IFRC

# MANAGING SOLID WASTE: SECTOR-SPECIFIC GUIDELINES FOR THE RED CROSS RED CRESCENT

GREEN RESPONSE · GREEN RESPONSE ·

Swedish Red Cross

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# List of acronyms

| | |
|---|---|
| **ACM** | Asbestos containing materials |
| **ADB** | Asian Development Bank |
| **BSF** | Black soldier flies |
| **CCA** | Chromated copper arsenate |
| **CfW** | Cash for work |
| **CGI** | Corrugated galvanised iron |
| **EAWAG** | Swiss Federal Institute of Aquatic Science and Technology |
| **ERU** | Emergency response unit |
| **GIZ** | German Agency for International Cooperation |
| **HFC** | Hydrofluorocarbon |
| **HP** | Hygiene promotion |
| **ICRC** | International Committee of the Red Cross |
| **IDP** | Internally displaced persons |
| **IEC** | Information, education and communication |
| **IFRC** | International Federation of Red Cross and Red Crescent Societies |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **IRS** | Informal recycling sector |
| **ISWA** | International Solid Waste Association |
| **JICA** | Japan International Cooperation Agency |
| **MHM** | Menstrual hygiene management |
| **MSB** | Swedish Civil Contingencies Agency |
| **OCHA** | United Nations Office for the Coordination of Humanitarian Affairs |
| **ODS** | Ozone depleting substances |
| **PCB** | Polychlorinated biphenyls |
| **PPE** | Personal protective equipment |
| **PVC** | Polyvinyl chloride |
| **RCRC** | Red Cross Red Crescent |
| **SPREP** | Secretariat of the Pacific Regional Environment Programme |
| **SRC** | Swedish Red Cross |
| **SWM** | Solid waste management |
| **UNDP** | United Nations Development Programme |
| **UNEP** | United Nations Environment Programme |
| **UNHCR** | United Nations High Commissioner for Refugees |
| **USAID** | United States Agency for International Development |
| **VCA** | Value chain analysis |
| **WASH** | Water, sanitation and hygiene |
| **WHO** | World Health Organization |

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# Introduction

There is an increasing awareness among humanitarian actors, including those within the Red Cross Red Crescent (RCRC) Movement, of the importance of improving environmental sustainability of programming and operations. Many are recognising that the deteriorating state of the environment can often be a trigger for crises and disasters. There is an urgent need to break the cycle between conflicts, disasters and environmental degradation, including reducing the environmental footprint of humanitarian action.

In emergencies, solid waste generated by both the affected population and humanitarian activities can accumulate quickly and in large amounts. Along with debris from disasters, large build-ups of unmanaged waste have clear potential impacts on health and the environment.

Solid waste management (SWM) solutions need to be adapted to the emergency context and involve all sectors across the breadth and length of a humanitarian response. Contextualised, well-coordinated SWM solutions can effectively minimise negative impacts on health and the environment while enhancing opportunities for material recovery and livelihoods support.

## Why this document?

Solid waste management often 'falls through the cracks' in an emergency response. It is everyone's, yet no one's responsibility. These guidelines attempt to break down the issue into sectoral priorities and actions, with the aim of leading to stronger waste management practices, better outcomes for affected communities and improved environmental sustainability.

Multiple guidance documents on SWM already exist, including for emergency situations. However, there is an increasing demand for immediate and practical advice to sector practitioners who are not necessarily specialised in waste management.

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## What is included in these guidelines?

Developed as part of the RCRC Green Response initiative, these guidelines provide practical, sector specific information on how to better manage solid waste to improve emergency response operations. Key concepts and best practices in solid waste management are presented, as well as existing resources and key references which can be easily accessed for further in-depth technical information. These guidelines are for all practitioners working in emergency operations.

These guidelines are organised in four main sections:

- **Section 1** – General framework for SWM in emergencies;
- **Section 2** – Sector specific guidance notes for water, sanitation and hygiene (WASH), shelter and settlements, livelihoods, relief and logistics, health and facility and office management;
- **Section 3** – General guidance notes on SWM including standards and legal requirements, waste assessments, waste collection systems, recycling, organic waste recovery, incineration and landfilling;
- **Section 4** – Additional resources and further information.

This document is not meant to repeat or replace existing guidelines and documents, but rather to present key concepts, best practices and sector specific information related to solid waste management, and to facilitate access to existing resources that are available.

These guidelines are intended to be a living document, with additional resources and lessons learned from emergency interventions planned to be added in the future.

## How to use these guidelines

These guidelines are structured so that many sections (and sub sections) can be used as independent, concise guidance notes.

The navigation menu on the left of each page allows quick access to relevant information for each sector.

Additionally, within the document internal links allow practitioners to quickly find basic information on key solid waste management issues. External links provide easy access to the most relevant technical guidance and reference documents for detailed information.

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# 01 Framework of solid waste management in emergencies



*Note Disaster waste management is a broad topic, which encompasses both solid waste and debris management. These guidelines focus on solid waste management in emergencies; debris management is not addressed in detail in this document.*

# 1.1 Basic concepts of disaster waste management

## Definitions

| | |
|---|---|
| Disaster waste | Waste that is generated both as a direct effect of the disaster and in the post-disaster phase as a result of the response and recovery processes.<br><br>Disaster waste often consists of large quantities of disaster debris (different materials mixed together, including vegetation, construction and demolition debris, animal carcasses, sediment, damaged vehicles, white goods and electronic waste, hazardous waste), but also solid waste from relief operations, domestic waste from temporary shelters and camps as well as unmanaged municipal solid waste. |
| Disaster waste management | Includes debris clearance (as an immediate after-crisis humanitarian activity), emergency solid waste management, as well as medium to long-term activities focused on supporting the re-establishment and improvement of pre-disaster waste management systems and livelihood recovery.<br><br>A systematic approach is required, following similar principles and standards as solid waste management (see Section 3.1), but considering the characteristics of emergency settings:<br>• Need to integrate preparedness measures at national and local levels (e.g. Disaster Waste Management Contingency Plans, prepositioning of equipment, etc.);<br>• Need to define and adapt priorities in the different phases of the response, looking at both limiting negative impacts and maximization of opportunities;<br>• Need to consider the complete chain of service (from clean-up to final treatment), and hierarchy of interventions (for example, the 4Rs: reduce, reuse, recycle or repurpose, as alternatives to burn and bury practices). |

## Disaster waste – Risks and opportunities

| | |
|---|---|
| Risks | • Obstacle to humanitarian access, recovery and rehabilitation activities.<br>• Threat to the environment and public health: Pollution of air, soil and water, spread of vectors and diseases, injuries, psychological impact, etc.<br>• Exceed the capacity of existing waste management facilities (waste collection systems, landfills, etc.). |
| Opportunities | • Support to recovery and reconstruction: Reuse of debris for reconstruction, recovery of recyclable material and organic waste, community mobilisation, emergency employment.<br>• Build Back Better: Improvement of the resilience of waste management systems, new facilities, capacity building and awareness raising, etc. |

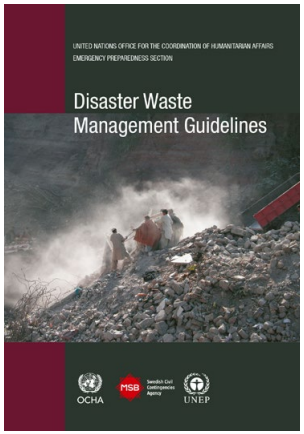
## Actors involved in disaster waste management

The table below outlines key actors who may be involved in debris and waste management activities during emergencies. To ensure a common strategy and increased effectiveness of interventions, an inter-sectoral and coordinated approach among all actors is needed.

| | |
|---|---|
| Public institutions | • National and local authorities responsible for environment, waste management, health, water and sanitation, forestry, emergency response. |
| Private sector | • Waste management companies, transporter and logistics companies, recycling sector (formal and informal), industries. |

| | |
|---|---|
| Humanitarian and development organisations | • Humanitarian actors - most clusters, sectors and working groups are potentially involved or impacted by debris and waste management activities.<br>• International development and humanitarian institutions specialised in solid waste management and disaster waste management (see Section 4.2).<br>• Local non-governmental organisations involved in solid waste. |
| Population | Affected population (including internally displaced persons, refugees and host communities). |

## **Key resources** Disaster waste management



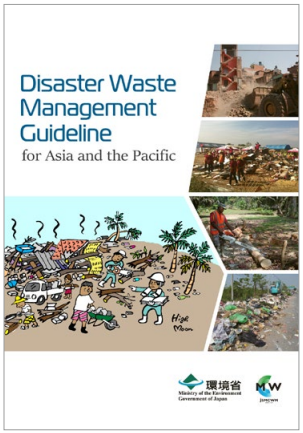

**Disaster Waste Management Guidelines**

UNEP/OCHA, 2011

https://www.eecentre.org/resources/dwm/

Provides an overview of typical disaster waste and their potential impacts, as well as guidance for the implementation of short, medium and long-term disaster waste management actions. The document includes several tools and checklists as Annexes, such as a waste hazard ranking tool, waste handling matrix, and contingency planning guideline.

*Available in English and Spanish.*




**Disaster Waste Management Guideline in Asia and the Pacific**

Ministry of the Environment – Government of Japan, 2018

https://www.env.go.jp/press/files/jp/110165.pdf

Short guidelines targeting mainly national and local authorities in Asia and the Pacific, but applicable to other regions (based on case studies from Japan and other countries). The guidelines provide information on typical types and quantities of disaster waste generated by different disasters, guidance on planning disaster waste management responses (including equipment and resources needed) as well as policy and preparedness processes.

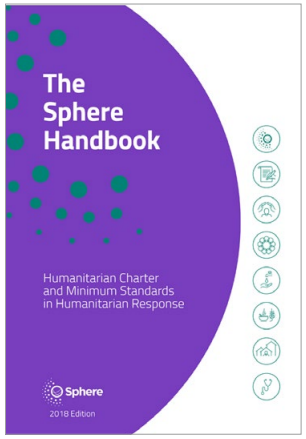

**Planning for Natural Disaster Debris**

EPA (United States Environmental Protection Agency)

https://www.epa.gov/sites/production/files/2019-05/documents/final_pndd_guidance_0.pdf

Complete guidelines on debris management. Although the guidelines are specific to the United States context, they provide relevant technical guidance on specific debris streams (e.g. hazardous waste, e-waste, etc.) and concrete lessons learned from real disaster responses.

# 1.2 Sphere standards for solid waste management




Sphere is a widely recognised set of common principles and minimum standards for humanitarian assistance.

The 2018 Sphere Handbook includes a large number of recommendations related to solid waste – including key actions, guidance notes and indicators – as part of the standards for the following sectors:

- Water, sanitation and hygiene promotion (WASH), including WASH in healthcare facilities
- Food security and assistance
- Shelter and settlements

Key recommendations and actions for solid waste as part of these sectors are detailed in the table below.

## Resource:

The Sphere Handbook Humanitarian Charter and Minimum Standards in Humanitarian Response

Sphere, 2018

https://www.spherestandards.org/handbook-2018/

| Standard reference | Synthesis of main recommendations |
|---|---|
| Water, sanitation and hygiene promotion (WASH) | |
| 2.1 Access and water quantity | • Prioritise treated water to bottled water whenever possible to reduce the amount of waste generated. If this is not possible, establish an appropriate plastic waste management system. |
| 3.3 Management of excreta | • Explore the possibility for co-processing of human waste and organic kitchen waste into compost. |

| Standard reference | Synthesis of main recommendations |
|---|---|
| Water, sanitation and hygiene promotion (WASH), sanitation and hygiene promotion (WASH) | |
| 5.1 Environment free from solid waste | • Design the solid waste disposal programme based on public health risks, assessment of waste generated by households and institutions, and existing practice.<br>• Assess capacities for local reuse, re-purposing, recycling or composting, and encourage these practices within the community.<br>• Work with local or municipal authorities and service providers to make sure existing systems and infrastructure are not overloaded, particularly in urban areas.<br>• Communal collection points: Initially, provide a 100 litre container for every 40 households. In the longer term, aim for one container per 10 households. As a guide, a 2.5 person maintenance team should be available per 1,000 persons.<br>• Protection for waste handlers: Provide personal protective equipment (PPE), soap and water for washing, and training on waste handling and risks. Work with the community to avoid stigmatisation.<br>• Use any safe and appropriate treatment and disposal methods, including burying, managed landfill and incineration. Disposal of solid waste at household level may be possible, and even preferred, in areas with lower population densities (rural areas).<br>• Minimise packing material and reduce the solid waste burden by working with organisations that are responsible for food and household item distribution. |

| Standard reference | Synthesis of main recommendations |
|---|---|
| Water, sanitation and hygiene promotion (WASH), sanitation and hygiene promotion (WASH) | |
| 5.2 Household and personal actions to safely manage solid waste | • Provide households with convenient, adequately sized and covered storage for household waste, or containers for small clusters of households. Consider preferences for the number and size of containers for reuse and recycling.<br>• Provide clearly marked and fenced public neighbourhood collection points where households can deposit waste on a daily basis.<br>• Organise a system to regularly remove waste from designated public collection points.<br>• Waste generation: Assume a generation rate of 0.5 kg/person/day, equivalent to 1–3 litres/person/day, based on typical solid waste density of 200 to 400kg/m3 (can vary depending on how food is obtained and cooked, and activities within or near the household, including seasonal variation). |
| 5.3 Solid waste management systems at community level | • Ensure that institutions such as schools and learning spaces, child friendly spaces and administrative offices have clearly marked, appropriate and adequate covered on-site storage for waste generated at that location.<br>• Provide clearly marked and fenced storage for waste generated in communal areas, especially formal or informal marketplaces, transit centres and registration centres. |

| Standard reference | Synthesis of main recommendations |
|---|---|
| Water, sanitation and hygiene promotion (WASH), sanitation and hygiene promotion (WASH) | |
| 6 WASH in healthcare settings | • Use a minimum three-bin method to collect and segregate waste as soon as it is created: General waste (not hazardous); Used sharps (hazardous, infectious); Not sharps (hazardous, infectious). Further segregation may be needed, including for pathological (human tissue), and pharmaceutical and chemical (laboratory reagents) waste.<br>• Train all healthcare workers in waste segregation and management.<br>• Collect segregated waste from the medical area at least daily, and immediately if highly infectious.<br>• Waste containers, trolleys and storage areas must be disinfected regularly.<br>• Ensure that healthcare waste handlers wear appropriate PPE and are vaccinated for hepatitis B and tetanus.<br>• Treat and dispose of waste depending on the available facilities. Examples include: |

| | |
|---|---|
| **General** | Recycle, burn, or bury in municipal landfill. |
| **Used sharps** | Sharps pit, encapsulate and bury in landfill, incinerate (not vials) then bury in ash pit (with caution, as sharps may not be blunted). |
| **Infectious (not sharps)** | Burial pit (cover waste with lime), incinerate then bury in ash pit, autoclave or chemically treat. |
| **Pathological** | Depends on socio-cultural norms: Burial pits (for example, placenta pit) or burial sites, cremation. |
| **Pharmaceutical** | Follow national guidelines if possible or return to supplier, encapsulate and dispose in landfill, special incinerators (higher than 1,200 °C). |
| **Chemical waste** | Follow national guidelines if possible or return to supplier, small amounts can be incinerated or encapsulated, treat in a treatment plant or rotary kiln. |

| Standard reference | Synthesis of main recommendations |
|---|---|
| Water, sanitation and hygiene promotion (WASH), sanitation and hygiene promotion (WASH) | |
| | • Incinerators should exceed 900 °C and have dual chambers. Low-quality incinerators produce toxic emissions and air pollutants and do not completely sterilise the contents.<br>• All pits and incinerators should be built to existing national and international standards and be safely operated, maintained and decommissioned. |
| Food security and assistance | |
| 6.2 Food quality, appropriateness and acceptability | • Use minimal packaging (biodegradable where possible).<br>• Provide food receptacles (containers) that can be reused, recycled or re-appropriated.<br>• Dispose of waste packaging in a way that prevents environmental degradation. |
| 7.2 Income and employment | • Support engagement of the affected population in environmental activities such as tree planting, camp clean-up and environmental rehabilitation through food and cash-for-work programmes.<br>• Ensure that any debris to be cleared does not contain hazardous materials. Cash-for-work programmes should not involve any clearance at industrial or waste management sites.<br>• Train people involved in environmental activities, and encourage composting of biodegradable waste for use as fertiliser. |

| Standard reference | Synthesis of main recommendations |
|---|---|
| Shelter and settlements | |
| 1 Planning | • Initiate debris management immediately after the crisis.<br>• Debris can be reused, recycled or identified for separation, collection and/or treatment and may provide opportunities for cash-for-work programmes.<br>• Key issues around management of debris include the presence of human bodies, structurally dangerous locations and hazardous materials.<br>• Removal of debris may require specialised expertise and equipment, so must be planned with other sector specialists. |
| 2 Location and settlement planning | • People returning to their original homes and those living in temporary locations or settlements require safe, secure and equitable access to essential services and facilities, such as solid waste disposal.<br>• Create an operation and maintenance plan to ensure the effective running of any facilities, services and utilities such as waste management. Key components of a plan include community participation, establishing user groups, defining roles and responsibilities, and having a cost recovery or cost sharing plan. |
| 5 Technical assistance | • Provide advice on issues such as demolition and debris removal. |

| Standard reference | Synthesis of main recommendations |
|---|---|
| Shelter and settlements | |
| 7 Environmental sustainability | • Plan debris management immediately after the crisis to promote the salvaging of debris for reuse, re-purposing or safe disposal.<br>• Coordinate with WASH, health, public works and other authorities, the private sector and other stakeholders to establish or re-establish sustainable waste management practices.<br>• Target is for 70 % or more (by volume) of solid waste to be reused, re-purposed or recycled. |

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# 02 Sector specific guidance

# 2.1 Water, sanitation and hygiene (WASH)

The WASH sector has a central role in solid waste management (SWM), and is often responsible for implementing SWM systems in camps, in coordination with camp management.

