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Proposal of a Disaster Management Model applicable at the household level for Srinagar City of Jammu & Kashmir with reference to Earthquakes

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Abstract

Earthquakes are the most feared natural hazards, as they occur without any recognizable warning, are unpredictable in space and time and inflict heavy losses in less than a minute duration. To reduce earthquake risk, each country needs to examine its strengths and weaknesses, build on the strengths and systematically take actions which reduce or eliminate the weaknesses. Public education and community participation is the key to success of the implementation of reduction and mitigation programmes. Jammu and Kashmir has been a region of major seismic activity. Srinagar city has been shaken numerous times by earthquakes in the past millennium, most recently by damaging earthquakes in 1885 and 2005. The purpose of the study is to propose an Earthquake disaster management model for Srinagar City applicable at the household level. The principle of this model is to protect the inhabitants of a household against the risk of an earthquake hazard. As per the model, for the management of earthquakes, at the household level, we need to focus on the structural and non-structural components.

Keywords: *Disaster Management, Earthquakes, Srinagar City, Model*

Introduction

The word ‘disaster’ is often used to refer to any sudden, unexpected or extra ordinary misfortune, regardless of whether it occurs to an individual, a family or other small group, a community, a region, a nation or the entire world (Kumar 1999). Disasters happen when a natural hazard strikes vulnerable people. Thus they involve both the extent and types of vulnerability generated by people’s situations within political and economic systems and the manner in which society deals with the hazard in terms of mitigation and preparedness (Cannon 1994). Disasters are frequent, ongoing and very likely to increase in the future with global climate change (Khan 2012). The frequency, intensity and scale of the recent disasters point towards staggering risks widespread in the world. Disaster recurrences not only challenge the superiority of planning but also the economic growth in dealing with their root causes (Wisner 2011;

Khan 2012). Natural and human-induced disasters cause unpredictable losses in terms of human fatalities, private and public buildings, infrastructures, and financial assets (Handmer and Dovers 2007; Tinguaro Rodriguez et al. 2009). Disasters, be they natural or man-made are a great threat to the well being of mankind (Futane 2013). In recent years, there has been a significant world-wide increase in high consequence disasters, extreme events associated with climate change, environmental degradation and ecosystem failure (Rezaei and Ghaderi 2013).

During the 1960s disasters were understood as uncontrollable events in which a society undergoes severe danger, disrupting all or some of the essential functions of the society (Fritz 1961). International Decade for Natural Disaster Reduction (IDNDR) (1992) defined a disaster as "a serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of affected society to cope using only its own resources". A natural disaster can be defined as some rapid, instantaneous or profound impact of the natural environment upon the socio-economic system (Alexander 1993), or as a suddenly disequilibrium of the balance between the forces released by the natural system and the counteracting forces of the social system (Albala-Bertrand 1993). As explained by Tobin and Montz (1997), a disaster is an event that has a big impact on society. Assessing the community impacts of natural disasters is important (Lindell and Prater 2003). It can cause major changes in common and ordinary patterns of life and create specific mental and psychological conditions to encounter (Emami et al., 2005; Forouzan et al. 2013). Developing countries are located among the most vulnerable regions in the world in relation to the intensity and frequency of natural, man-made and environmental disasters and face disproportionately high economic, social and environmental consequences (Rezaei and Ghaderi 2013). Current trends of rapid urban growth and ensuing environmental degradation increase people's vulnerability to disasters {International Decade for Natural Disaster Reduction (IDNDR) 1996}. Disasters not only reveal underlying social, economic, political and environmental problems but also contribute to worsening them and causing serious challenges to sustainable development (Rezaei and Ghaderi 2013).

The physical impacts of disasters include casualties and property damage (Berke 1995). Social impacts, which include psychosocial, sociodemographic, socioeconomic, and sociopolitical impacts can develop over a long period of time and can be difficult to assess when they occur (Friesma et al. 1979; Wright et al. 1979). Psychosocial impacts include emotional signs such as anxiety, depression and grief as well as behavioral effects such as sleep and appetite changes, ritualistic behavior and substance abuse (Rubin 1991). The most significant sociodemographic impact of a disaster on a stricken community is the destruction of households' dwellings (Bolin 1993). The property damage caused by disaster impact causes direct economic losses that can be thought of as a loss in asset value (Committee on Assessing the Costs of Natural Disasters 1999) and this can be measured by the cost of repair or replacement (Mileti 1999). Natural disasters' impacts upon environment are direct and indirect. Natural disasters are one of the factors directly causing environmental degradation (Rezaei and Ghaderi 2013).

