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

This technical briefing note deals with the handling and disposal of solid waste from refugee camps and in domestic environments in the immediate period following an emergency. Crowded conditions and the uncontrolled burning of waste within these environments present serious risks health and to safety. Poor waste management practices also create additional environmental risks, affecting the poorest and most marginalised sectors of the community.

Disasters have also an impact on the authorities that would normally be responsible for solid waste collection and disposal. This may include loss of staff, being overstretched and they are likely to be already under-funded and under resourced. In refugee camp environments there is often a lack of clarity of who is responsible for the collection and disposal of solid waste. The NGO undertaking water, sanitation and hygiene promotion in the camp, for example Oxfam, will often be tasked with the responsibility of managing solid waste.

In immediate post disasters situations there is often an increase in heavily packaged goods resulting from the relief efforts and associated supplies and equipments. This generally results in an increase in waste generation typically in plastics and metals.

It should also be noted that poor solid waste management is often a problem that increases after the immediate response period as more resources and people are made available during the emergency. Initiating good solid waste management practices during the initial response period can help in installing good practice which can be continue post emergency.

Risks from the Absence of Solid Waste Management

In the absence of formal or proper waste management strategy and support, refugees and internally displaced people (IDPs) are likely to resort to burning or burying their waste in an uncontrolled manner. This will often be found to be undertaken on the edge of camps or just outside.

Burning of waste in such a manner does not effectively break down all the waste, often leaving organic materials, which are high in water content, semi-burnt and continuing to decompose. Glass and metals will also remain presenting an on-going waste hazard. Additionally, low temperature burning of plastics results in gas emissions, which are hazardous to health and to the environment. This can be exacerbated by waste being burnt close to homes due to lack of equipment to remove it from these areas.

Risks associated with poor solid waste management:

- Fly breeding within waste, flies are disease transporting vectors;
- Mosquitoes breed in blocked drains and discarded cans, tyres and other items, mosquitoes are vectors for malaria, dengue, lymphatic filariasis and yellow fever amongst others;
- Rats find shelter and food in waste, they live and breed in and around waste, and are again a disease transporting vector;
- Heaps of refuse may present a fire risk
- Open burning of waste causes air pollution and gas emissions which are hazardous to health and the environment;
- Uncontrolled dumping of waste can create dust and fungi containing aerosols which can cause respiratory health problems;
- Items such as broken glass, razors, hypodermic needles, potentially explosive containers, etc present in waste pose danger to those handling the waste and to children;
- Leachate (polluted water) from rain washing through dumped waste can pollute water supplies;
- Waste ends up in drains, causing blockages and flooding;
- Psychological and aesthetic nuisance from waste in terms of smell and appearance.

The uncontrolled burying of waste usually does not take into consideration where the waste is being buried. Possible impacts on the environment and on groundwater resources are rarely considered, potentially resulting in

ponds and pools with floating waste which presents a nuisance and a point of pollution and contamination of shallow wells and water sources.

Focus in dealing with solid waste management is to minimise the risk to the health and safety of inhabitants of IDP camps, visitors and surrounding communities and to consider the impact on the immediate and wider environment.

Waste Hierarchy

There is a hierarchy of approaches to solid waste management that should be considered. However, effective solid waste management requires a balanced approach which takes into account the specific circumstances of the IDP camp or permanent settlement. In a emergency situation an approach should be taken that eliminates immediate risks to health and safety first, for example, removing waste which presenting an immediate risk to health and the environmental and appropriately disposing of it, is more important than setting up householder composting bins

The waste hierarchy

Waste Reduction & Minimisation

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Waste Reuse / Repair

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Recycling / Composting

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Landfill/Burial/Incineration

Fractions (Characteristics) of Waste in Emergencies

Waste from settlements and refugee camps will vary widely in composition and quantity, according to the amount and type of economic activity, the staple foods consumed and local practices of recycling and/or waste disposal. Typical constituents of solid waste may include the following:

- Packaging from emergency supplies, e.g. plastic water bottles, cardboard boxes, cans
- Waste containing excreta, for example the flying latrine following the tsunami in Indonesia where faecal material was disposed of in plastic bags
- Organic waste and food waste
- Non-organic wastes, such as metals, glass and plastics
- Hazardous wastes such as asbestos (including asbestos roof sheeting), chemicals, hydrocarbons, medicals wastes(including additional medical wastes associated with emergency supplies), etc.
- Wastes generated from the disaster itself, such as sludge, debris, bodies, etc (disaster waste is dealt with in a separate Technical Brief Note (TBN 17)).

