POST DISASTER WASTE MANAGEMENT STRATEGIES IN ACHIEVING SUSTAINABLE BUILT ENVIRONMENT

Gayani Karunasena, Dilanthi Amaratunga & Richard Haigh

Background

Disasters cause a substantial damage around the world every year. In the recent few years, large scale earthquakes and tsunamis brought tremendous damages to urban and rural areas in the world, especially in Asia. A disaster is a serious disruption of the functioning society, causing widespread human, material or environment losses which exceed the ability of affected society to cope using only its own resources" (Disaster Management Centre of Sri Lanka, 2008). According to official statistics issued by the Centre for Research on Epidemiology of Disasters (CRED) and United Nations International Strategy for Disaster Reduction (UNISDR) in 2008, natural disasters killed 16,517 people and destroyed US $ 60 billions worth of property and infrastructure in 2007 (UNISDR/CRED, 2008). According to the statistical figures although there is a reduction in impacts caused on human lives and infrastructure, the frequency of occurring disasters have increased during past years. (World disaster report, 2002, 2003, 2004)

Many disaster situations excessive demands were placed on environmental capacity, such as water and soil contamination, hazardous waste threatening public health and safety; damages on environmental infrastructure, building and industrial sites (Perera 2003; UNEP, 2005; Pilapitiya et.al, 2006). This statement illustrates that disasters are so closely intertwined with environment and proper environmental management and governance is essential for long term peace, stability and security in disaster prone countries, particularly, in developing countries where affected communities rely heavily on natural resources for survival. This is not an exception to a developing country like Sri Lanka which was heavily affected by the Asian Tsunami in 2004 and frequent smaller disasters.

Waste and debris (building waste) becomes a key issue when compared to the extent of debris created as a result of disaster especially the Tsunami , particularly from destroyed buildings which were very significant (Joint UNEP/OCHA, 2005). Although there is a National Strategy for Waste Management in Sri Lanka it is hard to implement when a disaster occurs due to unawareness, in

capabilities etc. Although, there has been many environmental awareness and education programs conducted by government as well as and non governmental organizations, with no significant progress in improving waste management issues in Sri Lanka (Kurita et.al, 2006). This causes serious environmental and economical burdens on normal living conditions, reconstruction phases as well as on general municipal waste collection process (UNEP 2005; Bandara and Patrick 2003). In this context, waste management and disposal has emerged as a critical issue in responding to a disaster.

This paper attempts to document issues and challenges towards a sustainable waste management practice in post disaster Sri Lanka and the role of built environment professional's regards to that.

Research Methodology

Comprehensive literature and documentary review was carried to identify waste management strategies, issues and challenges at post disaster scenario. This paper primarily based on the secondary data findings and includes more information pertaining to Asian tsunami 2004 since this is the single event disaster that recorded highest number of deaths, damaged houses and affected families during the past decade (Joint Report, 2005; Hettiarachchi, 2004). The structure of the paper consists of disasters, post disaster waste management practices and shortcomings, roles of built environment professionals and conclusions to conclude the paper.

Disasters in Sri Lankan Context

Sri Lanka is prone to natural disasters commonly caused by floods, cyclones, landslides, droughts and coastal erosion for generations with increasing losses of life and property. (Jayawardane 2006, p.1). Earthquakes have been recorded over the past 400 years and the country is also exposed to various human-induced hazards resulting from deforestation, indiscriminate coral, sand and gem mining and industrial pollutants (DMC 2005, p.1).

Sri Lanka is mainly suffered from the floods which imply that Sri Lanka is more vulnerable to floods. As an example, according to DMC recent flood on June 2008, 20 killed and 315, 368 people have been affected in 8 districts in island wide. However number of people affected by Tsunami which occurred in 2004 is nearly takes one third of number of people affected by the floods that occurred during three decades. Further, Natural Disaster Damage Statistics indicate this as the single event disaster that recorded highest number of deaths, damaged houses and affected families during the past decade (Joint Report, 2005; Hettiarachchi, 2004).

