RESTORING WASTE MANAGEMENT FOLLOWING DISASTERS

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Abstract

This paper deals with the key issues concerning the handling of solid waste following disasters and conflicts and will present *lessons learnt* from numerous such waste management rehabilitation works, including reconstruction works in Bosnia, Serbia and Kosovo (1994 – 2003), the Kobe Earthquake in Japan (1995) and Beirut in Lebanon (1994).

Following disasters and conflicts, significant quantities of solid waste are generated and the handling of these waste streams is a considerable challenge. Thus the immediate programmes designed to handle the wastes generated must recognize the scale of importance and be integrated with the ensuing works.

An important aspect of any intervention following disasters or conflicts is that of capacity building and employment generation. Numerous of the mentioned short to medium term initiatives outlined in the paper provide good opportunities for training local personnel in waste management, including recycling methodologies, emergency waste handling and remediation of dumpsites. This furthermore places considerable emphasis on designing for local requirements.

This paper presents *key issues and strategies* for handling these large quantities of solid waste (including demolition waste from damaged built environment), which in turn can be *integrated into the disaster prevention and mitigation plans* for a geographical area vulnerable to disasters and emergencies.

Keywords; Solid waste management, Disaster management, Capacity building, Appropriate technology.

INTRODUCTION

As a consequence of disasters and emergencies, significant quantities of solid wastes are often generated from the sources other than the normal daily generation of Municipal and Industrial wastes. These “new” wastes derive from both the damaged built environment and housing/industrial facilities, as well as from the subsequent relief and rehabilitation efforts.

Considering the often large quantities of such solid wastes produced, early action within the relief and rehabilitation programming is required in order to manage and handle these wastes in both an economically and environmentally sound manner.

Without such intervention, serious risks are created from the rapidly accumulating solid wastes, including;

- ⇒ to public health from open dump sites resulting in nuisances from odour and visual impact as well as assisting in the spread of diseases through human contact with decomposing wastes,
- ⇒ increase in vermin population at the site of waste dumping, often close to residential areas,
- ⇒ dumping of wastes near water courses (rivers, streams and lakes) can lead to groundwater contamination from the waste leachate, which in turn can contaminate the drinking water.
- ⇒ uncontrolled dumping of wastes leading to obstruction of the reconstruction works and daily traffic routes for the public,
- ⇒ lead to a negative psychological impact on the population as a constant reminder of the effects of the disaster.

For the purpose of this paper, the term *disaster* is used to mean an event ”*which overwhelms local capacity, necessitating a request to national or international level for external assistance."* (Disaster Databases, 2001). It thus includes both “natural” disasters, i.e. earthquakes and hurricanes, as well as “man-made” disasters, such as conflicts. Note that there are often similarities in waste management following natural disasters and post-conflict.

As regards the term ‘waste’, this paper focuses on solid waste, which mainly comprises municipal and household waste as well as demolition waste from the demolition of damaged buildings.

KEY ELEMENTS OF SOLID WASTE MANAGEMENT IN DISASTERS

Key Issues

The key issues arising from the management of solid wastes following disasters are as follows:

- *Collapse of Municipal solid waste utilities*, including probable lack of collection service and uncontrolled tipping of wastes. This results in waste piles rapidly building up in the streets and outside urban areas leading to vermin growth and spread of diseases. The potential for impact on environmental health is serious in residential areas.

  In addition, the waste management equipment, for example collection vehicles and waste containers, are often *damaged or looted* during or after the disaster, especially in the case of post-conflict situations.

  Further detrimental impacts include the *loss of senior and experienced* waste managers, either through death or departure from the area as refugee. This can result in the new managers being inexperienced and requiring skills training in order to rehabilitate and manage the waste management systems.

- Uncontrolled tipping of *health-care wastes* from hospitals and clinics, resulting in serious hygiene risks to local population and secondary infection to patients. Such piles allowed to fester with odour / disease risks.

- *Building rubble* from damaged buildings piled in urban areas, impeding access and constraining rehabilitation / reconstruction activities. Piles of rubble also attracts further waste tipping since site already considered a “waste dump”.

- *Hazardous wastes* from damaged and redundant industrial plants cause serious health risks through uncontrolled containment and handling.