WASH activities can also directly produce a large amount of waste through the distribution of non-food items (hygiene kits etc.).

As the leading sector for SWM, WASH plays an important role in raising awareness of SWM in other sectors, in particular the need for waste reduction and minimization (e.g. packaging reduction, logistics arrangements – see Section 2.4), managing special waste streams (especially hazardous waste – see Section 2.7), and working together to explore potential for reconstruction and livelihood recovery (see Section 2.2 and Section 2.3).

# Small scale emergency solid waste management in camps

## Baseline considerations

- Although the challenges in refugee and internally displaced persons (IDP) camps are often more acute (e.g. due to limitations in space and infrastructure), SWM in camps can be approached using similar concepts as for municipal SWM.
- Key concepts include: the need for an integrated approach addressing all aspects of SWM; consideration of the complete chain of service (from production of waste to final disposal); the hierarchy of interventions prioritising waste reduction and recovery; and the choice of technologies adapted to local context, particularly for waste collection and disposal.

*See Section 3 for general guidance on solid waste management.*

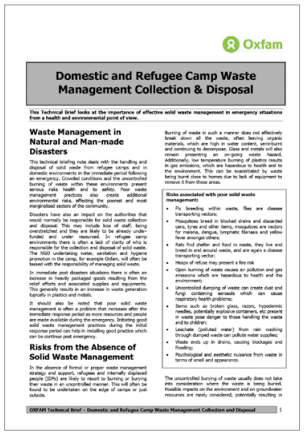
## Recommendations

It is important to ensure that emergency interventions are well integrated with the existing local municipal SWM system (if one exists), and to support it as much as possible by increasing local capacity.

- Conducting initial surveys (see Section 3.1) is important in order to set priorities and define solutions that are best suited to the situation.
- General recommendations that are valid for most emergency settings are:
  - Integrate the specific needs of SWM (particularly space and access) into initial camp designs, in coordination with site planning and camp management agencies (see Section 2.2).
  - Given the typical waste composition in emergency settings and developing countries in general, **prioritise attention on the organic waste stream** which offers a large number of solutions (see Section 3.5) and opportunities to link with livelihood support (see Section 2.3).
  - Co-processing of organic waste with faecal sludge is not recommended (even if options exist), due to the risk of epidemics if processes are not fully controlled.
  - **Regular waste collection (at least twice a week)** should be implemented. Waste collection systems should include basic monitoring as well as tracking indicators of performance (quantities of waste collected, efficiency and cost) so that improvement measures can be implemented as needed.

- Special attention should be given to potential accumulation (build-up) of waste near water sources and drains, as well as market waste and hazardous material within the waste stream.
- Whenever possible, **provide an alternative to the burning of waste**. Burning waste has negative health effects due to the release of pollutants into the environment (see Section 3.6).
- For recyclable materials, consider options that may add value such as pre-processing and accumulation of materials to economically viable quantities. Always take into consideration existing local recycling actors and market (see Section 3.4).

## **Key resources** Solid waste management in camps


Oxfam

Domestic and Refugee Camp Waste Management Collection & Disposal

This Technical Brief looks at the importance of effective solid waste management in emergency situations from a health and environmental point of view.

Waste Management in Natural and Man-made Disasters

Risks from the Absence of Solid Waste Management

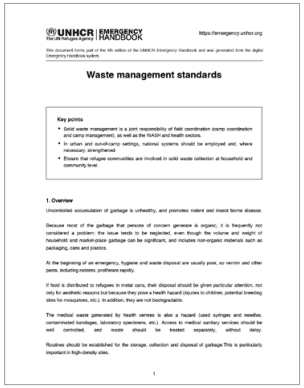
Risks associated with poor solid waste management

**Domestic and Refugee Camp Waste Management Collection & Disposal**

OXFAM, 2008

https://policy-practice.oxfam.org.uk/publications/domestic-and-refugee-camp-waste-management-collection-and-disposal-126686

Technical brief looking at the importance of effective solid waste management in emergency situations from a health and environmental perspective. The document provides guidance on handling and disposal of solid waste from refugee camps and domestic environments in the immediate period after an emergency.


UNHCR | EMERGENCY HANDBOOK

Waste management standards

Key points

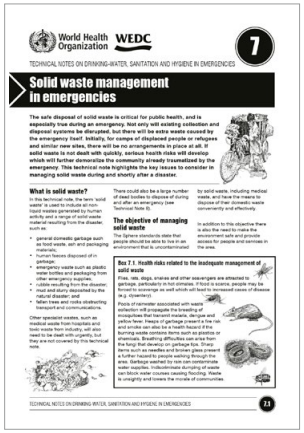
1. Overview

### Emergency waste management standard

UNHCR Emergency Handbook

https://emergency.unhcr.org/entry/116073/emergency-waste-management-standard

UNHCR standards for emergency waste management, applicable to UNHCR field staff and partners. Includes standards on storage, collection and transportation, market waste, hazardous waste, and medical waste management.


World Health Organization WEDC

7

TECHNICAL NOTES ON DRINKING-WATER, SANITATION AND HYGIENE IN EMERGENCIES

Solid waste management in emergencies

What is solid waste?

The objective of managing solid waste

Box 7.1 Health risks related to the inadequate management of solid waste

### Solid waste management in emergencies

WHO, 2011

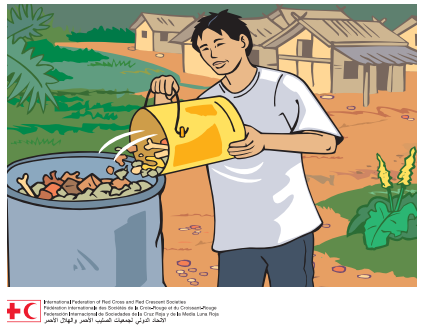
https://www.who.int/water_sanitation_health/emergencies/WHO_TN_07_Solid_waste_management_in_emergencies.pdf

Short technical note on SWM in emergencies which provides basic information on waste assessment, collection, disposal, community consultation and recycling.

# Hygiene promotion and solid waste management

## Baseline considerations

- Hygiene promotion (HP) is critical for the success of SWM activities – both to ensure positive participation of affected populations and to adapt SWM solutions to the local context.
- Existing global HP resources within the RCRC (e.g. HP Box) have very limited SWM content, and focus mainly on waste disposal methods. Country level HP resources and materials (for example, developed by National Societies as part of WASH or health programming) may include more detail on context-specific SWM issues.



*Example of IFRC WASH HP material on solid waste management*

## Recommendations

Include specific messages in HP campaigns about the risks, opportunities and best practices within the different waste streams (e.g. organic waste, recyclable material, hazardous material, etc.). Highlight the relationship between SWM and the environment in general, particularly with soil and food.

- Highlight the risks of burning waste (especially to health), particularly plastics (see Section 3.6) in HP activities. In general, there is limited awareness on this issue and burning is still common practice in clean up campaigns.
- Implement HP together with practical activities in communities and schools.
- Consider integrating new HP resources on SWM as part of standard material for WASH and Mass Sanitation Emergency Response Units (ERUs), and developing capacity and understanding of staff and volunteers in the topic (see Section 2.8).

## **Key resources** Hygiene promotion and solid waste


**Blue Schools - Linking WASH in schools with environmental education and practice**

Swiss Water & Sanitation Consortium

http://waterconsortium.ch/blueschool/

This resource includes a catalogue of technologies, facilitator's guide and catalogue of practical exercises on different topics such as "From Soil to Food" and "From Waste to Resource".

*Available in English, French and Spanish.*


**A handbook for schools on organic waste management**

ISWA / Climate and Clean Air Coalition (CCAC)

https://ccacoalition.org/en/resources/handbook-schools-organic-waste-management

Handbook specially designed to support the implementation of organic waste management activities in schools, in particular composting and vermicomposting.

The handbook shows how these activities can support a wider pedagogic purpose, linking a composting project to many standard educational topics such as science, environment and sustainability, mathematics and literature.

# Menstrual hygiene management links to solid waste management

## Baseline considerations

- Although menstrual hygiene management (MHM) is increasingly being considered as an emergency intervention from day 1 of a response, the management and final disposal of menstrual waste is rarely considered.
- The absence of effective menstrual waste disposal mechanisms can have negative impacts on:
- Safety of girls and women (alternative practices such as disposal at night can expose them to risks of attacks and sexual violence);
- Effectiveness of sanitation systems (disposal directly into latrines is likely to cause frequent blockages and to increase the filling rate of latrines).

## Recommendations

- MHM is very culturally sensitive. Participatory approaches with affected populations are critical, as well as frequent monitoring of practices to adapt solutions. Key consideration include:
- Reduction: Generation of menstrual waste can be reduced by distributing reusable, long-life products instead of single-use products;
- For selection of products, need to consider cultural acceptability as well as conditions and facilities for discrete and hygienic washing and drying of products;
- Complete waste management solutions (primary disposal, collection and final disposal) must be considered.
- Discrete primary disposal solutions include covered waste bins placed inside latrines and chute disposal systems, connected to a collection bin or a deep covered pit outside the toilet.

*Example of latrine equipped with chute for discrete disposal of MHM material (PVC pipe connected to a sealed pit) (Source: IFRC/Swedish Red Cross)*

## **Key resources** Menstrual hygiene management and solid waste


**A toolkit for integrating Menstrual Hygiene Management (MHM) into Humanitarian Response – The Full Guide**

Columbia University and International Rescue Committee, 2017

https://reliefweb.int/sites/reliefweb.int/files/resources/mhm-emergencies-toolkit-full_0.pdf

Cross-sectoral resource on MHM in emergencies providing strategic guidance on best practices and design considerations for integrating MHM across response activities. The document includes a complete section (Section 8) on MHM, Disposal and Waste Management (pages 49-56).


**Addressing menstrual hygiene management (MHM) needs - Guide and Tools for Red Cross and Red Crescent Societies**

IFRC, 2019

https://ifrcwatsanmissionassistant.files.wordpress.com/2019/08/mhm-guidelines-v7.pdf

Provides comprehensive guidance and practical tools for designing and implementing MHM action in humanitarian contexts, adapted for the RCRC context. Solid waste management appears as a cross-cutting issue to be considered in planning and implementation. The guide includes one practical tool specifically on solid waste: Tool 4 – Checklist – Minimum standards for inclusive, MHM-friendly solid waste facilities (pages 48-50).

# 2.2 Shelter and settlements

The Shelter and settlements sector has a strong relationship to solid waste management. Key considerations include:

- Specific needs for SWM services in planning of camps and settlements, in particular in terms of space and access;
- Potential re-use of debris to support the reconstruction process; and
- Solutions to reduce and manage waste linked to the end-of-life of temporary shelter solutions (tents, tarpaulins) and the distribution of household items.

# Space requirements for waste management activities

## Baseline considerations

- Availability of space and type of access are key limitations for identifying appropriate solutions for storage, collection and treatment or disposal of solid waste.

## Recommendations

- Keeping areas available for storage and disposal of solid waste should be considered in the planning of camps and shelters (as per Sphere standards - see Section 1.2).
- Site planners should coordinate with WASH to evaluate the most suitable options for collection, treatment and disposal, and subsequent needs in terms of space and access. Key points include:
- In the long-term, waste recovery options such as composting can be valuable in minimising space requirements compared to final disposal solutions (burial pits, landfills).
- When calculating the space required for disposal infrastructure, take into consideration the lifespan of the infrastructure or facility (long-term perspective).
- When space is limited for final disposal, small-scale decentralised disposal (e.g. household and community pits) and larger-scale disposal solutions (e.g. landfills) can complement each other (see Section 3.7).

# Potential re-use of debris material

## Baseline considerations

- Clearance of debris produced by a disaster is critical to allow the reconstruction process to begin. The re-use and recycling of debris can also provide opportunities for reconstruction.
- The type of material available and potential for re-use varies greatly depending on local construction methods and the type and intensity of disaster.
- Recovery of debris for reconstruction purposes can be assisted by providing appropriate tools and equipment.

## Recommendations

Examples of potential re-use and recycling of debris for reconstruction include:

| Material and potential re-use | Equipment needed |
|---|---|
| Re-use of rubble from building blocks or concrete structures as aggregate for concrete, or land-filling and sub-base material | • Sledgehammer (manual crushing)<br>• Mechanical crusher and screening units (different sizes available) |
| Re-use of corrugated galvanised iron (CGI) sheets for temporary shelter | • Metal cutter for CGI, to remove damaged portions of sheet from sections able to be reused |
| Re-use of timber | • Hammer with nail remover, wood-saws |
| Processing of fallen trees as construction poles | • Chainsaws with cutting guide (small scale)<br>• Sawmills for larger scale processing<br>• Wood treatment solutions |

- When wood is not suitable for construction purposes (e.g. when it is too damaged after floods or heavy rains and does not meet construction standards), it can still be recovered and used for other purposes such as low-grade timber, for production of furniture, or recovered as compost or mulch to support agriculture and tree replanting programs (see Section 2.3).
- It is essential to consider the need for specialised expertise when setting up debris recovery or recycling activities, in particular to address:
  - Demolition of damaged infrastructure and buildings;
  - Verification of structural integrity and long-term sustainability of materials for reconstruction (e.g. structural expertise, forestry etc.);
  - Training of operators (e.g. chainsaw handling, sawmill operation, health and safety, etc.);
  - Potential presence of hazardous material, such as material containing asbestos among the debris (see Section 2.7).

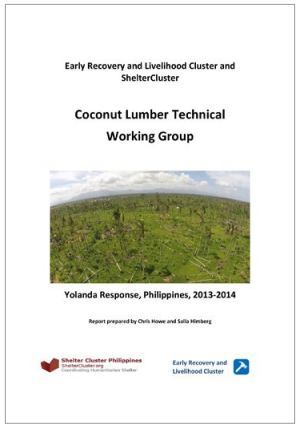
## **Key resources** Debris management and reconstruction


**Planning Centralised Building Waste Management Programmes in Response to Large Disasters**

Shelter Center / ProAct / Disaster Waste Recovery

https://postconflict.unep.ch/humanitarianaction/documents/02_03-04_01-03.pdf

Booklet providing practical advice and guidance on post-disaster building waste management. The Appendix offers guidance on developing a building waste management plan, including details on re-use and recycling potential for a large range of construction material.




**Coconut Lumber Technical Working Group - Yolanda Response, Philippines**

Early Recovery and Livelihood Cluster and Shelter Cluster, 2013-2014

https://www.sheltercluster.org/sites/default/files/docs/Coconut%20Lumber%20Technical%20Working%20Group%20Report%20Feb%202014.pdf

Example of a large-scale strategy for recovery of vegetative debris. The guideline focuses on resources from damaged coconut plantations and opportunities to process lumber into construction timber, lower grade timber and furniture, as well as chipping and charcoal production.

# 2.3 Livelihoods

Two key links between solid waste management (SWM) and livelihoods in emergencies are the potential for employment opportunities through cash-for-work schemes, and supporting recycling as an income-generating activity.

For both, it is essential to carefully consider implementation to apply the “do-no-harm” principle, avoiding or mitigating any negative social and economic impacts of such interventions.

The potential connection between agriculture livelihoods and debris and waste management, particularly organic waste recovery, can be explored as a priority.

## Waste collection and debris clean up through ‘cash-for-work’ schemes

### Baseline considerations

- Cash-for-work (CfW) describes a short-term intervention used by humanitarian actors to provide emergency employment in community activities (such as debris clearance), focusing on the most vulnerable segments of a population.
- In practice, CfW is widely used in all phases of emergency interventions for a broad range of activities, including disaster risk reduction and livelihood recovery activities. CfW also provides a good mechanism for sensitisation activities.