Tsunami and its impact

On 26th December 2004 Sri Lanka was hit by the Tsunami caused by a massive off shore earthquake, measuring 9.0 on the Richter scale which was one of the largest ever

recorded (World Disasters Report, 2005). According to the Joint Report of the Government of Sri Lanka and Joint Development Partners (2005), it claimed 35,322 human lives, injuring 21,441 orphaned 1,500 children and left many families without spouses (Joint report, 2005). In addition, it states that two thirds of the country's coastline was affected, with damaged roads, bridges, buildings, railways and other transport systems, ports and harbours, electricity and water supply systems, communication lines, markets, towns, and private property (Shaw, 2006; UN-OCHA, 2005; ADB, 2005).

The economic impact of the Tsunami includes assets losses (direct damages), output losses (indirect damages) and fiscal cost (secondary effects) (ADB, 2005). The preliminary assessment of damages done by end-January 2005 through a joint effort of the United Nations Development Program (UNDP), Asian Development Bank (ADB) and World Bank (WB) estimated that Sri Lanka suffered asset damages of around Rs. 105 billion (4.5% of GDP) (ADB, 2005). The destruction of private assets was substantial (around Rs.1120 million) in addition to public infrastructure and other assets (ADB, 2005). The trauma, grief, and suffering associated with deaths of family members, relatives and friends, destruction of houses, displacement, loss of livelihoods, savings and valued belongings are unquantifiable (ADB, 2005).

Disaster waste management in Sri Lankan context

The generation of waste at a post disaster scenario would not be avoidable at all. It is a national issue owing to capacity constraints of available landfills at most local authorities, particularly the Municipal Councils. Post disaster waste cannot be overlooked as it occupies a considerable proportion of landfill volume due to demolition waste and boom in construction activities after destruction. One major problem is the non-availability of landfills for such a huge volume of debris left over by a massive destruction.

In Sri Lanka the extent of debris created by the recent tsunami, particularly from destroyed building was enormous. A specific proportional breakdown of Tsunami-generated waste is not available (Pilapitiya et.al, 2006). A rapid inspection of waste at damaged areas, unauthorized dumps and unplanned landfills indicate that, by volume, a large part of waste consists of spoiled soil, damaged building material and vegetative matter, including branches, wood and domestic refuse. Smaller proportions of waste include plastic, metal (of various types and conditions) and items of undetermined origin. No significant presence of hazardous chemicals or technological items (eg., computers, televisions) was noted. Overall, an estimated 80% of waste was of spoiled soil, building material and vegetative matter (Pasche and Kelly 2007). Further, based on the assumption that the average weight of

debris (e.g. bricks, concrete and roofing material) per house destroyed was in the range of 3000 kg, for approximately 100,000 houses destroyed, there would have been about 300 million kg of debris from destroyed and damaged houses alone, without making allowances for lost household goods, furnishings, contents of shops, tens of thousands of vehicles and boats, fallen trees, destroyed roads, bridges and culverts. A conservative official estimate is about 200 million kg, but it could well be hundreds of millions more (UNEP, 2005). Disposal of these waste materials proved to be a huge issue because of the sheer volume and associated costs. Identifying the most suited and applicable strategy for each situation is of utmost importance in order to provide better assistance to victims and to avoid possible future vulnerabilities and environmental degradation (UNDP 2005; Blaine 1994; Moe and Pathranarakul 2006). Therefore, proper planning is of utmost importanance to reduce future vulnerabilities and to improve long-term sustainability (Cardinali, 2001).

In case of the Tsunami, the UNEP developed UN Post-Asian Tsunami Waste Management Plan was launched in the Maldives and Indonesia which supported removal of disaster debris (UNEP, 2005). In the Maldives 16 waste management centres were constructed for waste collection and disposal; preparations were made for construction of further 22 waste management centres and a regional waste management facility. In Indonesia over one million cubic meters of Tsunami waste were cleared, almost one hundred cubes of municipal waste collected through re-established municipal waste collection systems (EC, 2006).

Proper waste management practices include separation, removal, recycling and safe storage of waste. In a disaster situation, it may not be practical to employ a system of waste separation due to amount of debris and time and labour it would require (Treloar et al 2003; Bekin 2007). According to Selvendran (2005), waste separation system became impractical at a post disaster situation as cleanup and recovery became the first priority. Further, there were no previously organized waste management practices in most of Tsunami-affected local areas (Selvendran and Mulvey, 2005).