- Proliferation of scattered *waste piles and dump sites* leading to health risks (vermin and personal contact to waste) and risk of contaminating ground-water

Restoration of waste management systems has only recently been included in the Donor reconstruction programming for post-disaster reconstruction, with possibly Kosovo being the first example of a coherent strategy for the whole province. Waste is often not high on the priority list with Donors, this being an area which needs to be addressed!

In more common scenarios, waste is often addressed in an ad hoc fashion, and more along the lines of supplying equipment and funds for clean-up works, rather than a focus on capacity building and institutional strengthening. Without these skills training and management support, the provided equipment can be under-utilised and quickly become damaged due to improper use and low maintenance.

Addressing these issues and seeking more long term and beneficial waste management programmes for post-disaster reconstruction lies at the heart of this paper.

The following sections include extracts from a note by the Waste Management in Emergencies group on restoring waste management in post-conflict scenarios (WMinE, 2004)

Generation
Under normal conditions, solid waste is generated from the following main sources, this generation being typically stable with quantities and composition of wastes being known:

⇒ Households
⇒ Industries, for example factories and other industrial sites
⇒ Construction and Demolition sites
⇒ Hospitals with clinical and healthcare wastes

Following a disaster, there can be a marked variance in the generation of these solid wastes, which in turn affects the collection and disposal activities.

The following changes in the waste stream are typically seen in post-disaster:

⇒ Households; the supply of aid (food, clothing and shelter) creates an increase in waste, some of it often new to the environment. For example plastic bottles and packaging from the aid can create demonstrable problems for the waste collection.

In Bam, Iran, following the December 2003 earthquake, plastic bottles were not being collected in a coherent manner and ended up, in numerous cases, being thrown into latrines leading to serious sewage blockages.

⇒ Industries; disasters can lead to the temporary closure of factories and plants which can result in uncontrolled spillages of wastes from the facilities, mainly due to lack of personnel at site. Such wastes from industrial plants can be hazardous and thus potentially harmful to the surrounding environment, as well as water courses.

⇒ Demolition; the demolition and site clearance of damaged buildings and infrastructure leads to large quantities of debris. This debris can potentially be recycled into gravel and used in the reconstruction works, however, typically they are mixed with the municipal wastes and dumped at the landfill or local dumpsite, taking up valuable void space from other non-recyclable wastes.

⇒ Hospitals; with the breakdown of collection and disposal systems, hospitals can face severe problems with their clinical waste (including body parts, medicines and needles / sharps). The handling of these requires temporary alternative solutions, such as small, mobile incinerators designed especially for this purpose.

It can be appreciated that the generation of wastes can in many circumstances overwhelm the established waste management system from before the disaster, thus new measures will often have to be taken in the post-disaster phase.

Collection
The collection of wastes from the urban areas can often have been affected by the disaster due to damage to the collection equipment, quantity of wastes generated exceeding collection capacity, lack of personnel and even lack of salaries for the workers.

If no equipment or labour or funds are available to collect wastes, then setting fire to waste accumulations on street corners may be the safest approach in the immediate short term. However, this will require supervision in order to ensure safety.

Once some degree of normality has returned and the waste management company is being re-established, an ad hoc waste collection system can be implemented. Targeting the restoration of some form of collection service in districts of high population density has the highest potential benefit to public health.

Where mechanized collection vehicles are lacking, handcart pick up of waste to local transfer points (e.g. a large heap, bins or skips) is usually the easiest to start if money or food is available as payment. Larger quantities can be carried by animal carts and tractor-trailer methods but require money to be available to hire the vehicles. In some places aid agencies have successfully mobilised local scavengers into co-operatives to offer a collection service that householders pay for or the municipality (or aid agencies) pay through contracts.

If funds and resources are available for mechanised waste collection then, given the prevailing density of the waste, a skip based collection system would be more appropriate to introduce than the use of compaction vehicles. The latter are expensive to maintain and would provide little or no improvement in vehicle payloads.

In the post-disaster phase, disposal sites are in high demand and this space must be sought allocated for non-recyclables with the majority of recyclables being diverted to recycling depots. This can, however, prove difficult due to the large amounts of debris in the streets blocking access for waste collection vehicles. In addition, where debris has been tipped in the streets, it is often tempting for residents to see this as a place to also tip household wastes, thus increasing the health hazards and mixing the potentially recyclable demolition waste with household waste.

