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Karunasena, G. I., Amaratunga, Dilanthi and Haigh, Richard

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Waste Management Strategies during Post Disaster Phase: A Case of Sri Lanka

Karunasena, G.
Department of Building Economics, University of Moratuwa
(email: gayani@becon.mrt.ac.lk)
Amaratunga, D.
School of Built and Human Environment, University of Salford
(email: r.d.g.amaratunga@salford.ac.uk)
Haigh, R.
School of Built and Human Environment, University of Salford
(email: r.p.haigh@salford.ac.uk)

Abstract

Natural or man made disasters cause serious negative impacts on life, property, livelihood and industries often resulting in permanent changes to societies and environments. In disasters, creation of waste due to damaged buildings and infrastructure is unavoidable. If these wastes are not properly managed, serious environmental and economic burdens will fall on general living conditions, reconstruction and as well as general waste collection processes. Therefore, management of disaster waste has emerged as a critical issue and poses a significant challenge to governing bodies in responding to a disaster. This is not unique to Sri Lanka which is prone to frequent natural disasters such as floods, landslides and droughts apart from the Asian Tsunami of 2004. This paper addresses post disaster waste management strategies adopted and issues and challenges encountered at both national and local levels in Sri Lanka during post - Indian Ocean Tsunami period. A comprehensive literature review and a field survey were conducted to gather information. Accordingly, most affected six districts were selected based on three types of disasters namely floods, landslide and the Tsunami. Seven national institutes responsible for managing disasters were selected for collection of data at national level. Semi-structured interviews were used as the main method of data collection at each stage and content analysis was used to analyze data that was collected. Local level findings revealed that strategies, issues and challenges vary according to the type of disaster, magnitude and location. Unavailability of a centralized body, poor implementation of rules and regulations; poor standards of local expertise and capacities, inadequate funds, lack of communication and coordination were identified as key issues at national level.

Keywords: disaster waste, waste management strategies, local level, national level, C&D debris

1. Introduction

Impacts of disasters, whether natural or man made, have both human and environmental dimensions (Shaw 2006). Except, casualties, including deaths, injured and misplaced people, property damages, collapsing buildings, infrastructures and crop destructions are some critical matters (Lindell and Prater 2003; Shaw 2006) which lead to create tremendous amount of disaster waste. Managing disaster waste become further critical unlike ordinary waste as it is mixed and difficult to separate (Kobayashi 1995). Furthermore, disaster waste may be contaminated with certain toxic or hazardous constituents which lead to environmental degradation and health problems. Thus, ineffective management of disaster waste lay the foundations for serious environmental and economical problems in the country. Especially Construction and Demolition (C&D) waste block drainage systems, streams, rivers and lagoons creating number of issues like floods, decomposition, offensive odors and proliferation of vectors (Perera 2003; Kobayashi 1995). In addition, material shortage and high prices eventually occur as a result of sudden demand for construction material, due to increasing volume of reconstruction where C&D waste has a significant importance to ensure price stability by salvaging large amount of materials for reuse and recycling.

This is not unique to Sri Lanka which is prone to frequent natural disasters such as floods, landslides and droughts. Specifically, United Nations Environment Protection report (2005) states that in Sri Lanka about 100,000 houses were destroyed generating about 450,000 tones of debris by the tsunami of 2004. Furthermore, UNEP reveals that this debris was not properly disposed, reused or managed in Sri Lanka. Thus, in Sri Lanka there is a significant necessity to evaluate building waste management strategies adopted in post disaster scenarios during last decades. This study aims to explore waste management strategies adopted at both national and local levels in post disaster scenarios.