Local government authorities and volunteers worked diligently at removing and cleaning up neighbourhoods (Shaw, 2003). Land owners also cleaned their own premises depositing waste at locations for collection. Emergency efforts resulted in haphazard disposal of waste along roads, in open fields, into drainage ditches, low lying lands and waterways, including beaches. Burning of debris was also evident in certain areas impacting on air quality, which was later barred by the CEA. The CEA also instructed that solid waste be collected and deposited in open areas such as playgrounds until proper disposal sites were identified (Pilapitiya et.al, 2006).These practices caused long-term

problems by clogging waterways and polluting beaches.

The CEA identified a list of "suitable" sites for Tsunami related waste disposal which included "Best Practice Restoration Guidelines" prepared by the World Conservation Union (IUCN) with collaboration of the Sri Lankan Government for solid waste disposal (ICUN, 2005). The list of sites included abandoned clay mining pits, coral mining sites on land and publicly owned lands already been degraded by human activities, which could be restored. However, due to poor disposal practices waste was still visible at "open dump" sites identified by the CEA. Also in identifying suitable sites, the CEA did not conduct geotechnical or other technical investigations, but based its selection primarily on void space and availability of land. Therefore, these sites may contribute to long term adverse environmental impacts such as ground water contamination and exacerbation of flooding (World Health Organisation, 1990)

There was a considerable amount of recycling of building debris by individual homeowners who attempted to re-use material in reconstruction of houses. Recycling strategy is often to renovate all or part of a structure and rededicate it to new use (Bloomfield, 2004; Huge Brodin and Anderson 2008). Large amounts of bricks, tiles, timber, masonry stone and other roofing material was removed from the waste stream for re-use. Such recycling programs were generally spontaneous and were quite successful since there was a market for re-using of these materials. There were instances of NGOs organized recycling through "cash for work" programs which was environmentally beneficial as well as helped in livelihood restoration (Peppiatt, 2001, Harvey, 2005).

It revealed that only a few materials are reused or recycled such as *kapok* bricks, roofing timber, doors and windows (frames and sashes), asbestos roofing and ceiling sheets and steel pipes. This was not an isolated issue on construction and demolition waste but a major environmental and economic concern all over the world. Therefore, it is a paramount issue to implement waste management strategies which comprise of recover, reduce; reuse and recycle (4R strategy) that immensely solves problems of material shortages and impact on natural raw materials.

Challenges in disaster waste management

Main reason for failure in waste management is poor implementation of prevailing rules and regulations in the country (Perera, 2003). Rules and regulations connected to solid waste comprise of the National Environment Act 1988, Predeshiya Sabha Act 1993 and Urban and Municipal Council Ordinances 1987. The National Environmental Act 1988 restricts dumping of solid waste into environment and states the functions of the Central Environmental Authority (Perera, 2003). The local government Acts and

Ordinances state that local authorities are responsible for proper removal of non-industrial solid waste and should provide proper sites for dumping of solid waste (Perera, 2003). Further, Government enacted disaster management Act.No.13 of 2005 in May 2005 to provide legal basis for a Disaster Risk Management (DRM) in the country. However, due to scarcity of land and unawareness of new waste management strategies, still waste management is a critical problem in Sri Lanka.

According to the Rapid Environment Assessment Report for Sri Lanka (2005) next critical issue is poor coordination among national and local level authorities as well as absence of funds to cover costs of heavy equipment to support debris collection, recycling and disposal (UNEP, 2005).

Same source indicated that next critical issue is poor local expertise and capacities in recycling, composting and environmental management (UNEP 2005). Further, REA indicated that waste removal programs conducted at district levels with collaboration of NGOs do not consistently meet current best practices due to a lack of readily available guidance, practical procedures and resources (Shaw, 2003; Martin 2007).

Other critical issue for failures of waste management process is the resistant to change. Most victims of the Tsunami are low-income less educated people living along coastal lines of the Sri Lanka. Therefore, any significant social change needs to occur within context of individual attitudes and behaviors (Shaw et.al, 2003).