For demolition wastes, it will often be the demolition contractor who is responsible for the haulage of the wastes, which can be routed to specific recycling depots for processing into recycled gravel and aggregates for future use in the construction works. In certain situations, the Municipalities or Civil Administration can contract trucks to clear large areas of demolition debris.

In the case of clinical wastes from hospitals, simple 3-bin sorting systems can be implemented whereby the various types of wastes are placed in colour coded bins, which are then either burnt in the hospital incinerator or disposed on as hazardous wastes.

Disposal
Where there is no dedicated and approved landfill for the wastes, continuing the use of “out of town” open dumpsites may be the only option initially. Once collection is better established then there are a variety of low-tech approaches to convert an open dump into a controlled dumping operation. Basically, this involves improving gate control of vehicles entering the site, strict direction of vehicles on where to discharge loads, a small tipping area, flatten or cover the areas of the site not in use, eliminate fires and licence groups of scavengers to collect specific materials and to police their pitch from others.

Later, simple engineering methods such as draining away surface water, erecting a gate and gatehouse at the entrance and widening the access road on busy sites to allow vehicles to pass in both directions all begin to improve further the managed status of a disposal site.

The disposal of hazardous wastes, i.e. from hospitals or industries, should be in special cells within the dump site or landfill. Where possible, these must be controlled with a clay lining and daily cover to reduce the risks of leachate and unsupervised human contact.

With regards to demolition waste, specific recycling depots can be established for the storage and subsequent processing with crushers and screening plants. Such recycling is relatively simple and can produce a recycled gravel useful for road (re)construction and low strength concrete.

Environmental Impact Assessments (EIA)
A basic EIA can be useful where there are several options for the disposal site. However, in the initial stages of restoring waste management systems, time and resources should rather be focussed on addressing public health issues.

A basic and rapid EIA can be performed for comparison of proposed disposal sites, taking into account following aspects:

- ✓ Geology / Hydrology
- ✓ Water quality
- ✓ Air quality and noise
- ✓ Flora and fauna
- ✓ Visual impacts
- ✓ Socio-economic and cultural impacts

Based on the findings of the EIA, a decision on best option for disposal site can be made and appropriate mitigation measures incorporated into the design of the disposal site.

A key element is the soil condition of the area proposed for disposal site, which in turn affects the flow of leachate (the fluid arising from rain water percolating down through the waste and collecting acids). Considering the chemical composition of leachates, there is a need to control this since it can be detrimental to the ground water, and thus the drinking water.

Revenue generation
The initiation or re-establishment of fee collection for the waste management services is notoriously difficult due to monies often being directed more towards rehabilitation and reconstruction. However, it is best initiated by involving the local community in identifying various mechanisms for fee collection. Firstly, it is important to get the local community behind the idea that improved waste management is required and would benefit all from improved visual aspects as well as health issues.

Once a principle agreement has been achieved, it can be beneficial to target waste collection from service providers (i.e. food outlets, restaurants, m/hotels etc.) for initial fees and then expand to businesses. Finally, residential areas can be integrated into the fee collection system.

Note also that a large proportion of wastes can be compostable which means the food outlets can be involved in composting methods. This would have gradual impact on reducing waste quantities requiring disposal, (if all the foods are not already being “re-used”).

LESSONS LEARNT

The following brief presentations of waste management practices from past disasters illustrate many of the mentioned key issues.

Mostar
From 4 years of conflict in the city of Mostar, nearly 1,000 buildings were damaged beyond repair, constituting roughly 200,000 tonnes of demolition waste. In order to support the reconstruction process, a demolition waste management system was financed by the Danish Ministry of Foreign Affairs, which allowed for the reuse and recycling of construction materials in the reconstruction works.

The recycled materials produced met the national standards (a modification of the international standard ASTM D2940) for road base and sub-base materials. In addition, the recycled concrete also complied with specifications for concrete of average strengths 30 Mpa, sufficient for the production of, for example, concrete

foundations for buildings, internal concrete slabs in a passive environment and building blocks.

