

# Disaster Vulnerability Assessment in Parshuram Municipality, Dadeldhura, Nepal

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## Abstract

*This study explores the disaster vulnerability of adjoining community of Mahakali river, Parshuram municipality, Dadeldhura. A questionnaire was used to collect information on various physical, social, economic, and environmental vulnerability. Key informant interview was conducted with ward chairpersons and community disaster management committee members. Likewise, three focus group discussions were conducted with the purpose of drawing insight on different factors of disaster vulnerability in the community. Moreover, five community disaster risk management plans were reviewed to understand the types of vulnerability of community. It has been found that weak geological structure and weak physical infrastructure-house, bridge, buildings are the physical vulnerability. Likewise, lack of awareness on disaster preparedness, non-implementation of building code and traditional practice are the social vulnerability. Similarly, poverty, seasonal migration, lack of irrigation and land, low quality of soil are the economic vulnerability. Heavy rainfall, forest fire, lack of conservation of water source, encroachment of wildlife inhabitants and deforestation are factors to environmental vulnerability of study area. It is found that there are various vulnerability factors that need to be minimized through the capacity enhancement.*

**Keywords:** Flood, vulnerability, assessment, disaster, community, environment

## Introduction

Vulnerability is the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Vulnerability varies significantly within a community and over time. This definition

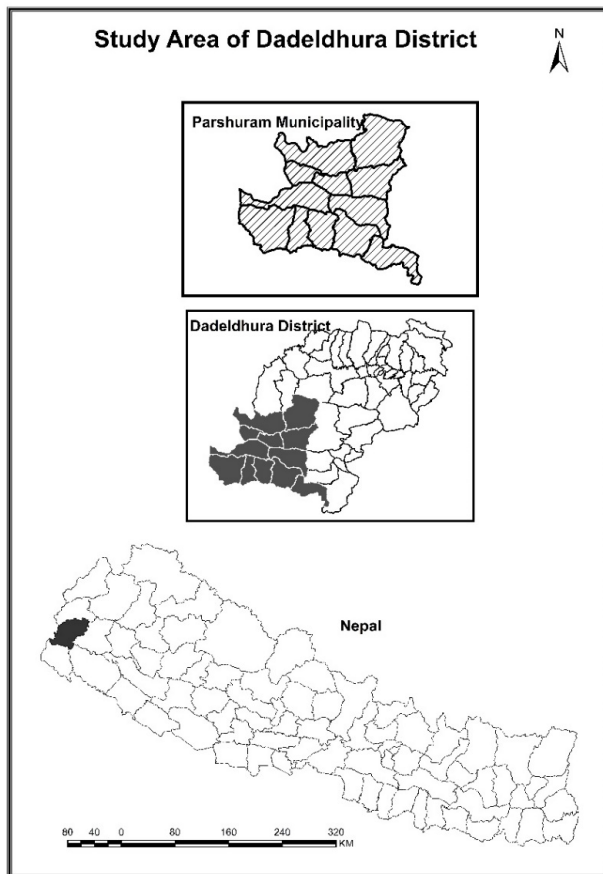
identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure (UNISDR, 2009). Social vulnerability is a pre-existing condition of the population that influences its ability to prepare for, respond to, and recover from hazard events (Chen, Cutter, Emrich, & Shi, 2013). Vulnerability refers to the propensity to be harmed, in this case by a hazard, and to be unable to deal with that harm alongside the social processes creating and maintaining that propensity. Vulnerability encompasses human decisions, values, governance, attitudes, and behaviour forming situations in which hazards could potentially cause harm. Harm might be casualties, social and business interruption, and property damage (Kelman, Gaillard, & Lewis, 2016).

Vulnerability refers to the population's capacity to anticipate, cope with, and recover from the impact of a hazardous event (Du, Ding, Li, & Cao, 2015). Vulnerability represents the susceptibility of a given population to harmful effects from exposure to hazardous events. It directly affects disaster preparation, response, and recovery (Testa, Pettigrew, & Savoia, 2014). The concept of vulnerability has been applied in various fields, such as disaster studies, sustainable development, urban growth, gender studies, and climate change, to better understand susceptibility to stresses and shocks originating in environmental and social change. Interpretations of vulnerability depend on disciplinary perspective and context (Aksha, Juran, Resler, & Zhang, 2018). Vulnerability is the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (an extreme natural event or process). It involves combination of factors that determine the degree to which someone's life, livelihood, property and other assets are put at risk by a discrete and identifiable event (or series or 'cascade' of such events) in nature and in society (Wisner, Blaikie, Cannon, & Davis, 2003).

