Disaster Vulnerability and Risk Reduction Measures: A Study of Urban Floods in Srinagar City

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This is to certify that the dissertation/thesis titled Disaster Vulnerability and Risk Reduction Measures: A Study of Urban Floods in Srinagar City submitted by Mr/Ms. Gulzar Ur Rehman in partial fulfillment of the requirements for award of degree of M.Phil/M.Tech/Ph.D of Jawaharlal Nehru University, New Delhi, has not been previously submitted in part or in full for any other degree of this university or any other university/institution.

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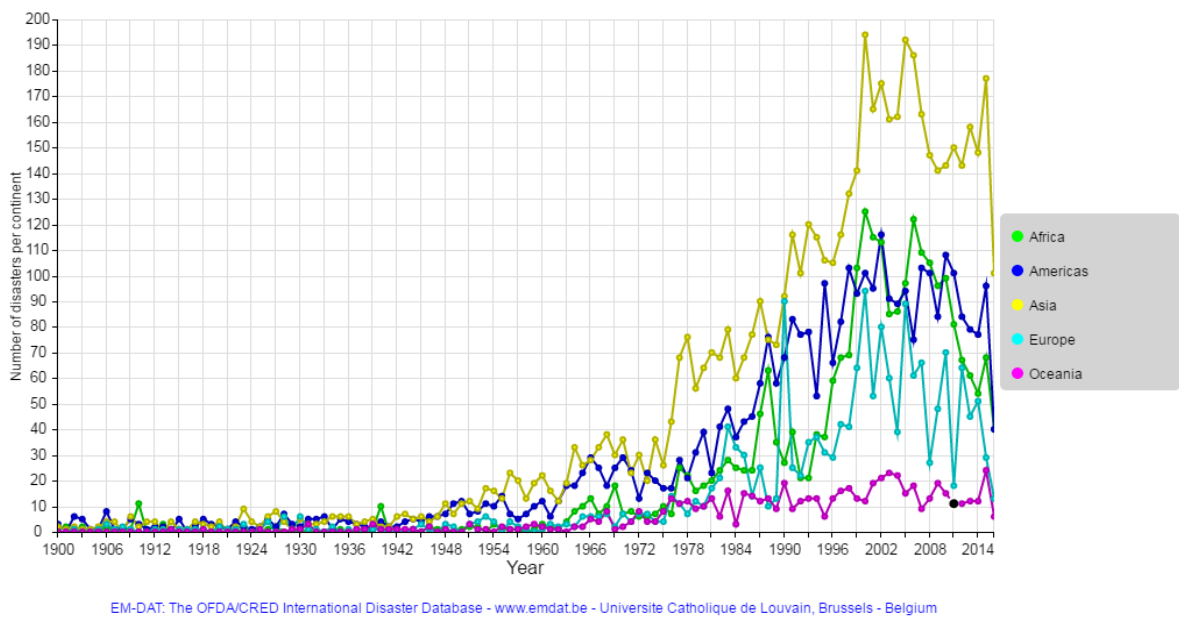
Chapter I
Introduction

1.1 Background to the study:

Environmental setting and events such as disasters have shaped human history. With time, the influences of environmental hazards have increased over time and have become an issue of serious concern. However, Disasters have typically been categorized based on their cause, like Natural, Human-made, or Complex disasters (where one single root cause cannot be identified). However, there is an increasing shift in this classification. The shift from viewing disasters as 'an act of God', to separating the notion of disasters from hazards (disasters are human-made, while hazards are natural events). This shift in the classification has been done, keeping in view the increasing human influence on the occurrence of disasters. The number of disasters reported has been on the increase for the last three decades. As seen in Figure 1.1, Since the 1970s and 1980s, the number of recorded floods from all five regions of the world has increased dramatically. The question as to whether the increased number is due to increased reporting or due to an actual rise in incidents is debatable. The comparative chart also showed that the Asian region reported the highest number of disasters.

Figure 1.1: Natural disasters recorded in various regions from 1900 to 2016

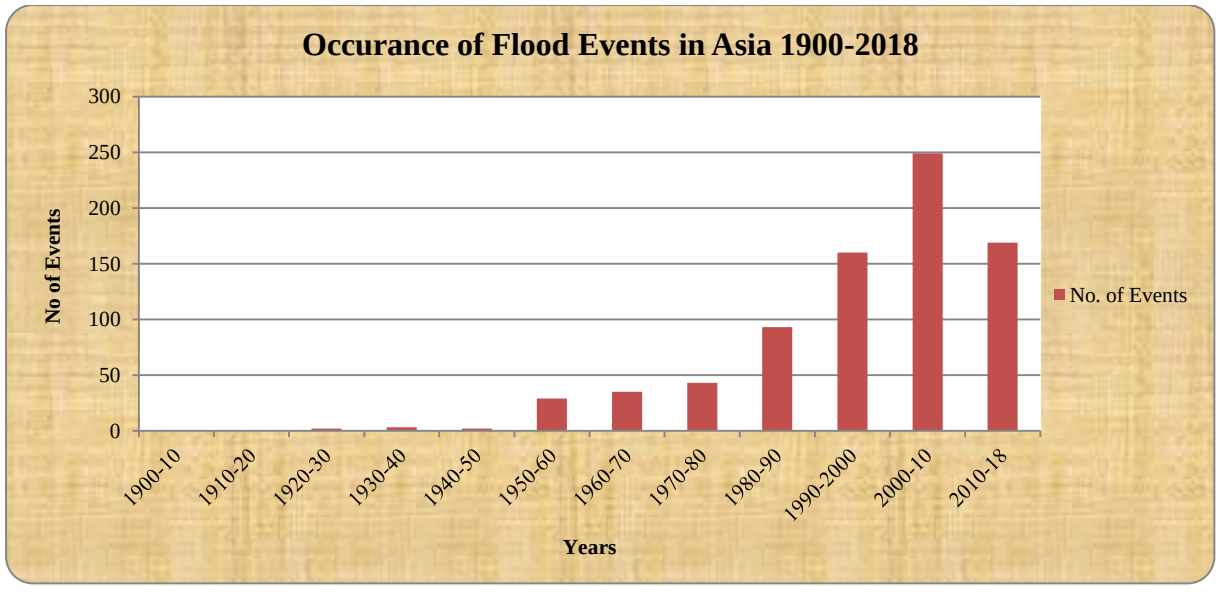


The highest numbers of disasters were recorded in Asia between 1900 and 2016, according to the continent-by-continent study carried out by International Disaster database. (EM-DAT, 2019). It has shown an increasing trend with time from 1950 in Asia, and it has also increased in other continents with time (Refer Figure 1.2). This increasing vulnerability of disasters with time is an issue of concern, and it will lead to catastrophe if efficient and timely

measures were not taken to mitigate their influence and to make provisions for their adaptation with time. Disasters have become more common over time and space, affecting people all over the world. However, disasters have resulted in the deaths of nearly 700,000 people, the injuries of over 1.4 million people, and the displacement of over 23 million people. About 1.5 billion people have been impacted by disasters in different ways, with women, children, and people in vulnerable circumstances bearing a disproportionate share of the responsibility. The economy lost a total of $1.3 trillion. In addition, 144 million people were affected by disasters between 2008 and 2012. Disasters are becoming more severe and serious as a result of climate change, stifle growth toward sustainable development significantly. Evidence indicates that people and property risk has increased faster than vulnerability has decreased in all countries, resulting in new threats and a gradual increase in the number of people killed or injured as a result of natural disasters, with significant short, medium, and long-term economic, social, health, cultural, and environmental implications, Particularly at the community and local levels. Cities, households, and small and medium-sized companies are disproportionately affected by small-scale disasters and slow-onset disasters, which account for a large percentage of all fatalities. All countries, especially developing countries where disaster-related deaths and economic losses are disproportionately higher, are facing growing levels of potential hidden costs and challenges in meeting financial and other obligations (UNISDR, 2015).