Earthquakes are one of the most important types of hazards having the greatest impacts in becoming disasters (Guzey et al. 2013). Earthquakes are the most feared natural hazards, as they occur without any recognizable warning, are unpredictable in space and time and inflict heavy losses in less than a minute duration (Goel and Kumar 2001). They are rapid-onset, short-duration, time-specific and potentially high-consequence events (Peduzzi et al. 2009), often causing significant secondary hazards and cascading impacts such as fire, flooding and release of hazardous chemicals (Rashed and Weeks 2003). The primary consequence of concern in earthquakes is of course human casualties, i.e. deaths and injuries. Many of the higher casualty counts have been caused by the collapse of buildings made of heavy, weak materials such as unreinforced masonry or earth. The physical consequences of earthquakes for human beings are generally viewed under two headings: (A) Death and injury to human beings; (B) Damage to the built and natural environments. The economic consequences of earthquakes occur both before and

after the event. Those arising before the event include protection provisions such as earthquake resistance of new and existing facilities, insurance premiums and provision of earthquake emergency services. Post-earthquake economic consequences include: (1) Cost of death and injury; (2) Cost of damage; (3) Losses of production and markets; and (4) Insurance claims (Dowrick 2003). Social losses during the earthquakes are determined by the level of the damage of buildings and construction (Zaalishvili and Kanukov 2013). Often the damage is due to improper construction methodologies and lack of awareness to take preventive measures to minimize the impact of an earthquake (Anbazhagan et al. 2010). For predicting the possible consequences of the earthquakes or other catastrophes, the careful study of the urbanized territories is required (Zaalishvili and Kanukov 2013).

Vulnerability of urban fabrics to potential earthquakes is related to several parameters including seismic and geological hazards level, site effects, physical vulnerability, social and economical conditions and disaster management/ emergency response capacity (Hosseini et al. 2009). Vulnerability is usually categorized using two main components: physical vulnerability and social vulnerability (Lindell et al. 2006). Physical vulnerability is a function of the intensity and magnitude of the hazard, the degree of physical protection provided by the natural and built environment and the resistance levels of the exposed elements (Eidsvig et al. 2011). The structural vulnerability of a building subjected to an earthquake is generally related to the capability of its structural members to maintain a certain degree of integrity which should be constant, at least for the same typologies of buildings in the same area (Mucciarelli et al. 2001). Assessment of seismic vulnerability of existing building stock in urban areas would help in disaster mitigation and management, by planning mitigation measures before an earthquake strikes (Agrawal and Chourasia 2007). Disaster vulnerability is socially constructed, i.e., it arises out of the social and economic circumstances of everyday living (Morrow 1999). Social conditions strongly influence the vulnerability factors both for direct and indirect impact and therefore have the power to transform the occurrence of a natural hazard into a natural disaster (Eidsvig et al. 2011). Social vulnerability is a measure of both the sensitivity of a population to natural hazards and its ability to respond to and recover from the impacts of hazards (Guzey et al. 2013). Vulnerability includes an economic element, dependent on people's access to resources and income opportunities and the variable element of protection against specific hazards (Cannon 1994).

Data and Methods

The chosen study area is Srinagar city, which is located between 33º53´49´´- 34º17´14´´ North latitudes and 74º36´16´´- 75º01´26´´ East longitudes. It is the most pivotal center of economy of the Kashmir Valley being a center of tourist attraction. The city has been shaken numerous times by earthquakes in the past millennium, most recently by damaging earthquakes in 1885 (M 6.2) and 2005 (M 7.6) with estimated EMS (European Macroseismic Scale) intensity VI-VII (Bilham et al. 2010).

The aim of the study is to propose an Earthquake disaster management model for Srinagar City applicable at the household level. Data for the proposal of the disaster management model was collected from both primary as well as secondary sources. A thorough study of the vulnerability indicators found in the city was carried out on the basis of which the model was proposed. The principle of this model is to protect the inhabitants of a household against the risk of an earthquake hazard.