Problem Areas

Photo: Example of Solid Waste Blocking Storm Water Drain in Accra, Ghana

Areas that are prone to uncontrolled and indiscriminate dumping of solid waste should be identified. Such areas are likely to include:

- Drains which then get blocked,
- Small pits and holes near to dwellings,
- The area surrounding a market, which will set up within any displaced population or refugee camp,
- In pit latrines particularly, if the people are not given specific disposal sites,
- Passageways in spaces in between shelters.

Waste Audit

To determine whether solid waste presents a risk and what activities Oxfam can carryout to reduce this risk, a rapid audit of solid waste should be undertaken.

Observations and discussions with the population, authorities, etc should be undertaken and the following questions considered:

- What are the waste streams?
  - o Is there a solid waste problem?
  - o How do people dispose of their solid waste?
  - o What is the composition and quantities of waste produced?
  - o Can solid waste be disposed on site or does it need to be collected and disposed off site?
- What are the existing problems?
  - o Are there any existing waste management, collection and disposal processes in operation? How does this operate and is it appropriate to develop and expand upon these?

- Are there medical facilities and activities producing waste? How are these disposed of and who is responsible?
- Is mass burial of human bodies and animals required?
- Are insects and vectors causing a nuisance?
- Is there evidence of increased morbidity, which can be linked to poor waste management practices?

- Who are the external agencies involved in waste management? What are their roles and responsibilities and have these changed as a result of the emergency situation?

A significant part of the audit can be undertaken by refugee camp residents or householders, such as identifying where camp waste is piling up, the sources and reasons why waste is being disposed of, e.g. material excess, packaging from relief supplies, etc.

Minimum Standards

Sphere standards:

Key indicators

- People from the affected population are involved in the design and implementation of the solid waste programme
- Household waste is put in containers daily for regular collection, burnt or buried in a specified refuse pit
- All households have access to a refuse container and/or are no more than 100 meters from a communal refuse pit
- At least one 100-litre container is available per 10 families where domestic refuse is not buried on site
- Refuse is removed from the settlement before it becomes a nuisance or a health risk

Many countries will have their own standards and legal requirements governing waste management, and it is important to consult with the local authorities to ensure these standards and legal requirements are respected.

Community Involvement

It is essential that in undertaking any solid waste management activities that community participation is central to planning, design and implementation. Involving the community will assist in identifying what normal practice is, developing preferred options for waste collection, in developing public health and other messages associated with waste management.

The requirements of men, women, young people, children, and those with special needs and disabilities in relation to solid waste management will be different. In consulting with the community it will be important the men and women are both consulted and their needs and requirements identified. For example, women will largely responsible for household and family waste management, while men may be involved (paid or unpaid) as waste loaders or in waste collection roles.

Waste pickers

In many communities individuals are already involved informally in waste picking and recycling waste items, as they have a resale value. In developing a waste management strategy, it's important to ensure such individuals are consulted and included in project implementation. Any existing salvaging and waste picking should be protected and an integral part of any new waste management system.

Example:

In some countries a stigma is attached to waste handling and it is expected that only certain groups, such as sweepers will handle the waste. This was the case following the earthquake emergency in Pakistan in 2005. Here it proved difficult to engage the general population in clearing refuse. Clearing refuse, as well as cleaning of public toilets, are generally tasks assigned to a group of people who are considered at the bottom of the social scale and known as 'sweepers'. The people whose job means that they were known as 'sweepers' did an excellent job in response to the emergency, but it meant that involving volunteers in the cleaning of communal refuse or latrines proved difficult.

Waste Management Options

Remember the four R's

- Reduce
- Re-use
- Repair
- Recycle

The approaches described below are in order of most to least desirable and reflects the priorities as set out in the waste hierarchy. However, as mentioned above the priority in an emergency should be for immediate health and safety. It should also be recognised that even with active pursuit of the 4Rs there will always be some element of waste residual, which will require proper disposal.

Waste reduction

This involves the reduction of waste generated and will include raising awareness and influencing the behaviour of those living in camps. It will be important that beneficiaries are engaged and take a lead in the process.

Once the source of waste is identified discussions need to take place on how the waste can be reduced. Messages need to be developed so people are aware of how they can be involved in reducing waste generation. For example, agencies bringing in relief materials for those living in the camps can check to see if it is possible to either make packaging more eco-friendly, or alternatively source goods that require little or no packaging.

