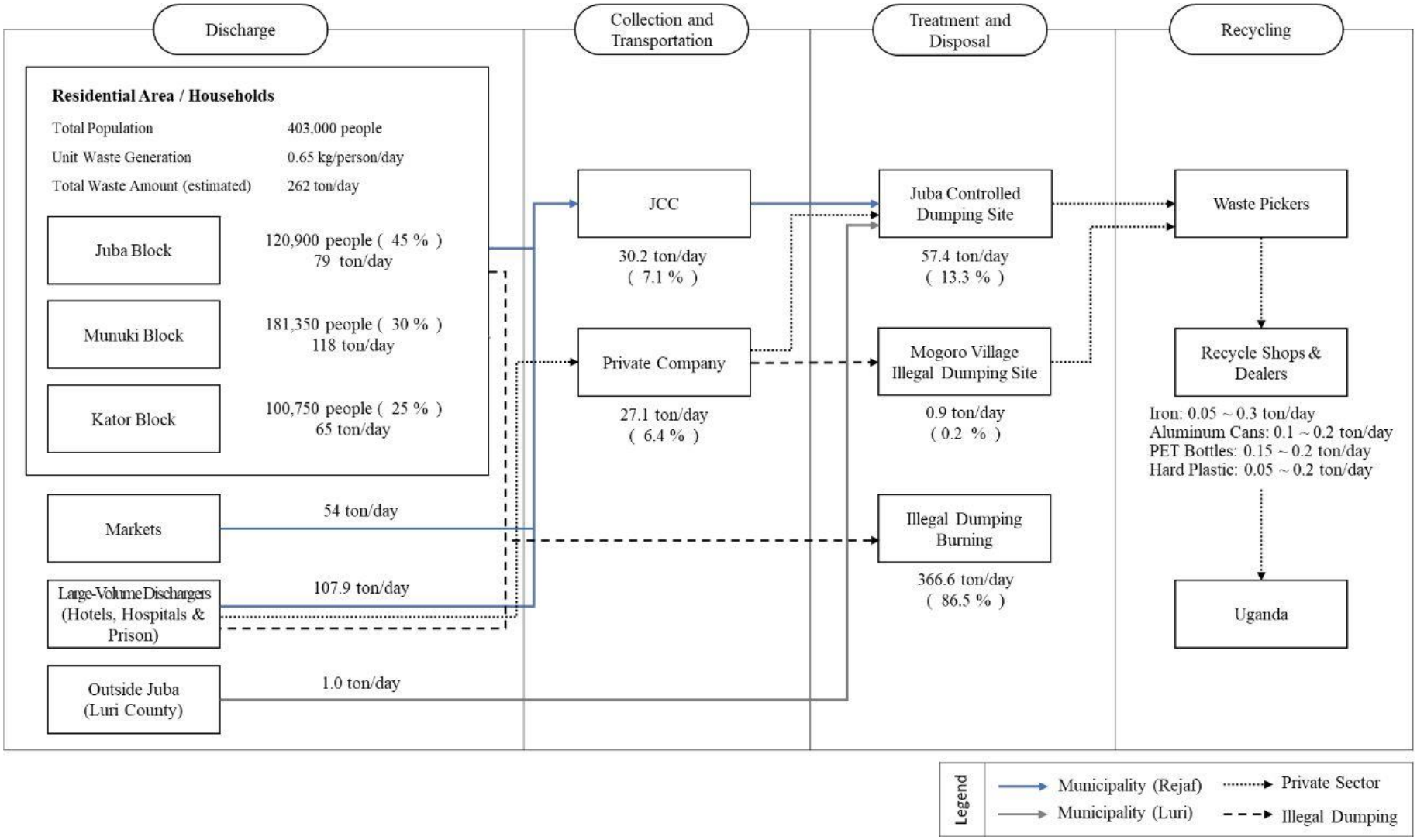
In South Sudan the SWM should be organized on the local administration level, depending on the type of settlement, land authority, capacities, and resources of the administration the approach differs. Usually the involved authorities are Municipality, Payam and County administrations. In the whole country there is only one semi-controlled dumping site in Juba, the rest is uncontrolled.

In Juba city waste collection and transportation is a responsibility of the Department of Environment and Sanitation under Juba City Council (JCC). The collection is done by the municipality owned trucks or through private companies, but the collection rate is low and estimated at "7.1 % by the municipality and 6.4%

[114] Zagabe, O.A., Ciribuka, G.B., Nabahungu, L.N. and Aleke, A.L. (2022) Quantification and Classification of Household Solid Waste in the City of Bukavu, DRC. Open Access Library Journal, 9: e9563. https://doi.org/10.4236/oalib.1109563.

by private sector"[115] and waste is accumulating on the city streets, being illegally burned, buried or thrown to the rivers. "As of March 2020, there are 10 registered private waste collectors, but a lot of unregistered private collectors were observed during the incoming waste collection vehicle survey."[116] Collected waste is being transported to the dumping sites including the only regulated and semi-controlled site on Yei road (Hai City; on the graph named "Juba Controlled Dumping Site") that is under Juba County jurisdiction and is being supported by the SWM project implemented by Japan International Cooperation Agency (JICA). At the dumping site waste is being measured per truck and origin (private, municipality, etc.) with different fees being applied for dumping. There is no compacting of waste now due to the lack of proper equipment, although burning is not recommended as a disposal practice it is observed. At the dumping site, informal waste pickers (including children) gather different types of waste (such as plastic, metal and aluminium) that later sell to informal businesses/recycle shops. Shops segregate waste, aluminium is being melted to produce new items, plastic is being colour and type segregated, shredded and along with metal scraps transported to Uganda to other private businesses. Unfortunately, the assessment team did not manage to follow the waste flow outside of South Sudan.

[115] Ministry of Environment and Forestry, Ministry of Health, Central Equatoria State, Juba City Council, Juba County - Rejaf Payam, & Japan International Cooperation Agency. (2021). Solid Waste Management Master Plan in Juba City 2021-2030 (p. 22). Retrieved from https://www.jica.go.jp/Resource/south_sudan/english/office/topics/fh2q4d000000rbey-att/221122_04.pdf.
[116] Ibid. (p.25).



Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

Figure 21: Juba city, South Sudan Waste Management Flow

Source: Ministry of Environment and Forestry, Ministry of Health, Central Equatoria State, Juba City Council, Juba County - Rejaf Payam, & Japan International Cooperation Agency, 2021, p. 22

In Yei Town, based on the local order issued by the Yei River County to avoid uncontrolled waste accumulation, all properties/households are ordered to handle waste on their premises in pits where later the waste is being burned or buried. Payam administration provides limited waste collection service that is paid. Collected waste is being taken to one of the agreed locations. Dumping sites are uncontrolled without proper infrastructure, mixed waste is being disposed of and later burned by the staff hired by Payam.

5.1.1.1 SWM stakeholders – humanitarian actors

In the selected areas, only one HA was identified to significantly contribute to SWM – Japan International Cooperation Agency (JICA). In South Sudan JICA is implementing the multiyear and multistakeholder SWM project for Juba City. The remaining organizations conduct small-scale initiatives and pilots. However, as shown in the KIIs and survey, HOs do form partnerships with local stakeholders and private sector working in SWM to manage their office waste where such services are available. Considering limited possibilities of SWM in both countries, the waste collected by the private sector is usually handled similarly to the public one. As for the humanitarian donors, they are increasingly expecting inclusion of environmental considerations, including SWM, to be part of project proposals (read *4.1.5 Donors* section above). The survey with international and national HOs however shows that HOs do not feel like donors focus sufficiently on the topic of SWM (figure 22), and most would welcome more interest in and funding to SWM from the donors' side.

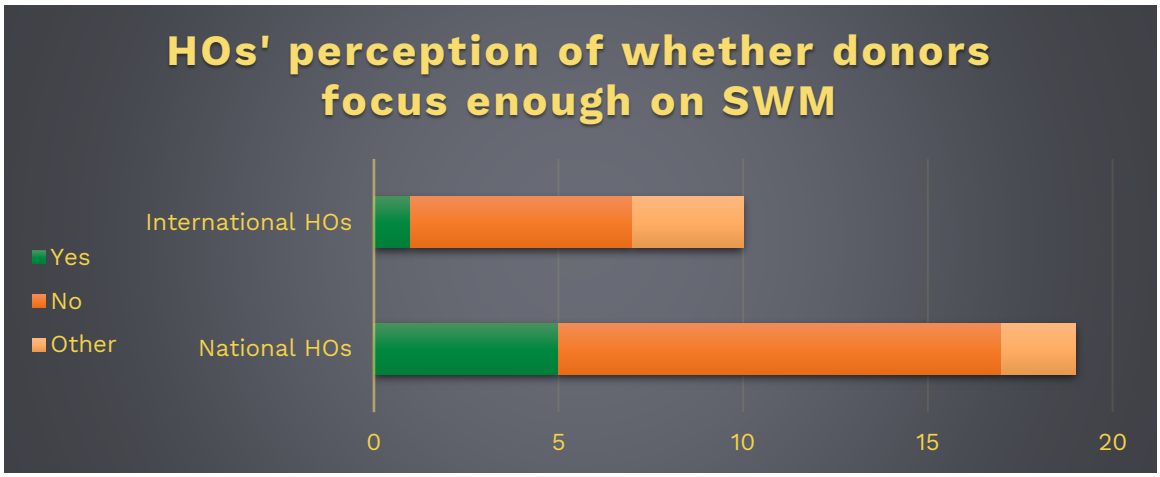


Figure 22: HOs' perception of whether donors focus enough on SWM

5.2 SWM Initiatives

Figure 20 shows how complex the SWM issue is. Coordination and partnerships between governments, HOs, donors, and other stakeholders is key for successful SWM implementation,[117] as well as pooling of resources and sharing of knowledge and good practices.[118] Nevertheless, coordination at different levels remains one of the biggest SWM challenges. There is a growing number of international initiatives

[117] European Commission. (2022). Humanitarian Aid Donors' Declaration on Climate and Environment (p. 3). Retrieved from https://civil-protection-humanitarian-aid.ec.europa.eu/document/download/8928aae4-4e2c-44d6-bbed-34d8cfdb90a9_en?filename=Donor%20declaration%20on%20climate%20and%20environment_ENG.pdf.

[118] ShelterBox. (2022). Managing Packaging Waste Sustainably - Lessons from Humanitarian Organizations (p. 3). Retrieved from https://shelterbox.org/wp-content/uploads/2022/09/MANAGING-PACKAGING-WASTE-SHELTERBOX-low.pdf.

and working groups focusing on SWM and related issues (e.g. green procurement), such as those shown in figure 23 below.

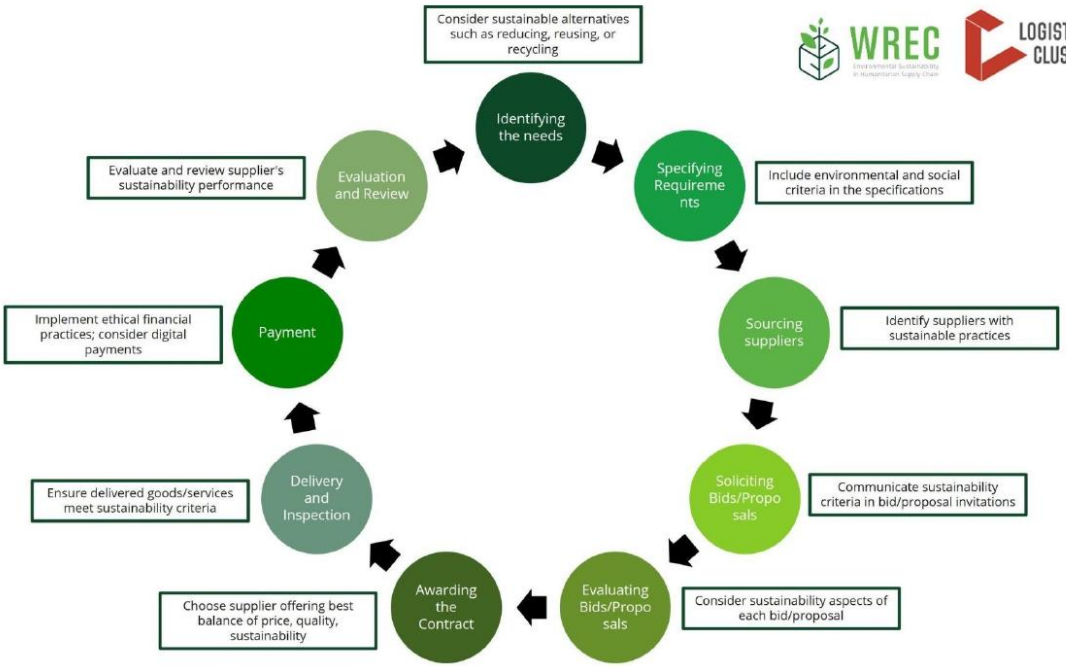


Figure 23: Green procurement working groups identified

Source: WREC, 2023, p. 4

The two main initiatives are the following:

The Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management (JI)

Funded by the USAID, multi-stakeholder[119], multi-disciplinary project with an overarching objective to support humanitarian actors to deliver lifesaving assistance more effectively and efficiently by protecting people from environmental risks. The project convenes humanitarian actors from the United Nations (UN) system, non-governmental organizations (NGOs), donors, and academics.

Key documents:

- *"Who's Doing What" on Sustainable Procurement. An Overview of What Humanitarian Organizations Are Doing To "Green" Their Procurement Practices*[120]
- *Packaging Baseline Assessment Based on Humanitarian Emergency Responses in 2021*[121]

[119] United States Agency for International Development (USAID), The United Nations High Commissioner for Refugees (UNHCR), World Wildlife Fund (WWF), the UN/Environment/OCHA Joint Unit (JEU), Norwegian Refugee Council (NRC), Swedish Civil Contingencies agency (MSB) and the International Union for the Conservation of Nature (IUCN).

[120] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2022). "Who's Doing What" on Sustainable Procurement: An Overview of What Humanitarian Organizations Are Doing to "Green" Their Procurement Practices. Retrieved from https://eecentre.org/wp-content/uploads/2022/12/Whos-Doing-What-on-Sustainable-Procurement.pdf.

[121] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Packaging Baseline Assessment Based on Humanitarian Emergency Responses in 2021. Retrieved

- *Procurement Decision Tree to Reduce the Environmental Impact of Humanitarian Packaging*[122]

The WREC (Waste management and measuring, Reverse logistics, Environmentally sustainable procurement and transport, and Circular economy) Project

A multi donor and multi stakeholder project, the WREC seeks to identify and reduce the adverse environmental consequences of humanitarian logistics through awareness, practical guidance, and real-time environmental expertise. The WREC is coordinated by the Global Logistics Cluster (GLC) and supported by a coalition of humanitarian organizations—the DRC, IFRC, Save the Children International, and World Food Programme (WFP).[123]

Key documents:

- *Literature Review: Waste management and reverse logistics in the humanitarian context*[124]
- *Waste or Material Characterization Exercise Guidance*[125]
- *WREC Approaches to Environmental Sustainability Concepts & Processes*[126]
- *Environmental Sustainability in Humanitarian Logistics Baseline and Mid-term Survey Report*[127]
- *Quick Guide. Environmentally Sustainable Procurement*[128]
- *Quick Guide. Solid Waste Management (SWM) Guide*[129]
- *Waste Management and Reverse Logistics in Humanitarian Context*[130]

from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-06/Packaging%20Baseline%20Assessment%20Based%20on%20Humanitarian%20Emergency%20Responses%20in%202021.pdf.

[122] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2024). Joint Initiative Procurement Decision Tree (English, French). Retrieved from https://logcluster.org/en/document/joint-initiative-procurement-decision-tree-english-french.

[123] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2022). Who's Doing What on Sustainable Procurement (pp. 6-7). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-12/Who%27s%20Doing%20What%20on%20Sustainable%20Procurement%20%28002%29.pdf.

[124] Tuomala, V., Aminoff, A., & Kovacs, G. Literature review. Waste management and reverse logistics in the humanitarian context. (2022). Hanken School of Economics, HUMLOG Institute. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-08/WREC%20literature%20review%20Nofoma.pdf.

[125] WREC. Waste or material characterization exercise guidance. (2024). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2024-03/Logistics%20Cluster_WREC%20Waste%20Characterization%20Process_2024.pdf.

[126] WREC. Approaches to environmental sustainability concepts & processes. (2023). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-09/WREC%20Approaches%20to%20Environmental%20Sustainability%20Concepts.pdf.

[127] WREC. (2023). WREC survey results report. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-08/WREC_Surveyreport%20240823_FINAL.pdf.

[128] WREC. (2023). Quick Guide. Environmentally Sustainable Procurement. An Introductory Guide. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-12/QuickGuide_Green%20Procurement_2023%20Final2.pdf.

[129] WREC. (2023). Quick Guide. Solid Waste Management (SWM) Guide. Retrieved from https://d10.logcluster.org/en/document/wrec-quick-guide-waste-management-august-2023.

[130] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context. Hanken School of Economics, Supply Chain Management and Social Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.

5.3 Waste streams

Waste streams are flows of specific waste, from its source through to recovery, recycling or disposal.[131] Waste streams in humanitarian settings consist of specific types of waste that need to be managed through appropriate collection, processing, recycling, and disposal methods. There are four main waste streams in humanitarian settings as identified by Waste Aid UK: plastics, organics, textiles and electronics.[132] The packaging of relief items generates unintended waste stream in the most fragile and strained contexts.[133] See bellow an example of material flow[134] within the SWM system, in the Rohingya refugee camps in the Cox's Bazar district in Bangladesh, where is high population density and waste presence (caused mainly by the use of individually wrapped and packaged commercial goods and distributed non-food items).