The implemented system employed nearly 20 staff and included substantial training and capacity building. Finally the system, with machinery and operations, was handed over as a grant to the City of Mostar for continued management within the Public Utilities companies. (Petersen, 2002)

Kosovo
Following the intervention of NATO in July 1999, the UN Mission in Kosovo (UNMIK) was established as the transitional government for the Province of Kosovo. As a result of more than 10 years lack of maintenance and investment by the Yugoslav authorities in waste utilities in Kosovo, the situation facing UNMIK at start of mission was dire. There was a severe lack of collection vehicles and subsequent adequate disposal facilities. Considerable work was initiated under UNMIK and World Health Organisation (WHO) mandates, as well as a multitude of NGO's and Government Agencies. (WMinE, 2003)

Early development of a wastes policy
WHO took the lead by developing at an early stage a policy on wastes management for Kosovo, within which long term strategies were built in order to guarantee that subsequent actions were in line with long term goals.

Municipal wastes
Severe lack of local collection vehicles, collection bins and trucks led to NATO forces in Kosovo (KFOR) being engaged at an early stage in the clean-up works, mobilising their trucks, bulldozers and provision of fuel. Location for disposal of these wastes required identification of dump sites which could be (relatively easily) upgraded. Co-ordination of this work rested with a central Public Utilities Department (under UNMIK).

Health-care wastes
For in-situ handling of health-care wastes, WHO introduced small basic incinerators, the De Montfort incinerator, which could be built locally and reached required temperatures. Basic waste segregation techniques were also introduced, which quickly improved hospital hygiene. These actions reduced the serious risk to health and the environment and it is understood that flat packs have since been developed which can be flown to site for quick local assembly. Permanent incinerators were also installed in the medium term to ensure a more sustainable treatment of health care waste was achieved.

Demolition rubble
A local organisation was established with heavy machinery for the demolition of the damaged buildings, bridges etc. Arising demolition rubble was recycled into gravel material to the ensuing reconstruction works. Teams also trained to deal with hazardous materials (asbestos) and demolition of sites hit by depleted uranium containing missiles.

The demolition and recycling organisation was, once established, financially self sustainable through the sale of the recycled materials to various public and private sector clients.

Awareness Raising

Extensive awareness campaigns implemented including designs by children (which engaged the local community), use of radio / TV spots as well as events in urban environments.

Key Lessons Learnt from Kosovo
From the Kosovo experiences, the following lessons have been identified:

- Immediate action should be taken to remove municipal wastes from key urban areas through existing municipal services and/or in collaboration with military resources, until the emergency waste plan is activated. Funds should be made available for this.
- Adequate finance set aside for implementation of emergency waste management plan. Funds need to be easily liquated to a professional procurement agency for swift action. UN procurement polices took too long thus exacerbating the hazards from the waste.
- Focus on capacity building and institutional strengthening at an earlier stage is required to maximise the utilisation of the wastes equipment, machinery and disposal facilities.
- NGOs operating in rural areas are well equipped to access and mobilise communities in smaller towns/ villages.
- Continuity in waste managers and personnel operating in theatre is required. In Kosovo several cases of institutional and local knowledge leaving mission within 6 months!
- Machinery and equipment brought into Kosovo should be locally repairable and able to be maintained (without having to transport in service teams or bulky spare parts).
- Local initiatives should be sought and supported: local solution to local problem. For example plastic bags and bins procured locally meant healthcare waste segregation could start immediately at main hospitals.

Kobe
As a result of the Hanshin-Awaji earthquake of 17th January 1995 in Kobe, more than 192,000 buildings were destroyed, as well as infrastructure such as railways and roads. The total quantity of demolition waste expected generated from the subsequent site clearing works was estimated at more than 15 million cubic meters (Kuramoto, 1995).

Only a minor proportion of this waste stream was actually recycled, with the majority being either disposed of or used for land reclamation in the Osaka Bay area. This resulted in the lifetime of the landfill being drastically reduced since void space for municipal and household wastes being taken up by demolition wastes.

Beirut, Lebanon
Following the cessation of nearly 17 years of hostilities in Beirut, the site clearing and demolition works in the Central Business District of Beirut were estimated to generate nearly 4 millions tonnes of demolition waste (Lauritzen, 1996). A stationary recycling plant was implemented for the processing of this waste stream, however, due to problems arising with the “cleanliness” of the demolition waste, the plant experienced serious operational problems. This highlights the need to sort the demolition wastes into recyclable and non-recyclable fractions before processing.

IMPROVEMENTS

With reference to the presented case studies and key issues surrounding waste management in disaster reconstruction programmes, this section discusses areas of potential improvement for future disaster planning.

