Risk Communication in Earthquake Vulnerability in District Bagh, Azad Jammu And Kashmir: Review of Literature and Pilot Study

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Abstract: This study is mainly concerned to assess the role of Risk Communication in Earthquake Vulnerability and its impacts on Building Resilience in District Bagh Azad Jammu and Kashmir. Disaster resilience is gaining attention from all over the world. More specifically, seismic resilience in buildings is of prime concern among governmental bodies of developed as well as developing countries. This is partially due to the fact that the collapsing of vulnerable structures contribute to a great proportion of the number of fatalities in the wake of increasing Seismicity. Secondly, the recurrence of earthquakes on a global scale is increasing with increase in its magnitude. This study was focused to assess the impact and role of risk communication in earthquake vulnerability in district Bagh, Azad Jammu and Kashmir in enhancing resilience of residential buildings and also its moderating role between Earthquake Vulnerability and resilience of residential buildings in study area. In fact there is great gape; people in the vulnerable areas do not get required information about various hazards. For this study District Bagh of Azad Jammu and Kashmir was selected due to the facts, it suffered a lot during 2005 Earthquake and still it is prone to more damages due to lack of implementation of building codes and requisite information on the vulnerability. An exploratory type of study has been conducted. For pilot study 50 respondents were approached for collection of data with the help of questionnaires in different areas of District Bagh. Findings of the pilot study along with recommendations for policy makers, managers and target readers have been given in detail. Contribution to the body of knowledge and future call is also jotted down. If people are educated well about various hazards they can reduce the vulnerability to a great extent. Nevertheless, through better integration of risk communication means and enhancing level of awareness would prove instrumental in overcoming the lapses

Keywords: Risk communication, Earthquake vulnerability and Resilience.

1. INTRODUCTION

1.1. Introduction

This study is concerned to assess the impact and role of risk communication in earthquake vulnerability which have direct links with structural resilience of housing sector in District Bagh, Azad Jammu and Kashmir. Due to 2005 Kashmir Earthquake irreparable losses were caused to lives and property. In that sad demise about 73,000 people perished in whole region and about 10,000 alone were dead in District Bagh (Human Rights Watch (September 2006), Christopher Snedden, Aqwam-e-Kashmir by Muhammad Din Fauq). Some of the houses/villages completely vanished from the surface (Khan *et al*. 2008). Due to national and international effort, rehabilitation was carried out, however, there are few factors which have not been addressed in true sense to guard against future seismic occurring. There are factors such as earthquake hazard, vulnerability and risk communication which have deep rooted links with structural resilience of housings in Bagh (Bolin and Stanford 2006). These stated factors need to be given due attention for integrating in any development for making the population more resilient to withstand the recurrence of ground acceleration particularly in Structural resilience in housing sector as under study area falls in Active seismic zone of earthquake hazards (Naseer, Khan *et al*. 2010).

1.2. Background of the Study

Earthquakes are unique amongst all the natural hazards as they occur without warning. During the earthquake when structures start shaking give the feelings as they were never strong enough to withstand. Since maximum part of Kashmir lies in active seismic zone, therefore, Kashmiri People have learnt to live with (Maqsood and Schwarz 2008). When earthquake starts, soft soil which is already prone to movement and lack of building codes accentuate the problem manifold. Previously people in Kashmir used to construct houses using local material as per traditions which were best suited according to topography of the area. But now since introduction of new engineering skills and architecture, people imported the model without realizing consequences. In

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past people used wooden floors, stone masonry, and wood houses which had the roof made of wood and loose earth, later replaced with tin roof huts. Those previously constructed houses were light in ground to weight ratio. With imported ideas, light roof huts have been replaced with heavy concrete buildings. Occurring of earthquake is a common phenomenon, previously losses were less. But now this vulnerability has increased manifold due to many reasons, such as, heavy buildings, in the event of seismic activity give chain reaction to landslides. Cutting of heavy concrete buildings is more difficult and is beyond the capabilities of local resources. In the earthquake 2005, people died due to collapsing of buildings, we know, earthquake do not kill, it is infrastructure/buildings which kill the people. Being close proximity of Himalyan region, and being located in active seismic zone (Anees and Bhat, 2015), lack of adherence to building code and deviation from local traditions has aggravated the condition. Violation of building code is there in worldwide due to apparent reasons; such as financial constraints. Violation in implementation of building codes is at increase, particularly in Pakistan and Kashmir (Boob and Rao). Due to lack of risk communication, people are unaware of the consequences which could be caused to them due to ground acceleration more than magnitude of 7. There is need to enhance the risk communication about the various hazards generally and earthquake vulnerability particularly to which they are approaching due to their own actions. Awareness and sensitization will prove instrumental in reducing the vulnerability in the futuristic seismic vulnerability (Bilham 2004). These mentioned reasons lead to their higher vulnerability. In order to ensure effective measures, mitigation strategies have to be focused on these areas which are located in active seismic zone (Anees and Bhat 2015).

1.3. Problem Statement/Research Gap

Recurrence of earthquake is a common phenomenon in Specific parts of Pakistan like Khyber Pakhtaunkhawa generally and Azad Jammu and Kashmir particularly being located in active seismic zone. In past population was less and houses were built as per local culture, tradition which besides simple also suited to the area considering the earth sustainability and slope failure aspects. Now with development in construction technology, high rise buildings have been constructed which are more vulnerable due to occurring of earthquakes of various magnitudes.

Previous researches focused on Seismic vulnerability of existing building stock in Pakistan and detailed analysis of .the Seismic. Vulnerable conditions of houses of Srinagar. City of Jammu and Kashmir. Other studies have been carried out on rupturing of surface areas due to 2005 earthquake in Kashmir, Pakistan, and its activated tectonic repercussions, Earthquakes in India and the Himalayan region: tectonics, geodesy and history Yet not much studies have been conducted to assess impact and role of risk communication on structural resilience of housing sectors in District Bagh Azad Jammu and Kashmir. In this study, therefore, an endeavor was made to explain the impact and role of risk communication between earthquake vulnerability and structural resilience of housing sector in District Bagh, Azad Jammu and Kashmir.

1.4. Research Purpose

Study was focused to assess the impact and role of risk communication on the structural resilience of residential buildings in District Bagh, Azad Jammu and Kashmir with a view to make it more resilient to various vulnerabilities, particularly earthquakes of different magnitudes.

1.5. Research Questions

Following were the specific research questions:

a. What is the Earthquake vulnerability/exposure and Hazard condition in District Bagh?

b. What are the resilience capacities of housing units in District Bagh?

c. What is the level of risk communication in District Bagh?

1.6. Research Objectives

Research focused impact of risk communication on relationship of vulnerability assessment and structural resilience of houses in study area. Main objective of study were:-

a. To assess the Earthquake vulnerability and hazard condition in District Bagh.

b. To ascertain the resilience capacities of housing units in District Bagh.

c. To assess the level of risk communication in District Bagh.

1.7. Significance of the Study

Publication of this study would be helpful for the population of Azad Jammu and Kashmir generally and particularly in District Bagh. It would also help them to take informed decisions in construction of their residential buildings. By understanding the role and impact of risk communication between the relationship of vulnerability and structural resilience of houses, it would help to other researchers for their focus on enhancing the risk communication amongst the vulnerable population in different areas of the world.

1.8. Scope of the Study

This research was limited to the District Bagh to assess the role and level of risk communication, Vulnerability assessment and impact of Risk Communication on structural resilience of residential buildings in the study area.

1.9. Limitation

The following limitations were there during the conduct of study:

a. Less time was available to complete this project so the study has been completed in short span of time.

b. Financial matters were also a constraint.

1.10. Thesis Outline

a. Introduction: An overview of the theoretical and analytical background of the study, along with the relative justification of need of this research is given.

b. Literature Review: The detailed elaboration of previous studies.conducted on the topic, with relevance to.context and content was carried out. Also, a set of hypotheses was formed in order to construct a model of research framework.

c. Research Methodology: The details of study type and design, along with mental and physical processes, employed in this research were highlighted. Results of the pilot. Study were given for validity and reliability of constructs.

d. Analysis and Discussion: Analyses of the research results, along with reasoning and justification are included. In addition, the important findings are summarized.

e. Conclusion and Recommendations: Finally, overview of study is given, with valuable. Recommendations to policy makers, managers and target readers.

2. LITERATURE REVIEW

2.1. Introduction

The chapter elucidates the relevancy of literature in relation to assess the impact and role of risk communication under vulnerability conditions. Detailed overview of the previous researches conducted on the topic of natural disasters, building codes, disaster resilience in buildings and infrastructure, and compliance were highlighted. Furthermore, the research framework was explained which was conceived during the review of literature.

2.1.1. Important Terms

<u>Hazard</u>

Hazard is defined as a potentially damaging physical phenomenon or human activity that may cause the loss of life or injury, damages the property, socially and economically disruption or degrades the environmental aspects (UNISDR, 2009).

<u>Earthquake</u>

An earthquake (also known as ground acceleration) is the shaking of the surface and subsurface of the Earth, which can destroy major buildings and kill many people Earthquake happen when two plates/blocks of earth slip or rub which one another. It can be even with heavy internal pressure of magma (USGS, 16).

<u>Resilience</u>

Resilience is the capability of and ability of the system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including of a system to restore and recover back from a shock / ground acceleration /damaging phenomenon (UNISDR, 2009).

It is the ability of a society or a system to resist or absorb it or to live with it within existing resources and carryout its normal functioning. It can be through preservation or restoration (Naseer, Khan 2010).

<u>Infrastructure Resilience</u>

Resilience of a infrastructure mean is its ability to resist or reduce its magnitude by various ways and means (Dondossola, 2012).

Risk communication

It is the process of two way exchange of information, and opinions among the various segment of a community (Bowen, 2007).

Risk is a basic issue in policy areas of health, safety, technology, environment and finance (Chess, 2001).

Several risk communication models are presented, as well as some thoughts on what new directions are to be expected and which important questions are to be addressed in the future (Fischhoff, 1995).

Exchange of information and opinions and establishment of effective dialogue amongts various segments of society responsible for assessment, minimize it and regulate risks and those individuals who may be effected by outcome of those stated risks (Sheppard, 2012).

Risk communication confronts dilemma of various hazards. It can be used to calm down the people and at the same time to sensitize them about some imminent hazard so that they are able to take preventive and precautionary measures (Pidgeon, 2003)

Risk Communication is effective if people under threat are provided with timely and reliable information (Chess, 2001).

Risk communication started in the 1980s and continues to this day. There are many factors that have contributed to its rapid growth. Risk Communication was started in public interest, safety and environmental issues and media coverage of the same.

Risk communication was formulated in response to various factors, however, it had faced lot of obstacles also like, mistrust, inconsistency, confusion, incomplete messages, lack of trust in information sources and selective reporting by the media etc. psychological and social factors also effected the risk communication (Renn, 1991) .