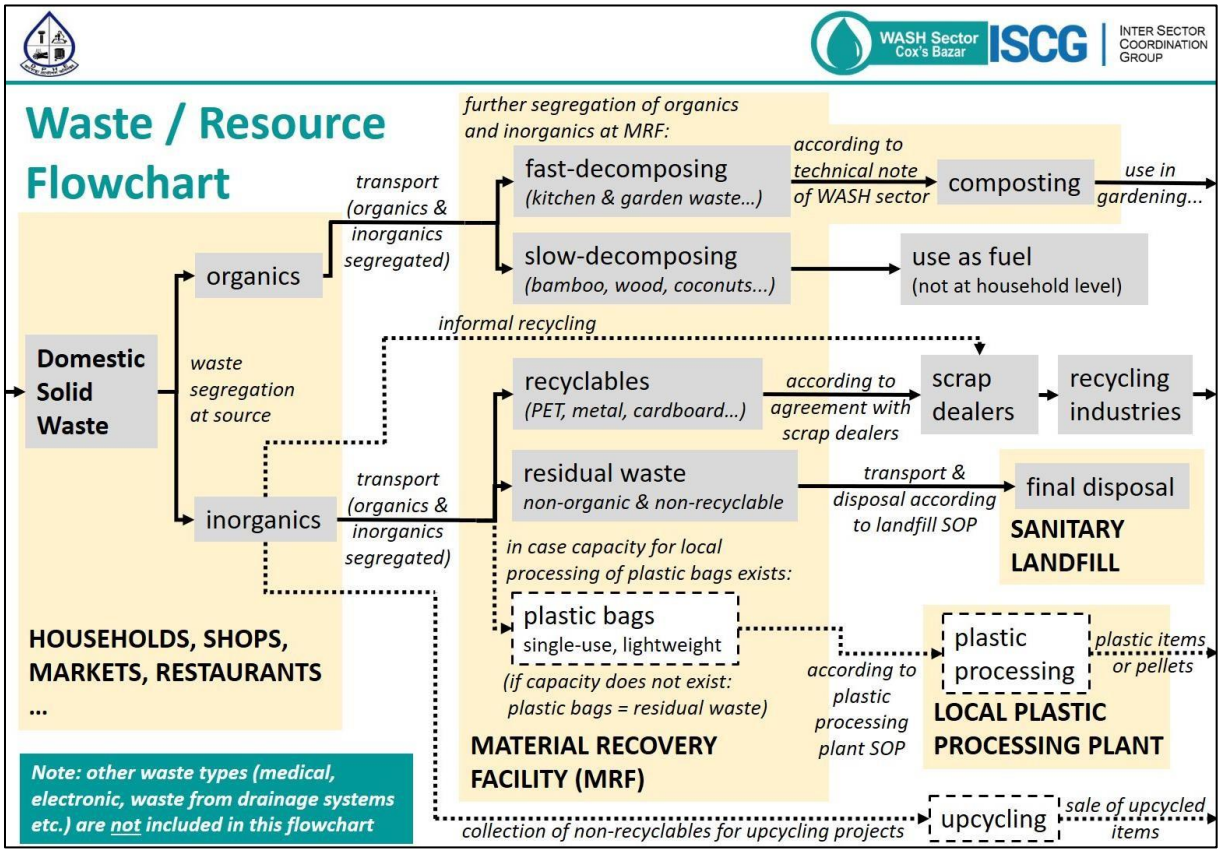


Figure 24: Flowchart for Waste and recovered Resources

Source: WASH Sector Cox´s Bazar, 2021, p. 11

[131] European Parliament. (2015). Understanding waste streams: Treatment of specific waste (p. 1). Retrieved from European Parliament. https://www.europarl.europa.eu/EPRS/EPRS-Briefing-564398-Understanding-waste-streams-FINAL.pdf.

[132] https://wasteaid.org/

[133] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO). (2022). Guidance on the operationalization of the minimum environmental requirements and recommendations for EU-funded humanitarian aid operations (p. 31). Publications Office of the European Union. Retrieved from https://data.europa.eu/doi/10.2795/467817.

[134] WASH Sector Cox's Bazar. (2021). Solid Waste Management Strategy (p. 11). Retrieved from WASHCXB-Solid-Waste-Management-Strategy-31.07.21.pdf.

5.3.1 Waste generation

It is almost impossible to identify where the waste comes from in the humanitarian settings. The humanitarian waste stream and its most significant contributors, such as widely used items like poly-woven grain bags and tarpaulins, are not well understood.[135] While it is recommended[136] to avoid/reduce the waste generation (especially inorganic and non-recyclable waste) whenever possible, the reality is that packaging of relief items is still the biggest problem in terms of waste streams. Packaging poses one of the biggest challenges to environmentally friendly logistics, despite its necessity for shipping and storage. Several overarching factors influence the delivery of humanitarian assistance and the resulting packaging waste. These factors include competing priorities, the type of emergency, and whether assistance is delivered locally or internationally. Waste production can be significantly reduced if humanitarian organizations plan their supply chains and procurement processes by optimizing distribution channels and considering the waste management costs associated with the delivered items.[137]

5.3.1.1 Humanitarian Supply Chain (HSC)

Humanitarian procurement is largely influenced by the emergency context and immediate needs: humanitarian aid supply chains must prioritize speed and efficiency to save lives. Consequently, purchasing decisions are often made quickly, favouring immediate availability and low costs, which can sometimes overshadow long-term environmental sustainability considerations. [138] Additionally, environmentally sustainable materials and products are rarely available in the markets of humanitarian contexts, and sourcing them from abroad can be too costly or time-consuming. To make environmentally responsible purchases, there may be a need for training, awareness raising, and additional resources. HOs must properly assess the sustainability of products and suppliers.

Engaging with the local market is key for the sustainability of the humanitarian action and can save costs and reduce carbon emissions and the use of packaging on long transport routes. HOs should ensure that their impact on the local market is positive and sustainable, for example by avoiding distorting the local market. HOs can also boost the capacity of local suppliers in the market, by increasing capacities of local services, or by working with local suppliers to inform them of upcoming needs.[139]

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[135] Elrha. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 64). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.

[136] WASH Sector Cox's Bazar. (2021). Solid Waste Management Strategy (p. 3). Retrieved from WASHCXB-Solid-Waste-Management-Strategy-31.07.21.pdf.

[137] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO). (2022). Guidance on the operationalization of the minimum environmental requirements and recommendations for EU-funded humanitarian aid operations (p. 33). Publications Office of the European Union. Retrieved from https://data.europa.eu/doi/10.2795/467817.

[138] WREC. (2023). Quick Guide. Environmentally Sustainable Procurement. An Introductory Guide (p. 3). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-12/QuickGuide_Green%20Procurement_2023%20Final2.pdf.

[139] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO). (2022). Humanitarian Logistics Policy (p. 18). Retrieved from https://ec.europa.eu/echo/files/policies/sectoral/humanitarian_logistics_thematic_policy_document_en.pdf.

Additionally, these organizations may encounter internal resistance to adopting more sustainable practices. If perceived as more complicated or expensive, sustainable practices may face reluctance and impede implementation, even when long-term benefits are recognized. Utilizing straightforward green procurement practices can alleviate some of these concerns by raising awareness of the issue and sharing simple strategies to integrate environmental sustainability into humanitarian organizations' purchasing and supply processes.

The Humanitarian Supply Chains (HSC) encompass the planning, procurement, storage, transportation, and delivery of various supplies, works, and services used for projects and emergency response.[140] For example, for the DG ECHO, the humanitarian supply chain (from procurement to the last point of delivery in the field) accounts for 60%-80% of humanitarian aid funding.[141] In 2019, around $6 billion was spent on supply chains.[142] The HCS and logistics significantly impact many of the key issues in humanitarian aid, such as funding gaps, access, environmental footprint, disaster preparedness, and localization. Many HOs based in Europe use the Humanitarian Procurement Centers (HPCs) instead of doing their own international procurement. HPCs provide centralized procurement services, leveraging economies of scale and expertise to support various humanitarian missions. Below are some examples of HPCs:

- United Nations Global Marketplace (UNGM)
- UNICEF Supply Division
- World Food Programme (WFP) Supply Chain Division
- UNHCR Supply Management and Logistics Service
- International Federation of Red Cross and Red Crescent Societies (IFRC) Logistics, Procurement and Supply Chain Management
- United Nations Office for Project Services (UNOPS)
- Global Humanitarian Assistance (GHA)
- Inter-Agency Procurement Services Office (IAPSO)

For example, MSF have their own system based on their own humanitarian supply centres delivering medicines,[143] medical supplies and logistics equipment to over 30 countries worldwide,[144] as shown in the figure below.

[140] Plan International EU Liaison Office. (2022). Supply chain changing the face of humanitarian aid. Retrieved from https://plan-international.org/eu/blog/2022/12/13/supply-chain/.
[141] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (DG ECHO). (2024). Humanitarian Implementation Plan (HIP) Strategic Humanitarian Supply Chain and Logistics (p. 1). Retrieved from https://ec.europa.eu/echo/files/funding/hip2024/echo_ssc_bud_2024_91000_v1.pdf.
[142] Plan International EU Liaison Office. (2022). Supply chain changing the face of humanitarian aid. Retrieved from https://plan-international.org/eu/blog/2022/12/13/supply-chain/.
[143] See more on how MSF reduces the volume of goods transported by air and systematically favours maritime transport here: https://climateactionaccelerator.org/successful-experiences/how_msf_france_reduced_its_carbon_footprint_by_switching_to_sea_freight/
[144] MSF Supply. MSF Supply within MSF. Retrieved from https://www.msfsupply.be/en/who-we-are/msf-supply-within-msf/.

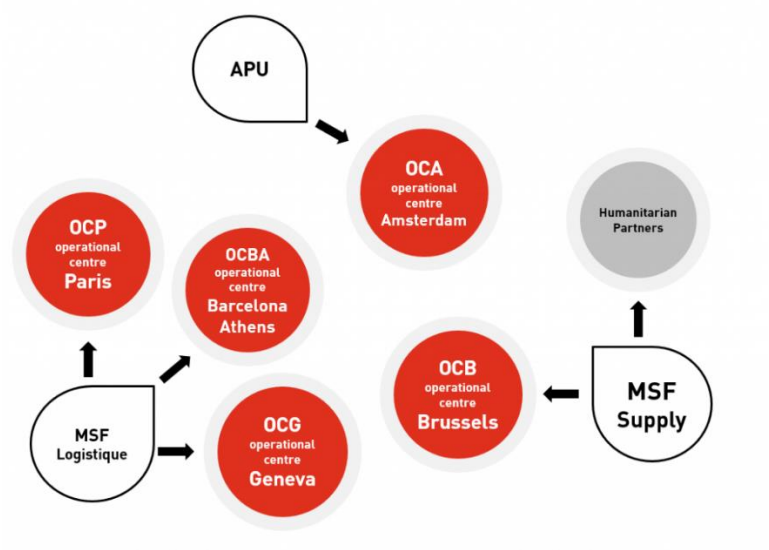

Figure 25: Humanitarian Supply Chain scheme

Source: MSF Supply within MSF (https://www.msfsupply.be/en/who-we-are/msf-supply-within-msf)

5.3.2 Waste Source Segregation

Source segregation of waste is the most crucial element in the SWM system. Implementing waste segregation at the earliest stages of waste generation and collection is crucial to maintain material quality and prevent contamination with other waste streams.[145] Without segregating waste into different types, safe disposal becomes the only viable option for handling it. Recovering reusable and recyclable materials is not feasible, or at least not efficient, without source segregation.[146] Basic segregation of waste into organic, inorganic, and special waste (e.g., electronic waste) before primary storage should be ensured[147] and the segregation systems kept as simple as possible (e.g. organic waste/non-organic waste), so they are easy to implement, such as e.g. the use different types of disposal containers for recyclable material (different colours and/or material).[148] Special segregation is needed for medical or hazardous waste, e.g. for pathological (human tissue), and pharmaceutical and chemical (laboratory reagents) waste.[149]

In reality, for example in Sub-Saharan Africa, there are only a few formal recycling systems and very few on-site material recovery facilities (MRFs). Therefore, most countries (municipalities) do not have necessary logistics and infrastructure for waste segregation and separation.[150]

[145] International Federation of Red Cross and Red Crescent Societies. (2020). Managing Solid Waste (p. 71). Retrieved from https://ehaconnect.org/wp-content/uploads/sites/2/2020/08/Managing-solid-waste.pdf.

[146] WASH Sector Cox's Bazar. (2021). Solid Waste Management Strategy (p. 12). Retrieved from WASHCXB-Solid-Waste-Management-Strategy-31.07.21.pdf.

[147] International Federation of Red Cross and Red Crescent Societies. (2020). Managing Solid Waste (p. 47). Retrieved from https://ehaconnect.org/wp-content/uploads/sites/2/2020/08/Managing-solid-waste.pdf.

[148] Ibid. (p.71).

[149] Ibid. (p.14).

[150] UNEP. (2018). Africa Waste Management Outlook (p. 38). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.

5.3.2.1 Waste Segregation in DRC and South Sudan

Waste segregation in DRC and South Sudan is generally limited and not widely practiced at the household level due to, among others, lack of awareness and insufficient SWM infrastructure. Consequently, most waste is mixed and disposed of in open dumps and poorly managed landfills without segregation. There are different initiatives done by HOs that would promote composting, reusing or repurposing waste, but their reach is limited to the project participants and project timeframe and usually do not significantly influence the general SWM system in the country. It was noted that also not all HOs segregate waste in their offices. In Goma, for example, there are only 3 (out of 18) neighbourhoods – Volcans, Katindo, and Himbi – whose households practice waste segregation into biodegradable and non-biodegradable waste. This sorted waste is then collected separately and transferred to the 3 waste transformation enterprises in the city. In Bukavu, SOA estimates that around 10% of households, all located in 3 neighbourhoods, are subscribed to waste collection, but most do not segregate their waste. Only those households that are subscribed with waste collectors who are also transformers, such as Briquette du Kivu, segregate waste. Waste segregation at the household level in rural and camp areas is practically non-existent.

Photo 4: Rwonyi official landfill near Yei Town, South Sudan *Photo 5: Dump site in Bulengo IDP camp, DRC*

Secondary segregation takes place in both countries, as informal waste pickers and businesses as well as official businesses are involved. It is common for waste pickers to enter the premises of landfills, as they are usually unprotected, and collect the type of waste they then recycle or resell. For example, in Yei Road (Hai City, Juba, South Sudan) landfill, waste pickers select certain types of waste, e.g.

plastic, metal and aluminium, which they then sell to businesses that either melt, pack or shred the waste and send it to Uganda for recycling. This kind of small businesses were also observed in Juba city where individuals can potentially come and sell their recyclable waste. Such approach is common for some of the big South Sudanese landfills and the actors involved have a system including weighing machines. Most segregated waste collected for the purposes of waste transformation in South Sudan is aimed for Uganda, while in DRC, communities, such as that in Kamanyola, were observed to sell their metal waste to businesses in Rwanda and Burundi to be transformed into construction materials. In DRC, businesses specialized in transformation of one kind of waste, such as PlastyCor in Bukavu or Resilience for Development Group (RDG) in Goma, employ their own waste pickers to collect the waste they need from the streets, water channels, Lake Kivu (PlastyCor), or IDP camps (RDG). PlastyCor also practices a very limited household-level collection of plastic. Waste segregation is sometimes, but rarely, practiced by non-SWM businesses, such as Carnack Tobacco in Yei. Carnac Tobacco segregates their waste, and the organic portion is used either for compost or to produce biogas for their own use in their biodigester, while the rest is collected by the Yei Payam Public Health Department.

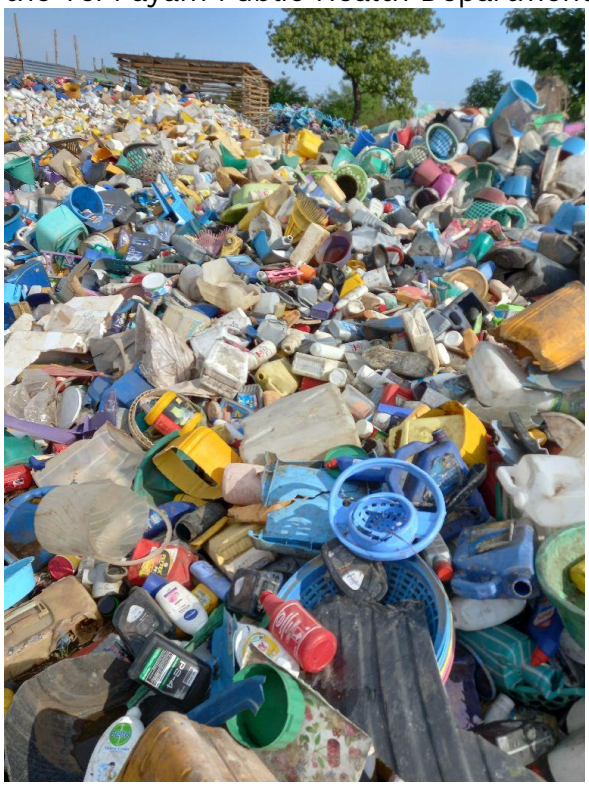

Photo 6: Sorted waste in Yei Road (Hai City) landfill, S. Sudan

Photo 7: Sorted waste in PlastyCor office, Bukavu, DRC

At the health facility level, waste segregation should be a general practice mandated by national regulations. However, a proper waste segregation is not always practiced due to lack of needed bins (yellow, red, black) and safety boxes (for sharps), inadequate, obsolete, broken, or incomplete waste management areas (WMAs)[151], lack of trained personnel, or lack of health facility SWM standards and guidance.

[151] For example, in DRC, health facilities are mandated to have incinerator, waste pit, placenta pit, and ash pit as a part of their WMAs.

5.3.3 Waste collection systems

In theory, there are two main collection options:

- Direct collection at households, shops, restaurants, market stalls etc.
- Collection of waste at collection points[152]

A waste collection system has the following components (all inter-related)[153]:

- Waste storage container (household storage, community bins that need to consider the loading system, e.g. for manual loading, a maximum weight of 25 kilograms per person should be considered.);
- Waste collection means and organization (equipment: e.g. manual collection by handcarts, carts pulled by animals; motorized collection by e.g. tractor with trailers, pickup truck, skip-loader, compactor truck, etc.) and personnel (informed vs formal, trained in safety and security);
- Waste collection frequency (e.g. at least twice a week, ideally every two days in warm climates) and routes (quality of roads and access ways, distances between collection points and final disposal sites and local capacity for maintenance needs to be considered).

Waste collection services in humanitarian settings are limited and ineffective. The average municipal solid waste collection rate in sub-Saharan Africa was 44%, but this varies considerably between cities (from less than 20% to above 90%) and the situation is much worse in rural areas.[154] Governments, especially in the low-income African countries, have limited resources and waste often becomes a lower priority. Less than half of the waste generated in Africa is collected formally and in rural areas almost none. The waste collection in cities is usually done by a combination of the city council, private waste contractors, and informal waste recyclers and pickers (together with community-based organisations and self-help groups).[155] In many cities, the collection of waste is done by the dual system: first door to door (usually by lorries, trucks, handcarts, tricycles, and donkeys) carried out by small- and micro-scale service providers and secondly from a centralized point where the waste is accumulated, from which small vehicles and trucks bring it to the final disposal site. In areas with poor or no road infrastructure, collection and block collection is done using manual equipment (e.g. push carts, tricycles, or wheel barrows).[156]

5.3.3.1 Waste collection systems in DRC and South Sudan

In DRC and South Sudan, both waste collection systems – direct collection and collection at collection points – were observed but the first approach was more frequent. However, it must be emphasized that waste collection virtually exists only in urban centres and even there covers only limited areas.

In South Kivu and North Kivu provinces of DRC, the waste collection system primarily involves local governments and private companies. The Provincial

[152]WASH Sector Cox's Bazar. (2021). Solid Waste Management Strategy (p. 32). Retrieved from WASHCXB-Solid-Waste-Management-Strategy-31.07.21.pdf.
[153] International Federation of Red Cross and Red Crescent Societies. (2020). Managing Solid Waste (pp. 67-70). Retrieved from https://ehaconnect.org/wp-content/uploads/sites/2/2020/08/Managing-solid-waste.pdf.
[154] UNEP. (2018). Africa Waste Management Outlook (p. 23). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[155] Ibid. (p.32).
[156] Ibid.

