

**URBAN DISASTER RISK REDUCTION: A CASE STUDY OF
BHAKTAPUR FLOOD 2018**



**APF Command and Staff College
Sanogaucharan, Kathmandu**

A Thesis Submitted to

Department of Humanities and Social Sciences, Tribhuvan University

In Partial Fulfillment of Masters Degree in Security

Development and Peace Studies

Submitted by

Ramesh Kumar Pandey

February, 2019

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DECLARATION

I hereby declare that this research paper entitled “**Urban Disaster Risk Reduction: A Case Study of Bhaktapur Flood 2018**” submitted to the Armed Police Force Command and Staff college, is entirely my original work prepared under the guidance and supervision of Dr. Naresh Nath Rimal.

I have made due acknowledgements to all ideas and information cited and extracted from different sources in course of preparing this research. The result of this research paper has not been presented or submitted anywhere else for the award of any degree or any other purpose. I assure that no part of the content of this research paper has been published in any form before. I shall be solely responsible if any evidences found against my research paper.

Signature:

Ramesh Kumar Pandey

APF Command and Staff College

4th February, 2019

LETTER OF RECOMMENDATION

I certify that this thesis entitled “**Urban Disaster Risk Reduction: A Case Study of Bhaktapur Flood 2018**” was prepared by Mr. Ramesh Kumar Pandey under my supervision. The researcher has fulfilled the criteria prescribed by the Department of Humanities and Social Science, Tribhuvan University.

I hereby recommend this thesis for the final evaluation and acceptance.

.....

Dr. Naresh Nath Rimal

Supervisor

Date: 4th February, 2019

LETTER OF APPROVAL

This thesis entitled “**Urban Disaster Risk Reduction: A Case Study of Bhaktapur Flood 2018**” submitted by Ramesh Kumar Pandey has been accepted in partial fulfilment of the requirements for Master's Degree in Security, Development and Peace Studies.

EVALUATION COMMITTEE

.....

Supervisor: Dr. Naresh Nath Rimal

Date: 4th February, 2019

.....

External Examiner: Prof Dr. Ramesh Raj Kunwar

Date: 4th February, 2019

.....

External Examiner: Prof. Dr. Sushil Raj Pandey

Date: 4th February, 2019

.....

External Examiner: DSP Netra Bahadur Karki

Date: 4th February, 2019

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Ramesh Kumar Pandey

ABSTRACT

Nepal is a disastrous prone country and water induced disaster especially flood is most common in Nepal as creates problem every year. The urbanization has also led to increased urban flooding phenomenon and it is increasing in trend. The District of Bhaktapur is the smallest in the country and urbanization combined with rapid population increment in last few decades. The Hanumante River flows from middle of Bhaktapur District and connect with all four municipalities. The catchment area of the Hanumante River is around 97sq.km. Out of 119 sq. km, it carries around 88 percent of water from Bhaktapur. The present thesis research is based on primary and secondary data. The data is gathered from flood affected area of Bhaktapur, Suryabinayak and Madhyapur Thimi Municipalities and from concerned offices. The data is collected from open and closed ended interview questions. The data analysis is triangulated.

The secondary data offered insight on sources and for causes and impacts. The primary data is received from field survey and observation. The stakeholders are aware of roles and responsibilities the flood. However, affected people have limited understanding and knowledge about the flood and remain in fear of flood. The major cause of flood is incessant rain in Bhaktapur. However, increased urbanization and lack of proper planning, encroachment of river are additional cause of concern in the study area which can be predicted and mitigated with available information, tools and techniques.

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LIST OF ABBREVIATIONS AND ACRONYMS

APA	American Psychological Association
BS	Bikram Sambat
CBS	Central Bureau of Statistics
DAO	District Administration Office
DM	Disaster Management
DPNET	Nepal Disaster Preparedness Network
DRR	Disaster Risk Reduction
DRRM	Disaster Risk Reduction and Management
EOC	Emergency Operation Center
Ft	Feet
Govt.	Government
Govt.	Government
GoN	Government of Nepal
IFRC	International Federation of Red Cross and Crescent
INGOs	Inter Non Governmental Organizations
KII	Key Informant Interview
M	Meter
mm	Millimeter
MOHA	Ministry of Home Affairs
NEOC	National Emergency Operation Center
NGO	Non Government Organization

NRCS	Nepal Red Cross Society
NSET	National Society for Earthquake Technology
Rs.	Rupees (Nepali)
SAARC	South Asian Association for Regional Cooperation
UNRCO	United Nations Resident Coordinator's Office
UNISDR	United Nations International Strategy for Disaster Reduction
UNICEF	United Nations International Children's Emergency Fund
VDC	Village Development Committee

CHAPTER I

INTRODUCTION

1.1 Background

The rapidly growing informal settlements and growing numbers of urban disasters arises from the failure of governments to improve and adopt to institutional and urban changes. When governments fail to address urban disasters, it derails local government structures in cities and metropolitan areas to provide institutional and infrastructural services (International Federation of Red Cross and Red Crescent Societies, 2010). Jha, Lalmond and Bloch (2012) define urban flooding as the following.

Urban flooding is a serious and growing development challenge. Against the backdrop of demographic growth, urbanization trends and climate changes, the causes of floods are shifting and their impacts are accelerating. This large and evolving challenge means that far more needs to be done by policy makers to better understand and more effectively manage existing and future risks (p. 1).

In general understanding, urban is an area where facilities like hospital, school, market, restaurants, and cinema hall are available and people use in every day's walk of life. A city or urban area is a set of infrastructure, other structures, and buildings that create an environment to serve a population living within a relatively small and confined geographic area. The lives and livelihoods of the population are supported by interrelated systems around which the urban area and society function.

Hundred and one countries use minimum population thresholds as a means of identifying settlements as 'urban', either as the sole criteria or together with others. The most frequently used threshold values are 2,000 inhabitants, and 5,000 inhabitants. The average of all these thresholds was just under 5,000 inhabitants (Deuskar, 2015).

An urban area can be defined by one or more of the following: administrative criteria or political boundaries (e.g., area within the jurisdiction of a municipality or town committee), a threshold population size (minimum urban settlement is typically in the region of 2,000 people, although this varies globally between 200 and 50,000), population density, economic function (where a significant majority of the population is

not primarily engaged in agriculture, or where there is surplus employment) or the presence of urban characteristics [paved streets, electric lighting, sewerage] (UNICEF, 2012). Japan's urbanized areas are defined as contiguous areas of densely inhabited districts using census enumeration districts as units with a density requirement of 4,000 inhabitants per square kilometer (Statistics Bureau, 2008).

According to the Census of India 2011, the definition of urban area is a place having a minimum population of 5,000 of density 400 persons per square kilometer and 75 percent plus of the male working population employed in non-agricultural activities. Places administered by a municipal corporation, cantonment board or notified town area committee are automatically considered urban areas (Government of India, 2011). Urban area in Canada is an area with a population of at least 1,000 people where the density is no fewer than 400 persons per square kilometer (Statistics Canada, 2009). The United States Census Bureau defines an urban area as "core census block groups or blocks that have a population density of at least 1,000 people per square mile (386 per square kilometer) and surrounding census blocks that have an overall density of at least 500 people per square mile (United States Census Bureau, 2010).

An urban hazard is a risk that threatens a city, its population, and related socioeconomic activities. If a risk threatens a capital or large city, the risk may resonate beyond the area of impact. In the discussion that follows, the focus is mostly on major disaster impacts, since smaller ones are less destructive and more easily absorbed, though much of the discussion is also applicable for smaller disasters (Kreimer et al., 2004). Around 54 percent of the world's population lives in urban areas, a proportion that is expected to increase to 66 per cent by 2050. Projections show that urbanization combined with the overall growth of the world's population could add another 2.5 billion people to urban populations by 2050, with close to 90 percent of the increase concentrated in Asia and Africa (United Nations, 2014).

Crisis may be defined as "an emergency situation arising out of natural or human activity which poses a threat to human life and property or leads to large scale disruption of normal life. A crisis may degenerate into a disaster if it is not properly managed resulting in an avoidable loss of human life and property on a large scale (Patel, 2017). Disaster is a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity,

leading to one or more of the following: human, material, economic and environmental losses and impacts (UNISDR, 2017). “Disaster Risk Reduction” shall mean the disaster risk analysis and evaluation, prevention and mitigation of disasters and mainstreaming of disaster risk reduction activities into the development activities (Ministry of Federal Affairs and Local Development, 2013).

Disaster Risk Reduction (DRR) is essential, both on the physical and human level. With our partners, Global Communities constructed durable shelters that are used as the core of future homes. There are a variety of models, from two-floor, steel framed shelters (an approach that maximizes space and is particularly useful in densely populated areas) to timber framed, stucco walled shelters that provide a sanitary, safe home for a family (Courtney Brown, 2012). Shelters were built on retaining walls that were essential to stabilizing the foundations and to encourage better homeowner driven construction on more solid footing. As informal settlements are perched alongside a ravine and watershed, the drainage built through the entire zone mitigates the effects of heavy rains that weaken the ground in the area. Finally, circulation paths to provide emergency access in case of fire, flood or earthquake were one of the greatest priorities given by the community as many residents were killed between the buildings in trying to escape the densely packed neighborhood (Courtney Brown, 2012).

According to Disaster Risk Reduction and Management (DRRM) Act 2017, DRR means analysis and assessment of risks before disaster, disaster prevention or reduction of harms to be caused by disaster and works concerning minimization of disaster risks in development activities (Government of Nepal, 2074). Disasters Management (DM) means entire activities concerning disaster risks reduction, disaster counteraction, and disaster recovery (National Disaster Risk Reduction Management Act, 2074). Disaster is the hazard’s effect on society as a result of the combination of exposure and vulnerability. So strictly, disasters, not hazards, cause deaths and damage (UNISDR, 2009). Hazard is a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation (UNISDR, 2009). A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR, 2009).

Vulnerability is a characteristic that influences damage: some communities absorb and recover more readily than others because of physical assets (building design and strength), social capital (community structure, trust, and family networks), and political access (ability to get government help and affect policies and decisions). Measures to reduce vulnerability include mitigation, prevention (measures to reduce damage, as with higher plinths for floods), preparedness [evacuation plans], and relief (United Nations, 2010). Disasters is culturally constructed and socially experienced differently by different groups and individuals, generating multiple interpretations of an event or process. A single disaster can fragment into different and conflicting sets of circumstances and interpretations according to the experience and identity of those affected. Disasters force researchers and practitioners alike to confront the many and shifting faces of culturally imagined and socially enacted realities (Hoffman & Oliver, 2002).

A flood is the inundation of land by large amounts of water. Floods can be produced by excessive rainfall, causing rivers and waterways to overrun their normal channels and spread out across the adjacent countryside (Coenraads, 2010). Floods are caused by natural factors or by a combination of natural and human factors. Risk is probability of loss and can be expressed as: $\text{Risk} = \text{Hazard} \times \text{Vulnerability}$ (Tingsanchali, 2012). Heavy or excessive rainfall in a short period of time that produce immediate runoff, creating flooding conditions within minutes or a few hours during or after the rainfall called flash flood (UNISDR, 2018). Flood is defined as “overflow of water from a stream channel onto normally dry land in the floodplain (riverine flooding), higher-than normal levels along the coast and in lakes or reservoirs (coastal flooding) as well as ponding of water at or near the point where the rain fell” [flash floods] (UNISDR, 2018).

Flood is a water induced disaster and seen frequently in Nepal especially southern part of Nepal. In regular interval, it destroys and damages huge human life, cattle and property. Susta Flood 1980, Makwanpur Flood 2002, Koshi Flood 2008, Seti Flood 2012, Mahakali Flood 2012 and Surkhet Flood 2014 are the major floods of Nepal (National Society for Earthquake Technology, 2018). The scenario of flood is changing because of urbanization in Nepal. Nepal is a disaster prone country and it ranked 30th in flood, 4th in Climate change, and 11th in earthquake (Ministry of Federal Affairs and Local Development, 2013).

Bhaktapur is an ancient city adjacent with Kathmandu, capital of Nepal. It is also known for its rich culture, traditions, heritage sites, handicraft and pottery. Few important destinations in Bhaktapur are Bhaktapur Durbar Square, Changunarayan temple, Nagarkot, Taumadi, Doleswor Mahadev, Kailashnath Mahadev Statue and Fun Valley (District Coordination Committee Office, 2019).

The Federal structure of Nepal has divided the administrative area in Federal, Province and Local bodies. Town and cities are classified in three types of municipalities' likewise Metro city, Sub-metro city, Municipalities and rural municipalities. So, here urban means cities and towns come under the metro, sub-metro and municipalities. There are six Metro cities, 11 Sub metro cities, 276 Urban Municipalities and 460 Rural Municipalities (Ministry of Federal Affairs and General Administration, 2074).

1.2 Statement of Problem

Urbanization is increasing in Nepal after declaration of Federalism in 2015. It is urbanizing but still there is lacking of proper planning and effective implementation of prevailing laws and guidelines. Within a short span of time, a number of municipalities have been declared and those areas are changing into urban from rural very fast. There is lacking of awareness program. The planning in urban area by concerned authorities and this type of lacking makes urban area more vulnerable. Bhaktapur district is regularly affected by flood. Though, 'Bhaktapur Flood 2018' was not the big event in disaster but in urban area this sort of disaster creates havoc among people and rampant the livelihood of people for long time.

The Hanumante River is the subsidiary river of Bagmati River. It passes from the mid of Bhaktapur and touches all four municipalities and also brings flood in lower part i.e. Bhaktapur, Madhyapur Thimi and Suryabinayak Municipalities. The width of river is narrowing down because of waste, garbage, construction and encroachment. Though, Bhaktapur flood did not take any human life but it destroyed lots of property, crops, cattle and affect the livelihood of people in regular interval. The flood affected the various areas of Bhaktapur Municipality, Madhyapur Thimi Municipality and Suryabinayak Municipality.

The area near to the bank is always threat for the inhabitants and especially in rainy

season, it is most dangerous to live and farming there. There are many agencies who are working on disaster, urbanization and welfare of the people. This study tried to find out whether Hanumante River is properly managed or not? Why does people often troubled by flood, whether it is predictable, mitigate and preventive, if so how it can be done. It would also try to find out which area and why those areas are vulnerable.

1.3 Research Questions

The urban disaster is a common event but flood different than other disasters. Government of Nepal prepared National Urban Development Strategy 2017 to make the urban sustainable, inclusive, resilience, green and efficient by taking care of urban land, density and infrastructure (Urban Development and Physical planning Division, 2017). So, this study has focused to answer the following research questions.

1.3.1. How is the Hanumante River managed by the government agencies to mitigate the flood?

1.3.2. What are the causes and impacts of Bhaktapur flood 2018?

1.4 Objectives of the Study

The objective of this research is to verify the management of the Hanumante River to mitigate and prevent the flood in Bhaktapur as well as find the causes of flood in Bhaktapur since long time regarding with current flood i.e. on July, 2018. To address the issue, following objectives have been set;

1.4.1. To explore how is Hanumante River protected by the Government agencies to mitigate the flood?

1.4.2. To find out the causes and impacts of ‘Bhaktapur Flood 2018’.

1.5 Significance of the Study

Urban disaster is a common and countries like Nepal where urbanizing is rapidly increasing after it went to federal on 2015. Most of the Village Development Committees (VDC) has become Municipalities and facilities are gradually upgraded by the

government. So, people are migrated and settled down in towns and cities. Though, GoN has prepared many policies regarding the urban settlement, river management and disasters but yet to implement. This research is beneficial to urban people, academician, engineer, promoter, municipalities, scholars, students, general public and stakeholders who are working on the disaster, disaster risk reduction, planning and urban management.

1.6 Limitation of the Study

This study covers the 'Bhaktapur Flood 2018' in regards with the Hanumante River focusing on the affected areas and management of the river to mitigate and prevent the flood. The problems associated with the river the present study is the issue of flood and how authorities are working to cope with it. The research did not deal with security forces and other stakeholders who are deployed after disaster for rescue and relief.

CHAPTER II

REVIEW OF LITERATURE

The disaster is eminent event and there are various literatures available on urban disaster. The Disaster Risk Reduction (DRR) and other disaster in the urban area is a natural and water induced disaster and its effect can be mitigated by various means and ways.

