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# Disaster risk reduction strategies and post-disaster infrastructure reconstruction

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## Abstract

**World's vulnerability to natural disasters has increased over the last few years. Hence, mainstreaming disaster risk reduction into constructed facilities has taken up an important role in the whole of the disaster management cycle. This paper aims to study the importance of mainstreaming disaster risk reduction in to post-disaster infrastructure reconstruction and the initiatives taken by the relevant bodies in order to minimize the future natural risks in reconstruction of infrastructure. Reconstruction serves to reinforce the society or sometimes even increase the vulnerability of the society. Therefore, investment in the physical infrastructure for disaster management is essential as it can result in reduced loss of lives in case of a disaster, do withstand disasters, reduces the risk of failure and thus contributes to disaster reduction and prevention. However, infrastructure reconstruction programs should aim to change the vulnerable conditions for the development of the country. It is well identified that all critical infrastructure facilities must be designed to a given level of safety from disaster impact. Moreover, such guidelines must be provided to designers and adequate monitoring system be in place. Thus, the routine reconstruction of infrastructure should, for example, incorporate design features that protect them from known hazards. The research reveals strategies used in general and in specific to the infrastructure sectors in addressing the above issues. A comprehensive literature review was carried out on the present situation with regard to above-mentioned measures. This research expects to strengthen the infrastructure reconstruction process by reporting the practical measures taken in reduction of future risks in the post-tsunami infrastructure reconstruction of Sri Lanka.**

**Keywords:** (Infrastructure reconstruction, Tsunami 2004, Disaster risk reduction strategies)

# Introduction

The world is facing an unprecedented scale of disasters (CRED, *Cited in* DFID, 2006). Nearly 25% of the world's landmass and nearly 75% of its population is at risk (DFID, 2006). Disasters impacts are exacerbated by a series of dynamic processes, including population growth, increasing levels of vulnerability, poor planning, climate change and corruption (DFID, 2006). In the 1970's natural disasters alone claimed nearly 2 million lives, but in the 1990's this had fallen to under 800,000 (IFRC, 2002). But still this is a terrible and loss of life (IFRC, 2002). Disasters damage the entire economy when disasters predominantly take place in the developing countries (UN-ESCAP, 2006; Ofori 2002). Thus, developing countries are less able to face the impacts of disasters (Ofori, 2002). More than half of disaster deaths occur in low human development countries, even though only 11% of people exposed to hazards live there (DFID, 2004). Such countries are faced with various natural risks leading to disasters, which cause immense loss of life and property (Baca and Gorcun, 2006). The average numbers of natural disasters per year has increased over the past few years where an average of 354 natural disasters occurred a year in the period 1991 to 1999 but from 2000 to 2004, this rose to an average of 728 a year (IFRC, 2005). Asia and the Pacific is the world's most disaster prone region, accounting for 91 percent of deaths from natural disasters in the past century and 49 percent of the resulting economic losses (UN-ESCAP, 2006). The under-sea earth-quake near the west coast on Northern Sumatra in December 2004 led to a widespread disaster of a Tsunami in Sri Lanka, India, the Maldives, Indonesia, Thailand with damage also in some other surrounding countries. This particular loss of lives and built environment structures is enough to substantiate the importance of reducing disaster risks through proper measures, which will tremendously assist in reducing the impact of disasters. This research focuses on the disaster risk reduction measures in use, which will be useful in post-disaster infrastructure reconstruction.

## Natural disasters and infrastructure

*What makes a disaster*

Not only are disasters the consequences of existing 'development' processes; they can also serve to provide new opportunities for development through post-disaster reconstruction (Jigyasu, 2002). DFID's Tools for Development handbook (DFID, 2002) mentions disasters only as an example of 'Risks that are essentially uncontrollable' and in a category of risk labelled as 'Act of God' (DFID, 2004). Disaster risk results from a combination of hazards (potentially damaging events or processes) and people's vulnerability to those hazards (DFID, 2004). Both hazards and vulnerability are to varying extents products of development processes (DFID, 2004). 'UN International Strategy for Disaster Reduction' defines the term 'Hazard' as 'a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption, or environmental degradation (Lloyd-Jones, 2006). In the same manner, the term 'Vulnerability' is defined as 'a set of conditions and processes resulting from social, economic and environmental factors that increase the susceptibility of a community to the impacts of hazards'.