Environmental Service collects taxes and fees related to SWM but does not provide direct services. Instead, local governments, such as municipalities or chefferies, are responsible for SWM but often lack the resources and infrastructure needed. As a result, waste collection is minimal in rural areas and camps, while urban centres like Bukavu and Goma rely on private companies for these services, as, for example, the municipality of Bukavu has only one waste collection truck available, and it is in a bad condition. These companies often operate through Public-Private Partnerships (PPPs) with municipalities and a great majority of them work in waste collection (as opposed to waste transformation, which is mostly absent) and concretely practice direct collection from households, shops, roads etc. There are also efforts to coordinate the various private actors through joint platforms and initiatives, such as zoning in Bukavu, which assigns waste collection areas to each partner business. Funding for waste collection comes chiefly from households, shops, businesses, and other institutions through subscription fees. There are usually no regulations that would stipulate the amounts to be paid for waste evacuation. However, it is estimated that only 10% of households and institutions subscribe to these services due to cost concerns, poverty, and lack of awareness. Funding for waste collection in public spaces, such as roads, markets, and water channels, comes from municipal fees, such as sanitation charges, imposed mostly on market businesses and some businesses and households. The second type of waste collection – at waste collection points – was only noted in Bulengo IDP camp and at a very limited frequency. In Bulengo, Caritas NGO established 7 small landfills hardened by cement for the community's use and, once in a while and without a fixed schedule, they affect a truck to evacuate this waste.

In South Sudan, waste collection services are also limited and concentrated in urban areas, as opposed to rural ones, and local administrations, such as municipalities, counties and payams, have the responsibility for the service provision. In contrast to DRC, there is a strong HO partner, JICA. Similarly to DRC, private businesses are an important partner and waste collection actors are able to evacuate only a fraction of waste produced. For example, JICA estimates that only about 10% of waste in Juba is collected. Waste collection and management in Juba city was decentralized in April 2024 and is now under the jurisdiction of 3 Blocks (Block is an equivalent of a city district) that are responsible for both households and collection from main roads, markets, airport, hotels, and businesses. Before, household waste collection was handled by Blocks, while Juba City Council took care of big businesses, hotels, markets etc. Moreover, several private SWM businesses used to be also involved; however, they did not provide services in line with their responsibilities due to lack of manpower and vehicles. As such, their contracts were terminated after pressure from the community. Waste collection in Juba city is to a large extent supported by JICA's project, which provides this service in 3 Juba blocks – 1st Juba block (includes Tongping), Kator block, and Munuki block (includes Gudele) – through the provision of 3 trucks. However, JICA plans to further reinforce Juba's capacity to collect waste thanks to 15 new trucks, which are being procured. Juba municipality created a stakeholders committee that meets monthly and whose goal is to coordinate SWM activities, especially waste collection and transport. Juba county has 13 payams but waste collection is only conducted in 5 – Gondokoro, Ladu, Luri, Managala, and Rajaf. Yei municipality has 2 trucks for waste collection and there are several SWM businesses that hire trucks for this purpose. Yei Payam has one malfunctioning truck, and they hire 2 external trucks for waste evacuation. Moreover, there are unofficial waste collectors who use rickshaws to remove waste. On the other hand, Way Station IDP camp has no official SWM system

in place and all waste produced in the camp remains there and is not collected nor removed. The only waste collection that takes place there is practiced by waste pickers who collect specific types of waste, mostly plastic bottles, to be reused or sold for further transformation. Waste collection is financed by taxes and fees collected by local authorities and SWM businesses. The rates are not established based on waste's volume but on the type of the client. Businesses working in Dar Salam market in Yei are obliged to pay 1,000 SSP (less than 8 USD) per month for weekly waste collection done by a hired truck. Households pay around 2,000 SSP (app. 15 USD) per month; however, not all households follow up on their fees, and, for example, waste collection in Juba payams is solely financed by fees imposed on shops. Small restaurants and hotels may be charged a monthly fee of around 3,000 SSP (app. 23 USD), shops around 5,000 SSP (app. 38 USD), while other big institutions, including HOs, can pay around 15,000 SSP (app. 115 USD).

In summary, waste collection in DRC and South Sudan is characterized by limited infrastructure as well as limited number and capacities of service providers, significant urban-rural disparities, and heavy reliance on both municipal authorities and the private sector. Despite some efforts, the system is underdeveloped, with substantial challenges in terms of funding, public awareness, infrastructure, and security environment. Due to the security challenges, not all collected waste reaches the designated landfills and may be deposed of elsewhere. Goma's PF-EHA/GIE tries to impose some monitoring mechanism to remedy such occurrences through the platform's brigade established for this purpose.

5.3.4 Recycling and reuse

The average municipal solid waste recycling rate in Africa is only 4% and there are only a few formal recycling systems[157] in sub-Saharan Africa. The recycling is mostly done at household level or by waste recycling businesses, heavily supported by a large and active informal sector that includes itinerant buyers and waste pickers. The informal sector might be supported by the municipalities in some countries, but very often is not welcomed (e.g. accused of vandalizing public infrastructure such as aluminium railings, electric cables, and poles to recover metals for secondary markets). Some recycled materials in Africa, such as metal scrap, recovered aluminium, and plastics, are exported and generate hard currency for the exporting countries.[158] The recycling of materials depends on available quantities of waste, market prices, and local recycling capacity. For example, materials such as glass and low-value plastics (e.g., plastic bags, mixed-layer plastics) often have low market value and limited demand. Electronic waste and batteries have recycling potential, but the process carries a high pollution risk due to the hazardous materials they contain.[159]

The meaning of recycling can vary according to the context:

- Manufacturing materials to make another product (ex: recycling virgin paper into recycled paper);
- Making handicrafts;

[157] See WREC Waste management facilities mapping: https://logie.logcluster.org/?op=wrec

[158] UNEP. (2018) Africa Waste Management Outlook (p. 39). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.

[159] International Federation of Red Cross and Red Crescent Societies. (2020). Managing Solid Waste (p. 73). Retrieved from https://ehaconnect.org/wp-content/uploads/sites/2/2020/08/Managing-solid-waste.pdf.

- Exporting waste to another country so that it can be manufactured (ex: plastic bottle flakes) etc.[160]

In low and middle-income countries, organic waste constitutes about 50% of the total waste produced. Here are the main technological options for processing organic waste:

- Composting;
- Vermicomposting;
- Anaerobic digestion;
- Black soldier flies (BSF); and
- Pyrolysis (charcoal production).[161]

There are also some upcycling initiatives in humanitarian contexts, focusing on converting waste materials into useful products, such as e.g. plastic bottles into building materials or bags.[162]

5.3.4.1 Recycling and reuse in DRC and South Sudan

The informal sector and household-level practices are the backbone of recycling and reuse activities in DRC and South Sudan. Government is notably absent from the waste transformation sector, while a few HOs engage in small SWM pilots.

Informal waste pickers, often operating independently or in small groups, collect recyclable materials from household waste, streets, water channels, and official or unofficial landfills. These materials typically include plastics, metals, and aluminium, which are sorted and sold to recycling businesses at home or abroad. A very common local level practice is collection of plastic bottles, which is also practiced by children, to be reused by small milk, alcohol, or juice businesses. In Kamanyola, DRC, the respondents specified that small businesses even buy plastic bottles, but only bottles of 0.5-liter capacity or more are wanted. Bottles are bought out for 100-200 CDF (less than 0.1 USD) depending on the size. To give examples of some large-scale practices, the team in DRC encountered informal actors involved in selling metal to recycling companies in Rwanda and Burundi, while PAH in South Sudan recorded the sale of plastic, metal, and aluminium to waste transformation businesses in Uganda. South Sudan used to have a formal business that handled the transport of plastic to Uganda – Eco Friendly company – but due to delayed payments from Juba City Council, they could not maintain their operations and had to close down.

[160] Climate Action Accelerator. Recycling waste in developing countries. Retrieved from https://climateactionaccelerator.org/solutions/recycle-waste-developing-countries/.
[161] International Federation of Red Cross and Red Crescent Societies. (2020). Managing Solid Waste (pp. 71-73). Retrieved from https://ehaconnect.org/wp-content/uploads/sites/2/2020/08/Managing-solid-waste.pdf.
[162] Global Platform for Action on Sustainable Energy in Displacement Settings. Electronic Waste (E-waste) Management for Off-grid Solar Solutions in Displacement Settings. Retrieved from https://www.humanitarianenergy.org/news/latest/electronic-waste-e-waste-management-for-off-grid-solar-solutions-in-displacement-settings.

Photo 8: Plastic shredder, Yei Road (Hai City) landfill, S. Sudan *Photo 9: Plastic shredding in process, Yei Road (Hai City)*

While the development of South Sudan's formal recycling businesses has been hindered, some waste transformation businesses can be encountered in urban centres of DRC, such as Briquette du Kivu and PlastyCor in Bukavu or RDG in Goma. However, these are rather small-scale, lack mechanization, and often employ artisanal rather than industrial techniques. One example can be charcoal production

from organic waste done by RDG located in of the IDP camps located near Goma. Waste collected from the surrounding IDP camp is not use only for charcoal production, but this enterprise also produces paving stones from different types of plastic waste.

Photo 10: Charcoal form used by RDG, Goma, DRC

Photo11: Bio-charcoal from organic waste, RDG, Goma, DRC

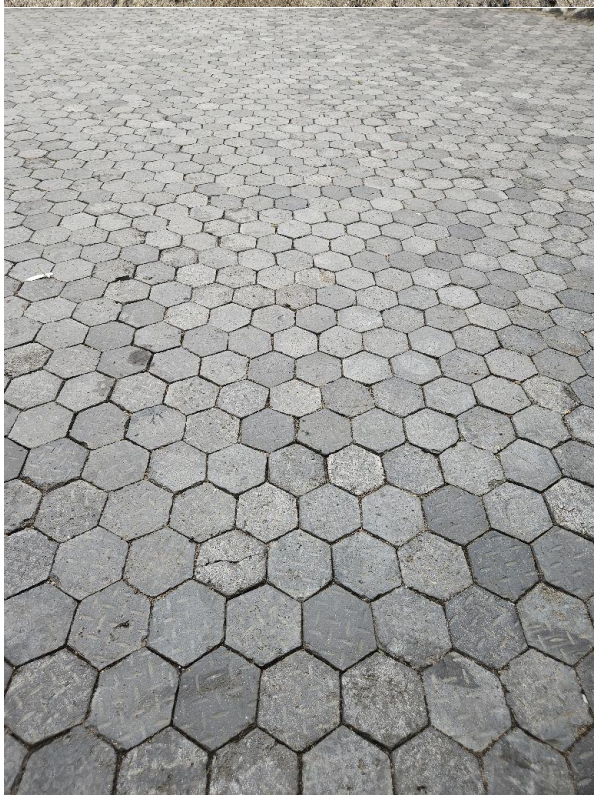

Photo 12: Plastic processing, paving stones, RDG, Goma, DRC *Photo13: Recycled plastic paving stones, RDG, Goma, DRC*

Households are more engaged in reusing (than recycling), which is driven by economic necessity and resource scarcity. For example, they collect plastic bottles to refill them with beverages or liquid soap for personal use. The most common

household-level practices are reusing organic waste as a fertilizer after being composted or burned (ashes) and reusing plastic bottles and sachets. Some households in Yei were also said to reuse ash from burned organic waste as local soap. In South Sudan, people also use tires to make shoes or ropes for cattle. DRC team observed instances of reusing torn mosquito nets as fences to prevent animals from entering fields and eating crops. Moreover, maize leaves are used or even sold by households for 3,000 CDF (1 USD) per bag as a preferred cooking fuel, since they emit little smoke.

In IDP camp settings, households practice similar reuse activities as those in rural and urban settings, but the occurrence seems to be more common due to more limited access to resources. In Bulengo, IDPs were observed to reuse polypropylene sacks to replace torn tarpaulins and cartons as shelter insulation. Plastic (e.g. oil bottles) and metal (e.g. tins) containers are also reused if available (sometimes through distributions).

Some research institutes, such as IITA, UOB, FabLab Ecowaste, UNIGOM and UNIPOD, or development and humanitarian organizations, such as GIZ and Caritas Bukavu, implement waste valorisation projects, but usually on a small or pilot scale. For example, UNIGOM work on prototyping and optimization and their research areas include green energy, SW composting, and bio-based innovations. They are currently working on projects such as biodegradable waste for energy production and optimization of existing practices, e.g. microbiological considerations to speed up biogas production. They also have an initiative to transform humanitarian medical/pharmaceutical waste. While UNIGOM focus on identifying and optimizing techniques, Congo Biotech[163] applies their research in practice. Congo Biotech focus on closed loops and integrated production systems and have in the past implemented several projects. For example, they produced biogas from animal waste, which was used to generate heat for chicken, while the resulting bio-slurry was applied as a garden fertilizer, and the resulting plant waste was used for mushroom production. Another actor, UOB, implemented together with GIZ a project on mushroom production with the use of composted agricultural waste within 3 Pygmy villages around the Kahuzi-Biega national park. IITA is currently implementing the second phase of the RUNRES project, which returns organic waste to the field as a fertilizer by creating linkages between coffee farmers, waste collectors and waste transformers. The UEA's FabLab is a manufacturing laboratory that is involved in prototyping. Under their Ecowaste[164] initiative, they are to prototype waste management solutions for 15 projects. Their priority is plastic waste and one of their initiatives is the development of intelligent bins that sort waste according to type or categorization. UNIPOD under the University of Juba researched bio-products creation from organic waste.

HOs and NGOs usually focus on sensitization and awareness raising. Communities implicated in the SWM-related projects implemented by HOs usually do not continue the new practices after the termination of HOs' support.

[163] Congo Biotech, https://congobiotech.com/.
[164] FabLab Ecowaste, UEA, https://fablabecodechetsuea.org/.

Table 10: Existing waste transformation initiatives identified through primary data collection

	DRC	South Sudan
Businesses	• Transformation of plastic into paving stones • Transformation of organic waste or carton into eco-charcoal and briquettes • Transformation of organic waste into animal feed (BSF larvae) • Repurposing of plastic waste as furniture and decoration • Recycling of paper and cardboard to produce envelopes • Recycling of paper to produce igniter stimulant (fire starter)	• Transformation of organic waste into biofuel • Repurposing of plastic waste as furniture and decoration
HOs	• Transformation of organic waste into biofuel	
Academia	• Transformation of organic waste into compost and fertilizer • Reuse of organic waste for mushroom production	• Transformation of organic waste into compost and fertilizer

Photo 14: Recycled plastic coaster, PlastyCor, Bukavu, DRC

Photo15: Recycled furniture, PlastyCor, Bukavu, DRC

HOs involved in the Logistics cluster may manage some of their waste abroad. For example, batteries can be sent to be recycled in Uganda, while pneumatics and batteries can be transported to Tanzania for repair. However, there are also in-country options. Kinshasa has a business that recycles pneumatics, batteries, and cartridges, while Goma has a business engaged in pneumatic and batteries recycling.

5.3.5 Waste disposal

Globally, 36,6% of waste is disposed of in landfills, 33% is openly dumped, 19% goes into recovery (13.5 recycling and 5.5% composting) and 11% is incinerated. See the figure below.

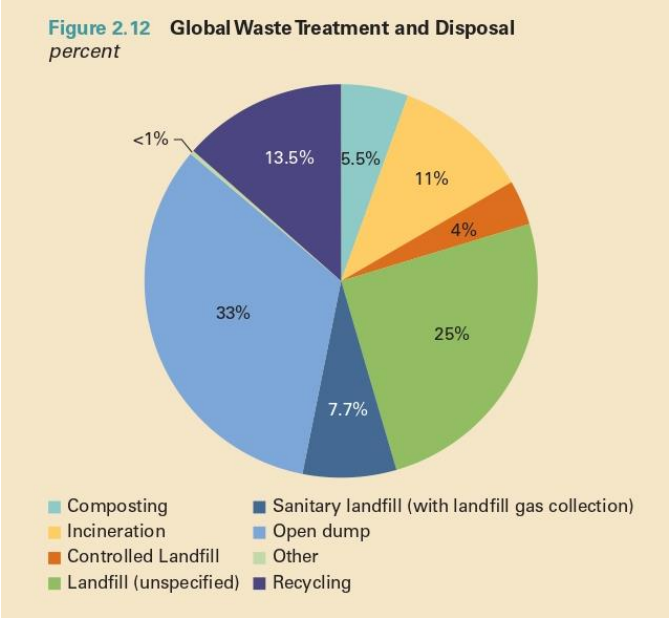

Figure 26: Global waste treatment and disposal (per cent)

Source: World Bank, 2018, p.34

While waste disposal systems in some Sub-Saharan African countries have been slowly improving—primarily in cities, where efforts focus on constructing landfills, closing dumps, and formalizing collection systems to mitigate environmental and health impacts—69% of waste is still predominantly openly dumped or burned. 24% of waste is disposed of in some form of a landfill and only about 7% is recycled or recovered.[165] Ideally, waste should be deposited in a designated safe disposal site, such as a sustainable or sanitary landfill. However, in practice, this is often not the case. Oftentimes, citizens do not want to place waste facilities near their homes.[166] In many areas, waste is often dumped on empty land or in canals, taken to transfer stations, or transported directly to final disposal sites or disposed even after design capacity of sanitary landfills have been exceeded.[167] Waste in open dumps is typically left untreated, uncovered, and unsegregated, with minimal to no groundwater protection or leachate recovery systems in place.

[165] UNEP. (2018). Africa Waste Management Outlook (2018) (p. 23). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[166] Kaza, Silpa; Yao, Lisa C.; Bhada-Tata, Perinaz; Van Woerden, Frank. (2018) What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. (p. 81) Urban Development. © Washington, DC: World Bank. http://hdl.handle.net/10986/30317 License: CC BY 3.0 IGO.
[167] Ibid. (p. 82).

See example below[168] of two disposal sites along the level of control ladder. Left picture (ELS-EG, 2018) shows an open dumpsite without control. The right picture is the engineered sanitary landfill in Cox's Bazar (photo credit: UNDP) and shows an improved level of control with site planning, waste compaction and covering, and leachate management.

Figure 27: Illustration of two disposal sites along the level of control ladder

Source: UNHCR, 2024, p. 6

5.3.5.1 Sanitary landfills

The sanitary landfills employ a range of technologies and practices to reduce the environmental impacts of waste disposal, such as the following[169]:

- liners (made of clay or synthetic materials to prevent waste materials from contaminating the surrounding soil and groundwater);
- leachate collection systems (to capture and treat the liquid that is generated as waste materials decompose);
- methane capture (produced by the decomposition of organic waste materials) is properly captured) in order to be used to generate electricity or heat.