Example:

Following the Asian tsunami in 2004, relief supplies where brought to refugee camps in particular bottled drinking water. Although in the immediate aftermath this was an essential supply, once locally supplied water was available the continued supply of bottle water presented an enormous waste problem in terms of the large volume of discarded plastic bottles that resulted.

Waste reuse

Opportunities should be explored with the beneficiaries for reusing items, which may otherwise be thrown out as waste. Many materials can be reused and opportunities for reuse will dependant on culture, location and facilities available. For example, wood from packaging can be used as firewood or for shelter items (in Banda Aceh the timber from packaging from water supply equipment was used to make a bedstead), boxes and containers reused for storage etc.

Waste recycling and composting

Refer to separate Technical Briefing Note on Recycling and Composting.

Other Waste Management Options

The following sections provide guidance on the burial and incineration of waste. These should only be undertaken where there are no alternative options available such as, municipal landfill, controlled incineration or similar and after waste has been reduction, reuse and recycling.

At a household level

Collection, containment & storage

Family bins are rarely used in emergency situations since they require an intensive collection and transportation system and the number of containers or bins required is likely to be huge. In the later stages of an emergency community members can however be encouraged to make and use their own refuse containers to be emptied at communal pits or disposal points.

Householders should be encouraged to keep all their waste in a specified container, which is covered to reduce smells and stop flies and rodents accessing the waste. Storage time before collection should be as short as possible especially in tropical, humid conditions, which increase decomposition time and therefore increase smells and breeding insects. Householders should also be encouraged to separate out any hazardous wastes, such as aerosol cans, any medical related waste, etc. so that it can be separately disposed of at appropriate facilities.

In an initial response no dwelling should be more than 10m from a refuse container or household pit (in line with Sphere standards).

Examples of household containers include:

- traditional baskets made by the families, which can then be covered;
- simple plastic buckets with handle and lids;
- sacks from rice, rations etc. that can be securely tied;
- plastic bags that can be secured.

Photo: Examples of Household Waste Container in a Basket and in Sacks

Disposal

Where disposal is not undertaken at a communal level, i.e. waste is collected and disposed of at a central facility, the following options can be considered at a household level:

Pits

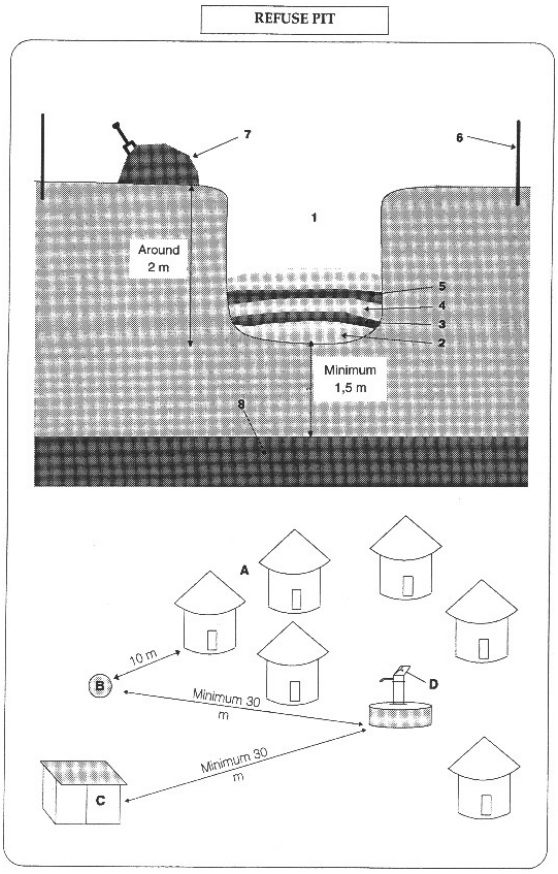
Small household pits offer a simple option for disposal of household waste where there is sufficient space. Families should be encouraged to regularly cover waste with soil from sweeping or ash from fires used for cooking. It should be noted that the disposal of organic material in pits will create methane gas with associated environmental atmospheric problems (methane is a five times more potent greenhouse gas than carbon dioxide (CO_2)). Where possible organic material should be removed from the general refuse and composted or used as feed for livestock (if appropriate).