2.1 Disaster, Flood, Urban and Urban Flood

Kerala flood displaced thousands people and destroyed the crops, infrastructure and life of human and cattle. Disaster may come any time and to mitigate it, needs preparation from all stakeholders to cope it effectively. Though, flood disturbed the urban and rural area. The government of Kerala response nicely and saved the life of thousand people (Economic Times, 2018). Shrestha explained how waste water of the Hanumante River is used by the farmers to clean the vegetables. The non treated water produces many health hazards, as farmers are regularly using for their daily use. Those vegetables that are cooked pose less microbial health risk but raw eaten vegetables like radish, coriander, carrot, lettuce pose high microbial health risk to consumers (Shrestha, 2018). The land use pattern of Bhaktapur has changed dramatically in since 1988 to 2015. Forest area is synchronized, Agricultural area is reduced, and urban area is massively increasing in Bhaktapur. The urbanization is increased around the Arniko Highway, especially from Tinkune (Kathmandu) to Suryabinayak (Bhaktapur) as Japan government constructed 9.1 km six lane long highway in that period (Thapa Chhetri & Moriwaki, 2017).

Nepal is recorded as one of the top fastest urbanizing countries in the world. The Kathmandu Valley includes cities of Kathmandu, Lalitpur, Bhaktapur and several other smaller cities and towns. Annual population growth was high in municipalities like Kirtipur 5 percent, Madhyapur Thimi 5 percent. There was 3.94 percent of urban growth rate between 2010 to 2014. The built up area was increased by about 120 percent whereby significant expansion took place along the major roads such as local roads, service roads and access roads (Ishtiaque, Shrestha, & Chhetri, 2017).

In 2017 flood took the human life around 159 people around the Nepal. The flood damaged thousand of agricultural land, affected around 4.5 million people, thousands of cattle and crops (Rural Reconstruction Nepal, 2017).

DRR measures are emphasized in school, local and national level. All policies and plan should include the DRR measures. The importance of disaster education has been identified by most of stakeholders. DRR helps to achieve the sustainable development goal. The writers focused on education of disaster in all level (Shaw, Yukiko, & Shiwaku, 2014). Though Nepal has formulated and implemented many policy and programs regarding the disaster risk reduction but there is no special curriculum included in the education system of Nepal. Kreysler stated that poor and isolated people and migrants labour suffered in town and cities and exposed to the hazard. Tools are used to overcome the vicious cycle. Economic globalization also interacts with both health and disaster (Kreysler, 2014).

The guidelines clearly prescribed the definition of disaster, preparation of the District Disaster Management Plan, preparation of the profile of vulnerabilities, risks and capacities with the role and responsibilities of Ministry, District Development Committee, Municipalities and then VDC level including other concerned agencies (Ministry of Federal Affairs and Local Development, 2013).

Scholar describes concepts, policy, plan and operation on integrated urban flood disaster and risk management. In most developing countries, flood disaster management activities are handled by government. Participation of nongovernmental agencies and private sectors are very limited. Activities are exercised rather independently without proper coordination or integration. Flood disaster management in developing countries is mostly reactive responding to prevailing disaster situations and prefers proactive response rather than reactive. It focuses on integrated flood disaster management for both long and short term activities (Tingsanchali, 2012).

The writers explained that the 21st Century provides comprehensive, forward-looking operational guidance on how to manage the risk of floods in a rapidly transforming environment and changeable climate. The Guide serves as a primer for decision and policy makers, technical specialists, central, regional and local government officials, and concerned stakeholders in the community sector, civil society and non-governmental

organizations, and the private sector. The Guide starts with a summary for policy makers which outlines and describes the key areas which policy makers need to be knowledgeable about to create policy directions and an integrated strategic approach for urban flood risk management (Jha et al., 2012). Oxfam reported Pakistan's 2012 flood left hundreds of thousands of people needing help to meet their basic needs, including clean water, food, shelter, health and medical services, sanitation facilities, and cash to buy other essentials (Oxfam International, 2012). The natural disaster and other contains important disaster with reasons of disaster, cause, importance, rescue methods and ways overcome from those disasters (Coenraads, 2010).

Flooding is an increasing environmental concern for many Canadian cities. There is increasing awareness of climate change and its impacts on precipitation behavior and flooding in urban areas. Knowledge gaps were identified in the literature concerning urban flood response planning, uncertainty and preparedness planning. This study examines and compares urban flood response measures and resilience building for natural disasters in the Cities of Toronto and Calgary. Non-structural measures for flood risk reduction that include policies, decision-making and community engagement were examined by conducting a literature review and semi-structured interviews of individuals from six groups: provincial government, municipal government, conservation authority, private sector, academics and non-governmental organizations (NGOs) (Asrai, 2012).

The breach of embankments brought the Koshi Flood 2008. The inundation damaged thousand Hectare of farm land, 15 km of Mahendra highway and households. It took life of 26 people and displaced around 70,000 people in Sunsari and Saptari districts. The management of victims was so difficult and their livelihood was disturbed for long time (MoHA & DPNNet, 2009). Gunn (2008) explained that there was a disastrous flood in Brisbane in 21st January 1974 which damaged life of human and cattle as well as huge property. The flood caused as of unexpected incessant rain. The twenty four hour rain resulted to both city and large area far beyond the city limits and also disconnected from the rest of the world. Early warning system and disaster plan was not enough to deal such flood though Australia regularly suffers from flood (Gunn, 2008). She discussed in her research paper how the Hanumante River is impact on the environment and household because of industries and also advised mitigation measures for the possible impacts

which cause pollution in the river. People are using the river water for the purpose of irrigation, washing vegetables, washing clothes and bathing (Shrestha, 2007).

The Disaster response and contingency guide focuses on disaster, vulnerability and risks. This document identifies the four goals and also priorities in plan, plan for and with and where and when. It clearly talks about the formation of institutional disaster planning and identification of resources and clearly defined terms like Institutional disaster planning, Disaster response plan, contingency response plan and Standard Operating Procedures (IFRC, 2007).

Husain explained clearly about the natural disasters, its tracking by Global Information System, post disaster management and how do society prepare themselves for mitigation and management of natural disasters in India and role of local bodies in pre disaster, during and post disaster nicely discussed. He clearly pointed out the measure to mitigate the flood by constructing embankments, flood forecasting and flood zoning (Husain, 2006). Kumar (2006) compiled disaster management in Asia, impact of disaster on development, state disaster management act, disaster risk management strategies, forest fires and plant diversity in Thailand.

It is expedient to amend and consolidate the prevailing laws concerning disaster risks reduction and management to make provisions for affording protection of life of people in general; for protection of public, private and personal property; for protection of natural and cultural heritage and physical structures by managing all activities of disaster management in coordinative and effective manner.

2.2 Review of Act and Policies

The Disaster Risk Reduction and Management Act 2074 BS is the latest document which guides and covers the important commitments on international arena like Hugo-Framework, Sendai Framework, and Sustainable Development Goals. It defines the types of disaster with role and functions of different stakeholders. There are 23 functions, duties and powers of District Disaster Management Committee and 16 functions, duties and powers of Local Disaster Management Committee. There is clear a demarcation of role and responsibilities of authorities like Security Force, Fire Brigade, Public organization and business enterprise (Government of Nepal, 2074).

Nepal National Building code was prepared to strengthen the infrastructure in urban and rural areas. It guides how and where one can take the assistance from engineers to make resilient society by making planned structure with the support of technical assistance. It talks about four type of designs and lack of an appropriate Nepal Standard should not be an excuse for poor design (Department of Urban Development and Building Construction, 2060).

Kafle mostly dealt with disaster cases of South East Asia and South Asia. He talked about the disaster knowledge and experience, and underlying causes of vulnerabilities and capacity of the populace. Nepal is the first country and Bhutan is the last country in the South Asian Association for Regional Cooperation (SAARC), respectively implemented Disaster Act on 1982 and 2012. Every SAARC nation has established Disaster Management Ministry and Department and National Disaster Management Commission or Authority except Nepal. There are around 13 government agencies, INGOs, National NGOs and United Nations and humanitarian organizations but early warning system is not effectively developed in most vulnerable area except few major rivers (Kafle, 2017).

The Sendai Framework for Disaster Risk Reduction gives guiding principles, priorities for action, role of stakeholders, international cooperation, global partnership and enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction. The given target and priority will be achieved by all member states by 2030 (United Nations, 2015).

National Disaster Response Framework, though guided by then Natural Calamity Relief Act 1982 but it adapted new measures mostly talk about the national system for disaster response, international assistance for disaster response, national and international assistance and coordination especially the cluster system and national framework for disaster response with specified time and responsibility of concerned authorities during disaster (Ministry of Home Affairs, 2013).

National Strategy for Disaster Risk Management is document which covers the strategy and commitment towards international arena and updated version in its own kind. It is focus on ‘One Window Policy’ and ‘Cluster Approach’ to coordinate with various organizations. It talks about the Early Warning, existing challenges to mitigate the

challenges and how to strengthen the response and preparedness activities including sectoral strategies. There is provision of monitoring and implementation of activities by concerned ministry, institutions and departments (Ministry of Home Affairs, 2011).

Bagmati Action plan working on Bagmati River, its tributaries (Hanumante) and sub tributaries to manage the river and reduced the degrading condition of all rivers as well as controlling the various disasters produced through water. All rivers are classified and zoning and this help in developing and implementation of action plan more effectively (Bagmati Action Plan, 2009).

2.3 Summary of Literature

There are various literatures, case studies, thesis and policies available regarding the disaster, urbanization, environment, microbial health risk, use of water in various purposes and pollution risk reduction by many scholars, researcher and columnist about the Hanumante River around the globe.

There is very little paper on the Hanumante River which relates with the disaster, especially on flood. Nepal has its own characteristics with very new geography and geo-structure. After the promulgation of Constitution of Nepal, 2015, the administrative structure has changed and many policies are formed regarding the disaster management from Federal to Local Level. The Natural Calamity Act 1982, one of the oldest disaster act of South Asia has replaced by Disaster Risk Reduction and Management (DRRM) Act 2017 (2074 B.S.). Nepal government is unable to form the National Disaster Authority to fully implement the laws. There are ample of legal documents regarding disaster but implementation is very slow and documents are intermingled with each other. The federal system changed the life styles of citizen and urbanization is increasing rapidly in Bhaktapur. Nepal is very prone in flood and urbanization is making it more challenging. Residents of Bhaktapur are facing flood in regular interval and still they are in risk of flood.

There is very few paper which focuses on the cause and impacts of flood in Bhaktapur. This research is focused on, management of Hanumante River to mitigate flood, to prevent the flood, analyzing the trend of urbanization in Bhaktapur Municipalities. It mostly focuses on what cause the flood in Bhaktapur in regular interval with its impact by focusing on ‘Bhaktapur Flood 2018’. This paper would also try to assess the works done by government to mitigate the flood and awareness program conducted by concerned authorities at vulnerable places, which are less discussed issues till now.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Method

The present research is a case study of the Hanumante River following qualitative and quantitative methods of data collection and analyzed structurally with available quantitative data and articulated it with information received from interviews focused on the Hanumante River flood and inundation.

3.2 Research Design

The mixed method design has been used in this study with explanatory strategy. The quantitative and qualitative data used to analyze the various data to get the actual and effective result but all are non experimental design. The field observation, field survey was done to cover the large number of sample for the study. The qualitative data is basically used to analyze the facts as most of the data are secondary source data. The descriptive, comparative and analytical methods are combined to get the appropriate results.

3.3 Source of Data

The primary and secondary data have been collected in the course of the present research. The primary data is collected from closed and open ended questions and observations. The random sampling used from flood affected areas. Key informants interview conducted with specific personalities from District Administration Office (DAO), Municipalities, Nepal Army, Nepal Police, Armed Police Force, Disaster Experts, Nepal Red Cross Society (NRCS), Engineer and Journalist. Topography map and Survey Map of Bhaktapur is also used to verify the field sites. The secondary data are collected from the different books, publications, District Administration Office, Nepal Police, Armed Police Force Nepal, National Society for Earthquake Technology (NSET), Municipalities of Bhaktapur district, Nepal Red Cross Society Bhaktapur branch, Department of Hydrology and Meteorology, Higher Powered Committee for

Integrated Development of the Bagmati Civilization office and websites are consulted for the primary and secondary data for this research. The source of data is obtained from specialized institutions.

3.4 Sampling and Data Collection Tools

Samples are selected randomly from the flood affected areas especially from victims and also focused on aged responders to get the history of flood in Bhaktapur. At least five samples collected from each flooded ward. The flood effected ward of municipalities in Bhaktapur are (1, 3, 4, 5, 7, 8), Madhyapur Thimi (4, 5, 9) and Suryabinayak municipality (2, 3, 4, 5). Altogether 65 random samples taken from flood affected area and asked questions (Appendix 'A') and 13 Key Informant Interview is conducted following questions (Appendix 'B') with district administration office, Nepal Army, Nepal Police, Armed Police Force, Mayor of respected municipalities, Journalist, Nepal Red Cross Society and engineers. Their view was collected separately.

Table 1

Data of Respondents

Respondent	Number of Sample
Bhaktapur Municipality	33
Madhyapur Thimi Municipality	12
Suryabinayak Municipality	20
Key Informant Interview	13

3.5 Data Validation, Processing, Analysis and Presentation

The collected data are explained and analyzed in text, tabulation, figures, and references. The American Psychological Association (APA) 6th edition is used as a general format of the thesis write-up. The quantitative information is presented in the form of tables, graph and subjective analysis is done for the qualitative information gathered. 1: 500 scale used to scale the survey map and 30 M tape is used to measure the length, width and depth of river. The interview questions and KII has been taken as tool for collecting

the primary data. Data collected from interview and KII has been validated and compared with each other. The collected data has been put in excel to compare and analyze. The survey map of the Hanumante River and field has been verified for the actual data and to know the fact. The collected qualitative and quantitative information with final result has been presented in tables, figures, map and graphs to describe, compare and to analyze. Topography map of Bhaktapur has been used describe the feature of Bhaktapur (Survey Department, Government of Nepal, 2000).

3.6 Study Area and Site Selection

Since the research is on the urbanization and disaster management especially flood in Bhaktapur which caused the Hanumante River. The study areas are the Hanumante River

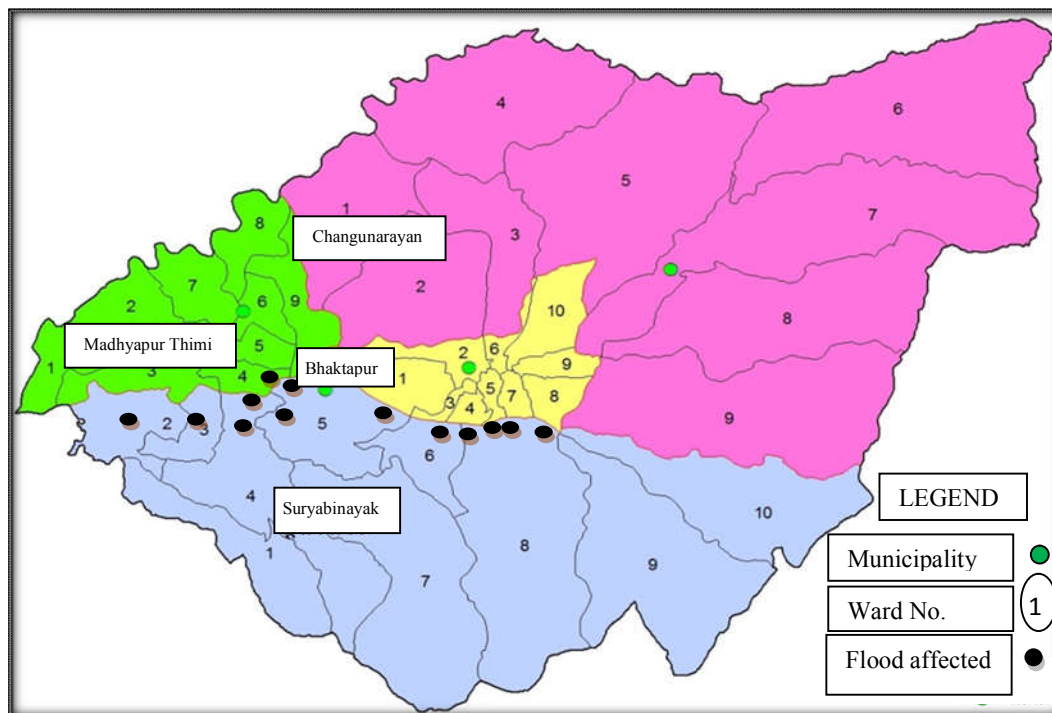


Figure 1: Topography Map of Bhaktapur with Flood Affected Wards

Source: Ministry of Federal Affairs and General Administration, 2019

and Ward Number 1, 3, 4, 5, 7, 8 of Bhaktapur Municipality, Ward Number 5, 4, 3, 2 of Suryabinayak Municipality and Ward Number 9, 4, 5 of Madhyapur Thimi Municipality (Figure 1) and covers around 11.55 Kilometer (Figure 2) of the Hanumante River. Three

locations respectively Chyamasing Hanumante Bridge (North) (Appendix ‘C’), Barahisthan Pati and Barahisthan Bridge (Appendix ‘D’) are taken as sample to verify the encroachment of the Hanumante River. Pictures taken at the field visit are also using to analyze and describe the fact.