Sanitary landfills are not suitable for hazardous and e-waste waste or organic and recyclable waste. Organic waste should be ideally treated and valorised[170] (e.g. animal feed, composting, biogas, or insect farming).[171] Recyclable materials should be ideally reused or recycled. Hazardous waste (e.g. medical) or e-waste should be

[168] UNHCR. (2024). Guidelines for the Safe Disposal of Solid Waste in Humanitarian Contexts (p. 6). Retrieved from https://www.unhcr.org/sites/default/files/2024-04/guidlines-for-safe-disposal-of-solid-waste-in-humanitarian-contexts.pdf.

[169] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2019). Alternatives to Conventional Plastics in Packaging (pp. 12-13). Retrieved from https://eecentre.org/wp-content/uploads/2019/07/Alternatives-To-Conventional-Plastics-in-Packaging.pdf.

[170] See more in Eawag – Swiss Federal Institute of Aquatic Science and Technology, Department of Sanitation, Water and Solid Waste for Development (Sandec). (2020). Selecting Organic Waste Treatment Technologies. Retrieved from https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/schwerpunkte/swm/SOWATT/sowatt.pdf.

[171] UNHCR. (2024). Guidelines for the Safe Disposal of Solid Waste in Humanitarian Contexts (p. 6). Retrieved from https://www.unhcr.org/sites/default/files/2024-04/guidlines-for-safe-disposal-of-solid-waste-in-humanitarian-contexts.pdf.

processed at a distinct location, in line with WHO[172] and UNEP[173] guidance that has been established to safely handle and dispose of such materials.[174]

5.3.5.2 Waste disposal in DRC and South Sudan

Most types of waste in DRC and South Sudan are thrown away into plots, pits, roads, water canals, and unofficial dumpsites, notwithstanding the setting (urban, semi-urban, rural, IDP camp). Some types of waste, such as sharps, and sanitary waste may be disposed of in latrines. Only a small fraction of households, businesses, and other organizations have their waste removed by waste collectors and transported to official or unofficial landfills. This is practiced only in urban areas where the needed road infrastructure and SWM services may be available and where there are individuals with financial means and environmental awareness. However, waste collection in densely populated urban areas may be hindered due to plots' accessibility and non-existence of roads, such as in case of Bukavu. Waste that is thrown away in own plots may be burned or, if organic, composted, while waste deposited in the streets and water channels often ends up in water ways, the process is expedited during rainy season.

Waste that reaches unofficial landfills usually decays but can also be burned as a waste removal strategy or some of it may be sorted and taken by waste pickers for consumption, reuse, or recycling. Waste that arrives to official landfills meets similar fate. In general, landfills do not employ security measures that would prevent entry, nor do they fulfil adequate safety or environmental standards.

At health facilities level, waste is usually sorted but the level and quality of sorting depends on whether trained personnel are in place, availability of bins and safety boxes for sharps, and whether the WMA is complete and functional. If all these three factors are fulfilled, biological waste is thrown into placenta pit, while sharps and other dry waste is incinerated in the incinerator. The resulting ash is stored in the ash pit. Organic and any remaining waste is thrown into the waste pit. In DRC, any expired medicines are sent to BCZ (Offices of Health Zones) that decides on the disposal – usually buried and sanitation cordon is created. In South Sudan, health facilities usually burn their expired medication. Sometimes HA such as MSF managed their expired waste themselves, e.g. by safely burying it.

Humanitarian waste is managed in similar ways to that of households and health facilities and, therefore, its management heavily depends on SWM facilities and services available in the intervention area. Where available in rural areas, humanitarian waste can be managed by SWM services, or else thrown away, burnt, and sometimes reused. If humanitarian aid is provided through health facilities, the resulting waste is either managed by the given facility or by the end beneficiaries. The first case includes instances such as nutritional input provision, as packaging usually has to be returned to the facility to demonstrate correct use. Moreover,

[172] WHO. (2014). Safe management of wastes from health-care activities (2nd ed.). Retrieved from https://iris.who.int/bitstream/handle/10665/85349/9789241548564_eng.pdf?sequence=1.
[173] UNEP. (2007). E-waste management manual: Volume II. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/9801/EWasteManual_Vol2.pdf?sequence=3&isAllowed=.
[174] UNHCR. (2024). Guidelines for the Safe Disposal of Solid Waste in Humanitarian Contexts (p. 6). Retrieved from https://www.unhcr.org/sites/default/files/2024-04/guidlines-for-safe-disposal-of-solid-waste-in-humanitarian-contexts.pdf.

packaging waste from distributions can be kept by the facility at the distribution point for accountability (e.g., flour is distributed in smaller sachets and the big sacs stay at the site to be counted). In this scenario, humanitarian waste management depends on health centre's SWM practices and facilities. The second scenario includes for example WASH or NFI kit distributions when beneficiaries take the items and packaging home with them. In this case the waste management will depend on the household's practices and SWM facilities available. To have a better understanding of community's SWM practices, as part of the ECHO Kimbi-Lulenge PDM, the research team collected data on the use of plastic packaging used for aquatabs distribution conducted by PIN. The results confirm the general trends gathered with qualitative methods. Most respondents either reused (42%) or thrown away (37%) the aquatab carton, whereas comparatively less (19%) beneficiaries burned it. The rest either saved and had not yet decided on the use of the packaging (1%) or gave it to someone else or did not know.

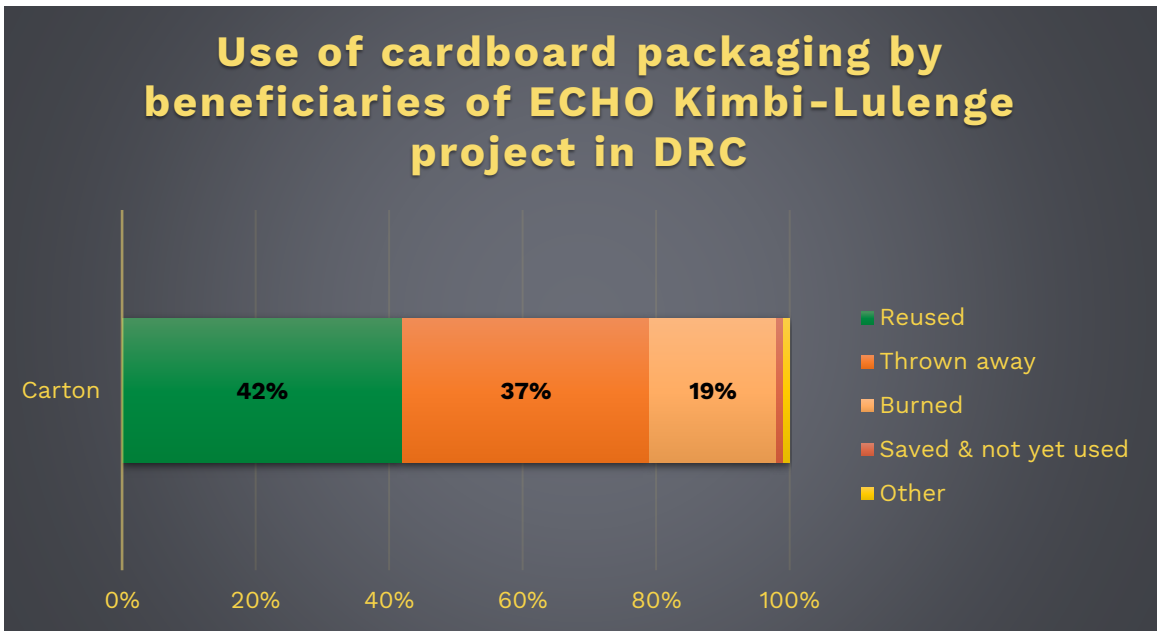

Figure 28: Use of cardboard packaging by beneficiaries of ECHO Kimbi-Lulenge project in DRC

Should any humanitarian aid expire or be exposed or contaminated, in DRC it is handled by provincial offices of either Ministry of Public Health (medical waste) or Ministry of Environment (other waste). Expired medical waste is safely buried, while non-medical waste is either thrown into river, buried, or burned. This depends on whether the waste is organic and can still be consumed by animals (thrown into water) and on the quantity, as large quantities are usually buried and not burned due to smoke. On the other hand, the government in South Sudan was not found to be handling expired waste; instead, private business may need to be contracted.

6. SWM Challenges

The current state of solid waste management (SWM) in humanitarian settings is characterized by several challenges mainly linked to the fact that waste management is a multifaceted issue characterized by intricate interdependencies,

complex social dynamics, and numerous stakeholders (a "wicked problem").[175] Moreover, the humanitarian contexts are complex and resource-constrained environments with lack of infrastructure and resources, logistical and operational constraints. Improper SWM is one of the top four global WASH gaps, although it is often overlooked[176] and the current funding is inadequate to cover the costs incurred by the SWM. For many local authorities, waste management can be the biggest budget item, especially in Global South, where most humanitarian operations take place, and disasters further exacerbate the challenges of waste management.[177]

While SWM should be the responsibility of every humanitarian actor and project, far reaching beyond the WASH sector,[178] the reality is often different. SWM in many humanitarian settings is at best inadequate, at worst non-existent, and there is reason to believe that Sphere standards are often not being met.[179] According to the WREC baseline survey (2023),[180] only 28% and 18% (baseline and mid-term survey) of respondents indicated that their organization has a SWM planning framework in place.[181] Similarly, only 9% and 18% (baseline and mid-term survey) responded that their organizations have mechanisms in place to measure waste volumes.[182] This indicates that proper waste management practices still lack in humanitarian settings.

Insufficient attention to waste reduction is a major factor contributing to the rapid increase in waste generation globally. Many countries struggle to provide waste management services to all citizens.[183] This is an overreaching challenge in SWM, the following have been identified as main challenges in the SWM: The challenges correspond to identified needs of the humanitarian sector with regards to SWM through the primary data collected in DRC and South Sudan.

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[175] United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource (p.43). Nairobi. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3 .

[176] Lantagne, D., Yates, T., Ngasala, T., Hutchings, P., Bastable, A., Allen, J., Hestbæk, C., & Ramos, M. (2021). Gaps in WASH in humanitarian response: 2021 update (p.3). ELRHA. Retrieved from https://www.elrha.org/researchdatabase/gaps-in-wash-in-humanitarian-response-2021-update/.

[177] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste Management and Reverse Logistics in the Humanitarian Context (p. 19). Retrieved from https://helda.helsinki.fi/server/api/core/bitstreams/717e1958-4bbb-4f60-be40-1b99f9e6f3a0/content.

[178] European Commission, Directorate-General for European Civil Protection and Humanitarian Aid Operations (ECHO). (2022). Guidance on the operationalization of the minimum environmental requirements and recommendations for EU-funded humanitarian aid operations (p. 23). Publications Office of the European Union. Retrieved from https://data.europa.eu/doi/10.2795/467817.

[179] Lantagne, D., Yates, T., Ngasala, T., Hutchings, P., Bastable, A., Allen, J., Hestbæk, C., & Ramos, M. (2021). Gaps in WASH in humanitarian response: 2021 update (p.40). ELRHA. Retrieved from https://www.elrha.org/researchdatabase/gaps-in-wash-in-humanitarian-response-2021-update/.

[180] Data collected from 168 individuals from 88 organizations and 49 countries.

[181] Ely, K., Insabato, F., Kucharski, M., Balzino, M., Bassel, M., & Rocheteau, M. (2023). Baseline and Mid-term Survey Report: WREC Survey Report (p. 12). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-08/WREC_Surveyreport%20240823_FINAL.pdf.

[182] Ely, K., Insabato, F., Kucharski, M., Balzino, M., Bassel, M., & Rocheteau, M. (2023). Baseline and Mid-term Survey Report: WREC Survey Report (p. 12). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-08/WREC_Surveyreport%20240823_FINAL.pdf.

[183] Lantagne, D., Yates, T., Ngasala, T., Hutchings, P., Bastable, A., Allen, J., Hestbæk, C., & Ramos, M. (2021). Gaps in WASH in humanitarian response: 2021 update (p.20). ELRHA. Retrieved from https://www.elrha.org/researchdatabase/gaps-in-wash-in-humanitarian-response-2021-update/.

6.1 Lack of Infrastructure to Manage the Waste

The SWM infrastructure in humanitarian contexts for waste segregation, collection (low coverage), recycling, and disposal in humanitarian contexts is often inadequate, including the absence of waste treatment plants and proper landfills, leading to reliance on open dumping and burning,[184] even before a crisis occurs. All this leading to the risks described above (e.g. pollution caused by inadequate practices such as dumpsites, open burning, littering etc.).[185] During and after an emergency, existing waste systems may experience reduced efficiency or be completely destroyed.[186] Local systems often lack the capacity to handle additional waste from humanitarian interventions, resulting in much of this waste ending up in uncontrolled landfills. In rural areas, the SWM infrastructure is limited or non-existent. Rural wastes that are not reused or recycled are often illegally dumped or openly burned on site.[187] Moreover, the waste collection systems in place are often irregular and inefficient leading to waste accumulation, unsanitary conditions, and increased health risks.[188] In addition to the lack of physical infrastructure, there is often a lack of effective management: no central organization oversees the collection and treatment of waste. Even when such an organization exists, waste policies are often not effectively implemented on the ground, and there can be a lack of intersectoral coordination to strengthen waste management efforts.[189]

6.1.1 Lack of qualified local suppliers

While the collaboration with local stakeholders [190] is key for humanitarian organisations, and the local knowledge needs to feed into the management and strategic level decisions, there is lack of qualified local suppliers in humanitarian settings who could guarantee the international quality and safety standards required by humanitarian organizations. This includes the ability to provide goods that meet specific technical specifications or health and safety regulations.[191] Moreover, local suppliers often have financial and technical constraints, both in

[184] UNEP. (2018). Africa Waste Management Outlook (p. 81). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[185] ISWA. (2021). The future of the waste management sector: Trends, opportunities and challenges for the decade 2021-2030 (p. 8). Retrieved from https://www.iswa.org/climate-change-and-waste-management/?v=928568b84963.
[186] ELRHA. Humanitarian contexts. Retrieved from https://higuide.elrha.org/humanitarian-parameters/humanitarian-contexts/.
[187] UNEP. (2018). Africa Waste Management Outlook (p. 33). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[188] Ibid. (p.23).
[189] ELRHA. (2022). Innovation opportunities in solid waste disposal in humanitarian settings: An exploration of problems to identify innovation opportunities in Uganda and Somalia (p. 22). A report produced for Elrha by UrbanEmerge, FLUSH, and Science Practice. Retrieved from https://www.elrha.org/wp-content/uploads/2022/10/Elrha_SWM-PE-Report_Final.pdf.
[190] DG ECHO. (2023). Promoting equitable partnerships with local responders in humanitarian settings. Retrieved from https://interagencystandingcommittee.org/sites/default/files/migrated/2023-03/EU%20DG%20ECHO%20guidance%20note%20-%20Promoting%20equitable%20partnerships%20with%20local%20responders%20in%20humanitarian%20settings.pdf.
[191] ELRHA. (2022). Innovation opportunities in solid waste disposal in humanitarian settings: An exploration of problems to identify innovation opportunities in Uganda and Somalia (p. 22). A report produced for Elrha by UrbanEmerge, FLUSH, and Science Practice. Retrieved from https://www.elrha.org/wp-content/uploads/2022/10/Elrha_SWM-PE-Report_Final.pdf.

terms of accessing the capital and lack of technical expertise[192] (skilled workforce and knowledge of international standards).

6.1.2 Lack of qualified recyclers

The lack of qualified recyclers represents is one of the biggest challenges when it comes to the SWM infrastructure in humanitarian settings[193]. The capacity[194] of formal recyclers[195] is often insufficient, and they often do not comply with the necessary local regulations and international standards. In many emergency contexts, there are no formal recyclers, or the cost of formal recyclers is too high, and most of the recycling is done by the informal sector whose capacities are limited and the quality of the recycling process they offer insufficient. The informal sectors' workers safety and security are not guaranteed.[196] Moreover, people with no alternative sources of income with which to survive are involved, such as women, people from racial or ethnic minorities, low-income individuals and families, people with disabilities and mental health conditions, children, youth and young adults, seniors, immigrants and refugees.[197] Transferring the waste to another country[198] involves a lot of challenges as well: it a complicated, lengthy, and costly process with no guarantees.

6.2 Lack of Resources

The lack of resources is categorized into two areas: *a)* lack of funding and *b)* lack of HR, as explained below.

6.2.1 Lack of Funding

SWM remains one of the most underfunded challenges in global development, both for local authorities and for the humanitarian sector.

