SELECTION OF TEMPORARY REHABILITATION LOCATION AFTER DISASTER: A REVIEW

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Abstract

Temporary rehabilitation is extremely important to recover after disaster allowing people to return back to their normal activities like work, school, cooking, housekeeping etc. This study recapitulates the different models used for the selection of temporary rehabilitation location after different disaster. It explains various guiding principles, selection criteria, minimum standard for victims to be provided, various tools and techniques used for locating the effective site. Basic services like health facility, transportation, accessibility and livelihood are primary concern while selecting any site for temporary resettlement.

Keywords: Site selection, temporary rehabilitation and temporary resettlement

Introduction

The International Federation of Red Cross defines disaster as "a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources" (IFRC 2001).

Disasters can occur as a consequence of the impact of a natural or a human-caused hazard. Natural hazards comprise phenomena such as earthquakes, volcanic activity, landslides, tsunamis, tropical cyclones and other severe storms, tornadoes and high winds, river and coastal flooding, wildfires and associated haze, drought, sand and dust storms, and infestations. The Emergency Events Database (EM-DAT), a global disaster database maintained by the Centre for Research on the Epidemiology of

Disasters (CRED) in Brussels, records upwards of 600 disasters globally each year. (Dilley 2005)

Contrasting the past two decades, the number of people killed in natural and manmade disasters was higher in the 1980s (86 328 annually) than in the 1990s (75 252 annually). However, about 211 million people per year were affected by disasters in the 1990s as compared to 1980s which was about only 147 million people per year. (Dilley 2005)

In 2011, about 196 natural disasters occurred throughout the world causing death of about 28,000 and affecting about 85 million people. The damage c aused by these events are estimated about US$290 billion. (ADRC 2012)

According to the UNHCR 2012, about 72 million peoples are displaced. This created a need of proper planning for the temporary resettlement for the victims .This require proper planning for the selection of sites as well as considering the socio economic perspective of the victims. Sometimes reconstruction takes more time than the expected. So it became necessary to plan properly for the temporary resettlement while maintaining the minimum standard for living for the victims.

In June2013, the unprecedented rainfall in Uttarakhand causes flash flood and landslide, affecting about 900,000 people, 4,200 villages and loss of 580 human lives (Govt of Uttarakhand, 2013).

It is widely accepted that in order to bring back the livelihoods of the affected communities, the reconstruction programme should start as soon as possible (UNDRO 1982). Providing a house is a fundamental step to establish some sense of normalcy in the life of the affected community, as well as to prevent the rising of deaths and the spread of diseases, increasing conditions to personal hygiene and giving protection against external factors like weather. (Felix et al. 2013)

Literature Survey

Different selection criteria for temporary rehabilitation location for different disaster are proposed based on the nature of disaster and the demographic condition of the area. Large number of studies has been carried out for proper planning of disaster preparedness and mitigation phases. Various studies has been done in past on different problem like location of emergency medical centre, location of shelter, selection of site for temporary shelter, location of emergency warehouse for relief item, etc.

Temporary location for resettlement after an Earthquake

Kilci et al. (2012) examines the dynamics of location problem for shelter site application in Turkey and develop a mixed integer linear programming mathematical location model which integrates with the requirements of the Turkish Red Cresent and improve their existing system. The mathematical model maximizes the minimum weight of open shelter areas while deciding on the location of shelter areas, the assigned population points to each open shelter area and controls the utilization of open shelter areas. The result of mathematical model is validated by generating a base case scenario using a real data. (Kilci et al. 2012)

Givechi et al. (2013) illustrates the site selection for temporary housing of the sixth region of the Shiraz Municipality of China because of the high probable seismic activity in the near future using the Analytic Hierarchy Process model. The existing study shows the tendency about selecting the location for the temporary housing as: the damaged masses prefer to stay close to their houses which mean the site should beside their damaged homes and damaged masses are ready to live in camps close enough to their houses. These criteria are used for the analytical descriptive method for the selection of the site for temporary housing.