Disasters halt progress and devastate the hard-won fruits of development efforts, setting countries back decades in their search for advancement. According to the NDMA, earthquakes with a frequency of mild to very high affect 58.60 percent of India's landmass; About 40 million hectares are affected by flooding and river erosion (12 percent of land area); cyclones and tsunamis affect close to 5,700 kilometres of India's 7,516-kilometer coastline; drought affects 68 percent of the cultivable area; and hilly areas affect 68 percent of the cultivable area (See Figure No. 1.2) (NDMA, 2009). As a result, the frequency and power of natural disasters are increasing over time. In the case at hand, the investigation reveals that the frequency of floods increases over time, resulting in massive obliteration of life and property in the long run. Regardless, Floods in developing countries also have larger effect than floods in developed countries.

Figure 1.2: Frequency of Occurrence of Flood events in Asia 1900-2018



Source: International Disaster Database, prepared by Centre for Research on Epidemiology of Disaster (CRED), 2019

The problem of flooding is a serious concern because its frequency and force change over time. However, the growing fear of an urban flood is major concern because floods affect the majority of the world's urban populations every year, and their frequency varies over time. However, when we consider an urban flood from a global perspective, we can see that significant flooding has occurred in various cities across Europe, the United States, the United Kingdom, Australia, China, and other countries over the last decade. Natural development in low-lying areas, heavy waste in urban seepage channels, and increased precipitation as a result of changing climatic patterns are all factors that contribute to urban flooding. The urban flood is distinct from the rural flood, which is caused by haphazard urbanisation and drastic changes in land use and cover.

Three factors mainly contribute to urban flooding: hydrological, meteorological, and human factors. The presence or absence of structural and non-structural measures in work, such as the immersion of water above stream banks and the incidence of elevated tides impeding waste disposal in seaside urban areas, are examples of meteorological influences, while hydrological factors include the presence or absence of measures, both structural and non-structural, such as the presence or absence of structural and non-structural measures in work, such as the immersion of water above stream banks and the occurrence of elevated tides impeding the disposal of waste in Human factors include increased built-up area, changes in land use and land spread, violations of flood fields and barriers to free flow of water, the

urban warming island effect, and the rapid arrival of water from upstream dams. Both of these factors led as a result of a rise in the number of people worried about low-lying areas flooding. Therefore, in this context, The study of urban floods and human systems' vulnerability to them and the hazards they cause is a relatively new area of study. The term Vulnerability is one of the significant subjects utilized under the umbrella of calamities. since there isn't any widespread meaning of vulnerability, it is for the most part utilized with the level of presentation of any framework to any catastrophe. The investigation of weakness has extended its writing and has promoted numerous phrasings identified with a fiasco like Resilience, Adaptation, Risk, Hazard, Coping Capacity and Risk Reduction Measures. Every one of these variables affects each other. So the investigation of fiasco helplessness and different hazard quantifies in work is one the significant worries of time with the goal that measures can be taken in future to alleviate their impact and make social orders adaptative to these catastrophes.

1.1.1 Flood Context in Indian Context

Urban flooding has become a global phenomenon, as its impact has expanded with time. The basic cause for it is substantial precipitation which overpowers the limit of waste frameworks and impromptu settlements. Be that as it may, the urban flood has been happening from time immemorial with changing intensity and frequency over time, yet adequate consideration was not made to manage it. Every one of our urban communities is helpless against floods. A large portion of them has now arrived at an immersion point as far as populace development and settlement, which has prompted the moving of formative exercises to low lying zones and the riverbanks. Thunderstorms and substantial precipitation can happen anyplace. Along these lines, at whatever point a city encounters a lot of precipitation inside a brief timeframe, There's a possibility it'll turn overburdened. In 2012, for example, In just two hours, Jaipur received 170 mm of rain.., and it immersed the entire city. Thus, in December 2015, Chennai was severely impacted by heavy rains, In 2016, severe damages occurred in Gurugram (Gurgaon), Bengaluru, and Hyderabad. As a result, according to the majority of studies, all cities in today's world, whether coastal, inland, hilly, cities on the banks of major rivers, or cities near dams/reservoirs, are equally prone to flooding (Refer Table No 1.1).

Table 1.1: Occurrence of flood events in Indian cities 2000 - 2015

Name of the City	Year of Flood
Hyderabad	2000
Ahmadabad	2001
Delhi	2002, 2003, 2009, 2010
Chennai	2004, 2015
Mumbai	2005
Surat	2006
Kolkata	2007
Jamshedpur	2008
Guwahati	2010
Srinagar	2014

Source: Daily Newspapers Reports.

Urban centres act as engines of growth. Damage to key infrastructure can have far-reaching consequences not only for the state and country, but also for the entire globe. In India's major cities, there have been casualties and collateral damage, disruption of transportation, and the severity and frequency of plagues. In this way, the control of urban flooding must be given top priority. The ever-increasing phenomenon of urban flooding is a wonder in and of itself, and it puts urban planners all over the world to the test. Urban floods can range from minor events to major disasters, with urban areas being submerged for hours to days. As a result, the impact may be limitless, resulting in temporary relocating of residents, disruption to public infrastructure, loss of water quality, and the possibility of epidemics.

India is prone to a wide range of disasters of varying degrees. Nearly 5,700 km of the 7,516 km long coastline is prone to cyclones and tsunamis; 68 percent of the cultivable land is vulnerable to droughts; and its hilly areas are susceptible to landslides and avalanches (Refer Table 1.2). India is also vulnerable to Chemical, Biological, Radiological, and Nuclear disasters and other man-made disasters. Changing demographics and socio-economic factors, unplanned rapid urbanization and ill development in high-risk regions, Deforestation, climate change, natural catastrophes, outbreaks, and pandemics all intensify disaster threats in India.

Natural disasters now pose a major threat to India's economy, population, and long-term development as a result of all of this.

India is prone to a wide variety of natural disasters, many of which have varying degrees of severity. More than 58.6% of the earth's surface is susceptible to moderate to extreme earthquakes; Floods and river flooding threaten more than 40 million hectares (12%) of land; cyclones and tidal waves threaten nearly 5,700 km of the 7,516 km long coastline; drought threatens 68 percent of the cultivable zone; and avalanches threaten its bumpy areas. India is also vulnerable to Chemical, Biological, Radiological, and Nuclear and other man-made disasters. Changing demographics and socioeconomic factors, natural disasters, outbreaks, and pandemics, as well as unplanned urbanisation and growth in high-risk areas, environmental degradation, climate change, natural disasters, epidemics, and pandemics, all exacerbate disaster risks in India. All of this leads to a situation in which natural disasters put India's infrastructure, population, and global growth in jeopardy. Between 1900 and 2016, there were 316 flood events in India, with 72,334 people killed and 84.9 million people affected, according to the report. The magnitude and impact of the other forms of disasters, on the other hand, have been fairly insignificant (EM-DAT, 2019).

Table: 1.2 Details of natural disasters reported in India from 1900-2016

Disaster type	**Event count**	**Total deaths**	**Total affected**	**Total damage ('000 US$)**
Drought	15	42,50,320	1,39,18,41000	24,41,122
Earthquake	32	78,315	2,85,65,623	52,22,700
Epidemic	62	45,43,581	3,25,476	0
Extreme temperature	57	17,562	250	5,44,000
Flood	316	72,334	84,99,58,256	5,77,15,188
Landslide	48	5,000	38,48,321	54,500
Storm	145	1,62,178	10,25,73,969	2,01,91,996
Wildfire	2	6	0	2,000

Source: International Disaster Database (CRED), 2019

1.1.2 Flood Hazard in the context of Jammu and Kashmir

The Union territory of Jammu and Kashmir has a long history of natural disasters dating back to time immemorial. Kalhana, in his epitome ‘Rajtarangni,' has rich explanation of several disasters that have resulted in significant loss of life and property. These disasters were caused by both natural and man-made forces. Due to its unique topography, rugged landscape, harsh weather, and underdeveloped economy, it has a unique topography, rugged terrain, harsh weather conditions, and an underdeveloped economy, disasters have wreaked havoc in Jammu and Kashmir. Table 1.3 displays the threat profile for Jammu and Kashmir:”