6.2.1.1 Lack of funding for national SWM systems

According to the World Bank, SWM costs comparatively more in low-income countries (nearly 20% of municipal budgets) than in high income countries (less than 4%).[199] Global municipal SWM cost US$252.3 billion in 2020. The most

[192] Human Rights Watch. (2024). South Sudan: Events of 2023. Retrieved from https://www.hrw.org/world-report/2024/country-chapters/south-sudan.
[193] Réseau Environnement Humanitaire. (2024). Minutes: Waste Working Group, May 2, 2024. Retrieved from https://www.environnementhumanitaire.org/wp-content/uploads/2024/02/HNPW-2024-Waste-WG-minutes.pdf.
[194] The recyclers capacity can be assessed using e.g. the WFP's assessment form: https://eecentre.org/wp-content/uploads/2019/07/Recycling-company-assessment-checklist_Haz-and-non-haz-waste.pdf.
[195] Mainly registered under the Ministry of the Environment and the department(s) in charge of waste, and WREC has also developed a waste management facility mapping: https://logie.logcluster.org/?op=wrec.
[196] Climate Action Accelerator. Recycling waste in developing countries. Retrieved from https://climateactionaccelerator.org/solutions/recycle-waste-developing-countries/.
[197] United Nations Environment Programme. (2024). Beyond an age of waste: Turning rubbish into a resource (p. 52). Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.
[198] International waste transfers are regulated under the Basel Convention, and transferring the waste across borders requires to follow all necessary steps. Some countries have bi-lateral agreements, such as Regional East African Agreement which allows HOs to avoid the Basel process.
[199] Kaza, Silpa; Yao, Lisa C.; Bhada-Tata, Perinaz; Van Woerden, Frank. (2018). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. (p. 1) Urban Development. © Washington, DC: World Bank. http://hdl.handle.net/10986/30317 License: CC BY 3.0 IGO.

expensive is usually collection (e.g. crew wages, vehicle fuel and maintenance, insurance, and other indirect costs), followed by recycling (including the necessary infrastructure) and waste disposal facilities (e.g. engineered landfills and waste-to-energy plants). SWM faces a significant and growing funding gap each year as the revenue generated from materials in municipal solid waste is consistently insufficient to cover the costs of an effective SWM.
Some of the barriers to establishing sustainable markets and finance for waste management are, as follows:

- Lack of investments from private sector in waste reduction (commercial barriers);
- Lack of ability and willingness to pay for waste management services;
- Lack of financial motivation for waste separation and collection;
- Low or no gate fees for disposal sites;
- Lack of legislation and suitable fees to prohibit open dumping and burning.[200]

Municipalities in humanitarian contexts are usually the responsible institution for SWM, but they lack financial support from the government. Consequently, they depend on local user fees (e.g. included in the electricity bill (e.g. in Haiti[201]), which are rarely collected[202] and not sufficient to cover the SWM costs even if paid.[203] Thus, financing the service remains a continuous challenge that the authorities are facing. Even if national and local governments manage to finance specific components of the waste system, relying solely on general government funding and waste fee collection often falls short in covering the operational costs necessary for effective SWM.[204]

6.2.1.2 Lack of funding for HOs

For HOs, the lack of funding (despite the recent donors' commitments to fund greening[205]) represent a major challenge when constantly balancing the ever-increasing humanitarian needs and a growing funding gap.[206] Humanitarian assistance is often funded by short term cycles (typically one-year projects) which further exacerbates the problem of “return on investment” that will not be felt during the lifespan of the project. Moreover, implementing sustainable/integrated SWM or sustainable supply chains management can incur additional costs (even though more can be saved in long term), HR resources and time. Many technologies,

[200] United Nations Environment Programme. (2024). Beyond an age of waste: Turning rubbish into a resource (p. 57). Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.
[201] Di Bella, V., Giardina, D., Vaccari, M., & Collivignarelli, C. (2019). Challenges for the SWM Sector in Post-natural Disaster and Post-conflict Scenarios: A Comparison (p. 7). figshare. Retrieved from https://hdl.handle.net/2134/30505.
[202] Lantagne, D., Yates, T., Ngasala, T., Hutchings, P., Bastable, A., Allen, J., Hestbæk, C., & Ramos, M. (2021). Gaps in WASH in humanitarian response: 2021 update (p.58). ELRHA. Retrieved from https://www.elrha.org/researchdatabase/gaps-in-wash-in-humanitarian-response-2021-update/.
[203] United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource (p.57). Nairobi. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.
[204] Kaza, Silpa; Yao, Lisa C.; Bhada-Tata, Perinaz; Van Woerden, Frank. (2018). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. (pp. 81-83) Urban Development. © Washington, DC: World Bank. http://hdl.handle.net/10986/30317 License: CC BY 3.0 IGO.
[205] E.g. DG ECHO, https://www.dgecho-partners-helpdesk.eu/elearning-greening-humanitarian-aid#/
[206] European Commission. (2021). Communication from the Commission to the European Parliament and the Council on the EU’s humanitarian action: new challenges, same principles (p. 7). Retrieved from https://ec.europa.eu/echo/files/aid/hacommunication2021.pdf.

practices and tools that could support SWM provision and coordination already exist (e.g. drone imaging, sensors on and bins and vehicles to measure weight, volume or frequency of emptying, and composting approaches such as for example using black soldier flies for waste decomposition), but are costly and demand additional human resources and time.[207] Currently, there is minimal specific (additional) funding from humanitarian donors to support HOs in greening their operations and organizational structures, including support for activities such as e.g. measuring carbon footprints, hiring environmental advisors, and transitioning to solar energy for their facilities. Several donors reported expecting their HOs partners to use non-earmarked funds for greening costs. This expectation arises from concerns about diverting funds from core humanitarian activities, a general lack of knowledge about the costs associated with greening, and the limitations of current funding mechanisms, such as a focus on project-based funding and short-term funding cycles.[208] Despite some changes,[209] HOs have problems to get the real cost of environmentally sound waste management funded[210] and there is still a lack on common donor stance on this.[211] Many organizations report to fund greening activities (e.g. exercises to measure their GHG emission, staff costs linked to the creation of new strategies and systems) with their own core budgets, with funding from private foundations, or by allocating part of indirect costs (overheads) from projects.[212] There is a dialogue gap between the HOs and the donor community on the issue of greening.

6.2.2 Lack of human resources

There is often a shortage of trained personnel to manage and implement SWM programs which can lead to inefficient operations and poor waste management practices.[213]

6.3 Lack of (Enforcement of) National Policies and Coordination Among Local Authorities in Waste Management

In most humanitarian contexts, comprehensive national policies addressing all aspects of SWM, including hazardous waste management, recycling, and sustainable practices, are lacking.[214] Furthermore, there is often a gap between policy development and actual practice on the ground;[215] even if SWM policies exist, their

[207] Lantagne, D., Yates, T., Ngasala, T., Hutchings, P., Bastable, A., Allen, J., Hestbæk, C., & Ramos, M. (2021). Gaps in WASH in humanitarian response: 2021 update (p.41). ELRHA. Retrieved from https://www.elrha.org/researchdatabase/gaps-in-wash-in-humanitarian-response-2021-update/.
[208] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management & Climate Action Accelerator. (2024). Operationalizing and Scaling-up Donors' Climate and Environmental Commitments: An Analysis of Progress, Gaps, and Opportunities (p. 12). Retrieved from https://climateactionaccelerator.org/wp-content/uploads/2023/11/CAA_MApping-Analysis_EN_V11.pdf.
[209] e.g. DG ECHO or Germany Federal Foreign Office willing to fund some environmental mitigation measures; Swiss Agency for Development and Cooperation to support the ICRC's Climate and Environment Transition Fund or the Dutch Ministry of Foreign Affairs to the Dutch Red Cross.
[210] Réseau Environnement Humanitaire. (2024). Minutes: Waste Working Group, May 2, 2024. Retrieved from https://www.environnementhumanitaire.org/wp-content/uploads/2024/02/HNPW-2024-Waste-WG-minutes.pdf.
[211] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Multi-donor policy landscape analysis (p. 5). Retrieved from https://eecentre.org/wp-content/uploads/2023/01/Multi-Donor-Policy-Landscape-Analysis.pdf.
[212] Ibid. (p.13).
[213] UNEP. (2018). Africa Waste Management Outlook (p. 72). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[214] Ibid. (p.55).
[215] Ibid. (p.2).

enforcement remains a challenge.[216] The main barriers to effective enforcement of SWM policies are governance issues, such as weak institutional capacity and lack of coordination among agencies. Lack of coordination among the different levels of the government is a typical challenge as the SWM agenda is under several stakeholders which creates confusion about roles and responsibilities. This is often exacerbated by fragility of local institutions: in some contexts, ministries are very new, the turnover is very high etc. The regulatory framework for SWM is also weak. In many countries in Africa, it is often fragmented, with lack of clear distinction between roles and responsibilities of the governorates, municipalities, service providers and waste generators.[217] While municipalities are responsible mostly for municipal SWM, no stakeholder is responsible for waste reduction which is largely responsible for rapid waste growth globally. Consequently, there is zero or little attention to waste hierarchy and circular economy models as they are considered as secondary to SWM.[218] In humanitarian contexts, the risk of corruption and monopolization is very high. The privatization of public services, including SWM, increases those risks (including e.g. bribery, kickbacks, nepotism and favouritism).[219]

6.4 Lack of Prioritization of SWM; Lack of HOs' Capacities and Policies for Implementing (Sustainable) SWM

For HOs, SWM is often not the biggest priority.[220] Lack of willingness to prioritize SWM can stem from various factors. In crisis situations, HOs focus on urgent needs like food, shelter, and medical care and SWM might be overlooked due to its less immediate impact.[221] Moreover, HOs often lack awareness, expertise and equipment needed for implementing sustainable (integrated) SWM. SWM is a cross-sectoral issue and consequently there are challenges when allocation of responsibilities and accountabilities within HOs. Roles and responsibilities within the humanitarian sector around SWM are often unclear, particularly in humanitarian camp settings.[222] According to WREC's baseline study results, only a minority of respondents to their 2023 baseline survey (28%) and the mid-term survey (18%) indicated that their organization has a SWM planning framework in place.[223] Moreover, the report showed that 91% of respondents (baseline) and 82% (mid-term) do not have any

[216] United Nations Environment Programme. (2024). Beyond an age of waste: Turning rubbish into a resource (p. 54). Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.
[217] UNEP. (2018). Africa Waste Management Outlook (p. 55). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[218] United Nations Environment Programme. (2024). Beyond an age of waste: Turning rubbish into a resource (p. 44). Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.
[219] Ibid. (p.54).
[220] The management of humanitarian waste. (2022). Défis Humanitaires. Retrieved from https://defishumanitaires.com/en/2022/07/01/the-management-of-humanitarian-waste/.
[221] Lantagne, D., Yates, T., Ngasala, T., Hutchings, P., Bastable, A., Allen, J., Hestbæk, C., & Ramos, M. (2021). Gaps in WASH in humanitarian response: 2021 update (p.40). ELRHA. Retrieved from https://www.elrha.org/researchdatabase/gaps-in-wash-in-humanitarian-response-2021-update/.
[222] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 53). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.
[223] Ely, K., Insabato, F., Kucharski, M., Balzino, M., Bassel, M., & Rocheteau, M. (2023). Baseline and Mid-term Survey Report: WREC Survey Report (p. 12). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-08/WREC_Surveyreport%20240823_FINAL.pdf.

mechanisms in place to measure waste volumes.[224] Most humanitarian contexts involve a diverse range of HOs, all of whom create waste. However, the responsibility of SWM is not shared. For example, the WASH sector along with logistics and supply chain management are the ones that bear the brunt of organizing the SWM practices.[225]

6.5 Lack of sustainable humanitarian procurement/supply chains

Humanitarian procurement is determined to a certain extent by the emergency context and needs: humanitarian aid supply chains need to be highly responsive, prioritizing speed and efficiency to save lives. The purchasing decisions can be made hastily, favouring immediate availability and low costs, which may overshadow long-term environmental sustainability considerations.[226] While there has been clear focus lately on sustainable procurement as a theme for the humanitarian sector (e.g. WREC´s (2023) Quick Guide. Environmentally Sustainable Procurement); the praxis is still different. Environmentally sustainable materials and products are very rarely available in humanitarian contexts 'markets and it might be too costly or time-consuming to purchase them from abroad. Humanitarian organisations might also lack human resources, expertise, and knowledge on how to assess properly the sustainability of products to be purchased. There might be also internal resistance to prioritizing green procurement.

While decentralizing procurement in humanitarian settings can enhance responsiveness, support local economies, and provide more tailored solutions, in practice, it causes multiple challenges. Within the humanitarian sector, the procurement is often decentralized and involves a myriad of stakeholders from local staff to strategic-level managers.[227] This can be challenging for its effective coordination and oversight. Moreover, decentralized systems may be more susceptible to corruption and mismanagement, especially in regions with weak governance structures.[228]

Within the humanitarian praxis the relief supplies are pre-positioned in warehouses in strategic locations globally, or context-specific items are procured immediately once the disaster has struck. This can lead to instances where there might be items sitting in warehouses for years, only to be discarded as they have reached the end of their lifespan.[229]

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[224] Ibid.

[225] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context (p.14). Hanken School of Economics, Supply Chain Management and Social Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.

[226] WREC. (2023). Quick Guide. Environmentally Sustainable Procurement. An Introductory Guide (p. 2). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2023-12/QuickGuide_Green%20Procurement_2023%20Final2.pdf.

[227] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context (p.12). Hanken School of Economics, Supply Chain Management and Social Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.

[228] United Nations Environment Programme. (2024). Africa Waste Management Outlook (p. 100). United Nations Environment Programme. Retrieved fromhttps://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.

[229] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context (p.12). Hanken School of Economics, Supply Chain Management and Social

WREC has identified other issues related to the procurement:

- Lack of supplier screening;
- Life-cycle assessment for relief items not conducted;
- HOs not engaging enough with environmental audits.[230]

6.6 Lack of quality waste data and monitoring

As already explained above, the absence of comprehensive data on SWM (including its characterisation, quantification, information on recycling, disposal etc.) in humanitarian settings presents numerous challenges that hinder effective waste management practices. There is also a lack of standardization in measurement and reporting of waste, as well as in establishing the composition of the waste streams.[231] The lack of proper monitoring systems leads to inadequate estimates for simple indicators such as e.g. total collected waste and the share of collected waste deposited in controlled landfills[232]. In many refugee/IDP camps and informal settlements, waste management practices are often ad hoc and undocumented, leading to significant gaps in data.[233] There is also absence of appropriate technology for waste monitoring and data collection and lack of qualified personnel to implement it.

6.7 Technical barriers

Technical barriers are related to different issues in waste reduction, segregation, collection, recycling and disposal efforts. In humanitarian contexts, there is still waste presence of non-recyclable products and packaging, despite the "design for recycling" that can be mandated through EPR regulations. Many relief items comprise multiple materials that cannot be separated (e.g. metalized sachets) and therefore they can be only disposed of. In humanitarian contexts with insufficient or inexistent SWM infrastructure, this means ending up in unsanitary landfills/dumpsite, being burned in the open, or leaking into the environment.[234]

The communities also lack awareness about and motivation for different SWM issues, such as how to properly segregate the source of waste in their households, restaurants, shops, markets etc. The communities lack e.g. the following:

- Understanding on how to segregate;

Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.

[230] Ibid. (p.13).

[231] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 63). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.

[232] United Nations Environment Programme. (2024). Beyond an age of waste: Turning rubbish into a resource (p. 17). Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.

[233] Human Rights Watch. (2024). South Sudan: Events of 2023. Retrieved from https://www.hrw.org/world-report/2024/country-chapters/south-sudan.

[234] United Nations Environment Programme. (2024). Beyond an age of waste: Turning rubbish into a resource (pp. 55-56). Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.

- Motivation or incentive to segregate;
- Responsibilities within the household (e.g. segregation is done by one household member and deposit of waste by another leading to the mix up of waste)
- Lack of ownership or perceived responsibility to keep areas clean of waste (e.g. in markets).[235]

6.7.1 Technical barriers linked to alternatives to plastic packaging of relief items

There have been different initiatives focusing on developing suitable alternative materials especially to petroleum-derived plastic packaging in humanitarian settings, such as the following:

- biodegradable plastics;
- compostable plastics;
- bio-based plastics;[236]
- bio-regenerative materials: seaweed, hemp, mushroom;
- natural fibres: jute and cotton;
- cardboard/paper;
- recycled plastics.

Those solutions bring multiple challenges. For example, alternatives to petroleum-based plastics are particularly challenging to use for food items. The quality and functionality of packaging (e.g., stability, strength, water resistance) remains a priority because food loss and food waste resulting from inappropriate or defective packaging can cause significant carbon emissions.[237] The challenges associated mainly to alternatives to plastic packaging relate to cost, performance, infrastructure, supply chain logistics, environmental impact, community acceptance, and regulatory barriers.

For example, challenges with regards to the end-of life are as follows:

- Biodegradable plastics only breaks down completely if exposed to specific conditions (e.g. humidity, temperature) and when discarded into the ocean, it's mostly much slower to degrade than in terrestrial settings. Moreover, biodegradable plastics need a separate collection system: if they end up in a landfill, their breakdown results in carbon and methane emissions and when collected alongside recyclable plastics, they can contaminate recyclable plastic batches and cause damage to recycling infrastructure;[238]
- Compostable plastics, if designed to be composted in industrial facilities, will only degrade if exposed to specific conditions (e.g. high temperature over a long period of time) and not in a home composter. Since industrial composting is very rare in humanitarian contexts, compostable plastics are not suitable for humanitarian organizations;[239]
- The degradation of bio-based plastics in natural environmental conditions is very slow, and industrial composting is required to achieve complete

[235] WASH Sector Cox's Bazar. (2021). Solid Waste Management Strategy (p. 12). Retrieved from WASHCXB-Solid-Waste-Management-Strategy-31.07.21.pdf.
[236] See more about use of the bioplastics in humanitarian aid here: https://drive.google.com/file/d/1tz6BVPcunve6tdpXIxNMw3Z91GLSVf-q/view
[237] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2019). Alternatives to Conventional Plastics in Packaging (p. 14). Retrieved from https://eecentre.org/wp-content/uploads/2019/07/Alternatives-To-Conventional-Plastics-in-Packaging.pdf.
[238] Ibid. (p.5).
[239] Ibid. (p.6).

biodegradation.[240] Moreover, some bio-based plastics are still partially composed of fossil-based plastic (bio-PET/starch blends) and contain chemicals that make their end-of-life management challenging;[241]

- For bio-regenerative materials: e.g. seaweed, hemp, mushroom the main challenge is their cost (significantly higher cost than petroleum-based plastics) and availability (suppliers not able to supply this in large quantities to meet the needs of humanitarian organizations).[242]

6.8 SWM challenges identified by research participants in DRC and South Sudan

The table below provides an overview of the most pressing challenges as identified during the primary data collection in DRC and South Sudan.

Table 11: SWM challenges in DRC and South Sudan identified during the needs assessment

Lack of (official) SWM infrastructure and services	In DRC and South Sudan, lack of SWM infrastructure and services was the most mentioned challenge during this research by all stakeholders in all settings (rural, semi-urban, urban, IDP camp). This issue starts at the household level with the lack of bins, and continues with public infrastructure, which lacks public bins, sufficient number of good quality waste collection trucks, and safe landfills. The number and capacities of official waste collecting businesses is insufficient, while official and registered waste transformation businesses are either small enterprises that use simple or even artisanal techniques or are completely absent. Moreover, there have been no notable efforts to bring the unofficial SWM providers into the official system.
Lack of financial resources and poverty	Insufficient or non-existent funding was the third most often mentioned concern of the research participants. The government lacks resources to provide services, while businesses do not have funding to expand, industrialize and improve the quality of their services, as there is lack of financing options and opportunities. On the other hand, their functioning is affected by a challenging business environment, in which they need to pay taxes but there are not enough clients willing or able to subscribe, pay, or even pre-pay. Businesses may be also challenged to market their products due to their financial situation. For example, the businesses producing recycled paving stones are struggling with finding customer base for their product. All of this influences the demand for their products.

[240] Ortiz, S. P. (2023). Are bioplastics the solution to the plastic pollution problem? PLOS Biology, 21(3), Article 3002045. (p.2). Retrieved from https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.3002045.
[241] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2019). Alternatives to Conventional Plastics in Packaging (p.7). Retrieved from https://eecentre.org/wp-content/uploads/2019/07/Alternatives-To-Conventional-Plastics-in-Packaging.pdf.
[242] Ibid. (p.8).

