# WORM

**Waste in humanitarian Operations:**
Reduction and Minimisation

# D1.1. Scoping exercise

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Author(s): **Tuomala, Virva; Barnhoorn, Claire; Joseph, Sarah; Juusela, Ville; Kiong Kok, Seng; Mellem, Nadine; Rocheteau, Margot; Tran, Duc Trinh; Uppstrøm Pankratov, Therese Marie**

Institution: **Hanken (FI), Solvoz (NL), KLU (DE), FRC (FI), RMIT (VN), Innovation Norway (NO)**

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## LIST OF ACRONYMS

| ACRONYM | FULL NAME |
|---|---|
| ADB | Asian development bank |
| CLD | Causal Loop Diagrams |
| EPA | Environmental protection agency |
| EPP | Environmentally Preferable Purchasing |
| ERP | Enterprise Resource Planning |
| ESPR | Ecodesign for sustainable product regulation |
| EU | The European Union |
| FEFO | First Expired First Out |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| GPP | Green Public Procurement |



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| | |
|---|---|
| HDPE | High-density Polyethylene |
| HIV | Human Immunodeficiency Virus |
| HNPW | Humanitarian Networks and Partnerships Week |
| HOs | Humanitarian Organisations |
| IHOs | International Humanitarian Organisations |
| IV | Intravenous |
| JI | Joint Initiative on Sustainable Humanitarian Packaging and Waste Management |
| KPI | Key Performance Indicators |
| LCA | Life Cycle Assessment |
| MW | Medical Waste |
| MWM | Medical Waste Management |
| NGOs | Non Governmental Organisation |
| NHS | UK National Health Service |
| OECD | Organisation for Economic Co-operation and Development |
| OR | Operations research |
| PHA | Polycaprolactone |
| PCL | Polycaprolactone |
| PP | Polypropylene |
| PPE | Personal Protective Equipment |
| RCNS | Red Cross National Society |
| RFP | Request for Proposals |
| RFQ | Request for Quotations |
| SME | Small and Medium sized Enterprises |
| SOP | Standard Operating Procedure |
| SPP | Sustainable Public Procurement |
| SWM | Solid Waste Management |
| UN | United Nations |



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| | |
|---|---|
| UNEP | Untied Nations Environment Programme |
| US EPA | United States Environmental Protection Agency |
| USAID | U.S. Agency for International Development |
| WHO | World Health Organization |
| WM | Waste Management |
| WORM | Waste in humanitarian Operations: Reduction and Minimization |
| WP | Work Package |
| WREC | Waste management and Reverse Logistics, Environmentally sustainable measuring and transport, and Circular economy |

## LIST OF PARTNER ACRONYMS

| ACRONYM | FULL NAME |
|---|---|
| ACF | Action Contre la Faim |
| CRS | Catholic Relief Services |
| FRC | Finnish Red Cross |
| Hanken | Hanken School of Economics |
| ICRC | International Committee of the Red Cross |
| IMC | International Medical Corps |
| KLU | Kuehne Logistics University |
| NRC | Norwegian Refugee Council |
| PSA | Pamela Steele Associates |
| VNRC | Vietnamese Red Cross |

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# BACKGROUND ABOUT WORM

WORM aims to design guidelines and support actions for circular economy in the humanitarian sector. It integrates bio-based technological solutions, leverages procurement for waste reduction, improves waste management methods and prioritises the sustainable livelihoods of waste pickers. WORM focuses on two selected settings: field hospital deployments and humanitarian livelihood programmes with a waste picking component. Following a collaborative and multi-actor approach, WORM brings together medical and humanitarian organisations, procurement service providers, logistics providers, waste management services and academic partners.

# EXECUTIVE SUMMARY

This document is a deliverable of the WORM Project, funded under the European Union's Horizon Europe research and innovation programme under the grant agreement No 101135392.

The aim of this document (D1.1) is to serve as the baseline for the project. As a scoping exercise, it set out to (1) define the product groups that will be prioritised throughout the project, (2) collect data for further waste stream analysis, and (3) assemble the extant procurement practices of WORM end users as relevant for the project.

WORM's priority products have been defined as Personal Protective Equipment (PPE) and particularly gloves, facemasks, surgical gowns and protective boots; syringes and needles; sharps containers (bins), plastic body bags; and temporary water/sludge bladders. These are relevant for the mandate and scope of the project with regards to a field hospital setting, and are such where bio-based alternatives would potentially have a significant impact on the waste generated in these settings.

Procurement being both a gatekeeper for products and materials, and a gateway for innovation, it is one of the main focus areas of the WORM project. For this scoping exercise, the procurement guidelines and documents from WORM end users have been collected, and various workshops run on both innovative, and sustainable procurement. In parallel, waste streams have been analysed from field hospitals on the basis of what is being delivered to a field hospital in the first place. Next deliverables and work packages will use the insights from this scoping exercise as their basis, elaborating more on the details of procurement, innovation, waste management in field hospitals, and also livelihoods programmes for waste pickers.

# NON-TECHNICAL SUMMARY

WORM seeks to find bio-based alternatives in a humanitarian context, in order to reduce the environmental impact of humanitarian operations. Two areas are particularly relevant to WORM: field hospital deployments, and livelihood programmes for waste pickers. This deliverable reports on the results of a scoping exercise. The results will guide the rest of the project.

The scoping exercise has resulted in setting priorities for which product groups WORM shall focus on. These are personal protective equipment, syringes and needles, sharps containers, body bags, and temporary water/sludge bladders. WORM is focusing at the same time on procurement practices to be able to find bio-based alternatives for these product groups, and on the waste treatment alternatives for these products.

# 1. INTRODUCTION

Climate change is a main driver for humanitarian need. Yet, humanitarian operations contribute to environmental pollution and degradation; disaster relief rarely leaves time to consider long-term consequences, and IHOs face frequent criticism for their lack of environmental policies despite their do-no-harm mandate (Brangeon & Crowley, 2020). Waste management (WM) is an integral part of the environmental sustainability of a humanitarian operation. WM is a complex area as it involves not only a myriad of organisations and sectors within IHOs, but also private sector actors and contextual infrastructure (Tuomala et al., 2022). IHOs further burden WM in disaster relief areas, and issues with WM were identified in almost all phases of the humanitarian operation (Corbett et al., 2022). Responding to these challenges, in 2022, DG ECHO introduced its new humanitarian logistics policy, which aims to make the delivery of humanitarian aid more efficient, effective, and green (European Commission, 2022).

Humanitarian supply chains generally function in linear manner, as portrayed in Figure 1. The short-term thinking related to the HSC functions leads to wasteful practices related to waste disposal, transportation, sanitation, and energy provision (Corbett et al., 2022).


*Figure 1 Linear supply chain model*

WORM's overall objective is designing guidelines and support actions for circular economy in the humanitarian sector. WORM focuses on two selected settings: field hospital deployments, and humanitarian livelihood programmes with a waste picking component. Across these settings, the project emphasizes several cross-cutting focus areas exemplified in Figure 2.

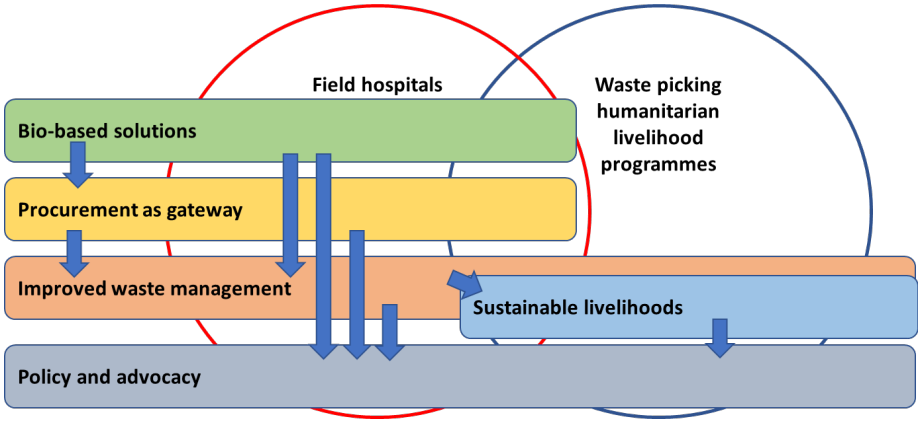


*Figure 2 WORM focus areas*

WORM seeks to identify appropriate bio-based technological innovative solutions for the humanitarian context, focusing on high priority product groups from a scoping exercise. Particular attention is paid to bio-based alternatives to single-use items such as packaging materials, plastic film, and PPEs as well as items that have previously been incinerated. WORM evaluates their sustainability from an environmental (LCA), technical, social and economic perspective. WORM recognises trade-offs between biodegradability



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and durability for preparedness, hygiene requirements in health and humanitarian operations, as well as the opportunity costs of raw material choices with regards to food security (for e.g. starch-based bioplastics) and deforestation (for cellulose-based bioplastics); as well as potential implications of changes in materials on the livelihoods of waste pickers.

Recognizing trade-offs and unintended consequences, WORM develops policies and mitigation strategies for the use and usability of bio-based solutions in the humanitarian context. WORM further incorporates technical specifications for bio-based solutions in procurement practices, to support comparative bid analyses for the integration of these solutions in humanitarian procurement. After all, procurement is a gateway for both refusing harmful materials and replacing them with recyclable and bio-based solutions. Further innovative circular economy solutions are identified from local contexts, and WORM develops guidelines and policy recommendations for the scaling up of sustainable, circular business models. For a field hospital setting, WORM further develops SOPs for the use, reuse, maintenance and repair, repurposing, recycling, refurbishment and reverse logistics of various materials, components, and products; and even for the handover and recovery of field hospitals and their materials. Furthermore, WORM evaluates different waste treatment methods as alternatives to otherwise toxic incineration techniques that are currently in use, and a set of WM guidelines and policy recommendations for field hospitals. Further WM guidelines and even local awareness campaigns are developed for livelihood programmes, highlighting the crucial role of informal waste-pickers. WM practices involve many different sectors in addition to informal waste-pickers, so fostering collaboration and sustainable innovation between sectors in order to create new business models is also an objective for WORM.

This very deliverable (D1.1) reports on the findings of a scoping exercise that lays the foundation for the rest of the project (see Gantt chart). The overall project is organised in 6 content work packages (WPs), two communication and two project management WPS.

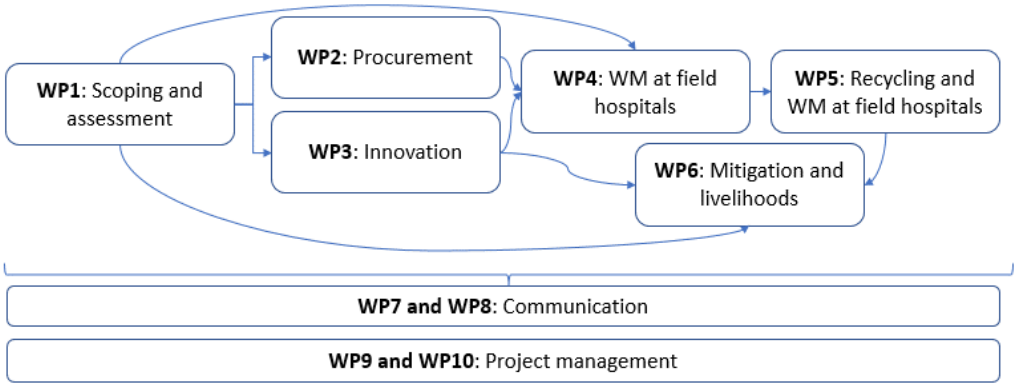


*Figure 3 Project Gantt chart*

Further work such as LCAs and viability assessments will also be undertaken in WP1, but crucially, it is this first scoping exercise that establishes a common understanding and common priorities throughout WORM.

# 2. LITERATURE REVIEW

## Medical waste management

The World Bank estimates that global waste could increase by up to 70% from current levels by 2050 if waste management processes are not urgently improved. Additionally, at least 33% of waste is currently mismanaged through open dumping and burning, which disproportionately affects poor communities worldwide (World Bank, 2022). Transitioning to a circular economy approach in waste management,



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which discourages excessive use of raw materials and waste generation through technological and biological loops, could yield significant positive outcomes. Within these loops, specific types of waste (both organic and inorganic) can be repurposed as resources for further development. For instance, many regions generate vast amounts of solid waste annually, yet their ability to use circular methods, such as waste-to-energy, remains limited due to inadequate infrastructure, technology, and knowledge.

Medical waste poses particular challenges for waste management due to its infectious, pathological, and toxic nature. Improper treatment or disposal can lead to health hazards and significant environmental damage. In many developing regions, the general infrastructure for waste management, especially for medical waste, is often insufficient for proper treatment, including specialized warehousing, sorting, and incineration, as well as circular economy activities. Medical and healthcare waste is also generated in various settings, such as hospitals, health centres, dental offices, research institutes, laboratories, and even private homes where residents require specific medical care. While most healthcare waste is non-risk, such as packaging and food waste, an estimated 15% is considered hazardous (WHO, 2018). On average, 0,5kg/bed and 0,2kg/bed of hazardous healthcare waste is produced in developed and developing countries respectively (WHO, 2018). This includes infectious waste, sharps, pathological waste, and pharmaceuticals.

On average, 0,5kg/bed and 0,2kg/bed of hazardous healthcare waste is produced in developed and developing countries respectively (WHO, 2018). In Table 1 the classification of waste is presented, with non-risk waste as its own category and the different categories of risk waste specified. In a humanitarian aid context, these averages per bed may be larger, as medical care and equipment such as PPE become a necessity and the need for care increases.

