Assessing Vulnerabilities to Natural Disasters of Malgagai Refugee Village Killasaifullah, Balochistan

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Abstract: Disaster mostly occurs when vulnerability and hazard hold together. Balochistan is no exception where a number of natural and manmade disasters interface resulting in catastrophes. The main objective of this paper is to assess the vulnerabilities to natural disasters of Malgagai refugee village Killa-Saifullah. A questionnaire survey was conducted among 400 households using simple random sampling. Composite community vulnerability index is used to achieve the objective of the study. Results revealed that the study area is vulnerable (socially, physically, institutionally and economically) due to lack of education, inadequate resources, poverty, poor building infrastructure, unemployment and lack of awareness and preparedness. Implementing of risk lessening measures in building infrastructures and carry out essential socio-economic activities (education, multiple sources of income, health, and community trust) is extremely fundamental to lessen the overall vulnerabilities of the study area prone to natural hazards.

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1 Introduction

Disaster mostly occurs when vulnerability and hazard merge (W. Neil Adger, 2006). For the last fifty years, it has been observed that the natural disasters affected the populations, economies, infrastructures and environments of various communities all over the world (Turner et al., 2003). Due to high rate of poverty and urbanization, Asia is known as the supermarket of disasters (James, 2008). Pakistan is prone to natural hazards with different levels of vulnerability in both the urban and rural areas (Kakar & Ahmad, 2013). Due to increasing trend of disasters, communities become more vulnerable socially, economically, physically and institutionally (Goel & Mehtre, 2015). The experiences gained through recent past disasters like ("Indian Ocean Tsunami 2004, Bam Earthquake 2003, Haiti Earthquake 2009 and Kashmir Earthquake 2005") and challenges faced by the local and national governments, donors and many other are thinking about prior disaster management activities to reduce the overall disaster risk and their impacts (Ainuddin & Routray, 2012b). In disaster management activities paradigm shift from post disaster activities to prior disaster activities like disaster risk reduction in line with two main Frameworks (Hyogo framework for action 2005-2015 (UNISDR, 2009) and Sendai Framework 2015-2030 (Aitsi-Selmi, Egawa, Sasaki, Wannous, & Murray, 2015). Therefore, this paper has made an attempt to assess the community vulnerability in the context of natural hazards in Baluchistan. The study area has been typically exposed to natural disasters (flood, Drought, earthquake), on account of its unique geographical conditions. In this paper vulnerability assessment is taken based on four main components social, economic physical and institutional. The study would be beneficial to addressing the grassroots level problems in the context of natural disasters at community level. Thus it helps in protecting livelihoods and assets during disaster periods.

2 Concepts and Approaches to Vulnerability

2.1 Vulnerability

In the discussion of disasters vulnerability is the most common word (Kapoi & Mundia, 2014). In the literature, vulnerability is defend with the number of

various definitions but the common definition is "the condition or a set of conditions that make a community susceptible to impacts of the hazards and disasters (Birkmann, 2006; UNISDR, 2009). Vulnerability assessment is rare and complex task (Ainuddin & Routray, 2012). The advance literature on vulnerability has distinguished the need of addressing the impacts and changes taking place due to overall environmental change. The venerability of any natural hazard may not be addressed alone rather it compared with resilience and sensitivity of such hazard (Turner, 2010). Therefore, building resilience to natural disasters need to start at the local level and turn into part of long-term considerations and an essential part of strategies related to economy, water, food security and hazard preparation.

2.2 Vulnerability Assessment

Vulnerability assessment is multifaceted and varies by nature of hazard and by geographical location, hazard power and the mitigation measures (Structural and Non Structural) of the community respond to a disaster. Researchers have different ideas in the understanding of vulnerability as of different direction, supporting ecology, human ecosystem, spatial study and physical knowledge,(W. Neil Adger, 2006). Whereas the measurement of vulnerable condition of various institutions, groups, and systems which find out flexibility in the background of ecological variation is a rising latest research problem(Wood, Burton, & Cutter, 2010). Typically vulnerability has been identified mainly with three important ideas (Turner, 2010). Firstly vulnerability as disaster practices describes the ways of technological or biophysical risks and identifies the vulnerable condition with the occurrences of risky events and allocation of dangerous circumstances. Secondly it sees vulnerability as community comeback, to examine the collective struggle and coping responses which is fixed in cultural, economic, historical and societal process (Birkmann & Wisner, 2006). "Thirdly the idea of vulnerability of places based on the mixture of the first two instructions apart from physically centered attractive both societal response and biophysical risk in an exacting geographic domain" (Wood et al., 2010).