	HOs also cited lack of funding from the donors' side as a major obstacle. Moreover, academia stakeholders have little funding to conduct rigorous research and monitoring.
Lack of (enforcement of) SWM national policies	In DRC, the SWM legislation is in place; however, it is not followed by sufficiently active enforcement from the government's side, including through imposition of sanctions for failure to comply. In fact, many respondents did not know that legislation regulating SWM existed. On the other hand, South Sudanese SWM legislation has not been completed and approved. The reasons include the recent conflict as well as constant, fast and unexpected changes in staffing of higher administration structures due to political reasons, while no or insufficient handovers take place
Lack of strategic planning for SWM	In both countries, there is a lack of proper planning for SWM at national and local levels. Moreover, HOs have not until now considered proper planning for their SWM during humanitarian interventions. This is caused due to low prioritization of SWM, insufficient financial resources, and lack of technical expertise.
Limited coordination among SWM actors	The existing SWM service providers tend to work in silos. For example, some of the waste transformers also arrange for their waste collection themselves, whereas systematic cooperation with waste collectors could be established. Nevertheless, this concept would also have to address the low availability of sorted waste evacuated by most waste collectors. Nevertheless, certain coordination initiatives were observed especially in DRC. These need to be further strengthened.
Lack of prioritization, capacities and policies of HOs for implementation of sustainable SWM	The survey conducted with HOs as well as the KIIs show that many humanitarian and development organizations active in humanitarian settings, such as DRC and South Sudan, do not have any or approved policies or guidelines regulating SWM in their operations and procurement. Moreover, this agenda is crosscutting and generally there is no single position that would lead it within HOs. On the contrary, different positions at different levels manage some aspects of SWM, resulting in insufficient prioritization of the topic. Another contributing factor is lack of technical capacity in this field.
Lack of quality waste data and monitoring	Monitoring of and having quantitative data on waste and its management is a big challenge for all stakeholders – government, HOs, businesses and academia. Without information, it is difficult to understand the extent of the problem and to devise and implement solutions that work.
Technical barriers	This was the second most discussed barrier of SWM by the research participants. Generally, there is a lack of technical experts that could plan and implement good SWM practices in both the government, academia, HOs, businesses, health facilities and communities.

Lack of SWM awareness	Awareness and general knowledge of good SWM practices and their correct performance among general population is very low, which means that many do not understand the good behaviours and, therefore, cannot require them from the responsible stakeholders or practice them correctly themselves. For example, although some households practice the generally approved reuse of bottles, if they do not sanitize these bottles properly, as is often the case, it may have negative health impacts. Health can be also affected if composting is not practiced correctly, and organic waste is mixed with other types of waste. Or, if sanitation waste and sharps are thrown into latrines, this prevents both the solid and liquid waste in the latrine from being well managed. SWM is a topic that is somewhat forgotten, as many research respondents revealed that their KII or FGD was the first occasion someone asked them about waste and how it is managed.
Mentality (low perception of responsibility)	The respondents noted a general lack of personal responsibility for how waste is managed. Community often refers to the responsibility of the government, while willingness to personally contribute by keeping own surroundings clean and subscribing to waste collection is low. On the other hand, responsibility on the government's side is also found wanting, if, for example, there are certain governmental institutions that collect taxes but do not use them for SWM service provision and are not transparent about the taxation use. Moreover, various governmental stakeholders may interpret the responsibilities codified in regulations in different ways.
Little involvement of academia	Universities and research institutes and laboratories are usually not much consulted or involved in SWM agenda by the government or by HOs. This hinders the development of local expertise and solutions, including their implementation.
Armed conflict	The general security environment poses barriers to SWM activities, including transportation of waste to landfills or cross-border for transformation.

Figure 29 provides further insight into the challenges as perceived by the surveyed HOs. Limited SWM capacities in the country and lack of funding are considered as the biggest barriers by the international HOs. However, the other three barriers – willingness to prioritize SWM, no coordinated SWM plans of the humanitarian sector, and lack of local SWM policies – are also considered important for the IHOs.

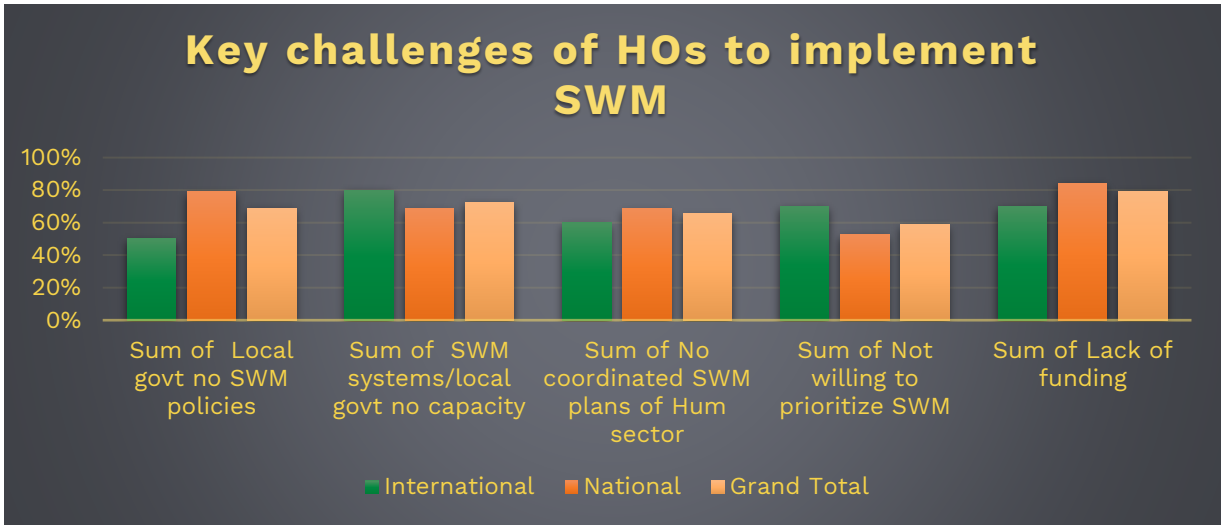

Figure 29: Key challenges of HOs to implement SWM management

7. Opportunities

It is impossible to estimate to what extent the above outlined challenges are being addressed currently in humanitarian settings around the world. Nevertheless, it is evident that waste has a great potential in the future. Globally, if managed sustainably, the waste sector can become a net reducer of greenhouse gases and a major contributor to climate change mitigation.[243] It can also serve as a valuable resource by producing secondary raw materials, enhancing soil quality with nutrients and soil-improving materials, and generating green and renewable energy and fuels.[244] Additionally, it holds the potential to create livelihoods[245] and wealth for cities and regions. According to ISWA, the waste industry can be transformed into a data-driven sector, becoming a central pillar of the future economic model. This model will emphasize circularity and the recovery of goods, materials, chemicals, and energy.[246] In low- and middle-income countries, waste management is expected to evolve from its current state to a formally organized sector where all materials are managed using up-to-date technologies.[247] To achieve this goal, waste management in humanitarian settings must adhere to the actions outlined in the waste hierarchy[248]. The involvement of multiple stakeholders is crucial, along with securing funding, including active participation and ideally investment from the private sector, whose decisions directly influence waste generation. The waste opportunities can happen only if the local government enables them (e.g.

[243] ISWA. (2021). The future of the waste management sector: Trends, opportunities and challenges for the decade 2021-2030 (p. 8). Retrieved from https://www.iswa.org/climate-change-and-waste-management/?v=928568b84963.
[244] Ibid. (p.8).
[245] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 52). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.
[246] ISWA. (2021). The future of the waste management sector: Trends, opportunities and challenges for the decade 2021-2030 (p. 7). Retrieved from https://www.iswa.org/climate-change-and-waste-management/?v=928568b84963.
[247] Ibid. (p.8).
[248] Ibid. (p.7).

regulations).[249] Given the context of humanitarian settings, where the informal sector plays a crucial role in SWM, it is also necessary to acknowledge the waste pickers and their efforts who are the key players who "put the matter in the public agenda".[250] Similarly, to ensure that SWM is effective, efficient, and sustainable, behavioural changes are needed within affected communities and the entire humanitarian sector.[251] By adhering to the waste hierarchy—starting with waste avoidance and reduction at the source (from design and procurement phases), followed by waste sorting and collection, repairing, reusing, and recycling, and finally, responsible waste disposal (through composting, controlled incineration, or regulated landfills)[252]—the SWM system can ultimately transition to a zero-waste and circular approach. To achieve this, products and resources must be recovered and sustainably maintained in the cycle for as long as possible. Additionally, the SWM sector needs to collaborate with other actors along the value chain.[253]
New models for financing waste management are certainly needed. The primary driving principles behind these new financial models should include the duty of preventing pollution, the life-cycle concept, the polluter-pays principle, and the adequate internalization of costs.[254]

However, national contexts vary significantly and there is no one-size-fits-all approach for systemic change. In humanitarian contexts, solutions for solid waste management (SWM) might appear technically simple but become managerially complex[255] due to insufficient or non-existent SWM infrastructure in crisis-affected countries and challenging cooperation with national authorities. Additionally, there is a lack of funding, and SWM often competes with other, more urgent priorities, as outlined above in *SWM challenges*.

The key opportunities for SWM in humanitarian settings are as follows:

7.1 Waste prevention/reduction (towards zero waste and waste minimization):

While the ideal solution would be to establish zero-waste systems, thereby preventing or significantly reducing waste through efficient resource management, preventing waste entirely in humanitarian contexts is challenging. For instance, packaging not only protects items during delivery but can also be utilized on-site.

[249] United Nations Environment Programme. (2024). Africa Waste Management Outlook (p. 134). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[250] ISWA. (2021). The future of the waste management sector: Trends, opportunities and challenges for the decade 2021-2030 (p. 19). Retrieved from https://www.iswa.org/climate-change-and-waste-management/?v=928568b84963.
[251] United Nations Environment Programme (2024). Global Waste Management Outlook 2024: Beyond an age of waste – Turning rubbish into a resource (p.43). Nairobi. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/44939/global_waste_management_outlook_2024.pdf?sequence=3.
[252] Waste management principles. Climate Action Accelerator. Retrieved from https://climateactionaccelerator.org/solution-areas/waste_management_principles/.
[253] ISWA. (2021). The future of the waste management sector: Trends, opportunities and challenges for the decade 2021-2030 (p. 15). Retrieved from https://www.iswa.org/climate-change-and-waste-management/?v=928568b84963.
[254] Ibid.(p.8).
[255] Reed, B. (2016). Solid Waste Management: WASH in Emergencies HIF Problem Exploration Report (p.2). Retrieved from https://www.researchgate.net/publication/313550238_Solid_Waste_Management'_WASH_in_Emergencies_HIF_Problem_Exploration_Report.

There is no way to eliminate the waste altogether in humanitarian settings.[256] HOs might start though by reducing waste at source by minimizing packaging for relief supplies and/or using bulk packaging.

HOs reduce or minimize the waste by:

- Green procurement – by design, during the procurement phase, by choosing products that offer the most environmentally sustainable option (e.g. improving production efficiency);
- Consumption - by adopting alternative practices to minimize waste or prolong the usability of relief items in office spaces, warehouses, and fleet workshops (e.g. reduce paper printing, maintenance of pallets or vehicles, stock management to avoid infestation, damage and expiration, etc.).[257]

In order to optimize waste minimizing efforts, it is necessary to understand, monitor and communicate data on waste inflows and outflows (e.g. in refugee/IDP camp settings). This data could help HOs to better advocate for a change in SWM dynamics in an emergency response.[258]

JI compiled a Compendium of case studies[259] documenting the experiences of eight HOs and their efforts to reduce the environmental footprint of their packaging, see one example bellow.

7.1.1 Example: ShelterBox's Success in Eliminating Single Use Plastic

ShelterBox focused on primary and tertiary packaging as "low hanging fruit" and successfully avoided the use of 173,396 pieces of plastic in 2021 by implementing sustainable packaging practices. Based on a mapping exercise of the composition of their relief items, including the review of their Post-Distribution Monitoring (PDMs) and together with their supplier Alpinter[260] (one of biggest suppliers of relief items), ShelterBox identified 13 different types of packaging used in their relief items that could be revisited, highlighted four as non-essential, and labelled three others as potentially reusable. The process[261] is shown in the figure below.

[256] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context (p.19). Hanken School of Economics, Supply Chain Management and Social Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.
[257] WREC. (2023). Quick Guide. Solid Waste Management (SWM) Guide (p.4). Retrieved from https://d10.logcluster.org/en/document/wrec-quick-guide-waste-management-august-2023.
[258] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 54). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.
[259] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2024). Managing Packaging Waste Sustainably – Lessons from Humanitarian Organizations. Retrieved from Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management.
[260] https://www.alpinter.com/
[261] ShelterBox. (2022). Managing Packaging Waste Sustainably – Lessons from Humanitarian Organizations: ShelterBox's Success in Eliminating Single Use Plastic. Retrieved from https://shelterbox.org/wp-content/uploads/2022/09/MANAGING-PACKAGING-WASTE-SHELTERBOX-low.pdf.

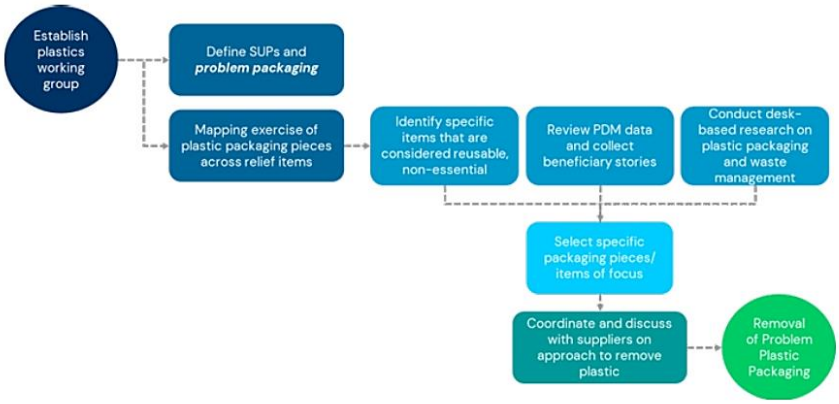

Figure 30: Summary of ShelterBox's Plastic Reduction Process

Source: ShelterBox, 2020, p. 4

By this exercise they defined so-called "problem packaging" that:

- Is not essential for the protection of a relief item;
- Is not essential for the safe delivery, storage, or use of a relief item;
- Will not be meaningfully repurposed by the beneficiaries who will receive the aid;
- May cause harm to the community or environment.[262]

7.1.2 Reduce high-impact waste sources

In order to avoid targeting smaller waste streams, with lower impact, it is necessary for the humanitarian sector to conduct waste stream analysis and follow by developing high-impact solutions that curb these sources. The best placed for such an effort are institutional researchers in materials science and engineering, and private sector product designers and developers.[263]

7.2 Reuse and Recycling:

In humanitarian settings, many materials are reused or repurposed before disposal. For example, large plastic containers are used by households for storing food, and food packaging materials are transformed into reusable bags. This includes activities such as repairing, refurbishing, or redistributing products and materials. The recycler companies need to be regularly checked to avoid corrupted or other unethical practices (child labour/uncontrolled landfill).[264]

Some HOs conduct the recycling of plastic packaging in small on-site workshops. This must be preceded by proper evaluation based on the country's context,

[262] Ibid. (p.4).
[263] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 63). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.
[264] Recycling waste in developing countries. Climate Action Accelerator. Retrieved from https://climateactionaccelerator.org/solutions/recycle-waste-developing-countries/.

packaging waste materials, and available infrastructure.[265] The safe recycling of packaging plastics on-site can be done through:

- Shredding

Shredding happens after the plastic packaging waste is collected and sorted. It is a process of reducing plastic packaging waste into smaller pieces or fragments to make it easier to handle, transport, store, and recycle.[266]

- Washing and drying plastic packaging waste

This is the next step after shredding; it involves cleaning the plastic packaging waste to remove dirt, debris, and contaminants such as chemicals, oils, and other pollutants. Waste washing aims to prepare the waste for recycling, as contaminated plastic waste can be difficult to recycle and can damage recycling equipment.[267] While the washing can be done in a series of tanks or machines that use water and detergents to remove contaminants, for humanitarian settings, washing by hand is recommended. After washing the plastic packaging needs to be dried, e.g. by applying a stream of air generated by fans or blowers, or by simply spreading the packaging plastic waste in a well-ventilated area and allowing it to air dry naturally.[268]

7.3 Waste-to-Energy and Waste-to-Resource

If HOs focus on waste as a potential source of livelihoods and resources through innovative models (funding and financing, partnership and procurement, and (de)regulation) this could lead to new circular business ventures through numerous support mechanisms, including local procurement.[269] Nevertheless, the local procurement needs to be tackled carefully. While working closely with procuring partners for innovative and environmentally sustainable products is essential, the environmental sustainability is not guaranteed simply by working with local partners, unless the life cycle of the sourced materials is known fully.[270] Also, when planning waste management integration into livelihoods programs through collaboration with local (grassroot) partners and markets, the viability in terms of livelihoods must be explored and considered. For example, the use of waste to manufacture building materials has had success in some contexts[271] but the possible negative effects of the product need to carefully explored.[272]

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[265] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Guidelines for Packaging Waste Management in Humanitarian Operations (p. 11). Retrieved from https://eecentre.org/wp-content/uploads/2023/09/Guidelines-for-Packaging-Waste-Management-in-Humanitarian-Operations-compressed.pdf.

[266] Ibid.

[267] Ibid.

[268] Ibid. (pp.11-12).

[269] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 61). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.

[270] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context (p.26). Hanken School of Economics, Supply Chain Management and Social Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.

[271] For innovative, creative, grassroot local sustainable solutions, see example here: https://fortomorrow.org/explore-solutions?page=1&sort=descending&categories=wasteManagement.

[272] Tuomala, V., Kovacs, G., Aminoff, A., & Ely, K. (2022). Waste management and reverse logistics in the humanitarian context (p.26). Hanken School of Economics, Supply Chain Management and Social Responsibility, HUMLOG Institute; Global Logistics Cluster, WFP. Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2022-09/Hanken%20Qualitative%20Review%20-%20Final%20Report%20-%20V2%20CLEAN%20%283%29.pdf.

Local entrepreneurs and communities have the potential to address waste management issues in various settings, such as IDP or refugee camps. In Africa, energy recovery technologies—like landfill gas recovery, biodigesters for organic municipal solid waste, and industrial biomass—are currently being implemented, though their usage remains minimal.[273] The opportunities in this field range from anaerobic digestion, landfill gas recovery and high temperature thermal treatment such as incineration. Moreover, the collection and sorting of waste can create many livelihood opportunities, with a specific focus on empowerment of women. In order to move from the waste hierarchy up, it is necessary to:

- Include the large informal sector (support its professionalization and formalization[274]);
- Involve the local regulators/authorities who will be actively promoting the new technologies;
- Support the development of local, grassroots waste entrepreneurs;
- Create resilient, localized waste-to-resource business models that support the development of local circular economies. These business models should not be dependent on access to global markets;
- Where possible, support safer access to waste to enable local small-scale enterprises (e.g. to IDP/refugee camps and settlements) to enter the waste-based economy, while managing health and safety risks.[275]

7.3.1 Example: The Food and Agriculture Organization (FAO) composting project in Zaatari refugee camps[276]

In 2016, the Food and Agriculture Organization (FAO) funded by EU, and in partnership with the National Agricultural Research Centre started a composting project in Zaatari refugee camp focused on integrated solid waste management (ISWM) system in the camp. FAO invested in ISWM hierarchy item 4 (Waste minimization and recovery of energy from waste by composting and anaerobic/biogas). The project enhanced the potential economic growth of the local economy of Mafraq Governorate and more precisely of Zaatari municipality. The project established a 16-ton capacity Material Recovery Facility, training 89 Syrian refugees in waste sorting and employing 24 in composting best practices. This initiative not only improved environmental conditions but also provided income and purpose for camp residents, supporting long-term job opportunities and self-reliance. The development of the Material Recovery Facility and the training programs reduced the pressure on municipal services and established a sustainable waste management system. As a result, the project has created green jobs, reduced waste by around 50%, decreased landfill costs, and cut emissions from waste transport.