Table 1.3: Hazard Profile of Union Territory of Jammu & Kashmir

S. No	Hazard	Areas Covered
1	Earthquake	Seismic Zone V (very high damage risk zone) encompasses the Kashmir Valley (15.3 percent of the state's area) as well as Doda, Ramban, and Kishtwar in the Jammu region, which is home to more than half of the population of the Union Territory. The majority of the state is in Seismic Zone IV, which includes the entire Ladakh region and much of the Jammu Division (84.7 percent of the total area of the state).
2	Floods	The Kashmir Valley's low-lying areas, as well as parts of the Jammu region, are at risk of flooding. All tributaries of the Jhelum, Indus, Chenab, and Tawi rivers endure flash floods in their upper catchments.
3	Avalanches and Snow Blizzards	All higher reaches of Kashmir division and Doda, Ramban, Kishtwar, Banihal areas of the Jammu region face avalanches and snowstorms.
4	Landslides	Landslides are a threat along major highways, especially in Banihal, Panthial & Ramban. Landslides are common in Doda, Udhampur, Kathua, Dawar, Gurez, Kishtwar, Gulmarg, Tangdar, Kargil & Rajouri.
5	Drought	The majority of Jammu is vulnerable to drought. Besides that, the area of Ladakh has been designated as a cold desert.
6	Windstorm	Occasional wind storms in different parts of the State in different seasons destroy roof-tops and crops. As per the hazard vulnerability atlas of India, the Ladakh region has been categorized in the sensitive category, about windstorms.
		Fires are common in densely populated areas across the state, especially in Kishtwar, Doda, and Gurez, as well as

7	Fires/Forest Fire	other inaccessible areas. Forest fires are also common in the state, especially during dry spells in the autumn.
8	Rail & Road accidents	Road accidents are common on hilly roads in Rajouri, Baramulla, Kishtwar, Doda, Reasi, Poonch, Anantnag, Budgam, Kathua, Jammu, Zogila, Leh, Kargil & Pulwama, among other places. However, with the increased number of vehicles on the road in recent years, there is hardly any place that is free of traffic accidents.
9	Cloudbursts	Cloudbursts are common in the state's hilly areas.
10	Human-induced disasters	Human-caused disasters pose a threat to all districts.
11	Others	Thunderstorms, flash floods, reservoir bursts, heavy snowfall, human and livestock epidemics, and pest attacks are all common hazards in different parts of the state, all of which have the potential to develop into disasters.

Source: J&K SDMA, 2017.

Among all the disasters, floods are more frequent in Kashmir in Jammu and Kashmir. The network of mountain systems that spread out of the Pamir Knot in different directions of the valley, clearly distinguishing the watersheds and basins, have an intrinsic genetic relationship with the valley of Kashmir. The valley resembles a basin, with high mountains on all sides and a broad alluvial plain in the middle, intersected by the Jhelum River and its numerous tributaries, which flow down from the mountains and are fed by the abundant snow and rainfall in those higher elevations. From east to west, the flat alluvial basin extends 150 kilometres and from west to east, 42 kilometres. The flat plain rises between 1500 and 1800 metres above sea level, with the land grain running south to north. Flooding has a long history in Jammu and Kashmir. The Jhelum River is prone to floods in the state, and it has a history of reaching the danger mark and flooding the Valley. In his book The Valley of Kashmir, Sir Walter Roper Lawrence writes: (1895) “Many devastating floods are mentioned in vernacular histories, but the greatest was the terrible inundation which followed the slipping of the Khadanyar mountains below Baramulla in AD 879.” The Jhelum river's channel was damaged, flooding a large portion of the valley.” According to Lawrence, the other major flood that affected Kashmir was in 1841, which “caused much damage to life and property.” The state's first major flood, however, occurred half a century later, in 1893, when 52 hours of nonstop rain started on July 18 and resulted in "a great calamity," as Lawrence

puts it. At the turn of the century, the Valley has experienced massive floods, the most destructive of which occurred ten years after the 1893 disaster. The flood of that day was dubbed the "greatest flood ever experienced," as it swept down the Valley and flooded Srinagar on July 23, 1903, turning the city into "a whole lake." The Valley did not experience significant floods for the next quarter-century, owing to creative lessons learned and remedial steps implemented. However, the Valley was struck by yet another major flood in 1929, this time affecting mostly parts of what is now Pakistan-controlled Kashmir. In 1948, Kashmir was once again flooded. Another big flood struck the state two years later, in September 1950, killing nearly 100 people. Surprisingly, the flood was triggered by the Jhelum's overflow. Another major flood struck Jammu and Kashmir in August-September 1957, with the Valley bearing the brunt of the damage. The floodwaters were so high that they almost submerged the entire valley. When four days of constant rain lashed the valley and Srinagar, triggering flooding in the Jhelum, the state was struck by yet another massive "glacial" flood, probably the worst ever at the time. Although floods occurred in the state over the next three decades, the one in 1992 was unparalleled in terms of its severity. In terms of deaths, the 1992 floods were the most destructive since 1959. About 200 people died in the floods, according to newspaper reports from 1992, and 60,000 people were stranded in many northwestern border districts. Floods occurred in 1996, as well as more recently in 2006. Massive floods were caused by a cloudburst in Jammu and Kashmir's Leh-Ladakh region on August 6, 2010, which triggered flash floods in the area after a night of heavy rain. Despite the fact that the cloudburst only lasted half an hour, the damage it caused was immense. Many buildings in the city of Leh were demolished.

Heavy rainfall began in Jammu and Kashmir on September 2, 2014, triggering extreme massive flooding and landslides across the state. Many streams were flooded, including the Jhelum, Chenab, and Tawi. Srinagar, Anantnag, Baramulla, Pulwama, Ganderbal, Kulgam, Budgam, Rajouri, Poonch, and Reasi were the worst-affected districts during september 2014 flood. The majority of Srinagar's city areas was submerged underwater. The river Jhelum overflowed, engulfing the city neighbourhoods of Rajbagh, Jawahar Nagar, Gogji Bagh, and Wazir Bagh, Sonwar Bagh, Shivpora, Batwara, Pandrathan, Lal Chowk.

The Jhelum River and its numerous tributaries, which flow down from the mountains and are backed by ample day-off precipitation in those elevated districts, cut through the valley like a bowl, with grandiose mountains on either side and a vast alluvial tract in the centre. From east to west, the flat alluvial bowl extends 150 kilometres and from west to east, 42

kilometres. The land field stretches from south to north, and the level plain ranges in height from 1500 to 1800 metres above sea level. In Jammu and Kashmir, flooding has a long history. The Jhelum River is associated with flooding in the province, and it has a history of colliding with the danger label, submerging the Valley. In his book The Valley of Kashmir, Sir Walter Roper Lawrence writes (1895), "the worst was the catastrophic immersion that followed the slipping of the Khadanyar mountains beneath Baramulla in AD 879. The channel of the Jhelum waterway was blocked, and a significant portion of the valley was flooded." According to Lawrence, the other major flood in Kashmir occurred in 1841, causing "a great deal of damage to life and property." The state's first wave of crippling extents arrived 50 years later, in 1893, when 52 hours of continuous precipitation began on July 18 and resulted in "an extraordinary catastrophe," as Lawrence puts it. When the new century came, the Valley was hit by a series of massive floods, the worst of which occurred ten years after the 1893 disaster. The floods of that day were dubbed the "highest flood at any point recorded," as they swept through the Valley on July 23, 1903, submerging Srinagar and turning the city into "an entire lake." The Valley did not experience major flooding for the next quarter-century, owing largely to the creative drills that were taught and the remedial steps that were put in place. Despite, a massive flood struck the Valley in 1929, affecting most of what is now Pakistan-controlled Kashmir. In addition, a flood hit Kashmir once more in 1948. After two years, the state was hit by another major flood in September 1950, which killed nearly 100 people. The flood was caused, predictably, by the Jhelum River. In August-September 1957, another major flood hit Jammu and Kashmir, with the Valley bearing the brunt of the damage. The floodwaters were so high that the valley was almost completely submerged. When four days of nonstop rain battered the valley and Srinagar, triggering floods in the Jhelum, the state was struck by yet another monstrous "frosty" flood, perhaps the worst ever at the time. Despite the fact that the state was subjected to floods for the next three decades, the one in 1992 was especially devastating. In terms of disasters, the floods of 1992 were the worst since 1959. More than 200 people have died in the floods, which trapped 60,000 people in a few north-western fringe areas, according to newspaper reports from 1992. In 1996, and even more recently in 2006, floods occurred. On August 6, 2010, a torrent in Jammu and Kashmir's Leh-Ladakh district caused massive floods after a night of heavy rain, causing glimmer floods in the region. The destruction caused by the downpour was massive, and it lasted for thirty minutes. It levelled a number of buildings in the city of Leh." "On September 2, 2014, heavy monsoon rains started in Jammu and Kashmir, causing