2.3 Community Vulnerability Indices

Indices are useful as they illustrate measurement of various areas throughout disasters, such as deficiency, societal development, quality of life, scarcity and human growth. Indices are used at different level globally, regionally and locally such as Cutter's social vulnerability index is the most popular index for the vulnerability assessment. In this article vulnerability weighted index is used for the assessment of vulnerability. The overall study is based on four main general components as social, economic, institutional and physical. Every component is further divided into different sets of indicators and variables as shown in table 4.1 and 4.2.

3 Study Area and Methodology

3.1 Study Area

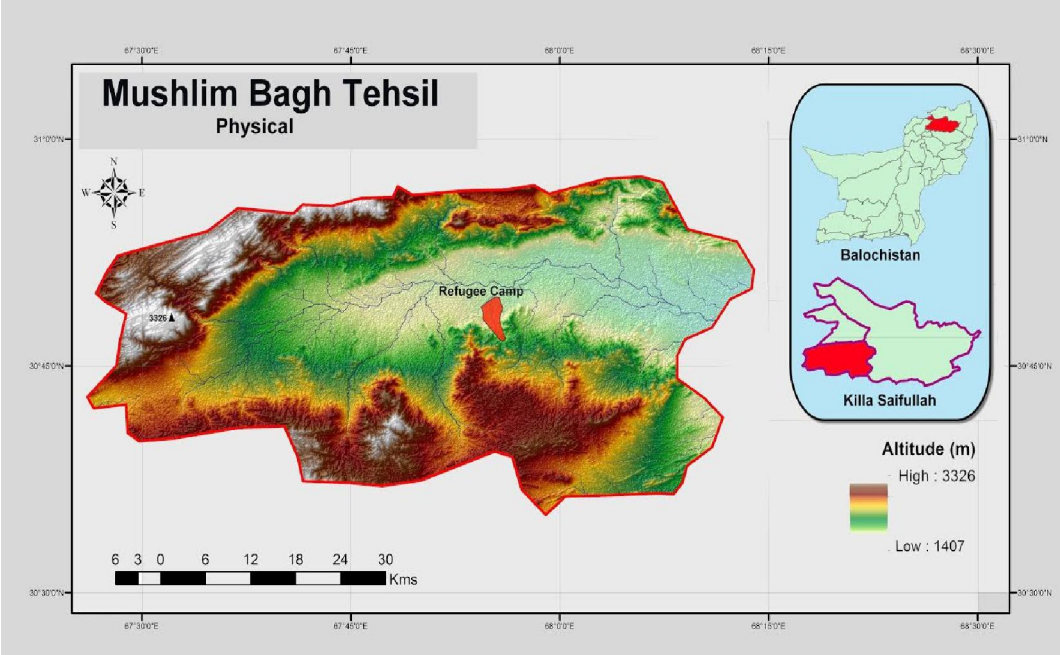

Figure 1: Study Area Map

The study area is situated in district killa-Saifullah tahseel Muslim Bagh. The village was severely affected by different natural hazards (drought, flood, earthquake etc). The total area of Killasaifullah district is 6,831 Square kilometers and is situated at ("67°17'37- 69°22'54" East longitude, and 30°30'35"- 31°37'10" North latitudes (Development, Department, & UNICEF, 2009).

3.2 Data Collection Tools

In order to achieve the objective of the paper, data was collected through both primary and secondary data sources. Primary data was collected through observation, household questionnaire survey and key informant interview. Secondary data was collected from various sources like, District profile of killasaifullah, Provincial Disaster Management Authority (PDMA), United Nation Higher Commissioner for Refugees (UNHCR), Killasaifullah district education planning departments and from the community center of Malgagai village. 400 respondents were selected and were personally interviewed using simple random sampling techniques. The total population of the village was around 10000 thousand individuals (UNHCR, 2015). The sample size was collected on the basis of Arkin and Colton formula (1963) given as.

$$n = \frac{NZ^2 \times P \times (1-P)}{Ne^2 + \{Z^2 \times P \times (1-P)\}}$$

Where n = Sample size
N = Population size
Z = Confidence Level (95%=1.96)
P = Degree of Variability (50%)
e = Level of precision or sampling error which is ±5%

The unit of analysis in this study is the household head and only male household were accessible for interview due to religious and customary values of the society. Inferential and descriptive statistics is used for data analysis using Statistical Package for Social Sciences (SPSS). In addition Geographical Information System GIS) is used to show the spatial picture of the study area.