Vulnerability

The level to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or stress/stressor (Blaikie, Cannon *et al*. 2014)"

Vulnerability has been variously defined and. described in both social and ecological contexts, however a simple definition is often used which has Latin origin. The root of vulnerable is vulnerare meaning "to wound"; therefore, vulnerability can be basically described as: "the capacity to be wounded (Bolin, 2006) "

Seismic Resilience

It is the ability of a system to reduce the chances of a shock, to absorb such a shock if it occurs and to recover quickly after a shock. More specifically, a resilient system is one that shows (Bruneau and Reinhorn 2006):

a. Reduced chances of failure.

b. Reduced consequences from failures, in terms of lives lost, damage, and negative economic and social consequences.

c. Less time of recovery.

2.2. Review of Previous Studies

This thesis has explained earthquake hazard profile firstly. Secondly it also assessed structural resilience of housings and evaluated the role of risk communication and its impact of structural resilience in District Bagh Azad Jammu and Kashmir. Very few previous researchers have discussed this transformation phenomenon.

Infrastructural resilience, is an assessment of community response and recovery capacity (*e.g*. shelter, housing units, and healthcare facilities and hostels). Vulnerable infrastructure includes particularly houses that are built without compliance of mandatory building codes (Cutter 2010). Sustainable development is the development carried out without compromising the needs of future generation (Keller, Siegrist. 2006).

2.2.1. Earthquake 2005

The 8^{th} October 2005. Kashmir Earthquake was one of the largest earthquakes in Northern Pakistan in history. It caused an unprecedented level of damage and destruction in Pakistan Administered Kashmir (PAK) and Khyber Pakhtunkhawa. According to the Meteorological. Office Peshawar, October 8^{th} 2005.Earthquake was the second major earthquake since 1929 in this region. February 1929 shock in northern district of Buner had magnitude 8.0 at the Richter scale but due to low. Population losses were less (Bilham, 2004).

2.2.2. Hindu-Kush Earthquake 2015

On 26th October, 2015 the Hindu Kush earthquake was felt throughout South Asia, causing widespread.damage in Afghanistan and Pakistan. The earthquake resulted from reverse faulting with its epicenter located about 67 km north-west of Chitral District in Pakistan (Bilham, 2004). The earthquake was initially given a magnitude of 7.7, which was later revised to 7.5 by US Geological Survey (USGS) On the contrary, the Meteorological. Department of Pakistan

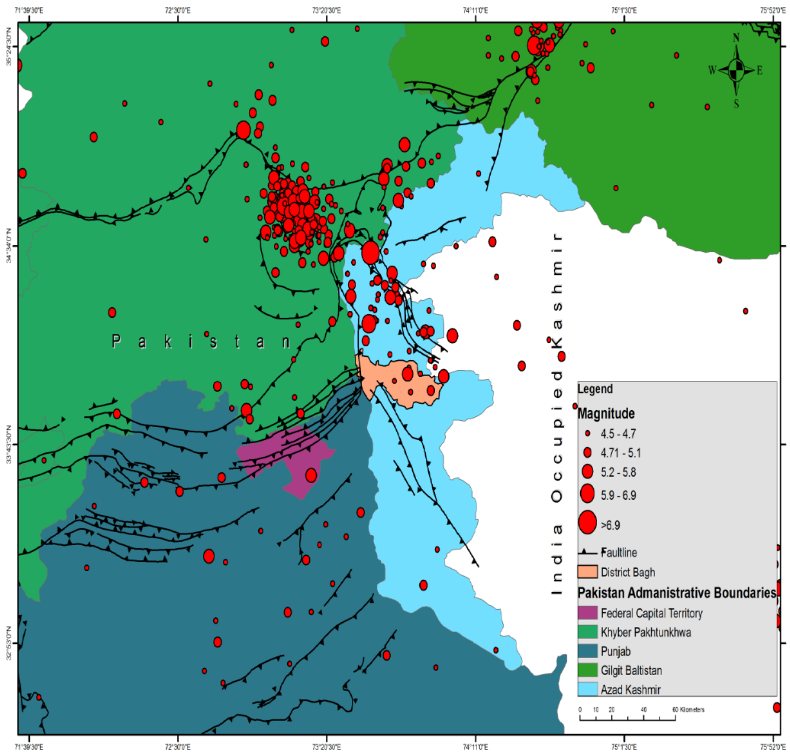


Figure 2. 1: Map with various magnitude and fault lines (**USGS, 2016)** Earthquake Data.

Table 2. 1: Earthquake Magnitude (Richter Scale)

Ser	Date and Time	Lat	Log	Depth	Mag	Place
8	2005-10-08T10:46:28.790Z	34.733	73.1	8	6.4	Pakistan
	2005-10-08T03:50:40.800Z	34.539	73.588	26	7.6	Pakistan
	2002-11-20T21:32:30.810Z	35.414	74.515	33	6.3	northwestern Kashmir
	1996-11-19T10:44:46.060Z	35.345	78.133	33	6.9	Kashmir-Xinjiang border region
	1992-05-20T12:20:32.850Z	33.377	71.317	16.3	6.3	Pakistan
	1984-02-01T14:22:07.900Z	34.616	70.484	33	6.1	Hindu Kush region, Afghanistan
	1981-09-12T07:15:54.170Z	35.693	73.594	33	6.2	northwestern Kashmir
	1975-01-19T08:12:08.100Z	31.95	78.521	33	6	western Xizang-India border region
	1975-01-19T08:02:02.500Z	32.455	78.43	33	6.8	Kashmir-Xizang border region
	1974-12-28T12:11:43.700Z	35.054	72.87	22	6.2	Pakistan
	1955-06-27T10:14:12.000Z	32.294	78.506	15	6.2	Kashmir-Xizang border region
	1945-06-22T18:00:53.000Z	32.509	76.247	20	6.5	Himachal Pradesh, India
	1937-11-15T21:37:28.000Z	34.728	78.258	30	6.4	Kashmir-Xinjiang border region
	1914-10-09T02:39:14.000Z	32.604	76.181	20	6.3	Himachal Pradesh, India
	1905-04-04T00:49:59.000Z	32.636	76.788	20	7.9	Himachal Pradesh, India

(PMD) reported a magnitude of 8.1. There were, 115 fatalities and 7679 buildings were damaged. In Pakistan, the damage was mostly in Gilgit-Baltistan (GB), Khyber. Pakhtunkhwa (KPK) and Federally Administered Tribal Areas (FATA). Its shocks were equally felt in Muzafafarabad and Bagh (Najif Ismail 2015).

2.2.3. Earthquake Data

The Earthquake Data has been worked out from 1900 to Feb 2017. In the table below, only data of earthquake has been reflected which is of magnitude of 6 or above, however, other details are also available for reference if deemed necessary (**USGS) Map depicts the various locations with magnitude of earth occurred:**

2.2.4. Seismotectonic Zoning of Pakistan

Basing on the plates tectonic information and recently known fault lines, Pakistan has been divided into five zones of various intensities.

The geographic domain of Pakistan comprises a network of five active defined broad. seismotectonic zones (Pakistan, 2001).

1) Himalayan seismotectonic zone in the north
2) Suleman-Kirthar Thurst-fold belt
3) Chaman-Ornach Nal Trasform Fault Zone
4) Makran Subduction Zone in the west
5) Run of Kutch Seismotectonic Zone in the southeast

Below is the map showing major active faults of Pakistan and surrounding areas that influence the seismicity in the region:

a. Main Karakoram Thrust
b. Raikot Fault
c. Panjal-Khairabad Thrust
d. Riasi Thrust
e. Salt Range Thrust
f. Bannu Fault
g. Chaman Transform Fault
h. Quetta-Chiltan Fault
i. Pab Fault
j. Allah Bund Fault
k. Hoshab Fault
l. Makran Coastal Fault
m. Main Mantle Thrust
n. Main Boundary Thrust
o. Himalayan Frontal Thrust

Fault Map of Pakistan / Azad Jammu and Kashmir

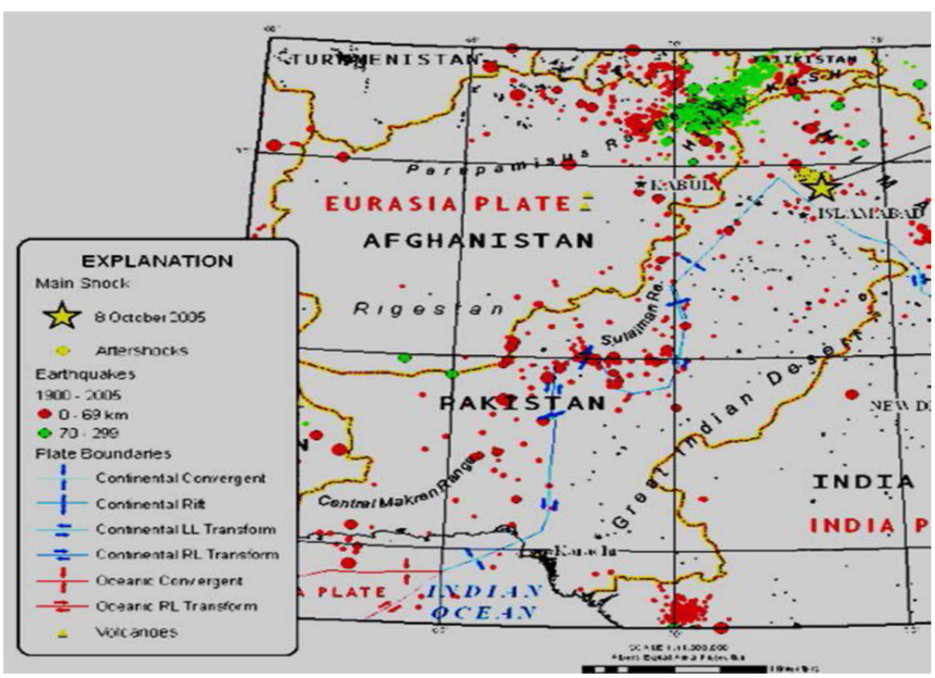
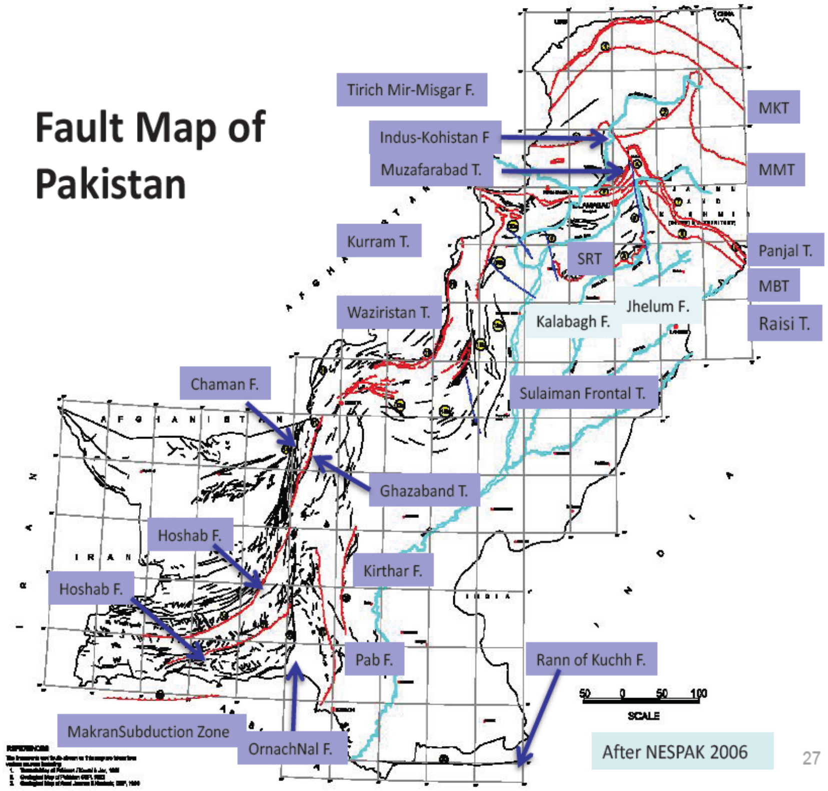


Figure 2. 2: Fault Map of Pakistan / Azad Jammu and Kashmir (Pakistan, 2001).