Although natural disasters affect everyone within their orbit, they are not 'levellers' in that their impacts do not fall on everyone in the same way. On the contrary, the risk of vulnerability and the impacts of disaster are disproportionately borne by those who are already socio-economically and physically disadvantaged and who have fewer resources to enable them to 'bounce back' to some measure of normality (Mehta, 2007). The concept of vulnerability clearly involves varying magnitudes. Some people experience higher levels than others. But we use the term to mean those who are more at risk. When we talk of vulnerable people, it is clear that we mean those who are at the 'worse' end of the spectrum. When used in this sense, the implied opposite of being vulnerable is sometimes indicated by our use of the term 'secure' (Wisner, Blaikie, Cannon, & Davis, 2003).

The vulnerability factors can be found out through the vulnerability and capacity assessment (VCA). Vulnerability assessment helps understand the complex set of factors that contribute to adaptive capacity of the households and describes a diverse set of methods used to systematically integrate and examine interactions between humans and their physical and social surroundings (Toufique & Islam, 2014). A hazard vulnerability assessment (HVA) systematically evaluates the damage that could be caused by a potential disaster, the severity of the impact, and the available medical resources during a disaster to reduce population vulnerability and increase the capacity to cope with disasters ((Du, Ding, Li, & Cao, 2015).

## Methods and Materials



**Figure 3.** Location of the study area

Parshuram Municipality is located in Dadeldhura district of Sudur Pashchim Province. This municipality was established in 2014 by merging of existing two village development committees. Parshuram municipality spreads  $29^{\circ} 07''$  north to  $29^{\circ} 02''$  north latitude and  $80^{\circ} 21''$  east to  $80^{\circ} 47''$  east longitude (Parshuram Municipality, 2019). Parshuram municipality is encircled with Aalital Rural Municipality in the east, Mahakali River in the west, mid-hill in the north and Chure range in south. The municipality, with an area of  $441 \text{ km}^2$  (Parshuram municipality, 2019) is divided into 12 wards. Out of total area  $414.70 \text{ km}^2$ ,  $32.17 \text{ km}^2$ ,  $50.48 \text{ km}^2$  and  $332.05 \text{ km}^2$  is occupied by settlement, agriculture and forest

respectively. The maximum elevation of the municipality is 1532 m and the lowest elevation is 303 m above sea level. There is a total of 5,765 household in the municipality.

The literacy rate is 74.8% in this municipality. It is 85 km far from the district headquarters and 745 km from Kathmandu. The total population of this municipality is 43,942 individuals (CBS, 2011). Mahakali, Rangun, Puntura, Shirsha, Sadhani are the major rivers of municipality. This is one of the flood prone area of Dadeldhura district (DPRP, 2075). Every year the adjoining community of rivers located in Parshuram municipality has been stricken by multiple disaster. So, the study focuses on the geographical area of Rangun, Mahakali, Puntura and Sadhani rivers namely Puntura, Motahaldu, Siddhathan, Sargauda, Simalkhet, Thandajala, Kunda, Chhela, Banda, Tatapani, Chandani, Sadhani, Rajeuda, Adiwani and Siddhanath village.

A questionnaire was used to collect physical, social, economic and environmental vulnerability factors as well as socio-economic data. It was carefully observed the geographical location, rivers, agricultural land, forest and settlement in all the villages of study area. Key informant interviews were conducted with the ward chairpersons and members of community disaster management committee (CDMC). Likewise, three focus group discussions were conducted with the participation of community member. Focus group discussions aimed to draw the insights of major vulnerability factors, possible disaster impacts and coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management. The collected different data were tabulated and analyzed in Microsoft Excel. The community disaster management plan was reviewed to understand the context of community vulnerability.

Vulnerability is the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management (UNISDR, 2017). Following are the four types of vulnerability.

**Physical vulnerability:** Physical vulnerability refers to the susceptibility of individuals, households and communities to loss due to the physical environment in which they find themselves (UNISDR, 2002:47). It relates to aspects such as access to suitable land, land use planning, housing design, building standards, materials used for building houses, engineering, accessibility to emergency services and other similar aspects. Physical vulnerability may be determined by aspects such as population density levels, remoteness of a settlement, the site, design and materials used for critical infrastructure for housing (UNISDR, 2002).