*Table 1 Waste categories and descriptions*

| Waste category | Description |
|---|---|
| Non-Risk waste | Paper & cardboard, packaging, food waste, aerosols, and so on |
| Infectious waste | Waste contaminated by any type of pathogens and includes cultures from laboratory work, waste from surgeries and autopsies, waste from infected patients, and discarded or disposable materials |
| Pathological waste | Tissues, organs, body parts, fetuses, blood, and body fluids |
| Sharps | Including – whether infected or not – needles, syringes, scalpels, infusion sets, saws & knives, blades, broken glass, and any other item that could cut or puncture |
| Pharmaceutical waste | Expired or unused pharmaceutical products, surplus drugs, vaccines or sera, and discarded items |
| Genotoxic waste | Used in handling pharmaceutical waste such as bottles, boxes, gloves, masks, tubes, or vials |
| Chemical waste | Cytotoxic drugs and outdated materials, vomitus, feces, or urine from patients treated with cytotoxic drugs or chemicals and materials such as syringes and vials contaminated from the preparation and administration of such drugs |
| Radioactive waste | Chemicals from diagnostic and experimental work, cleaning processes, or housekeeping |



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In Global North countries, such as Finland, there are stringent guidelines for the treatment and disposal of MW (Ympäristöministeriö, 2023). In contrast, regulations in the Global South are often lenient or absent, and compliance varies significantly between institutions. There is also a general lack of awareness about the different hazards and risks associated with improper waste management (Ali et al., 2017).

The management of medical and healthcare waste in the Global South is a multifaceted challenge, exacerbated by factors such as population growth, inadequate infrastructure, and limited resources (Khan et al., 2019). The COVID-19 pandemic has intensified challenges in MWM, with studies showing a surge in hazardous waste generation. For instance, cities like Manila, Bangkok, and Hanoi reported generating an additional 154 to 280 tons of MW per day during the pandemic, which, combined with disrupted services due to lockdowns, created significant waste management issues (You et al., 2020). The necessity for sustainable management approaches during pandemics is underscored by the increased risks and strain on resources in both the Global South and North (Adelodun et al., 2021). Ali et al. (2017) point to infrastructural deficiencies that lead to improper segregation, collection, and disposal of healthcare waste. The WHO (2014) estimates that up to 64% of medical facilities in the Global South lack adequate MWM facilities, contributing to environmental pollution, public health risks, and the spread of infectious diseases.

Globally, the most common methods for MWM are incineration and sanitary landfills (Hong et al., 2018). However, incineration without proper equipment, such as pollutant-capturing filters, results in the emission of toxins and heavy metals, in addition to other environmental consequences. There are stringent standards for these emissions in many Global North contexts (e.g., Ympäristöministeriö, 2023). Other MWM methods include chemical disinfection, autoclaving, microwaving, and encapsulation (Singh et al., 2020). Autoclaving, a heat-based and safe process, is becoming increasingly popular but remains out of reach in many areas due to its high cost (Rożek et al., 2019).

Table 2 presents an overview of different waste disposal methods, which are in frequent use in the medical sector both in permanent hospitals as well as field hospitals. As part of improving WM in the humanitarian sector, WORM will complete LCAs on the different types of options using data obtained from end users and waste management experts.

*Table 2 Waste disposal technologies*

| Technology | Description |
|---|---|
| Incineration | Incineration is the controlled burning of medical waste at temperatures between 900 and 1000 degrees Celsius, utilizing equipment such as air pollution control systems and secondary combustion chambers (Diaz et al., 2005). |
| Microwaving | Microwaves are electromagnetic waves with frequencies in between radio and infrared waves. The high frequency causes the liquid or solid molecules in the receiving body to vibrate quickly to align with the shifting electromagnetic field. Compared to incinerators, microwaving medical waste could be more cost-effective, however, large-scale treatment is not a good fit for microwave technology (Hossain et al., 2011). |
| On-site steam sterilization (Autoclaving) | Pressure, heat, and moisture are applied to inert microorganisms during the steam autoclave treatment process. Convenience and reduced hazards to the environment and public health are the main benefits of on-site healthcare waste treatment, which is achieved by containing hazardous medical waste on the hospital grounds. |
| Off-site steam sterilization | Larger units can achieve more cost-effectiveness in off-site centralized healthcare waste treatment, provided that the operating expenses for trash collection and transportation does not increase significantly. |



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|---|---|
| Landfilling | Landfilling is a popular method because of the low cost and easy operation in waste management. However, landfilling of healthcare wastes can be a potential threat to human health and the quality of the environment because of infectious content. |

## Bio-based and biodegradable products

In medical settings, particularly in humanitarian field hospitals, the choice between biobased and biodegradable materials is crucial for balancing sustainability and functionality. Biobased materials, derived from renewable biological sources such as corn starch, sugarcane, or cellulose, offer the advantage of reducing dependency on fossil fuels and minimizing the carbon footprint. These materials can be used to create a variety of medical products, including packaging, disposable utensils, and certain medical instruments. For instance, polylactic acid (PLA), a common biobased polymer, is used to manufacture biodegradable sutures and drug delivery systems due to its biocompatibility and ability to degrade into lactic acid, which is naturally metabolized by the body (RameshKumar et al., 2020).

On the other hand, biodegradable materials are designed to break down more quickly in the environment through natural processes involving microorganisms (RameshKumar et al., 2020). This characteristic is particularly beneficial in settings where waste management infrastructure is limited or non-existent. Materials such as PCL and PHA are examples of biodegradable polymers that can be used for medical applications like wound dressings and temporary implants. In the context of humanitarian field hospitals, biodegradable materials can help mitigate the environmental impact of medical waste, which often poses significant disposal challenges.

However, it is essential to consider the performance and safety of these materials. For instance, biodegradable polymers must have sufficient tensile strength, biocompatibility, and sterilizability to be suitable for medical use. While biodegradable materials are advantageous for reducing waste, they must still meet stringent medical standards to ensure they do not compromise patient safety or the effectiveness of medical procedures. Therefore, the ideal approach might involve integrating both biobased and biodegradable materials to maximize environmental benefits while maintaining the high standards required in medical care (VTT, 2023).

Contrary to general assumptions, biobased materials do not necessarily start to biodegrade earlier or quicker than other materials. Rather, their (bio)degradability often needs to be induced.

## Field hospital contexts

In most cases hospitals provide a certain level of medical care to communities (Fardi et al., 2022). However, disasters might have a devastating impact on hospital capacities, and may also create a significant increase in patients (Fardi et al., 2022; Salman & Gül, 2014). In such conditions, both hospital emergency care capacities and transportation would be insufficient and need to be supplemented with external assistance (Salman & Gül, 2014). Therefore, field hospitals play a critical role in providing medical care during humanitarian crises, such as natural disasters, conflicts, and disease outbreaks.

Field hospitals are defined as temporary medical facilities, designed to deliver rapid and urgent healthcare services in areas where existing infrastructure is insufficient or has been disrupted (Fardi et al., 2022; Tekin et al., 2017). They are positioned strategically, in pre-determined and safe zones close to affected areas or established hospitals and therefore play a critical role in addressing medical needs (Tekin et al., 2017).

Typically deployed within 36-72 hours following an incident, field hospitals can encounter delays attributable to unanticipated events, delayed information sharing, and political constraints (Finestone, 2001). Logistics is also a key component to establish field hospitals, however there may be insufficient



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expertise in mission-specific logistics among involved personnel, resulting in procurement delays and/or logistical setbacks (Burnweit & Stylianos, 2011).

The objectives, organization, staffing, and capabilities of field hospitals vary widely (Finestone et al., 2001). Some are equipped with staff with limited medical expertise, focusing primarily on logistical coordination, while other field hospitals are designed to look after specific populations, such as refugees or prisoners of war, providing shelter and food for large groups. Those in need of advanced medical intervention may require evacuation, while specialized field hospitals provide thorough on-site care (Finestone et al., 2001).

In field hospitals, equipment is catalogued and bought ahead of time, then deployed and assembled by a team of experts that operates under a recognized leadership structure (Burnweit & Stylianos, 2011). Facility development can be more difficult when the sponsoring organization is non-governmental with a constantly changing volunteer workforce and irregularly-provided supplies (Burnweit & Stylianos, 2011). Field hospitals usually lack central supply specialists and qualified staff to organize the warehouse. Similarly, operating room supplies and pharmacy organization tends to slow down the expansion of medical care units (Burnweit & Stylianos, 2011).

In their study, Fardi et al. (2022) identified eight considerations to undertake when setting up a field hospital, displayed in Table 3 below.

*Table 3 Field hospital considerations (adapted from Fardi et al., 2022)*

| Location criteria | Explanation |
|---|---|
| Proximity to transportation hubs | Ensures efficient transfer of displaced individuals to temporary shelters, easy access to medical facilities for patients, quick transfer of victims with acute injuries to permanent hospitals for specialized care, and an effective logistical support via arterial roads. |
| Proximity to existing hospitals | Facilitates quick patient transfers and allow coverage of larger areas, necessitating a balance between overall medical coverage and patient transfer efficiency. |
| Located in provincial capitals | Facilitates access to governmental financial assistance and incentives and logistical support. |
| Geo-environmental factors | Soil firmness (resistance to flooding and landslides), land ownership (preference for government-owned land), and topography (favoring savannahs, valleys, piedmonts, and stream beds for temporary shelters). |
| Located in areas with lower socio-economic status | Enables to be close to populations that often require more medical care. |
| Risk factors | Should be located away from fault lines, rivers, and other high-risk areas as well as gas stations and industrial centers to minimize danger. |
| Close to relevant infrastructures | Enables access to sewage and power systems to ensure sewage treatment systems and avoid hygiene issues. |
| Favor prebuilt locations | If safety conditions are verified, provides access to clean water and a well-designed drainage system, which can mitigate contamination risks. |



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However, despite their essential lifesaving role, field hospitals pose significant environmental challenges; the environmental footprint of hospitals is considerable, particularly concerning the MWM, which poses significant ecological risks (ICRC, 2011). Waste disposal practices are often inadequate, leading to the improper treatment of hazardous materials (WHO, 2018). Adoption of sustainable practices, such as incorporating bio-sourced or biodegradable solutions (which may imply less intense waste treatment), and implementing robust waste management protocols is imperative to mitigate these negative environmental impacts.

## Sustainability and innovation

Given that climate change and environmental degradation drive humanitarian needs and suffering (UN, 2021), HOs are motivated by both internal awareness and external pressures from donors and stakeholders to reduce their environmental impacts in alignment with the "do no harm" principle (Logistics Cluster, 2023) . Many HOs seek to promote sustainability by considering environmental and social factors alongside quality and financial costs. However, while several social criteria (e.g., no child labour) are mandatory, HOs vary in their systematic consideration of environmental sustainability in operational decisions. Implementation remains limited and often lacks systematic integration into practice (Anjomshoae et al., 2023; Tuomala et al., 2022). There is uncertainty about the significance of environmental factors compared to traditional criteria, highlighting the need for better information and support from donors, suppliers, and the wider humanitarian sector. Challenges such as market availability, misalignment with funding opportunities or requirements, and limited resources further complicate efforts to achieve systematic sustainable procurement. Additionally, there is often a lack of awareness and engagement among stakeholders regarding sustainability issues, resulting in resistance to change.

Despite these obstacles, there is a clear acknowledgment among HOs of the need to address the environmental impacts of humanitarian operations, especially considering the significant contribution of production and manufacturing to overall environmental footprints, in addition to the potential implications for social and economic sustainability (ICRC & IFRC, 2021). Proper preparedness and planning, including sourcing sustainable items, can play a crucial role in reducing a HO's environmental footprint, particularly in the early stages of disaster response when swift action is essential (CHORD, 2024).

Sustainability dimensions encompass specific focus areas, laying the groundwork for developing criteria and metrics to evaluate the impact and create change in humanitarian operations. The main sustainability considerations included in procurement guidelines include:

1) resource use and environmental impacts
2) waste management
3) quality and durability
4) efficiency of operations
5) localization
6) social requirements
7) economic viability
8) transparency and accountability

There are an increasing number of innovation projects taking place in the humanitarian sector applying innovation as a methodology to address waste management. However increasing, so far there are only a few, they are small in size, and approaches to sustainable scale is in its early infancy. There is a need to work on developing and implementing business models that can support these efforts scale (Supporting creative business models for innovators in the humanitarian sector, Innovation Norway, 2022). Efforts to introduce innovative procurement procedures in the humanitarian sector also shows that applying performance-based



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specifications leads to an increase in sustainability measures in procurement (IOM, 2023, Innovation partnerships, European Commission, 2023).

### Resource use and environmental impacts

Understanding resource utilization and environmental impacts is fundamental to integrating environmental sustainability into decision-making processes (ACF, 2023). Resources include natural resources like water, land, wildlife, and minerals, as well as materials, electricity, fuel, and other inputs necessary for production and distribution. Each of these processes carries associated impacts, such as GHG emissions, water pollution, or soil erosion. Commonly discussed topics include packaging, reducing emissions, energy efficiency, water use, material choices (including the use of bio-based or biodegradable materials), and the avoidance of hazardous chemicals and materials which may harm the environment during production or at the end-of-life.

### Social responsibility

Sustainable procurement also entails considering social factors such as labour rights, working conditions, and community impacts. This dimension ensures that procurement practices contribute to positive social outcomes, respect human rights, address ethical responsibilities, and promote health and safety in supplier practices. Many social sustainability practices are typically embedded into HOs' procurement guidelines (CRS, 2022; ICRC, 2023).