Requirements

- >10m from dwellings
- >15m from water sources
- Approximately 1.5m above water table (if possible drive a reinforcement bar down 1.5m and check if wet when pulled out, otherwise dig a small trench to 1.5m)
- A shallow pit approximately 1 to 1.5m deep, with soil to be left to one side to allow for daily covering of waste to reduce smells, flies, rodents, etc
- A small fence constructed around the pit to avoid accidents and scavenging

- When waste reaches just below the surface, the waste should be compacted and covered with soil

Figure: Basic Design of Household / Communal Refuse Pit (courtesy of MSF)



1. pit
2. refuse, day 1
3. earth, day 1
4. refuse, day 2
5. earth, day 2
6. fence
7. excavated earth
8. water table

A. dwellings
B. refuse pits
C. latrines
D. well

Burning

Burning or incineration of waste is often used for the disposal of combustible wastes. However, this should be used as a last option and should only take place off-site or at a considerable distance downwind of dwellings. Burning of waste near dwelling can cause nuisance from smoke and can be a fire hazard. Even away from dwellings burning waste creates an environmental hazard in relation to the gases, particularly CO_2, emitted to the atmosphere. However, burning of waste can reduce the volume of waste when there is limited space for burial or landfill.

If burning of waste is undertaken it should take place in pits and covered in soil once burnt as with burial. The constraints, which apply for sitting household refuse pits also apply here.

At a communal level

Communal waste collection points & containment

Collection points need to provide temporary containment for solid waste from a number of households prior to it being removed for disposal. These need to be sufficiently robust to prevent vermin and other animals gaining access or turning the container over and to prevent waste blowing around. The container should be non-flammable as people may burn waste either intentionally or accidentally. In choosing a suitable container, consideration should be given to locally available materials and the types of containment used under normal circumstances, (if applicable).

Example:

In Internal Displaced People (IDP) camps in Banda Aceh following the Asian tsunami prefabricated concrete rings were used for temporary solid waste containment. These were readily available and inexpensive, although were not able to fully contain waste in windy conditions. Also emptying waste from these containers proved difficult.

Examples of communal containers are:

- 200 litre drums cut in half
- Nylon 1m^3 sand bags – however these are difficult to manoeuvre, heavy to lift and can be burnt.

Where recycling is being undertaken appropriate containment should be provided for source-separated materials – refer to separate Technical Briefing Note on recycling and composting.

Communal collection points and containers should be located at least 15m from the nearest dwelling. During the initial emergency one 100-litre bin should be provided per 10 families. The location of the collection points should be determined through discussions with refugee communities.

Photo: Communal Collection point in Russia.

It should be noted that there are often problems with communal containers quickly overflowing, particularly where packaging and low density wastes are being disposed of, such as during the initial emergency. If at all possible opportunities to reuse some of these materials

should be explored and where disposal is still the only option, consideration should be given to compacting or shredding such material at or before the communal collection point. This may be done either though direct labour or mechanically if such equipment is available. Creating Cash-for-Work (CFW) schemes may be appropriate in some circumstances?

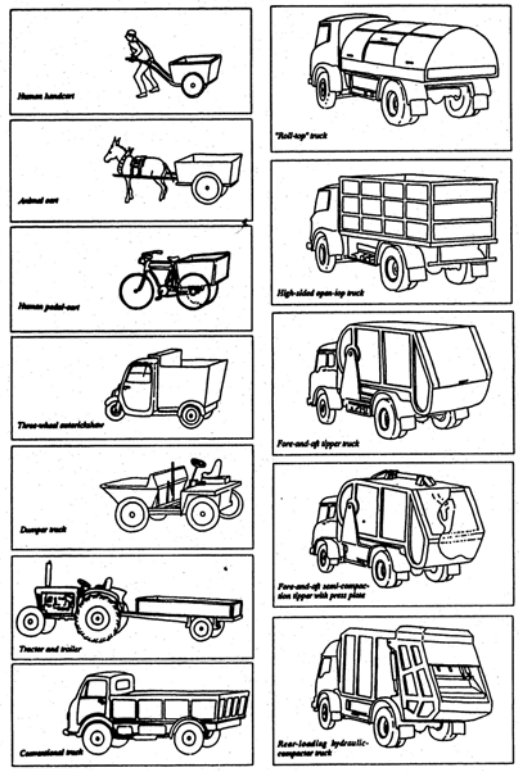
Waste transfer

Where waste cannot be disposed of on site it will need to be collected and transferred to a different location. Waste collection should aim to empty household, communal or refugee camp waste daily where large amounts of waste are created, or twice weekly for smaller volumes of waste.