**Social vulnerability:** Social vulnerability emphasize the different burdens of disaster losses within and between places (Chen, Cutter, Emrich, & Shi, 2013). Social vulnerability influences the ability to prepare for, respond to, and recover from disasters. The identification of vulnerable populations and factors that contribute to their vulnerability are crucial for effective disaster risk reduction. Nepal exhibits multi-hazard risk and has experienced socioeconomic and political upheaval in recent decades, further increasing susceptibility to hazards (Aksha, Juran, Resler, & Zhang, 2018).

**Economic vulnerability:** The level of vulnerability is highly dependent upon the economic status of individuals, communities and nations. The poor are usually more vulnerable to disasters because they lack the resources to build sturdy structures and put other engineering measures in place to protect themselves from being negatively impacted by disasters (UNISDR, 2002).

**Environmental vulnerability:** Natural resource depletion and resource degradation are key aspects of environmental vulnerability. The discussion of environmental aspects of vulnerability covers a very broad range of issues in the interacting social, economic and ecological aspects of sustainable development relating to disaster risk reduction. The key aspects of environmental vulnerability can be summarised in five distinctions. These are the extent of natural resource depletion, the state of resource degradation, loss of resilience of the ecological systems, loss of biodiversity and exposure to toxic and hazardous pollutants (UNISDR, 2002:47).

## **Results and Discussion**

This study has explored assessed physical, social, economic and environmental vulnerability of disaster.

### **Physical vulnerability**

Nepal is equally at risk due to its seismic activity. The subduction of the Indian tectonic plate into the Eurasian (Tibetan) plate has been continually thrusting the Himalayas upwards since its formation millions of years ago, making it geographically unstable (NDR, 2019). So, Parshuram municipality also has a weak structure that result high earthquakes impact. The constructed physical infrastructures particularly majority of the houses have not been followed the building code of Nepal's government. Exploitation of natural resources such as sand and gravel from the river is susceptible for flood and erosion. Nepal is highly prone to multiple hazards, which exist primarily because of its diverse topography and climatic conditions, geological position, rugged mountains and steep landscape (Nepal Disaster report, 2019). Not patched the hole of house and walls increase the vulnerability for snake bite. The embankment of river has been used as a road. Consequently, it might tend the possibility for flood and erosion.

**Table 1.** Physical vulnerability factors of Parshuram municipality

Physical vulnerability factors	Possible disaster
Weak geographical structure	Earthquake
Weak physical infrastructure-house, bridge, buildings etc.	Earthquake
Excavate the sand and gravel from river and close to embankment	Earthquake, flood
Not to patch the hole of wall	Snake bite
Flooded river of Mahakali, Puntura, Rangoon and Sadhani	Flood/drowning/swipe out, erosion
Sand and pebbles carrying truck runs on the embankment	Flood

**Source:** Field survey, 2019.

Houses in the rural area of municipality are built up with sand and mud or wood. This type of house is vulnerable to fire, windstorm, flood and earthquake. Out of 853 households of study area, 241 houses are *kachchi* houses. Empirically, rest of the houses also not followed the building code. Likewise, 162 households are close to different rivers. Being close to the river is itself vulnerable for flood, inundation, swipe out and drowning. Nearly about 4000 *ropani* land is susceptible to flood. Almost all 853 households have been suffering from drought in terms of irrigation and drinking water.

**Table 2.** Physical vulnerability of Parshuram municipality

Village	Flood			Drought	
	<i>Kachhi</i> House	House close to river	Land ( <i>Ropani</i> )	Possible affected House	Land
Puntura, Motahald, Siddhathan	28	18	150		
Sargauda, Simalkhet, Thandajala	21	22	300		
Kunda, Chhela	19	20	200	80	150
Banda, Tatapani, Chandani	17	21	150	98	150
Sadhani	24	19	800		
Rajeuda	32	18			900
Adiwan	50	21	1,200		
Siddhanath	50	23	1,200		
Total	241	162	4,000	178	1,200

**Source:** Field survey, 2019.

*Kachchi:* house made with mud and stone or wood with thatch roof or Zink or mud

## Social vulnerability

Table 3 depicts the social vulnerability of Parshuram municipality. The level of social well-being of individuals, households and communities directly impacts on their level of vulnerability to hazards. Levels of education, literacy and training, safety and security, access to basic human rights, social equity, information and awareness, strong cultural beliefs and traditional values, morality, good governance and a well-organised cohesive civil society, all contribute to social wellbeing with physical, mental and psychological health being critical aspects (UNISDR, 2002).