[273] UNEP. (2018). Africa Waste Management Outlook (p. 118). United Nations Environment Programme. Retrieved from https://www.unep.org/ietc/resources/publication/africa-waste-management-outlook.
[274] ISWA. (2021). The future of the waste management sector: Trends, opportunities and challenges for the decade 2021-2030 (p. 19). Retrieved from https://www.iswa.org/climate-change-and-waste-management/?v=928568b84963.
[275] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 62). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.
[276] Production of renewable energy with waste in Jordan. Global Compact on Refugees. Retrieved from https://globalcompactrefugees.org/good-practices/production-renewable-energy-waste-jordan.

7.4 Safe and accessible disposal sites

Challenges related to waste disposal in humanitarian settings were described above. Practical solutions for the safe disposal in refugee camps/settlements are described e.g. in the UNHCR's recent (2024) *Guidelines for the Safe Disposal of Solid Waste in Humanitarian Contexts*.[277] Nevertheless, there is a need for innovation in regulation concerning safe disposal options, the development of technical and operational standards, SWM models and strategies, and the engineering and design of disposal sites. The innovators to tackle this issue could include regulatory policymakers and enforcers in host countries, humanitarian standards developers, and operational staff whose work is governed by relevant regulations and standards.[278]

Controlled incineration can be an alternative to open-burning waste or leaving it in nature, but it must be managed properly, e.g. in line with the Industrial Emissions Directive (IED). Incineration must be at least 850 degrees °C for a minimum of 2 seconds to avoid the formation of very toxic gasses and long-term pollution in soil, water, and air.[279] HOs need to work with national or private well screened incinerators. The incineration generates heat that can be used to generate steam, which can consequently be used e.g. for drive turbines to generate electricity. The by-products of waste incineration (ash and gases such as carbon dioxide, nitrogen oxides, and sulphur dioxide) need to be treated properly (ash collected and disposed of in the landfill; gases treated) to reduce the negative impact of incineration on the environment. [280]

There are several following opportunities to be explored with regards to safe disposal in humanitarian settings:

- Safe, accessible final disposal sites need to be developed, accounting for location-specific constraints and being sensitive to host community needs;
- New methods to address disposal site risks should be proposed and tested (incl. ways to analyse and accept risks associated with site selection, construction, maintenance, management, control, monitoring and use);
- Successful SWM approaches from medical waste management need to be identified and adopted (especially for identifying, segregating and safely disposing of hazardous waste).[281]

7.5 Sustainable packaging/materials

There several initiatives in establishing environmental sustainability criteria and practical tips how to reduce environmental impact of humanitarian packaging, such

[277] UNHCR. (2024). Guidelines for the Safe Disposal of Solid Waste in Humanitarian Contexts. Retrieved from https://www.unhcr.org/sites/default/files/2024-04/guidlines-for-safe-disposal-of-solid-waste-in-humanitarian-contexts.pdf.
[278] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 55). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.
[279] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Guidelines for Packaging Waste Management in Humanitarian Operations (p. 12). Retrieved from https://eecentre.org/wp-content/uploads/2023/09/Guidelines-for-Packaging-Waste-Management-in-Humanitarian-Operations-compressed.pdf.
[280] Ibid.
[281] ELHRA. (2022). Innovation Opportunities in Solid Waste Disposal in Humanitarian Settings (p. 56). Retrieved from https://www.elrha.org/researchdatabase/innovation-opportunities-solid-waste-disposal-humanitarian-settings/.

as those developed by JI [282] that propose detailed sustainable packaging specifications for procurement tenders. The criteria are broken down into three categories: technical, administrative, and transport which help procurement officers make key decisions, weighing options at each stage in the process and eventually lead to waste reduction at the procurement stage.[283]

Some innovative approaches to item specifications to reduce emissions and waste creation have been explored within the WREC's green procurement initiative (e.g. eco-designs, using LCAs, packaging specifications and greener warehousing) and implemented by UNHCR, ICRC (leading the Sustainable Supply Chain Alliance - SSCA[284]), IFRC and other HOs. Some of the worked covered e.g. revision of non-food items (NFI) specifications, looking into a reduction of CO2 emissions and also exploring ways to support additional environmental and economic pillars of sustainability[285]. The crucial element in this endeavour is to work directly and closely with the suppliers and understanding what is possible from a manufacturing perspective and there is need for guidance and specifications to comply with the requirements of humanitarian organisations.[286]

7.5.1 Example: Eco-design tarpaulins for e.g. emergency shelters, latrine covers, walls and fences

ICHC, IFRC and UNHRC have produced an eco-design tarpaulin (as an alternative to plastic, polyethylene tarpaulin) with a reduced footprint[287]. The process of testing this tarpaulin involved: 3 years of lab tests and studies, a life cycle analysis, an ultraviolet (UV) test, two field surveys and a scientific study of bio sourced, biodegradable and recycled materials.

The following confirmed success in reducing environmental impact:

- Impact of 15% recycled polyethylene;
- Impact of 14% lighter in weight;
- Impact of extended lifespan (doubled);
- Impact of Long-term UV resistance;
- Impact of recycling;
- Repairable;
- Fire safety;

[282] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2023). Guidelines for Packaging Waste Management in Humanitarian Operations. Retrieved from https://eecentre.org/wp-content/uploads/2023/09/Guidelines-for-Packaging-Waste-Management-in-Humanitarian-Operations-compressed.pdf; Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2024). Joint Initiative Procurement Decision Tree (English, French). Retrieved from https://logcluster.org/en/document/joint-initiative-procurement-decision-tree-english-french.

[283] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management. (2022). "Who's Doing What" on Sustainable Procurement: An Overview of What Humanitarian Organizations Are Doing to "Green" Their Procurement Practices. (p.5). Retrieved from https://eecentre.org/wp-content/uploads/2022/12/Whos-Doing-What-on-Sustainable-Procurement.pdf.

[284] https://www.thessca.org/home

[285] WREC. (2024). Green Procurement Global Information Session, May 2024. (p.2). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2024-05/NFR%20Green%20procurement%20global%20info%20session%20May%202024%20FINAL.pdf.

[286] Ibid.

[287] Oger, P. (2023). Eco Design Tarpaulin: End of Project Report pp.6-7). Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2024-02/Tarpaulin%20Project%20final%20report%20v2.1.pdf.

- Points of attention;
- Transport.

The ICRC decided not to use the conventional biodegradable plastic (polyethylene) or bio sourced polyethylene in the composition of the tarpaulins for the following reasons:

- The climatic conditions of humanitarian settings where tarpaulins are used are too varied and it is consequently impossible to predict or guarantee the tarpaulins durability;
- The end of life of tarpaulins is not controlled in humanitarian contexts and will mostly not meet the conditions of biodegradation;
- Bio sourced polyethylene has a higher environmental impact than fossil-based plastics in certain categories (use of resources, depletion of the ozone layer, human toxicity, terrestrial ecotoxicity, photochemical oxidation, acidification and eutrophication);
- A potential conflict between food production and the production of bio-based plastics.[288]

7.6 Data and digitalization to strengthen the waste management value chain

The use of digitalization and AI advancements is growing even in the SWM sector in humanitarian settings, as shown by the following examples:

- WREC has developed a Waste management facilities mapping;[289]
- UN Habitat's Waste Wise Cities Tool[290] for monitoring SDG Indicator 11.6.1, which focuses on the proportion of municipal SWM in controlled facilities compared to the total generated waste;
- For real-time monitoring and tracking the IoT sensors have been used in some refugee camps (e.g. in Jordan's Zaatari camp, managed by UNICEF),[291] installed in waste bins to monitor fill levels in real-time. This allows waste collection teams to prioritize which bins need emptying, reducing the frequency of collection trips and optimizing resource use;
- In Kabul Afghanistan, GPS-Enabled Vehicles have been used for waste collection vehicles to track their routes and ensure timely and efficient waste collection. This system helps in planning the most efficient routes, saving fuel and time;[292]
- Some of the applications like "GarbageDay" [293] might be applied to humanitarian contexts and help with e.g. notifying residents about waste collection schedules, recycling guidelines, and disposal points;

[288] ICRC/IFRC/UNHCR Eco-design Tarpaulin Project 2021-2023 Project newsletter, December 16, 2022. Available at: https://climateactionaccelerator.org/wp-content/uploads/2023/07/Ecodesign-Tarpaulin-project-newsletter_2022-12-long-version94.pdf.
[289] https://logie.logcluster.org/?op=wrec
[290] https://unhabitat.org/waste-wise-cities
[291] UNICEF Jordan. (2017). “Smart Refugee Camps”: Applying the Best of IoT and ICT for Better Camp Management. Retrieved from https://medium.com/@unicefjordan1/smart-refugee-camps-applying-the-best-of-iot-and-ict-for-better-camp-management-e35e619e7310.
[292] Castro-León, G., Baquero-Quinteros, E., Loor, B. G., Alvear, J., Montesdeoca Espín, D. E., De La Rosa, A., & Montero-Calderón, C. (2020). Waste to Catalyst: Synthesis of Catalysts from Sewage Sludge of the Mining, Steel, and Petroleum Industries. Retrieved from https://doi.org/10.3390/su12239849.
[293] https://play.google.com/store/apps/details?id=com.rbc.ventures.garbageday&hl=cs&pli=1

- The use of platform such as Banyan Nation[294] used in India might be explored for use in humanitarian settings. This digital platform connects waste collectors with recyclers, enabling efficient trade of recyclable materials. By providing real-time pricing and demand information, Banyan Nation helps maximize the value of collected materials and promotes recycling.

7.7 Examples of other humanitarian projects[295] aiming at identifying solutions for SWM sector:

- DG ECHO's Innovation Fund: LCAs and research aimed at reducing the environmental footprint of metalized laminated sachets used for Ready to Use Therapeutic Food (RUTF) such as Plumpy'Nuts that are not reusable and are currently not recyclable;
- German Federal Foreign Office (GFFO) funding for the International Climate Initiative (part of the German government's international climate finance commitment) to a project run by the United Nations Institute for Training and Research (UNITAR) to help humanitarian actors solarize diesel-based energy systems in five countries in the Sahel;[296]
- Efforts to pool waste management, which allows for common, and therefore, more effective action to minimize negative consequences of waste in humanitarian settings. E.g. the ICRC, WFP and MSF have pooled their efforts and established a joint SWM action plan in South Sudan;
- Africa Ecology, a local association created in 2019, main partner of Réseau Logistique Humanitaire (RLH), composed of 9 NGOs, in Burkina Faso. Africa Ecology's mission is to collect waste and raise awareness on sorting and recycling in the country. They collect about 22 tons of waste per year. By establishing a strong partnership, the RLH group has become a major player in the development of Africa Ecology;
- GVD Africa offers professional training on pre-collection, sorting and recovery activities and develops the necessary tools and equipment for waste management. Thanks to their work, GVD has installed 100 waste recovery units in West and Central African countries, including 49 in Niger. Their training programs and equipment underline the importance of distinguishing and considering the particularity of each type of waste in the recovery process;
- The recovery of plastics and organic waste, e.g. Solidarités International work in the Sittwe camp in the Rakhine State, Myanmar. The camp hosted 80 500 displaced Rohingyas, to treat the 60m3 of sludge generated per day. This project started in 2012 by developing a centralized treatment system (the Sludge Treatment System) which reached 100,000 people living in 14 camps and using 4,000 latrines; [297]

[294] https://www.banyannation.com/
[295] WREC published in July 2024 WREC. (2024). Waste Management Landscape: Who is setting the pace in humanitarian waste management? Retrieved from https://s3.eu-west-1.amazonaws.com/logcluster-web-prod-files/public/2024-07/WREC%202024%20Waste%20Managment%203W%27s%20mapping%20%281%29.pdf.
[296] Joint Initiative for Sustainable Humanitarian Assistance Packaging Waste Management & Climate Action Accelerator. (2024). Operationalizing and Scaling-up Donors' Climate and Environmental Commitments: An Analysis of Progress, Gaps, and Opportunities (p. 13). Retrieved from https://climateactionaccelerator.org/wp-content/uploads/2023/11/CAA_MApping-Analysis_EN_V11.pdf.
[297] The management of humanitarian waste. (2022). Défis Humanitaires. Retrieved from https://defishumanitaires.com/en/2022/07/01/the-management-of-humanitarian-waste/.

- Sahrawi refugees running their own recycling workshop with the aim to create viable business model that can provide job opportunities and tackle the plastic problem at the same time; with funding from Humanitarian Innovation Programme;[298]
- UNEP's Piloting waste-to-energy solutions in humanitarian contexts. A feasibility study for piloting small-scale, turnkey waste-to-energy solutions in Jordan, Turkey and Tokelau.[299]

7.8 Opportunities as seen by the research participants in DRC and South Sudan

The KII and FGD respondents cited the increased employment opportunity as the most significant opportunity that the SWM sector can bring. In fact, one respondent called it "the porter sector that can help the state to resolve the problem of unemployment". If waste is properly segregated and collected, the actors could start diversifying and expanding the management approaches and create new jobs in the process. Respondents also highlighted that SWM development would be an opportunity for the SWM sector, as well as other sectors such as agriculture and construction, and development of the country overall. For example, if organic waste (estimated by one respondent to be 60%-80% of DRC's total solid waste) is processed well and on a large scale, agriculture and food production, and by extension the population and country, will benefit and address the issue of food security. If valorisation of metal waste were established, metal would not have to be sent abroad for recycling, but its transformation would be done in-country and benefit the national construction sector. If waste valorisation businesses were established, it would also bring an opportunity to enter the international market with valorised waste products. Moreover, improvements in and expansion of good SWM practices would reduce contamination as well as contribute to better sanitation and, thus, health of the population. The environment would also benefit, and the risk of flooding caused by water channels blocked by waste would diminish.

To achieve these positive impacts, the research participants in the two case study countries shared their views on the potential solutions to bad SWM in their contexts. The summary is below in table 12. When asked about bio-based solutions, most research participants were not familiar with the term and found it difficult to provide suggestions even after the researchers had explained the concept. A few respondents found bio-based solutions suitable in tackling waste challenges and protecting the environment (table 12). However, some noted that their implementation would be complicated and take time. Some challenges discussed were potential increase of HOs' budgets to include bio-based solutions, need to find resources and consumers (change of attitudes and behaviours), as well as having local actors ready to provide bio-based solutions.

[298] From waste to value: Plastic in humanitarian settings. Humanitarian Innovation Platform. Retrieved from https://hip.innovationnorway.com/article/from-waste-to-value-plastic-in-humanitarian-settings.
[299] Piloting waste-to-energy solutions in humanitarian contexts. UNEP Copenhagen Climate Centre. Retrieved from https://unepccc.org/project/piloting-waste-to-energy-solutions-in-humanitarian-contexts/.

Table 12: SWM solutions in DRC and South Sudan identified during the needs assessment

SWM sensitization and change of mentality	Sensitization of population on SWM and its benefits for all was actually the most often proposed solution by the respondents, as they highlighted that without community awareness raising and the subsequent mentality change, any improvements would not be adopted or respected, and that behaviour change needs to start at individual level. For example, transformation businesses need segregated waste and waste segregation needs to be adopted by individuals at the household level. Moreover, community awareness would lead them to require higher standards (e.g. to improve health and living environment), which would start putting pressure on further strengthening of SWM regulation and development. Awareness can be raised through local radios (such as in case of Kamanyola HC staff who sensitizes through 2 local radios on household waste management; or the case of Juba City Council that uses radio to raise awareness of regulations via radio), posters, and engagement of local leaders. Another type of mentality change that needs to take place for a successful implementation of SWM projects with the involvement of HOs is community's viewpoint that they get things for free from HOs. This type of mentality prevents an independent functioning and growth of SWM transformation businesses that need to find paying customers to finance their operation.
Increase SWM knowledge	Once the community is aware and their approach to waste is changed in the right way, they will be open to learning correct SWM practices, such as waste sorting or organic waste composting, they can practice themselves at the household or institutional level. As a result, a transformation will begin and create opportunities for bigger changes in the sector. This activity can engage actors who already function as sensitization and learning agents and have leadership status within communities, such as political, traditional and religious community leaders, teachers, health facility staff, WASH and health community volunteers, and any brigades established by SWM businesses (e.g. the brigade established by PF-EHA/GIE in Goma). The educational activities should focus especially on women, as they are the ones who usually handle waste within their households and take care of children who are much exposed to waste. Children can also be educated through inclusion of SWM topic into the school curricula, as they are the future changemakers. Universities should establish environmental departments (if they do not have them already) to teach and do research also on solid waste, its impact on the environment and its good management. Beneficiaries receiving humanitarian support could also be sensitized on the safe disposal of the packaging or items.