## Recommendation

- Key considerations for consultation with the community:
  - It is important to verify existing social cohesion and coping mechanisms (with the refugee community and the host community) before starting a CfW program.
  - **If clean-up campaigns are already being organised, implementing CfW for debris clean-up could hinder volunteer initiatives**. Alternative options for support could be explored (e.g. providing extra equipment, tools or training, instead of cash).
  - It is important to gather preliminary information with the community on waste generation and composition as well as existing waste management practices. This information can then be used to define the best options for interventions and to understand potential risks (e.g. presence of hazardous material, common practice of burning waste in the community, etc.).
  - Community consultation is also important to ensure that priorities of interventions are defined by the community themselves, and to discuss how to ensure the most vulnerable people benefit from the interventions.
- Considerations for selection of participants in CfW initiatives:
  - Examples of criteria for selection: Vulnerability assessment (e.g. income level, disability within the household), experience with SWM, gender. In refugee and internal displacement settings, interventions should include both the host and displaced communities.
  - When designing a CfW intervention, it is important to consider not only physical work such as waste collection but other activities that can be carried out by different members of the community (e.g. social mobilising, monitoring, cooking for the workers, etc.).
- Training of participants should be provided before starting the work, and should include the following topics:
  - Labour rights (particularly when the informal sector is involved);
  - Health and safety (focusing on SWM, including hazardous waste management);
  - Sorting and recycling.

*Example of community engagement for sorting and crushing of debris in Lebanon (Source: UNDP)*

- Adequate personal protective equipment (PPE) should be provided according to the specific risks of the activity to be implemented. Insurance schemes could also be considered for people involved in debris management.
- **Exit strategy and sustainability:** It is essential to connect CfW interventions as much as possible to longer-term and more sustainable livelihood support, such as supporting the recycling sector, supporting agriculture through organic waste management (see below) or linking debris management and reconstruction processes (see Section 2.2).

## Recycling as livelihood activity

### Baseline considerations

- The recycling sector often represents a significant livelihood opportunity in developing countries. However, it is a complex and fragile system, driven by a market with small margins and needing large quantities of material to be sustainable.
- After a disaster or during an emergency, it is very likely the recycling sector will be affected negatively. At the same time, the post-disaster situation will also offer new opportunities.

### Recommendations

- Any project promoting sorting and recycling activities needs to understand and integrate existing recycling systems, both locally and nationally, and particularly the informal recycling sector (IRS).
- Key information needed on the different actors along the value chain includes their status, main activity, mode of collection and transportation used, quantities collected and/or processed, level of income and unit prices by types of material.

*Member of informal recycling sector collecting recyclable material in Cox's Bazar, Bangladesh (Source: SRC)*

- A value-chain analysis is essential to compare with information on waste generation. It also allows a good understanding of bottlenecks that could be tackled without disturbing the existing system. This can be integrated into a wider market analysis conducted post-disaster.
- It is also important to collect information on the recycling system both before and after the disaster, in order to understand changes in needs and opportunities (e.g. new value-chain can appear and develop after a disaster, such as the recovery of debris for reconstruction).
- Potential support should focus on the most vulnerable actors of the system (the informal recycling sector), improving work conditions and reducing their vulnerability (e.g. support to upgrade equipment, provision of training and protection equipment, increasing of pre-processing capacity, etc.).

*More information on recycling is available in Section 3.4.*

## Other livelihoods opportunities - linking waste management to agriculture

### Baseline considerations

- Apart from the immediate destruction of farming resources themselves, disasters can impact agriculture livelihoods in many ways, such as:
  - Increase of pests and/or parasites in vegetative debris;
  - Pollution of water sources;
  - Lack of access to farmland; and
  - Lack of control of livestock (chicken, pigs etc.).
- Management of debris and disaster waste is essential to minimise these impacts and at the same time it offers opportunities for livelihood recovery and food security in rural, semi-rural and urban areas.

## Recommendations

- Activities connecting debris and waste management and livelihoods can include:
  - Re-use of debris (wood, timber, corrugated iron roofing) for fencing for animals or the establishment of home gardens;
  - Promotion of household composting together with home gardening (see example of keyhole gardens);
  - Promotion of preservation agriculture (use of wood chips from fallen trees/ mulch to prevent erosion, to reduce the need of water and to increase the quality of soil);
- Use of wood chips for animal bedding and production of high-quality fertilizer;
- Larger scale composting in support to re-planting programs and agroforestry initiatives.

*More information on recovery of organic material is available in Section 3.5.*

*Example of keyhole gardening, with composting basket located in the middle of the home garden (Source: Terre des Hommes)*

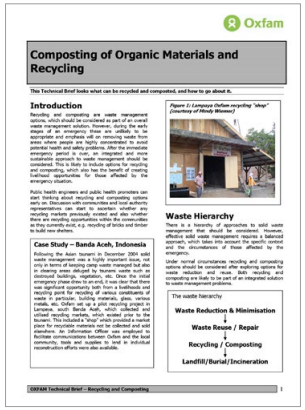
## **Key resources** Livelihoods opportunities in solid waste management in emergencies


### Guidelines for Implementing Cash-for-Work Projects in the Waste Management Sector

GIZ / Disaster Waste Recovery, 2017

https://data2.unhcr.org/en/documents/download/63383

Guidelines presenting principles and criteria for implementing CfW programmes in the waste management sector, as well as recommendations on how to use CfW as a means to achieve environmental goals and improve livelihoods. The document was prepared in the framework of the Syrian refugee crisis in Jordan but in many aspects is applicable to other emergency situations.




### Composting of Organic Materials and Recycling

OXFAM, 2008

https://policy-practice.oxfam.org.uk/publications/composting-of-organic-materials-and-recycling-126187

Technical brief providing basic recommendations on the potential of recycling and organic waste composting, with a focus on emergency situations.

# 2.4 Relief distribution and logistics

Relief distribution and logistics is related to solid waste management (SWM) in emergencies in a number of ways, including:

- Management of the waste produced by relief items (food and non-food) and the need to limit excessive or unwanted donations;
- Potential for reduction in packaging of food and non-food items;
- Potential support through logistics arrangements for transportation of some waste (e.g. take-back system, reverse logistics, identification of recycling and waste collection providers etc.);
- Special waste (including hazardous) produced by fleet maintenance needs to be managed appropriately.

## Excessive and unwanted donation

### Recommendations

- Ensure that relief items consider cultural aspects and will be accepted by affected populations.
- Consider take-back systems for donations if items are unused. This is easier to implement with local/regional suppliers.

## Packaging reduction

### Baseline considerations

- Packaging of relief items (food and non-food-Items) represents a large amount of the waste generated during an emergency.

- Excessive and uncontrolled packaging also represents a reputational risk as packaging branded with RCRC symbols can easily be discarded in an inappropriate way by the recipient.
- While some packaging is often needed to distribute items, there is space for reduction of unnecessary wrapping and double packaging, and innovative packaging alternatives.
- Packaging can often be seen as valuable to recipients – this should be taken into consideration when minimising or designing alternative packaging.

## Recommendations

- Use inclusive packaging where possible. This is when items to be distributed are used as packaging material, instead of single use packaging. Examples include buckets as packaging for hygiene kits, pallets to be used as tables, and tarpaulins repurposed into bags.
- Analyse all relief items for non-essential packaging and processes. For example, do metal items need to be wrapped in single use plastic? Do cardboard boxes need to be bleached, using chemicals that end up disaster affected areas?
- Integrate technical specifications regarding packaging reduction into procurement processes (both for local and international procurement):
  - **Minimum requirement (short-term):** Request suppliers to provide information on quantities, types and purpose of material that will be used for packaging (this baseline is essential to start building knowledge on packaging issues).
  - **Advanced requirement:** Specify maximum quantities and types of material to be included in supply of items, as well as specific minimisation measures (e.g. favouring suppliers that take back empty containers for refilling, or those that use materials with higher recycling rates in country).

*Example of menstrual hygiene kits packaged in plastic buckets. (Source: Netherlands Red Cross/IFRC)*

# Reverse logistics and waste exchange schemes

## Baseline considerations

- A high level of effort is put into logistics to make sure that assistance reaches the affected population (e.g. warehouses, distribution centres, vehicles). Many of these resources could also be used to support waste and debris management in emergencies, with little to no extra expense.
- Such arrangements can be particularly useful to facilitate removal of recyclable and special waste (e.g. electronic waste) from remote locations where very limited waste management capacity is available (rural and semi-rural areas, islands, etc.).

## Recommendations

- Explore logistics solutions which use relief distribution vehicles (e.g. trucks, boats) to transport disaster waste back from affected locations, instead of them coming back empty:
  - Specific requirements should be included in transportation agreements and contracts (additional effort and time is required for loading and unloading of material);
  - In affected locations, material needs to be already sorted and packed, ready to be loaded (e.g. packed in bulk bags etc.).
- **Waste management in warehouses:** When packaging reduction is not possible from the beginning of the supply chain, options for re-packaging in warehouses can be explored in order to reduce the amount of waste reaching affected communities.
- **Distribution centres and voluntary drop-off for recyclable material:** Using incentives for affected populations to bring their recyclables to distribution centres and other voluntary drop-off locations (e.g. schools) can be very helpful in order to increase quantities of material available and interest from the recycling sector.
  - Convention (1992) on the control of transboundary movements of hazardous wastes and their disposal, which was amended in 2019 to include a legally-binding framework on plastic waste transportation (see Section 3.1).

- **Considerations for identification and involvement of recycling and waste collection providers:**
  - Local suppliers and transporters can be helpful in providing information and contacts of recycling and waste collection providers.
  - Special requirements can be integrated within service agreements (e.g. request for providers to propose recycling solutions, management of electronic waste from solar lamps, batteries, etc.).
  - The information gathered on existing recycling and waste collection providers will help the set-up of logistics within the relief distribution system, and should be shared with other emergency sectors.
  - As part of disaster preparedness, identify and collect information on existing recycling and waste collection providers at national and local level (if possible). Establishing this information as a baseline before a disaster strikes will save time in an emergency.
  - If international transportation of waste for further treatment is foreseen, national and international regulations in waste transportation must be considered. In particular, logistic schemes must consider the Basel Convention (1992) on the control of transboundary movements of hazardous wastes and their disposal, which was amended in 2019 to include a legally-binding framework on plastic waste transportation (see Section 3.1).

## Vehicle maintenance waste

### Baseline considerations

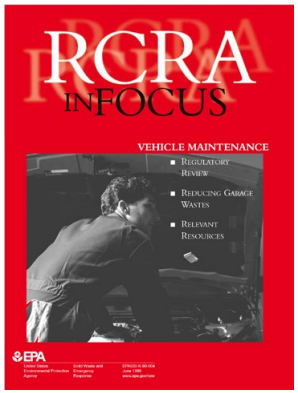
- Vehicle maintenance and fleet management activities can produce significant amounts of potentially hazardous waste (e.g. used oil, hydrocarbons, tyres, batteries, antifreeze, etc.), which require proper management.

### Recommendations

- All waste resulting from fleet management, particularly hazardous materials, should be properly managed starting with safe storage and labelling. Research locally available treatment solutions (*more information on hazardous waste management in Section 2.7*).

- When fleet management is outsourced, waste management procedures need to be part of the contractual agreement (e.g. list of maintenance procedures, waste produced and management solutions). Control that these waste management procedures respect national and international standards, as much as possible.
- **Used oil:**
  - Used oil must be properly stored in sealed containers and labelled. Avoid mixing different types of oils. Store containers in a place that is protected from rain and prevent direct leakage into the environment.
  - Explore potential solutions for refining used oil, or use as fuel in specially designed generators (available options will vary depending on the local context).
  - Bio-remediation solutions (e.g. using wood chips) can be implemented for small quantities of spilled oil or contaminated soil.

## **Key resources** Vehicle maintenance waste




**RCRA in focus - Vehicle Maintenance**

EPA (US Environment Protection Agency), 1999

https://www.epa.gov/sites/production/files/2015-01/documents/vehicle.pdf

This document presents the life cycle of waste material linked to vehicle maintenance. Although it is prepared according to US regulations, the document provides useful tools for management of hazardous vehicle waste that can be transferred to other contexts.

In particular, it includes a list of all main (hazardous) material linked to specific maintenance processes together with recommendations for minimisation, recycling and treatment (pages 10 – 13).

# 2.5 Health

Healthcare waste includes both infectious material and toxic chemicals, which pose contamination risks to people and the environment. Healthcare waste requires specialised management.

Most organisations involved in health activities have well documented protocols for management of healthcare waste. However in emergency settings, implementation of solutions is often more complex due to financial, physical and staff limitations and waste management practices may not always meet established standards.

## Baseline considerations

- Only 10 to 25% of the total waste produced in hospitals and clinics is hazardous (Source: WHO); the rest of the waste can be combined with domestic waste.
- The priority of healthcare waste management in emergencies is to avoid risk of contamination to people. Environmental aspects should also be considered, particularly for the final treatment of waste.

## Recommendations

- Key aspects of healthcare waste management include:
  - Waste minimisation (e.g. purchasing of PVC-free equipment, recycling, sterilisation, stock management, etc.);
  - Waste sorting at source and waste handling in different containers (e.g. sharps, potentially infectious waste, household refuse);
  - Collection, storage and transportation;
  - Treatment and disposal (including incineration, chemical disinfection, autoclave, encapsulation and burial).

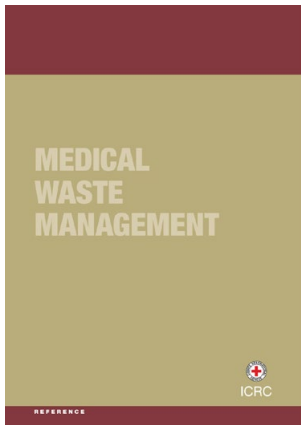
- All workers should be trained on healthcare waste management (including staff in charge of waste management, cleaning and collection teams).
- When transportation and treatment of healthcare waste is outsourced (e.g. to private sector or local authorities), it is essential to verify that minimum standards are respected in terms of health and safety and in the final treatment of waste. If needed, the necessary support should be provided to these operators so that minimum standards can be met.
- **Incineration:**
  - Open burning (including burning in barrels) should be avoided. Because it does not reach high temperatures, persistent organic pollutants (POPs) are produced and released into the atmosphere. There is also incomplete elimination of pathogens.
  - Incineration at high temperatures (at least 900°C as per Sphere standards) is recommended for medical waste. Incineration of chlorine containing material should be avoided (as this is a source of POPs). Incineration of vials should be avoided due to the risk of explosion during the incineration process.
  - Different types of small-scale incinerators can be used, depending on the context. For field and mobile clinics, portable incinerators can be an alternative where more permanent solutions are not feasible. Portable incinerators should be included as standard equipment for field hospitals and mobile clinics.
  - Incineration must be coupled with infrastructure for safe management of ashes (e.g. ash pit).

  *More information on incineration is available in Section 3.6.*

- **Management of distributed products**
  - Part of the health sectors' responsibility for solid waste includes the management of distributed health products (e.g. pharmaceuticals), in particular empty receptacles (containers).
  - Reverse logistics solutions can be implemented using distribution centres as voluntary disposal points for empty containers. Once accumulated, larger quantities are easier to deal with in an appropriate way compared to ad-hoc field solutions.
  - Arranging with providers of medicines to take back empty containers (and unused/expired goods) could also be explored.


*Example of a medicine distribution center that could be used as a reverse logistic hub for containers.*

## Key resources




**Medical waste management**

ICRC, 2011

https://www.icrc.org/en/publication/4032-medical-waste-management

Complete and practical manual for medical waste management in emergency settings, covering key aspects such as waste minimisation, sorting, collection and storage, transport, treatment and final disposal (different solutions adapted to different categories of waste).

The manual also provides guidance for organisational and health and safety measures, as well as detailed data sheets on the categories of hazardous healthcare waste, methods for waste treatment (analysis of advantages and drawbacks), and other tools for the implementation of waste management programs in healthcare facilities.


**Overview of technologies for the treatment of infectious and sharp waste from health facilities**

WHO, 2019

https://www.who.int/water_sanitation_health/publications/technologies-for-the-treatment-of-infectious-and-sharp-waste/en/

Document providing a wide overview of options for treatment of infectious and sharp waste, including an analysis of advantages and drawbacks for each technology. The document includes a chapter on technologies in low-resource settings (pages 30 – 37).

# 2.6 Facility and office management

Offices can be significant sources of waste, however there is often good potential for substantial reductions in the quantities of waste produced.

Office waste management also creates opportunities for raising awareness amongst different sectoral staff on the set-up and implementation of waste management best practices, as well as research of local solutions that could be applicable for field activities.

## Baseline considerations

- Typical waste produced in offices includes:
  - Paper and printed products;
  - Office equipment, including electronic waste;
  - Other waste such as food scraps, food packaging, water bottles and cleaning products.

## Recommendations

- **Reduction:**
  - Limit the number of documents to be printed (e.g. use digital documents);
  - Print on both sides of paper (set as default on printers);
  - Use refillable printer cartridges instead of disposable cartridges;
  - Use a common drinking water source, for example a reusable 20 to 30 litre container, to reduce use of individual water bottles;
  - Encourage food suppliers and restaurants to provide reusable packaging.