unprecedented widespread flooding and landslides across the state. Many streams were flooded, including the Jhelum, Chenab, and Tawi. Srinagar, Anantnag, Baramulla, Pulwama, Ganderbal, Kulgam, Budgam, Rajouri, Poonch, and Reasi were the worst-affected districts. The bulk of the city of Srinagar was submerged underwater. Sonwar Bagh, Shivpora, Batwara, Pandrathan, Lal Chowk, Rajbagh, Jawahar Nagar, Gogji Bagh, and Wazir Bagh were engulfed when the river Jhelum overflowed, engulfing the city neighbourhoods of Sonwar Bagh, Shivpora, Batwara, Pandrathan, Lal Chowk, Rajbagh, Jawahar Nagar, Gogji Bagh.

Floods in 2014 wreaked havoc on lives and property, exposing weaknesses in flood mitigation and preparedness policies that could have significantly reduced the destructive effects of floods. Despite the effectiveness of the state's emergency management strategy, the state was struck by a devastating flood in 2014, which resulted in considerable loss of life and property. This is an example of the state's inadequate prevention and preparedness policies in action. As a result, there is an urgent need for short-term interventions to supplement long-term strategies for dealing with the negative effects of floods. Our study, on the other hand, is based on the urban flood in Srinagar, the valley's heart and soul. The experience of floods in Kashmir valley demonstrates that if a flood occurs, Srinagar is the first place to be severely impacted in terms of human loss and property damage. Suburbs make up 99 percent of Srinagar's population, with many of them clustered along the Jhelum River's banks.

Since the Jhelum River flows through a low-lying region, the people have limited capacity to track the hydrological events that result from it. As a result, during the rainy season, Srinagar experiences heavy flooding in one or more parts of the city. The effect of floods in urban areas is becoming increasingly serious, with significant loss of life and property. As a result, managing urban flooding must be given top priority. Urban flooding is becoming a global issue, posing a major challenge to urban planners all over the world. The issues associated with urban flooding range from minor to major events, resulting in communities being flooded for hours or days. As a result, the consequences may be widespread, resulting in temporary relocations, public facility disruptions, water quality degradation, and the possibility of epidemics. The study therefore endeavours to evaluate the urban flood in Kashmir valley, with a focus on the Srinagar city flood of 2014.

1.1.3: Flood Hazard in the context of Srinagar City

The urban agglomeration of Srinagar is rapidly developing, with many wetlands and water bodies being converted into dwellings. Srinagar's municipal limits were just 83 square kilometres (sq. km) in 1971, but they now occupy over 230 sq. Km (Office of the Registrar General & Census Commissioner, 2018). Srinagar and its surrounding areas have lost many wetlands and water bodies as a result of urbanisation, Increasing their vulnerability to natural disasters in general and floods in particular. According to the Ministry of Environment and Forests, the state of Jammu and Kashmir had 291.07 square kilometres of wetlands in 1990, but that number has now dropped to 266.45 square kilometres. On the other hand, due to urban sprawl, the percentage of impervious concrete surfaces in Srinagar's southern areas has increased from 34% in 1992 to over 65% today, seriously impacting the Jhelum basin's hydrological processes as well as the encroachment of major wetlands in Srinagar city. According to official figures, approximately half of wetlands such as Batamaloo, Nambal, Rekh-i-Gandakshah, Rakh-i-Arat, and Rakh-i-Khan, as well as the streams of the Doodh Ganga and Mar Nalla, were completely lost to urbanisation between 1911 and 2004, while other lakes and wetlands shrank significantly. Flood spill channels have been encroached upon, and as a result, suburban colonies have developed closer to water bodies. Wetland is the first victim anywhere there is a need for land. Floods in Srinagar have become more frequent and intense as a result of this type of development strategy. The floods of 2014 in Srinagar city were the result of this type of approach of development, and it leads to huge devastation to life and property. Man is an active agent who is directly responsible for such disasters. His greed leads to encroachment of wetlands and deforestation on the one hand and his activities intensify the frequency of floods on the other hand. It takes year’s together and a huge amount of funds to build infrastructure in the form of roads, bridges, buildings, electricity, water supply, communication lines, and industries, etc. but unfortunately when a disaster strikes everything is razed to the ground within no time, and colossal damage is caused to the affected area. Therefore, the threat of disasters has to be minimised to a great extent to keep the gain the pace of sustainable development. It is not possible to eliminate disasters at all. However, their impact and intensity can be minimised to a great extent. Among all the disasters, floods and earthquakes are the active threats to the progress and development of Srinagar city. Since it lies in Seismic zone V, if an earthquake of high-intensity strikes, there is bound to be extensive loss of life and property. Similarly, the risk of flood in Srinagar city is high, which when strikes cause huge damage to life and property.

Therefore, there is much more need to study the vulnerability of Srinagar to floods and related disasters so that timely implementation of risk reduction measures can be put into action.

1.2 Aims and Objectives of the study

I) To analyse the land use land cover change and its relation with flood vulnerability in Srinagar city.

II) To examine the population characteristics and impact of floods on the socio-economic livelihoods of the people in Srinagar and the underlying causes of its vulnerability.

III) Evaluate the lessons learnt from the empirical evidence relating to preparedness, response and rehabilitation towards disaster risk reduction and community resilience.

IV) To examine the level of preparedness, Response, and Rehabilitation during and the aftermath of the Srinagar flood 2014.

V) To examine the Strategies and Measures taken by different stakeholders in the mitigation of flood

1.3 Research Questions

I) what was the lacuna in the adequate measures of protection and preparedness to face the challenge of vast devastation.

II) Who are the flood-affected groups, and what are their coping strategies?

III) Whether the socioeconomic practises of the settled population in flood-prone areas have some impact on flood threat mitigation and adaptation.

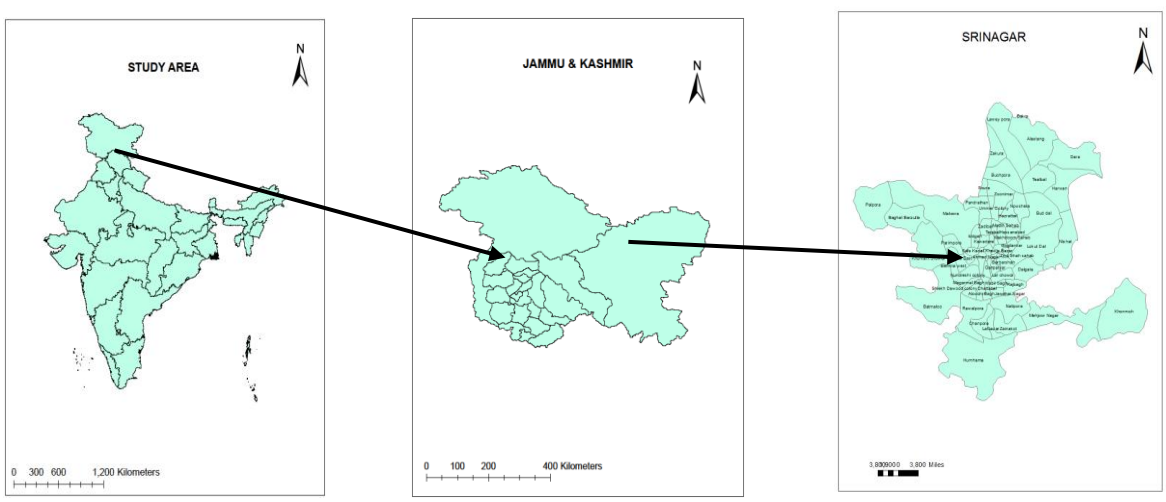
IV) What are the governments and community's response and perception towards future response and preparedness?