With reference to the challenges indicated, it emphasis the importance of increasing an organization's access to information and technical know-how by improving internal management structures, processes and procedures as well as strengthening partnerships among various players in waste management process.

Role of built environment professionals

Sri Lanka faced challenges in rebuilding a nation that never experienced such a calamity. The government forecasted that it would take 3-5 years to complete rehabilitation and reconstruction tasks and restore services and livelihoods that were severely affected. (Jayasuriya et *al.*, 2005). Inexperience, incapacity and lack of concentrated and effective planning and monitoring processes emerged as salient features of failures in rebuilding an affected nation. Within this context, active contributions of built environment professionals are becoming a one of the key salient features.

A number of disciplines dominate the term 'built environment' but there is no agreed definition of built environment as to the remit of the term (Amanda et al. 2005). CEBE (2005) includes Architecture, Construction, Housing, Landscape, Planning, Surveying and Real Estate as the built environment professions. Whilst some Universities would categories

Civil Engineering within the term built environment, this discipline is not normally so classified (Amanda et al. 2005). But Ashworth (2003) identified built environment is a term that encompasses the planning, design and construction of buildings and civil engineering structures and their ongoing management throughout their use.

There is growing concern for the safety and security of the civil infrastructure in relation to natural and manmade disasters. Safeguarding the future requires the expertise of professionals involved in the design, planning and construction of the built environment. This is particularly important to ensure that safeguards have the long-term vision to not only protect this generation, but future generations also (Loughborough University report 2006). Therefore it is recognized the necessity of contribution of the Built environment professionals in local context as well as in the international context to minimize the damages of disasters.

Ofori (1993) suggests that construction industry development has the following components: human resource development; materials development; technology development; corporate development; development of documentation and procedures; institution building; and development of operating environment of the industry. This not exception to waste management since the construction industry is the key contributor of the large proportion of building waste at the post disaster scenario.

Thus, it is evident that, for a construction industry to contribute effectively to the effort to manage disasters, certain elements must be in place. First, there should be a regime of statutory regulations and codes which guides planners and designers to take preventive action. Secondly, there must be an efficient and effective enforcement framework to give practical effect to the regulations. As discussed previously, although there are various rules and regulations for management of waste in Sri Lanka, there are not properly implemented due to poor standards of local expertise and capabilities and lack of coordination and absence of local investment in the process (Eceberger, 2006). Other issues relate with poor implementation of rules and regulations and strategies and plans dictated from top levels with minimal or zero input from the people mostly impacted. In addition, they are ill-informed of realities of most people's lives and therefore, often unrealistic and prone to failures.

Ofori (2002) also suggests that first, human resource development should equip construction professionals with the knowledge and skills required to undertake appropriate designs and construction. It should be possible for local practitioners to keep themselves informed of developments in knowledge overseas. Second, a programme of materials development should be instituted in each region to find high-performing (disaster-

resistant) materials which are suited to the local context and are of good quality, durability and affordability. Third, it is necessary to put measures in place in pursuit of the technological development of the industry to ensure that it has the capability to handle the various projects which will be required to provide protection against disasters, and those which the post disaster reconstruction process will involve. This further emphasis on the importance of capacity building to increase an organisation's access to information and technical know how by improving internal management structures, process and procedures and strengthening partnership among various players in the waste management process. These will eventually enhance the knowledge & skills of built environment professionals where they can contribute for effective waste management process.

Conclusions

The generation of waste at post disaster scenarios would not be avoidable at all. This is not an exception to Sri Lanka which was heavily affected by the Asian Tsunami in 2004. Among many other issues, post-disaster waste management is a key owing to capacity constraints of available resources including lands, expertise, funds and technology. Further, poor coordination and lack of communication led this to more critical status. As discussed previously, the emergency nature of a situation as well as poor planning with lack of commitment to address environmental impacts of the post-Tsunami scenario by the built environment professionals resulted in serious long term adverse environmental and natural resource consequences.