Prioritisation
Solid waste management needs to be addressed at an early stage in the relief, rehabilitation and reconstruction programme. The policy makers at Donor and NGO level are to factor in the restoration of waste management services, thus alleviating future waste clean-up projects.

If wastes are left to accumulate, the subsequent clean-up and remediation of these sites becomes progressively more expensive with time.

Co-ordination
In order to ensure area wide co-ordination and integration of waste management systems into the rehabilitation and reconstruction works, a central co-ordination group is essential. The group is responsible for bringing together those able to assist in post-conflict re-establishment of waste management system, e.g. Civil Administration, UN bodies, Donors, NGOs, possible international military forces as well as the Municipal hygiene companies.

This group to seek:

- Military engaged early on with their logistics capabilities and equipment
- Local waste management structures encouraged to restart operations with what equipment
- Integrate with rehabilitation and reconstruction works
- Co-ordinate with possible refugee flows and camps

Appropriate technology
The technology, equipment and systems used for the restoration of waste management systems in post-disaster reconstruction are to be appropriate for the area.

For example, equipment procured or brought into the area to replace or update the waste collection and disposal vehicles should be applicable to the maintenance and service facilities. It is not appropriate to procure high-tech compaction trucks with digital drive systems in a country where the repair or sourcing of spare parts is limited.

In addition, the systems and machinery used should be relatively simple and robust in order to ensure effectiveness. The use of handcarts and horse drawn carts can often be more efficient than new compaction vehicles.

Training
Necessary training and management support is required in order to ensure optimal utilisation of the machinery and systems introduced. With a lack of training and support, the implemented systems may not operate fully, thus leading to lack of benefit from the donations.

Emergency wastes management plan

An emergency waste management plan can be prepared for those areas which are vulnerable to future natural disasters, i.e. urban cities on seismic faults and hurricane prone cities.

Such an emergency plan will include a resource and management plan in case of a disaster, with identification of land areas for the handling and disposal of wastes generated. This aspect is covered in a separate paper presented at the 2nd International Conference on Post-Disaster Reconstruction (2004) by Filiz Baycan (2004).

CAPACITY BUILDING & INSTITUTIONAL STRENGTHENING

The efficient management of the waste system is crucial for the restoration and rehabilitation of the system, and relies fully on the skills and experience of the personnel responsible.

Institutional strengthening

The governmental departments and/or offices charged with responsibility for national waste management and environmental policies must be integrated into the formulation of the strategy for solid wastes management. Through this co-operation, opportunities to strengthen the institution's knowledge and competencies in managing solid wastes can be realised and a strategy can be formulated which seeks to support the national long term waste management and environmental policies.

An important first step is to gain a strategic overview of the waste streams, quantities and composition, in order to then be able to formulate waste plans for the area. This will often require technical assistance from experienced practitioners and consultants.

Workshops and seminars can contribute to the institutional strengthening, as well as study visits to functioning waste management systems nearby or abroad.

Furthermore, long term in-house management and technical support are required at each level within the organisations.

Capacity building and employment generation

An important aspect of any intervention following natural disasters or conflicts is that of capacity building and employment generation. The removal, handling, treatment and disposal of solid wastes provide good opportunities for training local personnel in waste management, including recycling and reuse methodologies, emergency waste handling and remediation of dumpsites. Note that many of the tasks involved can be made labour intensive in order to increase employment opportunities.

In addition, the capacity in wastes management consultancy sector should also be addressed in order to assist in the long term development of the environmental field in the area.

CONCLUSIONS

This paper has highlighted some of the key issues concerning the restoration of waste management systems in post-disaster reconstruction.

A balanced intervention focussing on appropriate technology and machinery is required with a supporting training and institutional strengthening, in order to ensure success.

In addition, an early recognition of the importance of tackling waste management in the relief and rehabilitation phase is crucial, otherwise the accumulating wastes pose increasing risks to public health and subsequent clean-up costs progressively escalate.

For disaster vulnerable geographic areas, an emergency waste management plan can be prepared, including training and resource allocation.

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Photograph 1. *Uncontrolled disposal of hospital wastes in Kosovo with body parts in front of container.*

Photograph 2. *Burning of wastes in street containers in Kosovo.*

Photograph 3. Accumulated and burning wastes in residential area of Prishtina, Kosovo.

Photograph 4. Recycling plant for demolition wastes in central Kosovo.