2. Post disaster waste management

In a disaster, generation of waste is unavoidable. In 2008, Environment Protection Agency in USA identified several items generated as waste at post disaster circumstances such as soil and sediments, building rubble, vegetation, personal effects, hazardous materials, mixed domestic and clinical waste and often, human and animal remains representing a risk to human health from biological, chemical and physical sources (EPA 2008). The type of disaster waste generated is largely dependent on nature of disasters (FEMA 2007; EPA 2008). Each type of waste may contain or be contaminated with certain toxic or hazardous constituents. Literature hardly revealed any statistics on types of disaster waste generated during the past decade except approximate quantities generated at few disasters such as 13 million tons from Marmara earthquake in 1999, 20 million tons from Kobe earthquake in 1995, 22 million tons from Hurricane Katrina in 2005, 10 million tons from Kosovo earthquake; 4 million from Beirut etc (Lauritzen 1998; Ardani *et al* 2007; Baycan and Petersen 2002; Zeilinga and Sanders 2004; Kuramoto 1995; Shaw and Goda 2004). However, report on managing disaster debris by Luther (2008) indicated that it is necessary to estimate total volume of debris to manage disaster waste appropriately as it provides for prior identification of appropriate staging grounds to separate waste, necessary landfill space, necessary contract services and anticipated special handling requirements applicable to hazardous debris.

Pike (2007) indicated that disaster debris management commences immediately following a disaster and continues during longer term reconstruction. The first phase of debris management is dedicated to immediate disaster relief, focused on removing debris from access routes and residential and commercial areas. The second phase of debris management is the long-term removal of debris, which assists reconstruction and adopts strategies to counter future threats to human health or environment (Blakely 2007). Literature on waste management strategies and models revealed that developed countries which experience frequent disasters, directed technological know how and expertise towards successful implementation of disaster debris management (Karunasena *et al* 2009).

Waste management represents without any doubt a main environmental issue of any post disaster scenario. This become critical as it differs from the normal situation which generates waste in stable quantities and composition whereas in a post disaster scenario, it radically changes in type and quantity (Peterson 2004). Specifically, C&D waste when it is contaminated with toxic substances such as lead, asbestos, arsenic it become hazardous which lead to environmental degradation and health problems (Pelling 2002).Thus, measures aiming at *controlling disaster waste generation* such as building regulations and codes are needed at mitigation phase of disaster management. Lauritzen (1998), Baycan and Petersen (2002) and Alameda Country Disaster Waste Management Plan (2008) emphasized on importance of designing early stage strategies to be managed in the most environmentally sound manner possible, maximizing source reduction and recycling options and minimizing land disposal. Rafee *et al* (2008) indicated that disposal of debris is a main challenge during a disaster recovery operation. Petersen, (2004) pointed out further adverse effects on water quality, air quality and noise, flora and fauna, visual impacts and socio economy arising from the waste management problem. Srinivas and Nakagawa (2007) also indicated solid waste and disaster debris as the most critical environmental problem faced by countries affected by the Tsunami in 2004. In spite of theses impacts, Raufdeen (2009), indicated benefits of C&D waste management such as conservation of virgin resources, economical utilization of landfills, environmental and economic sustainability, reduction of illegal and non authorized dumping, reduced energy usage, cost recovery and financial incentives and compliance with policies, laws and regulations.

Report on managing disaster debris by Luther (2008) indicated many challenges in managing disaster debris such as issues associated with managing large volumes of waste, ensuring ability of property owners to return to an area and assist with cleanup, separating hazardous and non hazardous waste and managing asbestos-contaminated waste. In addition, literature revealed deconstruction, establishment of permanent recycling infrastructure and enhancement of eco-industrial networks through strategic planning as some key barriers in C&D debris management (Baycan and Petersen 2002; Zeilinga and Sanders 2004; Ardani *et al* 2007). Ardani *et al* (2007) argued the lack of funds to acquire required technology and equipment as a major barrier visible in most disasters. Other than the capital, most authors interpreted lack of capacities of both local and national institutions as another key barrier for sustainable C&D debris management. Lack of vulnerability and risk assessment, environmental baseline data, technology know how, communication and coordination are some areas highlighted (UNEP 2005, UNDP 2005, ICUN 2005).