2.2.5. Fault Map Of Pakistan



(Pakistan, 2001)

p. Jhelum Fault

q. Kalabagh Fault

r. Kurram Fault

s. Ornach-Nal Transform Fault

t. Kirthar Fault

u. Kutch Mainland Fault

v. Nagar Parkar Fault

w. Nai Rud Fau

2.2.6. Seismic Zoning in Pakistan

2.2.7. Seismic Resilience

SEISMIC ZONING MAP OF PAKISTAN

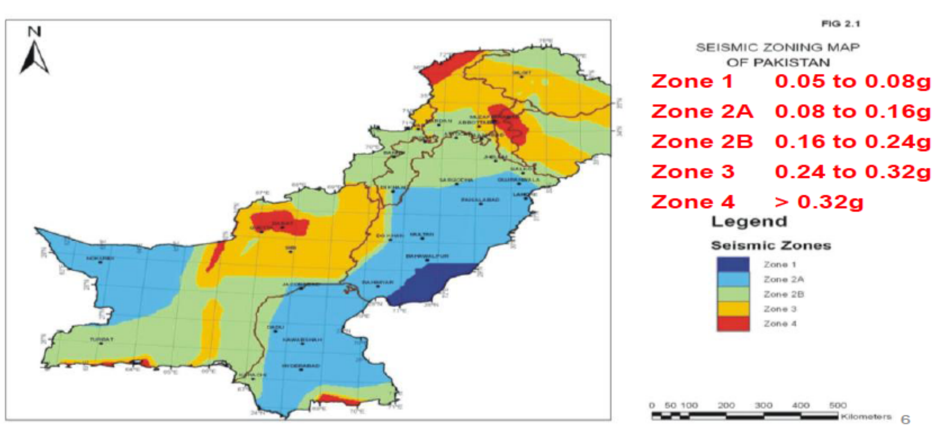


Figure 2. 3: Seismic Zoning Map of Pakistan (Pakistan 2001).

Seismic resilience performance can range from 0% to 100%. Resilience consists of robustness, redundancy, resourcefulness and rapidity (Bruneau and Reinhorn 2006).

2.2.8. Why is Resilience Important?

Infrastructure is considered an essential element for sound economies and stable communities and societies. It is critical for commerce movement of people, goods and information, and facilitates society's daily activities besides two way interaction (Rutter, 2007).

2.2.9. Effective Vulnerability Reduction and Resilience Promotion Framework

To assess the vulnerability and resilience of a community, it is important that a suitable framework is used. It also helps in investigating as to whether the community's physical and demographic characteristics contribute to reducing vulnerability and promotion of resilience or capable to sustain the certain pressure. In a resilient community, it is imperative that local communities to be made strong in terms of financial resources so that in the event of a disaster, affected community is capable to handle the situation and recover from the disasters, instead of waiting for external assistance (NDMA , (Khan, Vasilescu *et al*. 2008)).

2.2.10. The PAR Model

The Model was developed by Blaikie, Cannon, Davis and Wisner in the mid 1990's it provides a basic analysis of vulnerability in relation to specific hazards (Ben Wisner, 2003). The same has been defined by UN Disaster Management Training Program as progression of vulnerability as follows:

Underlying Causes

A deep-rooted set of factors within a society that together form and maintains vulnerability.

Dynamic Pressures

A translating process that channels the effect of negative cause into unsafe conditions; this process may be due to a lack of basic services or provisions; it may result from a series of macro-forces.

Unsafe Conditions

The vulnerable condition where people and property are exposed to the risk of disasters; the fragile physical environment is one element; other factors include an unstable economy and low-income levels (UNDP, 2015).

Gender and different age groups have different level of risks from a certain type of unsafe condition. Disasters are the consequence of a combination. of hazard and vulnerability. Hazard becomes a disaster when it strikes a community with high. Vulnerability (Sage, Sircar *et al*. 2015).

2.3. THEORETICAL BACKGROUND OF THE RESEARCH FRAME WORK

Community resilience planning must consider existing buildings and infrastructure systems as well as new construction for making resilient community.

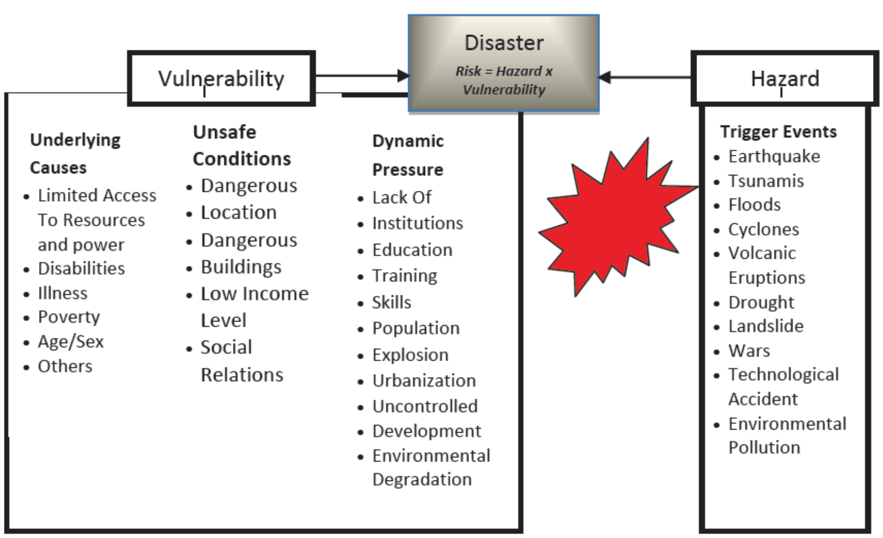


Figure 2. 4: PAR Model.

2.3.1. Building Construction

Construction standards do not require existing building to meet current codes and standards, because codes and standards were adopted at that time were in line when they were built as per requirement of area, culture, tradition and available material. It is difficult and costly to carry out the retrofitting of existing buildings as per new codes and standards, however some efforts can be put in to achieve relatively better conditions (Wene 1980).

2.3.2. Make Cities More Resilient

There are the Ten Essentials for Making Cities. Disaster Resilient which are following (Jabareen 2013);

- ❖ Essential 1: Institutional and Administrative Framework
- ❖ Essential 2: Financing and Resources
- ❖ Essential 3: Multi-hazard Risk Assessment-Know your Risk
- ❖ Essential 4: Infrastructure. Protection, Upgrading and Resilience
- ❖ Essential 5: Protect Vital Facilities: Education and Health
- ❖ Essential 6: Building Regulations and Land Use Planning
- ❖ Essential 7: Training, Education and Public Awareness
- ❖ Essential 8: Environmental Protection and Strengthening of Ecosystems
- ❖ Essential 9: Effective Preparedness, Early Warning and Response
- ❖ Essential 10: Recovery and Rebuilding Communities

How to Implement the Ten Essentials for Making Cities Resilient

- ❖ Phase One: Organizing and Preparing to Incorporate the Ten Essentials
- ❖ Phase Two: Diagnosis and Assessment of the City's Risk
- ❖ Phase Three: Developing a Safe and Resilient. City Action Plan
- ❖ Phase Four: Implementing the Plan
- ❖ Phase Five: Monitoring and Follow Up.

2.3.3. Building Resilience Assessment

In the study area the types of structures and constructions are classified into the following categories.

Urban area constructions/structures

1. Reinforced Concrete Frames (RCF)
2. Confined Masonry

Rural area construction/structures

1. Un-reinforced Brick Masonry (URM)
2. Adobe Masonry

<u>2.3.3.1. Urban area constructions/structures</u>

Reinforced Concrete Frames (RCF)

Reinforced concrete is one of the most widely used modern building materials. Concrete is “artificial stone” obtained by mixing cement, sand, and aggregates with water, however, its strength and durability can be different due to ratio of material used and treatment given at the time of construction of a specific building. RC frames provide resistance to both gravity and lateral loads through bending in beams and columns These buildings performed poorly in the Kashmir (2005) Earthquake due to lack of seismic design, soft story, poor detailing and poor quality of materials. It proved counterproductive during the earthquake of 2005 and caused loss of lives and property at mega scale (Camp, Pezeshk *et al*. 2003).

Confined masonry

Confined masonry construction consists of unreinforced masonry walls confined with reinforced concrete (RC) tie-columns and RC tie-beams. This type of construction is used both in urban and rural areas, either for single-family residential construction or for multifamily construction. Confined masonry is a technology and skill that, if built correctly, performs very well in earthquakes. In confined masonry construction, the masonry walls bear the seismic loads and the concrete is used to confine the walls (Tomaževič and Klemenc 1997).

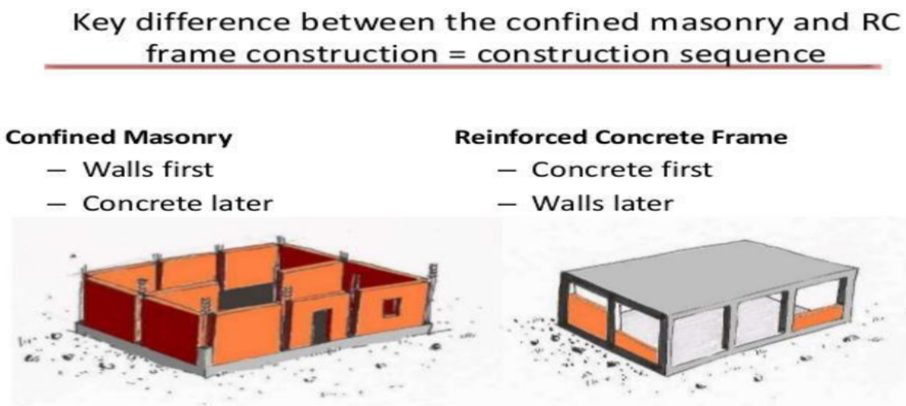


Figure 2. 5: confined Masonry and RC.

