Earthquake Vulnerability Mapping of Afghanistan

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Abstract *Assessing vulnerability to natural disasters such as earthquake can be regarded as an ill-structured problem (problem for which there is no unique, identifiable, objectively optimal solution). This paper reports on finding from a project in which a GIS methodology has been developed to assess vulnerability through spatial analytical procedure.*

In this study it has been found that the northern and northeast areas are the most vulnerable areas considering the three components of vulnerability (Exposure, Sensitivity, and Adaptive capacity).

Key Words*: *Natural disasters, Earthquake, vulnerable areas, Geographical Information System.

1. INTRODUCTION

Earthquake is a natural phenomenon that neglecting it will cause irreparable damage. Severe earthquakes have forced scientists to make a plan for reducing the risks and damages caused by it. Historical investigation shows that large areas of our country have suffered casualties due to this natural disaster. In 2015, a 7.5 magnitude earthquake killed 115 people and destroyed thousands of residential homes in Badakhshan province [3].

What causes the increase in earthquake casualties are not only earthquakes, but that are caused by neglect and lack of responsibility for the tasks performed by urban engineers, designers and construction practitioners. The city is not only a collection of buildings, but also human, social, cultural and economic phenomena. Thus, it is necessary not only at the level of a city but also at the level of a country-wide planning and seismic areas to be previously identified [1].

2. Research Method

The main aim is to prepare the earthquake vulnerability map of Afghanistan. To obtain the vulnerability map, we need to prepare the Exposure map, Sensitivity Map and the Adaptive capacity map (called the three components of vulnerability) and by overlaying these three maps, the vulnerability map will be obtained [2].

Required Data:

- Earthquake Data;
- DEM of Afghanistan;
- Afghanistan provincial Boundaries;
- Afghanistan District Boundaries;
- Population Density Map of Afghanistan;
- Afghanistan Roads Shape file.

3. Research Result

The result derived from this project represents the vulnerability map of Afghanistan considering the three components of the vulnerability (Exposure, Sensitivity, and Adaptive capacity). The first component of vulnerability [4].

Which is exposure (**A**), is being derived from the earthquake risk map. It represents the areas that are at high, medium, and low risk of earthquake (It classify the area according to exposure risk). The second component is sensitivity (**B**) which is being derived by overlying the population and the population under five years old. It represents the areas that these populations are at high risk of earthquake. The third component is the adaptive capacity (**C**) that is derived from the roads of Afghanistan, it represents the areas that are far from the roads are highly vulnerable because when a catastrophic events occurs, it takes a long time to provide help for the people. And finally the vulnerability map is derived which represents the high, medium, and low vulnerable areas due to an earthquake event [2].

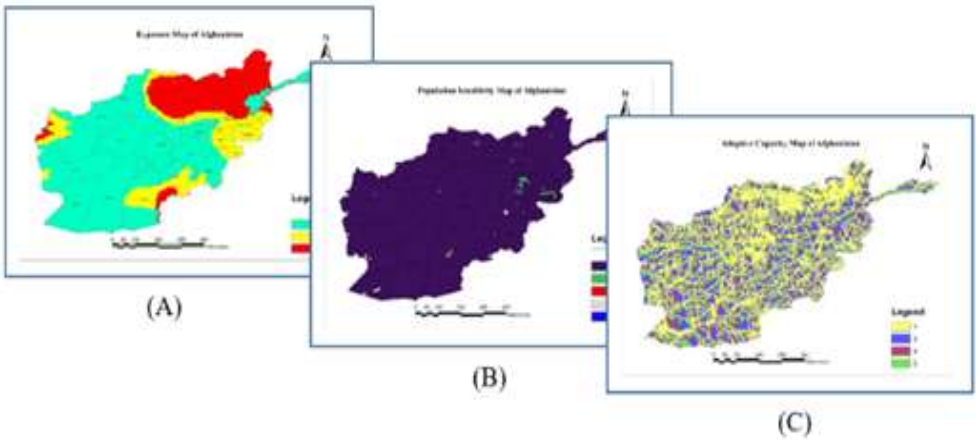
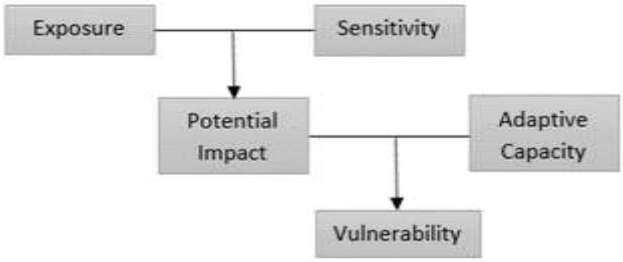