- **Segregation and collection:**
  - Ensure basic segregation of waste into organic, inorganic and special waste (e.g. electronic waste) before primary storage;
  - Ensure that contractual agreements for cleaning service providers encourage the involvement of local recyclers for recovery of recyclable materials.
- **Motivation techniques:**
  - Sensitise all staff on SWM, including the need for the office to be an example of best practices;
  - Utilise motivation techniques (e.g. 'recycling champions' and training) to motivate cleaners and facility management;
  - Keep a basic record of the quantities of waste produced (simple tracking), including the final destination (e.g. recycling, disposal, etc.).
- **Electronic waste:**
  - Electronic waste requires specific handling (see Section 2.7), in particular potentially hazardous materials (batteries, accumulators, light bulbs, etc.).
  - Reduction measures should assess the quality of the equipment, the local capacity for maintenance, and existing recycling and treatment options.
  - In emergencies, the tendency is for all equipment to be left with the National Society. End-of-life solutions (including possible arrangements for international shipping) should be explored to avoid 'leaving the problem' behind.

WASTE IN UN ENTITIES – 2019

| UN entity | Waste per capita (kg/person/ annum) | Reused/ recycled/ composted/ recovered (%) | Incinerated - Closed (%) | Incinerated - Open (%) | Landfilled (%) | Controlled disposal (%) | Other (%) |
|---|---|---|---|---|---|---|---|
| CTBTO | 235 | 93% | 6% | 0% | 1% | 0% | 0% |
| FAO | 176 | 15% | 0% | 0% | 85% | 0% | 0% |
| IAEA | 209 | 94% | 5% | 0% | 1% | 0% | 0% |
| ICAO | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| IFAD | 98 | 40% | 0% | 0% | 16% | 0% | 44% |
| ILO | 208 | 83% | 0% | 0% | 11% | 0% | 6% |
| IMF | 446 | 63% | 0% | 0% | 36% | 0% | 1% |
| IMO | 500 | 92% | 0% | 0% | 0% | 0% | 8% |
| IOM | 118 | 4% | 0% | 1% | 6% | 78% | 12% |
| ITC | 71 | 67% | 32% | 0% | 0% | 0% | 1% |
| ITCILO | 274 | 100% | 0% | 0% | 0% | 0% | 0% |

*Example of institutional tracking of waste disposal method by United Nations agencies (Source: https://www.greeningthebluereport2019.org/waste )*

# 2.7 Hazardous and special waste

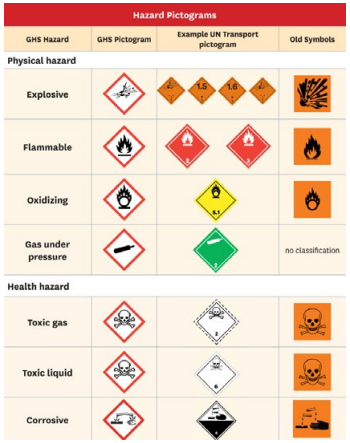
Hazardous waste has physical, chemical, or biological characteristics that pose risks to health or the environment. Hazardous waste required special handling and disposal procedures. In emergencies, hazardous waste can include material generated by the disaster itself as well as products used in the emergency response.

It is essential for emergency practitioners, volunteers and affected communities to be able to identify risks and implement measures to mitigate these risks. Among hazardous material commonly found in emergencies settings, asbestos and treated timber require special attention. If they are incorrectly included in material recovery processes, both volunteers and affected communities could be put at risk.

## General approach to hazardous waste management

### Baseline considerations

- Examples of hazardous waste include:
  - Petroleum, oil and lubricants;
  - Electrical transformers with polychlorinated biphenyls (PCBs);
  - Treated timber;
  - 'Under-the-sink' items (paint, varnishes, detergents, etc.);
  - Chemicals such as acid, chlorine and pesticides;
  - Electronic waste (fluorescent lamps, batteries, etc.);
  - Ammunitions;
  - Asbestos containing materials (ACMs);
  - Hazardous healthcare waste (sharps and/or infectious waste).
- Hazardous materials are usually classified based on the type of hazard (e.g. explosive, flammable, toxic, corrosive, etc.) and the physical state (liquid, solid or gas).




*Example of hazards types of waste and their symbols (Source: UN Environment)*

## Baseline considerations

The potential impact of hazardous material depends on the **hazard** (type of chemical hazard), the **quantity** of material released and the **exposure** to receptors (people and the environment).

- In order to prevent any impact from hazardous materials, one of the elements (hazard, quantity, exposure) needs to be removed.
- The **exposure pathway** refers to the way that people and/or the environment can come into contact with a hazardous substance. Potential pathways vary depending on the state of the hazardous substance (liquid, solid, gas) and include air, soil, groundwater, water bodies (e.g. lakes, rivers or seas), humans and animals.

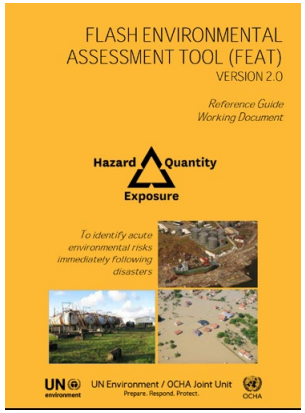

*The hazard, quantity, exposure triangle. (Source: UN Environment)*

## Recommendations

- Support from specialised organisations may be required to deal with hazardous material (potential resources are listed in Section 4.2)
- Key steps for hazardous waste management include:
  1. Identification (type of hazardous substance, quantities);
  2. Segregation (avoid mixing with the domestic waste stream);
  3. Storage and labelling, ensuring that leakages are prevented (e.g. containers protected from rain, spill prevention measures, cement base for storage facilities, drains, etc.);
  4. Appropriate storage conditions will vary depending on the type of hazardous waste. For example, fluorescent lamps need careful storage and handling to avoid breaking the lamps which releases hazardous substances into the environment;
  5. Safe disposal and treatment. If no infrastructure is available for safe final disposal, temporary storage should be implemented.
- Hazardous waste regulations and the availability of disposal and treatment infrastructure differs from country to country. Local context and availability should be taken into consideration when defining hazardous waste management options.

- If no suitable solution is available in country, final disposal might require international transportation to another country. In this case, stipulations of the Basel Convention (see Section 3.1) will need to be considered.
- If management of hazardous waste is outsourced, it is essential to verify that the procedures used by the service provider meet national and international regulations (including the need for proper licenses, etc.).

## **Key resources** Hazardous waste management




**Flash Environmental Assessment Tool (FEAT)**

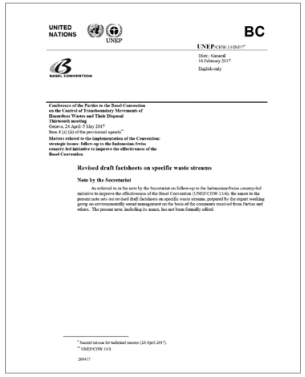
Joint UNEP/OCHA Environmental Unit, 2018

https://www.eecentre.org/resources/feat/

The FEAT is a tool designed to help identify acute environmental risks immediately following disasters. It includes a list of potential hazardous material for different types of processes and facilities, and a list of substances and related hazard type.

*Available in English, French, Russian and Spanish.*

*Free online training available on:* https://www.eecentre.org/training/
*(details in Section 4.3)*




**Fact sheets on specific waste streams**

UNEP/BASEL CONVENTION, 2017

http://www.basel.int/Default.aspx?tabid=5843

Technical fact sheets to support the implementation of environmentally sound management practices for hazardous wastes and other wastes in accordance with the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal. The sheets include specific information for the following waste streams: waste vehicles, healthcare or medical waste, lead-acid batteries, waste oils and pneumatic tyres.

## Specific considerations on treated timber, asbestos and electronic waste

### Treated timber

- Timber used in construction and infrastructure (e.g. electricity poles) can be impregnated with hazardous chemicals such as chromated copper arsenate (CCA).
- CCA treated timber should not be burnt, used as firewood for cooking, or composted as these practices will release arsenic into the air, soil, food and water.
- Potential re-use of treated timber locally for reconstruction, or fencing of agricultural lands should be favoured.
- Consider the potential risk of injuries from nails in timber.

### Electronic waste and white goods

- Lots of electronic waste, or e-waste, contains dangerous chemicals and heavy metals such as lead, mercury, cadmium or brominated flame retardants, which are considered hazardous waste under the Basel Convention (see Section 3.1). E-waste includes items such as:
  - Used electric and electronic equipment (e.g. televisions, computers);
  - Energy-saving light bulbs;
  - Batteries.
- White goods such as fridges, freezers and air conditioners often also contain ozone depleting substances and synthetic gases such as hydrofluorocarbons (HFCs). These have a very high greenhouse gas effect potential and require proper management, as stated in the Stockholm Convention (see Section 3.1).
- Soil and water risk being permanently polluted if electronic waste is burnt or stored improperly (e.g. through release of heavy metals or persistent organic pollutants).
- E-waste also offers potential for extraction of valuable material (e.g. gold, copper). However:
  - E-waste recovery needs to be done in specialised facilities;
  - Non-professional e-waste processing can result in heavy pollution (e.g. burning of PVC cables to recover copper, leakage of battery acid, etc.).

## Asbestos

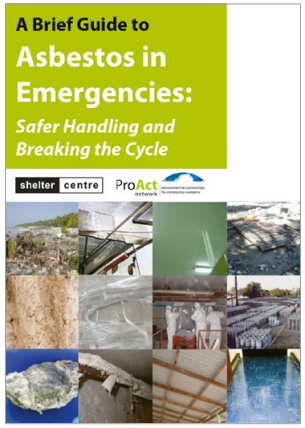
- Asbestos is a naturally occurring fibrous mineral with good tensile (flexible) strength, insulation and fire resistance properties.
- Asbestos is used in construction materials such as fibre-cement (e.g. cement sheeting, pipes, corrugated cement roofing) and insulation materials.
- The inhalation of asbestos fibres has been proven to cause lung diseases and cancers.
- Two main types of asbestos containing material (ACM) are:
  - Non-friable or bonded ACM (e.g. asbestos cement, in which asbestos fibres are bonded into the cement material);
  - Friable ACM, which is brittle and can be crumbled by hand (e.g. sprayed insulation). This is particularly dangerous as asbestos fibres are not bonded and are easily airborwne.

*Example of suspected asbestos containing material among debris from Tropical Cyclone Idai, Mozambique.*

- ACM must be handled by trained personnel who follow standard procedures to minimise the release of asbestos fibres. Personnel must be equipped with adequate personal protective equipment (PPE).
- Suspected ACM needs to be tested in a laboratory to verify the presence and type of asbestos. If presence of asbestos is suspected, assume that the material does contain asbestos while laboratory tests are being performed.
- Each country has different regulations regarding the use and management of ACM. **Many countries still use and import some asbestos containing material**.
- Management of ACM is a highly specialised area and requires **deployment of specialists in emergency situations** if presence of asbestos is suspected.

*Countries with bans on asbestos.*
*Red: countries with full or partial bans;*
*Orange: countries expected to ban asbestos completely by 2020;*
*Grey: countries with no bans.*
*(Source: http://asbestosglobal.org)*

## Key resources Management of asbestos containing material

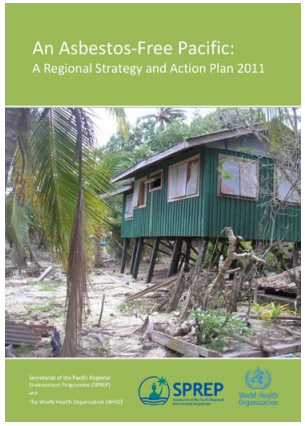



**Asbestos in Emergencies: Safer Handling and Breaking the Cycle**

Shelter Center / ProAct / Disaster Waste Recovery

https://postconflict.unep.ch/humanitarianaction/documents/02_05-08.pdf

Simple and practical guide for transitional settlement and reconstruction practitioners, providing basic information on asbestos and its associated health risks, and key recommendations for minimising the risks of dealing with asbestos in post-disaster transitional settlement and reconstruction operations.




**An Asbestos-free Pacific - Regional Strategy and Action Plan**

SPREP / WHO, 2011

https://www.sprep.org/publications/an-asbestos-free-pacific-a-regional-strategy-and-action-plan-2011

Document providing useful guidance for management of asbestos containing material in emergencies, in particular Appendix 1. Asbestos disposal options (page 16 – 17), Appendix 2. PPE guidelines for asbestos handling (page 18), Appendix 3. Asbestos handling guidelines (pages 19 – 20), and Appendix 4. Post-disaster asbestos safety and collection guidelines (page 21).

GENERAL STRATEGY FOR RISK REDUCTION
LINKED TO ASBESTOS CEMENT

1. Situation Analysis

1.1 Impact of the Cyclone IDAI

Tropical Cyclone IDAI made landfall near Beira city, Sofala province, on the night of 14th to 15th of March. Strong winds (185 – 220 km) resulted in heavy damage to buildings in the area, in particular destruction of roofs. Available damage assessment indicators that around 70% of buildings[1] were damaged in the city of Beira, including public buildings, schools, hospitals, industries and warehouses, as well as private properties. In the provinces of Sofala and Manica, the total number of houses totally or partially destroyed raises to 240,000[2].

Concerns were raised early in the response about the possible presence of Asbestos-Containing Materials among damaged roofing and debris (fibre cement) by Humanitarian Actor, Government and Local Authorities.

Figure 1 – Damaged fibre cement roofing in Palmeira and Commercial buildings in Beira city

Fibre cement material was produced in a local factory ("Lusalite") located in Dondo city (30 km from the Beira City). Information from current owner of the factory indicate that the products are asbestos-free only since 2003[3], so it can be assumed that most fibre cement products used until that date will probably contain asbestos.

Information from National Statistics Institute (see table 1 below) indicate that high percentages of "Lusalite" roofing for housing can be found in Beira (10.6 %) and Dondo

[1] Source: Beira Municipal recovery and Resilience plan
[2] Source: FEWs
[3] It is confirmed on the Mozalite website (source: https://mozalite.net/a-mozalite/)

**General Strategy for Risk Reduction linked to Asbestos Cement**

Shelter Cluster/UNDP, Mozambique, 2019

https://ehaconnect.org/wp-content/uploads/2019/09/Asbestos-Cement-General-Strategy-Risk-Reduction-Final-1.pdf

The strategy addresses the issue of asbestos cement material within the debris from Tropical Cyclone Idai in Mozambique. The document includes suggestions for awareness raising, training, safe removal and handling as well as final disposal of asbestos cement material, together with long-term considerations for regulation and capacity development.

# 2.8 Organisational development

Organisational development within the Red Cross Red Crescent (RCRC) Movement is essential to improve existing capacity to manage solid waste in emergencies, and should be considered as a key preparedness activity.

Organisational development should include capacity building of RCRC staff and volunteers along with improvement of RCRC institutional capacity to take preparedness measures, capitalise on lessons learned and define best practices for solid waste management (SWM) in emergencies.

## Current training materials

- At a global level in the RCRC, there are currently limited SWM related training resources available. National Societies or regions may have additional training materials developed through WASH or health programming on context-specific solid waste issues.
- The Austrian Red Cross WASH Emergency Response Unit (ERU) training package (revised in 2019) includes surface water and solid waste management. Sessions cover the disaster waste management chain, impacts of disaster waste, relevant waste streams, assessment questions for SWM in emergencies, characteristics and challenges for waste collection and treatment, and the importance of personal protective equipment (PPE).

## Recommendations for capacity development

- Systematically include SWM within training programmes for staff and volunteers:
  - Comprehensive training on SWM for WASH staff and volunteers (making use of existing resources outlined above);
  - Basic or specific training modules for staff and volunteers of other sectors (e.g. health, shelter and settlements, logistics).
- Consider adapting and translating training material into other languages to improve reach and accessibility.
- Take advantage of existing e-learning courses (see Section 4.3).


*Extract of SWM training module developed by Austrian Red Cross for WASH Emergency Response Unit.*

## Recommendations for improvement of institutional capacity

- Network and collaborate with global and local actors of SWM prior to emergencies and maintain up-to-date information on SWM at national and regional levels.
- Implement systematic monitoring of SWM initiatives in emergency and longer-term programming within the RCRC to capture lessons learned, and:
  - Share findings within the RCRC movement and wider humanitarian community through existing platforms (see Section 4.1 and Section 4.2);
  - Periodically improve and update this guidance document with information from the field.
- Set up an online repository (webpage) where key internal RCRC documentation (e.g. guides, cases studies, reports etc.) on solid waste can be shared systematically, with a view to strengthening learning from past experiences and improving accessibility to resources.
- Through National Societies, collect information on the country recycling context, key actors in waste management, and so on. Having baseline information collected before a disaster or emergency can help facilitate the rapid set-up of waste management or recycling schemes, and allow comparison with pre-disaster waste management systems to understand what the impact of the disaster has been.