<u>2.3.3.2. Village area construction/structures</u>

Un-reinforced Brick / Stone Masonry

Unreinforced masonry buildings are generally stone buildings constructed prior to earthquake-resistant design and technology. An unreinforced masonry building is a type of building where load bearing walls, non-load bearing walls or other structures are made of brick and stone. The brick or stones are not strengthened with embedded steel bars or concrete slabs and is therefore called “unreinforced.” In earthquakes, the brick and stone walls fall outward, creating a hazard for people below and sometimes causing the building to collapse. This is the most common type of residential building throughout the Pakistan, Kashmir as well as in the study region. Stone masonry is commonly used in Kashmir due to its availability and skill of local laborers and Masson (Sowden, 1990).

Adobe Masonry

This is low cost building. These are mud wall structure or mud brick with mud to bind these bricks and stones. It uses local material. Mud is one of the

Figure 2. 6: stone Masonry.

Figure 2. 7: Adobe Masonry.

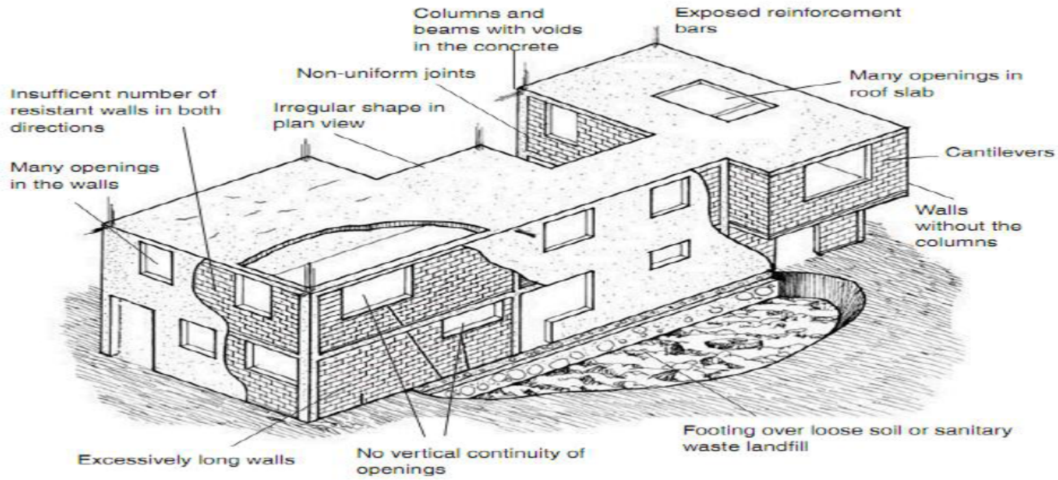


Figure 2. 8: Structure.

world's most ancient building materials (Rana, 2013). These type of buildings are highly vulnerable and. can also be found in rural area of Pakistan and. in some areas of Kashmir (Vargas, Bariola *et al*. 1986).

Drawing shows the most common errors in confined masonry structures are not safe during earthquake (Pakistan 2001)

2.4. Background of Theoretical Framework

The current chapter is focused on the theoretical part of this study. Supplementary overview of previous and other researches pertinent to the topic have been cited. Different theories and variables which are essential for understanding the topic of the study are presented. The literature review formulates the base for the development of the study and to interpret results (Sekaran and Bougie 2016).

2.5. Chapter Summary

The chapter has built a systematic step-wise roadmap towards the research framework, by analyzing the body of literature on earthquake vulnerability, hazard information, structural Resilience in housing sector and the impact and of the risk communication. Consequent and logical hypotheses are derived to frame a research model for testing the model with relevant sample.

CHAPTER 3

Research Methodology

3.1. Introduction

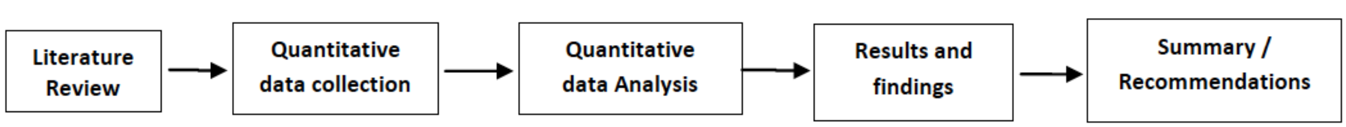
This chapter deals with research methodology which is used in this study to check the validity. A brief description of the setting of the study is provided. It explains the type, setting, research Inference and sampling of the study which is used. The chapter also explains what kind of data is used to examine the variables of the study.

3.2. Type of Study

The research is exploratory in type, which aimed to define and assess the relationships among the different variables. This led to data collection method and design. Subjects are selected according to the nature of study (Sekaran and Bougie 2016).

3.3. Research Design

The design has covered quantitative aspect in this research and study is explanatory in nature. In this approach, quantitative data is analyzed while undergoing different stages of the research procedure (Sheppard, Janoske *et al*. 2012, Sekaran and Bougie 2016).



3.4. Research Procedure

Based on the above design, quantitative tools were used. In first stage, facts and figures were collected from the Government of Pakistan and International database regarding earthquake in the region.

A thorough review of literature was carried out on the resilience, earthquake vulnerability, types of constructions and risk communication. Problem identification, research questions, objective and a proposed conceptual model were outcomes of this stage. Development of the quantitative data collection tools is also based on literature review and expert opinions.

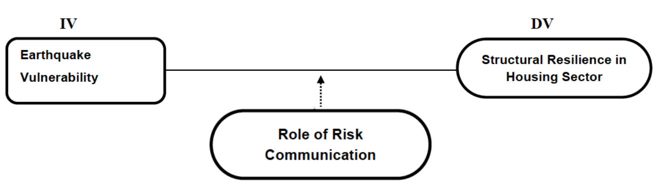
Collection, compilation and analysis of the quantified data based on the proposed model were carried out in the next chapter. The results of the quantitative data collection and analysis were also cross checked by qualitative data while having interaction with various stakeholders in the study area. Exact operational measures were applied for interpretation and analysis of data for deriving recommendations (Sekaran and Bougie 2016).

3.5. Research Methodology

3.5.1. Hypothesis

Earthquake vulnerability is the independent factor which have the direct link with structural resilience of housings in District Bagh. Risk communication is an important factor which contributes towards resilience.

3.5.2. Research Model *(Sekaran and Bougie 2016)*



3.5.3. Hypothesis Derived

On the basis of above discussion, it is hypothesized that:

H1: IV-1 (Earthquake Vulnerability) has significant negative relationship with DV (Structural Resilience in Housing Sector).

H2: MV (Role of Risk Communication) has significant positive relationship with DV (Structural Resilience in Housing Sector)

H3: MV (Role of Risk Communication) has moderating role between IV (Earthquake Vulnerability) and DV (Structural Resilience in Housing Sector)

3.5.4. Scheme of Analysis

The table below gives an overview of the types of analysis techniques used to identify and elaborate the relationships between various variables in the study, and consequently checked the hypothesis. All the data collection was undertaken through questionnaires. Interviews were only conducted rarely and were not included in validating the instrument.

The demographics of respondents were collected through the questionnaires that gave a general idea of the qualifications, experiences and age groups along with other individual details.

3.5.4. Geographical Scope of the Study

<u>Bagh District</u>

Is one of the Ten districts of Azad Jammu and Kashmir. Previously it was part of Poonch. District, later, it was created in 1988 as separate district. The district is bounded by Muzafarabad District to the North, Poonch. District to the south, and Poonch District of Indian-occupied Jammu and Azad Jammu and Kashmir to the east; it is bounded by the Punjab, Rawalpindi and Abbottabad District to the West. The total area of the District is 1,368 square kilometers.

Table 3. 1: Scheme of Analysis

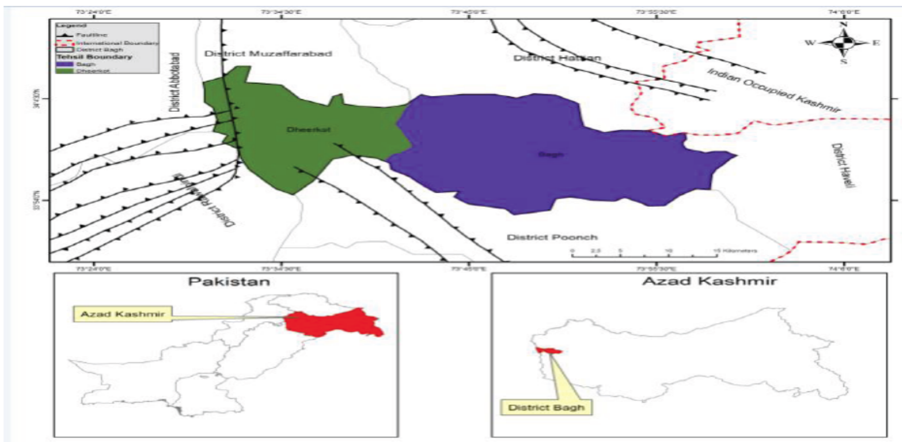
S #	Research Objective (RO)	Research Question (RQ)	Hypothesis	Data Collection (DC) Tool	Analysis Techniques
1	To assess the Earthquake vulnerability and hazard condition in District Bagh.	RQ1	H1	Questionnaire	Factor Analysis, Correlation and Regression Analysis
2	To ascertain the resilience capacities of houses in District Bagh	RQ2	H2	Questionnaire	Factor Analysis, Correlation and Regression Analysis
3	To assess the level of risk communication in District Bagh.	RQ3	H3	Questionnaire	Factor Analysis, Correlation and Regression Analysis

Bagh District is linked to Muzzafarabad by two roads, one via Sudhan Gali (80 km) and the other through Kohala (97 km). It is situated 46 km from Rawalkot. It has two Tehsils ie, Tehsil Bagh and Tehsil Dhirkot Topographically, the entire Bagh District is a mountainous area, generally sloping from northeast to south-west. The area falls in the lesser. Himalayas zone. The main range in the district is Pir- Panjal. The Haji-Pir Pass is situated at the height of 3421 meters above sea level. The general elevation is between 1500 and 2500 meters above sea level. The mountains are generally covered with coniferous forests. Mahl Nala, in the Bagh sub-division, and Betar Nala, in the Haveli sub-division, are the two main streams. Annual rainfall is about 1500. Millimeters (Mayo and Zaidi 2006).