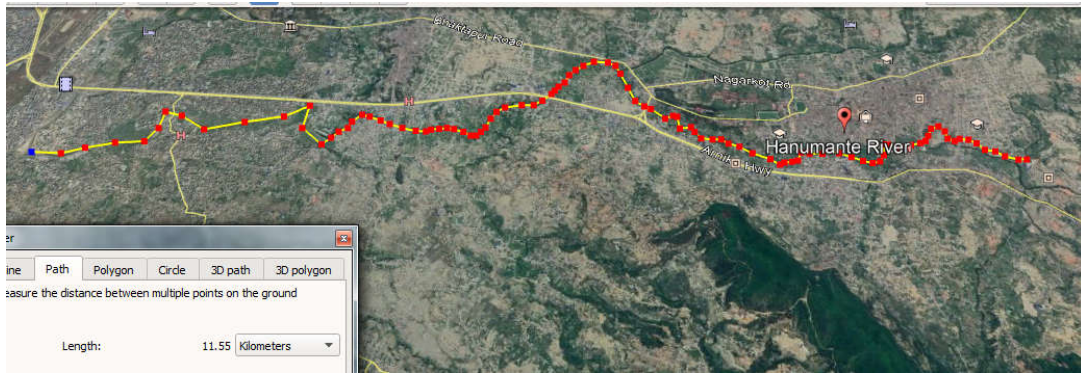


Figure 2: Map of Study Area (Chyamasing to Hanumante-Manahara Junction)

Source: Google Earth Pro, 2019 (marked by researcher)

3.7 Ethical Consideration

The research followed the APA 6th edition and its formats. A letter of declaration about ethical consideration is included in this research paper. Authentic and approved sources have used for data collection. Copy of other research avoided and well cited as well as references of all sources is mentioned. This research is not motivated to hurt the feelings of nationality, society, community, personally, psychologically, economically, family relation, human ethics or any other basis and also not against government policies and procedures and followed all legal procedure related to the research. Research participant were not subjected to harm in any ways whatsoever and respected the participant’s dignity. Full consent was obtained from the participants prior to interview or during data collection. The protection of the privacy of research participants is ensured. Any type of communication in relation to the research was done with honesty and transparency and any type of misleading information, as well as representation of data findings in a biased way is fully avoided.

CHAPTER IV

DISCUSSION AND ANALYSIS

4.1 Geographical Information of Bhaktapur

Bhaktapur is the smallest district covers 119 sq km and located east of Kathmandu, Capital of Nepal. The ancient City of Bhaktapur in Newari culture, tradition and it has few world heritages sites like Bhaktapur Durbar Square. The highest point is Bageswori Reserve Forest 1800M (Nagarkot) and lowest 1298M (Radhe Radhe) from sea level (Survey Department, Government of Nepal, 2000). Forest covers around 17.93 percent (Madhyapur Thimi Municipality, 2075). It has four municipalities namely Bhaktapur, Madhyapur Thimi, Suryabinayak and Changunarayan. It had a population around 304,651 with 3.01 growth rate and 2560 population density (Central Bureau of Statistics, 2011).

4.2 Hanumante River

Nepal is prone to natural disasters especially in water induced disasters because of rivers. Nepal has more than 6000 rivers (Water and Energy Commission Secretariat, 2011) and most of them flows from mountainous region to Terai region. The river system in Nepal has unique characteristics that impose high costs and high risks for investment in river and the government has a limited capacity to maintain system.

Hanumante River is the second largest river after Manahara River in Bhaktapur. It is one of the important tributaries of Bagmati River. It flows from mid of Bhaktapur and also causing serious damages to agricultural land, standing crops and lives every year (Bagmati Action Plan, 2009). Due to the meandering path that it follows, it is affecting a large amount of arable land and generating troubles to the nearby settlers. The settlement, public property and the highly fertile land along the river are at high risk of flood causing the loss of investment of farmers, land and property. The Hanumante River is a 6th order drainage stretches for 18.30 Km and confluences with 6th order Godawari Khola. It has drainage area around 97.051 sq. km with 53.233 km long perimeter (Shrestha, 2010).

Tabyakhusi Khola starts its journey from Bagheswori Reserve Forest (known as Mahadev Khola) and Chakhu Khola starts its journey from Tukucha Nala and Nalachhap and meets at Hanumanghat. Then, two streams called the Hanumante River. Hanumante Rivers receives water from Sipadol Khola, Kalka Khola and Khasyan Khusum Khola Gakhu Khola and Ghatte Khola (Survey Department, Government of Nepal, 2000).

Bagheswori Reserve Forest (1800 M), Telkot Reserve Forest (1600 M), Nankhel (1776 M), Gundu (1719 M) surrounds the urban area of Bhaktapur which has height around 1298 M high from sea level. The urban area of Bhaktapur has height below 1400M (Survey Department, Government of Nepal, 2000). This shows all rain water flows downward to the Hanumante River and sometime it goes beyond the bank or streams.

There are 887 open spaces are identified in Kathmandu Valley. Bhaktapur Municipality has 17, Madhyapur Thimi has 13 and other Suryabinayak and Changunarayan have 23, altogether 53 Open places are identified for the emergency settlements of victims. Government of Nepal (GoN) identified more 19 Open places in Bhaktapur for providing various services during disaster such as Humanitarian assistance, security, rescue and relief and establishment of temporary camps (Kathmandu Valley Development Authority, 2014).

On 16th November 2008 (1st Mangsir, 2065 B.S.), the Government of Nepal decided Hanumante River's width 20 meter and both side from river bank 20 meter each (Bagmati Action Plan, 2009). The survey map, which was done on 2021 B.S. (Bikram Sambat) shows, the width of river varies from minimum at 34 ft (Map Bhaktapur, Nagar no. 2 gha) to around 135ft [Map of Balkumari-1] (Survey Office Bhaktapur, 2019). The banks of the river are treated as dumping site of municipalities. The waste is spotted everywhere at bridges, in and besides the river banks (Figure 3B). There is no equipment to measure the water level in the Hanumante River, The sewer pipes are directly connected into the river. There are around 37 sewerage points, from Chyamasing to Thimi area among them 10 sewerage points are having pipe diameter between 1000 Millimeter (mm) to 1500 mm. The list of pipeline with area is shown in the table 2 below.



Figure 3: Garbage (A) at Chyamasing and Waste Management (B) at Barahisthan

Source: Researcher

Table 2

Sewerage Pipeline in the Hanumante River

Location of Pipe	Number of Pipe
Ghalaten	2
Subarna Chowk	1
Iwali Bridge	1
Hanumanghat	1
Bhimsenthan	1
Nayabasti (Madhyapur Thimi)	1
Thimi	2
Radhe Radhe	1

Source: GIETC Lama Raman JV, 2015

‘The Bhaktapur Flood 2018’ is a moderate flooding. According to Robert moderate flooding is a type of inundation, which will produce flooding of main bridges and adjacent low lying areas. It may also result in the small scale evacuations of housing and

caravan parks along rivers and the removal of livestock to higher ground (Coenraads, 2010).

The field observation (Figure 13A, 14) shows, there is no strong measures implemented by government authorities to mitigate and prevent the flood prior to 'Bhaktapur Flood 2018'. There is a lack of proper construction of embankments, levees and other measures to protect the soil erosion. The waste thrown by inhabitants of Bhaktapur filled the river and reduced its depth, need to clear or remove prior to rainy season. The river bank is vulnerable in many places as of weak and lacking of structure. The plain area is the lowest area of Bhaktapur and water from periphery collected in this place and it makes inundation.

4.3 Flood Affected Municipalities and Urbanization

There are four municipalities in Bhaktapur but Bhaktapur, Madhyapur Thimi and Suryabinayak Municipalities are adjacent with Hanumante River. The lowest and plain areas of those municipalities are often flooded.

4.3.1 Bhaktapur Municipality

The District of Bhaktapur and Bhaktapur Municipality occupies 6.88 sq. km. It is rich in Newar culture and tradition. It has ten wards with around 100 thousand people (Bhaktapur Municipality, 2018), 83,658 according to Central Bureau of Statistics (CBS) 2011 and it has around 81,748 people living in 17,639 households in year 2013/14 (Poudel, 2017). This data shows the population in Bhaktapur Municipality is in decreasing trend. The registration of house in Bhaktapur Municipality since last five years is as shown on Figure 5 (Bhaktapur Municipality, 2019).

4.3.2 Madhyapur Thimi Municipality

The Madhyapur Thimi Municipality declared on 29th December, 1996 (Poush 14, 2053) with 11.47 sq. km. It has around 83,036 populations according to CBS 2068 with a growth rate 5.67 percent. The density of population is 7,239 and it has nine wards (National Planning Commission Secretariat, 2014). The population of Madhyapur Thimi

is around 1,00,000 (Madhyapur Thimi Municipality, 2075). The registration of house since last five years is shown on Figure 5 (Madhyapur Thimi Municipality, 2019).

4.3.3 Suryabinayak Municipality

Suryabinayak Municipality is created in December 2014 and on 2017, it added the areas of then Anantalingeswar Municipality. Now, it has 10 wards which covered 42.45 sq. km. It has 78,490 populations with 50.44 female and 49.56 male who are accommodated in 18,446 households. The registration of house since five years is shown on Figure 5 (Suryabinayak Municipality, 2019).

4.3.4 Urbanization in Bhaktapur

In 2011, Bhaktapur has two municipalities (Bhaktapur and Madhyapur Thimi), it has total population 3,04,651 and 1,64,758 population was urban population i.e. 54.1 percent (National Planning Commission Secretariat, 2014). The urban population of Nepal is rapidly increasing, clearly shows in Figure 4 below (Department of Economic and Social Affairs, Population Division, 2019).

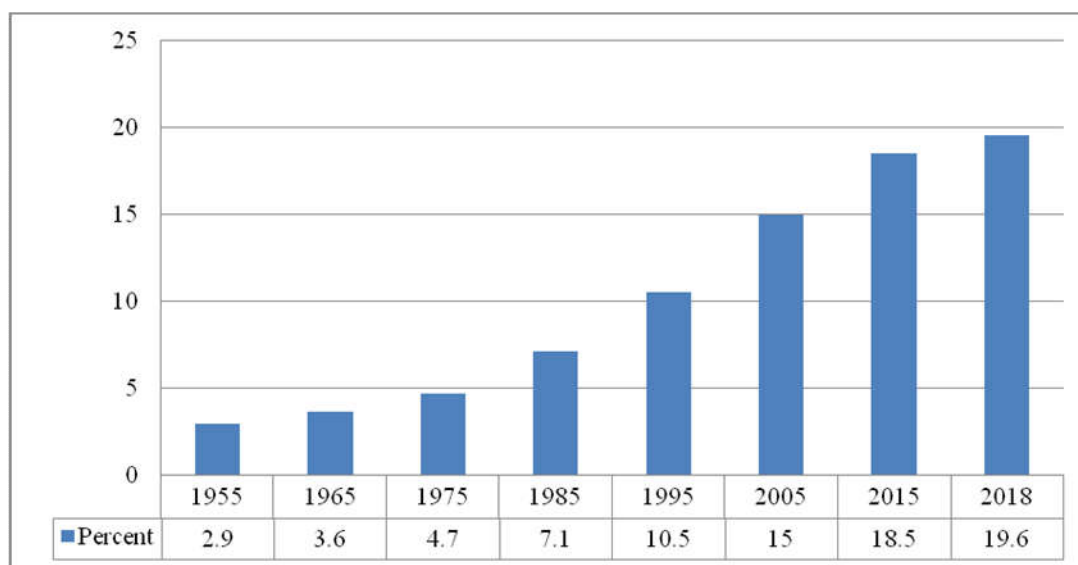


Figure 4: Urban Population Trend in Nepal from 1955-2018

Source: www.worldometers.info/world-population/nepal-population

Figure 5 shows, the registration of house in Bhaktapur, Madhyapur Thimi and Suryabinayak Municipality since last five years until Poush, 2075. The ratio of building new houses is high in Suryabinayak and low in Bhaktapur Municipality.

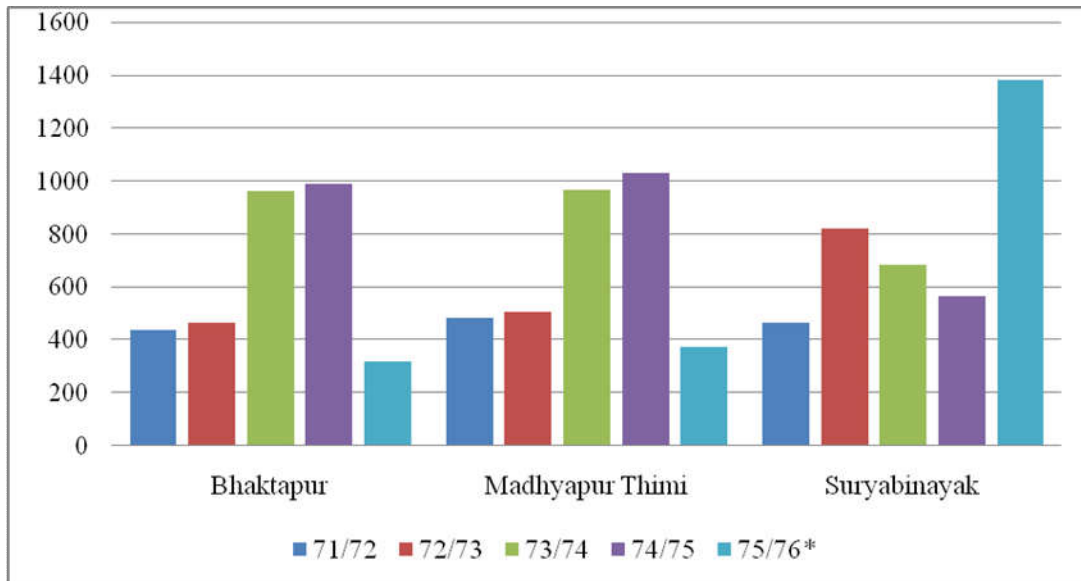


Figure 5: House Registration in Municipalities

Source: Bhaktapur, Madhyapur Thimi and Suryabinayak Municipality

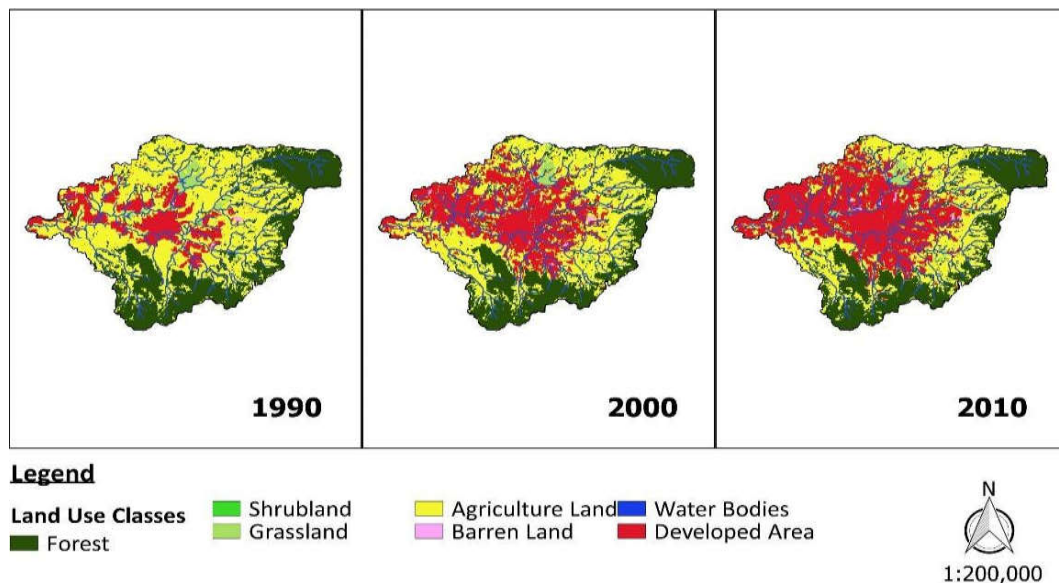


Figure 6: Land Use Changes of Hanumante River Basin since last three Decades

Source: Bagmati River Basin Improvement Project Office, 2019

Figure 6 shows, how urbanization is increasing from 1990 to 2000 and 2000 to 2010. Developed (built-up) area is increasing and agricultural land is reducing very fast. The growth rate of population in Bhaktapur, Madhyapur Thimi and Suryabinayak Municipalities are respectively (83,658) 1.43 percent, (84,142) 5.67 percent and (78,490) 3.5 percent according to CBS 2011 (Central Bureau of Statistics, 2011). The data shows population is increasing rapidly in all three municipalities. Bhaktapur is the smallest among three and Suryabinayak is the largest in area. So, there is a possibility of increasing more population growth rate in Suryabinayak in near future.