V) Whether the rehabilitation process has been satisfying, if not, what measures need to do and what steps could be taken to enforce disaster reduction strategies adopting Sendai framework declaration and encouraging community resilience measures.

1.4 Study Area

Srinagar is the summer capital of Jammu and Kashmir, an Indian union territory. It is situated in the Kashmir Valley on the banks of the Jhelum River, a tributary of the Indus, as well as the Dal and Anchar lakes. The city is located on both sides of the Jhelum River, which is referred to as Vyath in Kashmir. The river flows through the city and through the valley before continuing on to the Wular Lake, where it deepens. The city is renowned for its nine old bridges that link the city's two halves. It covers a total area of 234.46 square kilometres (municipal limit). Its latitudinal and longitudinal extents are 33°59′14″ N to 34°12′37″ N and 74°41′06″ E to 74°57′27″E, respectively. It stretches from Alestang to Humhama in the north, and from Lawaypora to Khanmou in the southeast. The river Jhelum, which runs through the city, divides it into two sections. In the south and west, Srinagar is characterised by low-lying fertile fields in the Jhelum River's flood plain. In the east and north, it has steep hills, and in the far southeast, it has the popular Karewa. Srinagar has a Sub-Mediterranean climate, with hot summers between June and August and cold winters between December and February. The annual rainfall is about 660 millimetres. The city receives nearly 70% of its rainfall in July and August, and snowfall is common from December to February. The Jhelum River and its canals drain the city of Srinagar (locally known as Khuls). The Jhelum River rises from a spring known as Verinag in the southeast of the valley, at the foot of a spur of the Pir Panjal range. Several tributaries join it from there, making it navigable between Khanabal and Wular Lake.

Map 1.1: Locational Setting of Study Area



1.5 Methodology

The study of disaster vulnerability and risk mitigation measures necessarily requires the compilation and analysis of qualitative and quantitative data through a combination of household surveys, institutional analysis, and physical structure and infrastructure surveys, with a focus not only on property damage but also on the effect of floods on welfare and income-earning opportunities. (Parker, 2000)

The scientific emphasis on disaster-related research in India includes important issues such as flood vulnerability, rainfall trend, land use land cover change, literacy level, population growth, population density, people's occupation etc. Given the objectives set for the given study, the data used for the given study includes both primary and secondary sources. The methodological steps used to carry out a given study are as:

To calculate the annual trend of rainfall, the data was collected from the state Irrigation and Flood control department, and the data was subsequently used to analyse the annual trend of rainfall distribution in Srinagar city from 1980-2017. Whereas, to analyse the Rainfall variability in Srinagar district methods like Average, Standard Deviation and Coefficient of Variation were used. The most crucial feature shaping flood hazard is flood frequency. To analyse the changing behaviour of river Jhelum the available Daily Gauge Level of water at Different Stations of Jhelum River was collected from the state Irrigation and Flood control department, and the data was subsequently used to generate the maps showing the daily Gauge Level of water at Different Stations of Jhelum River from 2008-2018.

Landsat MSS (79m) data from October 1972, Landsat TM (30m) data from October 1992, IRS LISS-III (23.5m) data from October 2005, and Landsat OLI (30m) data from 2013 were used to quantify and analyze changes in land use and land cover dynamics in the Srinagar district. For the accuracy assessment of the LULC data, field surveys using handheld GPS and Google Earth were used in addition to the satellite data survey of India (SOI) chart. To determine its accuracy, the validity and accuracy of the LULC map from 2013 were validated in the field. The accuracy estimate is essential for determining the classification map's reliability. For the final LULC map, the Kappa coefficient, a reliable measure of accuracy estimation, was calculated." In addition, the total accuracy, consumer accuracy, and manufacturer accuracy were all calculated to determine the LULC's accuracy.

The following formula calculates overall classification accuracy:

$\rho = n/N * 100$..... (I)

Where ‘n' is the number of points correctly classified on the image and ‘N' is the number of points tested in the area, and ‘' is the classification accuracy. Cohen's Kappa statistics provide access to the precision that accounts for the possibility of a random agreement. The following formula was used to calculate the Kappa coefficient, a robust predictor of the accuracy estimation for the final LULC map. The formula for is:

$$K = \frac{Pr(a) - Pr(e)}{1 - Pr(e)}$$

Using the observed data to measure the probabilities of each observer randomly saying each category, Pr (a) is the relative observed agreement among rates, and Pr (e) is the hypothetical probability of chance agreement. Data was obtained from the directory of lakes and waterways in Jammu and Kashmir to analyse the area covered by Lakes and Waterbodies in Srinagar City in 2012.

Demographic indicators such as population growth, population density, sex ratio, population forecast, male-female structure, literacy trend, and occupational pattern were studied using statistical methods. However, in order to examine the problem of Demographic Vulnerability in Srinagar, important indicators such as Growth Rate, Population Density, and Number of Households have been taken into account. Since Demographic Vulnerability is an important predictor that has a significant impact on an area's long-term growth. The chosen indicators play a significant role in determining flood vulnerability in Srinagar. In order to construct the demographic vulnerability index, weights to the indicators were applied in several phases. A mathematical model was used to develop the heterogeneity of metrics, and all variables were standardized. Individual measures have been given a Z-score in order to measure the demographic vulnerability index. The final index is then calculated by adding all of the individual Z- Scores values together. The Z-Score is estimated as follows:

$$Z\text{- Score} = (X - \text{Mean})/SD$$

X = Actual Observations

X = Mean of All Observations

Vulnerability analysis is the foundation for both flood risk management and flood damage assessment. Flood vulnerability has been identified as the primary cause of disasters. It seems that we need to work on our vulnerability awareness (J.T.Klein, 2006). Total population, population density, housing density, female population, female literacy, primary working population, and elevation are some of the main indicators used to assess social vulnerability in Srinagar. Person indicators' Z- scores were used to measure the Social Vulnerability index. The final index is then calculated by adding all of the individual Z- scores values together.

1.6 Data Sources

For the given study, the data was collected from various sources they are as:

The data of demographic indicators like ward wise density of population, sex ratio, the absolute population was collected from the census of India. The data related to elevation and altitude was collected from the primary survey as well as from SRTM (Space Shuttle Radar Topography Mission. Data on house material used for construction and the proportion of child and old age groups of the population were collected from the office of Srinagar municipality and town directory.

Besides, a primary household survey of 400 Households in 16 wards of Srinagar city was carried out from 2017- 2019 where households were randomly selected from 16 wards to represent the Srinagar municipality. The field study methods include field observations, group discussion and interview of Kashmir based NGO's. Structured questionnaires were prepared to have both quantitative and qualitative components with open-ended and multiple-choice question-answers. The collection of data was done in compliance with the ethical code of conduct where prior consent from the respondents was sought before data collection to ensure that the rights of the individuals and groups participating in the survey are neither violated nor trespassed upon.

1.7 Review of Literature

1.7.1 International context

A wide range of relevant research sources are included in the literature survey, including discipline-based reference material from dictionaries, encyclopaedias, and related discipline books, as well as various research papers, both print and online, grey literature, such as unpublished reports, conference proceedings, newspaper reports, and other official publications, data, and other official publications (Leary, 2010). The current literature is an

ongoing method of documenting applicable information in order to justify similar study in other areas of the world. Global, national and state-level documents of related literature are provided separately for your convenience.