3.5.5. Demography of Bagh

The total population of the district according to the 1998 census was 395,000, which is estimated to have increased to 434,000 in 2013, with an annual growth rate of 2%. There are minerals in Bagh such as deposits of slate, where there are proven deposits of 1 million tons which are suitable for building materials,

Location Map of Bagh Azad Jammu and Kashmir



(USGS, 2016)

Population Density Map of Bagh Azad Jammu and Kashmir

(*Human Rights Watch (September 2006),* Christopher Snedden, *Aqwam-e-Kashmir* by Muhammad Din Fauq)

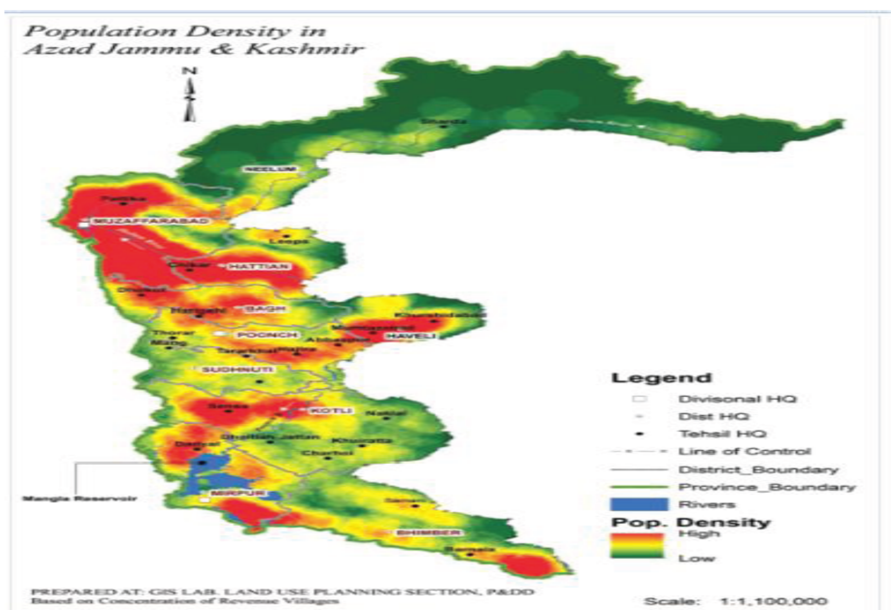


Figure 3. 1: Population Density Map of Azad Jammu and Kashmir.

specifically roofing and flooring. Bagh is ranked 16 out of 148 districts of Pakistan and Kashmir in terms of education. For facilities and infrastructure, the district is ranked 108 out of 148. The city of Bagh, like other areas of the district, was heavily damaged in the 2005 Kashmir Earthquake Sixty percent buildings collapsed. Thousands of people died and many more found themselves homeless.

3.6. Unit of Analysis

The unit of analysis for this research study is the population living in District Bagh and Administrative set ups responsible for management of various aspects in the area (Sekaran and Bougie 2016).

3.7. Population and Sampling Techniques

3.7.1. Population

The population of the current study comprises the people residing in District Bagh.

3.8. Sampling Techniques

The study is based on purposive random sampling due to time limitations. The data was collected from the general population living in the area and followed by field survey and interactions with stakeholders (Sekaran and Bougie 2016).

3.9. Sampling Techniques

For assessing the impact and role of risk communication in earthquake vulnerability in the study area, a questionnaire was distributed among 200 respondents living in the area. Data was filled by male and females of different age groups (Sandelowski 2000).

3.9.1. Data Collection Tools

Primary Data

For the planned study the primary data has been collected through the following tools;

Questionnaires/Interview Schedule

Prepared questionnaire was used to collect the primary data. The questionnaire was prepared on the basis of the objectives of the study. Questionnaire was distributed among 200 respondents to obtain information on the hazard, vulnerability assessment, risk communication and structural resilience of housings with a view to evaluate the role of risk communication (Sandelowski 2000).

Secondary data

Review of Relevant literature of case studies of 2005 earthquake, 2015 earthquake, Seismic vulnerability of existing building stock in Pakistan and Assessment of The Seismic Vulnerability was carried out Secondary data was also obtained from National Disaster Management Authority (NDMA), Pakistan Metrological department, Civil Defence, Rescue 1122, NGO's & INGO's, current research studies and case studies (Hox and Boeije 2005).

3.9.2. Data Analysis Tools and Techniques

After collection of the primary data from the field it was analyzed through SPSS. Required tables and graphs were also drawn accordingly where necessary for graphical interpretation of the results.

3.10. Limitations of Methodology

Methodology adopted is limited to the population living in District Bagh only.

3.11. Pilot Study

Many authors consider important that pilot study should be undertaken to pre-test the questionnaire. Piloting is a key stage in the development of the questionnaire allowing evaluation of the instrument before the main study is conducted. The pilot study also allows a check on whether the length and structure of the questionnaire are problematic. The validity and reliability of the questionnaire can also be checked at the pilot study stage (Field 2009). According to Cooper and Schindler (2003), research instrument should (Williams 2011) be pilot tested to detect weaknesses or errors in the instrument. The pilot test should be conducted with the subjects from the target population and simulate the procedures and protocols that have been designated for data collection. (Cooper and Schindler, 2003). According to them, the size of the pilot groups may range from 25 to 100 subjects, depending on the method to be tested.

In the present study, pilot study was conducted on a small sample of the population in the same manner as the main study. It gave the opportunity of checking. if the respondents understand the questions in the same way, if all questions are relevant and if all the instructions are clear and to evaluate the information provided in the questionnaire and to test the reliability of the questionnaire. A pilot study with a random sample of 100 respondents was conducted. The data was collected from respondents of two Tehsils of District Bagh, Azad Jammu and Kashmir. The data was collected during the month of Jun 2017. The main objective of the pilot test was to pretest the questionnaire(Sekaran and Bougie 2016) with the respondents and ensure that there was no ambiguity in the questionnaire which has been done. The respondents had no major issues with the questionnaire.

There are several rules employed by researchers to serve as benchmarks for validating results of different tests. Our research used the following standards as well:

3.11.1. Exclusion Criteria

An exclusion criteria was developed for removing an item. (Sams 2005), including the most used “rules of thumb” as follows

1. If there is zero variance for an. item then remove it.
2. If the value of Alpha Cronbach is less than 0.4 then remove it.
3. Positively skewed indicators: An item with strongly positive skewness indicates that the respondents. do not see it as a factor relating to the construct and the indicator should be removed. Skewness and kurtosis values that fall between 1 and -1 are considered excellent and values between 2 and -2 are acceptable. If the distribution for any of the variables had skewness or kurtosis values of an absolute value greater than ±2, then that variable will be examined for outliers, as they can cause abnormality in distributions (Tabachnich and Fidell 2007).
4. If the item’s communality is less than 0.50 than the item will be removed (Hair, Black *et al*. 2010).
5. If an item rotated factor loading on a given factor is less than 0.40 or it cross-loads with any other factor greater than 0.40 (Hatcher 1994, O'Rourke, Hatcher *et al*. 2005) then we have to examine the item-to-total correlation prior to a removal decision. Factor analysts however stated that in a sample size of more than 100, a value of factor loading will be considered meaningful if it is above + – 0.3 (Child 2006, Gropp 2006).
6. If the item-to-total correlations with other indicators are less than 0.35 then remove the item(Nunnally and Bernstein 2010).
7. Reconsider any item to be removed from the view point of the study objectives and even if an item scored low on any of the above criteria, but it is important for analysis on other instruments then don’t remove it.

The above rules are applicable keeping in mind the importance of item in terms of research objectives. Therefore, even if an item is out of the criteria in a test, it may not be removed due to its importance in the study.

Firstly, the reliability analysis necessitates calculating. Alpha Cronbach values. The Alpha Cronbach values of IVs, MV and DV were checked.

In IV1 which is about Hazard information, test was conducted for respondent of 100, the there were total 5 x items, the value of Alpha and other tests are as under:

Table 3. 2: Reliability Results (Reliability Results of Variables)

Ser No	Variable	No. of items	Cronbach’s Alpha
1	Hazard Information (IV1)	5	0.703
2	Vulnerability of Buildings (IV2)	11	0.450
3	Risk Communication (MV)	8	0.685
4	Building Resilience (DV)	13	0.542

3.11.2. Demographic Description of Respondents

The demographic characteristics of the respondents are explained in the Tables **3.2** to **3.4.** Male and female respondents were 45.2% and 54.8% respectively. Other details are given in the succeeding paragraphs.

3.11.3. Discussion on findings of the Pilot Study

The pilot study has findings for all the variable of the study. The first construct “Hazard Information” has five items. The overall Alpha value was 0.703, which falls in to the desirable level. No items were excluded because the value of Alpha (0.400 to 0.900). Other statistics are also in acceptable range. **See Annex 1 for detailed statistics of Hazard Information.**

Table 3. 3: Respondents Age Profile

Ser No	Age Groups	Percentage
1	<20	5.8
2	20-30	61.6
3	31-40	22.2
4	41-50	4.9
5	51 and Above	5.5

Table 3. 4: Respondent Source of Income

Ser No	Source	Percentage
1	Farming	14.4
2	Gov, servant	34.6
3	private Job	23.1
4	Own Business	2.9
5	Labor	2.9
6	Student	22.1
	Total	**100.0**

Table 3. 5: Respondents Education Level (Education of Respondents)

Ser No	Level of Education	Percentage
	Primary	4.8
	Matric	5.8
	Intermediate	15.4
	Graduation	33.7
	Above Graduation	40.4

The second variable "Vulnerability Assessment" has 11 items. The overall Alpha value was 0.450 which falls in to the desirable level. No items were excluded because the value of Alpha is in good and acceptable range. **See Annex 2 for detailed statistics of Hazard Information.**

The third variable which is MV "Risk Communication" has 7 items. The overall Alpha value was 0.685 which falls in to the desirable level No items were excluded because the value of Alpha which is in acceptable range. **See Annex 3 for detailed statistics of Hazard Information.**

The fourth variable which is DV "Building Resilience" has 13 items. The overall Alpha value was 0.542 which falls in to the desirable level. **See Annex 3 for detailed statistics of Hazard Information.**

No items were excluded because of the value of Alpha being in acceptable range for all the variables. Table **3.5** is providing a summary of the statistics of the pilot study.

5. CHAPTER

CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This chapter concludes the thesis by giving general recap of the context and main findings of the research (study). Besides having proved the relationship among Vulnerability, Structural resilience of houses and Risk communication it also suggests some ways and means to enhance the capability of stakeholders. Hazards are inevitable however; there effects can be minimized if proper precautions are taken. Important recommendations have been listed and elaborated to the various members of society, particularly the policy makers and managers of disasters management auth for their appropriate actions for safety and security of the various stakeholders. Significant highlights have been summarized in the succeeding paragraphs.