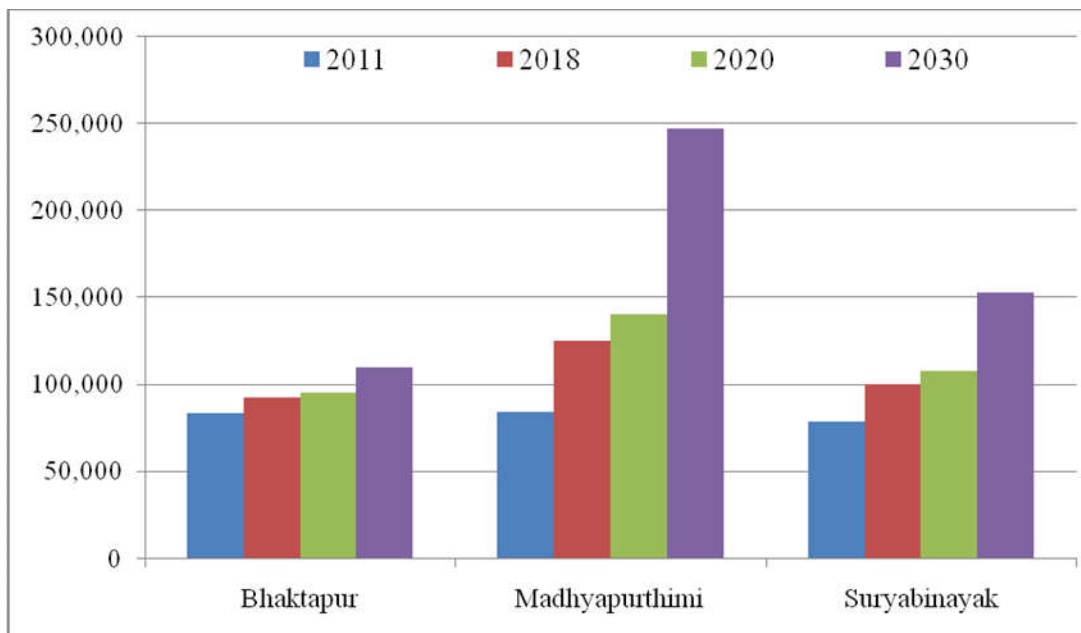


Figure 7: Population Projection of Municipalities

Source: Projected by Researcher

The population growth of Bhaktapur district is 3.01 percent and other Madhyapur Thimi and Suryabinayak has more than district growth rate. The city areas are increasing and are highly concretized and compacted with tall buildings to accommodate the growing population. The population and built up has become one of the indexes of the development of cities (Thapa Chhetri, Fujimori, & Moriwaki, 2017). The population of Bhaktapur was 1,44,420 (1981), 172952 (1991), 225461 (2001), 304651 (2011) and growth rate is 3.01 with population density 2550 (Population Education & Health Research Center (P) Ltd., 2016).

Figure 5, 6 and 7 shows, urbanization and population is increasing day by day. It means the arable land of Bhaktapur is changing into concretization and there is no community park, open places in urban area except roads. The unplanned settlement and settlement near the river proves people more vulnerable. So, government, municipalities must to work on the management of urban area to lessen the vulnerabilities. Previously, the registration of house is done by municipalities and there was no proper planning for recreation, open spaces, drainage system.

4.4 Institutional Framework

The Bhaktapur District Disaster Management Committee prepared District Disaster Plan and circulated to all concerned authorities for their action and implementation. There is a disaster fund of two million for disaster (District Administration Office, 2075).

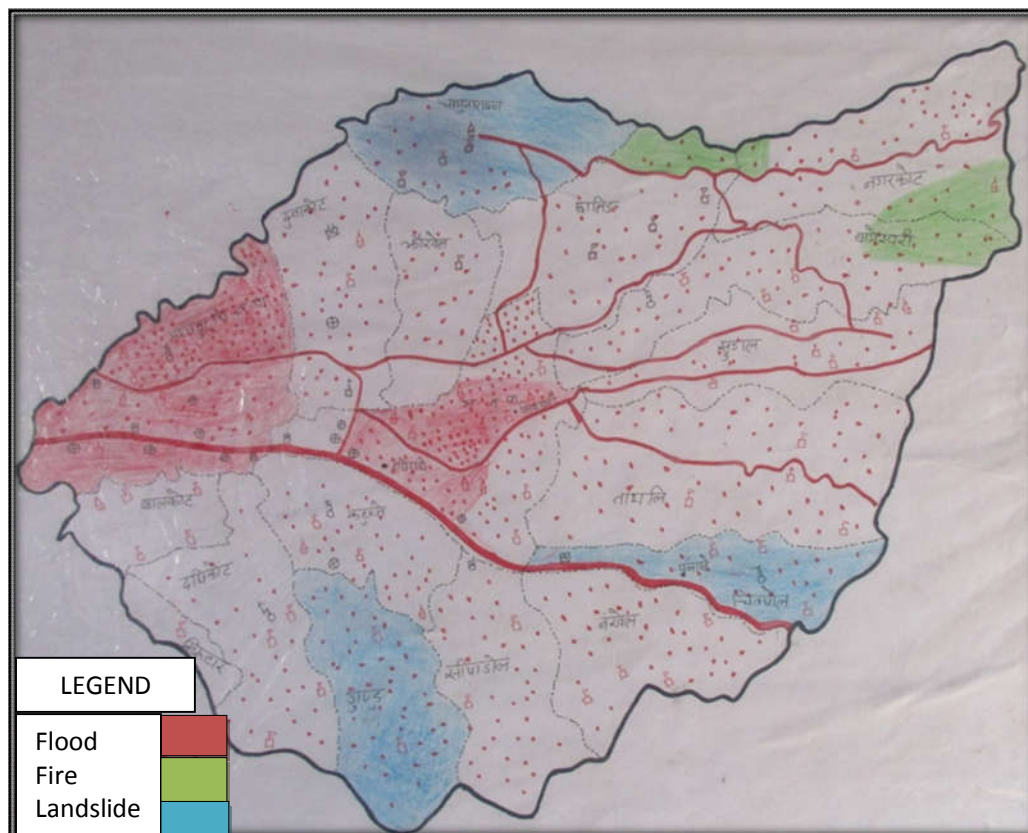


Figure 8: Disaster Mapping of Bhaktapur District

Source: Armed Police Force, Nepal No.22 Battalion Headquarter, 2019

The Disaster Risk Reduction and Management Act 2074 has clear provision of various committees from Federal, Province, District, Local bodies and even in ward level. All municipalities have formed the committee according to the provision but still a lot to work on detail disaster mapping and to find out the vulnerability in fine manner. During field survey, researcher found the certain lacking in disaster planning though all concerned authorities are working on it (Government of Nepal, 2074). There is no Local Emergency Operation Center (LEOC) Center in Bhaktapur. The mechanism and structure of disaster management is shown on Figure 9. According to respondents they do not have community disaster mechanism. The other offices like department of forest, Irrigation, Water Induced Disaster, Agriculture, education, health are also working on the sector of disaster. There is no community settlement level management disaster committee, which is very important to make the community resilient (Figure 9).

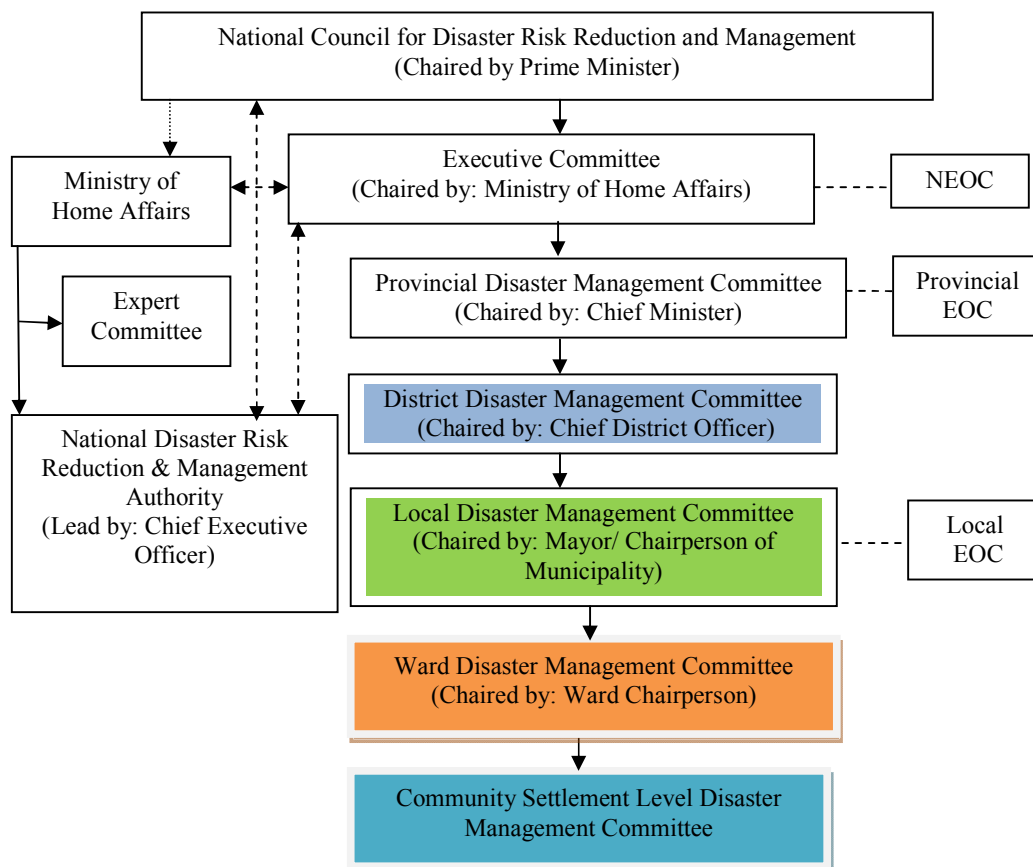


Figure 9: Institutional Framework of Disaster Management

Source: Disaster Risk Reduction and Management Act 2074

4.5 Bhaktapur Flood 2018

There are two main rivers in Bhaktapur, the Manahara River and the Hanumante River and both are the tributaries of the Bagmati River (Bagmati Action Plan, 2009). The Hanumante River flows middle of Bhaktapur and connects all four municipalities.

On July 12 July, 2018 inhabitants of Bhaktapur district suffered by flood. Water inundated the lower part of Bhaktapur since the early morning of 12th July and water remains for many days in Bhaktapur area. The flood felt by the residents of Bhaktapur municipality around 0300hrs and around 0500hrs on at Radhe Radhe area according to respondents. The level of water was gradually extended in Arniko Highway and lower part of Bhaktapur came under water. The water remained at the section of Arniko Highway from Sallaghari to Thimi chowk till 1500hrs on that very day.

There was incessant rain in Kerala from 1st June to 15th August, 2018, it received 2087 mm rainfall. The pattern of rain was also different than earlier. It was suffered by disastrous flood after 94 years and it was unexpected for the Kerala Government. There was a huge destruction of crops in around 57,000 Hectare lands, 20,000 houses damaged, and around 483 people lost their lives. The government, politician, people responded tremendously and that saved huge property including the lives (Upadhya, 2018).

A major cause of local flooding due to heavy rainfall in many cities is the blocking of drainage facilities with garbage. Cleaning and maintenance of drainage facilities is essential to their operational reliability. Storm water retention measures are vital for mitigation of urban floods as well as for prevention of downstream floods. The aim of urban flood risk management is to minimize human loss and economic damages. It can be fully avoided but it can be managed (Tingsanchali, 2012).

Building codes play an important role in decreasing the physical vulnerability of houses and infrastructure. Flood warning systems need to be communicated to the communities at risk by converting forecast information into practice and by sending warning dissemination to people. Success of such a system is closely related to people's knowledge of flood risk and their familiarity with emergency response to incoming floods (Tingsanchali, 2012).

The office of resident coordinator pointed out the constraints regarding flood in Terai among the clusters (Office of the Resident Coordinator, 2017). The flood in urban area is increasing shows the table 3. Government and concerned stakeholders need to work on urban disaster risk reduction in all urban areas around Nepal. Local bodies and community mechanism should activate simultaneously to make the community resilience in respective disaster.

Table 3
Flood in Urban Area from 2013-16

Place	2013	2014	2015	2016	Total
Ghorahi	1	0	0	1	2
Dhangadhi	3	0	1	1	5
Budhanilakantha	1	0	0	2	3
Bardibas	1	0	0	1	2
Rajbiraj	1	0	0	0	1
Lahan	1	0	0	2	3
Itahari	1	0	0	1	2
Hetauda	0	0	1	1	2
Belbari	0	0	1	2	3
Bhaktapur	0	0	1	1	2

Source: NSET, 2016

The rivers in Nepal are characterized by wide, seasonal fluctuation of flow. The monthly flows generally reach their maximum in July-August and decline to their minimum in February-March. About 80 percent of the total flow occurs during five months (June - October) and the rest during the remaining months. It can be generalized that the smaller the size of the river catchment area, the wider is the range of flow fluctuation (Bagmati Action Plan, 2009).

Figure 10A shows the water bodies in Bhaktapur district. It has many water bodies in northern, western and southern part. Figure 10B shows the catchment area of the Hanumante River. From Figure 11B, it is clear that more than 60 percent of water channelize into the Hanumante River (Higher Powered Committee for Integrated Development of the Bagmati Civilization, 2018).