2.1 Post disaster waste management in Sri Lanka

Statistics of recent past (2004-2008) reveal that Sri Lanka was heavily impacted by frequent landslides and floods. In addition, the Asian Tsunami of 2004 is widely acknowledged as the largest, most devastating natural catastrophe reported in the history of the country. Joint report of government of Sri Lanka and joint development partners in December 2005 indicated that within a short period it claimed 35,322 lives, injured 21,441, orphaned 1,500 children and left many families without members, fully damaged 78,199 houses and partially damaged 48,911 houses. In addition, it states that two thirds of country's coastline was affected where most of industrial and commercial activities took place resulting in damaged roads, bridges, buildings, railway and other transport systems, ports and harbors, electricity and water supply systems, communication lines, markets, towns and private properties estimated at US$105 million (4.5 % of GDP) (Jayasuriya *et al* 2005; Jayawardena 2006). In order to facilitate harmony, prosperity and dignity of human life through effective prevention and mitigation of natural and man-made disasters, National Council for Disaster Management (NCDM) was established by the Disaster Management Act No. 13 of 2005 as a high-level inter-ministerial body that provides direction to Disaster Risk Management work of the country (DMC 2005a; 2005b; 2006a, 2006b; Jayawardena 2006).

It is noted that the most highlighted failures of post Tsunami waste removal programs of Sri Lanka when compared with other countries such as Maldives and Indonesia were due to non existence of mandatory or statutorily enforceable pre planned disaster waste management rules and regulations (Martin 2007; EC 2006; UNEP 2005). Further, in-depth review on national level polices for disaster management (Refer, Disaster Management Act no 13 of 2005) and waste management (Refer National Environmental Act 1981) indicates no provisions for disaster waste management. United Nations Environment Protection report (2005) also reported that debris were not properly disposed, reused or managed in Sri Lanka (Pilapitiya *et al* 2006; Peppiatt *et al* 2001; UNEP 2005). However, few regulations like restrictions on burning disaster waste along coastal line were implemented after the Tsunami. Also it seems that those regulations were not observed by citizens due to lack of preparedness for large scale disasters, lack of knowledge of government officials regarding management of disaster waste and zero input from mostly impacted. In addition, most changes were not aligned with social context of impacted individuals (Shaw *et al*, 2003).

Jayawardena (2006) illustrated on uncontrolled open dumping of waste contaminated with hazards which had significant negative public health and environmental impacts through contaminants leaking into soil and groundwater, increased vermin presence, negative odour and visual impacts after the Tsunami. Further, according to Europe Aid co-operation office (2006), C&D debris is not recycled and reused at its optimum capacity in Sri Lanka which disposed them to landfill sites. Main obstacles include lack of knowledge, relatively new practice, limited recycling markets, limited market awareness, high costs and space requirement (Raufdeen 2009). However, there was evidence for recycling of C&D debris by individual homeowners who attempted to re-use material in reconstruction and also cash for work programs organized by NGOs which were environmentally beneficial and helped with livelihood restoration (UNDP, 2005). Further, risk assessments conducted in recent past indicated that most disaster waste management programs conducted at local levels with collaboration of NGOs do not consistently meet current best practices due to lack of readily available

guidance, practical procedures and resources (UNDP, 2005;UNEP 2005; EC 2006; Martin 2007). In 2007, National Disaster Management Committee of Sri Lanka also indicated that capacities of Sri Lankan institutions are inadequate for successful disaster management (DMC, 2009a). Literature hardly revealed any details on waste management strategies adopted at national and local levels.

3. Research methodology

Comprehensive literature and documentary survey was conducted on post disaster waste management to identify nature of disasters, disaster management, waste management strategies, models, etc.

Semi- structured interviews were selected as data collection methods in this study due to feasibility, accessibility and convenience. Seven national institutes responsible for managing disasters were selected for collection of data at national level covering both government and non government organizations. Key professionals involved with post disaster management were selected for interviews form each institute. At local levels, six districts were selected for data collection covering three types of disasters which were more frequent and critical during last five years. Two districts severely affected by each type were selected. Interviewees were selected from top or middle management as well as field officers from both government and non-government organizations involved with post disaster building waste management processes. As state organizations Municipal Councils, Urban Councils and Pradeshiya Sabas were selected for data collection.

Content analysis was used in order to analyze collected data. Nvivo software was used for easier and speedy content analysis. Relevant coding structures were prepared using software and analyzed in order to determine practicing strategies and their issues.