CONTENTS



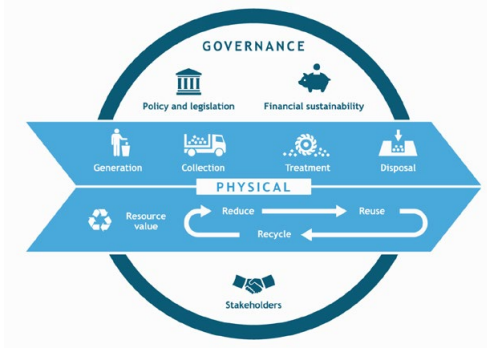
# 03 General guidance on waste management

# 3.1 Standards and legal requirements

## Integrated solid waste management

For a solid waste management (SWM) system to be effective and sustainable, a number of elements need to be addressed simultaneously and in a cohesive way. Components of integrated solid waste management (SWM) include:

- The complete SWM chain, from waste generation to final disposal;
- The 4Rs components (reduce, reuse, recycle, repurpose);
- Governance and cross-cutting elements such as policy and legislation, financial sustainability, and stakeholder involvement (including community engagement, private sector and informal actors).



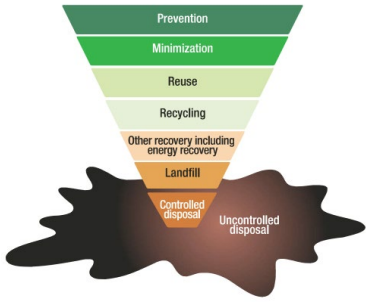

*Elements of integrated solid waste management (Source: EAWAG)*

## Hierarchy of interventions

The waste management hierarchy is a simple and regularly used 'rule of thumb', which provides a general order of priority for waste management options and technical approaches. The objective is to encourage treatment options that deliver the best overall environmental outcome (Source: UNEP/ISWA).

Actions to reduce, re-use and recycle waste are preferred, followed by other recovery options (including energy recovery). Landfilling and controlled disposal follow at the bottom of the hierarchy.

Uncontrolled disposal (which includes open burning of waste) is placed outside of the hierarchy and should not be considered as an appropriate or acceptable option.




*Hierarchy of interventions in SWM (Source: UNEP/ISWA, 2015)*

## International agreements

There are several international agreements related to waste and hazardous waste management. These agreements are not ratified by all countries in the world, and therefore national regulations should always be verified as part of any baseline assessment (see Section 3.2). Key international agreements related to waste management include:

### Basel Convention on the control of transboundary movements of hazardous wastes and their disposal, 1992

The main objectives of the Basel Convention are to minimise hazardous waste generation, to treat hazardous waste as close as possible to where it was generated, and in particular to reduce transboundary movement of hazardous waste.

The Convention specifies some exceptions for transboundary movements, in particular if the country of export does not have the technical capacity or the necessary facilities for safe disposal of a specific type of waste.

Technical guidelines on transboundary movements of electrical and electronic waste and used electrical and electronic equipment were developed, which clarify the distinction between waste and non-waste of such material under the Basel Convention.

In 2019, the Convention was amended to include plastic waste in a legally-binding framework which aims to make global trade in plastic waste more transparent and improve regulation. In particular, it was agreed that mixed, unrecyclable and contaminated plastic waste exports require the consent of importing countries before waste exports can proceed.

For more information see http://www.basel.int/

### Stockholm Convention on Persistent Organic Pollutants, 2004

The Stockholm Convention aims at eliminating or reducing the production and release of persistent organic pollutants (POPs) into the environment.

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

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

The Convention recommends that priority consideration should be given to alternative processes, techniques or practices which avoid the formation and release of POPs, and in the case of incineration, to improve combustion through the control of parameters such as incineration temperature or residence time.

For more information see http://www.pops.int/

## Montreal Protocol on Ozone Depleting Substances, 1987

The Montreal Protocol regulates and aims at phasing out the production and consumption of nearly 100 man-made chemicals referred to as ozone depleting substances (ODS).

The Kigali amendment (2016) also integrates the phasing out of hydrofluorocarbons (HFCs), which are not considered as ODS but have a very high potential effect on the greenhouse.

# 3.2 Waste assessments

The implementation of solid waste management (SWM) requires a sound understanding of the system in which the activities will take place (see Section 3.1), including waste generation, current practices in term of collection and disposal, community perceptions, the institutional framework, recycling systems and so on.

Activities implemented at different levels (e.g. institutions, community) can impact on the whole system. Regular monitoring is important to understand possible changes in the system and to adapt accordingly.

## Waste generation

### Baseline considerations

Knowledge about waste generation is essential to plan for any SWM system. This information will influence the type and size of storage and collection equipment, waste reduction and recovery opportunities, potential hazards and treatment options.

Key information required in terms of waste generation includes:

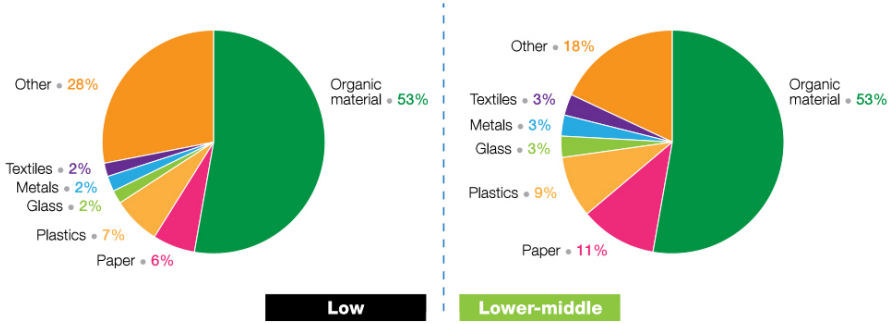
- Waste production (in kilograms/day/person for domestic waste);
- Average waste composition (percent of different waste fractions);
- Waste density (in kilogram per cubic metre, kg/m3).
- Additional information (requiring advanced studies) can be needed for specific processes, such as moisture content and calorific value for waste-to-energy processes.

## Recommendations

Usually, information regarding waste generation is gathered through a local characterisation survey, covering both households and the commercial sector. Standard methodology is available in many guidelines (see key resources below) and includes:

- Definition of a characteristic sample size (number of households, shops, institutions);
- Daily door-to-door collection of waste for 8 days, followed by sorting and weighing;
- Data processing and quality control.

- Waste characteristics may vary between generation and disposal locations (e.g. waste density is usually higher in collection containers than at households, due to natural compaction).
- The following information can also be used temporarily in the absence of a characterization survey or to complement information:
  - Visual analysis of waste composition, at informal disposal sites and landfill (e.g. verify the presence of specific waste streams, hazardous material, recyclable and organic material, etc.);
  - Reference values from previous surveys in the region, country or in similar contexts (use with caution as waste generation is specific to each context).
- Typical values used in emergency settings (as per Sphere standards, see Section 1.2) and in low and middle-income countries are:
  - Waste density: 200 to 400 kilograms /cubic meter (kg/m3);
  - Waste production: 0.5 kilograms/day/person, equivalent to 1–2 litres/day/person;
  - Waste composition: > 50% organic material (see graphs below).



# Assessing existing systems

## Waste collection systems

- **Time and motion surveys** aim to understand the effectiveness of a waste collection system and to identify potential for improvement. They consist of registering and analysing the time spent for different steps of the collection process, including:
  - Loading of waste at collection points;
  - Transportation between collection points;
  - Transportation to the disposal facility;
  - Unloading of waste at the final disposal facility.
- Assessment of a waste collection system should also include information on:
  - Type and number of containers (including their geographical distribution);
  - Equipment used for transportation;
  - Staff involved in the collection process, including health and safety practices;
  - Quantities of waste collected;
  - Specific limitations and difficulties such as conditions of access roads, overflowing containers, etc.

## Waste disposal facility

Key aspects to be looked at when assessing a waste disposal facility (e.g. dumpsite, landfill) are:

- Access (from collection area and internally within the disposal facility);
- Environmental and health impacts (e.g. environmental protection measures, fires, proximity to water bodies, proximity to agriculture land and houses, risk of landslides etc.);
- Control measures (e.g. fencing, control and registration of vehicles etc.);
- Available capacity for further disposal of waste (e.g. size, topography etc.);
- Existing practices (e.g. waste disposal operations, health and safety practices, presence of the informal recycling sector, presence of hazardous waste, illegal dumping of waste etc.)

### Financial assessment

The financial assessment of a waste management system aims to understand the cost per ton of waste managed, and if possible:

- Cost for waste collection, including equipment, staff, consumables;
- Cost for disposal including operation of the disposal facility, but also loss of productive land (because knowing the "real" cost of final disposal is important to compare with alternative recovery options);
- Other costs (e.g. administration, information and communication, etc.);
- Potential revenues from taxes, sales of recyclable material, and so on.

### Recycling

- Value chain analysis (VCA) identifies the different steps of recycling, the actors in the value chain, and potential commercial viability of recycled materials, including secondary products. More information on recycling is available in Section 3.4.

## Institutional and regulatory considerations

Key information to be gathered about the institutional and regulatory framework include:

### Responsibilities and capacity

Distribution of responsibilities and existing capacities for:

- Municipal waste management (usually local authorities such as municipalities or districts);
- Healthcare waste management (usually Ministry of Health);
- Hazardous waste management (usually Ministry of Environment).

### Regulation and strategies (national and local levels)

- Solid waste management strategies: National policies, local solid waste management master plans, disaster waste management contingency plans, etc.
- National regulation: Hazardous waste management (e.g. asbestos bans), single-use plastics and plastic bags, waste disposal, incineration and emissions standards, etc.

## Consultation and cultural issues

- Community consultation is essential to understand current practices (e.g. backyard burning, burying) and perceptions about waste, distribution of responsibilities within the household, and knowledge of risks and opportunities related to waste. Communities can also have different beliefs associated with waste, including superstitions and rumours, and it is vital these aspects are understood and used to guide SWM activities together with the community.
- Involving affected populations in the identification of current issues and discussion of potential solutions increases the likelihood of their positive involvement in the implementation of these solutions.

## **Key resources** Waste assessment


### Making Waste Work: A Toolkit. How to measure your waste

WasteAid UK, 2017

https://wasteaid.org/toolkit/how-to-measure-your-waste/

Short guide providing recommendations on how to implement a waste characterisation survey (including main waste categories, staff, health and safety and equipment needed, training requirements, steps of characterisation, result processing and interpretation).


### Practical Guide to Solid Waste Management in Pacific Island countries and territories

SPREP / JICA, 2018

https://www.sprep.org/publications/practical-guide-to-solid-waste-management-in-pacific-island-countries-and-territories

Guide prepared for the Pacific region, however recommendations can be applicable to other countries. The document includes detailed guidance on waste surveys required for waste management planning: waste flow, waste characterization and composition, time and motion, public opinion
(pages 9 – 13).

# 3.3 Waste collection systems

A waste collection system has a number of different components, which are all inter-related:

- Waste storage container (variations in size, type and distribution);
- Waste collection means and organisation (e.g. equipment, staff);
- Waste collection frequency and routes.

Decisions about the characteristics of each component should be made based on the local context and after consultation with the community.

## Waste storage (containers)

### Household storage

- Household waste storage containers should include covers (or lids) to avoid attracting rodents and insects.

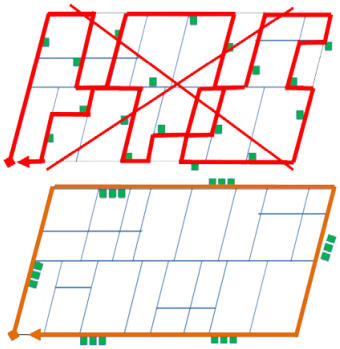
### Community bins

- The type and size of community bins needs to take into consideration the loading system used for waste collection (for minimisation of loading time). In particular:
  - For manual loading, a maximum weight of 25 kilograms per person should be considered (i.e. for a team of two people, containers larger than 80 litres are not appropriate);
  - Fixed concrete bins should be avoided as they are very difficult to empty;
  - Larger commercial waste containers are not adapted to all settings as they require good road conditions and collection trucks with mechanical or hydraulic lifting systems (for loading containers).

*Example of fixed concrete bin, very difficult to empty (left), and an 80 litre barrel more adapted for manual loading by team of two people (right).*

### Distribution of collection points

- When planning the number and geographical distribution of collection points, the following aspects need to be considered:
  - Number of containers needed to avoid overflowing, based on information about waste generation and frequency of collection;
  - Distribution of collection points should respect a maximum distance of approximately 100 metres from households (not too far to make sure people will still dispose of their waste, but not too close so that collections points are a nuisance);
  - Distribution should also consider the collection route and need to optimise transportation and loading times.



*Example of routing strategy and optimisation of container distribution (Source: EAWAG)*

## Waste collection equipment

### Options for collection systems

- Type of collection equipment:
  - Manual collection (e.g. using handcarts, carts pulled by animals);
  - Motorised collection (many options for vehicles: tractor with trailers, pickup truck, skip-loader, compactor truck, etc.).
- Number of collection stages:
  - Direct collection (same equipment used from collection area to final disposal site);
  - Multiple-stage collection: use of different equipment for primary collection, secondary collection and transfer stations.


*Examples of waste collection equipment (Source of bottom pictures: UN Habitat)*

### Key aspects to be considered in choice of collection equipment

- Quality of roads and access ways.
- Distances between collection points and final disposal sites.
- Local capacity for maintenance.
- Availability of funding for investment, operations and maintenance.

### Recommendations

- Frequency of collection should be at least twice a week, ideally every two days in warm climates.
- For manual loading of waste, collection vehicles should not be higher than 1.5 metres.
- Vehicles which are not designed for waste collection usually require small adjustments to improve the efficiency of collection (e.g. raising the side of a trailer to allow more waste to be collected).

## Personnel

Waste collection is a potentially dangerous activity. It is important to ensure that all personnel involved are properly equipped and trained, including:

- Minimum personal protective equipment (PPE): safety footwear, gloves and high-visibility clothes;
- Vaccinations (tetanus and hepatitis B);
- Training on health and safety, including the risks linked to waste management and hazardous waste identification.

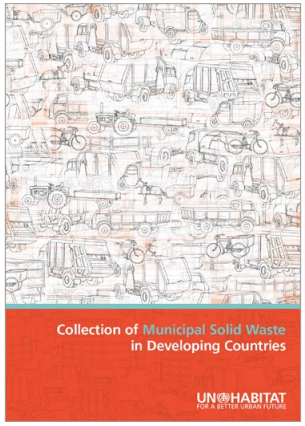
## **Key resources** Waste collection


**Making Waste Work: A Toolkit. How to collect waste safely and efficiently**

WasteAid UK, 2017

https://wasteaid.org/toolkit/how-to-collect-waste-safely-and-efficiently/

Short guide addressing the different aspects of waste collection systems, including types of containers, cleaning equipment, transportation means and collection routes.




**Collection of Municipal Solid Waste in Developing Countries**

UN Habitat, 2010

https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/E-Learning/Moocs/Solid_Waste/W1/Collection_MSW_2010.pdf

Complete guide on waste collection systems, including key components such as methods of waste collection (chapter 4), storage systems (chapter 5), collection vehicles (chapter 7), and transfer stations (chapter 8). The document also addresses important topics such as institutional arrangements and financial aspects, and has annexes on recycling and final disposal of waste.

# 3.4 Recycling basics

## What can and cannot be recycled

- In theory, many materials can be recycled including paper, cardboard, metal and plastic, as well as textiles and construction material.
- In practice, whether materials are recycled or not depends a lot on the quantities available, market price (financial viability) and local capacity for treatment. In particular:
- Material such as glass and low-value plastic (e.g. plastic bags, mixed layer plastic) usually have a low value and limited market;
- Electronic waste and batteries have potential for recycling, however there is a high risk of pollution during the process as they include hazardous material (see Section 2.7).

## Waste segregation

- Implementing waste segregation as early as possible in the waste generation and collection chain is essential to ensure good quality of material and to avoid contamination with other waste streams.
- Segregation systems at source should be kept as simple as possible (e.g. organic waste/ non-organic waste), so they are easy to implement.
- Use different types of disposal containers for recyclable material (different colours and/or material), to encourage their use.

*Example of routing strategy and optimisation of container distribution (Source: EAWAG)*

## How to increase value

- Processes that increase the value of recyclable material include:
- Segregation and storage of larger quantities;
- Pre-processing (e.g. washing, shredding, cullet processing, baling and compacting).
- Alternative options such as upcycling into handicrafts often has a limited potential in terms of quantity (limited demand from customers), however it can be very effective for awareness raising.