This is not a new study field to analyse disaster-related issues at the research level within the academic limitations of geography. A geographic study group began asking them a few questions when they were working on the 1956 evaluation of improvements in land-use in selected flood plains following the Flood Control Act of 1936. This includes questions such as: (I) What is the nature of the physical hazard involved in extreme fluctuations in stream flow, (II) What adjustments man has made to such variations in stream flow, (III) What is the total range of possible adjustments, (IV) What causes for variations in adaptation strategies from place to place and time to time, and (V) What will be the impact of adjusting public policy in so far as it affects the total range of possible adjustments? In light of these four questions, a disaster-related research report has steadily gained momentum (Singh, 2015).

The scope of studying a variety of diversified types of research has also grown at the global, national, and local levels as the number of different types of disasters has increased over time. The following discussion of literature tries to include a wide range of current research and information applicable to the report. Statistics are applied as required and necessary in addition to the various publications. In various chapters, relevant literature is often referred to. Any reviewed and cited literature is listed in the bibliography section at the end of the article, along with links to their sources and other relevant information.

Risk, exposure, vulnerability, and response are the four main elements of hazards, according to the technical report of the International Hydrological Programme (IHP), 2001 under UNESCO. Disruption and response method is easily more plentiful and accurate than exposure and vulnerability awareness. These two variables are extremely volatile, especially in the context of urban threats, which can react quickly to changes in demographics and land use. The most vulnerable groups, according to WHO, should be identified using two criteria: the social component, such as religious faith, superstition, etc. suggesting individuals at higher risk, such as females, pregnant women, child groups, diseased, elderly, and so on (Affeltranger, 2001).

During the rainy season, flood water draining through the creeks affects the city of Santiago, which is situated in a depression between the coastal range and the vast Andes, according to a hazard study conducted in Santiago. The structural vulnerability of a dwelling was assessed

using factors such as construction material, building location in relation to the ground surface, green space per building, and so on. To assess social vulnerability, researchers look at age, gender, educational attainment, household size, employment status, flood experience and awareness, and other factors. Responses to a standardised questionnaire with closed and open questions were collected from 82 households using systematic random sampling (Muller, Reiter, & Weiland, 2011)

The importance of increasing the vulnerable population's adaptation strategies to natural hazards is highlighted in the literature on danger and vulnerability. A report focused on Puerto Rico aims to investigate the adaptation strategies used by members of the two flood-prone communities, as well as how the adoption of these strategies, in combination with other factors, can affect future disaster resilience and flooding vulnerability. The study discovered that having access to information such as material, economic, and human resources made it easier for communities to cope with floods, but not everyone could respond in the same way (Marrero, 2010).

The issue of threat susceptibility and adaptive potential is primarily a theoretical investigation of those who work with such a device's local wisdom. All community-directed projects include analysis to assist both outside administrators and community members in making better decisions. Sessions with local forest practitioners and group climate change seminars, for example, are suggested for a better forest management strategy in a study area. As part of a wider adaptive management system, residents stressed the value of formalising a monitoring network based on local information. They also wanted to play a key role in any dialogue about adapting to current forest management plan activities and policies, with the main goal of developing a community-driven adaptation plan (Ogden & Innes, 2009).

Another interesting look at the issue of exposure to modern hazards in the sense of a globalising world revealed how technocratic and social modernity's hegemony shapes it. Its results are based on a field study in Rawalpindi, Pakistan, on flood threats. Flood victims seem to have a much broader variety of options in coping with flood threats than state agents dealing with the problem from the outside. This is most likely why using indigenous wisdom to solve people's problems will be more efficient and meaningful (Mustafa, 2005).

The IFRC team compiled a study to explain vulnerability and capability assessments. Unlike hazard tracking, which can be computerised using GIS and other software, the team discovered that the weakness in the project cannot be seen from above. Vulnerability changes

over time, reflecting the current state of social, economic, cultural, and political affairs. However, it has the potential to significantly intensify the consequences of a catastrophe. Similarly, societies' ability to cope with threats and disasters can vary depending on local circumstances and expectations. Vulnerability and Capacity Assessment is used to determine how vulnerable individuals are to hazards. It's an essential part of emergency planning. It enables people to prioritise identifying and understanding their danger, which leads to the development of action plans that contribute to disaster risk mitigation at the local level. (IFRC, 2013).

Another study on global climate vulnerability conducted a thorough field investigation, summarising issues such as who is vulnerable (by age and gender), what is vulnerable, and which hazards are they vulnerable to, and so on (Thomalla, Dowing, Spanger, & Rockstorm, 2006).

The destruction and misery triggered by the Bangladesh flood disasters of 1987 and 1988 prompted major aid donors to consider how they could assist Bangladesh's government in finding a long-term solution to the country's persistent flood disaster crisis. This devastation was highlighted in a study conducted in the region. Strengthening existing embankments, work to avoid bank erosion, flood forecasting, warning and preparedness programmes, disaster monitoring, and training are all part of Bangladesh's flood control action plan (Brammer, 1990)”

Several initiatives have designed indexes to evaluate vulnerability to environmental change since the early 1990s. One study attempted to look at the core conceptual and empirical issues that come with such indexes. The South Pacific Applied Geosciences Commission created the environmental vulnerability index (EVI). It indicates that indexes of vulnerability to environmental change are unlikely to be important in a complex area, and that smaller-scale research should be prioritised (Barnett, Lambert, & Fry, 2008).

In a research paper on flood risk, the researcher attempted to assess the flood threat vulnerability of Tegucigalpa, Honduras' capital city, using the Participatory GIS system. A participatory GIS (PGIS) is a good way to evaluate need and analyse challenges, local attitudes, and goals in order to better understand people's adaptation and coping strategies. A simple community-based geographic data collection system can also be thought of as PGIS (Kundu & Kundu, 2011).

Rapidly industrialising developing countries are increasingly vulnerable to environmental disasters. According to a report on the response to complex flood hazards, rising disaster losses are a sign of unsustainable growth. Flooding is becoming more common in Peninsular Malaysia as a result of rapid urbanisation and growth. Flood-prone people make up a large percentage of the population, and flood damage has been confirmed to be serious. Modernization also challenges conventional lifestyles and erodes indigenous danger adaptation, according to another important observation (Weng & Parker, 1996).

New indicators of vulnerability and adaptive potential were investigated as part of a Tyndall Centre for Climate Change Research project. The study brought attention to the issue of processes that influence vulnerability (Adger, Brooks, Bentham, Agnew, & Eriksen, 2004).

In climate risk research, the concept of vulnerability is growing rapidly, especially in assessing the potential effects of extreme events, instability, and patterns on society and the economy. Another research attempts to discuss the dynamics of vulnerability and coping mechanisms. While they are inextricably related, coping and adaptation are two distinct words that should not be used interchangeably. Adaptation often includes adjusting the context within which coping takes place, while Coping is described as behaviour and activities that occur within the current context (Adger, Vulnerability: Global Environmental Change, 2006).

Physical vulnerability refers to exposure to stress, crisis, and other consequences of physical hazards, whereas the capacity of a person or a group to respond to physical effects is referred to as social vulnerability (Eriksen, Brown, & Kelly, 2005).

Another study examines the vulnerabilities and contributing factors that the growing number of urban poor in low-income countries faces, focusing on tenants in Khulna, Bangladesh. The adaptation responses of squatters and low-income tenants were compared in Khulna, Bangladesh, as the problems were highlighted with input from squatters and low-income tenants. In the office, the vulnerability was tweaked slightly. Normally, vulnerability is classified as either physical (external) or social (internal). The survey, however, paid special attention to the importance of social vulnerability in low-income people in the study area, subdividing it into politico-legal and socio-economic vulnerability (Roy, Hulme, & Jahan, 2013).

A team from Kyoto University in Japan undertook another large-scale empirical vulnerability assessment study in the Huaihe river basin in Eastern China, looking at bio-physical and social vulnerability. The goal is to determine the biophysical vulnerability (percentage of flooded area) as well as social vulnerability (density, land use), susceptibility (GDP, dependence, and income level), and resilience (percentage of flooded area) of a given zone (expenditure, saving, institutional preparedness). The term "holistic vulnerability indices" refers to the combination of bio-physical and social vulnerability. The research aims to determine how risk is linked to the hazard's physical context as well as the socioeconomic system (Zheng, Takara, & Yamashiki, 2009).