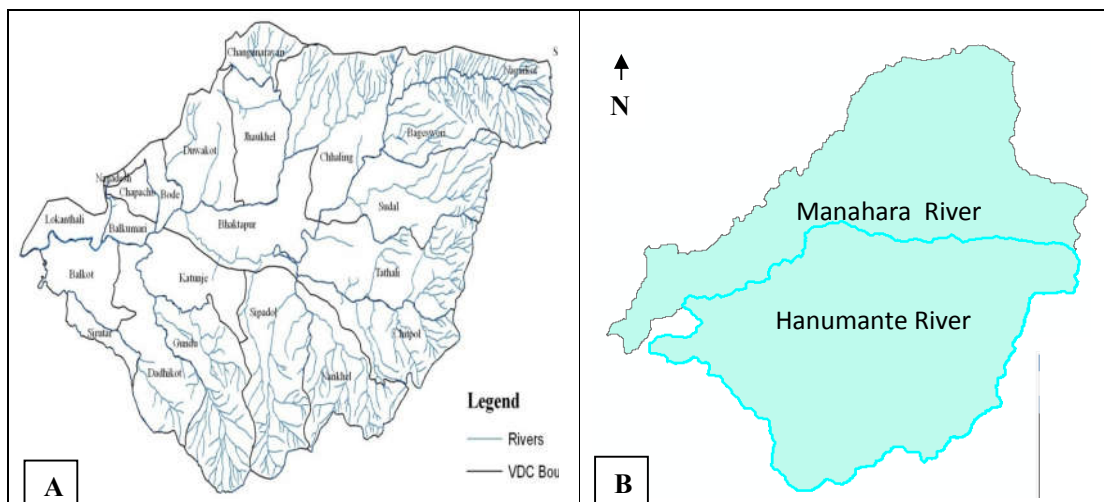


Figure 10: Water Bodies in Bhaktapur (A), Catchment Area of the Hanumante River (B)

Source: Bagmati River Basin Improvement Project, 2019

Flood is very old phenomena in disaster but there is lack of proper recording system in Nepal. National Society for Earthquake Technology (NSET) is keeping the record of all disasters and recorded data shows that till 2016, around 3902 people lost their life as of flood with following damages; 4162 events, 3902, 571 injured, 99,113 house hold destroyed, 114091 house hold affected and 5,43,114 livestock killed (National Society for Earthquake Technology, 2018). There are 418 flood events and 135 people lost their life in 2017 and 2018 (Government of Nepal, 2019). The recorded data were collected from newspaper and media reporting. So, recorded data are also not 100 percent true to analyze any event.

Due to continuous heavy rainfall, the streets of Bhaktapur have been flooded with excess rainwater affecting the settlements of local peoples in places like Srijananagar, Jagati, Maheswori, Sallaghari and Radhe Radhe (Texas Nepal Reporter, 2015).

Hundreds of dwellings in Bhaktapur and Thimi have been inundated due to the flash flood following the torrential rain this morning. The flooding caused by the swollen Hanumante rivulet has submerged large swathes of areas along its banks, throwing life out of gear. Most settlements in Bhaktapur and Madhyapur Thimi are fully inundated. The most affected areas were Jagati, Chyamhasingh, Bhelukhel, Ram mandir and Barahisthan are the worst affected areas due to the deluge (Republica, 2015).

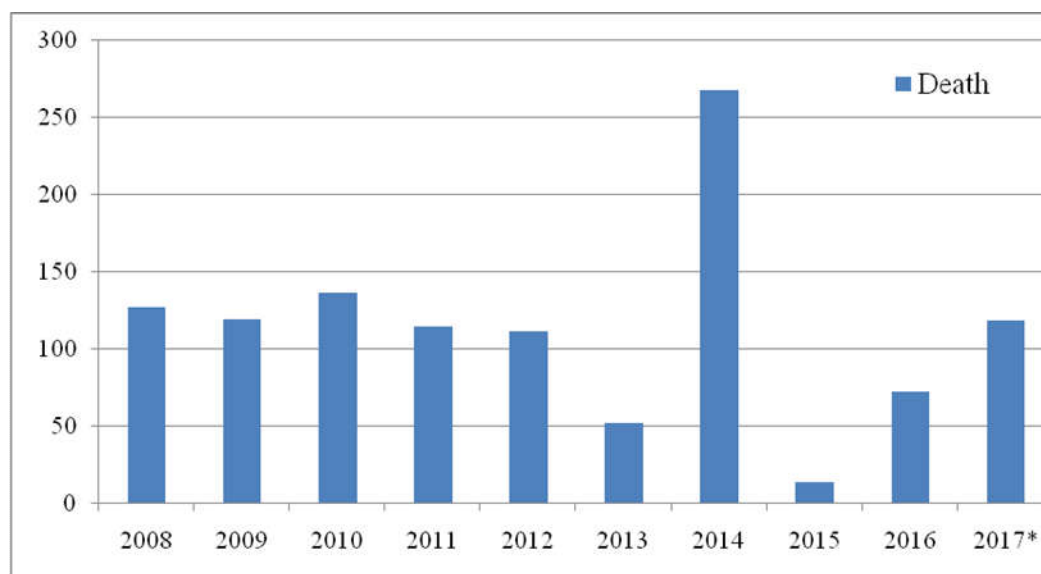


Figure 11: Casualty by Flood from 1971-2016

Source: Desinventar_1971 to 2016 events and (*<http://www.drrportal.gov.np/>)

The flood affected three municipalities out of four at lower part or also called the valley of Bhaktapur. Ward No. 8, 7, 5, 4, 3 and 1 ward of Bhaktapur were flooded on 2018 Bhaktapur flood. Chyamasing (8), Ram Mandhir (4), Barahisthan are regularly comes under water. Sallaghari was badly affected in 2018's flood. There were three Wards of Madhyapur Thimi which came under the flood likewise Ward No. 9, 4 and 5. Two Wards of Madhyapur Thimi Ward No.9 and 4 were badly affected and people suffered lot. Ward No. 5 of Madhyapur Thimi was slightly affected. There were four Wards of Suryabinayak Municipality affected on 2018 flood respectively Ward no.5, 4, 3 and 2. Ward No. 5 was badly affected among others. Ward no 1 of Bhaktapur, Ward No. 9 and 4 of Madhyapur Thimi and Ward No. 4 and 5 of Suryabinayak Municipalities were most affected Wards.

According to respondents, in Newar language flood means “Khusibaa” (‘Khusi’ means water, ‘baa’ means extreme). Aged respondents (more than 65 years) has saw flood more than 7 times but they have memory of only 2015, 2016 and 2018. The respondents stated *“flood is common for us because a decade ago there were few houses and it comes and drowned the farmland and over but now the houses are built everywhere and the water disturbs their life.”*

4.6 Causes of Flood in Bhaktapur

The respondents and KII were asked the cause of flood in Bhaktapur. According to respondents view, following are the main causes of flood in Bhaktapur (Figure 12).

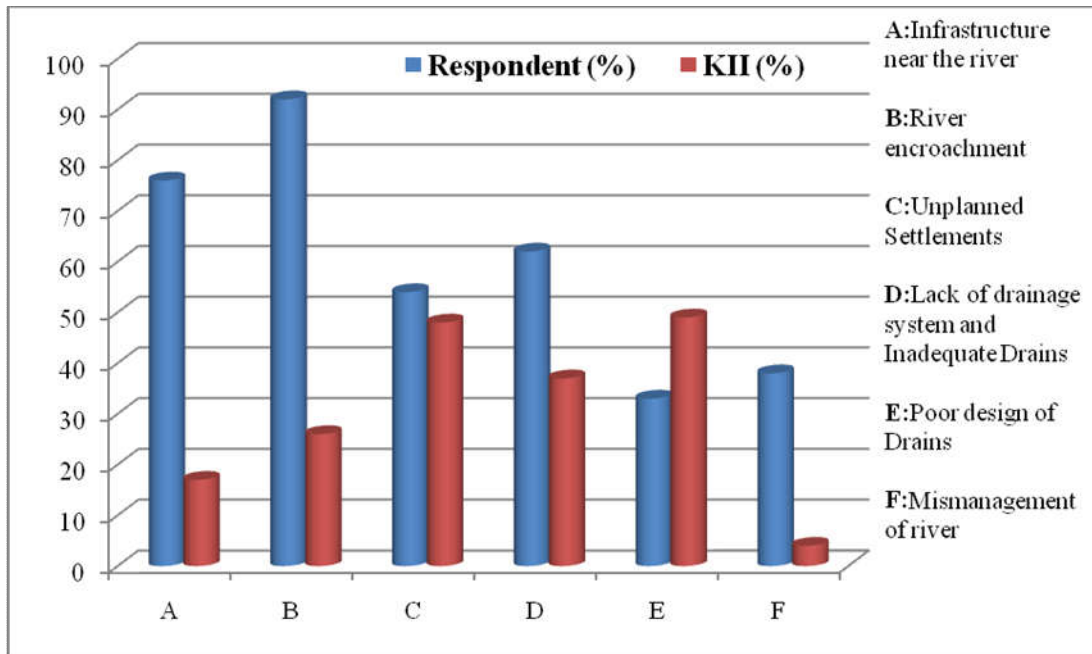


Figure 12: Causes of Flood in Bhaktapur around Hanumante River

Source: Field Survey, 2019

The view on causes of flood between victims (respondents) and KII differs in infrastructure near to river (60%), river encroachment (70%), and mismanagement (40%). But there is less variation on unplanned settlements (10%), lack of inadequate drainage system (20%) and poor design of drains (10%). The views on infrastructure near to river have huge variation because both KII and respondents has their own perception. So, among six three causes which has similar view of both KII and respondents are subsidiary causes of the flood in Bhaktapur.

4.6.1 Infrastructure near the River

Around 70 percent of the respondents said the infrastructure is made near the river. Garment factory, Washing, religious structures and houses are built very close to the river (Figure 13 A, B).

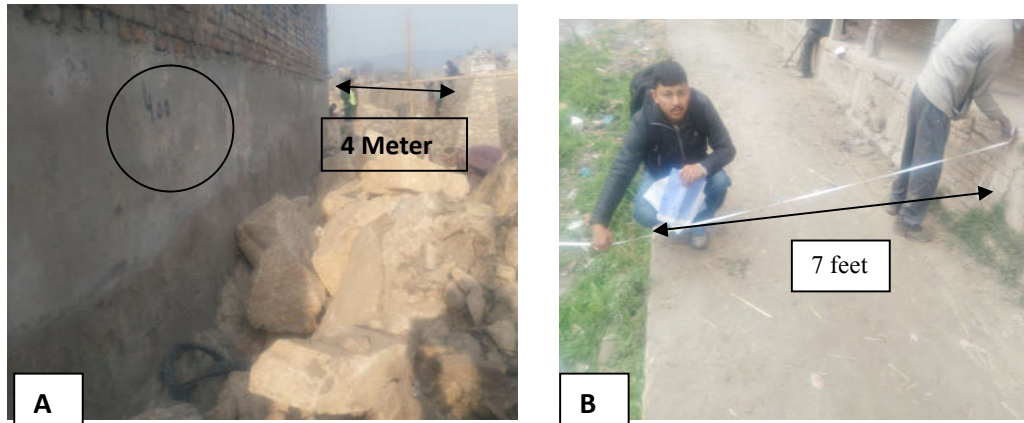


Figure 13: Encroachment by the Garment and Washing Factory (A), Pati build at the Bank of river at Barahisthan (B)

Source: Field Survey by Researcher

4.6.2 River Encroachment

The Hanumante River is encroached in many places because it is not delineated. Around 90 percent of respondent and around 20 percent of KII gave their view on this. At Figure 13A, the distance between river bank and Garment factory is only four meter (shown on round circle), the gap supposed to be 20 meter. At Barahisthan, the Pati was built at the distance of 7ft from the river bank (Figure 13 B).



Figure 14: Unplanned Drainage (A) around 100M West of Siddhi Memorial Hospital and Mismanagement of River (B) at Chyamasing East of Bridge

Source: Field Survey by Researcher

4.6.3 Unplanned Settlements

The VDC used to register houses without engineering and that create problem in the urbanization. There is no drainage system in the city to pass the water. Sewerage pipe are directly thrown into river (14 B). The respondents stated as *“now there is no land and only buildings are everywhere and water is not charge by the land as of concretization so directly goes to river.”*

4.6.4 Lack of Drainage System and Inadequate Drains

There is very less sewerage management system in Bhaktapur. The rain water travels directly to river from everywhere as lack of drainage and canal. Around 60 percent of respondent and 30 percent KII support this statement.

4.6.5 Poor Design of Drains

City, town and water bodies are not managed and planned nicely so around 50 percent of respondents give their view that this is also a cause of flood in Bhaktapur.

4.6.6 Mismanagement of River

Around 40 percent respondents said mismanagement of river is a cause of flood during field survey and this statement is true as there is no embankment in many place, from where river easily entered into urban area and make inundation (Figure 14A). The statue of God and Goddess are also constructed in the river banks.



Figure15: Idols of God in the river

Source: Field Survey, 2019

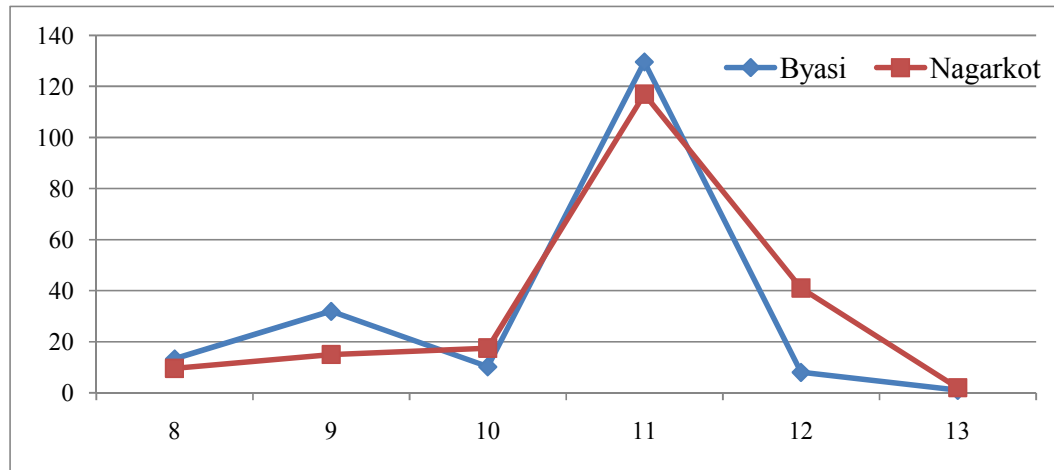


Figure 16: Rainfall Measurement at Nagarkot (1043) and Bhaktapur (1052) Station from July 8-14, 2018

Source: Department of Hydrology and Meteorology, 2019

Figure 16 shows, there was incessant rain prior to flood and on 11th July rainfall was recorded 129.6 mm and 117 mm respectively at Bhaktapur and Nagarkot station. According to respondents and KII, there are other causes of flood in Bhaktapur which are as following.

- a. There is a blockade of river by waste in many areas.
- b. The catchment area of the Hanumante River is big and it is the only channel to pass the water from urban area.
- c. The rate of urbanization is very fast in Madhyapur Thimi and Suryabinayak Municipalities.
- d. There is less depth in river in comparison to volume of water and river is also filled by garbage, soil and wastes.
- e. The level of river is coming up as of garbage and waste.
- f. Flooded areas are mostly lower and plain part of Bhaktapur and there is lack of drainage system.

g. Flood is regular in Bhaktapur but now the concretization makes it more disastrous. Ground recharge level is less as of rapid urbanization. The agricultural land absorbs the water prior to urbanization but now all water goes finally to river and that makes flood and inundation in the urban area.

The hydrological and meteorological stations are established at Nagarkot and Byasi (Bhaktapur) of Bhaktapur district. The station of Byasi shows more temperature than Nagarkot and temperature is also rising in trend. It is a matter of further research whether increasing minimum temperature brings more precipitation or not.



Figure 17: Minimum Temperatures from Nagarkot (A), Bhaktapur (B) Station from 2013 to 2017

Source: Department of Hydrology and Meteorology, 2019

During last five year the minimum temperature of Nagarkot and Bhaktapur was ranging respectively from 15 to 24 degree Celsius and 19 to 21 degree Celsius. Minimum and maximum temperature was quiet fluctuating in the month of June.