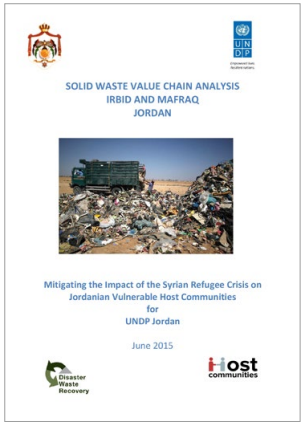
## **Key resources** Recycling


**Making Waste Work: A Toolkit. How to prepare plastics to sell to market**

WasteAid UK, 2017

https://wasteaid.org/toolkit/how-to-prepare-plastics-to-sell-to-market/

Short guide providing guidance on basic pre-processing activities to increase the value of plastic material (cleaning, drying, sorting, agglomeration/accumulation, size reduction). Includes tips to identify the different types of plastic (PET, PE, PVC, etc.).




**Solid Waste Value Chain Analysis – Irbid and Mafraq, Jordan**

UNDP/ DWR, 2015

https://www.jo.undp.org/content/jordan/en/home/library/poverty/solid-waste-value-chain-analysis.html

Study conducted in the context of the Syrian Refugee Crisis in Jordan, with the objective of providing robust data and information for the design and implementation of solid waste management interventions, particularly recycling and waste recovery activities. Similar studies could be implemented in other contexts in order to better understand the recycling sector and define potential interventions.

# 3.5 Organic waste recovery

## Benefits of organic waste recovery

Usually, more than 50% of waste produced in low and middle-income countries is composed of organic waste. Diverting this fraction (or part) from the main waste stream can drastically reduce the need for collection and disposal, and related expenditure. In addition, products from organic waste recovery can greatly benefit the environment and support livelihood programs linked to agriculture (see Section 2.3).

Main technological options for organic waste processing are:

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

The choice between the different options will vary depending on key aspects such as organic waste properties, quantities, local capacity and know-how, and demand for final products.

## Key resources Organic waste recovery


**Biowaste Management: the key to sustainable municipal solid waste management**

EAWAG/SANDEC, 2017

https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SWM/General_Overview/biowaste_policybrief.pdf

Policy brief on the importance of organic waste management and recovery within municipal solid waste management systems. The document includes a short presentation of the different technologies available and their characteristics (e.g. type of organic waste, labour requirement, lifetime of infrastructure etc.).

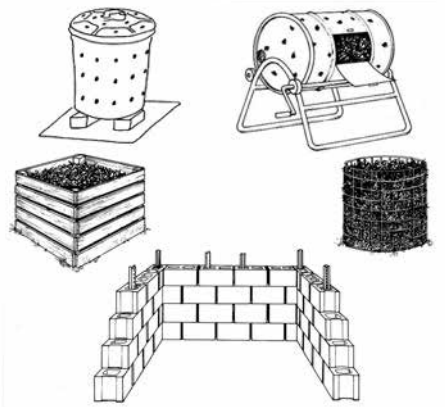
## Composting

### General principle

- Organic waste is transformed by micro-organisms in aerobic conditions (in the presence of air), resulting in the production of carbon dioxide, heat, water and compost.
- There are two main phases: the active phase, during which the temperature rises significantly resulting in the elimination of pathogens and seeds, and the curing phase when maturation of the compost occurs.
- Composting time varies depending on the technology and waste input (usually around 90 days or 3 months).

## Recommendations

- There must be a balance between "brown" material which is rich in carbon (e.g. wood chips, leaves, etc.) and "green" material which is rich in nitrogen (e.g. kitchen waste).
- Composting can be labour-intensive (e.g. turning of compost piles). It also requires regular monitoring and troubleshooting, for example the addition of brown material if the compost pile is too humid and lacks oxygen.
- A variety of composting methods can be used, with the main principle being to facilitate circulation of air:

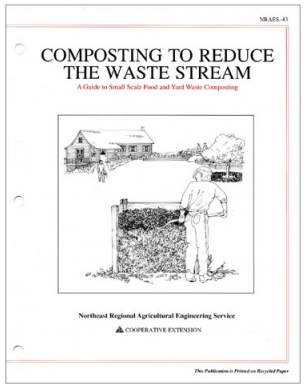


*Examples of small-scale options for composting*[1]

| | |
|---|---|
| Small-scale solutions | • Static piles<br>• Bin composter (commercial or self-made composter)<br>• Box composter (e.g. wooden box, metal mesh, concrete box etc.) |
| Medium to large-scale solutions | • Windrow composting<br>• Passively or forced aerated piles and windrow systems<br>• Enclosed composting |

1 Sources: Composting to reduce the waste stream, NRAES, N.Dickson, T.Richard, R.Kozlowski, 1991 Master Composter Manual, Cornell Waste Management Institute, 1998

## Key resources Composting




**Composting to reduce the waste stream: Guide to small scale food and yard waste composting**

NRAES, 1991

https://ecommons.cornell.edu/handle/1813/44736

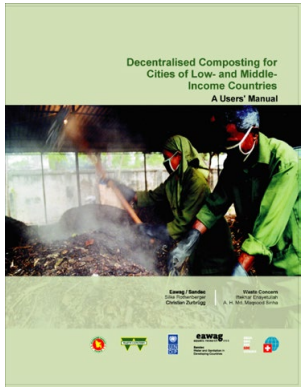
Complete guide presenting the detailed composting process and different methods for bin and box composting at household level (also applicable for small groups). The document includes advice in terms of material to be composted, maintenance of the compost pile, troubleshooting, how to use the guide for education purposes as well as plans for building compost bins and boxes.


**Composting from A to Z**

R.FARES, E.FARES, F. DE NARDO, 2011

https://www.academia.edu/11692803/Composting_from_A_to_Z

Short guide providing information on composting, including basics of the composting process and influencing factors, description of main steps of the composting process, and troubleshooting of typical problems. The document was developed for use in Lebanon but the basic information provided is applicable to other contexts.




**Decentralised composting for cities of low- and middle-income countries**

EAWAG-SANDEC / WASTE Concern, 2006

https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SWM/Decentralized_Composting/Rothenberger_2006_en.pdf

Complete document covering all aspects for establishment of composting facilities in low and middle-income countries, including design options and operational needs, stakeholder involvement, waste collection, marketing and financial sustainability.

*Available in English, French and Hindi.*

# Vermicomposting

## General principle

- Organic waste is transformed with the support of earthworms, resulting in the production of solid ("compost") and liquid ("compost tea") fertilizers.
- Compared to normal composting, the process is quicker (about 30 days), less labour intensive (no need to turn the piles) and results in a high-quality fertilizer.
- Worms can also be used as animal feed resource.

## Recommendations

- Different types of earthworm can be used depending on the climate and local availability. It is recommended to use local worm species (worms can usually be found in manure) due to the possible environmental risk of importing foreign worm species (including possible importation challenges).
- Moisture and temperature need to be controlled, and a good quality bedding is required (material with good absorbency, bulking potential and a high carbon ratio – e.g. chopped cardboard, paper, rice straws etc.) to maintain health of the earthworm colony.
- Vermicomposting works very well with fruit and vegetable waste (chopped into smaller pieces first to allow quicker processing). Some waste such as oils, meat and citrus should be avoided.
- Vermicomposting can be used to complement classic composting (for example, pre-composted waste used as the input), allowing more types of waste to be accepted and better elimination of pathogens and seeds.

*Example of vermicomposting installation (Source: EAWAG)*

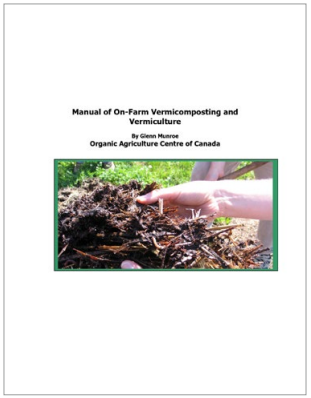
## **Key resources** Vermicomposting


**Making Waste Work: A Toolkit. How to turn organic waste into compost using worms**

WasteAid UK, 2017

https://wasteaid.org/toolkit/how-to-turn-organic-waste-into-compost-using-worms/

Short guideline presenting general principles of vermicomposting and step-by-step recommendations for vermicomposting solutions both at households (boxes) and community levels (pits).




**Manual of On-Farm Vermicomposting and Vermiculture**

Organic Agriculture - Centre of Canada

https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/E-Learning/Moocs/Solid_Waste/W4/Manual_On_Farm_Vermicomposting_Vermiculture.pdf

Complete manual on vermicomposting, including recommendations and findings from experiments of different systems with focus on medium to large scale installations processing agricultural waste (adaptable for community level or market vermicomposting).

# Anaerobic digestion

## General principle

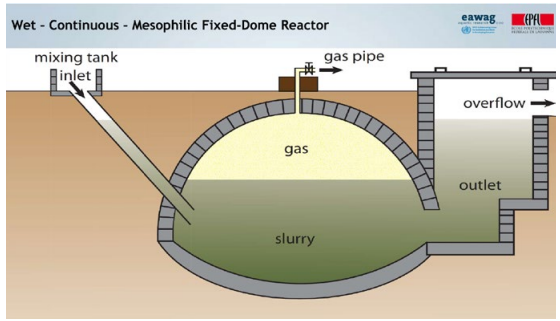
Organic matter is broken down and stabilised by micro-organisms in anaerobic conditions (**absence of air**), resulting in the production of biogas and digestate with a high nutrient content.

The biogas is mainly composed of methane and carbon dioxide, which can be used in household and community kitchens, as fuel for vehicles or lamps, and for electricity generation.

## Recommendations

- Countries such as China, India, Nepal and Bangladesh have significant experience with anaerobic digestion.
- Different types of digester and storage systems are available, including:

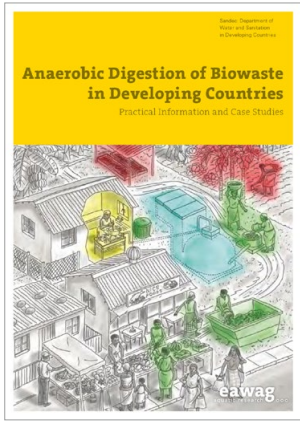
| | |
|---|---|
| Digester system | • Fixed-dome digester<br>• Floating-drum digester<br>• Tubular digester |
| Storage system | • Low, medium and high-pressure storage<br>• Direct use (combustion, heat) |




*Scheme of a fixed-dome digester. (Source: EAWAG)*

- The organic waste input needs to be minced (chopped into small pieces) and mixed with water to improve the anaerobic digestion.
- Socio-cultural aspects need to be considered regarding the acceptance of biogas for cooking, especially when faeces are used as input in the digester.
- Special care needs to be taken regarding health and safety, in particular:
  - Slurry needs to be treated (e.g. composted) before use or discharge to avoid pathogens;
  - Gases can be dangerous (e.g. risk of explosion or suffocation).

## **Key resources** Anaerobic digestion

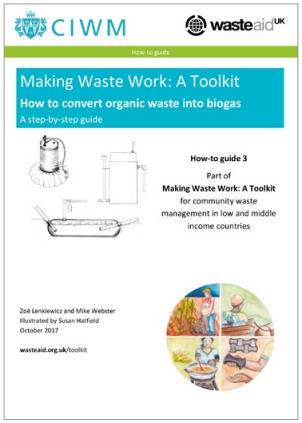



**Anaerobic Digestion of Biowaste in Developing countries**

AEWAG/SANDEC, 2014

https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SWM/Anaerobic_Digestion/biowaste.pdf

Complete guide on anaerobic digestion of biowaste in developing countries. The document includes a presentation of case studies from South America, Africa and Asia with detailed information on the design and size of systems chosen, type and quantities of waste used as feedstock, resulting biogas production, and investment costs.




**Making Waste Work: A Toolkit. How to convert organic waste into biogas**

WasteAid UK, 2017

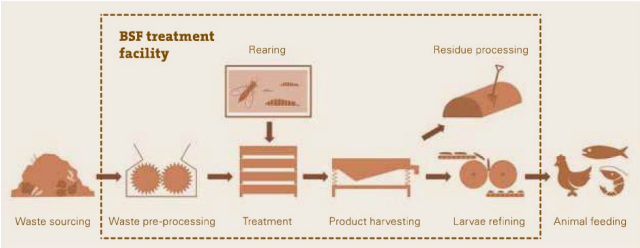
https://wasteaid.org/toolkit/how-to-convert-organic-waste-into-biogas/

Short guide on converting organic waste into biogas, with general guidance on maintenance and troubleshooting as well as step-by-step instructions on how to build tubular plastic and floating dome biodigesters.

# Black soldier fly (BSF) biowaste processing

## General principle

- Organic waste is broken down (decomposed) through the use of black soldier fly (BSF) larvae, resulting in the production of residue and mature larvae.
- BSF larvae are a high quality protein source and can be used as feed for chicken and fish. The residue can be used similarly to compost for agriculture purposes.

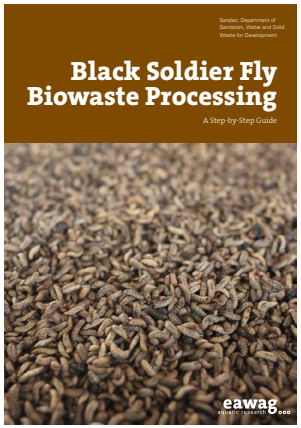



*Main steps of BSF biowaste processing. (Source: EAWAG)*

## Recommendations

- The BSF process is quite complex to setup, and as such may not be suitable for emergency settings. The full life cycle of the fly must be controlled (e.g. egg harvesting etc.), and there are possible import limitations (as an alien or foreign species).
- There needs to be a demand for the final product (e.g. mature larvae as feed for livestock).

## **Key resources** BSF processing of organic waste




**Black Soldier Fly Biowaste Processing**

EAWAG, 2017

https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SWM/BSF/BSF_Biowaste_Processing_LR.pdf

Step-by-step guide which presents the principles of BSF biowaste processing and describes the five main units of a processing facility (rearing unit; waste receiving and pre-processing unit; treatment unit; product harvesting unit; post-treatment unit - larvae refining and residue processing).

*Document available in English and Chinese.*

# Pyrolysis (charcoal production)

## General principle

- Biomass is processed by heat (in the absence of oxygen), resulting in the production of either char (a solid product from slow pyrolysis) or bio-oil (from fast pyrolysis).
- A similar process is used to produce charcoal from wood resources.

## Recommendations

- Pyrolysis works mainly with dry plant matter (lignocellulosic biomass), such as rice husks, wood chips, sawdust from carpentry workshops and sawmills etc.

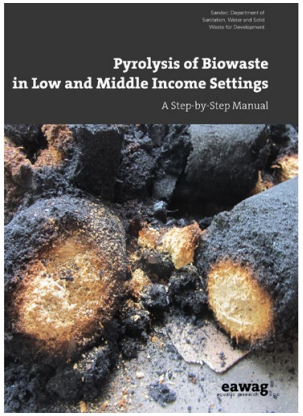
## **Key resources** Pyrolysis of biowaste


**Making Waste Work: A Toolkit. How to transform woody waste into fuel briquettes**

WasteAid UK, 2017

https://wasteaid.org/toolkit/how-to-transform-woody-waste-into-fuel-briquettes/

Short guide to charcoal production which transforms woody waste into fuel briquettes. Includes a description of waste materials to be used, preparation and operation of a carbonising barrel, briquette press and marketing.




**Pyrolysis of Biowaste in Low and Middle Income Settings**

EAWAG, 2019

https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SWM/Carbonization_of_Urban_Bio-waste/slow_pyrolysis_manual.pdf

Guide on slow pyrolysis of biowaste, focusing on a double-barrel reactor system which allow efficient pyrolysis including pre-drying of biowaste. Also includes recommendations on construction, operation and financial analysis.

# 3.6 Incineration

## Basics of incineration (definitions)

| | |
|---|---|
| Incineration | • Incineration is the combustion of waste under controlled conditions (temperature, turbulence, retention time and oxygen supply).<br>• The objectives of incineration are usually to:<br>  ▪ Reduce the volume of waste;<br>  ▪ Destroy disease-causing pathogens;<br>  ▪ Produce energy (either direct thermal energy [heat] or indirect production of electricity).<br>• In the incineration process the temperature is raised to high levels (greater than 800°C) which allows almost complete combustion and minimises the production of hazardous materials (see below). |
| Open burning | • Combustion of waste in uncontrolled conditions.<br>• The temperature usually does not exceed 300°C and does not allow complete combustion of waste.<br>• Open burning results in the production and release of large amounts of pollutants in the environment (see below) and does not guarantee the destruction of pathogens. |

## Potential environmental and health impacts

Potential environmental and health impacts of incineration include:

- Production of persistent organic pollutants (POPs):
  - POPs do not break down in the environment and accumulate in the food chain (high risk of exposure through food intake, maternal milk etc.);
  - Exposure to POPs can lead to serious health effects including certain cancers, birth defects, impacts on immune and reproductive systems, greater susceptibility to disease and damage to the nervous system;
  - The production of POPs varies greatly depending on the temperature (they are formed when temperatures are between 200 to 450°C), retention time and type of waste incinerated;
  - Polyvinyl chlorine (PVC) and other chlorine containing materials are known to produce large amount of POPs when incinerated.
- Heavy metals (e.g. mercury, lead and cadmium) are released when materials containing these substances are incinerated, such as electronic waste and timber treated with chromated copper arsenate (CCA).
- Incineration produces ash, which can have particularly high concentrations of hazardous substances (both bottom ashes and fly-ashes).