Several studies to understand the process of managing disasters, both at international and national level were used as secondary sources of information, few of which have been discussed. Focus on the role of geomorphology in the prevention of natural disasters in developing countries, where their impact has devastating consequences was done by Ayala (2002). In this study the importance of the incorporation not only of geomorphological research, but also of geomorphologists in risk assessment and management programs in the poorest countries is emphasized. The growing role of web-based geospatial

technology in disaster response and support was outlined by Kawasaki, Berman and Guan (2013) in the case studies of Sichuan and Haiti earthquakes. Their study shows how conventional Geographic Information System (GIS) disaster responses by governmental agencies and relief response organizations and the means for geospatial data-sharing have been transformed into a more dynamic, more transparent and decentralized form with a wide participation. Rao (2000) discussed the role of space technology in the field of Disaster Management by taking the examples of various natural hazards, earthquakes being one of them. George and Dar (1999) discussed about Disaster Management Information System (DMIS) and also about the George's Preparedness Index and their importance in the field of Disaster management. Nateghi (2000) presented the existing organization chart of earthquake disaster management in Iran. The study described the governmental organization presently operating in Iran and also discussed the problems related to the existing chart. Kumar (1999) raised questions regarding developmental policies, disaster mitigation concerns and also about governance. The study stressed on the need to have gender sensitive policy hazard and vulnerability mapping.

Vinten (2000) focused on whistle blowing towards disaster prevention and management in USA. In the study disaster case studies were presented involving a variety of industries from the nuclear power to the petroleum, aircraft, space and oil industries. A critical thinking skills assessment of local emergency managers was conducted by Peerbolte and Collins (2013) that tested for correlations among age, gender, education and years in occupation. The study explored the extent to which local emergency managers have the skills to think critically as they assume and manage risk. Islam, The emergency preparedness and disaster management in Hawaii was studied by Prizzia and Helfand (2001). Tasnuva, Islam and Haque (2014) focused on an overview of disaster scenario in Bangladesh. The main aim of the research was to examine the existing Disaster Management System (DMS) and investigate the development of DMS. The study attempted to develop a proposed model for enhancing DMS for reducing loss and coping with all kinds of disasters in Bangladesh. Kanwar (2001) discussed about the disaster management in India and its key issues including its prevention, mitigation, preparedness, response, relief and rehabilitation. Mishra, Fuloria and Bisht (2012) enhanced disaster management by mapping disaster proneness and preparedness in the state of Tamil Nadu.

Results and Discussion

Disaster management can be defined as the discipline and profession of applying science, technology, planning and management to deal with extreme events that can injure or kill large numbers of people, cause extensive damage to property and widespread distribution to society (Kreps 1991). In developing countries, disaster management is limited to post-disaster recovery, rehabilitation and reconstruction. Developed countries concentrate towards disaster planning and preparedness measures which considerably reduce the overburden on post disaster activities and also saves valuable lives. Impact of disasters on the society can be reduced by preparing communities to be more disaster resilient (Poland 2010; Koshy et al. 2010). Disaster management is critical not only to prevent human and material loss, but also to prevent other related contingencies and threats. The UNDP report (2004) states that disasters (particularly natural disasters) have a negative influence on all developmental activities. It argues that managing disasters is even more important today, since disasters may have an even greater impact on people and economies. And while multiple disasters may strike independently of each other, the overall impact may be cumulative. McEntire (2001) who focuses on vulnerability as an essential ingredient for disaster, suggests that various factors such as social, physical, cultural, political, economic and technological ones contribute to increased vulnerability (Mishra et al. 2012).

Disaster Management is a complex form of management which requires many disciplines and specialties. It requires a detailed allocation of tasks and a good knowledge of the domain of the disaster

itself (Nateghi 2000). It is not a simple process (Drabek and Hoetmer 1991) and requires many experts from different fields to contribute and manage a large amount of data and information, a significant part of which is spatial. Thus the geospatial information managers have an inevitable position in disaster management groups before, during and after the catastrophes. Disaster management deals with complex decision making in different time periods and consists of prevention, responding and recovery from natural and human-made hazards (Michalowski et al. 1991; Hashemi and Alesheikh 2012). Disaster management involves: (i) pre-disaster planning, preparedness, monitoring including relief management capability, (ii) prediction and early warning, (iii) damage assessment and (iv) relief management (Rao 2000). Disaster planning and management, impact and response, even research, are largely social processes (Morrow 1999). The lack of a comprehensive and coherent planning to prevent and confront disasters is a major issue in developing countries (Handmer and Dovers 2007). Developing an easy-to-use framework for the assessment of damages and consequences of natural hazards is a critical issue in disaster management that may result in more effective sustainable rehabilitation programs and preparedness (Tinguaro Rodriguez et al. 2009). There are several systems worldwide for disaster management (Hashemi and Alesheikh 2012).