4. Survey findings

4.1 Post disaster waste management strategies: National level

Disaster Management Centre (DMC) is the key national level institution established for planning, coordinating and implementing disaster management plans by the Disaster Management Act no 13 of 2005. The DMC functions under Ministry of Disaster Management and Human Rights and National Disaster Management Council (NDMC). Further, it is indicated that disaster management takes place through five levels as national, provisional, district, divisional or local and *Grama Niladari* (GN) or village level and all sectors have been delegated with different levels of authority by the Act no 13 of 2005 (Refer Sri Lanka Disaster Management Act No.13 of 2005). National level institutes such as DMC is involved with policy making, resource allocation, prioritization of activities, budget allocation and monitoring of disaster management plans whereas all other related activities are delegated to other levels (Refer Sri Lanka Disaster Management Act No.13 of 2005). Disaster Management Centre operates in two levels as national and intermediate/ local. At national level, several divisions are established as Preparedness Planning, Training & Public Awareness, Mitigation & Technology, Emergency Operations, Multi Hazard Early Warning & Dissemination, Risk Assessment & Data Collection, Administration, Finance and Media while at intermediate level

Districts Emergency Operation Units are established (DMC, 2006a). District Emergency Operation Units are responsible for preparing disaster preparedness and response plans for district, divisional and GN levels, capacity building of village level volunteers, awareness programmes etc (DMC, 2006a). However, one key requirement is that provincial and local level plans shall be prepared in conformity with national level disaster plans.

Further, in-depth review on national level polices for disaster management (Refer, Disaster Management Act no 13 of 2005) and waste management (Refer National Environmental Act 1981) revealed that there are no provisions for disaster waste management. Disaster Management Act only states that disaster management council shall provide protection for environment and maintain and develop affected areas (Disaster Management Act, 2005) whereas National Environmental Act addresses general solid waste management (Raufdeen 2009). In Sri Lanka, C&D waste is still classified as solid waste as there is are no regulations specifically dealing with C&D waste. Further, National Disaster Management Plan and National Emergency Operation plan in progress which would be enforceable in near future also have less provisions for disaster waste management.

Further, findings revealed that in large scale disasters C&D debris have been managed with the collaboration of national level organizations. Role and functions of an organization in disaster waste management varied based on type of disaster. As a result, organizations do not owing any responsibility over disaster waste made contributions at massive disasters in their own specialized areas. For example, while one organization cleaned roads, another cleared debris from the sea shore. Moreover, some organizations provided equipment and technical knowledge whereas some other organizations gave financial assistance.

Regarding C&D waste management strategies, although pre planned strategies were not existing, it was revealed that government sector has attempted to produce at least some guidelines or plans regarding disaster waste management such as rules pertaining to restrictions on burning and illegal dumping of disaster waste along costal lines after the recent Tsunami, whereas the non government sector only implemented some practical measures to minimize impact. In terms of collecting and transporting disaster waste, both government and non government organizations actively participated where non government sector more actively supplied manpower, technical support, equipment and vehicles. Further, there is no evidence that disaster waste has been processed in Sri Lanka where majority was disposed to land filling. The only recycling plant that was implemented for construction waste management in Galle (COWAM, 2008; Raufdeen, 2009) with the intension of processing post Tsunami construction waste also was not feasible due to delays in operation. Further, transporting from dump to the plant for recycling provided significantly lower benefits with transportation costs.

Interviews revealed that lack of capital and political will were the key barriers impacting on implementing proposed C&D debris management programs in the recent past. In addition, unavailability of a single point authority for disaster waste management is also significant, leading to various issues such as *ad hoc* programmes and poor coordination among authorities. This is further affected by lack of intellectual capacity such as lack of knowledge, expertise and training related to post disaster management with relevant local authorities/ institutions.