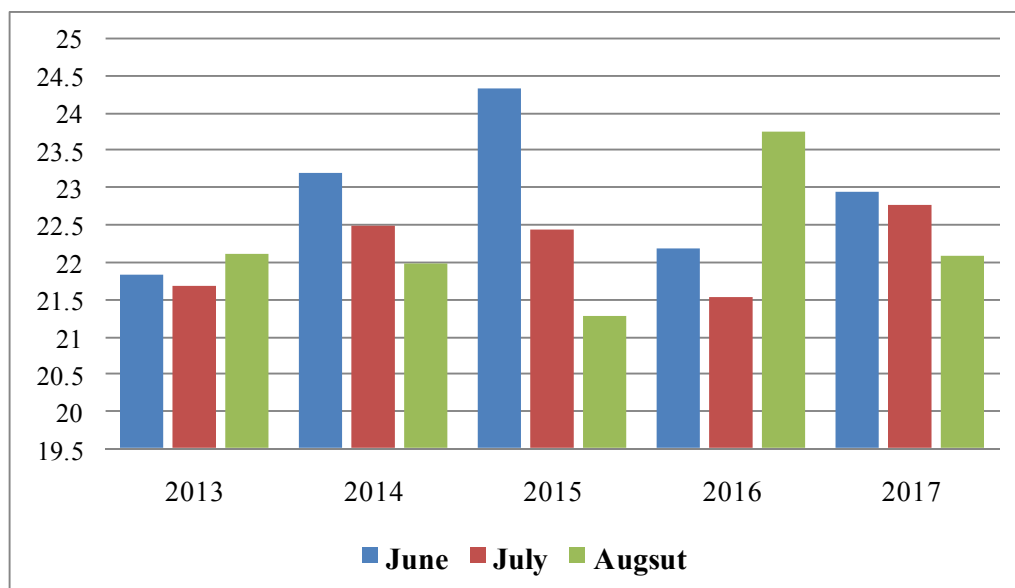


Figure 18: Maximum Temperatures from Nagarkot Station from 2013 to 2017

Source: Department of Hydrology and Meteorology, 2019

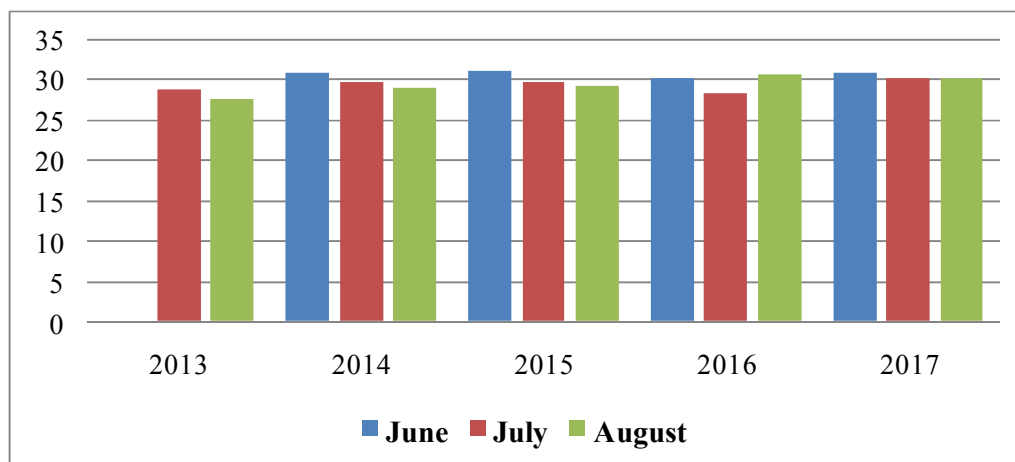


Figure 19: Maximum Temperatures from Bhaktapur Station from 2013 to 2017

Source: Department of Hydrology and Meteorology, 2019

During last five year the maximum temperature recorded at Nagarkot (Figure 18) was 21 to 24 degree Celsius and at Bhaktapur 27 to 31 degree Celsius (Figure 19). The temperature recorded at both station shows the temperature of June is always higher. The month of July has increasing trend of temperature in Bhaktapur but Nagarkot has fluctuating temperature.

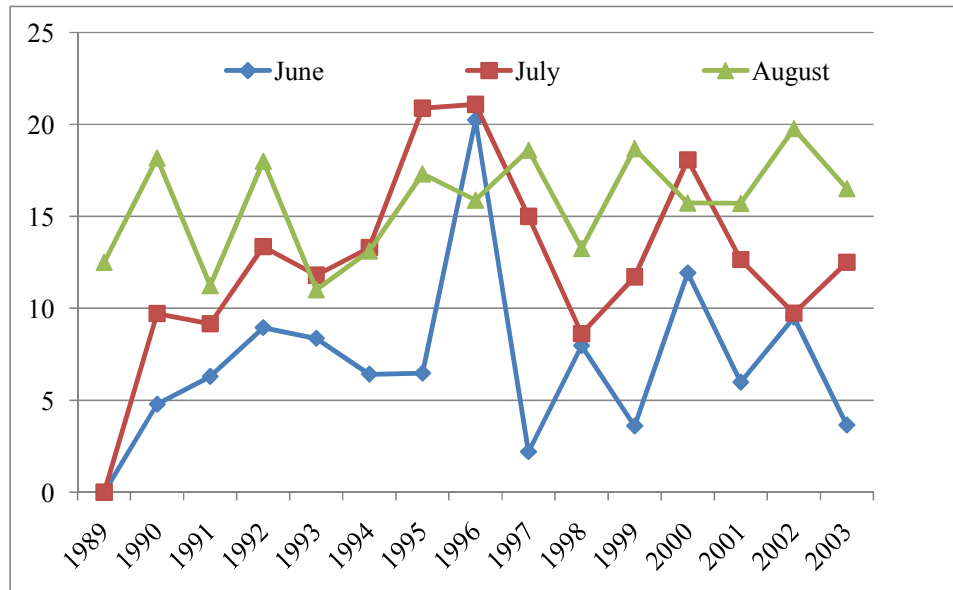


Figure 20: Precipitation Data from Nagarkot Station from 1989 to 2003

Source: Department of Hydrology and Meteorology, 2019

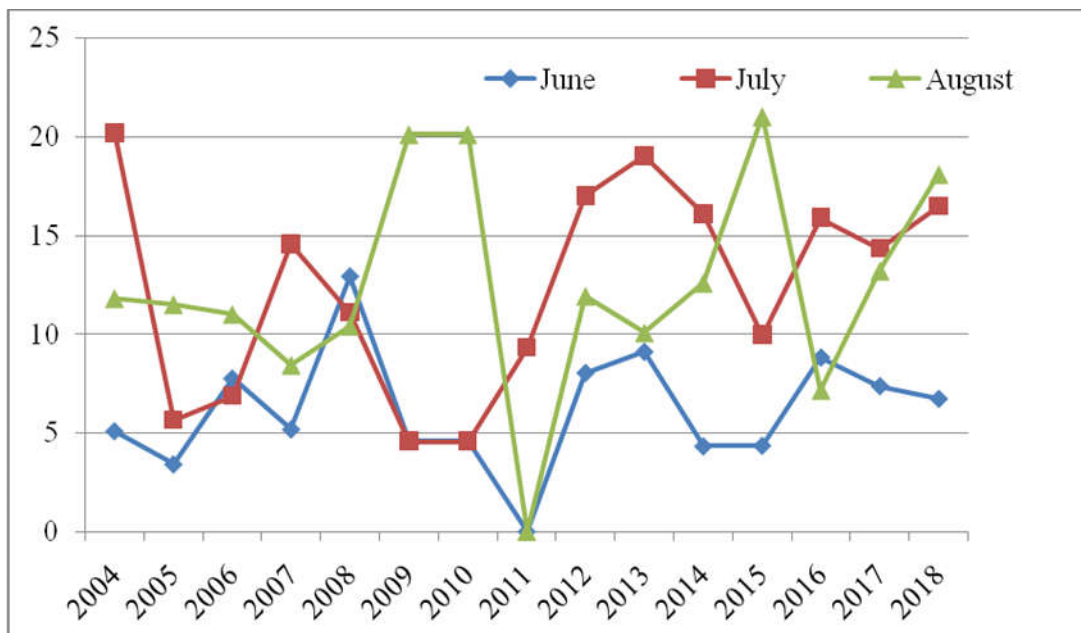


Figure 21: Precipitation Data from Nagarkot Station from 2004 to 2018

Source: Department of Hydrology and Meteorology, 2019

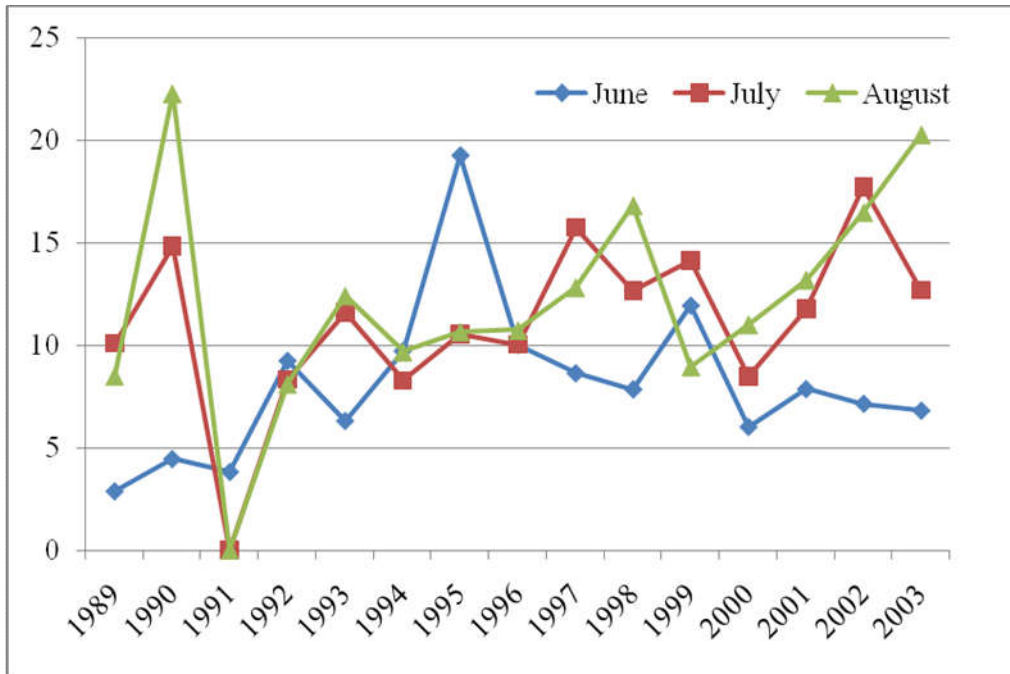


Figure 22: Precipitation Data from Bhaktapur Station from 1989 to 2003

Source: Department of Hydrology and Meteorology, 2019

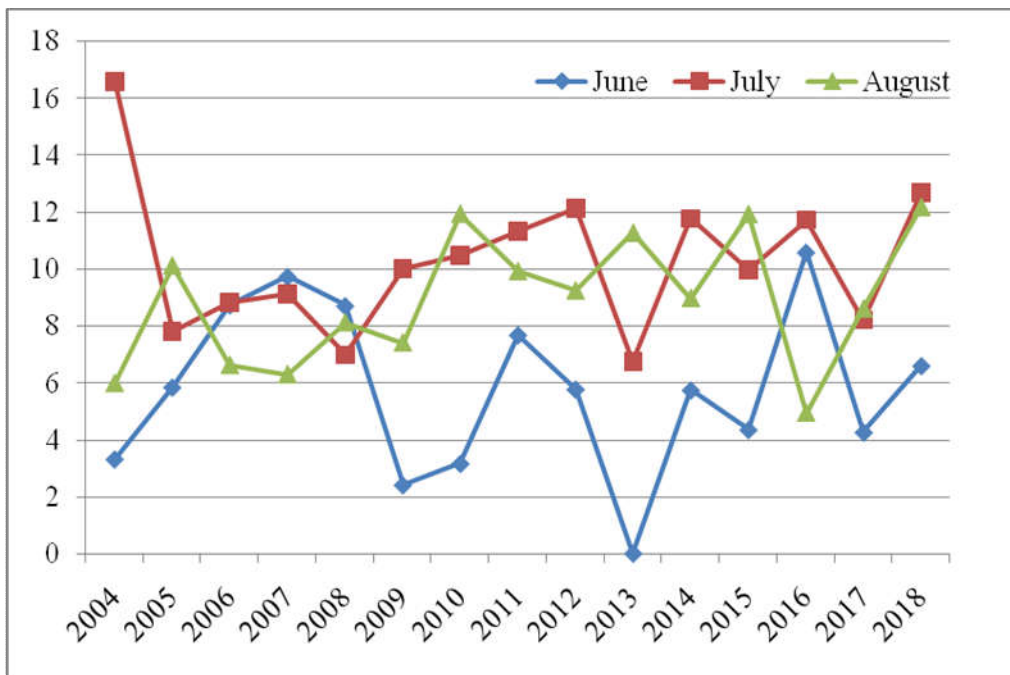


Figure 23: Precipitation Data from Bhaktapur Station from 2004 to 2018

Source: Department of Hydrology and Meteorology, 2019

June, July and August is the rainy season and mostly Nepal receives rain in these three months. The last 30 years rainfall data of three months are analyzed here for its effect and impact. The precipitation from the Nagarkot (Figure 20, 21) and Bhaktapur (Figure 22, 23) Station shows the rainfall data since 1989 to 2018. July and August is most raining month but July receives more rain than other two months. Prior to 12th July 2018, Bhaktapur received incessant rain and that brought flood in Bhaktapur.

The disaster response planning process should ascertain how the population is warned of emergencies, and identify those responsible for notifying others. Systems should be put into place in association with organizations that monitor disasters (IFRC, 2007). There are around 70 percent people who gave their view on the prediction of flood is possible (Figure 24).

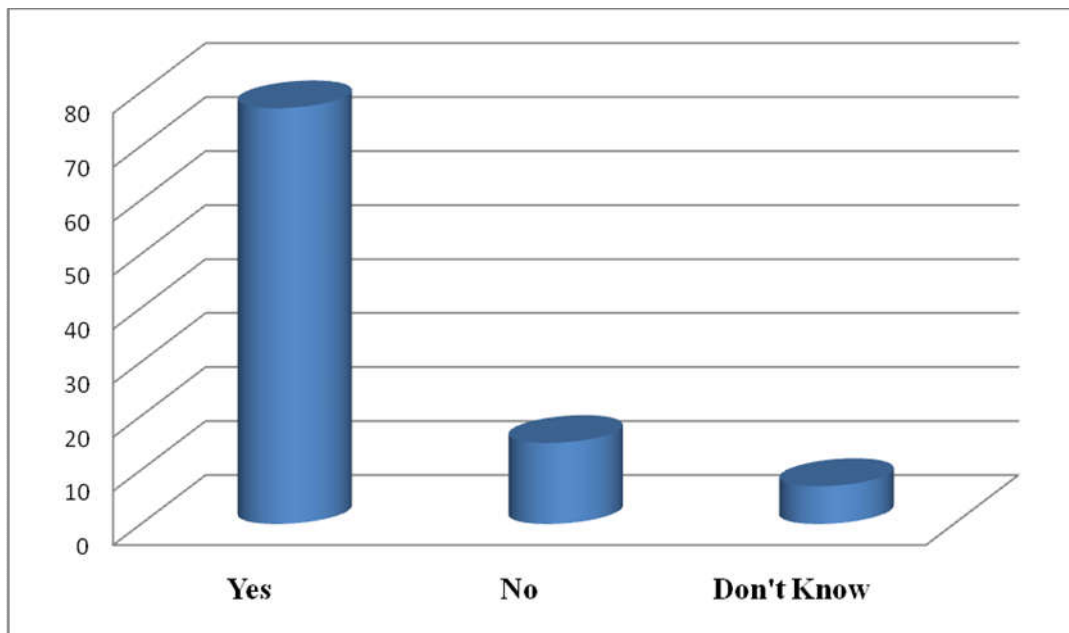


Figure 24: Prediction of Flood in Bhaktapur

Source: Field Survey, 2019

The rainfall data of last 30 year shows rainfall is very high in the month of July every year. Government needs to work on it to forecast the flood by establishing early warning. It shows the concerned authority can predict if she wants to predict because every year July month receives huge rainfall.

The data on table 4 shows there are encroachment of river by community, people, and other organizations and those are not monitored. Field survey and measurement of survey map data are not same. It supposed to be same if there is no any discrepancy. It means there are encroachments, mismanagement of the Hanumante River and the area near the river is not planned according to the water bodies' criteria.