### Economic viability and efficiency

Economic viability and efficiency ensure that procurement decisions are financially feasible and contribute to long-term organizational resilience. This involves assessing the total cost of ownership, considering factors beyond the initial purchase price which may incur direct or indirect costs throughout the lifecycle of the product. This also includes mitigation of economic risks through assessing the viability of the relationship with the supplier.

### Waste management

Although waste management is also tied to resource use and environmental impacts, it is increasingly being recognized as a key component of sustainability and often has a standalone reference in sustainable procurement guidelines (Corbett et al., 2022; Regattieri et al., 2018; Tuomala et al., 2022). Waste management also has the potential to improve social and economic sustainability, for example, by reducing hazardous waste pollution which is detrimental to human health and costly to clean up. Some HOs employ the "Waste Management Hierarchy (5R)"[1] process to prepare for the end-of-life of the products during the procurement phrase. This may also include plan to recycle, reuse, repurpose, or take-back items at the end of their useful lifecycle to reintroduce them back into the supply chain to support sustainable resource management.

### Quality

Quality is also identified as a vital factor to support sustainable procurement (IFRC & ICRC, 2021). Quality criteria encompass factors such as durability, repairability, and robust material use. Although quality does not specifically focus on sustainability, the production of new items is often the largest contributing factor to environmental impacts in the supply chain. Longer product lifespans support sustainability as they imply less need for new items to be produced, slowing consumption of resources and the resultant environmental impacts of production and distribution. Thus, HOs aim to purchase durable items with a high repairability rate.

[1] Waste Management Hierarchy (5R): Refuse, Reduce, Reuse, Repurpose, and Recycle.



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### Efficiency of operations

Apart from energy efficiency, operational efficiency is another pertinent dimension for environmentally sustainable procurement to reduce resource use, waste, and emissions (Mishra et al., 2022). It includes measures such as maximizing transportation efficiency and freight movements, pallet optimization, reducing energy consumption, and optimizing production processes. Many HOs view operational efficiency as a readily attainable goal to enhance sustainability across the humanitarian supply chain. This may also include an increased attention towards prepositioning to reduce the need for extra movements during a disaster (Ali Torabi et al., 2018; Iakovou et al., 2014).

### Localization

Localization, widely advocated in the humanitarian sector, promotes procuring items locally for social, economic, and potentially environmental benefits (Moshtari et al., 2021). Notably, as DG ECHO pointed out in a joint workshop for both WORM and Bio4Human on Apr 16, 2024, that localization is increasingly also interpreted as locally driven response rather than international organisations working with local partners. While buying locally can reduce emissions from long-distance transportation, its environmental advantages may be overshadowed by other factors in the item's lifecycle, such as production. Furthermore, local procurement does not necessarily mean the item was also produced locally. Rather, local suppliers may also procure the products and/or raw materials from international sources. Thus, some HOs already indicate that a locally procured item is not always better for the environment and identify the need to prioritize sustainably produced local items.

### Transparency and accountability

Lastly, transparency and accountability are identified as essential dimensions of sustainable procurement (ACF, 2023). This includes ensuring HOs are transparent about their procurement practices (and accountable for environmental, social, and economic impacts) and implies the need to assess suppliers to do the same. Assessing suppliers based on their sustainability performance also helps to identify potential risks and opportunities to improve production practices. This includes developing supplier sustainability policies, conducting supplier audits, and collaborating on projects to reduce the environmental and social impact of production.

### Innovation

Innovation is crucial in addressing the complex sustainability challenges of medical waste management, which includes the efficient handling, treatment, and disposal of waste generated by healthcare facilities such as field hospitals. Gaeta et al. (2021) categorize innovation in SWM into three factors: process, product, and organizational changes. The evolving landscape of medical waste management requires continuous innovation to improve the operational efficiency of processes, reduce environmental impact, and mitigate public health risks. Technological advancements in products, such as new waste treatment methods and infrastructure and intelligent waste tracking systems, provide promising opportunities for enhancing the sustainability of medical waste management practices (Bauwens et al., 2020). These innovations streamline waste management processes and help healthcare facilities comply with stringent regulatory requirements and industry standards, thus promoting environmental stewardship and public safety (Ranjbari et al., 2022).

### Additional considerations

Additionally, sustainability in medical waste management involves holistic approaches that prioritize resource conservation, waste reduction, and circular economy principles. Figure 4 conceptualizes the different pillars of sustainability and their relation to MWM. Embracing a circular economy/sustainable outlook within the context of MWM offers numerous benefits. These benefits, such as increased business opportunities, contribute to social and economic sustainability by improving livelihoods for local populations and reducing environmental risks, which can worsen already critical situations. Processes like



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waste-to-energy view waste as a valuable resource rather than a problem to be disposed of (Bauwens et al., 2020).

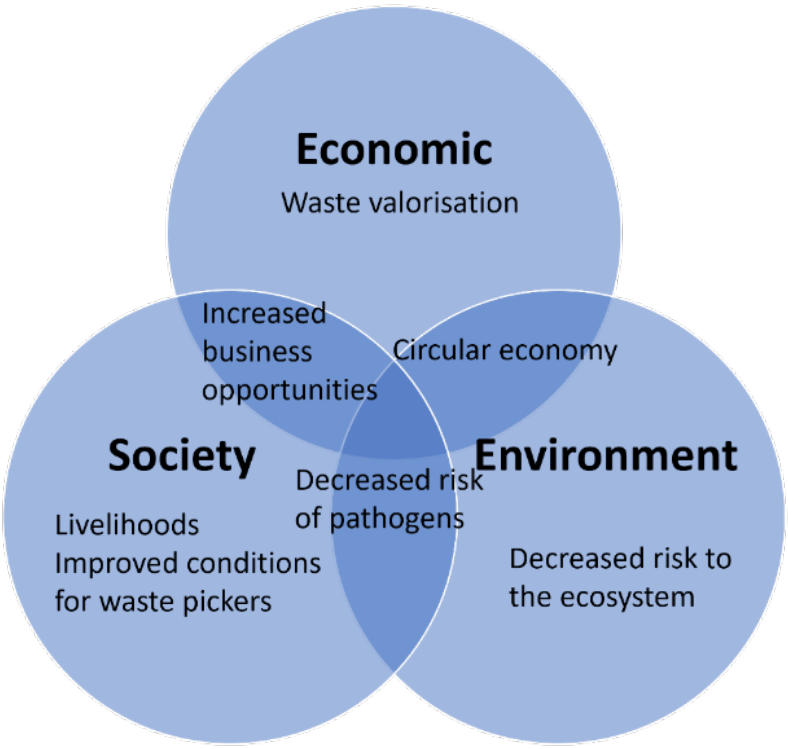


*Figure 4 Sustainability elements of MWM*

Implementing sustainable practices involves strategies to minimize waste generation at the source, optimize resource utilization through recycling and reuse initiatives, and explore alternative treatment methods with lower environmental footprints. By adopting these sustainable actions, healthcare facilities can reduce their ecological footprint, lessen reliance on traditional waste disposal methods such as incineration and landfilling, and support the transition towards a more environmentally conscious healthcare sector (Singh et al., 2022). Collaborative efforts among healthcare providers, waste management companies, policymakers, and environmental advocates are essential for fostering innovation and sustainability in medical waste management, ensuring that the healthcare industry aligns with the principles of environmental stewardship and social responsibility.

Sustainable and circular development is often initiated by top-down approaches such as regulations, standards, certifications, and eco-labels (Corona et al., 2019). Within the humanitarian context, WORM utilises a top-down approach to sustainable and responsible procurement strategies by providing sustainability criteria for several product groups that are related to the implementation of field hospitals. The agreed sustainability criteria are integrated through relevant technical specifications in procurement processes, thereby enabling sustainable procurement for the circular economy. Technical specifications don't only assist in tendering and evaluations (such as comparative bid analysis, CBA) in public procurement, but are further used in WORM to develop SOPs for how to appropriately use, reuse, recycle, and dispose of such products during the operation as well as recovery or handover of field hospitals. Thereby the CBAs will incorporate a life cycle costing approach. Accompanied with WM guideline for field hospitals, this further supports the overall reduction of waste in the environment.

## Integration of sustainability measures into humanitarian operations

Some HOs mandate certain sustainability criteria, integrating them into strategies, guidelines, and bid analysis. However, in most cases, sustainability considerations, especially those relating to the



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environment, remain limited, optional and/or context specific. Sustainability criteria is often applied selectively, implying environmental sustainability is often not embedded systematically into procurement decisions as much as social or economic indicators. The degree to which sustainability is systematically considered in humanitarian procurement also depends on factors such as organizational priorities, resources, and the maturity of the HO in terms of sustainability.

As previously described, social and economic dimensions are often more systematically embedded into humanitarian procurement. In terms of the systematic integration of environmental sustainability criteria, HOs can be categorized into three stages:

1) mandatory implementation of environmental sustainability considerations in procurement;
2) optional or non-systematic considerations;
3) limited or not included.

In the second case, environmental sustainability may be optionally integrated into procurement procedures, with compliance being voluntary or specific to certain cases where requirements are not obligatory. In the last, environmental considerations were only briefly mentioned in procurement documents or not referenced at all. Figure 5 summarises the differences in stages of HOs considering their environmental footprints in the HSC.

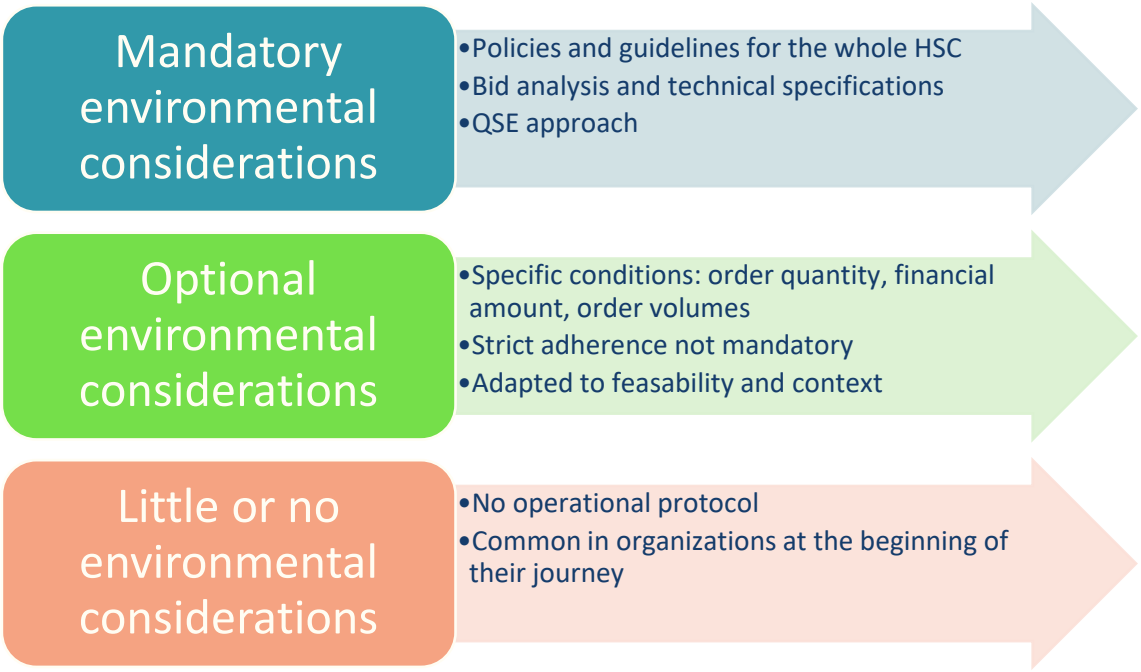


*Figure 5 Three stages of environmental considerations for HOs*

## Procurement

Procurement accounts for 60-80% of a HO's activities, making it a relevant gatekeeper for greener solutions in humanitarian aid, including waste management practices (Moshtari et al., 2021). Learning from SPP provides useful and valuable information for developing effective strategies on the sustainable humanitarian procurement. SPP offers experience-based insights into integrating environmental, social, and economic considerations into procurement processes. By adopting these practices, the humanitarian sector can envisage to ensure resource efficiency, reduce environmental impact, and promote social equity through humanitarian procurement processes. The concept of SPP was coined as early as 2006 when one of the first approaches to SPP guidelines titled "Procuring the Future" was published in 2006 by the UK Government's Sustainable Procurement Task Force (UK Gov, 2006). Since then, there are



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numerous guidelines and successful case studies reported globally (UNEP, 2021). Therefore, it is expected that SPP experiences can help HOs establish robust and holistic sustainability criteria to align with the regional policies, and they can also provide valuable information on how to improve supplier collaboration.

Public procurement makes up a significant part of global economic activity, at an average of 13% of GDP in low-income countries and 13.2% in middle-income countries (UNEP, 2021). This proportion can be significantly higher in some countries such as Botswana (28%) and in Kenya (26%) (UNEP, 2021). The economic scale of public procurement has been recognised as a critical tool, not only for achieving its primary purpose of acquiring goods and services to support the delivery of public services, but also for delivering other important policy objectives. Indeed, many policy makers have identified procurement as a powerful mechanism for achieving policy objectives and procurement is no longer seen as a transactional and administrative activity. UNEP published in 2012 the first edition of "Sustainable Public Procurement Implementation Guidelines" (UNEP, 2022) and much has been learned since then. The importance of SPP has been recognised generally and governments apply SPP as a tool for achieving economic, social, and environmental advantages with specific targets.

A UN survey of 45 national governments showed that 47% made SPP policy commitments with both environmental and socioeconomic issues, while another 47% instituted policies purely on the environmental issues (UNEP, 2022). All 27 respondents to an OECD survey (OECD, 2023) used public procurement to achieve at least one sustainability objective at a national level. All respondents reported having a framework to support environmental objectives in public procurement, 70% have a framework for human rights, 41% have a framework for gender considerations, and 48% target some form of discrimination (UNEP, 2022).