There is caste-based discrimination in the community. Caste based discrimination is punishable by law but hardly find implementation. Similarly, gender-based discrimination is also a social disorder in the community. Both cast based and gender-based discriminations are factor of vulnerability for multiple disaster. Traditional norm and values also play significant role to the vulnerability. Key issues that contribute to women's vulnerability include lack of education, limited access to resources, economic conditions, and cultural issues. Several studies have reported that women are more vulnerable because they have less access to education and information. Awareness and knowledge of hazards and the risk they pose is the first step in order to manage disaster risks (Erikson, 2014).

Most of the houses are build up with mud and stone and wood. Majority of the houses have not been followed the building code sanctioned by government of Nepal. There is low literacy rate. Consequently, the awareness level of community on the safety from different disasters is also lower. Community have no practice of regular simulation.

**Table 3.** Social vulnerability factors of Parshuram municipality

<b>Social vulnerability factors</b>	<b>Possible disaster</b>
Caste based discrimination	Multiple disaster
Gender based discrimination	Multiple disaster
Traditional norms and values	Multiple disaster
Not implementation of building code	Earthquake
Low literacy rate	Multiple disaster
Lack of awareness	Multiple disaster
Lack of earthquake safety plan	Earthquake
Lack of Go Bag preparation	Multiple disaster
Not conducting simulation	Multiple disaster
Not connected early warning system	Flood
Lack of awareness on non-structural mitigation	Multiple disaster

**Source:** Field survey, 2019.



Vulnerability is not equally distributed. The aged, orphans, nursing mothers and their offspring, and the disabled are more vulnerable than others. The issue of gender and in particular the role of women requires special consideration (UNISDR, 2002). Person with disability, senior citizen, children, Dalit, Janajati, women are the major vulnerable groups of community. There are 853 households in the study area where is 2,132 females survive. Those all are vulnerable in various spheres mainly gender, caste, traditional norms and values. This type of social taboo is a factor of social vulnerability for disaster. In addition, there are 66 persons with disability, 339 senior citizens, 584 children under the age of 5 years and 1414 children under the age of 18. Likewise, 615 Dalit and 515 Janajati. These all-age groups, caste and person with disability are the vulnerable group of community.

**Table 4.** Vulnerable population of Parshuram municipality

Village	Person with disability	Senior citizen	Children under 5 years	Children 6-17 years	Dalit	Janajati
Puntura, Motahaldu, Siddhathan	8	60	52	144	150	35
Sargauda, Simalkhet, Thandajala	6	32	50	115	50	0
Kunda, Chhela	3	36	59	167	25	5
Banda, Tatapani, Chandani	3	41	59	163	45	50
Sadhani	17	40	86	175	35	175
Rajeuda	6	32	89	240	130	195
Adiwan	19	58	93	195	25	55
Siddhanath	4	40	96	215	155	0
Total	66	339	584	1414	615	515

**Source:** Field survey, 2019.

The risk of vulnerability and the impacts of disaster are disproportionately borne by those who are already socioeconomically and physically disadvantaged and who have fewer resources to enable them to ‘bounce back’ to some measure of normality. These include the very young and very old, those living in poverty, ethnic minorities, the physically and mentally disabled, and women -especially those who are poor, elderly, pregnant, or lactating (Mehta, 2007).



### **Economic vulnerability**

There is poverty in the community. Similarly, there is very limited opportunity for the employment locally. On the other hand, majority of the people has not the enough land to cultivate the crop. Consequently, economically active population specially men use to go India as a seasonal migration. In the absence of young generation, there is scarcity of human resource for search and rescue and manage to safe from disaster at the time of disaster. Market centre of these areas is far to purchase the daily necessity. This area is located in the foot of Chure range. So that there is sandy soil which has low fertility. Majority of the agrarian land is in drought so that there is lack of irrigation facility.