Table 4

Comparison of Distance at the Field and Map

Place	In Field (Feet)		Other Findings	Survey Map
	Width	Depth		
West side of Bridge	29	-	-	40
Chyamasing Bridge (North)	25	5	-	
East side of Chyamasing Bridge	23	-	23	36
Bridge Construction	43	6	No embankment, Sewerage point to river	
Barahisthan (Pati)	64	3.6	Religious idol of Shivalinga and Goddess inside river, River bank to Pati 7ft	90
Gyantara School (Barhisthan)	91	10 *	*River bank to School	110
Corridor constructed by Municipality	16 *	-	Constructed by filling wastes *from river to private land	70

Source: Field Survey, 2019

4.7 Impacts of Flood in Bhaktapur

On July 17, 2018 the District Administration Office (DAO) published the details of Bhaktapur flood through press conference and provide following details of flood. The flood damaged properties worth around Rs 34.2 million in Bhaktapur Municipality; Rs 69.51 million in Madhyapur Thimi Municipality and Rs 27.91 million in Surya Binayak Municipality. The DAO estimates around Rs 39,395,125 worth of damage inflicted on

industries, factories and petrol pumps. The estimated damage on wholesale and retail stores is around Rs 34.16 million. (Rastriya Samachar Samiti, Bhaktapur, 2018).

The flood damaged property worth Rs 119.35 million which was triggered by the incessant rains on July 11 and 12. Emergency team rescued 111 people from the inundated areas and four were injured. Flood damaged 522 houses, 28 industries and factories including petrol pumps, 133 retail and wholesale shops, a bridge and a road each and two hospitals and two schools (Nepal Police Bhaktapur, 2075)

4.7.1 Negative Impact

The Bhaktapur Flood 2018 left many negative impacts to the society, people, and business sectors, some impacts according to the respondents are as follows;

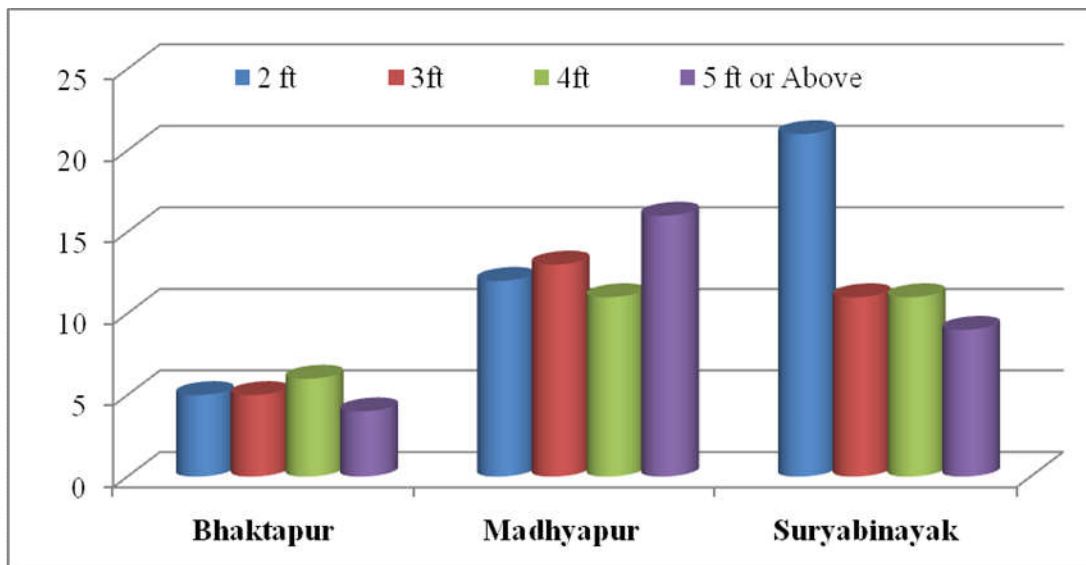


Figure 25: Percentage of Level of Water at House

Source: Field Survey, 2019

According to the respondents, the water level reached up to 10 ft in some house (Figure 26B) as many houses were made on underground. Most of Bhaktapur residents bored the water level up to 4ft, Madhyapur Thimi 5ft and Suryabinayak 2 ft (Figure 25).



Figure 26: Level of Water in Different Places: Outside (A) and Inside of House (B)

Source: Field Survey, 2019

4.7.1.1 Destruction

The flood damaged property worth Rs 119.35 million which was triggered by the incessant rains on July 11 and 12. Emergency team rescued 111 people from the inundated areas and four were injured. Flood damaged 522 houses, 28 industries and factories including petrol pumps, 133 retail and wholesale shops, a bridge and a road each and two hospitals and two schools (Nepal Police Bhaktapur, 2075). According to respondents flood mainly damage the water pumps of field and house, electric items, food grains and utensils.

4.7.1.2 Crops and Cattle

The overflowing water from the Hanumante River swept the vegetables and crops and also brought sand into the agricultural field. The sty made near the river was blown away with many pigs by the river.

4.7.1.3 Livelihood

The flood affected the life of thousand people as the Arniko Highway was also blocked for hours as of inundation. The hospitals and schools were remaining closed for many days because of inundation, according to respondents. Around 90 percent of respondents said their daily activities were hampered by the flood (Figure 27).

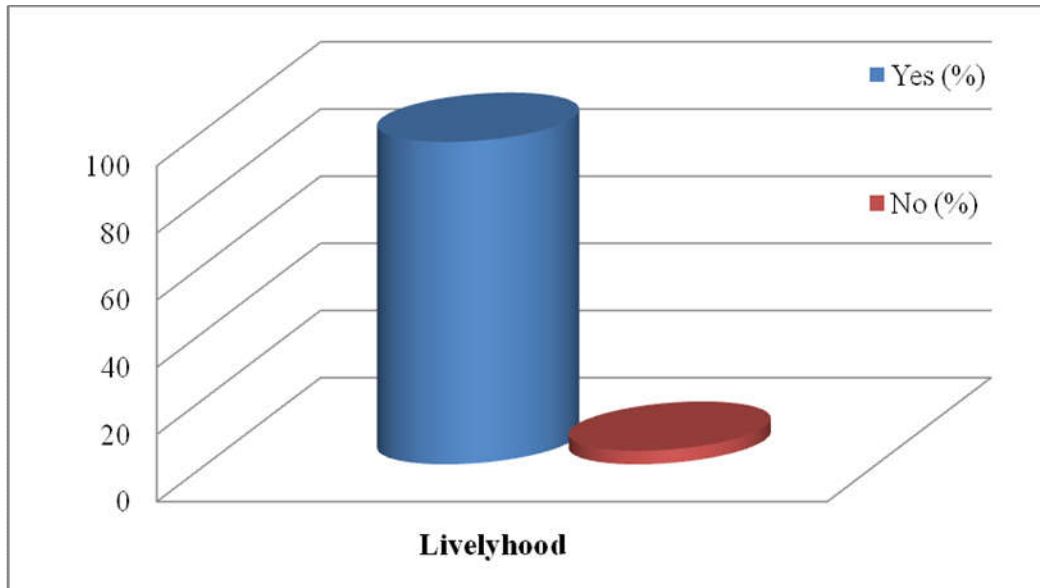


Figure 27: Respondents View on livelihood Affect

Source: Field Survey, 2019

4.7.2 Positive Impact

The Bhaktapur Flood also gave positive impact to the society and other agencies. According to the respondents and KII following are the positive impacts of the flood;

4.7.2.1 Sewer Management

The sewerage management project was working in Bhaktapur since last four years but there was no progress due to various problems but after 'Bhaktapur Flood 2018', the progress of work is tremendous and there are fewer problems during work by locals (GIETC-Lama Raman JV, 2014).

4.7.2.2 Construction of Corridor

Thought, there is a concept of the Hanumante Corridor but flood make it more vibrant and bureaucrat and politician forced to start the project as early as possible. The construction of the Hanumante Corridor is going on rapidly and within four months they have completed around 22 percent of their work (Higher Powered Committee for Integrated Development of the Bagmati Civilization, 2018).

4.7.2.3 Insurance

Figure 28 shows, around 15 percent of victims have insurance and they said, “*We think about insurance after this flood.*” Now, people understand the importance of insurance.

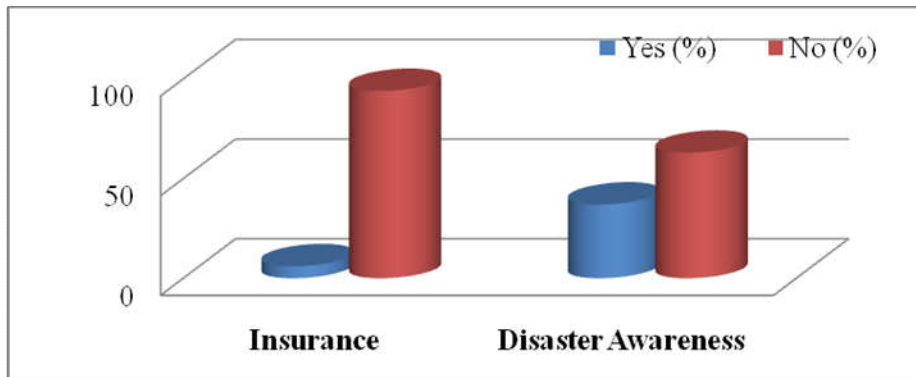


Figure 28: Respondents view on Insurance and Disaster Awareness

Source: Field Survey, 2019

4.7.2.4 Response of Stakeholders

The role of concerned authorities during disaster like District Administration Office, Local Government (Govt.), Security Forces (Nepal Army, Nepal Police and Armed Police Force, Nepal), NRCS, NGO are also assessed by the community and by themselves. The role of Security Forces is highly appreciated by the community. NGOs are highly criticized by the community as they did not have any presence during and after disaster. Community is not active in disaster and there are very less knowledge

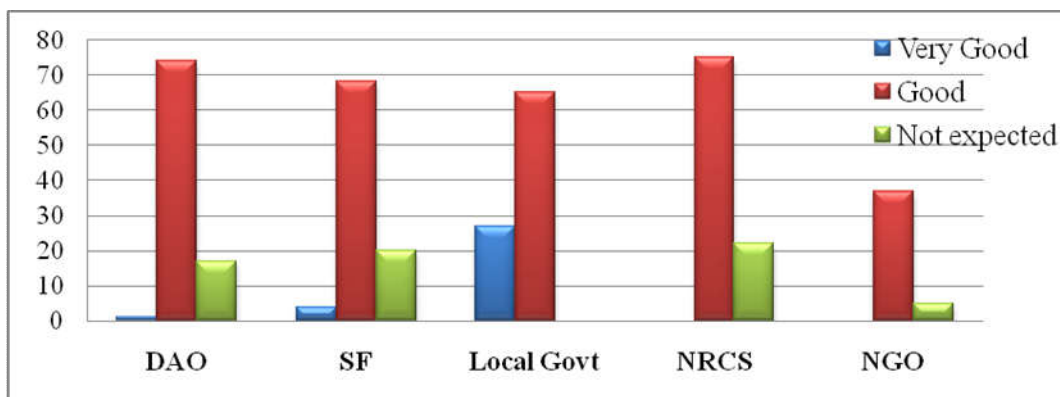


Figure 29: Response of Stakeholders during Disaster

Source: Field Survey, 2019

about flood, they do not have any plan what to do before, during and after the disaster. Figure 29 shows, the response of authorities were no very liked by the people. Though, security forces did their best with their limited resource and equipments but they are expecting more than what they did?

4.7.2.5 Conscious People

Community people are more conscious on disaster and they are putting pressure to the respective wards for the mitigation measure according to the respondents. They are registered their house in municipality to get more facilities after flood.

4.7.2.6 Awareness Program

Figure 28 shows; the disaster awareness rate is very less in affected area. Around 63 percent does not have idea and they did not know anything about the disaster awareness program in their community. Though, KII informants said they have disaster management plan. It means the plan needs to implement by giving priority in most vulnerable area wise. Hanumante cleaning and Arniko Highway cleaning program is conducting in district for cleaning and to aware people about the waste and disaster.

4.7.2.7 Hanumante Clean Campaign

The Hanumante River cleaning campaign was started to clean the waste and garbage of the Hanumante River as well as waste around the river and concept emerge after the 'Bhaktapur Flood 2018'. The river is filled with waste and that caused flood because it decreases the depth of river and water goes beyond the bank. The Hanumante cleaning campaign has completed 47th week and they are extended it to 100th week (Hanumante Cleaning Campaign, 2018).

4.8 Flood Mitigation Measure

The government is concerned about the flood and initiated many program in flood affected area especially to manage the Hanumante River. The Hanumante river is not only reason to cause flood so there are other planning also going on in municipalities regarding the management of urban area. They are strict in house registration and engineering of house. Most of respondents do not have any idea regarding the flood

mitigation work done by the government authorities. There are two big project is undergoing in Bhaktapur to mitigate the flood and manage the Hanumante river and many drains are under construction according to the KII. According to Water Resource and Development Division Bhaktapur there is no project on the Hanumante River because Metropolitans are working with their own master Plan (Water Resource and Irrigation Development Division, 2075).

4.8.1 Hanumante Corridor

The Hanumante Corridor is under construction for 2800 Meter (M) both side of the river. Construction is started from 200M North of Radhe Radhe Bridge (Arniko Highway) to Madhyapur Thimi. The budget of the construction is Rs. 820 million and contractor PS Golden Good Samanantar Joint Venture (JV) has started its work. The construction work also included the work of shoulder and Tick drain (40 cm) in every 30M to 40M to drain the rain into river. There are many problems in construction due to encroachment and meandering. There is a Dispute Settlement Committee comprises of Chief District Officer, Mayor of Madhyapur Thimi Municipality and Suryabinayak Municipality, Honourable House of Representative Mister Mahesh Basnet and President of District Coordination Committee for solving the arising problems. There is a provision, if more than 50 percent of land is come under the project then the committee would provide land from the land pulling method according to the project engineer (Higher Powered Committee for Integrated Development of the Bagmati Civilization, 2018).

4.8.2 Sewerage Management Project

Kathmandu Upatyaka Khanepani Limited has also project on the Hanumante River on management of sewerage along the Hanumante River. The project is around 12 Kilometer long and there is two water treatment plant one at Sallaghari and another at Manohara River. The construction work covers both side of river; the company lays the Hume pipe and collects sewerage at two places and after the treatment, the water release to the river. The project was started on July 2016 and going to finish on July 2019 but till now only 29 percent work has been done. The budget of construction is Rs. 56,28,69,202. There are many problem mainly ownership of land, sewerage, meandering of river and religious construction near the river. Most of the river bank is full of idols of various deities and people do not want to remove them. There were more than 80

incoming sewer pipe (ranging from 250 mm to 1500 mm) into the Hanumante River (GIETC-Lama Raman JV, 2014).

4.8.3 Hanumante Cleaning Campaign

The campaign committee is headed by Mayor of Suryabinayak Municipality undertaking awareness program regarding disaster and managing the city and river by cleaning. The campaign is participated by security forces, community, students and government officials. The business entrepreneurs collected two million Nepali currency and contributed to the cause through Mayor of Suryabinayak. The amount is used for Rubber Boats (Raft) as disaster equipments.

4.9 Summary

Bhaktapur is rapidly urbanizing with high population growth rate. The change of water bodies and land use show the arable land is converted into concrete land. The concretization of land reduced the charging level of water. The urban areas are not well planned but construction of houses is increasing in trend. It has plain land in mid Western and mid Southern part, which regularly receives flood because it is the lowest part of the district. In previous time, flood comes and goes but people and media did not cover because it went through the farm land and it only damages crops and vegetables. Now, the density of Bhaktapur is very high. The river areas are vulnerable in flood it is also marked by the district Disaster Management Committee but the people living over there has very less knowledge about the flood.

The Hanumante River is passes through mid of Bhaktapur. It has huge catchment area and collected more than 60 percent of water from the district. It is filled by wastes, garbage's, soil and it is also encroached by industries, community, farmers and religious groups. New construction is undergoing and on the name of Hanumante Cleaning Campaign both cleaning of wastes, garbage and awareness program are conducted to the community. There is more precipitation on July as it receives more water in rainy season

‘The Bhaktapur flood 2018’ hampers the daily life of thousands of people more than a week. The flood destroyed property, cattle, crops and vegetables. The most important thing is it made people suffer for at least weak because of garbage and polluted water

which accumulated inside the house. Though, the reasons behind the Bhaktapur flood are encroachment of river, unplanned settlement, mismanagement of river, poor design of drains, lack of drainage system, infrastructure near to river and inadequate drains. But the main reason behind “The Bhaktapur flood 2018” was incessant rain in Bhaktapur since last three four days prior to flood. The most affected area is the lowest area from the sea level. The flood is predictable and possible to forecast in Bhaktapur by installing equipments in the river. The flood can be mitigated and prevented by constructing embankments, levees, machinery wall, gabion wall along the river bank and most vulnerable places.