### Definitions of SPP and other procurement models to achieve sustainability goals

The UN defines SPP as a "process whereby public organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life-cycle basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst significantly reducing negative impacts on the environment" (UNEP, 2021). Thus, both environmental and social considerations are included in the term "sustainable public procurement". The EU also considers that SPP involves both environmental and social criteria in purchasing decisions (European Commission, 2016).

In addition to SPP, other procurement concepts have been defined and promoted by European Commissions. Green Public Procurement (GPP) is defined in the European Commission's Communication (European Commission, 2008) as, "a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured". Circular public procurement is defined as a "process by which public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains, whilst minimising, and in the best case avoiding, negative environmental impacts and waste creation across their whole life-cycle" (European Commission, 2017). In addition, Socially Responsible Public Procurement recommends public buyers to look beyond the price of products or services, and consider how they are produced, sourced and delivered (European Commission, 2021).

In the following sections, we will explore how the SPP is approached in different global regions to understand their perception of SPP. The purpose of this assessment is to identify the priorities set by each region (by governments, development banks, and regional policy makers) regarding the SPP. Such information can be useful for the humanitarian sector as it may be of their interest to align and join forces to achieve common sustainability goals through the humanitarian procurement processes.



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### Sustainable Public Procurement in Africa

In Africa, SPP is seen as a powerful tool for responding to social and economic development and environmental challenges, such as climate change. SPP is mainly seen as a process to integrate social and environmental factors into economic factors, and the economic advantages such as promotion of national and regional industries, employment generation, knowledge and technology transfer, empowerment of groups at risk and minorities, market development, cost savings on a long-term basis, and minimising disposal costs are emphasised in the guideline published by African Development Bank (2020). Key considerations of the SPP practices recommended to African nations are summarised below (African Development Bank, 2020):

- Social aspects
  - Protection of human rights, reduction of poverty, hunger and inequality, food security, decent work and living conditions, health and safety, and gender equality
- Economic aspects
  - Value for money, economic growth, job creation, promotion of SMEs, environmental and social integration, total cost of ownership, and life cycle costing
- Environmental aspects
  - Efficient use of natural resources, maintaining the quality of the ecosystems (air, water, and land), conservation of biodiversity, reduction of the ecological footprint, and alternative energies

### Sustainable Public Procurement in Asia

SPP is gaining momentum across Asia, with many countries recognising its potential to drive sustainable development that considers social, economic, and environmental aspects. The Asian Development Bank (2021) promotes the use of SPP to increase efficiency and reduce procurement time, deliver value for money, improve performance, and improve fitness for purpose. ADB considers SPP for its effectiveness and efficiency in terms of money and time. ADB also provokes the institutional pilar of SPP in addition to classical three pilar (social, economic, and environmental dimensions) to clearly recognise the institutional reforms as a key to successful implementation of SPP. Key considerations of these four pillars are summarised below (Asian Development Bank, 2021):

- Social aspects
  - Human rights, ethical supply chain, cultural and indigenous empowerment, food security, fair pay and labour law protections, local skills and employability development, anti-child labour and forced labour laws, fair trade, health and safety, gender equality including universal education, women-owned business, child mortality and maternal health, and healthy lives and well-being for all
- Economic aspects
  - Economic regeneration, sustainable economic development, emerging markets, development of SMEs, total cost of ownership and life cycle costing, value for money, supply chain capacity development, and poverty reduction
- Environmental aspects
  - Environmental resource management, urban planning, carbon reduction, alternative energies, water management, sustainable agriculture, marine resources management, protection of ecosystems, pollution and waste management, and clean drinking water
- Institutional aspects
  - Business ethics, sustainable institutional development, governance and management, quality of teaching and learning, relations with the community, equality, encouraging strengthening systems, OECD MAPS assessment, MAPS (sustainable public procurement modules), use of country systems, and policies and targets



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### Sustainable Public Procurement in Latin America

Latin America considers SPP as a means of ensuring that the products and services purchased by governments are as sustainable as possible, both in the sense of generating the lowest possible environmental impact, and in the sense of producing the most positive social impacts (IISD, 2020).

Latin America is making strides towards embracing SPP as a driver of inclusive and sustainable development. Here's a breakdown of the contents, policies, and recommendations for SPP practices in the region, considering social, economic, and environmental aspects:

- Social aspects
    - Improve working conditions, increase minority employment, fair allocation of procurement contracts, enhance access of SMEs to public procurement, promote local entrepreneurship and innovation, add value to the development of goods, services and works for local, national and export markets, and support rural economic development
- Economic aspects
    - Create demand for sustainable goods and services, support new, efficient industries and sectors, foster innovation, support the growth of SMEs, generate more and better jobs, raise production standards, create economies of scale for sustainable goods and services, and support producers to compete globally
- Environmental aspects
    - Efficient use of natural resources, waste management, improve air and water quality, reduce the use of hazardous chemicals, invest in energy-efficient products, apply evaluation and selection criteria that favour energy from renewables over energy from fossil fuels to reduce GHG emissions

### Sustainable Public Procurement in Europe

Europe is a frontrunner in SPP, integrating social, economic, and environmental considerations into public procurement practices. The EU has comprehensive guidelines for SPP. The primary document "Buying Green! - A Handbook on Green Public Procurement" (European Commission, 2016) provides detailed guidance to help public authorities procure goods, services, and works with reduced environmental impacts. As already explained, EU promotes GPP that focuses primarily on the environmental considerations to embed sustainability in public procurement processes. The priorities are placed on:

- Environmental impact
- Budgetary importance
- Potential to influence the market

And the factors such as political priorities, market availability of sustainable alternatives, cost considerations, availability of criteria, visibility, practical considerations are listed as decision-making factors in making the final selection.

The availability of criteria is mentioned as EU has set a set of GPP criteria for several product and service groups including cleaning products and services, copying paper, office buildings, furniture, to name but a few. In addition, the EU has been promoting the development of labels in collaboration with international, national, and regional certification bodies. Furthermore, the use of e-procurement systems is well developed in most member states and such systems are seen as a valuable tool to support GPP implementation as such systems can allow to track the use of GPP criteria and to verify that suppliers have provided the required information for their compliance (European Commission, 2016).



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### Sustainable Public Procurement in the USA

The United States implements SPP through with a primary focus on environmental aspects, and EPA promotes "Environmentally Preferable Purchasing (EPP) programs as a strategy to embed sustainability into public procurement processes". US EPA classifies potential human health and environmental impacts into seven categories (EPA, 2023b):

- Toxic exposures
- Air pollution
- Water pollution
- Climate change
- Natural resource use (energy, water, materials)
- Waste disposal
- Ecosystem damages

It is also recognized that these impacts may occur just one or at many places throughout the product's life cycle (e.g., extracting raw materials, manufacturing, packaging, distribution, retailing, and product use, repair or maintenance, and disposal). EPP program also has shaped sustainability criteria to incentivise some products with renewable energy use and energy efficiency in supply chains, lower global warming potential of process chemicals, greener transport and shipping, chemical safety, circular economy by using recycling and reuse of critical minerals, reducing single use plastics, design for refurbishment and reuse, as well as environmental justice (EPA, 2023a)

The humanitarian sector, which allocates over 60% of its budget to procurement, can coordinate and develop its sustainable procurement framework by drawing lessons from SPP policies and experiences from global regions. African nations emphasise local economic development and social equity, Asian policies focus on effective and efficient procurement processes to maximise the value for money aspects with total life costing approach. Latin America highlights strategic public procurement for generating the maximum social impact with lowest environmental impact. Others set their priorities in the environmental benefits of SPP while EU offers comprehensive guidelines with GPP criteria, and the US provides guidance through the EPA's EPP program. By adopting these diverse strategies and policies, the humanitarian sector can improve sustainability, efficiency, and socio-economic impacts in its procurement practices.

# 3. DATA COLLECTION INSTRUMENTS AND METHODOLOGIES

Empirical material for WORM will be collected in several different ways. All data collection will adhere to applicable standards of research integrity and procedures, as well as data protection laws.

The project takes an interdisciplinary multi-method approach, combining quantitative analysis of e.g. end user ERP data, and survey responses for Life Cycle Assessments (LCAs) and waste stream estimations/analyses with qualitative interviews and focus groups.

Sampling strategies for the data collection, both for qualitative data and quantitative analysis begin by establishing a sample universe (Robinson, 2014). In WORM's case this means the sampling is done primarily within the humanitarian context. The inclusion criteria include organizations that deploy field hospitals and/or focus heavily on procurement of items needed for humanitarian operations. Data will also be collected from the suppliers of the items, which makes the sampling more heterogeneous, as it will include stakeholders from IHOs, NGOs, and private sector. Table 4 presents an overview of the objectives of each phase of WORM, what are the main types of data required and the methodologies for



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its collection and analysis. More specific descriptions of the data collection instruments are presented in this section as well.

*Table 4 Data collection processes*

| | Objectives | Required data | Methodology |
|---|---|---|---|
| Phase 1 – Scoping & baseline (M1-M12) | • Prioritised product groups<br>• Procurement practices<br>• Waste stream estimation<br>• Data collection instruments<br>• Sustainability criteria | • Procured items<br>• Dispatched items in field hospital deployments<br>• Policies/regulations/guidelines<br>• WM processes<br>• Supplier data | • Document analysis<br>• Interview<br>• Focus group<br>• ERP data from end-users |
| Phase 2 – Evaluation (M7-M12) | • LCAs on prioritized products<br>• Assessment of bio-based alternatives<br>• Supply market analysis<br>• Sustainable WM business models | • Procurement and waste volumes<br>• Policies on waste picking and livelihoods programmes<br>• Technology and infrastructure data<br>• Capacities of WM partners | • LCA<br>• Questionnaire<br>• Survey<br>• Interview<br>• Focus group<br>• Document analysis<br>• ERP data from end-users |
| Phase 3 – Policy and implementation (M13-24) | • Development of SOPs<br>• WM guidelines and policy recommendations<br>• WM business models for livelihoods<br>• Limitations and trade-offs of bio-based alternatives | • End-user experiences on bio-based alternatives | • CLD<br>• Interview<br>• Focus group<br>• Document analysis |

This deliverable pertains to phase 1 and presents the findings from the scoping exercise that underlines the entire project. For this deliverable, data was collected via the following methods:

**Scoping 1 product groups**: discussions with WORM end users and their larger stakeholder groups (e.g. HULO, WREC) to establish priority product groups, and document review and interviews with extant other projects in the area of greening humanitarian supply chains to eliminate potential duplications. The results of these were taken to the WORM general assembly meeting on May 7, 2024, and validated in a WORM workshop at HNPW 2024 on May 8, 2024. Scoping 1 was reported as complete via milestone (MS) 1.1. Results and their rationale are elaborated upon in section 4 of this document.

**Scoping 2 waste stream analysis**: for this analysis (see results in section 5 of this document), quantifications were collected from end users on expected expiries in their warehouse, and through field hospital product lists of medical and non-medical items from the end users that send out field hospitals (IMC and FRC/ICRC). Data on waste treatment options was collected via interviews with both regular hospitals and field hospitals, and focus groups with waste management companies in Vietnam (with a focus on medical waste management), complemented with a workshop with end users on waste management, organised by FRC. Further data comes from desk research. This scoping exercise was reported as complete under MS1.2 on May 22, 2024.

**Scoping 3 procurement practices**: For this scoping exercise, procurement guidelines from WORM end users and some additional organisations were collected into a project-internal repository. A summarising



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matrix of procurement guidelines and practices has been compiled. These have been reported in MS1.3 on May 29, 2024. Furthermore, two procurement-related workshops have been organised on June 25, 2024, one by Innovation Norway on procurement for innovation, and another one by Solvoz (together with DG ECHO) on sustainability criteria in procurement (MS2.1 reached on June 25, 2024). First insights from these have already informed this deliverable in section 6; results from a further detailed analysis will inform D2.1 (M8) / Task 2.1 in WP2 on procurement.

This deliverable reports on all these three aspects of the scoping exercise and forms the basis for all WPs in WORM. The deliverable thus also includes elements on methods that will be used in later WPs.

### Life Cycle Assessment

Life cycle assessment (LCA) is a methodology used to understand the contribution of the life cycle stages and the overall environmental performance of products with the objective of:

1) identifying and prioritizing improvement opportunities; and/or
2) comparing different products or processes (including input materials) to each other.

WORM uses LCA to quantify the environmental impacts of the priority products based on different production and WM scenarios. This includes comparing the environmental impacts of conventional materials (e.g., fossil-based plastic) used in medical items to alternatives such as bio-based materials. Additionally, LCA is used to compare current waste treatment options, considering conventional materials, in comparison to the proposed bio-sourced alternatives. Lastly, LCA is used to measure the environmental impact of current waste treatment processes for hazardous medical waste (e.g., incineration) and alternatives (e.g., sanitary landfill, pressure steam sterilisation, chemical disinfection, or microwave sterilisation) to provide evidence on the complex topic of medical WM.