Table 3. 6: Summary of Pilot Test (Summary of Pilot Study)

Variable	N	Mean	Std. Dev	Variance	Alpha	Initial Items	Retained Items
Hazard Information	5	3.9519	2.84000	8.066	0.703	05	05
Vulnerability Assessment	11	11.97980	31.598560	998.469	0.450	11	11
Risk Communication	7	94.0865	122.72964	15062.565	0.685	7	7
Building Resilience	13	84.8077	89.92587	8086.662	0.542	13	13

5.2. Overview of the Study

Great effort has been put in the research to ascertain the significance of relationship between the various variables. Keeping in mind the fragility of topic of structural resilience of the houses, and its ironical carelessness according to the perspective of various professionals and experts, we started with to validate and assess our model. Agreement in the opinion regarding the importance of providing resilience in buildings, whether it is in commercial buildings or residential apartments. The changing global climate (Hertin, Berkhout, Gann, & Barlow, 2003) and dangerous trend of natural disasters reinforce this importance. However, there is a lack of efforts in terms of risk communication that ensures resilience of these residential buildings/houses. Awareness and knowledge about some phenomenon, event and activity to the stakeholders can help them to take protective measures for their safety of lives and property. Since Risk communication is very important aspect which can play an important role in view of the changing trends globally and climatic changes taking place due to various natural and man induced factors. Therefore, a sample of respondents of 200 households was formed using simple random sampling method from different cities and remote villages of District Bagh, Azad Jammu and Kashmir. After approaching 200 respondents, they responded by filling the questionnaire. Questionnaire was designed to obtain the maximum information about various prevailing hazards in the area, make and type of houses, means of risk communication available, people trust on the various sources of information and building resilience assessment. Besides the questionnaire, interaction in terms of discussion with expert people were also carried out in the area under study to validate the data. Our results were found out to be consistent with our model.

5.3. Important Findings

From the detailed literature review, analysis of data in chapter 4 and discussion with different stakeholders, following facts can be recorded for future references. Important findings of this research study are explained in the succeeding paragraphs.

Vulnerability and Building Resilience have Significant Negative Relationship (explained below)

There was a significant negative relationship between the two variables. Considering this relationship, it is evident that the vulnerability has direct impact on the Building Resilience in Housing sector. The magnitude of earthquakes is high as far as the region of Azad Kashmir is concerned. Both the variables are anti to each other. If vulnerability is more, the building resilience would be less. More vulnerability mean more challenges to be faced in terms of various hazards. Therefore, this merits consideration that before any construction, Vulnerability Assessment should be carried out in the Region of Kashmir so that practical steps be incorporated in the conceived project during its construction.

Risk Communication has a Moderating role between Vulnerability and Structural Resilience of Housing Sector (explained below)

This was the research objective where an endeavour was made to ascertain the impact of Risk Communication. From the analysis of data it was ascertained that Risk Communication plays a role as moderator between vulnerability and structural resilience of housing sector. If risk communication is enhanced down to lower level, it will help various stakeholders to take informed decisions particularly in selection of construction sites and adopting the technology matching with local environmental requirements. There are very few ways of risk communication in the region, people are only forced to rely on news channels, news papers and various reports. Measures can be taken to enhance the level of communication through multiple sources. Normally people in such areas take it light due to less awareness and more blame give to the nature for its actions, there can be many ways through which these people can be taught to accept the veracity of facts. Therefore in future for safe construction and making the existing houses, more resilience risk communication be increased among the people of various segments in different areas of Azad Jammu and Kashmir. They need information on types of vulnerability, construction practices matching with local environment and various soil test analysis. People in the Kashmir carryout construction of various projects without giving due consideration to the bearing capacity of the earth, consequently they observe cracks in the buildings and these faults are exploited by natural forces in the event of earthquakes of various magnitudes.

Risk Communication has Positive Significant Relationship with Structural Resilience of Housing Sector (explained below)

From the results it was ascertained that Risk Communication has positive significant relationship with Structural Resilience of Houses. For making more resilient residential buildings, risk communication is required to be enhanced for safety and security of the people living in area under study. Risk communication mean, informing the people about various hazards in their area, in their constructed houses and allied facilities. Earthquakes do not kill the people, these are the buildings which kill. if information is available about various hazards in the area and there consequences, definitely due attention can be given in this aspect to make it more resilient. When these hazards meet with various types of vulnerabilities cause disasters which have been witnessed many times like, Earthquakes of various magnitude in the world i.e. 2005 Earthquake in Kashmir and others disasters alike. Hazards cannot be finished; however, vulnerabilities can be minimized. To address the vulnerabilities, in residential buildings and other allied facilities, requisite knowledge is required and it can be achieved through effective risk communication campaign. There is a need to develop multiple ways to enhance the risk communication. For old people who are out of the schooling age, other ways like availability of media i.e. televisions, radio and other indigenously developed ideas can help to educate them. For people under education, same may be introduced in their syllabus in different classes.

5.4. Contribution to the Body of Knowledge

Researchers have done a great deal of case studies on resilience levels in various countries such as Australia, the US and UK, India, in addition to tourist places like the Caribbean. However, developing countries are more vulnerable to natural hazards due to their financial constraints and high population density. This can be observed from the examples of Kashmir earthquake of 2005 and more recently, the Nepal earthquake (2015). Moreover, population is consistently rising, requiring urgent attention in terms of resilient infrastructure.

Earthquakes, amongst all other natural hazards, are unpredictable in nature. We need even more vulnerability assessment in different areas and measures be adopted to enhance the risk communication in various vulnerable areas throughout the length and width of Kashmir. Vulnerability and Building Resilience can be moderated by adopting more indigenous measures to enhance the risk communication. Based in Kashmir, Pakistan, this research can serve as an exemplary research guide for researchers studying building resilience in different developing countries in the world.

From the Seismic Map of Pakistan and Kashmir (covered in details in Chapter 2), Northern areas and Kashmir Region fall in high hazard zone, basing on this study, assessment can be carried out more about risk communication in these areas which in turn can be used to enhance the structural resilience of houses. More information about the risk are communicated mean more people would be cautious in their safe construction of houses, commercial plazas, hotels, educational buildings and health care setups.

5.5. Recommendations and Suggestions

5.5.1. Researchers (future research calls)

"How to Enhance Risk Communication among the Vulnerable Population for Acquiring Resilience in Residential Buildings"

The research demonstrated a significant contribution to the body of knowledge as regards to building resilience. However, there are certain areas where further research can be done to complement this research. So, for example, this topic was about to ascertain the moderating role of Risk Communication between Vulnerability Assessment and Building Resilience, other researchers can research on the Topic as "How to Enhance Risk Communication among the Vulnerable Population for Acquiring Resilience in Residential Buildings". This study has been carried out in District Bagh Azad Jammu and Kashmir, whereas same can be carried out for other parts of Pakistan and Azad Jammu and Kashmir and other adjacent areas. This study can be carried out in different parts of the world. In various underdeveloped countries of Africa and other continents same template can be applied, although vulnerabilities are different, however, risk communication is common which can help the affected communities of the world to address their vulnerabilities by taking informed decisions in their respective areas and regions.

5.5.2. Policy Makers (Recommend the Steps to be taken at Macro Levels)

There has been an observable positive trend among researchers in recent times; the social and economic factors that are concerned with disaster resilience have been identified and assessed to a great deal (Kapucu, *et al*., 2013). Likewise, policy makers in Azad Jammu and Kashmir and Pakistan need to understand the significance of the Risk Communication and there is need to take practical steps to enhance the awareness of vulnerable population by enhancing the Risk Communication for safety of the poor population living in vulnerable areas of Kashmir and Pakistan. Following Steps can be taken By the authorities:

a) Vulnerability awareness through educational institutions. Different topics on vulnerability, natural hazards and type and strengths of soil be included in the syllabus from class 8th to 12th area wise.

b) Various means of Risk Communications be introduced and systems must be established at different locations for prompt and reliable risk Communication to the various segments of the populations.

c) Risk Communication should be constant process, some measures should be taken such as display of bill boards at public places, showing various vulnerabilities. Pictures of various buildings which are safe as per building codes vis a vis those vulnerable due to some reasons. For better and easy understanding of the people, various captions be used with pictorial explanation.

d) Pictorial stories of various disasters caused due to lack of information and sheer negligence of people should also be displayed at public places.

e) Establishing of big TV screens at public places which should frequently explain the various vulnerabilities to the people.

f) Media talks of expert and influential people on the topics of vulnerability and importance of risk communication, so that people could be influenced in persuading the required goals.

g) Introducing the literature on disasters such as taming the disasters etc(written by Israr Ayub)

h) In the light of risk communication strict measures be imposed to follow and abide by the rule and regulations in different constructions.

5.5.3. Managers (Recommend the Steps to be taken at Organizational Levels)

Provision of information to different stakeholders in the society on various hazards can save precious lives and costly property. Risk Communication need to be propagated through all available means in peace time and in emergency alike. This can be done through following steps:

a) Holding regular meetings with stakeholders. Through meetings, view points of different stake holders can be exchanged and debated for better out come and implementation in the vulnerable areas.

b) Awareness lectures by authorities in different educational institutions. Expert individuals of Government Department should be deputed to deliver the lectures on vulnerabilities of various types and importance of risk communication in different universities, colleges and schools and other public gatherings on regular basis.

c) Establishing more reliable Risk Communication systems in different parts of the country. More risk communication means be introduced and established in the form of early warning systems, PMD propagation be given more attention and media coverage be also increased in remote areas.

d) Enhancing of road network will also add to words risk communication. People will have more access to educational and other institutions for risk communication and will be more informed about various aspects of vulnerability etc.

e) Ensuring the reliability of information. Normally, people avoid such information which do not have truth and reliability. Some measures can be taken to provide real time information. Such as about weather, rainfall, snow fall and etc. Once confidence of population will increase in the reliability of information, they would be more willing worker.

5.5.4. Target Readers (if any)

There has to be awareness regarding this serious and important aspect of risk communication which has moderating role between vulnerability and Building Resilience at all levels. Therefore, it is binding on all the individuals to spread awareness regarding the issue, play their role in communicating the risk to other stakeholders for their safety and better interest.

5.6. Conclusions

There were various lessons derived this study. Firstly, it must be understood that the risk communication plays an important role in Building resilience, therefore, it may be given priority and various means and sources be utilized to enhance the awareness of people about the risk which in turn enhances the resilience of vulnerable society. Practical steps be taken to enhance the risk communication by the authorities for safety and better interest of the population. Lives and property of people living under vulnerable conditions should not be put on risk at any cost. To address the vulnerabilities, in residential buildings and other allied facilities, requisite knowledge is required and it can be achieved through effective risk communication campaign. There is a need to develop multiple ways to enhance the risk communication. For old people who are out of the schooling age, other ways like availability of media i.e. televisions, radio and other indigenously developed ideas can help to educate them. For people under education, same may be introduced in their syllabus in different classes. Suggestions and recommendations have been included this chapter for policy makers, managers and target readers separately for effectively addressing the issue of risk communication.