4 Data and Methods

4.1 Selection of Indicators

Generally vulnerability is a compound idea, which is based on institutional, financial, social, infrastructural, and environmental community fundamentals. Four main components of vulnerability that includes economic, social, physical and institutional are selected for vulnerability assessment of the study area. All these have various sets of indicators depending on the widespread prior researches on vulnerability mostly associated to natural hazards. Every value of the primary data was used in percentages to remove complexity associated to various units of measurements, for community vulnerability (Ainuddin & Routray, 2012b).

The first sub-component of the community vulnerability is the social vulnerability, of the people/community that suffers from natural hazard, and can be assessed through different social aspect such as peoples educational level, age distribution of the individuals in a family, people interactions and community trust during disaster (Cutter et al., 2003). Economic vulnerability is the second component of the community vulnerability; and it assess the community vulnerability in terms of financial system, such as people with low level of income, families without diversified source of income, life insurance and families without savings. The low level of financial system attracts the overall community towards vulnerability (Cutter & Finch, 2008; Wisner et al., 2004). The third component of community vulnerability is the institutional vulnerability that identifies the vulnerabilities associated to institutions such as preparation for disaster, mitigation measures and public awareness and preparedness. The fourth component of the community vulnerability is the physical vulnerability, which identifies the physical and geographical vulnerabilities of the study area, such as physically vulnerable location, vulnerable housing structures and housing locations in a river-bed or at the foot of mountain in rural areas that make the particular area vulnerable during earthquake and in flooding situation (Ainuddin & Routray, 2012c; Cutter & Finch, 2008; Turner et al., 2003; Wisner et al., 2004). In order to assess the community vulnerability, following indicators from these four components of vulnerability have been selected for further investigation (see Table 1).

Table 1: Variables selected for constructing community vulnerability index

Category	Variables/indicators	Effects	Justification
Social Vulnerability Educational level	Percent of people with high school and above education Percent of people without any education (Cutter & Finch, 2008; Fassinger & Morrow, 2013; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008).	Negative Positive	Higher the education level plays a vital role in a community for understanding the disaster management activates
Age	Percent of people above 60 years of age and below 15 years of age (Cutter et al., 2003; Cutter & Finch,	positive	Higher the ratio of aged people and under 15 years of children's having

Category	Variables/indicators	Effects	Justification
	2008; Fassinger & Morrow, 2013; Tobin, 1999).		constraints during evocation.
Health Insurance	Percentage of people with health insurance (Cutter & Finch, 2008; Friedman, Dunn, & Merrell Jr, 2002)	Negative	Health insurance facilitates the people of the community aftermath of a disaster.
Disability	Percent of people with any mental or physical disability (Wood et al., 2010)	Positive	Disabled persons will increase the household finance during disaster.
Social capital	Community trust during disasters (Cutter et al., 2003; Norris et al., 2008).	Negative	Community trust facilitates the cooperation and coordination during emergencies.
Economic Vulnerability Employment	Percent of people without employment occupation(Cutter et al., 2003; Tierney et al., 2001).	Positive	Employment occupation increases the will-being of the people and reduces the poverty level.
Category	**Variables/indicators**	**Effects**	**Justification**
Multiple source of income	Percent of people without diversified source of income (W. N. Adger, 2000; Cutter, Burton, & Emrich, 2010; Norris et al., 2008).	Positive	Multiple sources of income provide alternatives to the community at rehabilitation and recovery stage.
Income	Percent of people below poverty line (Cutter, Mitchell, & Scott, 2000; Hewitt, 1997).	Positive	People with below urban poverty line may be impacted more than those who with above poverty line.
Institutional Vulnerability Mitigation	Percent of people with hazard mitigation plan (Cutter & Finch, 2008; Cutter et al., 2000).	Negative	Mitigation plans reduce the high impacts of losses from disasters
Awareness building	Percent of people without mock drills and training programs (Paton & Johnston, 2001).	Positive	Prior disaster activities lessen the overall affects of a disaster
Physical Vulnerability Shelter facility	Percent of people facilitated with vacant shelters(Cutter et al., 2010).	Negative	Vacant shelters helps in the aftermath of a disaster particularly in earthquake.
Vulnerable Structures	Percentage of houses with vulnerable structures (Cutter et al., 2010).	Positive	Vulnerable housing structures make the community more vulnerable
Location	Percent of housing units at the foot of mountain and at river-beds for rural areas (Cutter & Finch, 2008; Cutter et al., 2000).	Positive	more density provide less vacant places around the housing units