**Table 5.** Economic vulnerability of Parshuram municipality

<b>Economic vulnerability factors</b>	<b>Possible disaster</b>
Poverty	Multiple disaster
Not enough land for agriculture	Multiple disaster
Seasonal migration to India	Multiple disaster
Far from the market center	Multiple disaster
Lack of irrigation	Multiple disaster
Low production due to sandy soil	Multiple disaster

**Source:** Field survey, 2019.

The level of vulnerability is highly dependent upon the economic status of individuals, communities and nations. The poor are usually more vulnerable to disasters because they lack the resources to build sturdy structures and put other engineering measures in place to protect themselves from being negatively impacted by disasters. Whilst a wide range of factors combine to contribute to levels of vulnerability to the impact of hazards in developing countries, poverty probably has the single most important influence. It should also be clear that our definition of vulnerability has a time dimension built into it: vulnerability can be measured in terms of the damage to future livelihoods, and not just as what happens to life and property at the time of the hazard event. Vulnerable groups are also those that also find it hardest to reconstruct their livelihoods following disaster, and this in turn makes them more vulnerable to the effects of subsequent hazard events (Wisner, Blaikie, Cannon, & Davis, 2003).

### **Environmental vulnerability**

Parshuram municipality also has environmental vulnerability related to multiple disaster. The community has an impact of global warning. So, the cropping season, hazard season and weather calendar also changed comparing to the past. The global warming tends to the climate change therefore the rate of precipitation is fluctuated. Heavy rain triggers

the flood and no rain tends the drought. Forest fire cause the forest degradation and house of the village. Most of the community face problem related to drought mainly due to the lack of conservation of water source. Likewise, wildlife attack to the human being, domestic animal and damage crops due the unavailability of food in the forest. Moreover, when human being encroaches the forest to establish settlement and habitat of wildlife, community has been suffering from wildlife. Due to the lack of sanitation, firewood and fodder dumped inside the house and surrounding; and in search of frogs and mouse in and surrounding the house leads to vulnerability of snake bite.

**Table 6.** Environmental vulnerability of Parshuram municipality

<b>Environmental vulnerability factors</b>	<b>Possible disaster</b>
Global warming	Drought, fire
Heavy rainfall	Flood
Forest fire	Fire
Lack of conservation of water source	Drought
Not available food for wildlife	Wildlife attack
Establish human settlement and cultivation close to forest	Wildlife attack
Lack of sanitation	Snake bite
Firewood and fodder dumped inside the house and surroundings	Snake bite
Searching the food such as frogs and mouse by snake in and surrounding the house	Snake bite
Deforestation	Multiple disaster
Lack of plantation in bare land	Multiple disaster

**Source:** Field survey, 2019.

## **Conclusion**

Parshuram municipality is one of the disaster-prone areas of Dadeldhura district. Particularly, due to the Mahakali river and its tributaries, people who live nearby to river and hill area are highly vulnerable. Heavy precipitation, high wetness and steepness of watersheds and river channels contribute to flood magnitudes. Moreover, the subduction of the Indian tectonic plate into the Eurasian (Tibetan) plate has been continually thrusting the Himalayas upwards since its formation millions of years ago, making it geographically unstable. So, this is also one of the earthquake prone area. There is inner Tarai and hill area in Parshuram municipality which is vulnerable from multi disaster. All the four vulnerabilities namely physical, social, economic and environmental are existing in this municipality. Mud and stone houses are vulnerable to earthquake, fire and wooden house for windstorm. Likewise, most of the houses are not followed

building code sanctioned by Government of Nepal. River encroachment and excavating of sand and gravel which results the vulnerability for flood and erosion.

There is mixed settlement of Dalit, janajati, women, person with disability, children, senior citizen and poor. So, there is a social vulnerability as well. People have lack of awareness on simulation exercise, national building code and non-structural mitigation. Similarly, there is caste based and gender-based discrimination and practices of traditional norms and values. So that the social vulnerability is existing. Community has not the opportunity for employment, not enough land for food production, lack of irrigation and poverty tends to economical vulnerability. Global warming, heavy precipitation and less precipitation, forest fire, deforestation, lack of conservation of water resource are the major environmental vulnerability of Parshuram municipality. Likewise, establishing the human settlement and cultivation close to forest and wildlife inhabitant susceptible for environmental vulnerability. In terms of vulnerability, Aidiwan and Sidhanath community are highly vulnerable in comparison of other communities. Likewise, Banda, Tatapani, Chandani are the lowest vulnerability. This study has explored the vulnerability of villages that are adjoined with Mahakali, Rangun, Puntura and Sadhani river. But other area of the municipality might have various vulnerability to be explored.

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