Item-Total Statistics

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
IV_HI_Prevailing Hazard in the area	3.1800	5.806	.602	.468	.609
IV_HI_What type of Disaster mostly affecting your area	3.0900	4.850	.659	.548	.560
IV_HI_Have you or someone in yhour household experienced any of the followiing disaster	3.2300	6.381	.527	.305	.647
IV_HI_How many time you witness EQ in your Life	3.4900	6.879	.194	.075	.749
IV_HI_Intensity of EQ	2.9700	4.595	.463	.273	.678

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
3.9900	8.293	2.87973	5

Factor Analysis IV-1Hazard Information

Communalities

Variable	Raw		Rescaled	
	Initial	Extraction	Initial	Extraction
IV_HI_Prevailing Hazard in the area	.479	.219	1.000	.457
IV_HI_What type of Disaster mostly affecting your area	.818	.548	1.000	.670
IV_HI_Have you or someone in yhour household experienced any of the followiing disaster	.346	.103	1.000	.298
IV_HI_How many time you witness EQ in your Life	.616	.032	1.000	.052
IV_HI_Intensity of EQ	1.373	1.082	1.000	.788

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues[a]			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.984	54.613	54.613	1.984	54.613	54.613
2	.684	18.831	73.445			
3	.554	15.262	88.707			
4	.217	5.965	94.672			
5	.194	5.328	100.000			
1	1.984	54.613	54.613	2.265	45.291	45.291
2	.684	18.831	73.445			
3	.554	15.262	88.707			
4	.217	5.965	94.672			
5	.194	5.328	100.000			

Extraction Method: Principal Component Analysis.

a. When analyzing a covariance matrix, the initial eigenvalues are the same across the raw and rescaled solution.

Component Matrix[a]

Variable	Raw	Rescaled
	Component	Component
	1	1
IV_HI_Prevailing Hazard in the area	.467	.676
IV_HI_What type of Disaster mostly affecting your area	.740	.818
IV_HI_Have you or someone in yhour household experienced any of the followiing disaster	.321	.546
IV_HI_How many time you witness EQ in your Life	.180	.229
IV_HI_Intensity of EQ	1.040	.887

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

APPENDIX 2

Details of Analysis Results IV-2 Vulnerability Assessment

Cronbach's Alpha	N of Items
.450	11

Item Statistics

Variable	Mean	Std. Deviation	N
IV_VA_Building Type	.22105	.604574	95
IV_VA_Bulding Structure	.35789	.617403	95
IV_VA_Building Structure Type	.81053	1.024121	95
IV_VA_Building Value in PKR million	.34737	.648540	95
IV_VA_Name of adding to the current Bulding in the past years	3.90526	17.319939	95
IV_VA_Number of stories above ground	.30526	.584802	95
IV_VA_Number of stories below ground	.06316	.284737	95
IV_VA_Number of Occupied Floor	1.40000	10.144069	95
IV_VA_Level of Vulnerability of your Structure to EQ	1.10526	1.356416	95
IV_VA_What are the reason of vulnerability	1.08421	1.520520	95
IV_VA_Does your HH/Business have insurance for Catastrophic Events	2.87368	14.210606	95

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	1.134	.063	3.905	3.842	61.833	1.477	11
Item Variances	55.601	.081	299.980	299.899	3700.033	10736.113	11

Item-Total Statistics

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
IV_VA_Building Type	12.25263	1034.957	-.012	.434	.455
IV_VA_Bulding Structure	12.11579	1035.657	-.030	.434	.455
IV_VA_Building Structure Type	11.66316	1036.204	-.036	.240	.456
IV_VA_Building Value in PKR million	12.12632	1035.346	-.022	.618	.455
IV_VA_Name of adding to the current Bulding in the past years	8.56842	334.865	.631	.573	.077
IV_VA_Number of stories above ground	12.16842	1035.056	-.015	.529	.455
IV_VA_Number of stories below ground	12.41053	1033.011	.096	.177	.453
IV_VA_Number of Occupied Floor	11.07368	720.537	.388	.477	.327
IV_VA_Level of Vulnerability of your Structure to EQ	11.36842	1007.256	.299	.497	.438
IV_VA_What are the reason of vulnerability	11.38947	1030.113	.025	.478	.454
IV_VA_Does your HH/Business have insurance for Catastrophic Events	9.60000	622.243	.297	.362	.380

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
12.47368	1034.848	32.169049	11

Factor Analysis IV-2 Vulnerability Assessment

Communalities

Variable	Raw		Rescaled	
	Initial	Extraction	Initial	Extraction
IV_VA_Building Type	.366	.001	1.000	.002
IV_VA_Bulding Structure	.381	.003	1.000	.007
IV_VA_Building Structure Type	1.049	.043	1.000	.041
IV_VA_Building Value in PKR million	.421	.003	1.000	.007
IV_VA_Name of adding to the current Bulding in the past years	299.980	290.117	1.000	.967
IV_VA_Number of stories above ground	.342	.002	1.000	.007
IV_VA_Number of stories below ground	.081	.005	1.000	.060
IV_VA_Number of Occupied Floor	102.902	68.676	1.000	.667
IV_VA_Level of Vulnerability of your Structure to EQ	1.840	.259	1.000	.141
IV_VA_What are the reason of vulnerability	2.312	.014	1.000	.006
IV_VA_Does your HH/Business have insurance for Catastrophic Events	201.941	198.404	1.000	.982

Extraction Method: Principal Component Analysis.

Component Matrix[a]

Variable	Raw		Rescaled	
	Component		Component	
	1	2	1	2
IV_VA_Building Type	-.029	-.010	-.047	-.016
IV_VA_Bulding Structure	-.048	-.018	-.077	-.029
IV_VA_Building Structure Type	-.088	.188	-.086	.184
IV_VA_Building Value in PKR million	-.053	-.007	-.082	-.011
IV_VA_Name of adding to the current Bulding in the past years	16.615	-3.748	.959	-.216
IV_VA_Number of stories above ground	-.046	-.015	-.079	-.026
IV_VA_Number of stories below ground	.012	.069	.042	.241
IV_VA_Number of Occupied Floor	6.140	-5.566	.605	-.549
IV_VA_Level of Vulnerability of your Structure to EQ	.354	.366	.261	.270
IV_VA_What are the reason of vulnerability	-.056	-.105	-.037	-.069
IV_VA_Does your HH/Business have insurance for Catastrophic Events	8.690	11.086	.612	.780

Rotated Component Matrix[a]

Variable	Raw		Rescaled	
	Component		Component	
	1	2	1	2
IV_VA_Building Type	-.030	-.001	-.050	-.002
IV_VA_Bulding Structure	-.051	.000	-.083	.000
IV_VA_Building Structure Type	-.015	-.207	-.015	-.202
IV_VA_Building Value in PKR million	-.052	-.012	-.080	-.019
IV_VA_Name of adding to the current Bulding in the past years	14.164	9.460	.818	.546
IV_VA_Number of stories above ground	-.049	-.002	-.083	-.004
IV_VA_Number of stories below ground	.036	-.060	.125	-.210
IV_VA_Number of Occupied Floor	3.734	7.398	.368	.729
IV_VA_Level of Vulnerability of your Structure to EQ	.461	-.215	.340	-.158
IV_VA_What are the reason of vulnerability	-.090	.078	-.059	.052
IV_VA_Does your HH/Business have insurance for Catastrophic Events	12.089	-7.230	.851	-.509

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

APPENDIX 3

Details of Analysis Results MV Risk Communication

Cronbach's Alpha	N of Items
.685	7

Item Statistics

Variable	Mean	Std. Deviation	N
MV_RC_Availability and Effectiveness of EW system in the community	.4100	.84202	100
MV_RC_Have you Ever recieve any warning before disaster and how	1.5100	9.92853	100
MV_RC_About which disaster the warning was	35.9600	47.52775	100
MV_RC_From whom did you last recieved Information	35.0700	47.16043	100
MV_RC_What was the source of warning	23.0600	41.72125	100
MV_RC_What is the most effective way for you to recive information	.9800	.75183	100
MV_RC_Whom would you most trust to provide you information	.7400	1.13369	100

Summary Item Statistics

Items	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	13.961	.410	35.960	35.550	87.707	282.383	7
Item Variances	903.542	.565	2258.887	2258.322	3996.244	1229022.439	7

Item-Total Statistics

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
MV_RC_Availability and Effectiveness of EW system in the community	97.3200	15254.179	.324	.272	.703
MV_RC_Have you Ever recieve any warning before disaster and how	96.2200	15063.082	.066	.105	.704
MV_RC_About which disaster the warning was	61.7700	6970.058	.768	.656	.500
MV_RC_From whom did you last recieved Information	62.6600	6572.530	.853	.741	.451
MV_RC_What was the source of warning	74.6700	8551.557	.652	.547	.557
MV_RC_What is the most effective way for you to recive information	96.7500	15269.846	.279	.132	.703
MV_RC_Whom would you most trust to provide you information	96.9900	15254.838	.236	.257	.703

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
97.7300	15322.260	123.78312	7

Factor Analysis MV – Risk Communication

Communalities

Variable	Raw		Rescaled	
	Initial	Extraction	Initial	Extraction
MV_RC_Availability and Effectiveness of EW system in the community	.709	.072	1.000	.102
MV_RC_Have you Ever recieve any warning before disaster and how	98.576	.584	1.000	.006
MV_RC_About which disaster the warning was	2258.887	1881.080	1.000	.833
MV_RC_From whom did you last recieved Information	2224.106	1990.183	1.000	.895
MV_RC_What was the source of warning	1740.663	1147.857	1.000	.659
MV_RC_What is the most effective way for you to recive information	.565	.042	1.000	.075
MV_RC_Whom would you most trust to provide you information	1.285	.065	1.000	.050

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues[a]			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5019.883	79.368	79.368	5019.883	79.368	79.368
2	826.299	13.064	92.433			
3	385.372	6.093	98.526			
4	90.949	1.438	99.964			
5	1.346	.021	99.985			
6	.512	.008	99.993			
7	.429	.007	100.000			
1	5019.883	79.368	79.368	2.620	37.427	37.427
2	826.299	13.064	92.433			
3	385.372	6.093	98.526			
4	90.949	1.438	99.964			
5	1.346	.021	99.985			
6	.512	.008	99.993			
7	.429	.007	100.000			

Extraction Method: Principal Component Analysis.

a. When analyzing a covariance matrix, the initial eigenvalues are the same across the raw and rescaled solution.

Component Matrix[a]

Variable	Raw	Rescaled
	Component	Component
	1	1
MV_RC_Availability and Effectiveness of EW system in the community	.269	.319
MV_RC_Have you Ever recieve any warning before disaster and how	.764	.077
MV_RC_About which disaster the warning was	43.371	.913
MV_RC_From whom did you last recieved Information	44.611	.946
MV_RC_What was the source of warning	33.880	.812
MV_RC_What is the most effective way for you to recive information	.206	.274
MV_RC_Whom would you most trust to provide you information	.254	.224

Extraction Method: Principal Component Analysis.