## Technologies available

### Barrel burners

- Do not guarantee controlled conditions for combustion (even improved models with chimney);
- **Should not be considered as an incinerator** (they are equivalent to open burning).

*Example of barrel burners (with and without chimney).*

## Portable commercial incinerators

- Small-scale solutions which are easy to deploy and transport;
- Some systems are adapted barrels (equipped with a specifically designed air blower to improve combustion);
- Usually require an energy supply (electricity).

*Example of portable incinerator (and ash pit behind).*

## Self-built incinerators

- Small-scale solutions which are relatively easy to build with locally available material. They are low-cost, but need to be well constructed and operated.
- A well-documented option are the De Montfort incinerators, developed by University of De Montfort in the United Kingdom, for countries with limited resources (Source: https://mw-incinerator.info):
  - Different models are available, with different lifespans, treatment capacities and building costs;
  - De Montfort incinerators usually include primary and secondary combustion chambers, chimney, an oxygen supply and ash removal systems.

*Example of De Montfort incinerator. (Source: PATH)*

## Large scale incinerators

- Often have integrated energy recovery systems (heat or electricity production) from waste and refuse derived fuel. Examples include industrial incinerators and cement kilns.
- Need of follow strict standards, including control of input waste and feed preparation (e.g. selection of waste with high calorific value, removal of PVC and other hazardous materials) and gas treatment.

# Recommendations

## Terminology

- Avoid mixing the terms “incineration” and “open burning” – use the correct terminology for the facility.

## Applicability to emergency settings

- In emergencies and the context of low-income countries, incineration should be restricted to healthcare waste management. Solutions which guarantee a minimum standard of incineration (such as De Montfort or small-scale portable incinerators) should be used.
- When deciding on the incinerator type, consider the type of material to be incinerated, temperature requirements, the need for fuel, and treatment capacity (quantities).
- Consider national regulations (e.g. legal restrictions on use and quality of incinerators).

## Waste input

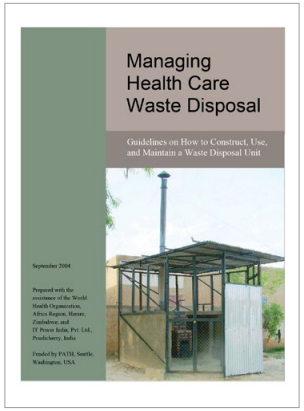
- PVC and other products containing chlorine should be avoided at all cost, as well as treated timber and electronic waste.
- Material with high levels of moisture should also be avoided (it is difficult to combust).

## Control of incineration operations

- Incinerators should be located a safe distance from dwellings and agricultural lands, preferably downstream from dominant winds.
- Training of operators in the incinerators operation is essential.

- Where devices/equipment to check the temperature and other parameters of incineration are not available, the colour of the smoke can be used as an indicator of the quality of combustion:
  - Dark smoke means incomplete combustion and a large amount of POPs produced;
  - Transparent smoke means good combustion, with production of POPs minimised.
- Ash should be considered as a hazardous material (high concentration of pollutants) and treated accordingly.

## **Key resources** Incineration



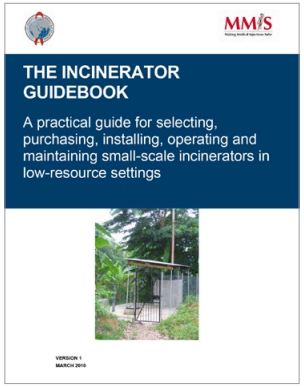

### Managing Health Care Waste Disposal

PATH, 2004

https://mw-incincerator.info/en/201_guidelines.html

Guidelines focusing on the specification, construction, installation, operation, and maintenance of a self-built De Montfort incinerator. The document addresses common dimensional and construction quality inconsistencies by providing clear technical specifications and engineering drawings for each component of the De Montfort.

*Document available in English and French*.




### The Incinerator Guidebook

PATH, 2010

https://www.path.org/resources/the-incinerator-guidebook-a-practical-guide-for-selecting-purchasing-installing-operating-and-maintaining-small-scale-incinerators-in-low-resource-settings/

Short practical guide for selection, purchasing, installing, operating and maintaining small-scale incinerators in low-income countries for healthcare waste management. The guide includes a buyer's guide with a list of small-scale incinerators available commercially.

# 3.7 Landfilling

Landfilling and burial of waste aims to minimise the direct negative effects from waste (e.g. smell, proliferation of disease vectors, contamination) by removing it from the immediate proximity of humans. Another key objective is to minimise the effect of waste accumulation on the surrounding environment, in particular the pollution of air and water resources.

In practice, different types of landfilling or burial practices can be observed, such as:

- Household and community pits;
- Dumpsites (uncontrolled landfills);
- Controlled landfills;
- Sanitary landfills.

Two general recommendations which are valid for all landfill and burial options are:

- Design and dimensions should be based on knowledge of waste generation and expected quantities (volume) to be disposed of;
- Limit the amount of waste to be disposed of, through recovery of materials for recycling, production of compost, etc.

## Environmental and health impacts of landfilling

Common issues and risks linked to landfilling and burial of solid waste include:

- Facilities have a limited life-time, and usually get full more quickly than expected;
- Permanent pollution of soil (e.g. once filled with waste, land is no longer suitable for construction or farming);
- Pollution of water bodies (groundwater, rivers, lakes and seas/oceans).

- Uncontrolled emission of methane (CH4) linked to the anaerobic decomposition of organic waste (methane is known as a significant greenhouse gas with much greater impact than carbon dioxide (CO2) over a 100-year period. Source: IPCC);
- Landslides;
- Open fires caused either by spontaneous combustion (due to the presence of methane )or by waste picking activities can cause the release of harmful gases and persistent organic pollutants;

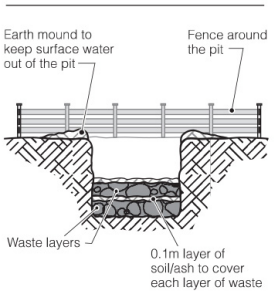
## Household and community pits

### General principle

- Once all possible reduction and recovery options have been explored, waste pits are often the main viable disposal system in rural settings and locations where no or limited waste collection services are available.

### Recommendations

- The pit needs to be sufficiently large and deep (shallow pits do not last long). The type of soil (to avoid risk of collapse) and groundwater levels must be taken into consideration when determining the depth of the pit.
- If possible, layers of waste should be regularly covered with a thin layer of soil to minimise negative impacts (e.g. smell, rodents and insects).
- Community pits should be fenced to avoid access by children and animals.
- Installing a basic cover will limit infiltration of rainwater into the waste pit and reduce related negative effects (e.g. increase of smell, breeding of insects etc.).
- The location of pit is generally a compromise between the need to be close to dwellings (for accessibility) yet far enough to avoid negative impacts. Direct proximity to water bodies and water wells should be avoided.




*Suggestion of basic design for community pit (Source WHO/WEDC)*

*Example of community pit with cover system (Source: Swedish Red Cross)*

# Dumpsites

## General principle

- A dumpsite is usually a place where waste is disposed of in an uncontrolled way, without specific measures to reduce environmental impacts of the waste accumulation, in particular:
  - No regular soil cover of waste;
  - No leachate collection or control, no drainage system;
  - Poor access to the tipping area for collection vehicles;
  - No specific control of waste disposal (e.g. shaping, compacting);
  - No access control (land open to scavenging);
  - Uncontrolled open burning.

*Example of a dumpsite in Beira, Mozambique.*

## Recommendations

- **Transforming a dumpsite into controlled landfill** is not necessarily a very costly process, and can be done using a step-by-step approach:
- For a new disposal site, multi-criteria analysis for site selection help to minimise potential impacts. The general site selection criteria outlined below are valid for all landfill solutions:
  - **Geology:** Preference for soil with low permeability, such as clay, to reduce the risk of groundwater pollution;
  - **Groundwater level:** Deep groundwater sources are less likely to be impacted than shallow aquifers;
  - **Safe distance from water bodies** (rivers, lakes, sea) should be respected;
  - **Topography:** Natural topography (e.g. slopes) can facilitate some key landfill processes (e.g. water runoff);
  - **Land use:** Proximity to agricultural land or areas with dwellings should be avoided;
  - **Distance and access from collection areas:** Large distances and poor access to the disposal location increases the risk of illegal dumping, and increases the cost for waste collection and transportation. The collection frequency also risks being reduced due to lack of resources (e.g. if vehicles need to drive long distances).

# Controlled landfill

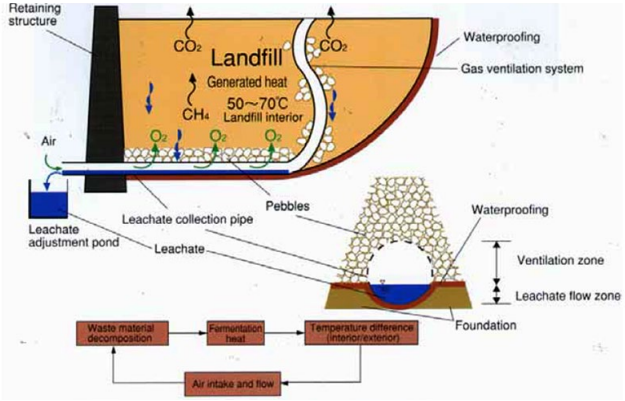
## General principle

The objective of a controlled landfill is to increase control of the facility and to reduce its negative impacts, but without the large investment and operational costs of a sanitary landfill.

- A controlled landfill should include at a minimum:
  - Control of access to and within the landfill;
  - Basic drainage and leachate management, including slopes in waste disposal areas to reduce stormwater infiltration into the waste;
  - Control of emissions of gases and fire management.

## Recommendations

- Follow the Fukuoka method for semi-aerobic landfill. The general principles are:
  - Install a leachate collection system that is also used to facilitate the circulation of air within the waste;
  - Semi-aerobic conditions reduce the production of methane and improve the quality of leachate;
  - Such systems can be implemented with relatively low investment cost and are well-adapted to medium-size disposal sites (including upgrading of existing dumpsites).




*General principle of the Fukuoka method (Source: Fukuoka City Environmental Bureau)*

*Key components of Fukuoka method – leachate collection and vertical gas venting pipes (Source: JICA/SPREP)*

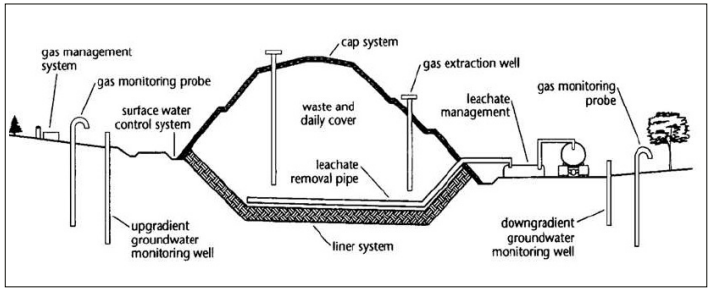
# Sanitary landfill

## General principle

- A sanitary landfill (see figure below) is a waste disposal facility designed to minimise impacts on the environment. It generally includes the following characteristics:
  - Site selection based on a complete environmental risk assessment;
  - Extensive site preparation, including installation of bottom liner systems isolating the disposal cells from soil and groundwater;
  - Full leachate and surface water management, as well as groundwater monitoring;
  - Full gas management;
  - Daily compaction and waste cover;
  - Fence and gate, monitoring of type and quantities of waste disposed of.

## Recommendations

- Sanitary landfills may not be appropriate for emergency settings (due to the long process, and high investment and operation costs).

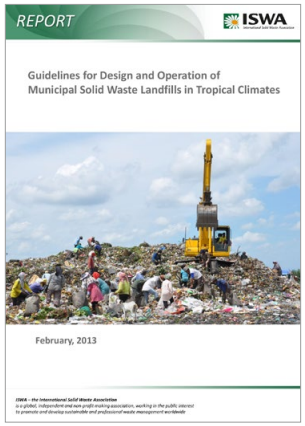



*Schematic of a typical sanitary landill (Source: UNEP)*

## Equipment

- Typical equipment needed for preparation and operation of waste disposal sites includes bulldozers, excavators, loaders, landfill compacters and graders.
- When deciding on equipment needed, consider the size and operation model of the disposal site as well as local capacity for operation and maintenance.

## **Key resources** Final waste disposal

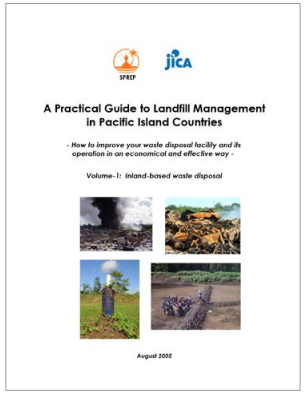



**Guidelines for Design and Operation of Municipal Solid Waste Landfills in Tropical Climates**

ISWA, 2013

https://www.iswa.org/index.php?eID=tx_iswaknowledgebase_download&documentUid=3159

Guidelines prepared specifically for low and middle-income countries where financial resources are limited. The document includes some recommendations for estabilishing new infrastructure, and also for extending the life-span of existing landfill facilities.




**A Practical Guide to Landfill Management in Pacific Island Countries**

SPREP / JICA, 2005

https://www.sprep.org/att/IRC/eCOPIES/pacific_region/14.pdf

Guide specifically designed for Pacific Island countries, but applicable for waste disposal in low and middle income countries. The solutions presented are based on the concept of semi-aerobic landfill (Fukuoka method), and include the improvement of existing landfill facilities.


**Making Waste Work: A Toolkit. How to design and operate a basic waste disposal site**

WasteAid UK, 2017

https://wasteaid.org/toolkit/how-to-design-and-operate-a-basic-waste-disposal-site/

Short guidance outlining how to design and operate a basic waste disposal site (household pit or small community disposal site), including the choice of location, selection of landfilling method and restoration and improvement of uncontrolled dumpsites.

CONTENTS



# 04 Additional resources

# 4.1 Red Cross Red Crescent Movement

Available resources within the Red Cross Red Crescent (RCRC) Movement on solid waste management include:

**Green Response Working Group** https://media.ifrc.org/ifrc/green-response/

The goal of Green Response is to ensure the Red Cross and Red Crescent can continue to save lives and reduce suffering without risking damage to the environment or the livelihoods, assets, health and survival of people affected by disasters and crises.

While life-saving interventions will always be the priority aim of any emergency response operation, we are committed to integrating environmental considerations when planning and implementing our response and recovery operations. This includes taking action seeking to avoid and minimise adverse impacts on the surrounding environment and ecosystems. Our aim is that our disaster and crisis response and recovery operations will strengthen communities' ability to recover from disasters, and their resilience to future climate shocks and stresses.

Globally, identifying the areas of most significant environmental impact is an important step to improving our global environmental footprint. Equally, we must look at our local footprint – the direct environmental impact of our actions. Green Response focuses on improving practices before a disaster strikes, while also improving practices during response and recovery operations.

The Green Response Strategy 2019–2023 works towards three outcomes:

1. Green Response is mainstreamed across RCRC Movement policies, systems, tools and operations.
2. Green Response is embedded in National Society institutional strengthening initiatives.
3. The RCRC Movement is influencing policy and practice that enhances the environmental sustainability of humanitarian action internally within the Movement and among external actors.

## Contact:

**Caroline Gardestedt**
Chair of the Green Response Working Group
Caroline.Gardestedt@redcross.se

## IFRC Watsan Mission Assistant

Resource for field practitioners specialised in water, sanitation and hygiene promotion (WASH). It includes access to:

- Up-to-date documents and tools on WASH;
- Information, education and communication (IEC) material, including country specific and translated documents;
- Training modules for water and sanitation Emergency Response Units (including several modules on waste management).