	This solution, however, needs to go hand in hand with basic SWM infrastructure creation, e.g. providing public and household bins, so that the newly acquired knowledge can be actually put in practice.
Increase technical capacities	The need for technical capacity building was highlighted by all research participants, including businesses, government, academia, health facilities, and HOs, to improve their SWM practices and approaches. Business representatives also expressed interest in exchange visits learning opportunities
Ensuring waste segregation	Waste transformation and valorisation is much challenged by the absence of waste segregation. Inadequate or non-existing waste sorting is practiced by multiple actors, including households, businesses, government and HOs. Moreover, there are no businesses or facilities that would address this gap at a secondary stage once waste is collected from its producers. To address this, the respondents suggested to demand local governments to promote and demand waste sorting at the household level, as well as provide bins for the purpose. Another proposition is to establish a waste sorting station.
Establishment / strengthening of SWM infrastructure, incl. waste valorisation businesses	After the population is sensitized and the practice of waste segregation is being adopted, the research participants agree that the next step is to strengthen SWM infrastructure and establish waste transformation businesses. The current SWM capacities of the government and businesses need to be strengthened first in terms of the capacity to collect and transform waste. This requires the placement of a sufficient number of household and public waste bins that can accommodate segregated waste. Households that are not accessible by road need to have an assigned waste collection point. Next, actors that specialize in all aspects of the whole SWM chain need to be established and strengthened in terms of capacity and technical knowledge. Local governments and waste collection businesses need to be equipped with a sufficient number of vehicles that fulfil the necessary safety standards. The proprietors need to be well trained in the management of these vehicles, as this was one of the issues identified due to which some actors struggle with the availability and size of waste collection fleets. The establishment of safe, secure and accessible (distance, road quality) landfills that are monitored and fulfil good environmental standards is crucial and one of the biggest challenges. Waste collectors should be also equipped with sufficient tools and PPE. Some waste collectors complain the current landfills are far and suggest establishing public transit waste collection points/landfills within their cities to aid the waste evacuation process and render it more efficient. However, identification of an available space may be challenging in crowded cities. Suitable and strategic waste transformation value chains need to be identified, infrastructure built, and key

	relationships established. Waste processors are a vulnerable link in the SWM chain, and they need to be supported and protected to ensure their functionality, incl. through enabling them to receive sorted and good quality waste and establishing them at the market to find final users of their products.
Strengthening government's involvement and governance	The general view is that the government should strengthen the promotion and governance regarding SWM. First, the technical capacities needed need to be attracted and thorough handover procedures followed during staff circulation. Internal management of SWM assets should be ensured by adding clauses to agreements and handovers. Required legislation should be put in order, passed and promoted, and management of funds strengthened. At the community level, households should be obliged to follow correct practices with the support of awareness raising and repercussions. Local governments should identify safe spaces for SWM, such as landfills and transformation businesses. They should also create a good business environment and policy to stimulate the SWM enterprises to get involved, enable them to maintain their operations, as well as encourage them to grow and develop. Moreover, the government should create synergies and connect all SWM actors, projects and initiatives for efficient management. The government should also establish a waste monitoring system to e.g. monitor and limit the amount of waste entering countries from abroad, but also the waste generated and managed within. Government representatives should set a good example through their own behaviour.
Strengthen coordination of SWM actors	There are no coordinating platforms that would engage decision-makers, civil society, academia, businesses and HOs established. As such, frameworks for discussion and consultation on SWM should be established to promote the issue and its coordination. Moreover, SWM actors themselves need to change their mentality of working solo but find linkages and establish coordination with other businesses in the value chain. PPPs need to be created and strengthened. Some respondents also raised the potential for cross-border or regional cooperation in waste management, as it is a joint problem for the countries in the region. As for the Has, cluster members can also adopt a coordinated approach to SWM durable solutions and multisectoral response, as well as include the topic into their exit strategy plans.
Funding	Financial resources to finance all the solutions mentioned by the respondents are key for any progress. Funding needs to be identified and secured.
HOs set an example	SWM should be promoted by HOs as a cross-cutting issue the same way as GESI, PSEA, protection and accountability

	have been, as multiple sectors are waste producers. HOs also need to start monitoring waste, as well as including the topic in e.g. distribution PDMs. Once the data is collected, they need to use it, devise strategies to address the issues, and learn from it. HO staff themselves should set good example and not throw waste on the ground for example in IDP camps. Their equipment and office waste should be well disposed of, e.g. by contracting a waste collector engaged in waste transformation or linked to waste transformer(s). Moreover, clusters could facilitate the awareness and connection of HOs with various waste transformation businesses to support their waste management. Clusters could also initiate a coordinated approach to SWM durable solutions and include this topic into exit strategy plans. Furthermore, they could update relevant global indicators to factor in more SWM considerations and work on more comprehensive guidelines on SWM solutions within various sectors (e.g. pilot scale study of refuse derived fuel (RDF) in Istanbul, Turkey[300]).
Strengthen monitoring and data collection	Monitoring systems at different levels (government, businesses, communities, HOs) need to be set up to understand waste streams, including identification, quantification and management of waste at every level.
Engagement of universities to strengthen research and innovation	Governments, businesses and HOs should form strong connections with academia to leverage their experience and expertise to improve SWM legislation and practice, while providing incentives and opportunities to do research and test innovative approaches and solutions. Academia should be involved in all big SWM projects to provide technical support but also to conduct research and gain expertise. Some of them are already tackling the topic of bio-based and sustainable solutions and they can thus become leaders in identifying and promotion of local solutions. For example, UNIGOM work on prototyping and optimization and their research areas include green energy, SW composting, and bio-based innovations. They are currently working on projects such as biodegradable waste for energy production and optimization of existing practices, e.g. microbiological considerations to speed up biogas production. Other examples are UNIPOD under University of Juba, which research bio-products creation from organic waste, or FabLab Ecowaste at UEA that have already several research projects ongoing and are applying approach of presentation of an economic model of prototyped SWM solutions. already several research projects are ongoing and are applying the approach of presentation of an economic model of prototyped SWM solutions.

[300] More can be read in: Mustafa Kara, Esin Günay, Yasemin Tabak, Şenol Yıldız. Perspectives for pilot scale study of RDF in Istanbul, Turkey.
Waste Management, Volume 29, Issue 12, 2009, Pages 2976-2982. ISSN 0956-053X.
https://doi.org/10.1016/j.wasman.2009.07.014https://doi.org/10.1016/j.wasman.2009.07.014.

Production of fertilizer / compost	Fertilizer and compost production was noted as a concrete example of waste valorisation that can be easily practiced even at a household level and that tackles one of the most notorious types of waste available.
Items from biodegradable materials	The term “bio-based solution” was not well known to most research participants and, not surprisingly, not many mentioned such approaches as a solution, albeit some of them did. Apart from fertilizer production from organic waste, the other bio-based solutions mentioned was substitution of current materials, such as polyethylene, polymer and petroleum products, with biodegradable ones. The items suggested to be substituted included plastic bags, plates and sacks. Some examples of using biodegradable packaging included usage of biodegradable sisal bags and paper plates and packaging.

8. Conclusions

8.1 Characterization of waste in humanitarian context

8.1.1 Humanitarian waste as complex issue

- Finding innovations for humanitarian waste without considering the entire context of waste in humanitarian settings does not make sense and can be counterproductive. See the following reasons:
    - Interconnected Waste Streams:

Humanitarian and general waste often enter the same waste streams, making it difficult to separate and manage them independently. The humanitarian waste, unless branded, is unrecognizable from general waste. Moreover, with the no-logo and cash whenever possible trends in humanitarian sector, the distinction of humanitarian waste and general waste will be almost impossible in the future. Innovations must account for the broader waste management infrastructure to be effective.

    - Comprehensive Impact:

Addressing only a portion of the waste problem might shift the burden rather than solve it. For example, replacing plastic with another material without considering the local waste processing capabilities might lead to other environmental issues.

    - Sustainability and Scalability:

Innovations need to be sustainable and scalable across different contexts. A solution that works in one area might fail in another if the entire waste ecosystem is not considered. Understanding local practices, infrastructure, and cultural attitudes toward waste is crucial.

    - Regulatory and Policy Frameworks:

Waste management is often governed by local regulations and policies. Innovations must align with these frameworks to be implemented effectively and legally. Ignoring these aspects can lead to non-compliance and ineffective waste management.

    - Resource Optimization:

Humanitarian settings often operate with limited resources. A holistic approach ensures that innovations are resource-efficient and do not inadvertently waste materials or effort by focusing too narrowly on one aspect of waste.

- Beneficiary Involvement:

Beneficiaries' behaviours and practices are integral to the success of waste management innovations. Solutions must be designed with input from the communities they serve to ensure they are practical and adopted widely.

- Environmental and Health Impacts:

Waste innovations must consider the overall environmental and health impacts. For instance, replacing one type of waste with another might reduce pollution in one form but increase it in another if not carefully planned.

8.1.2 Waste quantification and categorisation

- Quantifying and categorizing the humanitarian waste and general waste is difficult, as the destination countries of humanitarian aid lack mechanisms to monitor waste; research literature on the topic is scarce; and HOs do not have SWM agenda unified under the responsibility of one staff but it is rather a cross cutting issues handled by various staff at different levels. While there are newly developed methodologies (e.g. WREC) for HOs to implement e.g. waste audits, surveys, observations, and waste weighing exercises, the following challenges remain too significant for HOs to effectively implement them:
  - Lack of infrastructure and resources (funding and personnel) for accurate waste measurement);
  - Mixed waste streams (see above *8.1.1. Humanitarian waste as complex issue*);
  - The data collection methodologies vary significantly across the humanitarian sector leading to inconsistent and unreliable data;
  - Humanitarian settings are often dynamic, with rapidly changing populations and conditions, making continuous and accurate waste quantification challenging.
- The UNEP Global Waste Management Outlook provides some data about municipal solid waste composition. In Sub-Saharan the municipal solid waste is 57% organic, 13% plastic, 9% paper, 4% metal, 4% glass, 13% other. Research participants confirmed that the most ubiquitous waste is organic and plastic.

8.2 Sustainable SWM trends

SWM policies and guidelines have evolved to incorporate sustainable practices. The primary sustainable SWM models include the SWM hierarchy and Integrated Solid Waste Management, circular economy and green procurement.

8.2.1 Main Trends in SWM

- Focus on Sustainability:
  - HOs have been increasingly focusing on integrating sustainability into their SWM policies and practices to minimize environmental impact (in line with donors' requirements, such as e.g. DG ECHO's MERS) and

promote resource efficiency. This includes measures to reduce, reuse, and recycle waste. For example, the UNHCR lately published guidelines[301] emphasize e.g. the reduction of plastic waste and the valorisation of bio waste.

- Sustainable Practices:
  - HOs have started adopting sustainable waste management practices such as composting organic waste, using renewable energy sources for waste treatment, and promoting the use of eco-friendly materials.
- Circular Economy Principles
  - Closed-Loop Systems: Implementing circular economy principles involves creating closed-loop systems where waste materials are reused or recycled back into the supply chain, reducing the need for virgin resources.
- Resource Efficiency:
  - Efforts to maximize resource efficiency include optimizing logistics to reduce waste generation, improving the durability of humanitarian aid items, and promoting the refurbishment and repurposing of materials.
- Green Procurement
  - Environmentally Preferable Purchasing: Green procurement involves selecting products and services that have a lower environmental impact throughout their life cycle. This includes using suppliers that adhere to environmental standards and certifications. HOs are updating their procurement policies to prioritize eco-friendly products, reduce single-use plastics, and incorporate recycled and biodegradable materials.
- Supplier Engagement:
  - Engaging suppliers in sustainability efforts ensures that the materials and products they provide meet the organization's environmental criteria. This includes requiring suppliers to provide information on the environmental impacts of their products.
- Innovative Approaches and Technologies
  - Use of Technology: Advanced technologies like GIS mapping, mobile data collection apps, and automated waste sorting systems can be employed to enhance waste management efficiency and accuracy.
  - Behavioural Change Initiatives: Programs aimed at changing the behaviours of beneficiaries and staff regarding waste management practices are crucial. This includes education campaigns on waste reduction, proper disposal, and the benefits of recycling.

8.3 SWM in DRC and South Sudan

- Waste collection infrastructure and services are very limited and can be found only in urban areas. The capacity of the existing services is very low – in Bukavu it is estimated that less than 10% of generated waste is evacuated to a landfill. Most services in DRC are provided by private sector, usually under PPP with local government, while in South Sudan waste transformation services are carried out by the local government, private sector and JICA.

[301] UNHCR. (2024). Guidelines for the Safe Disposal of Solid Waste in Humanitarian Contexts. Retrieved from https://www.unhcr.org/sites/default/files/2024-04/guidlines-for-safe-disposal-of-solid-waste-in-humanitarian-contexts.pdf.

- There are virtually no safe landfills that would fulfil basic environmental standards.
- Most waste ends up being disposed of in the streets, water channels, and spontaneously created dumpsites. Over time it enters waterways, including rivers and lakes. Burning is another waste removal strategy.
- Waste of good quality is reused by the population due to poverty and need. Types of waste that are reused include plastic bottles, sachets and sacks, metal containers and carton.
- Very few wastes are recycled because there are either no recycling businesses or their capacity is limited, and they lack machinery. Some waste (metal, aluminium, plastic) is transported by informal waste pickers to Uganda, Rwanda and Burundi for recycling.
- Management of humanitarian waste that enters humanitarian context is dependent on the SWM systems, services and facilities in the aid recipient country. There is no separate waste management mechanism set up by HOs. Moreover, there are few SWM initiatives supported by HOs and those that exist are mostly pilot and small-scale projects.

8.4 Risks associated with waste in humanitarian context

- The risks associated with waste in humanitarian setting include negative impact on public health, environment, climate, and public health.
- The risks identified by research respondents additionally included impact on livelihoods, heightened exposure of children and conflict with neighbours.

8.5 SWM challenges in humanitarian context

- There is a lack of SWM infrastructure and services (e.g. recycling) with either non-existent or nascent official waste transformation system.
- There is a general lack of financial resources on the side of governments and HOs to finance (sustainable) SWM.
- National policies regulating SWM either lack or are not sufficiently enforced and coordination among authorities on SWM is weak. The government does not plan strategically for SWM and often poses barriers to private SWM businesses that are trying to fill in the gap.
- There is a lack of coordination among SWM stakeholders (including HOs) and actors tend to work in silos, e.g. waste collectors do not create linkages with waste transformers.
- HOs lack financial and human capacities and policies to implement sustainable SWM. Moreover, this topic is not prioritized by HOs. There is also a lack of sustainable humanitarian procurement/supply chains.
- The technical capacity of all actors in SWM is low.
- There is a general lack of quality waste data, monitoring and research both on the side of governments, academia, private sector and HOs, which affects the understanding of the problem and searching for sustainable solutions. This is exacerbated by the fact that academia is not much involved by the governments to support SWM policymaking and implementation.
- Armed conflict negatively affects the SWM infrastructure and services.

8.6 Solid waste opportunities in humanitarian context

- To reduce waste in humanitarian context, the preferred solution is waste prevention and reduction towards zero waste/waste minimization and circular approach given the weak state of SWM infrastructure. The second step is the establishment of official and good quality reuse and recycling systems that can transform waste into a resource and energy.
    - Include the large informal sector and support its professionalization and formalization;
    - Involve local regulators/authorities who will be actively promoting new technologies;
    - Support the development of local, grassroots waste entrepreneurs;
    - Create resilient, localized (independent from global markets) waste-to-resource business models that support the development of local circular economies.
- Involve multiple stakeholders and secure funding, ideally with investment and participation from private sector to create safe and accessible disposal sites and sustainable packaging/materials, e.g. eco-design tarpaulins for emergency shelters, latrine covers, walls and fences.
- Establish data collection and monitoring mechanisms as well as digitalization to strengthen waste management value chains.
- Research participants also highlighted the following:
    - It is important to prioritize sensitization of all stakeholders to change the mentality of low responsibility and increase the overall knowledge of why good SWM practices are important and their positive impact on individuals;
    - Build technical capacities of governments, academia, private sector and HOs to increase their ability to plan and implement good SWM;
    - Governments need to promote and require waste segregation at household level to encourage further SWM;
    - Coordination among various SWM needs to be strengthened and links across the SWM chain created;
    - HOs need to set an example by prioritizing SWM and promoting it as a cross-cutting issue. They need to strengthen monitoring of their waste and use the data to address waste creation. Clusters can be engaged as promoters of SWM through promotion of durable solutions and including the topic into relevant global indicators;
    - Local research actors and academia should be more engaged by governments, businesses and HOs. The existing research and initiatives should be supported to enable the creation and implementation of local solutions as well as the capacity growth of local academia actors.

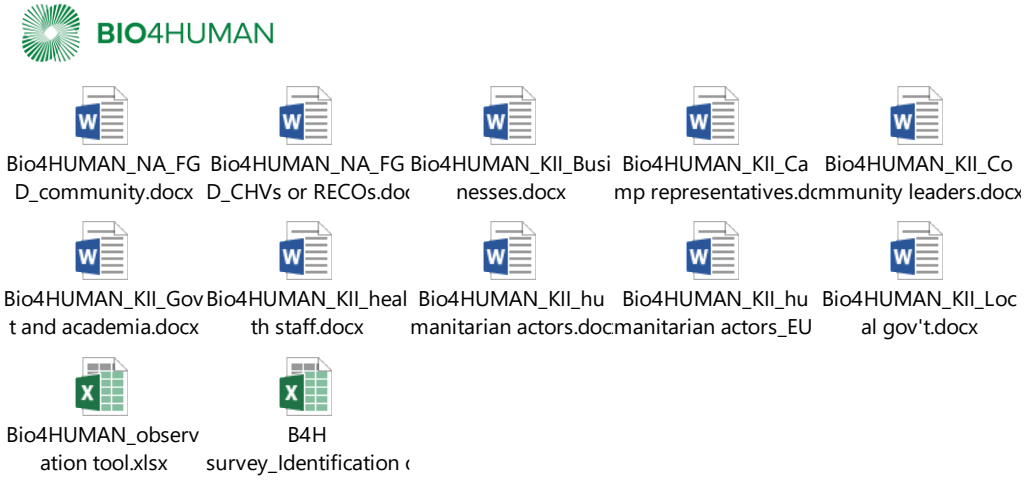
8.7 Bio-based solutions in humanitarian contexts

- Humanitarian sector has been searching for sustainable alternatives to packaging and the identified options include: 1) biodegradable plastics, 2) compostable plastics, 3) bio-based plastics, 4) bio-regenerative materials, 5) natural fibres, 6) cardboard/paper, 7) recycled plastic packaging, 8) oxo-degradable plastics. This is an indicative list that should be considered as potential solutions, but attention should also be paid to making more systematic shifts.

- The potential application of bio-based solutions might go beyond packaging, such as for example for construction material (e.g. mycelium composites for insulation panels, bricks, and other structural components for shelters); energy production (e.g. bioenergy such as biodigesters converting organic waste into biogas); water purification (e.g. bio-based water filters from e.g. natural fibres); agriculture and food security (e.g. bio-fertilizers and soil enhancers from compost and other organic waste products); healthcare and medical supplies (e.g. biodegradable medical supplies from bio-based materials); or textiles and clothing (e.g. sustainable textiles from e.g. natural fibres). The application of bio-based solutions in humanitarian settings faces significant challenges. Higher costs and limited availability of bio-based materials pose barriers to their widespread adoption. Ensuring that these materials perform reliably under diverse and harsh conditions typical of humanitarian contexts, such as maintaining biodegradability, is crucial. Additionally, the effective implementation of bio-based materials requires adequate infrastructure for processing and utilization, which is largely lacking in humanitarian settings. In order to make the application of appropriate bio-based solutions effective and sustainable, the involvement of local actors is necessary, including local suppliers.
- Most research participants were not familiar with the term bio-based solutions. Those familiar with the concept worried their implementation would be complicated, slow, costly and would require a change of attitudes and behaviour as well as having local actors ready to provide such solutions. The two bio-based solutions that the research participants were in favour of include creation of compost / fertilizer form organic waste and replacement of plastic items (e.g. bags, sacks, plates) by those made of biodegradable materials, such as paper and sisal.
- The few HO projects that were identified as implementing bio-based practices were small-scale pilot initiatives whose activity did not continue beyond projects' termination. The activities included production of organic fertilizer from household waste and crop residues, transformation of biomass into fertilizer and biogas in biogas digesters, transformation of charcoal dust into briquettes for cooking, and bio-charcoal production form sugarcane husks. The only bigger project is implemented by a research institute – IITA – and focuses on returning organic waste back to fields as a fertilizer by linking farmers, waste collectors and waste transformers.
- Local bio-based practices identified included animal feed production (BSF larvae feeding on organic waste), biogas production in biodigesters, bio-charcoal production from different wastes (carton, mixed organic household or field waste), production of compost / fertilizer form organic waste, ignition stimulant production from paper waste, and mushroom growing on agricultural waste.

Annexes

Annex 1 – Qualitative & quantitative research tools in English



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