APPENDIX 4

Details of Analysis Results DV Building Resilience

Cronbach's Alpha	N of Items
.542	13

Item Statistics

Variable	Mean	Std. Deviation	N
Building's stiffness (Degree of resistance to deflection or drift)	2.1900	.96080	100
Buliding Strength (Resist and bear applied forces within a safe limit)	2.2800	.87709	100
Building Ductility (steel is ductile in a building)	1.9800	.94259	100
How well-anchored are shear walls	2.0700	.94554	100
measure taken to provide resilience in non-structure items gas pipelines and electric wires	2.7300	4.33416	100
measure taken to provide resilience in non-structure items Bricks, stones and veneer	2.4400	.96735	100
measure taken to provide resilience in non-structure items Parapet walls	3.3500	9.72799	100
measure taken to provide resilience in non-structure items Canopies and Marquess	29.8900	44.40150	100
measure taken to provide resilience in non-structure items Chimneys and stacks	28.9300	43.92493	100
measure taken to provide resilience in non-structure items Partitions, Doors and windows	3.7200	9.67563	100
measure taken to provide resilience in non-structure items Suspended Ceiling	2.3700	1.04112	100
measure taken to provide resilience in non-structure items Routes of exit and entrance	2.9200	.97110	100
measure taken to provide resilience in non-structure items Furniture and equipment	2.5300	1.02942	100

Summary Item Statistics

Item	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	6.723	1.980	29.890	27.910	15.096	101.664	13
Item Variances	316.571	.769	1971.493	1970.724	2562.734	527051.605	13

Item-Total Statistics

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Building's stiffness (Degree of resistance to deflection or drift)	85.2100	8218.511	.099	.709	.545
Buliding Strength (Resist and bear applied forces within a safe limit)	85.1200	8214.511	.134	.689	.544
Building Ductility (steel is ductile in a building)	85.4200	8215.155	.121	.572	.545
How well-anchored are shear walls	85.3300	8180.769	.321	.573	.542
measure taken to provide resilience in non-structure items gas pipelines and electric wires	84.6700	8197.536	.026	.305	.546
measure taken to provide resilience in non-structure items Bricks, stones and veneer	84.9600	8198.503	.212	.428	.543
measure taken to provide resilience in non-structure items Parapet walls	84.0500	8013.422	.074	.513	.544

Item-Total Statistics

Variable	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
measure taken to provide resilience in non-structure items Canopies and Marquess	57.5100	2415.283	.882	.956	.123
measure taken to provide resilience in non-structure items Chimneys and stacks	58.4700	2455.383	.885	.956	.120
measure taken to provide resilience in non-structure items Partitions, Doors and windows	83.6800	8016.563	.073	.530	.544
measure taken to provide resilience in non-structure items Suspended Ceiling	85.0300	8199.625	.191	.682	.544
measure taken to provide resilience in non-structure items Routes of exit and entrance	84.4800	8180.171	.316	.521	.542
measure taken to provide resilience in non-structure items Furniture and equipment	84.8700	8213.104	.120	.615	.544

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
87.4000	8236.646	90.75597	13

Factor Analysis DV – Building Resilience

Communalities

Variable	Raw		Rescaled	
	Initial	Extraction	Initial	Extraction
Building's stiffness (Degree of resistance to deflection or drift)	.923	.002	1.000	.002
Buliding Strength (Resist and bear applied forces within a safe limit)	.769	.006	1.000	.008
Building Ductility (steel is ductile in a building)	.888	.007	1.000	.008
How well-anchored are shear walls	.894	.072	1.000	.080
measure taken to provide resilience in non-structure items gas pipelines and electric wires	18.785	.004	1.000	.000
measure taken to provide resilience in non-structure items Bricks, stones and veneer	.936	.027	1.000	.029
measure taken to provide resilience in non-structure items Parapet walls	94.634	.586	1.000	.006
measure taken to provide resilience in non-structure items Canopies and Marquess	1971.493	1901.094	1.000	.964
measure taken to provide resilience in non-structure items Chimneys and stacks	1929.399	1857.438	1.000	.963
measure taken to provide resilience in non-structure items Partitions, Doors and windows	93.618	.612	1.000	.007
measure taken to provide resilience in non-structure items Suspended Ceiling	1.084	.018	1.000	.017
measure taken to provide resilience in non-structure items Routes of exit and entrance	.943	.082	1.000	.086
measure taken to provide resilience in non-structure items Furniture and equipment	1.060	.006	1.000	.005

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues[a]			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3759.954	91.362	91.362	3759.954	91.362	91.362
2	220.101	5.348	96.711			
3	88.738	2.156	98.867			
4	21.247	.516	99.383			
5	18.457	.448	99.832			
6	4.041	.098	99.930			
7	.861	.021	99.951			
8	.542	.013	99.964			
9	.454	.011	99.975			
10	.375	.009	99.984			
11	.267	.006	99.991			
12	.233	.006	99.996			
13	.155	.004	100.000			
1	3759.954	91.362	91.362	2.176	16.740	16.740
2	220.101	5.348	96.711			
3	88.738	2.156	98.867			
4	21.247	.516	99.383			
5	18.457	.448	99.832			
6	4.041	.098	99.930			
7	.861	.021	99.951			
8	.542	.013	99.964			
9	.454	.011	99.975			
10	.375	.009	99.984			
11	.267	.006	99.991			
12	.233	.006	99.996			
13	.155	.004	100.000			

Extraction Method: Principal Component Analysis.

a. When analyzing a covariance matrix, the initial eigenvalues are the same across the raw and rescaled solution.

Component Matrix[a]

Variable	Raw	Rescaled
	Component	Component
	1	1
Building's stiffness (Degree of resistance to deflection or drift)	.046	.048
Buliding Strength (Resist and bear applied forces within a safe limit)	.076	.087
Building Ductility (steel is ductile in a building)	.087	.092
How well-anchored are shear walls	.268	.283
measure taken to provide resilience in non-structure items gas pipelines and electric wires	.062	.014
measure taken to provide resilience in non-structure items Bricks, stones and veneer	.165	.170
measure taken to provide resilience in non-structure items Parapet walls	.766	.079
measure taken to provide resilience in non-structure items Canopies and Marquess	43.602	.982
measure taken to provide resilience in non-structure items Chimneys and stacks	43.098	.981
measure taken to provide resilience in non-structure items Partitions, Doors and windows	.782	.081
measure taken to provide resilience in non-structure items Suspended Ceiling	.135	.130
measure taken to provide resilience in non-structure items Routes of exit and entrance	.286	.294
measure taken to provide resilience in non-structure items Furniture and equipment	.075	.073

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

QUESTIONNAIRE

PERSONAL INFORMATION

UC_______________Name ________________ Gender ________________ Age_______________

Language_________________Qualification_________________ Disabilities___________________

Income source

a. Farming b. Govt. servant c. Private job d. Own business e. labor
f. student

Trainings Conducted__________________

HAZARDs INFORMATION

1. Prevailing hazards in your area?
   a. Floods and flash floods
   b. Earthquake
   c. Cyclones/Storms
   d. Water logging
   e. Torrential/prolonged rainfall
2. What type of disasters (priority-wise) mostly affecting your area?
   a. Floods and flash floods
   b. Earthquake
   c. Cyclones/Storms
   d. Water logging
   e. Torrential/prolonged rainfall
3. Have you or someone in your household experienced any of the following disasters?
   a. Floods and flash floods
   b. Earthquake
   c. Cyclones/Storms
   d. Water logging
   e. Torrential/prolonged rainfall

4. How many times you witnessed earthquake in your life?
   a. Below 5 b. 5-10 c. 11-15 d. 16-25 e. Above 25
5. Richter Scale of those Earthquakes?

a. 4.0 - 5.0 b. 5.1 - 6.0 c. 6.1 - 7.0 d. 7.1 - 8.0 e. 8.1 and Above

BUILDING ASSESSMENT (Part one)

1. Building type?
   a. House b. Flat c. School/college d. Market/Mall e. Other __________
2. Building structure?
   a. 1 story b. 2 story c. 3 story d. 4 story e. 5 and above
3. Building Structure Type?
   a. Reinforced Concrete Frames
   b. Confined masonry
   c. Un-reinforced Masonry
   d. Mud Structures
   e. Don't Know
4. Building value in PKR million?
   a. 2-5 M b. 6-10 M c. 11-15 M d. 16-20 M e. Above 20 Million
5. Name of addition made to the current building in the past years?
   a. Rooms b. Balcony c. Floor d. Pardah wall e. Other________
6. Number of stories above ground
   a. 1 b. 2 c. 3 d. 4 e. 5 and above
7. Number of stories below ground?
   a. 0 b. 1 c. 2 d. 3 e. 4 and above
8. Number of occupied floors?
   a. 1 b. 2 c. 3 d. 4 e. 5 and above
9. What is the level vulnerability of your structure to earthquake?
   a. Highly vulnerable
   b. Moderate vulnerable
   c. Minimal vulnerable
   d. Safe
   e. Don't know
10. What are the reasons of vulnerability?
    a. No implication of building codes
    b. Major defects are evident
    c. Badly deteriorated
    d. Potential structure problems

e. Other, specify ______________________

11. Does your household or business have insurance coverage for catastrophic events?

a. Not necessary

b. Never considered it

c. Not familiar with it/don't know about it

d. Too expensive

e. Forbidden in Islam

RISK COMMUNICATION GAP

1. Availability and effectiveness of EWS in the community?

a. Not Available b. Poor c. Medium d. Good e. Very good

2. Have you ever received any warning before disaster and how early?

b. Never b. Half hr c. 1 hr d. 2-3 hrs e.4-6 hrs

3. About which disaster the warning was?

a. Flood/flash flood b. Earthquake c. Cyclones d. Hail Storm e. Other______

4. From whom did you last received information?

a. Media b. Pak-Met c. PDMA/DDMA d. Police e. Other______

5. What was the source of warning?

a. TV/Radio b. Internet c. Mobile message d. Police e. Other______

6. What is the most effective way for you to receive information?

a. Newspapers b. TV/Radio c. Mobile Message d. Police e. Other______

7. Who would you most trust to provide you with information?

a. Media b. Pak-Met c. PDMA/DDMA d. Police e. Other______

BUILDING RESILIENCE ASSESSMENT

A	**How are the structural measures taken to provide resilience**	**Option/Scale**				
1	Building's stiffness (degree of resistance to deflection or drift)?	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
2	Building's strength (resist and bear applied forces within a safe limit)?	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
3	Building's ductility (steel is ductile in a building)?	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
4	How well-anchored are shear walls (capable of transferring lateral forces from floors and roofs to the	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*

	foundation)?					
B	**How are the measures taken to provide resilience in non-structural items, namely:**	**Option/Scale**				
5	Gas pipelines and electric wires	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
6	Bricks, stones or veneer	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
7	Parapet walls (Pardah walls)	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
8	Canopies and marquees	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
9	Chimneys and stacks	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
10	Partitions, doors, windows	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
11	Suspended ceilings	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
12	Routes of exit and entrance	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*
13	Furniture and equipment	*Very Poor*	*Poor*	*Medium*	*Good*	*Very Good*

GENERAL GUID

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