CHAPTER V

SUMMARY AND CONCLUSION

5.1. Summary

The urban disasters are common around the world and urbanization is increasing in Nepal. The most of urban area especially plain areas are frequently receiving flood. The Bhaktapur is the smallest district and it has little bit of plain lands and that area is regularly affected by flood. The regular flooded area is the lowest part (1300-1400 M) of Bhaktapur in comparison to other areas. All three municipalities are urbanizing and populated very fast. The mixed method design is used to prepare this paper. The primary data are collected from the field survey and field observations and also from offices. The secondary data collected from various government offices of Bhaktapur district and literatures. The collected data are processed and validated with KII and already published fact and figures.

The management of the Hanumante River is not properly handled shows all counts and survey. The bank of Hanumante River has been encroaching by the community, farmers, and religious groups since long time and also settlements are established near the river. There is a fixed criterion of Hanumante River but those are not managed and followed. The catchment area of the river is enormous and it carries more than 60 percent of water from Bhaktapur district. The waste and sewerage are thrown into the river and dumped near the bank of river. There are no strong embankments made by the authority though they are working since long time. The idols and constructions are constructed in and near the river bank. The depth of river is less in comparison to water level. So, depth of river must be increased according to the place and accumulation of water and it has around two and half meter depth.

On 12 July, 2018 Bhaktapur suffered by flood. The main reason behind the flood was the Hanumante River because the water of river flows beyond the bank. The main cause of 'Bhaktapur Flood 2018' was incessant rain in Bhaktapur and other subsidiary causes are unplanned settlements, lack of drainage system. People have thought that flood can be mitigated and prevented. The flood in Bhaktapur can be predicted by installing

equipments at the river and by constructing machinery walls and gabion wall at vulnerable area. The vulnerable areas are mapping by the stakeholders but the people who are living in vulnerable area do not have knowledge about the disaster and its risk. Thimi and Radhe Radhe are the lowest part of Bhaktapur and this area is often flooded.

5.2. Conclusion

Nepal is prone to water induced disasters and every year flood affecting human lives and destroying infrastructure and property. The Bhaktapur District frequently receives flood around the periphery of the Hanumante River. The district is urbanizing with increasing population rapidly causing flood because as people are not aware of the disaster and flood vulnerable area of Bhaktapur.

The Hanumante River caused flood because it is encroached by the community, farmers, religious groups and factory. The main cause of 'Bhaktapur Flood 2018' was the incessant rain prior to flood. The flood can be predicted and mitigated by constructing machinery wall, embankments, clearing the waste from the river and installing equipments in the river. The research identified that the river covers large catchment area and all water comes finally to the Hanumante River from various sources. The waterways of river are altered because of encroachment and waste dumping. The most flooded area is the lowest part of Bhaktapur.

There must be quick intervention of govt. authorities on management of the Hanumante River to mitigate and prevent the flood. The drainage system inside the urban area needs to manage properly. There must be further study to predict the flood by installing equipments on the Hanumante River Basin. The research also identified the following ways to mitigate and prevent the flood. The government agency need to manage waste product through proper planning of urban area, construction of embankments and drainage system, clear waste from rivers ways and protection of river rights.

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APPENDICES

Appendix 'A'

(Referred to Page 17 and Para 5)

Interview Guide: Key Informant Interview Questions

Researcher Name:

Interview Date and time:

Namaste

My name is Ramesh Kumar Pandey. I am conducting an academic research on '**Urban Disaster Risk Reduction: A Case Study of Bhaktapur Flood 2018**'. Your responses will be kept strictly confidential. You have full authority and rights to escape any question as well as leave the interview at any time. Results will be reported in aggregate form only. This is only for research purpose.

Interview Questions:

Name (optional):

Contact:

Office:

Age-

Gender-

1. How are you working on Disaster regarding the Disaster Risk Reduction management Act?

2. What do you think of the causes of floods?

(i) Infrastructure near to river [] (ii) River encroachment [] (iii) Unplanned Settlements [] (iv) Lack of/Inadequate Drains [] (v) Poor design of Drains [] (vi) Mismanagement of river []

3. Did the local government take initiative on Disaster risk reduction?

Yes [] No [] I don't know []

4. Have you formed the committee to work on the Policy if so how?

5. Do you have an idea of Cluster? Are they are active? If so how are they coordinating each other?

6. Does any disaster preparedness program initiated by your municipality/ward in your Area of Responsibility? Yes [] No [] If any....
7. Do you have an idea of the Government Nepal's urbanization policies? Yes [] No [] yes then are it implemented properly?
8. Is it possible to mitigate the flood by managing the Hanumante River? Yes [] No [] If Yes then specify.....
9. Are you conducting Disaster Awareness program?
10. Do you have the mapping of various disasters (Flood)?
11. Do you have any disaster plan/ document to prevent/control the disaster? Yes [] No []. If yes then
12. Do you have enough Disaster equipments in your office? Y/N
13. The event of July 11, 12, 2018 (27th and 28th Asar, 2075) is an inundation or Flood?
14. Is flood forecasting possible (Hanumante River)? Y/N
15. Is there any suggestion or comments on Disaster Risk Reduction and Management Act 2074?

Appendix 'B'**(Referred to Page 17 and Para 5)****Interview Questions (for Victims)**

Researcher Name:

Interview Date and time:

Namaste

My name is Ramesh Kumar Pandey. I am conducting an academic research on '**Urban Disaster Risk Reduction: A Case Study of Bhaktapur Flood 2018**'. Your responses will be kept strictly confidential. You have full authority and rights to escape any question as well as leave the interview at any time. Results will be reported in aggregate form only. This is only for research purpose.

Interview Questions:

Name (Optional): _____ Place (Area): _____ Age-
 Education- _____ Local (L)/ Migration (M): _____ Gender-
 Occupation: Householder/Student/Civil Servant/Public Servant/Unemployed, Other
 Specify ...

Disaster

1. Since how long you are staying/ living in this community?
 - a. 1-3yrs [] b. 4-7 [] c. 7-10 [] d. 10-20 [] e. above 20yrs []
2. Do you observed any event of disaster? If yes what are they? Focus on Flood occurred, how many time?
3. Do you think these floods can be permanently prevented? Yes [] No [] I don't know [] If yes, how?
 - (i) Provision/proper maintenance of adequate drains []
 - (ii) Raising of buildings/shelters/shops well above ground level []
 - (iii) Education on prevention and dealing with floods []
4. Do you know any organization working on flood mitigation to reduce the risk of

disaster? (i) Yes [] (ii) No [] (iii) if yes specify.....

River Management and Policies

5. Do you think the Hanumante River is managed by government to mitigate the disaster (flood)? Yes/How

6. Do you know about any mitigation measures done in Hanumante river in order to reduce the risk of flood? (i) Yes [] (ii) No []

7. Is local govt. conducting any disaster awareness program? Y/N.... if yes....

Cause and Impacts of Flood

8. What do you think of the causes of floods?

(i) Infrastructure near to river [] (ii) River encroachment [] (iii) Unplanned Settlements [] (iv) Lack of/Inadequate Drains [] (v) Poor design of Drains [] (vi) Mismanagement of river []

9. What was the extent of flood on your premises? (i) up to 2 ft [] (ii) up to 3ft [] (iii) up to 4ft [] (iv) over 5 ft []

10. How was the response during disaster and are you satisfied with the response mechanism of following Normal/Good /very good

- | | |
|----------------|--|
| a) DAO | good [] very good [] Not as expected [] |
| b) SF | good [] very good [] Not as expected [] |
| c) Local Govt. | good [] very good [] Not as expected [] |
| d) NRCS | good [] very good [] Not as expected [] |
| e) NGO. | good [] very good [] Not as expected [] |

11. Are you still feeling the risk of being flooded?

12. What people used the term flood in their language (Newar)?

13. What is their perception regarding flood? (Culturally and regionally)?

14. Did floods affect your livelihood? Yes [] No []

15. Did flood affect you? If yes what did you lose? How it effects etc...

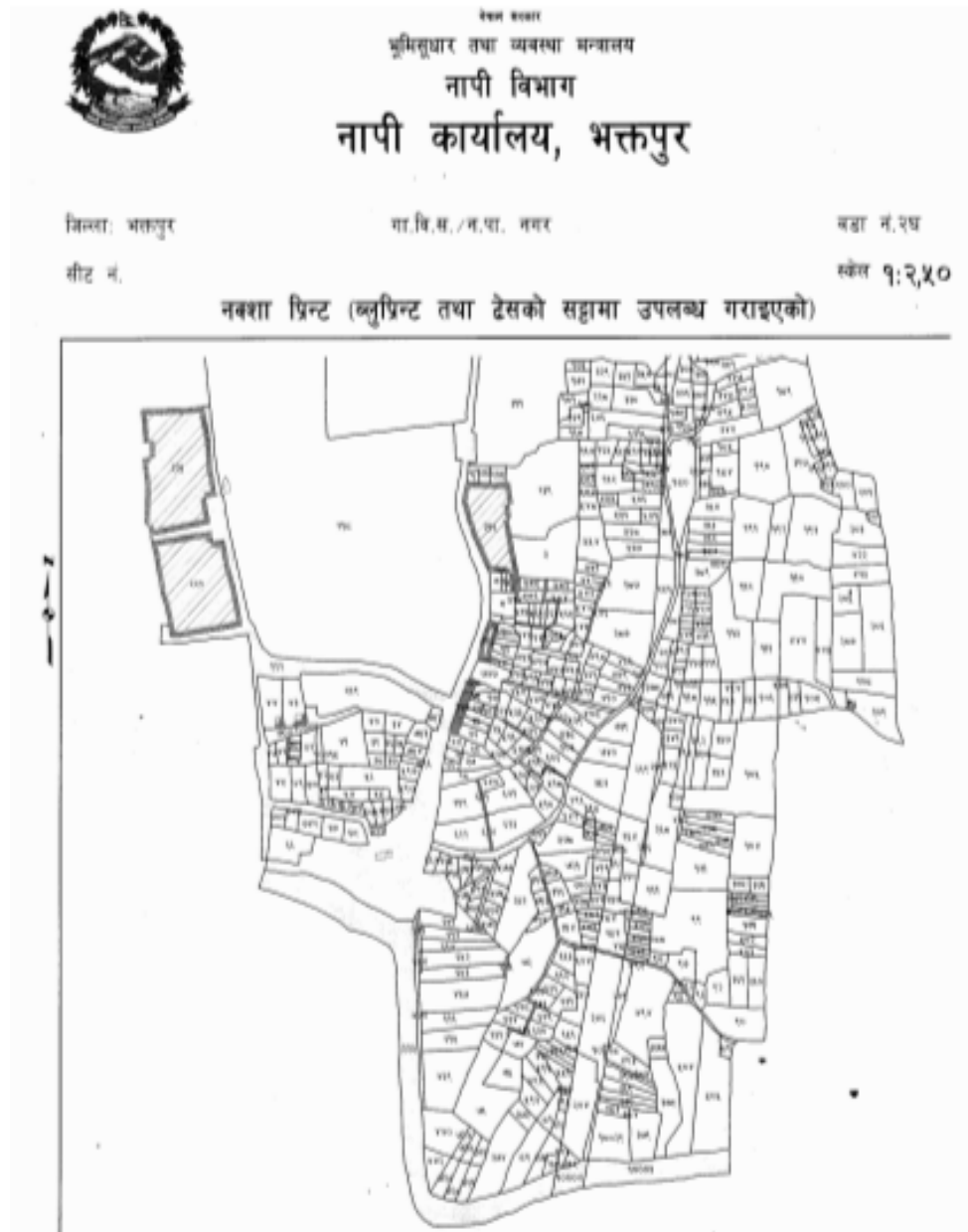
16. Do you have Insurance of House/ Shop/ Crop/Property

17. What are your suggestions in regards to mitigate the flooding risk time and again?

Appendix 'C'

(Referred to Page 7 and Para 4)

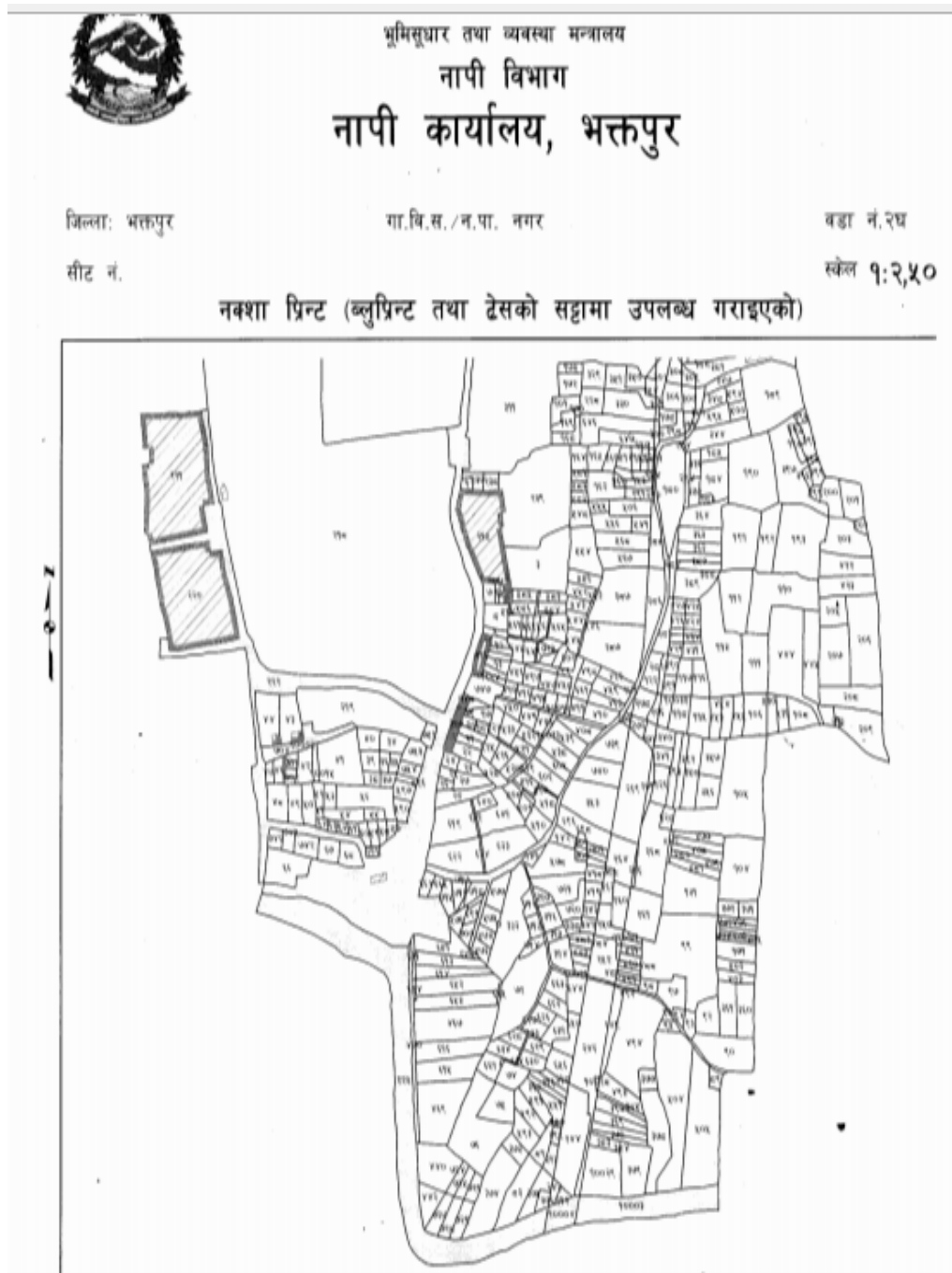
Survey map Panchayat Nagar Ward No. 2 Gha (Chyamasingh)



Source: Survey Office, Bhaktapur, 2019

Appendix 'D'
(Referred to Page 7 and Para 4)

Survey Map District Bhaktapur, Panchayat-Nagar, Ward No. 16 (Barahisthan)



Source: Survey Office, Bhaktapur, 2019