Table 2: Weighting of indicators for vulnerability index

Category	Variables/indicators	Optimum level of vulnerability in %
Social Vulnerability Educational level	Percent of people with high school and above education	60
	Percent of people without any education (Cutter & Finch, 2008; Fassinger & Morrow, 2013; Norris et al., 2008).	50
Age	Percent of people above 60 years of age	15
	and below 15 years of age (Cutter et al., 2003; Cutter & Finch, 2008; Fassinger & Morrow, 2013; Tobin, 1999).	20
Health Insurance	Percentage of people with health insurance (Cutter & Finch, 2008; Friedman et al., 2002).	50
Disability	Percent of people without any mental or physical disability (Wood et al., 2010).	75
Social capital	Community trust during disasters (Cutter et al., 2003; Norris et al., 2008).	50
Economic Vulnerability Employment	Percent of people with employment occupation (Cutter et al., 2003; Tierney et al., 2001).	50
Multiple source of income	Percent of people with diversified source of income (W. N. Adger, 2000; Cutter et al., 2010; Norris et al., 2008).	50
Income	Percent of people below poverty line (Cutter et al., 2000; Hewitt, 1997).	60
Institutional	Percent of people with hazard mitigation plan (Cutter & Finch, 2008;	50

Category	Variables/indicators	Optimum level of vulnerability in %
Vulnerability Mitigation	Cutter et al., 2000).	
Awareness building	Percent of people without mock drills and training programs (Paton & Johnston, 2001).	60
Physical Vulnerability Shelter facility	Percent of people facilitated with vacant shelters (Cutter et al., 2010).	60
Vulnerable Structures	Percentage of houses with vulnerable structures (Cutter et al., 2010).	30
Location	Percent of housing units at the foot of mountain and at river-beds (Cutter & Finch, 2008; Cutter et al., 2000).	40

4.2 Numerical Analysis for Vulnerability Index

Community vulnerability index mainly based on four main journal components as discussed in previous sections. Each component is further divided into different sets of indicators and variables. All the value of indicators is taken in percentages. The interpretation of the indices is illustrated as, larger the value of the indicator, larger is the weight and index value, and lastly greater is the vulnerable of that particular variable within a component. Numerically vulnerability factor index is assessed as.

Vulnerability Factor Index (VFI) of i^{th} positive indicator = % Value of the i^{th} indicator (real) / % value taken as the level of the vulnerability of the i^{th} indicator

Vulnerability Factor Index (VFI) of i^{th} negative indicator = % Value taken as the level of vulnerability of the indicator / % value of the i^{th} indicator (real):

Small value approximately approach to zero is to be considered low vulnerable and greater values near to one or greater than one is considered high vulnerable.

In journal there are many indicators and variables contributing to vulnerability, but in the current study indicators and variables are selected according to the existing situation and availability of the data in the study area.