The available information data for the study region, selection criteria and the indicators are weighted according to the views of experts of crisis management, couple comparison and Expertchoice software. The output of this step is weights value table of the studied criteria, in terms of importance in studied region. Surface zonation map is generated for the region six of Shiraz municipality using the ArcGIS and AHP (Analytic Hierarchy Process) model. A layer is generated for each specified weighted criteria and the result is combined to produce the complete surface map of the region six. Givechi et al. (2013)

Various guidelines are proposed for the design of the temporary shelter from architectural and urban design point of view. The guidelines considers two major issues firstly the community participation which create ownership feeling in the victims and secondly is the probability of converting the temporary shelters in the permanent shelters which require more creative and innovative structural and architectural design. (Forouzandeh et al. 2008)

It is noticed that although a number of studies have been carried out with regard to temporary shelters, but very few cases have discussed the issue form architectural and urban design point of view. The type of spatial setting (linear, central, and hybrid) of shelters, the situation of neighboring textures (regarding the orientation and form considerations), and access ways are other issues which are discussed in this paper. Other problems which are taken into consideration are: type of materials, internal setting of spaces by consideration of behavioral patterns of the stricken community, the location of open areas, and the users expectations. (Forouzandeh et al. 2008)

Bolin and Stanford (1991) examine the problem associated with the temporary housing and emergency shelter of the victims after disaster. It includes the differential access to shelter and housing aid, demographic factors, relation between the post disaster and housing and the role of social support networks in the housing.

Cultural diversity effects emergency sheltering and the long term housing. After the 1989 Loma Prieta earthquake in Watsonville, California it is found that the shift in demographics put minority groups and the poor at the greater risk and increases the sheltering problem (Philips 1993). The report of the emergency sheltering and housing of earthquake victims for the Santa Cruz County raised the issues like provision of temporary shelter and housing for the large population of the state. (Bolin et al. 1993)

The problem of locating disaster response and relief facilities in the city of Istanbul is solved by a two tier distribution system that utilizes the existing public facilities locally in addition to the new facilities that will act as a regional supply points. A mathematical model is used to decide the location of the new facilities with the objective of minimizing the average weighted distance between the casualty location and the closest facility and opening a small number of facilities subjected to distance limit and backup requirements under the vulnerability considerations. (Gormez et al. 2011)

Various scholars have suggested various guidelines for the selection of suitable sites for the temporary resettlement (Hossenini et al 2006, Forouzandeh et al. 2008). These can be concluded as:

- Number of refugees
- Functionality of the Sites
- Infrastructure available at the site
- Configuration of the Sites
- Accessibility
- Ownership

Temporary resettlement of the facilities in the disaster prone area

FEMA in 2001 required every Florida County to identify the potential locations of disaster recovery centers. The project team used a mathematical model called the covering location model in a two stage approach to find, recommend and have accepted DRC locations. Stage 1 approach gave three idealized DRC location requiring each residence in the county to be within 20 miles of the closed DRC. In stage 2, they relaxed the 20 miles requirement and identified locations and also satisfy the evaluation criteria not included in the stage 1. The result provides significant improvement to the original FEMA location criteria while maintaining acceptable travel distance to the nearest DRC. (Dekle et al. 2005)

Typhoon emergency shelters are places for the people to live temporarily when they cannot live in their residence during disaster. An integrated location-distribution model is proposed for coordinating logistics support and evacuation operations in disaster response activities. The example explained uses the proposed model to optimize the location of typhoon emergency shelter location near the coastal areas in the China. The statistics data shows that there are almost 27 to 28 tropical cyclones happened in the North Pacific Ocean which closes to China and South China Sea every year, which is about 38 percents of the total of typhoons in the world. Covering models are the most widespread location models for formulating the emergency facility location problems. (PAN 2010)

Two models are proposed for hospital location and capacity allocation on an area prone to natural disaster. The first model aims to locate hospitals and allocate capacities so that the mean travel distance for the patients to the hospital is minimized while the other models aims to reallocate capacity among hospitals so as to maximize the system's effectiveness to upcoming disaster. Heuristic solution methods of the two models are investigated, so as to make the approach computationally viable and to gain insight into the location and capacity allocation strategies The result of both these models are illustrated with the case studies, one based on earthquake scenario in Northridge, California, and another based on a hurricane scenario in New Orleans. (Paul and Batta 2006)