WORM uses the LCA software Simapro combined with the EcoInvent database and collects data from end users, including the HOs, suppliers, and (if necessary) WM actors to model the production and end-of-life phases of the selected products. The data collected from end users (using various instruments, as described below) is complemented with generic background data on, e.g. energy sources, from the database. Input data is then converted to outputs (emissions to air, water, and soil), which is then translated to specific environmental impact categories using the Environmental Footprint 3.1 (EC, 2021), the European Commission's reference method. This methodology is commonly used in research and practice to measure the environmental performance of products (De Laurentiis et al., 2023; Sala et al., 2020). The European Footprint 3.1 methodology considers sixteen environmental impact categories: acidification, climate change, freshwater ecotoxicity, particulate matter, marine eutrophication, freshwater eutrophication, terrestrial eutrophication, carcinogenic human toxicity, non-carcinogenic human toxicity, ionising radiation, land use, ozone depletion, photochemical ozone formulation, fossil resource use, mineral and metal resource use, and water use.

### Casual Loop Diagrams (CLDs)

Causal loop diagrams (CLDs) are used map causal links and feedback loops across variables within a larger system, highlighting how polarities can be balancing or reinforcing one another. Understanding the long-term effects of decision making is a necessary component to support sustainable humanitarian response and thus it is key to identify any unintended consequences that may arise under different decision-making scenarios. WORM develops CLDs together the HOs to identify relevant trade-offs for integrating bio-based solutions in the humanitarian sector, in addition to the wider implications for sustainable livelihoods and waste picking programmes. Examples of trade-offs include: a) the need for bio-based materials vs their durability; b) material selection vs hygiene requirements; c) increase in bio-based materials vs food security, deforestation, and climate change; and d) change in materials vs the impact of the livelihoods of waste pickers.



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Furthermore, while waste picking is a (negative) coping mechanism following disaster, HOs also engage with the affected population in waste picking under the umbrella of livelihood programs. Proper WM practices are therefore necessary to ensure reduced exposure to pollutants and to promote the safe disposal of waste so that it does not further pose a risk to the environment or human health. Using CLDs, WORM engages IHOs and their local stakeholders in a multi-actor approach to identify relevant feedback loops and help support policy development for sustainable waste picking programmes considering environmental, social, and economic aspects.

### Interviews

Qualitative interviews are used to gain insights into details that are not captured through surveys, document analysis, or questionnaires. This approach is crucial for developing a comprehensive understanding of the context, sustainability criteria as the stakeholders understand them, as well as frameworks used in procurement and WM. Interviewees can elucidate their perspectives and experiences in real-world circumstances which is particularly relevant in a humanitarian context. This enables WORM to formulate criteria that is practical and aligned with user needs. Interviews are also crucial in understanding the potential trade-offs and limitations of certain criteria and items, such as bio-based alternatives. Socio-economic impacts and livelihoods of vulnerable populations, such as waste-pickers, contribute to a holistic and equitable approach of WORM to WM in a humanitarian context.

Interviews also contribute to filling in gaps in e.g. the procurement and WM processes that may arise in the document analysis and survey. Additional insight can also be provided regarding the prioritised products that can be added to the LCAs. Interviews with suppliers also complement the LCAs regarding production processes and will allow for accurate and relevant LCAs. As WORM aims to develop policies and regulations for WM processes, it is important that the data reflects and targets real-world practices and challenges, and stakeholder interviews play a crucial role in this.

### Focus groups

Focus groups convene a group of individuals together to discuss a predetermined theme (Cyr, 2016). The discussion is generally led by a facilitator using a set of questions, akin to a semi-structured interview, but with the goal of generating conversation among participants on their individual perspectives. Focus groups present an opportunity for researchers to draw from a range of experiences and potentially reveal a group consensus. In theory, focus groups can produce data on three separate levels: the individual, group, and interactive.

Focus groups bringing together WM companies and hospital employees were used as an initial query into different WM mechanisms of MW. Focus groups will be a significant data collection instrument in WP3 WP5 and WP6, where the WM practices' livelihoods and socioeconomic implications are explored in further detail.

### Workshops/webinars

Workshops provide a collaborative experience, which enables researchers to collect data more effectively (Ahmed & Asraf, 2018). When a researcher requires information-rich data, workshops provide an excellent opportunity to meet individuals who have agreed to be part of the study, and therefore who may be able to provide more in-depth insights into a topic. This is particularly relevant in the study because it can be difficult to map which stakeholders joined the different. Therefore, the use of a workshop will guarantee the gathering of highly rich and relevant data.

In addition, workshops are successful when participants engage in collaborative conversations and provide constructive feedback to the facilitator (Ahmed & Asraf, 2018). They offer a collaborative learning environment for stakeholders from various organizations to interact and learn about a certain issue enabling the researcher to collect data through jointly shared experiences. WORM has completed one



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hybrid workshop, and two fully online workshops. These workshops have proven to be engaging and relevant for both stakeholders and project members.

Finally, in a qualitative investigation long-term engagement is a key factor in creating a rapport with the participants (Dundon & Ryan, 2010). Such trust can be built in a workshop by a facilitator's genuine interest for interacting with the participants, which should make them feel appreciated and heard and so more eager to provide rich information (Ahmed & Asraf, 2018; Dundon & Ryan, 2010).

### Questionnaires and surveys

Questionnaires and surveys will be employed as a key research methodology to gather comprehensive data from a diverse range of stakeholders. These methods allow for the collection of both quantitative and qualitative information, providing insights into end-users' and other stakeholders' perspectives, behaviours, and preferences related to various aspects of the project. Structured surveys with closed-ended questions will facilitate the quantification of data, enabling statistical analysis to identify trends and patterns. Meanwhile, open-ended questions will allow respondents to provide more detailed, nuanced responses, capturing the complexities of their experiences and opinions. This dual approach ensures a balanced and thorough understanding of the issues at hand, contributing to more robust and informed decision-making.

To ensure the effectiveness of the questionnaires and surveys, careful attention will be paid to their design and distribution. Questions will be crafted to be clear, concise, and relevant to the research objectives, avoiding any potential biases that could influence respondents' answers. Pre-testing the questionnaires with a small sample of end-users will help identify any ambiguities or issues, allowing for necessary adjustments before wider distribution. The questionnaires will be distributed through various channels, including online surveys, emails, and in-person interviews, to maximize reach and response rates. Analysing the collected data will involve both descriptive and inferential statistical techniques, as well as thematic analysis for open-ended responses. This comprehensive approach to questionnaires as a research methodology will provide valuable insights to support the goals of WORM.

### Document analysis

The document analysis methodology will involve the systematic collection and examination of various documents provided primarily by end-users to support multiple tasks throughout the project. This approach will include analysing procurement documents to identify priority products or product groups for LCA, establishing sustainability criteria, and developing CLDs. Documents detailing procurement procedures, such as tender documents, will be reviewed to help in the formulation of sustainability criteria. Additionally, documents indicating the volumes and types of waste generated by end-users will be assessed to measure the environmental impacts of waste through LCA, identify typical waste management processes, and develop corresponding CLDs.

Furthermore, documents describing existing waste picking programs from relevant partners (e.g., ACF, CRS, ICRC, IMC, NRC, PSA, VNRC) will be analysed to develop a policy framework for sustainable humanitarian livelihood programs. Quantifications and other potentially relevant data from procurement platforms will be included to support WORM. Other relevant documentation, including policies, procedures, and reports, will be examined to support all baseline data, and establishing policies. This comprehensive document analysis will ensure that all aspects of the project are informed by accurate and relevant data, facilitating the development of effective sustainability strategies and policies.

# 4. PRIORITISED PRODUCTS

In deliverable 1.1, five item categories were selected: Personal Protective Equipment (PPE) and particularly gloves, facemasks, surgical gowns and protective boots, syringes and needles, sharps containers (bins), plastic body bags, and temporary water/sludge bladders.



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The process of product prioritization started with the WORM kick-off meeting held on January 25, 2024 (MS9.1). During this meeting, initial discussions were centred around identifying and prioritizing potential products. This collaborative session was crucial in setting the groundwork for subsequent activities and ensuring alignment among all stakeholders from the start.

Following the kick-off meeting, the Hanken team engaged in bilateral discussions with end-users to gather insights directly from them, ensuring their needs and preferences were adequately reflected in the product list. The suggested product list was then reviewed and refined by the entire project team, ensuring the list was comprehensive and addressed the key needs identified during earlier discussions. Each partner in the project engaged with their respective networks to further validate and enhance the product list. These additional discussions helped improve the relevance and reliability of the proposed products by incorporating diverse perspectives and expertise from various stakeholders within the partners' networks.

To avoid duplications, the project team conducted additional meetings with the Joint Initiative on Sustainable Humanitarian Packaging and Waste Management (JI), the Waste management and measuring, Reverse logistics, Environmentally sustainable procurement and transport, and Circular economy (WREC) coalition, and Bio4Human, which have been actively involved in the mapping and design of circular initiatives in the humanitarian sector. Through these discussions, it was identified that the U.S. Agency for International Development (USAID) had already been involved in efforts to minimize the impact of packaging waste in humanitarian operations for food and non-food items in Kenya and Ethiopia (USAID, 2021). In addition, the JI was involved in the creation of guidelines for handling and managing packaging waste in humanitarian operations, emphasizing safety, reuse, repurposing, and recycling of packaging materials (JI, 2023). The question of circular packaging has been extensively covered in previous circular projects in the sector, leading to its exclusion from the current product list.

In May 2024, further discussions took place during the Humanitarian Networks and Partnerships Week (HNPW) conference in Geneva. These discussions assessed the continued relevance of the chosen products. A workshop was also conducted at HNPW with a broader audience, providing an opportunity to validate the product list with a diverse group of stakeholders. Feedback from this larger audience helped ensure that the products selected were robust and widely accepted.

At the end of May, a final call was made to ensure that the chosen products adhered to the project's mandate and scope, especially with regards to the field hospital setting. This step was essential to avoid any potential oversights and to confirm the feasibility of implementing the products in the field, specifically in Vietnam and Kenya. Additionally, the circular potential of the selected items was assessed, leading to the exclusion of energy source items such as solar panels, generators, and batteries. Despite the high demand for circular solutions in the field, these items were excluded due to the lack of suitable biodegradable or bio-sourced alternatives.

In the project, five item categories were selected following the methodology detailed in the previous section. The chosen categories include PPE, syringes and needles, sharps containers, body bags, and temporary water/sludge bladders. These items Just were selected based on their critical role in field hospitals and their potential for circularity.

### Personal Protective Equipment (PPE)

The PPE category in field hospitals includes gloves, facemasks, surgical gowns, and protective boots. These items were selected due to their essential role in protecting patients, and healthcare workers from infectious agents (Khan et al., 2023). Proper use of PPE significantly reduces the risk of healthcare workers contracting infections while caring for patients (World Health Organization (WHO), 2020). In addition, protective boots are also a concern for waste pickers. In a humanitarian context, especially in field hospitals, the demand for PPE is high due to the increasing risk of infection and the need to protect both healthcare workers and patients in often challenging and resource-limited environments (Lowe et al.,



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2021). The Covid-19 pandemic exacerbated this issue, increasing the demand for plastic-based PPE and subsequently polluting beaches, rivers, cities, and water bodies (Adyel, 2020). PPE items, such as surgical facemasks, often contain materials like polypropylene (PP) and high-density polyethylene (HDPE), which break down into microplastics over time, harming aquatic life and entering the food chain (Khan et al., 2023).

Analysing the transition to bio-based or biodegradable solutions for PPE is therefore crucial due to its potential for circularity in humanitarian settings. There are successful examples of circular initiatives in the healthcare sector such as the Revolution-ZERO initiative, which collaborated with the UK National Health Service (NHS) to replace single-use surgical gowns and operating theatre drapes, anticipating significant cost savings and reductions in GHG emissions and waste (Revolution-ZERO, s.a.).

### Syringes and Needles

Syringes and needles, categorized as sharps, pose a high risk of injury, and are considered highly hazardous waste (ICRC, 2020). They are essential in field hospitals for drug delivery, playing a pivotal role in saving lives (Quronfuleh et al., 2024). In humanitarian settings, the safe and effective administration of medications and vaccines is essential, particularly during outbreaks and emergencies where rapid response is necessary.

Historically, syringes were made for reuse from materials like glass and stainless steel. However, the shift to single-use plastic syringes for economic, safety, and convenience reasons has led to significant environmental impacts (Quronfuleh et al., 2024). In addition, the improper recycling of disposable syringes, needles, and IV sets without proper sterilization are responsible for viral diseases such as Hepatitis and HIV (Mathur et al., 2012). An estimated 16 billion syringes are improperly disposed of annually (WHO, 2018). Improper disposal can lead to needlestick injuries, contamination, and increased landfill waste. However, syringes offer high potential for circularity, with ongoing research into recycling, reusing, and rethinking their design and disposal (Quronfuleh et al., 2024).

### Sharps Containers

Sharps containers, typically made of plastic, contribute to plastic pollution when disposed of. The NHS has identified clinical waste containers as one of the top 20 medical devices with the highest carbon footprint (McPherson et al., 2019). Improper handling of these containers also poses safety risks to waste management workers.

A previous study has demonstrated that converting disposable plastic to reusable sharps containers reduces sharps waste stream greenhouse gas emissions by 84% (McPherson et al., 2019). Circular solutions for sharps containers include developing bio-based plastics or compostable materials and implementing recycling programs (Global Product Stewardship Council, 2020).

### Body Bags

Traditional plastic body bags remain in the environment, contributing to plastic waste, releasing harmful chemicals during decomposition. Indeed, single-use plastics, including body bags, pose a major threat to the environment and public health, with a significant proportion ending up in landfills (Clancy et al., 2023). Biodegradable body bags are available from medical supply companies, and researchers are exploring other sustainable and circular alternatives (Thompson, 2024).