The Flood Hazard Research Centre at Middlesex University in the United Kingdom conducted a report to look into flooding risk in terms of health and social factors. The ‘people factor' of hazard-related research was emphasised. The paper leads to the process of evaluating the ‘people factor,' which is currently widely overlooked in flood protection decisions. The author writes, "We have a method for estimating the financial benefits and losses from such investment decisions, but not for measuring the decreased quality of life that floods trigger for many of their victims." The paper also addresses studies aimed at predicting the social impacts of floods in order to better reduce them (Tapsell, Penning-Rowsell, Tunstall, & Wilson, 2011).

Flood-vulnerable areas in a river basin in Eastern Nigeria, Africa, were the subject of a multi-criteria report used to analyse the flooding threat in detail. Rainfall, the region's drainage network, the slope basin, soil type, and land cover were among the parameters used in the multi-criteria study. In addition, the pair-wise analysis and rating approach is used to investigate decision-makers' preferences. Finally, using the multi-criteria technique on the GIS platform, a composite map is created to display flood prone areas. Areas are classified as high, medium, or low vulnerable zones, with percentage values representing the total flood vulnerable region. (Yahaya, 1993).

by social vulnerability, which is a pre-existing condition. Individuals and sites are assessed for social vulnerability using the Social Vulnerability Index (SoVI). There were 134 research units in the Yangtze River delta survey, including 25 city districts and 109 counties. Income, percentage of female, infant, elderly, and minority residents, unemployment, population density, household, labour force type, education status, civic amenities, and other variables are analysed to better understand social vulnerability structure. SoVI was created with the aid of Principal Component Analysis. Six components with Eigen values of 1.0 were added after computing in SPSS. After computation, the standard deviation from the mean is used to map the spatial variability across the area. From -5.51 to 7.37, the SoVI was measured. (social vulnerability ranges from low to high). The 11 research units that have been designated as the safest have been identified. As a result, the social vulnerability status of various study groups, as well as the underlying factors that influence them, is investigated (Chen, Cutter, Christopher, & Peijun, 2013).

Having a better understanding of the interconnections and social patterns of flood risk assessment, preparedness, vulnerability, flood harm, and mitigation, as well as integrating this into contemporary disaster risk analysis and flood risk management designs, are among the most recent flood damage challenging problems (Messner & Meyer, 2006).

1.7.2 National context

After the creation of the National Disaster Management Authority in India, several aspects have become mandatory (NDMA). Threat, Vulnerability, Danger, and Capacity Analysis has emphasised the establishment of ward-level disaster management committees to oversee the wards and villages (HVRCA). The NDMA guideline identifies a number of areas for improvement, including responding to warnings, moving to safer locations ahead of time, and planning to attend to the poorer sections, such as the elderly, diseased, females, and children. Insurance of household goods must also be considered in addition to ensuring the protection of animals and other household property (NDMA & IGNOU, 2012).

Another study on city flood vulnerability assessment in India has seven chapters on flood hazard, flood impact, structured flood risk management: structural steps, adaptive flood risk management: non-structural measures, and exploring various flood risk management options: decision-making tools, among other topics. The authors attempted to understand the real-world differences in flooding in rural and urban areas. An urban flood is more expensive and difficult to control than a rural flood, which can impact vast areas of land and

disproportionately affect the poor. Flood damage is much more serious and costly in cities. The book emphasises structural engineering control of river flow characteristics in terms of monitoring measures, with non-structural serving as a counterpart to the structural. Emergency management through warnings and evacuation, preparedness through awareness, flood prevention through land-use planning, and speeding up the recovery process are four non-structural regulating steps (Jha, Robin, & Jessica, 2012).

Kapur's (2010) book, Vulnerable India, is a very well analysis of the country's disaster vulnerability trends, highlighting all disaster events and their various impacts, responses, and recovery over time. According to the author, 40 million hectares of India's 328 million hectares of geographical area is flooded each year. It accounts for nearly ten percent of all disasters and sixteen percent of all deaths. Within the Meso-region of the Brahmaputra valley, Assam's western, central, and eastern valleys have been divided into three (3) flood micro-regions by Kapur. It consists of eighteen (18) flood-affected districts, with seven (7) in each of the Brahmaputra valleys' western and eastern valleys and four (4) in the central valleys. There are two more micro-regions in the Barak valley: the Cachar plain (3 districts) and the Karbi-Anglong and North Cachar hill districts, the latter of which is vulnerable to flooding (Kapoor, 2010).

During the literature evaluation, numerous hazard-specific findings were tracked. In a study on climate change vulnerability and resilience in the context of water management, the state of Rajasthan was stated. The study examines the climatic vulnerability of Rajasthan districts by examining 30 years of rainfall and temperature data (1980-2009). The Flood Manual of Rajasthan is used to assess flood and drought-prone areas. Floods are classified as moderate or extreme based on average annual rainfall in each district. As part of its flood control policy, the concerned government has initiated a variety of structural and non-structural measures. In the background of the evolving pattern of flood and drought, the paper also highlighted the problem of changing land-use (Upadhyaya, 2014).

Another research of flood vulnerability in the Kharad Region of Satara District, Maharashtra, attempted to unfold a vulnerability study that included both villages and the surrounding area. Due to its unplanned development, Kharad is situated at the intersection of the Krishna and Koyana rivers, in an area that is often flooded. Using remote sensing and GIS, flood risk zones have been established. 27 villages and the city of Karad were included in the study area. To create spatial data, Maharashtra Krishna Basin Development Corporation used a toposheet,

a Landsat TM picture, and a flood-affected village boundary. Non-spatial data include IMD rainfall data from 2005 onwards, as well as census data from 2001. For multiple criteria analysis, the weighting overlay approach is used, which is based on the relative significance applied to the assessment criteria under consideration. The drainage density, population density, surface runoff, and slope map are used to determine the urban flood vulnerability region. Drainage density was measured in six sub-basins and superimposed on fragile villages that already existed. Flood risk mapping uses population density as a strong predictor. Vulnerability is proportional to population density. The study area's village-level population data is integrated into the map (Warghat, DAS, Doad, & Mali, 2012).

Another research in rural Karnataka on flood vulnerability and disaster recovery based on disaster recovery at the household level. The study focused on the Badami Taluk in the Bagalkot district of Northern Karnataka, where disaster recovery at the household level was assessed in light of rural Karnataka's vulnerability to flooding (Thomas, 2012).

A analysis of climate-induced adaptation and mitigation by rural households at the household level in four case study villages in Orissa's drought-stricken district attempted to establish some indicators for constructing a Climate Vulnerability Index (CVI). Panda calculated risk by looking at rainfall-temperature trends, danger frequency, and the number of hazard hits, among other things. Vulnerability was assessed by an impact evaluation, income source, poverty level, and the number of dependents, among other things. Changes in paddy variety, crop calendar, another source of income, crop insurance, level of education, migration to suitable locations, and other factors Panda used a variety of factors to quantify risk, including rainfall-temperature patterns, danger duration, and the number of hazard impacts, to name a few. An impact assessment, as well as income source, poverty level, and the number of dependents, were used to determine vulnerability. Differences in rice variety, crop calendar, another source of income, crop insurance, education level, migration to suitable locations, and other indicators were chosen for the study of adaptive potential (Panda, 2014).

Research study on flood vulnerability at the local level in Assam has made little progress, though studies on landslides have been conducted. The Gauhati University research cell's library collection, on the other hand, cited many complex flood-specific research activities. One study aims to learn more about the river's bank line migration in the study area, as well as the harm it causes in the villages. Case studies were conducted in seven villages and one ward of Palasbari Town (Bordoloi, 1995).