4.2 Post disaster waste management strategies: Local level

Six districts according to a statistical analysis by which most affected districts based on three types of disasters namely tsunamis, floods and landslides during last five years (2004 onwards) were selected, as illustrated below;

- Tsunami : Batticaloa and Galle districts
- Floods: Kaluthara and Gahampa districts
- Landslides: Nuwara Eliya and Kandy districts

Municipal Councils, Urban Councils and Pradeshiya Sabas are the key organizations involved in post disaster waste management processes at local levels. Non existence of pre planned waste management strategies are evident at local levels where open dumping and land filling were used as common waste management strategies. Solid waste management rules of local government agencies were applied for management of C&D disaster waste such those of Municipal Councils Ordinance (section 129,130,131), Urban Councils Ordinance (section 118,119,120) and Pradeshiya Sabhas Act No.15 of 1987, section 93,94) (Raufdeen, 2009). Findings of post disaster waste management strategies at local levels are summarized at table 01.

Table 1: Summary of waste management strategies-local levels

Waste mgt. strategies	*Tsunami*	*Floods*	*Landslides*
Collecting and transport	*Initially both districts cleared access routes to collect waste. In Batticaloa relevant authority separated building waste prior to dumping. In Galle collected waste dumped at temporary dumping places without separation.*	*In both districts waste was dumped without separation.*	*In both districts waste was dumped without separation.*
Processing	*In both districts private owners reused the reusable waste. In Batticaloa a small proportion of building waste were reused for temporary huts whereas in Galle a recycling plant was constructed funded by a German organization to recycle C&D waste.*	*In both districts private owners reused reusable waste and there were no recycling processes.*	*In both districts private owners reused reusable waste and there were no recycling processes.*
Disposal	*Batticaloa used building waste to fill damaged roads and low level grounds where as in Galle waste was transported from temporary dumping places to permanent dumping places located within a 5km distance of the Galle town.*	*In Kalutara directly dumped all types of waste collected to dumping yards and in Gampaha they used a small proportion to fill damaged roads and dumped rest at a dumping yard.*	*In Nuwara – Eliya disposal of waste was done by filling lakes, sides of roads and covering up dumped garbage. In Kandy all waste was dumped at garbage dumping yards.*

Lack of heavy vehicles and labor impacted at all stages of disaster waste management process at local levels. In Batticaloa disaster waste separation was mainly done by non government organizations where most were stolen by third parties, which again was is critical issue visible in that district. In Galle, main issues were identifying temporary dumping yards and clean drinking water. Further, recycling plant took a long time to put into operation which drastically reduced its effectiveness. In Kalutara, requirement for an alternative dumping ground and malpractice of re-usable of waste were identified as critical issues. In Nuwara- Eliya, geographical location and protests against the municipal council for disposing of waste in forest area were the major issues.

5. Conclusions

Disaster is not a new phenomenon that the world is witnessing today with devastating impacts towards communities and the environment. Although, the human loss is the true tragedy of disasters, destruction of buildings and infrastructure can also be considered as a significant impact on an economy as well as an ecosystem. Those ruined buildings and infrastructure generate tremendous quantity of debris including rubble, concrete, bricks steel and timber which place an additional burden on a community in order to cope. Thus, in rebuilding, the process should encourage incorporation of building waste reduction, reusing and recycling strategies. Sri Lanka is also identified as a disaster prone country, experiencing a variety of disasters with immense damages to livelihoods, interrupting economic and social activities during the recent past, such as the Asian Tsunami of 2004. Except deaths and injuries, building and infrastructure damage causes tremendous quantities of waste. Hence, this study aims to identify post disaster waste management strategies adopted in Sri Lanka during the recent past. Data were collected using semi-structured interviews at both national and local levels and content analysis used as the analysis technique.

Findings revealed poor waste management strategies to be creating many environmental and social issues. This was further aggravated by unavailability of enforceable legislation, non-availability of institutional framework, lack of coordination and communication, non-availability of district and divisional contingency plans, less political will and inadequate resources including finance, equipments and labour. In conclusion, although government institutions encompass certain legal powers to carry out post disaster building waste management, it has not happened due to lack of resources such as finance and technology. Conversely, non government organizations do not posses any legal power to implement their own projects, where as most of them are willing to provide their financial and other technical supports on managing disaster debris. Therefore, it is evident that proper waste management strategies need to be adopted in Sri Lanka for sustainable waste management.

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