*http://www.watsanmissionassistant.org/*

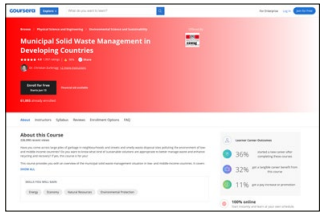
# 4.2 Organisations specialised in waste management

| Organisation | Description | Website / Contact |
|---|---|---|
| Emergency organisations | | |
| UN Environment / OCHA Joint Environment Unit (JEU) | The JEU provides assistance in preparing and responding to environmental emergencies. The JEU can support with guidance and deployment of experts on specific hazardous waste management issues. | www.unocha.org/unep |
| MSB (Swedish Contingency Agency) | Stand-by partners to many United Nations (UN) organisations, providing deployment of experts for emergency responses. MSB has a large roster of disaster waste and hazardous waste management specialists. | https://www.msb.se/en/about-msb/contact/ |
| Disaster Waste Recovery | Non-governmental organisation providing debris recovery and waste management support to disaster and conflict-affected communities. | https://www.disasterwaste.org/contact/ |

| Organisation | Description | Website / Contact |
|---|---|---|
| Development organisations | | |
| UNDP | UNDP is often involved in post-emergency debris and solid waste management programs, as part of their leading role in the early recovery process. | https://www.undp.org/content/undp/en/home/crisis-response.html |
| SPREP | Regional organisation supporting management of the environment and natural resources in the Pacific, including long-term interventions on solid waste and disaster waste management. | https://www.sprep.org/ programme/waste-management-and-pollution-control |
| JICA | Organisation involved in many solid waste management projects worldwide, with a strong presence in the Pacific region (long-term collaboration with SPREP). | https://www.jica.go.jp/english/our_work/thematic_issues/management/index.html |
| GIZ | Organisation involved in many solid waste management projects worldwide, particularly in Africa and Central America. | https://www.giz.de/ |
| Waste Concern | Organisation specialised in solid waste management including research, project assistance, and support to institutional development and capacity building. Strong experience in South East Asia and with organic waste processing (e.g. design of composting centers). | https://wasteconcern.org |

| Organisation | Description | Website / Contact |
|---|---|---|
| Development organisations | | |
| Waste Aid | Non-profit organisation supporting practical and low-cost waste management solutions in low-income countries (focussed on community-based solutions). | https://wasteaid.org/contact/ |
| EAWAG - SANDEC | Research institute specialised in solid waste management in low and middle-income countries. Interventions include technical support to project implementation, training, capture of lessons learned and production of guidelines. | https://www.eawag.ch/en/department/sandec/ |
| ISWA | The International Solid Waste Association (ISWA) is a global, independent and non-profit association promoting and developing sustainable and professional waste management worldwide. | https://www.iswa.org/ |

# 4.3 Online courses



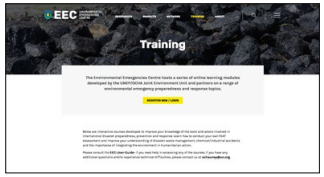

**Solid waste management in developing countries**

EAWAG /Université Polytechnique de Lausanne

https://www.coursera.org/learn/solid-waste-management/

Free online course which comprehensively covers all key aspects of integrated solid waste management, with practical solutions adapted to developing countries (and emergency settings).

*Course in English (subtitles in French, Spanish, Portuguese).*



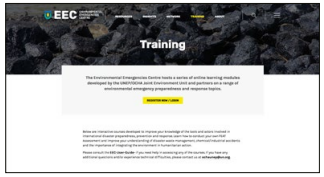

**Disaster Waste Management: Best Practices and Tools**

UN Environment / OCHA Environmental Emergency Centre

https://www.eecentre.org/training/

Free online course based on the UNEP/OCHA Disaster Waste Management Guidelines. Recommended for anyone wanting to learn more about disaster waste management and how to identify, prioritise and respond to the different types of disaster waste.

*Available in English, Spanish, French and Russian.*




**Flash Environmental Assessment Tool (FEAT)**

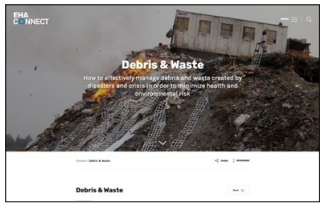
UN Environment / OCHA Environmental Emergency Centre

https://www.eecentre.org/training/

Free online course based on FEAT, aiming to equip environmental experts and international first responders with the necessary knowledge to rapidly identify, prioritise and mitigate the impacts of industrial chemical releases to human health and the environment.

*Available in English and Russian.*

# 4.4 Resource hubs and document libraries

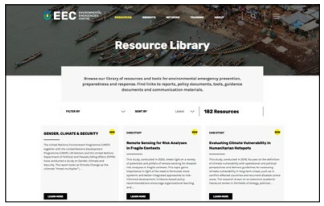



**Environment in Humanitarian Action (EHA) Connect**

https://ehaconnect.org/themes/debris-waste/

A repository of resources related to environment in emergencies (including one section on debris and waste management).

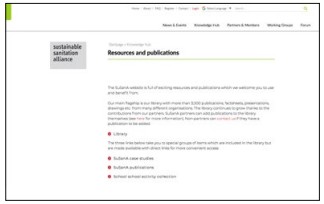
The Environment in Humanitarian Action (EHA) initiative includes several organisations: UN Environment, OCHA, USAID, UNHCR, WWF, MSB, IUCN and NRC.




**Environment Emergency Centre - Resource library**

https://www.eecentre.org/resource-library/

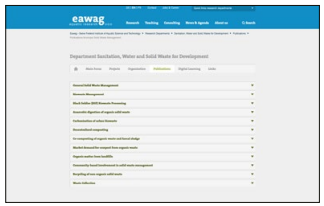
Library of resources and tools for environmental emergency prevention, preparedness and response, including reports, policy documents, tools, guidance documents and communication materials (initiative of UN Environment and OCHA).




**Sustainable Sanitation Alliance (SUSANA) knowledge hub**

https://www.susana.org/en/knowledge-hub/resources-and-publications/

Repository of resources related to sustainable sanitation solutions. Includes documentation on solid waste management, biogas and composting/ vermicomposting.



**EAWAG - Department of Sanitation, Water and Solid Waste for Development (SANDEC) - Publication repository**

https://www.eawag.ch/en/department/sandec/publications/ publications-municipal-solid-waste-management/

Repository with a large number of publications, including guidelines and case studies on all aspects of waste management (focussed on low and middle-income countries).

**Plateforme Re-sources (Réseau pour une gestion durable des déchets solides) – Centre de documentation**

https://www.plateforme-re-sources.org/

Documentation centre in French, with resources available on all main topics related to solid waste management (collection, composting, recycling, landfills, hygiene promotion, etc.).

# 4.5 Complementary literature

In addition to the key resources outlined for each specific topic in this guide, other relevant resources for solid waste management (SWM) in emergencies are presented as a complementary listing in this final section, including:

- Documentation from the Red Cross Red Crescent Movement;
- General documentation on solid waste management;
- Additional documentation related to disaster waste management;
- Documentation covering specific topics such as organic waste recovery, healthcare waste, landfilling, recycling, hazardous and special waste.

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| Red Cross Red Crescent documentation | | | | |
| Snapshot: Green Response | Swedish Red Cross | 2018 | Short snapshot covering what Green Response is, the need for and existing commitments to Green Response, and key achievements and resources. | https://media.ifrc.org/ifrc/wp-content/uploads/sites/5/2018/08/Green-Response-Snapshot-March-2018.pdf |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| Red Cross Red Crescent documentation | | | | |
| Review of Menstrual Hygiene Management (MHM) actions with a focus on solid waste | IFRC / Swedish Red Cross | 2018 | Report outlining findings and recommendations to improve MHM action (and particularly SWM) in the ongoing operation in Cox's Bazar, Bangladesh, and more broadly for future operations. | |
| Scoping study – Developing Solid Waste Management Activities for Pilot Project | Lebanese Red Cross | 2017 | Scoping study exploring options for pilot SWM activities in the context of the Syrian refugee crisis. | |
| Environmental assessment of the RCRC Response to the Sierra Leone Ebola Virus Disease epidemic:<br>• Environmental Impact Assessment Report<br>• Greenhouse Gas Emission Assessment | Swedish Red Cross | 2017 | Documents providing retrospective environmental impact assessment of Red Cross activities in response to the Ebola epidemic in Sierra Leone in 2014 and 2015, including findings related to SWM, in particular for the health sector. | |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| Red Cross Red Crescent documentation | | | | |
| Consideraciones ambientales en el contexto del Plan Único de Recuperación [...]<br><br>Operación Terremoto Ecuador 2016 | Ecuadorian Red Cross / IFRC | 2016 | Environmental evaluation of the response to the earthquake emergency in 2016, covering different sectors of intervention (WASH, health, office management, etc.), and including recommendations on SWM.<br><br>*Document in Spanish.* | |
| Approach to Green Response | IFRC | 2015 | Scoping study and strategy for roll-out of "Green Response", covering different environmental considerations for emergency responses including SWM. | |
| Green response - Practice note | IFRC | 2013 | Environmental evaluation of emergency response support services and programs (fleet and base camp management, relief products, WASH, shelter) in Haiti (2010) and El Salvador (2011), including considerations and recommendations on SWM. | |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| **Red Cross Red Crescent documentation** | | | | |
| Unidades de Respuesta a Emergencias ERU - Manual de Buenas Prácticas Ambientales | Spanish Red Cross | N/A | Guide of best environmental practices for the different Emergency Response Units (WASH, IT & telecom, health, logistics) providing some recommendations on SWM (including a list of potentially hazardous waste produced by each unit).<br><br>*Document in Spanish.* | |
| **General documentation on solid waste management** | | | | |
| Waste Regional outlooks | UNEP/IETC | 2017/ 2018 | Several outlooks on SWM in different regions of the world: Latin America and the Caribbean, Small Island Developing States, Asia, Central Asia, Africa. | https://www.unenvironment.org/ietc/resources |
| What a Waste 2.0 | World Bank Group | 2018 | Document providing global and regional information on SWM, including case studies and information by country on waste generation, treatment and disposal. | https://datacatalog.worldbank.org/dataset/what-waste-global-database |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| General documentation on solid waste management | | | | |
| Integrated Solid Waste Management for Local Government - A practical guide | ADB | 2017 | Guide for SWM covering key topics such as:<br>• SWM planning;<br>• Waste categories;<br>• Waste containers and collection;<br>• Waste processing and diversion;<br>• Landfill development and operation;<br>• Contract issues. | https://www.adb.org/documents/solid-waste-mgt-local-gov |
| Guidance Note - Municipal solid waste management in crisis and post-crisis settings | UNDP | 2014 | Document aiming to support government counterparts and strengthen capacity of UNDP Country Offices and implementing partners to plan, design and implement projects for municipal SWM in crisis or post-crisis settings. | https://www.undp.org/content/dam/undp/library/Sustainable%20Development/GuidanceNote_Solid_Waste_Management.pdf |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| General documentation on solid waste management | | | | |
| Guidance Note - Debris Management | UNDP | 2013 | Document providing practical advice to UNDP Country Offices on how to plan, design and implement a short-term project that swiftly links governments and communities in the assessment, clearance, recycling and management of debris following a significant national catastrophe. | https://www.undp.org/content/dam/undp/library/crisis%20prevention/SignatureProductGuidanceNoteDebrisManagement11012013v1.pdf |
| Large Scale Environmental Clean-up Campaigns | OXFAM | 2008 | Technical brief providing guidance on management of large quantities of bulk wastes generated by natural disasters and conflict situations. | https://policy-practice.oxfam.org.uk/publications/large-scale-environmental-clean-up-campaigns-126688 |
| UN Environment/ OCHA Joint Unit – Disaster Waste Management Factsheet | UN Environment, OCHA | 2019 | Factsheet describing the supporting role the UN Environment/OCHA Joint Unit (JEU) plays in disaster waste management activities. | https://www.eecentre.org/wp-content/uploads/2019/07/factsheet_DWM_new-logo.pdf |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| Organic waste recovery | | | | |
| Manual de compostagem domestica com minhoca | COMPOSTA SAO PAULO | 2014 | Short guideline on vermicomposting at household level.<br>*Document in Portuguese.* | https://www.compostasaopaulo.eco.br/compostasp_manual.pdf |
| Anaerobic Digestion of Biodegradable Solid Waste in Low- and Middle-Income Countries | EAWAG / SANDEC | 2007 | Document providing an overview of existing technologies for anaerobic digestion of organic waste and assessment of case studies from several countries. | https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/SWM/Anaerobic_Digestion/Mueller_2007.pdf |
| The Art and Science of Composting | Cooperband | 2002 | Resource for farmers and compost producers, presenting key concepts and recommendations for implementation of composting activities. | https://www.cias.wisc.edu/wp-content/uploads/2008/07/artofcompost.pdf |
| Master Composter Manual | Cornell Waste Management Institute | 1998 | Complete technical guide prepared to support the implementation of composting programs at community level.<br>*Note: The Cornell Waste Management Institute website includes many resources on composting at different scales, including composting of dead animals.* | http://cwmi.css.cornell.edu/mastercompostermanual.pdf |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| Healthcare waste management | | | | |
| Sector Environmental Guidelines Healthcare Waste | USAID | 2019 | Guidelines providing recommendations for healthcare waste management including: generation, handling, treatment, and disposal. | https://www.usaid.gov/sites/default/files/documents/1864/FINAL_HCW_SEG_508_12.02.19.pdf |
| ENCAP Visual Field Guide: Healthcare Waste | USAID | 2010 | Short guide targeting non-specialist staff for quick identification of serious environmental and biosafety concerns in management of waste from small health care facilities. | https://www.usaid.gov/sites/default/files/documents/1860/ENCAP_VFG-MedicalWaste_Jan2010.pdf |
| Landfilling | | | | |
| Training Module - Closing of an Open Dumpsite and Shifting from Open Dumping to Controlled Dumping and to Sanitary Landfilling | UNEP | 2005 | Training module presenting recommendations for: (1) Decommissioning or closure of open dumpsite in an environmentally sound manner, including rehabilitation and re-development, and (2) Shifting from open dumping to controlled dumping and sanitary landfilling. | http://wedocs.unep.org/handle/20.500.11822/9182 |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| Recycling | | | | |
| The Economics of the Informal Sector in Solid Waste Management | GIZ / CWG | 2011 | Booklet presenting the findings of a study on informal sector activities in SWM, including the informal recycling sector. | https://www.giz.de/en/downloads/giz2011-cwg-booklet-economicaspects.pdf |
| Hazardous and special waste | | | | |
| Hazardous waste, Technical Brief | OXFAM | 2008 | Short technical brief providing guidance on handling and storage of hazardous wastes such as hospital waste, industrial waste, chemical, asbestos and gas canisters. | https://policy-practice.oxfam.org.uk/publications/handling-and-storage-of-hazardous-wastes-126687 |
| Recycling – From E-waste to resources | UNEP / UN University | 2009 | Study providing an analysis of the market potential of relevant technologies for the E-waste recycling sector in selected developing countries and potential framework to foster the transfer of innovative technologies. | https://www.researchgate.net/publication/278849195_Recycling_-_from_e-waste_to_resources |

| Document name | Organisation | Year | Short description | File location (url link) |
|---|---|---|---|---|
| Hazardous and special waste | | | | |
| E-waste Volume I - Inventory Assessment Manual | UNEP | 2007 | Manual providing guidance on how to identify E-waste as an environmental issue and to quantify it. It includes a summary of the available legislation on E-waste in different countries. | http://wedocs.unep.org/handle/20.500.11822/7857 |
| E-waste Volume II - Management Manual | UNEP | 2007 | Guidance document to support the development and implementation of an E-waste management system. It summarises current practices in different countries, the technologies for E-waste management (collection, transportation, treatment and disposal) and the important pre-requisites for effective and sustainable E-waste management. | http://wedocs.unep.org/handle/20.500.11822/9801 |

# THE FUNDAMENTAL PRINCIPLES OF THE INTERNATIONAL RED CROSS AND RED CRESCENT MOVEMENT

## Humanity

The International Red Cross and Red Crescent Movement, born of a desire to bring assistance without discrimination to the wounded on the battlefield, endeavours, in its international and national capacity, to prevent and alleviate human suffering wherever it may be found. Its purpose is to protect life and health and to ensure respect for the human being. It promotes mutual understanding, friendship, cooperation and lasting peace amongst all peoples.

## Impartiality

It makes no discrimination as to nationality, race, religious beliefs, class or political opinions. It endeavours to relieve the suffering of individuals, being guided solely by their needs, and to give priority to the most urgent cases of distress.

## Neutrality

In order to enjoy the confidence of all, the Movement may not take sides in hostilities or engage at any time in controversies of a political, racial, religious or ideological nature.

## Independence

The Movement is independent. The National Societies, while auxiliaries in the humanitarian services of their governments and subject to the laws of their respective countries, must always maintain their autonomy so that they may be able at all times to act in accordance with the principles of the Movement.

## Voluntary service

It is a voluntary relief movement not prompted in any manner by desire for gain.

## Unity

There can be only one Red Cross or Red Crescent Society in any one country. It must be open to all. It must carry on its humanitarian work throughout its territory.

## Universality

The International Red Cross and Red Crescent Movement, in which all societies have equal status and share equal responsibilities and duties in helping each other, is worldwide.

The International Federation of Red Cross and Red Crescent Societies (IFRC) is the world's largest humanitarian network, with 192 National Red Cross and Red Crescent Societies and around 14 million volunteers. Our volunteers are present in communities before, during and after a crisis or disaster. We work in the most hard to reach and complex settings in the world, saving lives and promoting human dignity. We support communities to become stronger and more resilient places where people can live safe and healthy lives, and have opportunities to thrive.

Follow us:

ifrc.org | twitter.com/ifrc | facebook.com/ifrc | instagram.com/ifrc | youtube.com/ifrc