A further common perception is that disasters are usually large-scale events involving a single hazard, such as a flood or an earthquake. The Emergency Events Database (EM-DAT) managed by the Centre for Research on the Epidemiology of Disasters (CRED) at

the Université Catholique de Louvain in Belgium uses an absolute definition for a disaster. Accordingly, for a disaster to be entered into their database at least one of following criteria must be fulfilled;

- 10 or more people killed
- 100 or more people reported affected
- a call for international assistance
- a declaration of a state of emergency

Infrastructure is a built environment facility, which tends to be highly affected by natural disasters. Half of the world's natural disasters and 70 percent of all floods have been recorded in Asian countries and much of the damage inflicted by floods is to the infrastructure (UN-ESCAP, 2006). By some estimates, infrastructure losses account for 65 percent of all flood losses (UN-ESCAP, 2006). Approximately 50 percent of the World Bank's total lending is equivalent to total cost of damage to infrastructure due to natural disasters in the Asian context (UN-ESCAP, 2006). The annual investment needed for post-disaster reconstruction of infrastructure and economic recovery in developing countries of the Asian and Pacific region would require an estimated $15 billion, for a total infrastructure-financing requirement estimated at $55 billion per year (UN-ESCAP, 2006). The creation of significant negative consequences to infrastructure, together with other built environment facilities due to disasters, would lead to pathetic economic consequences and impoverished quality of life often for long periods of time (Government of India, 2002). When events such as natural disasters destroy infrastructure, their opportunity cost becomes painfully evident (Palliyaguru *et al*. 2008).

## Research methods

A comprehensive literature review was carried out on the present practice of mainstreaming disaster risk reduction in to post-disaster infrastructure reconstruction, the types of disaster risk reduction strategies and importance of mainstreaming disaster risk reduction in to post-disaster infrastructure reconstruction.

**Research questions:**

- What is the importance of mainstreaming disaster risk reduction in to post-disaster infrastructure reconstruction?
- What are the prevailing general risk reduction strategies in use?
- What is the present practice of mainstreaming disaster risk reduction in to post-disaster infrastructure reconstruction?

**Research Objectives:**

- Study the importance of mainstreaming disaster risk reduction in to post-disaster infrastructure reconstruction
- Investigate the prevailing risk reduction strategies in general
- Explore the present practice of mainstreaming disaster risk reduction in to post-disaster infrastructure reconstruction

## Research results

This section presents the out comes of the literature review on disaster risk reduction strategies.

### Disaster risk reduction strategies in general

Disaster risk reduction is aimed at tackling the fundamental elements of disaster risk: vulnerability, hazards (or shocks) and exposure (DFID, 2006). Disaster risk reduction entails measures to curb disaster losses by addressing hazards and the vulnerability of people to them (DFID, 2004). Good disaster risk reduction happens well before disasters strike, but also continues afterwards, building resilience to future hazards (DFID, 2004). 'UN International Strategy for Disaster Reduction' defines the term 'Disaster risk reduction' as 'the systematic development and application of policies, strategies and practices to minimize vulnerabilities and disaster risks throughout a society' (http://www.unisdr.org/eng/library/lib-terminology-eng.htm). Reducing disaster risk is not just about additional investments – it is also about ensuring that development interventions are sound. For example, ensuring appropriate construction of critical infrastructure in highly vulnerable areas (DFID, 2006).

Disaster risk reduction measures can be categorised in various ways. One such general way is policy and planning measures, physical preventative measures, physical coping and/or adaptive measures; and community capacity building (DFID, 2005). All such categories of measures are of paramount importance for post-disaster infrastructure reconstruction.

Policy & planning measures include (i) Implement a national plan for protection against disasters, including preparedness and contingency planning (ii) Land-use planning that better incorporates risk of flooding (iii) Integrated management of flooding and water supply (iv) Integrated warning and response system (v) Improving networks / links with local governments (DFID, 2005).

Physical (Prevention) measures includes (i) Flood defences (eg: Dam, multipurpose, seaborne etc) and sea wall (ii) Natural protection against floods (eg: reforestation of watersheds) (iii) Installation of drainage pumps (DFID, 2005).

Physical (coping /adaptive) measures include (i) Raised plat forms (equipped with latrines and drinking water) (ii) More resilient roads and infrastructure (eg: raised roads) (iii) More resilient water supply systems (eg: boreholes, raised hand-pumps) (vi) Design and

building of contingency mechanisms for coping with disasters, (eg: escape roads) (DFID, 2005).

Community level capacity building measures include (i) Community based disaster preparedness-communities trained in disaster preparedness (ii) Public warning system (iii) Safety nets to ensure that poor households can rebuild productive livelihoods (through building on existing programmes) (iv) Revolving funds managed by the community used to better cope in disaster situations (eg: for storing and distributing food) (DFID, 2005).