The World Summit on Sustainable Development (WSSD 2002) concluded that an integrated, multi-hazard, inclusive approach to address vulnerability, risk assessment and disaster management, including prevention, mitigation, preparedness, response and recovery is an essential element of a safer world in the 21st century (O'Brien et al. 2006). The United Nations International Strategy for Disaster Reduction (UNISDR 2001) adopted the term resilience and defined it as the capacity of a system, community or society to resist or to change in order for it to obtain an acceptable level in functioning and structure. This is determined by the degree to which the social system is capable of organizing itself and the ability to increase its capacity for learning and adaptation, including the capacity to recover from disaster (O'Brien et al. 2006). The approach is readily taken by different nations (Paton 2006; Buckle 2006; Cutter et al. 2008). It has been noted that the key to enhance resilience is to reduce overall vulnerability including physical and socioeconomic vulnerability (Colten et al. 2008). Vulnerability and resilience are not entirely a contrast but relate to each other (Zhou et al. 2010). Planning only for resilience may also increase vulnerability in some cases. One important distinction between the two phenomena is that vulnerability is a pre-event characteristic of the community that makes it liable to suffer from a disaster, while resilience is a post-event characteristic that helps the community to cope and recover from the disaster (Cutter et al. 2008). Planning for resilience therefore also requires an understanding of vulnerability. Vulnerability is dynamic and it changes in both space and time (Cutter and Finch 2008; Khan 2010). An understanding of the existence and cause of vulnerability over space provides an opportunity to reduce it and strengthen local resilience (Khan 2012).

Focusing on disasters after they occur is essential but not sufficient for reducing their tragic consequences to people, economies and the environment. Identifying and measuring risks and vulnerabilities before a disaster occurs; and also after disasters have happened are essential tasks for effective and long term disaster-risk reduction (Birkmann and Wisner 2006; Birkmann 2007). To reduce earthquake risk, each country needs to examine its strengths and weaknesses, build on the strengths, and systematically take actions which reduce or eliminate the weaknesses (Dowrick 2003). Enhancing disaster-risk reduction before a disaster occurs and also during the reconstruction process, requires enhanced knowledge regarding the most vulnerable groups, the areas at risk and the driving forces that influence and generate vulnerability and risk (Bogardi and Birkmann 2004). In recent years, an increasing number of global and local initiatives have been launched to measure risk and vulnerability with a set of indicators and indices (Birkmann 2006; Birkmann 2007). Despite the availability of a significant number of risk reduction measures, implementing seismic risk mitigation is a major challenge in most earthquake-