Table 3: Vulnerability component index values

No	Component indicators	Percent value	Vulnerability factor index	Optimum level
Social vulnerability				
1	Percent of people without any education	80	1.60	50
2	Percent of population exceeding 60 years of age	6	0.40	15
3	Percent of people below 15 years of age	47	2.35	20
4	Percent of population with disability	2	0.03	75
5	Community faith in disaster	55	0.90	50
	Component vulnerability factor index		**1.05**	
Economic Vulnerability				
6	Percent of people unemployed	98	1.96	50
7	Percent of people without diversified source of income	38	0.95	40
8	Percent of residents below poverty line	53	0.88	60
	Component vulnerability factor index		**1.26**	
Institutional Vulnerability				
9	Percent of people voluntarily work during disaster	70	0.71	50
10	Percent of people without disaster preparedness	29	0.48	60
	Component vulnerability factor index		**0.56**	
Physical Vulnerability				
11	Percent of houses located in river-bed	70	2.16	30
12	Percent of houses with vulnerable structure	52	1.30	40
	Component vulnerability factor index		**2.18**	
	Over all community vulnerability index		**1.26**	

5. Results and Discussion

Socioeconomic, physical and institutional factors are interconnected and influenced each other. In this study social, economic, physical and institutional factors are considered for the vulnerability assessment. Low resilient communities are more vulnerable to disasters. They face significant harms in their daily life. Low educational level, poverty, lack of capital and resources are the key factors of the vulnerability. Low educational level of the community affects their livelihood, income, ability and adaptation to modern information related to disasters. Education plays a significant role for understanding and copes with any hazardous condition; similarly the role of institutions in any sort of disaster can lessen the overall risk through best policies and strategies. Results reveal that, the social value index 1.05 is greater due to low level of education such as 80 percent people in the study area are illiterates as well as a higher proportion (47 %) of the people under 15 years of age which is a risky sign for the community to evacuate during disasters (see in table 3) Low percentage of disabled peoples and small proportion of people above 60 years of age is a little bit satisfactory sign for community.

Economic vulnerability is the second component of the vulnerability index. From prior studies it is indicated that the higher ratio of unemployed people in a community, higher population rate below poverty line and population without diversified sources of earnings attracts the overall community towards vulnerability. The economic vulnerability index 1.26 is greater due to high ratio of unemployed people, such as 98% people have no employment/occupation in the study area and they are completely dependent on daily wages occupation, which creates problems in recovery phase for the community. The higher ratio of people without diversified source of income and people below poverty line are significantly shows the sign of vulnerability.

Regarding Institutional vulnerability the study has examined vulnerabilities linked to hazard preparation, risk lessening activities, and public preparedness and awareness. The overall institutional vulnerability value index 0.56 is low as compared to social and economic vulnerability value index. The collaboration level among peoples was almost 70 % during disaster and almost 29 % people were prepared in hazard prone areas.

Physical vulnerability is the fourth and last component of vulnerability index. From Table (3) the physical vulnerability component has the highest vulnerability value index as 1.73. Physical vulnerability value index is greater due to high proportion of houses with vulnerable structures such as 52 % houses were made by loose materials (mud and stones), which making the houses structures extremely physically vulnerable during earthquakes and flash floods and almost 65 % of the houses were built in a river channel and such river-channel was prone to flood,. Even the low level of an earthquake can destroy the village. Lack of capital and resources made people not able to re-build and relocate their houses at a safer place.

6. Conclusion

Vulnerability assessment is a multi-dimensional concept that helps to identify those factors and characteristics of individuals or communities that enable them to respond and recover from natural disasters.

This article has attempted to analyze vulnerability based on previous studies focusing on natural disasters and risk, with a detailed assessment technique assigning weights to various components depends on their significance.

In general, the composite community vulnerability index identifies the overall image of the community exposures, based on socioeconomic data gathered during field observation and questionnaire survey about various components of community vulnerability of the study area. The study identified different indicators of the vulnerability such as illiteracy rate, population below 15 years of age, people unemployment rate, people below poverty line and housing locations and their structures that attract the overall community towards vulnerability.

The study recommends the necessary improvements in institutional, economical social and physical components by rising the preparedness and awareness of community about flooding situation and their housing structures. Implementing of risk lessening measures in building infrastructures and carry out essential socio-economic activities (education, health, and community trust) is extremely fundamental to lessen the overall vulnerabilities of the study area prone to natural hazards. Additionally it is important, to highlight the multiple source of income activities to decrease poverty that will reduce the people vulnerability to a better extent in the long run.

Availability of Data and Materials

Data will not be shared because the data is collected as a primary data from community.

Competing interests

There is no competing interest of authors

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Authors Contribution

Mr jamal-ud-din contributed as a corresponding author, rest of the authors have contributed as a supervisor, co-supervisor and as classmates.

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