An automated decision support system for optimizing the temporary housing arrangements are proposed which serves as a tool for the decision makers to estimate the expected displacement of the families after natural disaster. Different software systems Mid-America Earthquake Center system MAEviz and Hazards United States-Multihazard (HAZUS-MH) are used for this purpose but they lack the capability of providing temporary housing solutions. After the occurrence of the disaster different emergencies agencies require to provide the adequate temporary housing solution to rehabilitate the large number of displaced ones. This developed system is integrated with the MAEviz to optimize the different objectives like minimizing the socioeconomic impacts, maximizing the housing safety, minimizing negative environmental impacts and minimizing the public expenditure. To implement this system it is divided in three different models namely data collection, automated optimization and output analysis and visualization. (Anwar et al. 2009)

Methodology

Different methodology is adopted by different author to select the effective temporary rehabilitation sites. Kilci et al. 2012 uses the mixed integer linear programming model to locate the temporary housing after an earthquake. The model uses the district data which is obtained from the Google map while population data is obtained from the Turkish Statistical

Institute. The candidate location and the shelter area along with the defined selection criteria are pinned on the map using the ArcGIS software.

Gormez et al 2011 uses two tier distribution model based on the linear integer programming. In the first stage integer programming is used to locate the temporary facilities to each district in its neighborhood. In the second stage these temporary facilities are treated as the demand points, for which permanent facilities are located to service considering the minimum total weighted distance. All the models discussed above uses the same concept to minimize the total weighted distance between the location and the demand points. The main aim of the entire model is to decrease the running time while increasing the efficiency of the model. Models used for the facility location also focus on the capacity allocation along with the shortest distance.

Result and Discussion

All these problems are formulated using various models having some limitations and advantages with them. The table below shows different models and the problem for which it is used for along with the limitations and advantages.

Table1: Comparison of Different Models

Models	Used for	Advantages	Limitations	Proposed by
Mixed integer linear programming Model	Locating sites for temporary housing after an Earthquake	-Consider shelter area utilizations -Computation of scenario is too fast	-For some particular case it takes long time (11 hours) to compute the scenario	Kilci F, Yetis Kara B, Bozkaya B
Covering location facility model using pick the farthest algorithm	Locating potential disaster recovery center after disaster	-Serves both dispersed and aggregate demand points -Easy to understand and explain	-It does not cover the entire problem -Aggregation criteria results are not accurate as ideal conditions	Dekle J, Lavieri M.S, Martin E, Farinas H. E and Francis R.L
Maximal Covering Model based on Ant Colony Optimization	Facility location in Large Scale emergencies	-Provides each demand points with multiple quantity of facility location	-Efficiency is same as that of traditional models -used only with maximal Covering model rather than P-centre and P-median problem	Xiang-lin LU and Yun-xian HOU

Two tier distribution system using integer programming model	Locates disaster response facilities in Istanbul	-Efficiency of result is very near to ideal condition	-For larger problem computation time is too much	Gormez N, Koksalan M and Sakman F S
Heuristics Model	Locate hospitals and allocate capacities in area prone to disaster	-Optimal solution is obtained for smaller and short time problem	-Computation time increases for moderate and large size problem	Paul AJ and Bhatta R
Maximal covering location model	Determines the number and location of distribution centre in relief network	-Enable relief practitioner for efficient decision for pre-stocking and locating facility	- Computation time of model analysis increases for larger problem	Balcik B and Beamon BM
Integrated location distribution model	Coordinates logistics support and evacuation during disaster response activities	-Dual objective model	-Theoretical model	Anping PAN

Conclusion

Different models discussed above have both limitations and advantages. All the models works based on their assumption and the constrained applied to find the appropriate site for the rehabilitation after the disaster. Different assumption of the model is based on the nature of the disaster and the requirements of the victims. All the models are either based on the linear integer programming or the covering location problem. For the facility location in the disaster prone areas heuristics model and maximal covering location model are preferred over the integer programming.

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