**Mainstreaming disaster risk reduction with post-disaster infrastructure reconstruction**

After the Tsunami hit Sri Lanka, the Disaster Management Act was passed in May 2005. The act implies the shift in emphasis towards preparedness for and response to disaster. In this way, it is weaker in linking disaster management to development. Following passing of the Act, the Government set up the National Council for Disaster Management (NCDM) in October 2005 to provide direction in disaster risk management in the county. The Disaster Management Centre (DMC) was also set up as the lead agency for disaster risk management in the country. Later further institutional changes took place. A Ministry of Disaster Management (MoDM) was established under the purview of the Prime Minister and the DMC moved to the new Ministry. The MoDM has been given a key role in directing the strategic process for disaster response, risk mitigation, preparedness planning and risk reduction.

'Towards a Safer Sri Lanka: Road Map for Disaster Risk Management' is a key Government policy document and was published by the Disaster Management Centre under the Ministry of Disaster Management in December 2005. The Road Map aims to provide an overall framework for disaster risk management in the country and is an effort, through the MoDM to unify efforts of different agencies. The Road Map recognises the importance of providing safer critical infrastructure in hazard prone areas and it has been prioritised as one of the project proposals under the theme 'Mitigation and Integration of Disaster Risk Reduction into Development Planning'. This suggests that all critical infrastructure facilities must be designed to a given level of safety from disaster impact. Moreover, it suggests that such guidelines must be provided to designers and adequate monitoring system be put in place (The Ministry of Disaster Management and Human Rights, GoSL, 2006). The activities identified in the proposal include (i) implement guidelines and codes for hazard resistant infrastructure construction, (ii) identify the critical infrastructure to be provided in hazard prone areas, (iii) develop guidelines for construction of critical infrastructure in hazard prone areas, (iv) review construction programmes to ensure adoption of hazard mitigation measures in all infrastructure development activities etc (The Ministry of Disaster Management and Human Rights of Sri Lanka, 2006). The expected outcome of these actions is to increase the disaster resilience in critical infrastructure in hazard prone areas ensured through use of planning and construction guidelines.

Each of the critical infrastructure sectors needs model standards for reliability and resilience. These standards include provision for natural disaster loss reduction and accelerated service restoration following disasters. In the recovery process, critical infrastructure systems should be restored in a manner consistent with such vulnerability

reduction and resiliency standards. Formal vulnerability assessments should be required based on comprehensive hazard assessment for the area covered by the service system. Further, making investments to reduce future disaster loss is a measure, moreover an indicator of implementation of disaster risk reduction within the infrastructure systems. Other possible development of risk reduction measures for the affected areas include existence of legally binding risk management standards for each infrastructure system. Adoption of physical preventative measures and physical coping and/or adaptive measures depends on the type of infrastructure system (Krimgold, 2006)

## Discussion and conclusions

Effective reconstruction of the infrastructure is often essential to sustain recovery as ineffective post-disaster reconstruction affects society in many ways and exacerbates civil imperfections. Due to society's strong dependency on goods and services provided by the critical infrastructure, their failure during post-disaster reconstruction may in turn cause further devastating effects followed by later natural disasters (Lenz, 2006). Therefore, infrastructure reconstruction programs should aim to change the vulnerable conditions for the development of the country. It is well identified that all critical infrastructure facilities must be designed to a given level of safety from disaster impact. Moreover, such guidelines must be provided to designers and adequate monitoring system be in place. Thus, the routine reconstruction of infrastructure should, for example, incorporate design features that protect them from known hazards.

The more general literature on natural disasters does indicate that there are significant benefits to be realised from well developed disaster risk reduction strategies (DFID, 2005). For example, major investments in disaster risk reduction strategies in Bangladesh in the 1990s, following catastrophic loss of life as a result of flooding in 1970 and 1991, have hugely decreased the fatalities associated with comparable storm events (DFID, 2005). Similarly, average fatalities caused by major earthquakes in developed countries have fallen from about 12,000 in the period 1900 to 1949 to 2,000 in 1950 to 1992, largely as a result of better structural engineering and preparedness (DFID, 2005).

The link between disasters and development has been a very critical issue many authors. Davis (2005) claimed that looking at disasters as development opportunities is becoming one of the core principles of disaster management (Asgary *et al*. 2006). Conventionally, reconstruction and development were perceived and represented linearly (Lewis, 1999). In reality however, they are simultaneous, each 'stage' overlapping with others and in response to the same or different disasters (Lewis, 1999). Adoption of disaster risk reduction is simply a best method of converting disasters into development opportunities as disaster risk reduction makes development sense for many reasons. Disaster risk reduction measures often have significant development benefits, even in the absence of natural disasters. The literature suggests that a systematic assessment of the benefits of disaster risk reduction measures is certainly possible. There can be positive economic returns from disaster risk reduction strategies and that additional development benefits can be realised. 'Disaster-proofing' development has the capacity to transform 'vicious spirals' of failed development, risk accumulation and disaster losses into 'virtuous spirals' of development, risk reduction and effective disaster response (DFID, 2004).

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