Within this context, expanded efforts should address all project aspects, including organization, logistics, recycling, disposal and landfill site selection and management. To achieve above, it is needed to identify requirements of national and local authorities for resources, equipment and environmental expertise and match these with donor offers. Further, best practice approaches to debris removal should be developed to minimise negative environmental impacts. As a result this paper concludes with highlighting the importance of capacity building of built environment professionals for their contribution for effective waste management and their role in minimising the disaster waste management.

References

1. ADB (2005), *An initial assessment of the impact of the earthquake and tsunami of 25th December, 2004 on South and Southeast Asia*, Asian Development Bank Report, Manila, Phillipines.
2. ADPC (2005) *Report on Post Tsunami Rapid Assessment in Sri Lanka*, ADPC, Bangkok Thailand
3. Asche, A. and Kelly, C. (2005), improving the disposal of tsunami generated waste, UNDAC/Sri Lanka (Available from: www.humanitarianinfo.org/srilanka)
4. Ashworth, A 2003, 'Higher Education in Further Education Colleges', University of Salford.
5. Bandara, N. J.G.J. and Patrick J H. (2003)" Environmental Impacts Associated with Current Waste Disposal Practices in a Municipality in Sri Lanka- A Case Study." *Workshop on Sustainable Landfill Management*, Chennai, India. pp. 19-26.
6. Bekin, C., Carrigan, M. and Szmigin, I. (2007) "Caring for the community an exploratory comparison of waste reduction behaviour by British and Brazilian consumers" *International Journal of Sociology and Social Policy*, Vol. 27 No. 5/6, pp. 221-233
7. Blaine, P. (1994), *Risk: Natural Hazards, People's vulnerabilities and Disasters*, Rontledge, Florence, KY.
8. Bloomfield, G. (2004), "Target recycling: aiming for 50 per cent and beyond", *Friends of the Earth*, London.
9. Cardinali, R. (2001) "Waste management: a missing element in strategic planning", *Work Study*, Vol 50. No 5, pp. 197-201
10. CEBE, 2005, Supporting External Examiners on Architecture Courses in UK
11. DMC (2005), Towards a Safer Sri Lanka – Road Map for Disaster Risk Management, Disaster Management Centre, Sri Lanka
12. Eceberger, D.L. (2006) *How the sustainable solid waste management can be achieved in Sri Lanka*, School of training Sri Lanka, Sri Lanka
13. European Commission (2006), *Progress report on Post Tsunami rehabilitation and reconstruction program* (available online: http://ec.europa.eu/comm/world/tsunami/index.htm)
14. Harvey P. (2005), *Cash vouchers in Emergencies*, Overseas Development Institute, London.
15. Hettiarachchi, N. D (2004)" National Disaster Management Policy – Implications for Regional Development", *Proceedings of the Workshop on Regional Development Experience in SL*, Sri Lanka
16. Huge Brodin, M. and Anderson, A. (2008) "Recycling calls for revolution", *Supply Chain Management*, Vol 13 No 1, pp. 9-15
17. IUCN (2005), *Series on Best Practice Guidelines (Sri Lanka)*, After the Tsunami: Solid Waste Management