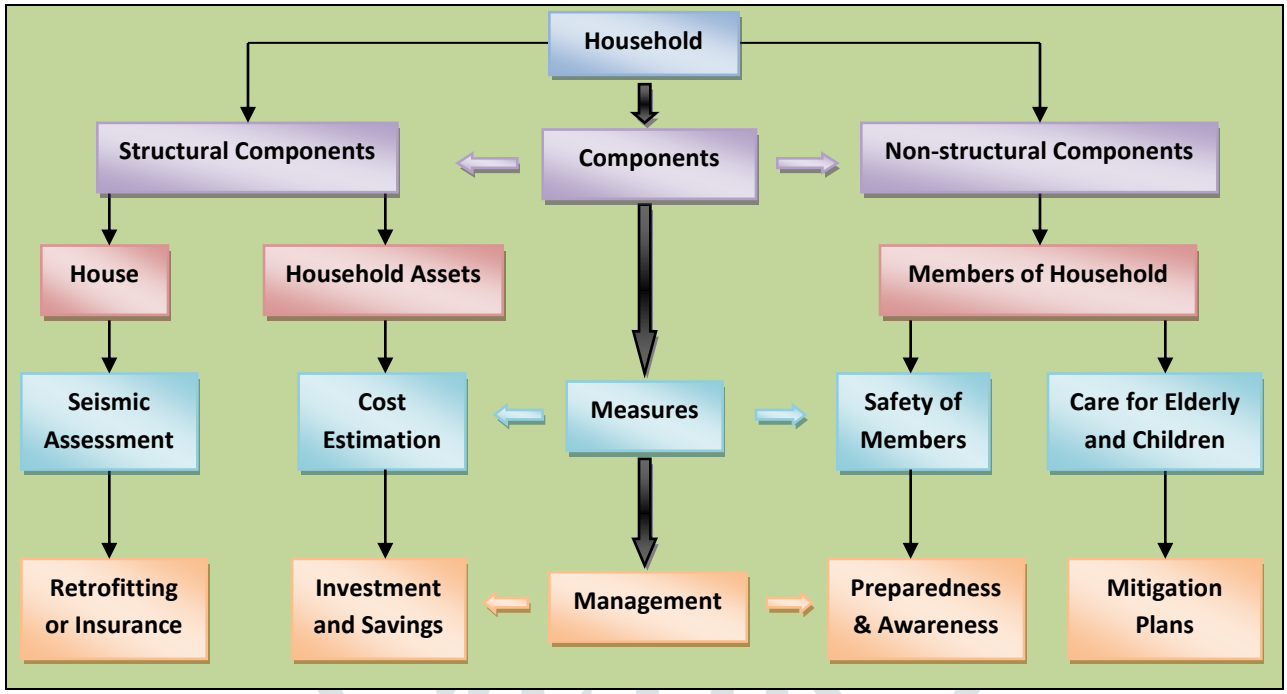
prone countries (Stoppa and Berti 2013). The GoI-UNDP Disaster Risk Management Programme is a national initiative to reduce vulnerabilities of communities in some of the most hazard prone districts of India (169 districts and 17 states). The Programme (2002-2007) aims to contribute to the social and economic development goals of the National and State Governments, enable them to minimize losses to development gains and to reduce their vulnerability to natural disasters. The programme relies upon a community based approach to disaster management, and seeks to build capacities of communities, government functionaries at all levels, and other stake-holders in disaster management, at all levels, in an organized manner (GOI-UNDP 2002-2007).

Conclusions

The Jammu and Kashmir has been a region of major seismic activity. Some of the largest earthquakes in India have occurred in this zone (Sharma et al. 2013). With the numerous raise of buildings and infrastructures earthquake hazards become one of the most devastating natural hazards (Devi 2012). To make buildings and other structures resistant to hazards, engineering solutions must be found (Tierney 1993). Strengthening existing structures (retrofit) can be achieved through adding bracing, stiffening and adding new structural elements (Nateghi 2000). Traditional structures in Kashmir have proven to be robust in earthquakes from their combination of flexibility, energy dissipation and redundancy (Langenbach 2009). The owners of the household at their own level can check for the hazard elements in or outside their houses in order to reduce their vulnerability in case an earthquake was to strike. Public education and community participation is the key to success of the implementation of reduction and mitigation programmes (Devi 2012). Hazard mitigation can be achieved through building construction practices that make individual structures less vulnerable to natural hazards (Lindell and Prater 2003).

An Earthquake disaster management model applicable at the household level has been proposed for the Srinagar city (Figure 1). The principle of this model is to protect the inhabitants of a household against the risk of an earthquake hazard. As per the model, for the management of earthquakes, at the household level, we need to focus on the structural and non-structural components. In the structural part, we have the house structure and the personal assets which we use to meet our daily requirements. The measures which we need to adopt for the management of these components include Insurance of house, Seismic assessment of the structure with the help of any structural engineer, Incorporation of retrofitting measures if required, Cost estimation of the valuable items at home and keep the savings accordingly in different forms of financial sources. In the non-structural component, we have the inhabitants of the house. The main concern regarding each family member relates to their safety in case any earthquake disaster occurs. In order to achieve that, every member of the family needs to be aware and consequently prepared to face any such situation. Also, in case of the children, elderly or any member with disability, special care and procedures should be taken for their safety, evacuation and rescue keeping in view their higher vulnerability and related limitations.

Figure 1: Disaster management model proposed for households



Source: Proposed by author

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