### Temporary Water/Sludge Bladders

Wastewater treatment is crucial for reducing environmental and public health impacts, as many parasite transmission routes involve wastewater and sludge (Jiménez et al., 2004). Temporary water and sludge bladders are often made of plastic materials, contributing to plastic pollution and the contamination of soil and water if improperly managed (Jiménez et al., 2004). The increase in wastewater treatment plants in developing countries has led to a rise in sludge production, necessitating proper treatment and



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management to mitigate harmful effects (Murray & Lopez, 1998). In some cases, sludges are disinfected with peracetic acid, which has detrimental effects on aquatic biodiversity (Liu et al., 2024). Investigating bio-based or compostable materials for bladders or developing reusable or recyclable solutions is essential for addressing these issues in field hospitals, where sustainable water and WM is crucial.

# 5. PROCUREMENT PRACTICES

Procurement is an essential function within the HOs' core activities, accounting for 60-85% of expenditure. Disasters create a sudden peak in demand for supplies, for which HOs prepare for by e.g. pre-positioning items in strategic locations, as well as procuring additional items as a response to a disaster occurrence (Moshtari et al., 2021).

Figure 6 represent the standard procurement principles found across organizations. These principles ensure that the right number of products of acceptable quality are delivered to the right place at the right time. The process must also remain fair, open, and competitive for potential suppliers, and where appropriate, strengthen local markets and systems. In addition, organizations are now adding sustainability criteria to their procurement guidelines, which adds environmental and social considerations to all the principles. Sustainable procurement contributes to organizations' efforts to reduce GHG emissions and better management of hazardous waste resulting from humanitarian operations.

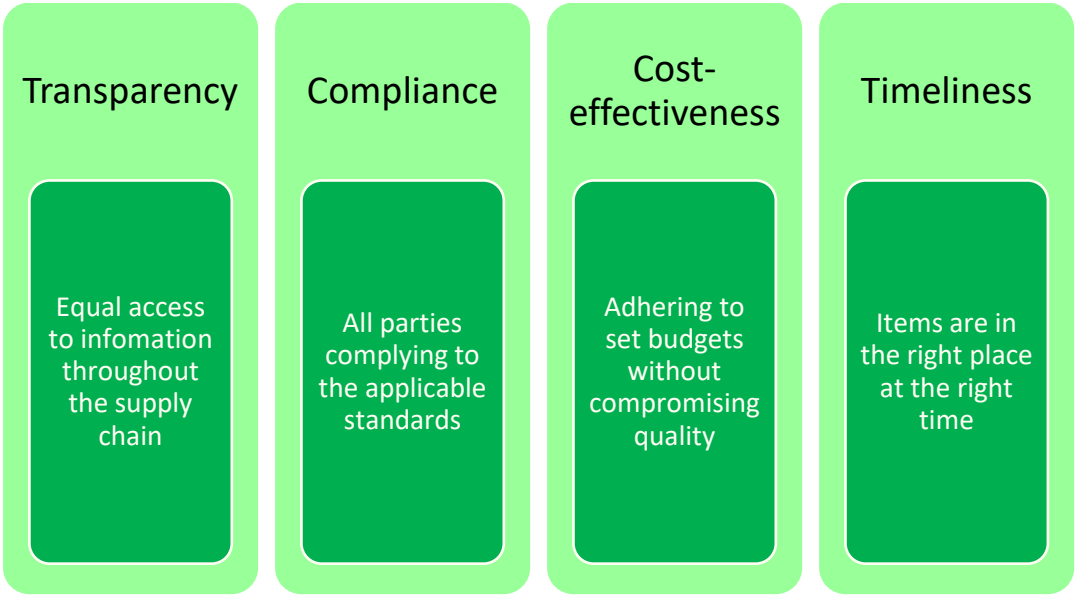


*Figure 6 Procurement principles*

Humanitarian procurement must provide the right product, in the right quantity, in the right place, and at the right time, which meets the demands expressed by the population (Moshtari et al., 2021). Procurement processes can vary depending on factors such as the nature of the emergency (e.g., emergency vs. routine), type of contract, payment method, funding mechanism, organization's policies and procedures, and specific needs of the affected population. Procurement processes may also consider factors such as framework agreements, local, partnership, and/or collaborative procurement, as well as in-kind donations.



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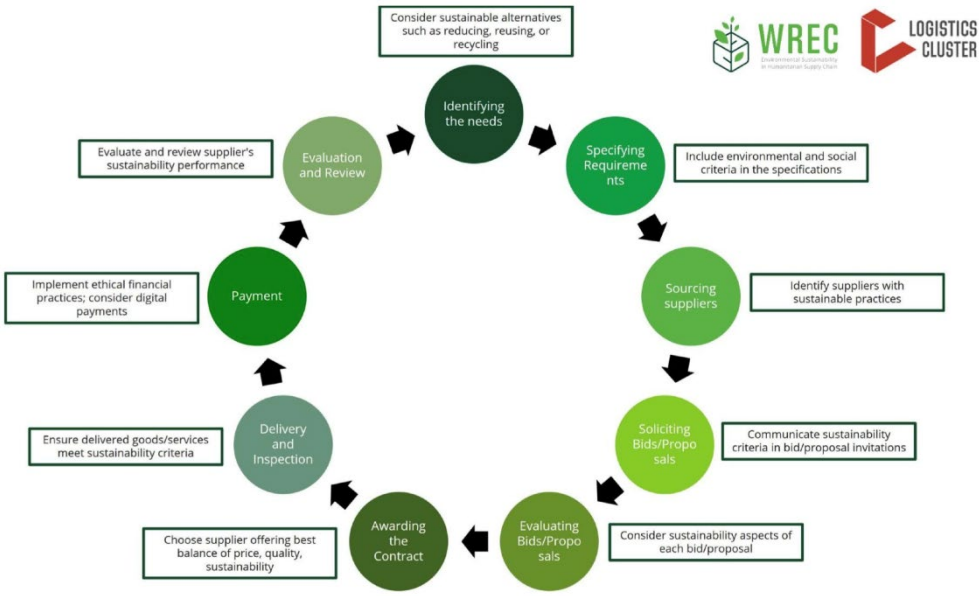


*Figure 7 Procurement Cycle and how to embed sustainability in each step (WREC, 2023)*

**Typically, procurement follows a general process, as displayed in Figure 7:**

1. Needs assessment: Assess the needs and requirements of the humanitarian operation. This involves identifying the specific goods and services required to support relief efforts, considering factors such as the nature of the crisis, the affected population, and the operational context.
2. Specification development: Develop specifications for the required goods and services. These specifications outline the technical requirements, quality standards, and any other relevant criteria that suppliers must meet for the requested items.
3. Supplier identification and pre-qualification (in many cases): Identify potential suppliers who can provide the required goods and services (e.g., sourcing campaign). This includes conducting market research, compiling a list of potential suppliers, assessing their capabilities and suitability, and establishing communication channels with a selected group.
4. Tendering: Communicate the procurement requirements to the interested parties (e.g., request for proposals (RFP) or request for quotations (RFQ)). This may be through an open procedure (any interested suppliers may submit a tender after publication of a tender notice) or to already selected suppliers. Suppliers then submit their bids or proposals based on the requirements outlined in the tender documents.
5. Supplier evaluation and selection: Evaluate bid/proposal/quotation based on predefined criteria such as price, quality, and compliance with specifications and funding requirements. The evaluation process aims to select the most suitable supplier(s) who can meet the needs of the humanitarian operation effectively and efficiently. This usually includes further due-diligence steps such as asking the supplier to provide samples, reference checks, or, in some cases, as site visit.
6. Contract negotiation and award: Negotiate with selected supplier(s) to finalize contract terms and conditions. Once negotiations are complete, contracts are awarded to the selected supplier(s), and formal agreements are signed regarding the requirements indicated in the specifications and/or quotes.
7. Order fulfilment and delivery: Place order with the selected supplier(s) for the required goods and services. Suppliers are responsible for fulfilling orders according to the agreed-upon terms, including delivery schedules, quality standards, and any other contractual requirements.



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8. Quality control and inspection: Conduct quality assurance processes such as inspections or testing samples to ensure compliance with contractual obligations.
9. Monitoring and performance evaluation: Monitor and evaluate supplier performance of contractual requirements, quality, and status of deliverables. This step may also include setting clear Key Performance Indicators (KPIs), regularly reviewing supplier performance against these metrics, addressing issues promptly, providing feedback, documenting performance data, and using insights for decision-making.

Therefore, procurement acts as a gatekeeper through the control of the quality and timeliness of medical supplies, while simultaneously having a gateway role in field hospitals, facilitating the shift acquisition of necessary resources to address urgent medical needs.

## Innovation-friendly procurement

Procurement is both a gatekeeper where material choices can be made for humanitarian operations, and a gateway for bringing in innovative solutions. Reduction, repair, and recycling are three important waste management strategies. Strategic procurement is key to ensuring that we make reduction, repair and recycling possible. Procurement is more than an operational function; it can be a powerful force for change, if managed holistically and strategically (The Future of Public Spending, UNOPS 2022). However though new solutions are being developed that lend themselves better to these processes, it can often be challenging to get them into the humanitarian market (Innovation Norway, 2021).

Innovation friendly procurement is a procurement approach that can help humanitarian actors balance the need to safeguard against corruption, tight budgets, maximise the impact of the procurement, and manage sustainability considerations. The process lends itself particularly well for a strategically important procurement connected to an organisation's core business, where there is little competition in the market and a buyer wants to stimulate market growth, and in areas or markets that evolve quickly. The different between an ordinary procurement and an innovation friendly procurement lies in:

- the approach to the needs assessment, with an increased focus on the outcome that is sought with the procurement and less on the input,
- the introduction of an open and transparent dialogue between the buyer and the private sector, an element that is often prevented by humanitarian organisations' procurement regulations today
- in the formulation of the specifications in the request for proposals. These should be formulated around the performance and impact sought, not on technical specifications describing a solution

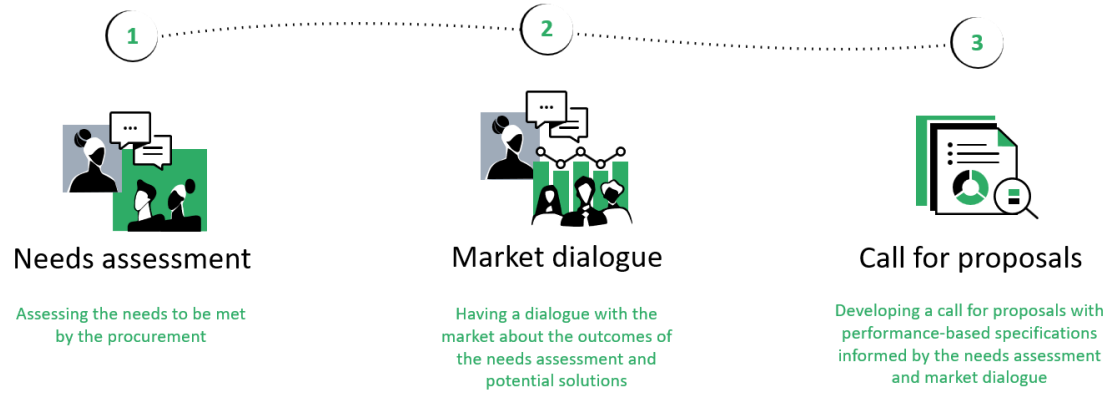


*Figure 8 Three main steps in an innovation friendly procurement process*



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The process can lead to the procurement of a solution, making it an innovation friendly procurement, or it can lead to the procurement of an innovation process, making it an innovative procurement (Innovation Norway, 2021). WORM has held a webinar on innovation-friendly procurement on June 25, 2024, showcasing three innovations and elaborating on this process to a wider audience. Separately, another workshop was also held on June 25, 2024 on sustainability criteria in procurement (MS2.1). This was organized in conjunction with DG ECHO to reach out to a wider audience of donors, humanitarian procurement professionals, and sustainability experts.

# 6. WASTE MANAGEMENT

*One surgery [in a field hospital] produces one large bin bag of waste. – ROWHUMMED20240523*

Any kind of humanitarian operation will produce a certain amount of waste. While reduction and minimisation are possible through for example reducing packaging, it is vital to also improve the processes of waste management (WM). To explore medical waste management (MWM) further, data was collected from both hospital operational staff and WM companies in Vietnam and Finland to gain insight what kind of processes and technologies are available in the field of MWM. Additional data has been provided by WORM end users from various field hospital deployments in the rest of the world (ROW). While the field hospital context is unique, the processes correspond to those used in static hospitals and healthcare facilities.

Figure 9 presents a simplified MWM process. Segregation of waste at the source is a vital part of the WM process, and further highlighted by e.g. contamination risks present in the medical context. This segregation is done by medical personnel and hospital employees, which inevitably leads to human error. Hazardous waste such as medicine, chemicals, pathological waste, and sharps are segregated, as are the non-hazardous waste that healthcare facilities produce.

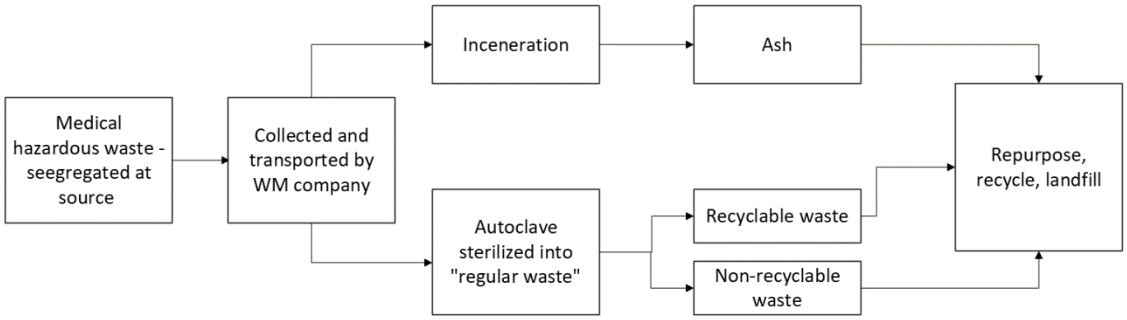


*Figure 9 Waste management process*

Another key component to understanding MWM in the humanitarian sector is to identify what types of products (and materials) are used in medical items and equipment. A field hospital requires a wide array of products and there is often very limited visibility about what happens to the items at the end-of-life. In this initial scoping exercise, WORM assumes that the items sent to the field hospital will also end up as waste in the end, which provides a basis for calculating the total amount of waste generated for a specific field hospital setting by the end-user. This is then combined with the data from other end users to highlight commonly procured products.