18. Jayasuriya, S., Steele, P. and Weerokon, D. (2005), Post Tsunami Recovery: Issues and Challenges in Sri Lanka (Available from: www.ips.lk/news/newsarchive/2005/01122005_p_tsun/tsunami_recovery.pdf)
19. Jayawardane, A.K.W., Disaster mitigation initiatives in Sri Lanka (Available from: http://www.Kochifull!paper-final.pdf)
20. Joint Report (2005), *Sri Lanka Post Tsunami Recovery and Reconstruction – progress, challenges and way forward*, Joint Report of the Government of Sri Lanka and Development Partners
21. Kurita, T., Nakamura, A., Kodama, M. and Colomboga, S. R N. (2006) "Tsunami public awareness and the disaster management system of Sri Lanka", *Journal of Disaster Prevention and Management,* Vol.15 No.1, pp. 92-110
22. Lagcao, M (2003) Snakes and Ladders for Civil Society, One World UK [online] [Date accessed: 20th February 2006] Available from World Wide Web:http://uk.oneworld.net/article/view/47508
23. Loughborough University 2006, 'Lack of joined up thinking is putting UK's built environment at risk', Retrieved May 30, 2006, from http://www.lboro.ac.uk/
24. Martin, N. (2007) " The Asian Tsunami: An urgent case for improved government information systems and management, *Journal of Disaster Prevention and Management,* Vol.16 No.2, pp. 188-200
25. Moe, T.L. and Pathranarakul, P. (2006) "An integrated approach to natural disaster management" *Journal of Disaster Prevention and Management,* Vol.15 No.3, pp. 396-413
26. Ofori, G. (2002) Developing the construction industry to prevent and respond to disasters. *Proceedings of the First International Conference on Post-disaster e-construction: Improving post-disaster reconstruction in developing countries*, 23- 25 May 2002, University de Montreal, Canada.
27. Ofori, G. (2004). *Construction Industry Development for Disaster Prevention and Response* [online]. National University of Singapore. Available from: www.grif.umontreal.ca/pages/i-rec%20papers/ofori.pdf [Accessed 27 February 2006].
28. Peppiatt D., Mitchell J. and Holzmann P. (2001), *Cash transfers in Emergencies: Evaluating Benefits and Assessing risks*, HPN Network paper No. 35, Overseas Development Institute, London
29. Perera, K. L. S. (2003) "An Overview of the Issue of Solid Waste Management in Sri Lanka" *Proceedings of the Third International Conference on Environment and Health*, Chennai, India. pp. 15-17
30. Pilapitiya, S., Vidanaarachchi, C. and Yuen, S. (2006) "Effects of the tsunami on waste management in Sri Lanka", *Waste Management*, pp. 107-109

31. RICS (2006), *Mind the Gap: Post disaster reconstruction and the transition from humanitarian relief*, Royal Institution of Chartered Surveyors, London.
32. Selvendran, P.G. & Mulvey, C. (2005) Reducing solid waste and groundwater contamination after the tsunami, 15 Tuesday, February, Daily news
33. Shaw R., and Goda, K. (2004), "From disaster to sustainable civil society: the Kobe experience", *Disaster*, Vol. 28(1), pp. 16-40.
34. Shaw, R. (2003) "Role of non-government organizations in earthquake disaster management: on Asian perspective", *Regional Disaster Dialogue*, Vol. 24(1), pp 117-129
35. Shaw, R. (2006), "Indian Ocean tsunami and aftermath: Need for environment-disaster synergy in the reconstruction process", *Journal of Disaster Prevention and Management*, Vol.15 No.1, pp. 5-20.
36. Shaw. R., Gupta M. and Sharma A. (2003), "Community recovery and its sustainability: lessons from Gujarat earthquake in India", *The Australian Journal of Emergency Management*, Vol. 18(2), pp. 28-34.
37. Treloar, G.J., Gupta, H., Love, P.E.D and Nguyen, B. (2003) "An analysis of factors influencing waste minimization and use of recycled materials for the construction of residential buildings", *Management of Environmental Quality*, Vol. 14 No. 1, pp. 134-145
38. UNDP (2005), *Post-Tsunami Recovery and Reconstruction Strategy*, United Nations Development Programme
39. UNEP (2005), *Natural Rapid Environmental Assessment – Sri Lanka*, UNEP Sri Lanka Country Report
40. UNEP/UN-OCHA Environment Unit (2005), *Indian Ocean tsunami Disaster of December 2004,* Joint UNEP/UN-OCHA Environment Unit, Switzerland
41. UNESCO, (2005) Assessment of Capacity Building Requirements for an Effective and Durable Tsunami Warning and Mitigation System in the Indian Ocean, Consolidated Report for Countries Affected by the 26 December 2004 Tsunami, UNESCO, IOC/INF- 1219, Paris
42. UNISDR/CRED (2006), "2005 disasters in numbers", University Catholique de Louvain (UCL), Belgium, (available at: www.em-dat.net/documents/2005-disasters-in-numbers.pdf)
43. World Disasters Report (2005), International Federation of Red Cross and Red Crescent Societies, Oxford University Press, Zagreb.
44. World Health Organization (1990), *Rapid Health Assessment in Sudden Impact Natural Disaster,* Emergency Preparedness and Response Unit, Emergency Relief Operation, Geneva