Figure- 1: Exposure, Sensitivity and Adaptive Capacity maps of Afghanistan.



$$\text{Vulnerability} = \frac{(A) + (B) + (C)}{3}$$

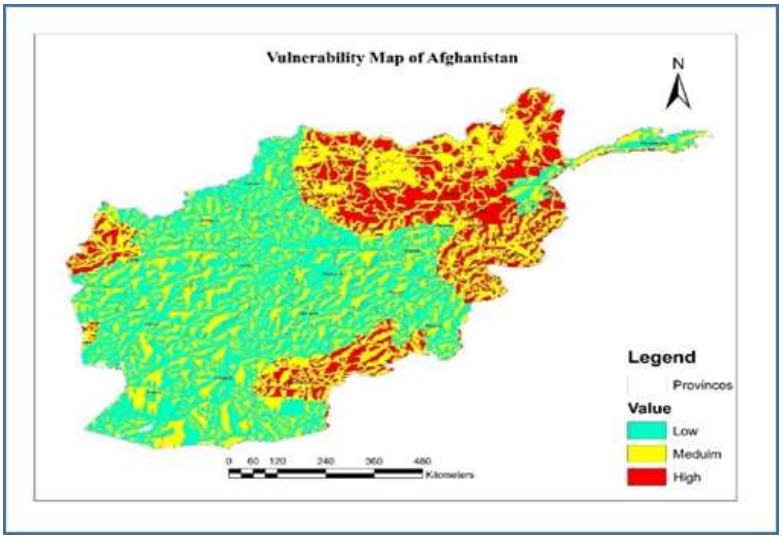


Figure- 2: Final vulnerability map of Afghanistan.

According to the vulnerability map, the provinces that are fully and partially exposed to damage are as follows:

Table – 1: The fully and partly vulnerability Provinces

Fully	Badakhshan, Baghlan, Nurestan, Takhar, Kunduz, Samangan, Panjshir, Laghman, Kandahar, Balkh, and Sar-e-Pul.
Partly	Herat, Khust, Pakteya, Lugar, Kapisa, and Kabul.

4. CONCLUSIONS

The history of destructive earthquakes in Afghanistan spans more than four thousand years. Earthquakes have killed many people in the last 100 years, including the Badakhshan earthquake in October 2015 that killed an estimated 115 people.

Therefore, in order to specify vulnerable areas, there was a need for mapping at the level of a country-wide, as a result the northern and northeast areas are the most vulnerable areas considering the three components of vulnerability (Exposure, Sensitivity, and Adaptive capacity).

To reduce earthquake disaster mortality in the country, there are some recommendations to improve the following:

- The country needs to have the macro-zonation map for seismic activity.
- The hazard mapping of the country due to different kind of disaster is needed to specify the disaster prone areas.
- For reduction of the disasters, it is necessary to include the disaster subjects in different school levels.
- Development of technical and material resources in high risk areas.

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REFERENCES

[1] Ware, J. 2007 GIS for Earthquakes, USA. Pages (98-125)

[2] Mehedi Ansary, Ishrat Islam. 2015 GIS based mapping of vulnerability to earthquake and fire hazard in Dhaka city, Bangladesh. Pages (1-11)

[3] Ambrarseys, Nicholas, and Billham, Roger, 2003, Earthquakes in Afghanistan Seismological Research letters, Pages (107-123)

[4] Ulrich Kamp, Benjamin J Growley, Ghazanfar A Khattak, Lewis A Owen, 2005. GIS–based landslide susceptibility mapping for the Kashmir earthquake region. Pages (1-7)

BIOGRAPHIES

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