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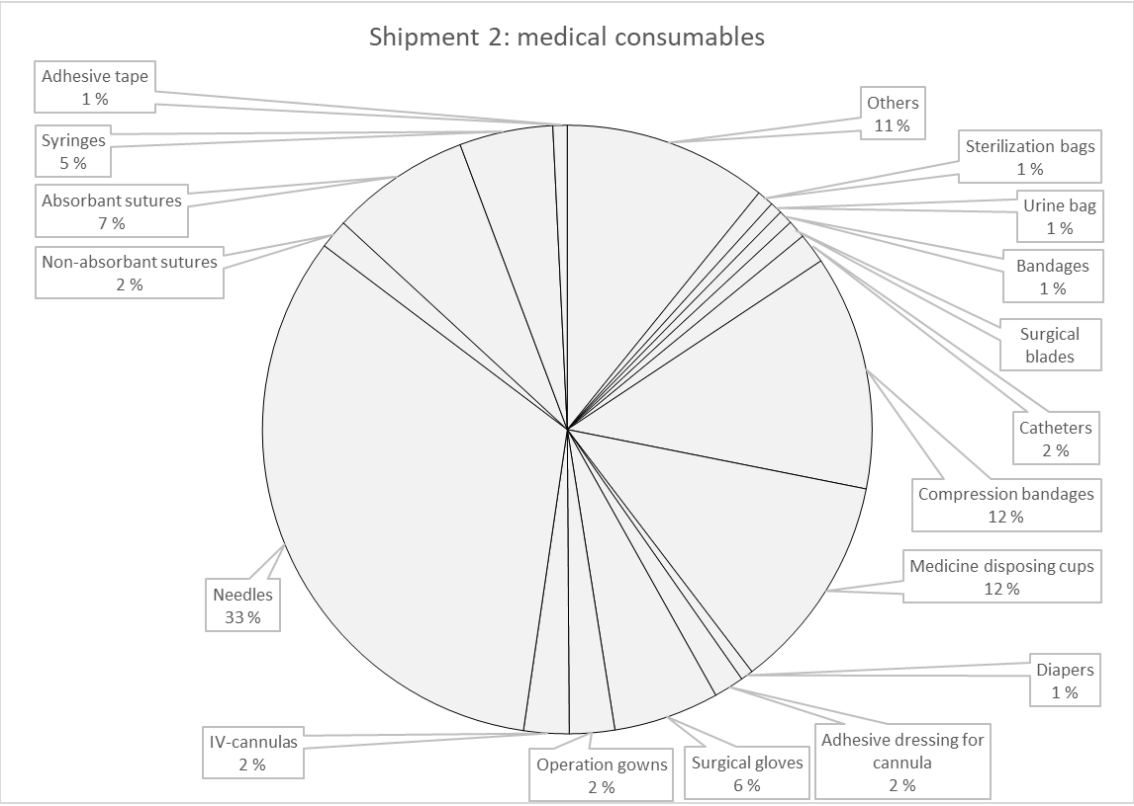


*Figure 10 Medical consumables contained in the second shipment to the field hospital (percentage breakdown by item)*

Figure 10 illustrates the breakdown of items sent to a field hospital deployment by the FRC in Bangladesh. While this is just one of the organizations surveyed as part of the waste stream analysis, the visual is used to provide a snapshot of the type of data collected to help define the priority products and estimate waste generated. As previously mentioned, the priority items were selected based on several criteria (beyond volume of waste generated), such as the potential for a bio-based alternative, risk for environmental impacts, novelty (little to no research done before on this item), etc. Field hospitals also operate under diverse circumstances and each deployment is "unique" in its own regard, yet through this scoping exercise WORM could identify the "typical" items that are ubiquitous to healthcare and field hospital settings.

*If we had a "typical" field hospital, the deployments are always unique and rarely go according to plan. - ROWHUMLOG20240403*

Table 5 specifies the total items sent for the selected deployment to provide a clearer understanding of total waste volumes for medical consumables in a field hospital setting. All items are considered "single use" and thus will be disposed of on-site, implying a significant amount of (in many cases hazardous) waste generated. Furthermore, HOs operating in emergency situations also integrate preparedness measures, such as a safety stock in a warehouse, as pointed out in the scoping interview with ROWHUMLOG20240403. This often leads to additional waste generated in the form of expired stock.

*As a preparedness measure, a field hospital needs to be deployable in two days, which means we have consumables in the warehouse, which run the risk of expiry. In joint operations [with other RCNSs] we try to deploy according to the FEFO principle. -ROWHUMLOG20240403*



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*Table 5 Medical consumables sent to field hospital (one shipment)*

| Item | Unit | Amount |
|---|---|---|
| Others | piece | 13531 |
| Sterilization bags | piece | 1100 |
| Urine bag | piece | 800 |
| Bandages | piece/roll | 930 |
| Surgical blades | piece | 1200 |
| Catheters | piece | 2010 |
| Compression bandages | piece | 15610 |
| Medicine disposing cups | piece | 14400 |
| Diapers | piece | 822 |
| Adhesive dressing for cannula | piece | 2000 |
| Surgical gloves | pair | 7000 |
| Operation gowns | piece | 3004 |
| IV-cannulas | piece | 3000 |
| Needles | piece | 41300 |
| Non-absorbent sutures | piece | 1944 |
| Absorbent sutures | piece | 9264 |
| Syringes | piece | 6200 |
| Adhesive tape | piece | 948 |

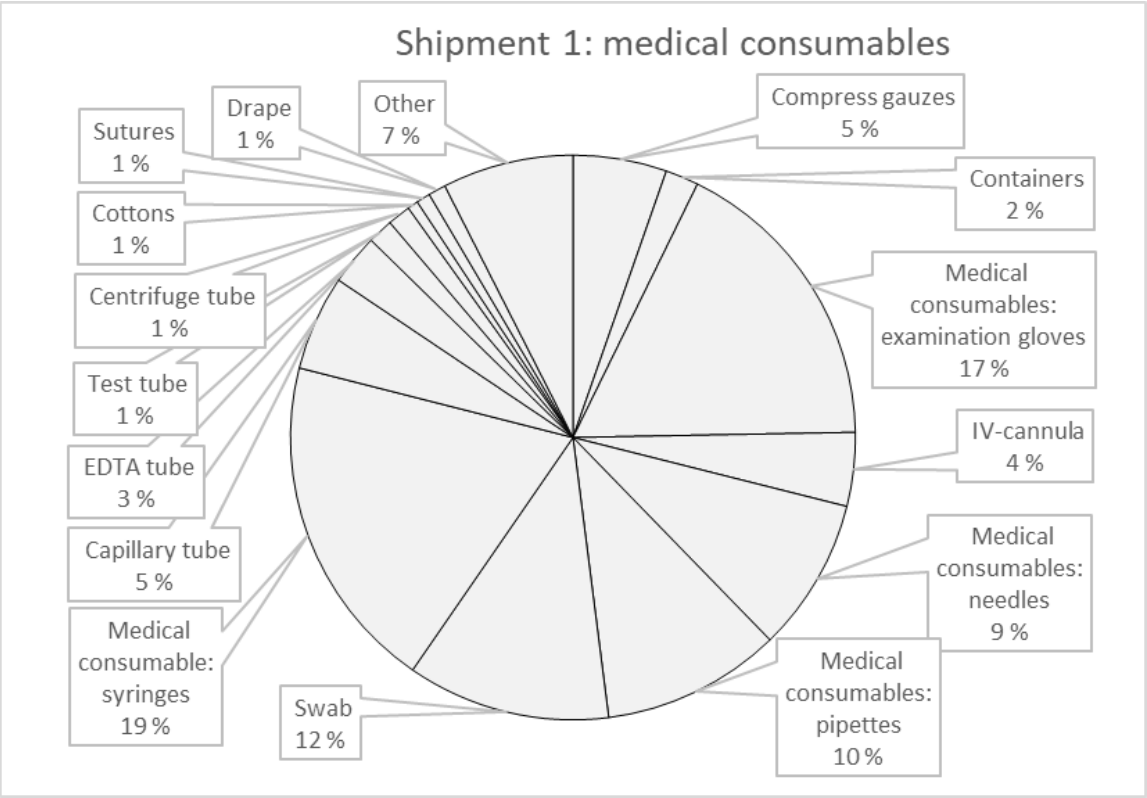


*Figure 11 Medical consumables contained in the first shipment to the field hospital (percentage breakdown by item)*

*As a preparedness measure, a field hospital needs to be deployable in two days, which means we have consumables in the warehouse, which run the risk of expiry. In joint operations [with other RCNSs] we try to deploy according to the FEFO principle. -ROWHUMLOG20240403*

As HOs that deploy emergency items, such as field hospitals, preparedness includes a safety stock in a warehouse, as pointed out in the scoping interview with ROWHUMLOG20240403. This leads to excessive amounts of medicine that is wasted.

# 7. NEXT STEPS

### Innovation and sustainability in procurement

An innovation- and sustainability-friendly procurement process is crucial also in safeguarding against corruption, particularly in HOs. Conducting a needs assessment is essential, focusing on the impact of the research rather than the inputs aimed to be achieved. Maintaining an open market dialogue with relevant stakeholders is critical, as it allows for the continual update of data and enables suppliers to propose relevant solutions. It is important to document these dialogues and ensure all information is accessible to everyone involved.

When calling for proposals, using performance-based specifications can foster high competition, low risk, and a wide range of alternative solutions. There are four types of specifications to consider: performance-based (emphasizing impact and performance), standard (varying levels of competition and risk), functional (high competition and low risk with many alternatives), and detailed (low competition, high risk, and few alternatives).



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Not all procurement should aim for innovation, but key strategic parts should be innovation-friendly, particularly in sectors with limited competition. Sustainability on the other hand should be a baseline requirement for stakeholders within the HSC.

Buyers can stimulate the development of solutions by engaging in dialogue, especially in markets with little competition. The rapid development of some technologies necessitates an open procurement process, as procurement experts cannot always stay updated on technological advancements. Moreover, this is not solely a procurement challenge but an ecosystem challenge. It begins with identifying needs and striving to achieve impactful outcomes. Public procurement can serve as a powerful tool for change, initiating with KPIs to stimulate the development of green solutions and overall innovation and sustainability.

WORM emphasises the sustainability framework introduced by the European Commission for ESPR (Figure 12). These are the sustainability criteria for bio-based and biodegradable products that WORM will highlight in its procurement guidelines and catalogue.


*Figure 12 Ecodesign for sustainable product regulation*

Sustainability in the HSC is a holistic concept, that goes beyond the everyday activities of the SC, and encompasses policy along with strategic objectives embedded within the organization. It includes criteria for supplier assessments and the sustainability of the SC, specifying what stakeholders need to adhere to, as well as technical and product specifications. With biobased and biodegradable products, the potential trade-offs with durability and reliability will be particularly focused on, and this will be demonstrated with the LCAs performed.

In a procurement workshop held in June 2024, which consisted of donors& funders, sustainability experts, and representatives of different HOs, key challenges, recommendations, and opportunities were thoroughly discussed. These discussions align with WORM's objectives and provide validation that the objectives established are on par with the direction HSCM practice wants to take.

A general consensus on the importance of mandatory environmental requirements was established, which is also a key component of WORM's principal goals. A need for supply market intelligence, through stakeholder assessments as well as assessing the availability of environmentally sustainable goods and services. There is also a call for larger organisations to invest in their downstream SC through trainings, risks assessments, and accreditations to improve the SCs sustainability metrics.

One of the challenges and opportunities highlighted by this stakeholder groups was the focus on transactional actions, such as procurement, and therefore neglecting the strategic side of the



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engagement. By firmly implementing aspects such as sustainability in the strategy and code of conduct of the organisation, the transactions can become more comprehensive, encompassing the values of the organization better. Suppliers are often inundated with procurement requests, which makes it difficult for them to adhere to specific guidelines set forth by individual organizations. A common catalogue or transaction platform, as proposed by WORM, is a potential solution. This would also harbour cross-sectoral collaboration as a way to leverage collective expertise and resources, as well as alleviate supplier and procurement team fatigue. The capacity of teams at all levels of the SC was pointed out as a challenge, as limited resources hinder the implementation of holistic sustainability strategies. These are particularly challenges in the field, where resources are especially scarce. This highlights the need for strategic alignment from the entire HSC level, where sustainably sourced and/or biobased materials are the norm.

Fostering dialogue between different stakeholders along the HSC is also a crucial step in advancing a more strategic approach to transactional actions. regulations often hinder direct communication, and neutral platforms facilitated by donors could bridge this gap. WORM emphasises addressing the communication barriers and enhancing collaboration between stakeholders. WORM will also address the frequently heard argumentation about donor requirements to prevent a shift towards sustainable HSCM and the need to obtain an overview towards those requirements in order to get a better understanding to address this.