Transportation of waste should be simple, appropriate and as low cost as possible. Examples of transportation options include:

- Handcarts - Wheelbarrows or small push carts with bins. Either locally available or locally made.
  - Max working area of about 1 km and therefore a population of between 10,000 – 20,000.
  - Load size of approx 0.5m^3
  - Not suitable for hilly areas
  - Handcarts can be easily managed by the affected population
- Animal carts - Donkey, horse or Ox pulled trailers.
  - Max working area of 3km
  - Load size of approx 2m^3
  - Suitable for hilly areas
  - Only suitable if population traditional use draught animals and they are available
- Small powered vehicles - Trailers pulled by small horticultural cultivators as used for local transport can be adapted.
  - Good for areas over 5km
  - Load size of approx 3m^3
  - Suitable for steep hills and small tracks
  - They need intensive maintenance and external support
  - Requires on-going funds for fuel and maintenance
- Skip trucks and tractors with trailers - These allow large waste containers to left in the areas, which can be towed away.
  - Good for large areas
  - Load sizes of >3m^3
  - Suitable for hills
  - Only suitable for large populations (Approx >50,000)
  - Expensive in terms of fuel and maintenance costs
  - Usually run by municipality or local government
- Ordinary trucks - Hiring of local flatbed trucks with 3 – 7 tonne capacity, fitted with high sides for refuse collection.
  - Good for large areas
  - Load sizes of approx 5m^3
  - Suitable for steep slopes
  - Rapid action for communal collection
  - Need approx 5 workers with hand tools for loading and off loading
  - Expensive in terms of fuel and maintenance costs
  - Usually run in conjunction with municipality and local government
- Specialised waste collection trucks – these may include waste compactors which can compress and carry large volumes of waste,
  - Good for large areas
  - Load sizes in excess of 5m^3
  - Depending on size, may or may not be suitable for steep slope
  - Only suitable for large populations (Approx >50,000)
  - Very expensive in terms of fuel and maintenance costs
  - Usually run by municipality or local government

Example: Various Options for Waste Transportation



Waste disposal

Waste can be buried and/or incinerated where recycling and reuse options are not applicable. The choice of method of disposal will be dependant on local conditions, labour and equipment availability.

Burial of waste

Waste can be buried in communal pits on site where there is sufficient space and where it will not cause health or environmental risks or cause nuisance to nearby residents. Pits should be located at least 30m away from the nearest dwelling. **No medical waste should be disposed of in these pits.** Care should be taken in siting a burial pits to ensure that leachate does not contaminate ground water and should be located at least 30m away from water courses and wells.

The main source of leachate is from rainwater percolating through the waste into the surrounding soil, which will occur in soils other than clay. To reduce this problem, where possible the pit should be lined with clay or other similarly impermeable material.

Covering the waste with an impermeable soil such as clay or providing a shelter to protect the pit can contain the volume of leachate. Covering of waste should take place daily with a thin layer of soil/earth. This further prevents attracting flies and vermin. Where faecal materials, such as children's faeces/ nappies is being disposed of these must be immediately covered.

The area being used for on-site burial pits should be fenced off to prevent accidents and access from children or animals.

Pit sizing (based on self compaction):

volume of the pit = volume of waste produce per person per day × population × number of days until camp closure

or as estimate for long-term use, use $6m^3$ per 50 people per week.

The volume will denote the size and number of pits required. The pit depth must be determined by the height of ground water and the surrounding soil conditions. The groundwater level should be a minimum of 5m below the pit bottom at the end of the rainy season. Where this cannot be achieved burial should not be used as an option. The soil/ground conditions will also affect the depth of the pit. The sides of the pit need to be stable and should be at 45 degrees unless a geotechnical expert advises otherwise.

All hazardous waste, including batteries should not be included in a household waste burial pit.

Requirements:

- >30m from dwellings
- >30m from water sources
- Approximately 1.5m above water table (drive a reinforcement bar down 1.5m and check if wet when pulled out)
- The pit size to be determined by population size
- Waste to be covered with soil daily to reduce smells, flies, rodents, etc
- A small fence constructed around the pit to avoid accidents and scavenging
- When waste reaches just below the surface, the waste should be compacted and covered with soil
- A "cut-off" drain around the pit boundary should be provided to reduce surrounding environmental pollution

Incineration

Incineration should only be used as a last option. However, in reality informal burning of waste is often endemic in many parts of the world.

Incineration should only be considered when the following conditions have been fulfilled:

- All plastic products are removed before incineration
- Incineration takes place downwind of dwellings
- The local area is not suitable for burial of waste

Incineration can be undertaken at a basic level using barrel incinerators or garden type incinerators, which increase burning temperatures and efficiency compared with open burning. However, these often do not reach sufficiently high temperature to obtain full combustion and air pollution is often a hazard.

Photo: Example of an Incinerator in the Maldives (courtesy of Peter Lingwood)

Effective incineration requires sufficient dry combustible refuse which even in tropical climate can be difficult to achieve. Thus effective incineration often relies upon the use of expensive fuels, which makes this option inappropriate.

Incineration is not recommended for the disposal of domestic waste, but it is recommended as a disposal method for medical and hazardous wastes. Refer to Technical Briefing Note on hazardous wastes, and MSF publications on incineration of medical wastes, or De Montfort medical waste incinerators:

(http://www.mw-incinerator.info/en/101_welcome.html)

If used appropriate health and safety measures should be undertaken and the area around the incinerator should be fenced off to prevent people accessing the incinerator.

Off-site disposal and linking with existing services

Every effort should be made to identify official, controlled solid waste disposal services. Co-ordination with the local authorities and other aid agencies will be essential in ensuring that such facilities are accessible and appropriately managed.

Uncontrolled landfill should be avoided at all cost. These present a risk to Oxfam's reputation and also cause poor environmental and public health control. Care should be taken to ensure if employing contractors to collect and dispose of waste that they are not illegally dumping the waste, which may be an easier and cheaper option for them.

Controlled landfill: Use of controlled landfills should be undertaken in co-ordination with local authorities and other aid agencies to ensure that appropriate disposal access is provided and that the landfill is well managed from an environmental, public health, health and safety point of view.

Controlled or sanitary landfill is an off-site disposal method. Waste is placed into a large excavation in the ground, which is back-filled with excavated soil each day waste is tipped. The cover soil should be 0.5m deep to prevent animals digging up the waste and lies breeding and should cover all the deposited refuse.

The landfill location should be decided upon through consultation with local authorities and the affected population. Its location will be largely dependant on availability of land, collection and transportation systems. The site may have been used before the emergency by the local authority and assistance may be required to get the system operational again.

Figure: EU funded Engineered Landfill, Romania

Requirements:

- Design for approximately $3m^3$ of waste per 200 persons per week
- >800m from dwellings
- >50m from water sources
- Should be a minimum of 5m above water table at the end of the rainy season (Note that where the water is being used as a water source lining of the landfill will be essential)
- Waste to be covered with 0.5m of soil daily to reduce smells, flies, rodents, etc
- A fence should be constructed around the site to avoid accidents and scavenging

Health and Safety

For those who are involved in working and handling waste, protective clothing must be provided. At the very minimum this should include appropriate footwear, gloves and overalls or other suitable clothing. A dust mask should also be considered. Facilities should be provided for worker to wash and change wherever possible.

Care should be taken to ensure that lifting of loads takes place, for example lifting waste onto a collection vehicle, that loads are not excessive for a single person lift (for example, in the UK the maximum load permitted for one person to lift at one time is 25kg ref: Health & Safety Executive).

Appropriate tools must be provided to enable those transporting and collecting waste to undertake their job properly. These may include shovels, buckets, etc.

Provision should be made to ensure that appropriate size clothing and equipment are available for women who are actively involved in implementation and delivery of waste management.

When working on landfill sites to deliver waste particular care should be taken. Accidents involving vehicles running over landfill workers and waste-pickers are not uncommon where landfills are not well managed and in many developing countries where waste-pickers are commonly found on landfill sites.

Further reading

- Guidance for Solid Waste Management, prepared by the Sanitation Task Force, March 2006
- Engineering in Emergencies – a practical guide for relief workers, Jan Davis & Robert Lambert
- Guidelines for Solid Waste Management in Emergencies – An Oxfam Technical Guidelines
- Emergency Sanitation – Assessment and Programme Design by Peter Harvey, Sohrab Baghri and Bob Reed, WEDC, Loughborough University, UK, 2002
- Public Health Engineering in Emergency Situations, MSF

Additional Support / Expert Advice

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