### Links to next deliverables

This deliverable has reported on a scoping exercise that laid the foundation for WORM. Prioritised products will be taken into account in the following WPs: procurement (WP2), innovation (WP3), WM at field hospitals (WP5), recycling and WM at field hospitals (WP5), and mitigation and livelihoods (WP6). These are the products that are in focus to seek bio-based alternatives for in a supply market intelligence (D1.4), and the LCAs in WORM (D1.2).

The scoping exercise on procurement sets the foundation for the work in the procurement (WP2) and innovation (WP3) WPs. The procurement guidelines and documents that have been collected for the procurement scoping will be further analysed for Task 2.1 and reported on together with the analysis of the sustainability procurement workshop in D2.1 (M8). D2.1 is a policy brief that provides a framework and sustainability criteria for product evaluation (task 2.1).

The waste stream analysis of field hospitals is relevant both for understanding the impact of potential bio-based alternatives in the humanitarian sector, and also for setting priorities in procurement. As an immediate next step, it feeds into the analysis of local humanitarian waste management models (D3.1, M8). The waste treatment alternatives are also in focus in the LCA for D1.3. Generally, the scoping data from D1.1 lays the foundation for further waste management analysis in WP4 and WP5 that both focus on the field hospital setting. Looking at MWM is also essential for the considerations of safe and effective livelihood programmes for waste pickers (WP6).

# REFERENCES

ACF. (2023). *Sustainable procurement guide intended for the use by all teams*. https://www.actioncontrelafaim.org/en/publication/sustainability-in-humanitarian-procurement/

Adelodun, B., Ajibade, F. O., Ibrahim, R. G., Ighalo, J. O., Bakare, H. O., Kumar, P., Eid, E. M., Kumar, V., Odey, G., & Choi, K. S. (2021). Insights into hazardous solid waste generation during COVID-19 pandemic and sustainable management approaches for developing countries. In *Journal of Material Cycles and Waste Management* (Vol. 23, Issue 6, pp. 2077–2086). Springer Japan. https://doi.org/10.1007/s10163-021-01281-w

African Development Bank. (2020). *Sustainable Public Procurement*. www.afdb.org



Funded by the European Union

Ahmed, S., & Asraf, R. M. (2018). The Workshop as a Qualitative Research Approach: Lessons Learnt from a "critical Thinking Through Writing'' Workshop." *The Turkish Online Journal of Design, Art and Communication*, 1501–1510. https://doi.org/10.7456/1080SSE/201

Ali, M., Wang, W., Chaudhry, N., & Geng, Y. (2017). Hospital waste management in developing countries: A mini review. In *Waste Management and Research* (Vol. 35, Issue 6, pp. 581–592). SAGE Publications Ltd. https://doi.org/10.1177/0734242X17691344

Ali Torabi, S., Shokr, I., Tofighi, S., & Heydari, J. (2018). Integrated relief pre-positioning and procurement planning in humanitarian supply chains. *Transportation Research Part E: Logistics and Transportation Review*, *113*, 123–146. https://doi.org/10.1016/j.tre.2018.03.012

Anjomshoae, A., Banomyong, R., Hossein Azadnia, A., Kunz, N., & Blome, C. (2023). Sustainable humanitarian supply chains: a systematic literature review and research propositions. *Production Planning and Control*. https://doi.org/10.1080/09537287.2023.2273451

Asian Development Bank. (2021). *Sustainable Public Procurement: Guidance Note on Procurement*. https://www.adb.org/sites/default/files/sustainable-public-procurement.pdf

Bauwens, T., Hekkert, M., & Kirchherr, J. (2020). Circular futures: What Will They Look Like? *Ecological Economics*, *175*. https://doi.org/10.1016/j.ecolecon.2020.106703

Brangeon, S., & Crowley, F. (2020). *Environmental footprint of humanitarian assistance - Scoping review* (Issue May).

Burnweit, C., & Stylianos, S. (2011). Disaster response in a pediatric field hospital: Lessons learned in Haiti. *Journal of Pediatric Surgery*, *46*(6), 1131–1139. https://doi.org/10.1016/j.jpedsurg.2011.03.042

CHORD. (2024). *Measuring the greenhouse gas emissions and waste of humanitarian supply chains: A quantitative research study on the environmental impacts of humanitarian disaster response*. https://www.help-logistics.org/fileadmin/user_upload/Dateien_HELP/documents/report/WREC_Report_Measuring_GHG_Emissions.pdf

Corbett, C. J., Pedraza-Martinez, A. J., & Van Wassenhove, L. N. (2022). Sustainable humanitarian operations: An integrated perspective. *Production and Operations Management*, *31*(12), 4393–4406. https://doi.org/10.1111/poms.13848

Corona, B., Shen, L., Reike, D., Rosales Carreón, J., & Worrell, E. (2019). Towards sustainable development through the circular economy—A review and critical assessment on current circularity metrics. In *Resources, Conservation and Recycling* (Vol. 151). Elsevier B.V. https://doi.org/10.1016/j.resconrec.2019.104498

CRS. (2022). *Supplier and service provider code of conduct*. https://www.crs.org/our-work-overseas/research-publications/supplier-and-service-provider-code-conduct

EPA. (2023a). *Engagement in Environmental Performance Standards Development*. Sustainable Marketplace: Greener Products and Services. Sustainable Marketplace: Greener Products and Services

EPA. (2023b). *Why Buy Greener Products?* https://www.epa.gov/greenerproducts/why-buy-greener-products

European Commission. (2008). *Public procurement for a better environment*.

European Commission. (2016). *Buying Green Handbook* (3rd ed.). European Union. https://doi.org/10.2779/04621



Funded by the European Union

European Commission. (2017). *Public Procurement for a Circular Economy*. https://circulareconomy.europa.eu/platform/sites/default/files/knowledge_-_public_procurement_circular_economy_brochure.pdf

European Commission. (2021). *Buying Social-a guide to taking account of social considerations in public procurement*. https://ec.europa.eu/docsroom/documents/45767

European Commission. (2022). *Humanitarian logistics policy*.

Fardi, K., Ghanizadeh, G., Bahadori, M., Chaharbaghi, S., & Shokouh, S. M. H. (2022). Location selection criteria for field hospitals: A systematic review. *Health Promotion Perspectives*, *12*(2), 131–140. https://doi.org/10.34172/hpp.2022.17

Finestone, A. S. (2001). Diagnostic Medical Auxiliary Equipment in a Field Hospital: Experience from the Israeli Delegation to the Site of the Turkish Earthquake at Adapazari. *Military Medicine*, *166*, 637–640. https://academic.oup.com/milmed/article/166/7/637/4819567

Gaeta, G. L., Ghinoi, S., Silvestri, F., & Tassinari, M. (2021). Innovation in the solid waste management industry: Integrating neoclassical and complexity theory perspectives. *Waste Management*, *120*, 50–58. https://doi.org/10.1016/j.wasman.2020.11.009

Hong, J., Zhan, S., Yu, Z., Hong, J., & Qi, C. (2018). Life-cycle environmental and economic assessment of medical waste treatment. *Journal of Cleaner Production*, *174*, 65–73. https://doi.org/10.1016/j.jclepro.2017.10.206

Iakovou, E., Vlachos, D., Keramydas, C., & Partsch, D. (2014). Dual sourcing for mitigating humanitarian supply chain disruptions. *Journal of Humanitarian Logistics and Supply Chain Management*, *4*(2), 245–264. https://doi.org/10.1108/JHLSCM-03-2013-0008

ICRC. (2023). *Supplier code of conduct*. https://www.crs.org/our-work-overseas/research-publications/supplier-and-service-provider-code-conduct

ICRC, & IFRC. (2021). *Climate and Environmental Charter for Humanitarian Organizations*. https://www.climate-charter.org/wp-content/uploads/2022/05/ClimateEnvironmentCharter-EN.pdf

IFRC, & ICRC. (2021). *Information sheet: Sustainable procurement*. Standard Products Catalogue. https://itemscatalogue.redcross.int/green--2/sustainable-procurement--25/sustainable-criteria--112/information-sheet-sustainable-procurement--SUSTAINABLE.aspx

IISD. (2020). *Toward Strategic Public Procurement in Latin America and the Caribbean.* https://www.iisd.org/publications/toward-strategic-public-procurement-latin-america-and-caribbean

Khan, B. A., Cheng, L., Khan, A. A., & Ahmed, H. (2019). Healthcare waste management in Asian developing countries: A mini review. In *Waste Management and Research* (Vol. 37, Issue 9, pp. 863–875). SAGE Publications Ltd. https://doi.org/10.1177/0734242X19857470

Logistics Cluster. (2023). *A supply chain framework for the future: Reducing the carbon footprint of humanitarian aid*. https://www.climate-charter.org/wp-content/uploads/2022/05/ClimateEnvironmentCharter-EN.pdf

Mishra, J. L., Chiwenga, K. D., Mishra, N., & Choudhary, S. (2022). Extending dynamic capabilities towards lean thinking in humanitarian supply chains. *Production Planning and Control*, *33*(6–7), 655–675. https://doi.org/10.1080/09537287.2020.1834136



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Moshtari, M., Altay, N., Heikkilä, J., & Gonçalves, P. (2021). Procurement in humanitarian organizations: Body of knowledge and practitioner's challenges. *International Journal of Production Economics*, *233*(January). https://doi.org/10.1016/j.ijpe.2020.108017

OECD. (2023). *Government at a Glance 2023*. OECD. https://doi.org/10.1787/3d5c5d31-en

RameshKumar, S., Shaiju, P., O'Connor, K. E., & P, R. B. (2020). Bio-based and biodegradable polymers - State-of-the-art, challenges and emerging trends. In *Current Opinion in Green and Sustainable Chemistry* (Vol. 21, pp. 75–81). Elsevier B.V. https://doi.org/10.1016/j.cogsc.2019.12.005

Ranjbari, M., Shams Esfandabadi, Z., Shevchenko, T., Chassagnon-Haned, N., Peng, W., Tabatabaei, M., & Aghbashlo, M. (2022). Mapping healthcare waste management research: Past evolution, current challenges, and future perspectives towards a circular economy transition. *Journal of Hazardous Materials*, *422*. https://doi.org/10.1016/j.jhazmat.2021.126724

Regattieri, A., Gamberi, M., Bortolini, M., & Piana, F. (2018). Innovative solutions for reusing packagingwaste materials in humanitarian logistics. *Sustainability (Switzerland)*, *10*(5). https://doi.org/10.3390/su10051587

Rożek, P., Król, M., & Mozgawa, W. (2019). Solidification/stabilization of municipal solid waste incineration bottom ash via autoclave treatment: Structural and mechanical properties. *Construction and Building Materials*, *202*, 603–613. https://doi.org/10.1016/j.conbuildmat.2019.01.056

Salman, F. S., & Gül, S. (2014). Deployment of field hospitals in mass casualty incidents. *Computers and Industrial Engineering*, *74*(1), 37–51. https://doi.org/10.1016/j.cie.2014.04.020

Singh, N., Ogunseitan, O. A., & Tang, Y. (2022). Medical waste: Current challenges and future opportunities for sustainable management. In *Critical Reviews in Environmental Science and Technology* (Vol. 52, Issue 11, pp. 2000–2022). Taylor and Francis Ltd. https://doi.org/10.1080/10643389.2021.1885325

Singh, N., Tang, Y., & Ogunseitan, O. A. (2020). Environmentally Sustainable Management of Used Personal Protective Equipment. *Environmental Science and Technology*, *54*(14), 8500–8502. https://doi.org/10.1021/acs.est.0c03022

Tekin, E., Bayramoglu, A., Uzkeser, M., & Cakir, Z. (2017). Afet durumunda hastanelerin tahliyesi, sahra hastanesinin kurulumu ve haberleşme. In *Eurasian Journal of Medicine* (Vol. 49, Issue 2, pp. 137–141). AVES Ibrahim Kara. https://doi.org/10.5152/eurasianjmed.2017.16102

Tuomala, V., Kovács, G., Aminoff, A., & Ely, K. (2022). *Waste management and reverse logistics in the humanitarian context*. https://logcluster.org/document/wrec-research-waste-management-and-reverse-logistics-humanitarian-context-september-2022

UK Gov. (2006). *Procuring the Future*. https://assets.publishing.service.gov.uk/media/5a78e19040f0b6324769ae5f/pb11710-procuring-the-future-060607.pdf

UN. (2021). *The climate crisis and humanitarian need: taking action to support the world's most vulnerable communities*.

UNEP. (2021). *Sustainable Public Procurement How to "Wake the Sleeping Giant."* https://www.oneplanetnetwork.org/sites/default/files/from-crm/SPPWSG.pdf

UNEP. (2022). *Sustainable Public Procurement: 2022 Global Review (Parts I and II)*. https://www.oneplanetnetwork.org/knowledge-centre/resources/sustainable-public-procurement-2022-global-review-parts-i-and-ii



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VTT. (2023). *Bio-based materials in healthcare*. https://www.vttresearch.com/sites/default/files/2023-10/Bio-based%20materials%20in%20healthcare.pdf

World Bank. (2022). *Solid Waste Management*. https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management#:~:text=Around%20the%20world%2C%20waste%20generation,kilograms%20per%20person%20per%20day.

Ympäristöministeriö. (2023). *Terveydenhuollon jäteopas*. https://julkaisut.valtioneuvosto.fi/handle/10024/164724

You, S., Sonne, C., & Ok, Y. S. (2020). Covid-19's unsustainable waste management. In *Science* (Vol. 368, Issue 6498, p. 1438). American Association for the Advancement of Science. https://doi.org/10.1126/science.abc7778



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Reduction and Minimisation

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