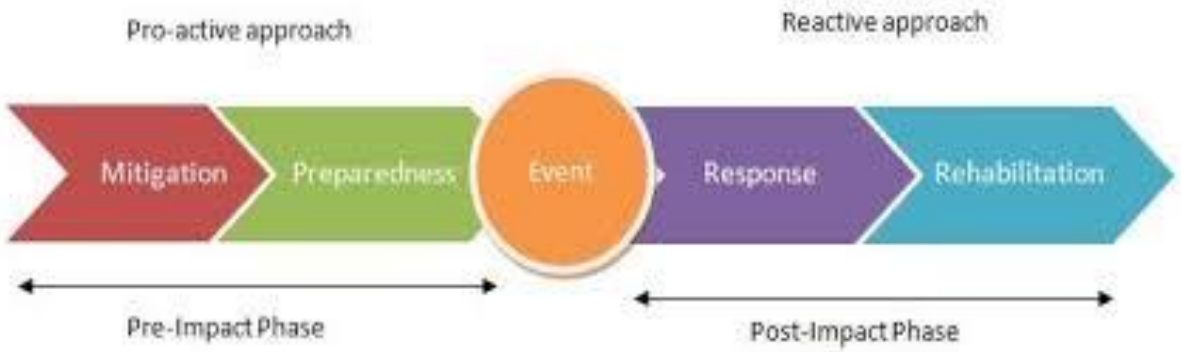
Another research in Barak Valley, Assam, attempted to examine socio-economic deprivation in the flood-affected village. Dudhpatil, a flood-prone village on the north bank of the Barak River in Assam's Cachar district, was investigated for its socioeconomic vulnerability. Land ownership, family size, gender ratio, and basic facilities have all been investigated in the study field. The data bank may be used as a benchmark for future vulnerability detection because these variables have either a positive or negative impact on vulnerability (Das & Dey, 2011)

1.8: Conceptual Framework of Study Area

The Conceptual Framework recognized to oversee and inspect is Disaster Risk Reduction. Calamity Risk Reduction is the strategic creation and implementation of methods, policies, and processes to reduce vulnerabilities and disaster risks across society in order to retain a critical course away from (expectation) or to restrict (balance and preparation) the confrontational effects of dangers within the broad context of sensible progress. As showed in the introduction, calamitous occasions and floods, explicitly, have ended up being continuous and are most likely going to occur in future because of environment changeability. As a result, It may be difficult to completely eliminate the flood risk. As part of the Disaster Risk Reduction strategy, it's important to understand the possibility of flooding and its effects. This can be accomplished by creating flood risk and hazard profiles that can be used to create effective flood control and mitigation plans while also improving people's quality of life.

The Disaster Risk Reduction Conceptual Framework was chosen to direct this investigation. Calamity Risk Reduction is the effective combination and application of frameworks, methodologies, and techniques in society to minimise vulnerabilities and catastrophe risks, as well as to keep a safe distance from (counteraction) or prevent (alleviation and readiness) the negative effects of potential dangers in a vast setting of reasonable development. As seen in the presentation, Due to the climate change, catastrophes, especially floods, have happened throughout history and will most likely occur in the future. As a result, trying to evacuate the flood zone could prove challenging. In this situation, it's important to provide a thorough understanding of the flood risk and its implications within the Disaster Risk Reduction process. This can be done by creating flood risk and danger profiles, which can then be used to prepare successful flood protection and relief measures and assess people's resiliency and severity. All conventional disaster-related systems are built on the 2P2R architecture

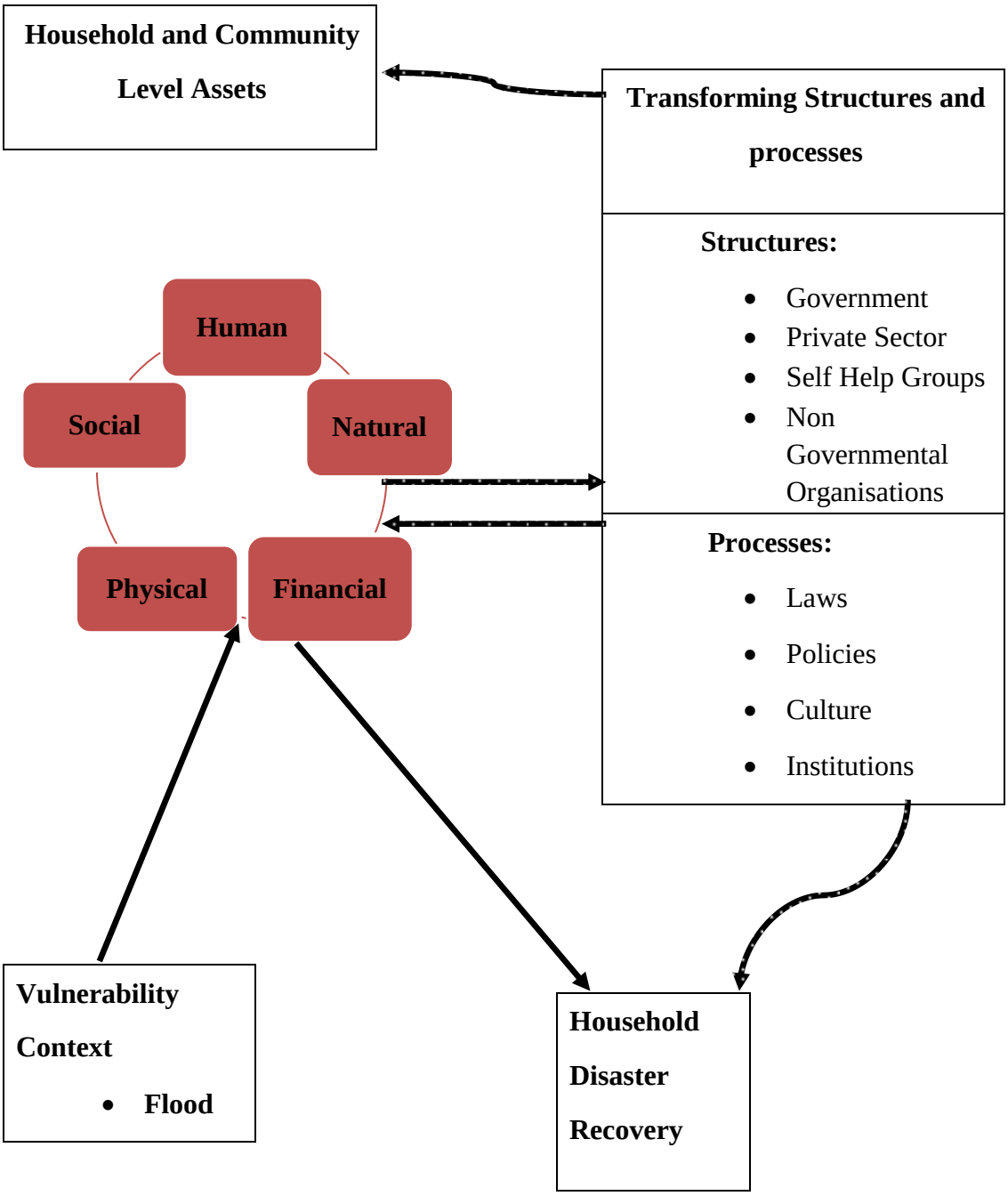
(prevention, preparedness, response, and recovery).



The 2Ps – prevention and preparedness refer to steps taken before disaster strikes. Prevention is taking proactive steps to prevent a hazard from turning into a disaster, such as building levees and floodwalls to protect against floods or strengthening building bye-laws to ensure earthquake-resistant buildings. Preparedness is gearing up to face the disaster, such as stockpiling of food, ensuring access to cyclone shelters, having lifeboats ready and so on. Of the 2Rs, response refers to actions immediately after the hazard strikes, while recovery refers to the longer-term steps taken to help the affected community recover from the impact of the hazard.

While the above framework is useful for throwing light on the different aspects of a disaster such as stages, events, actions and time frame, this linear model does not clarify the changing capabilities and vulnerabilities of disaster-affected individuals and households. It presumes a longitudinal progression of vulnerabilities. In a research context where the emphasis is on the lives of the affected populations, the framework's lack of a development connection limits its utility.

Figure 1.4: Modified Sustainable Livelihood Framework of Flood Vulnerability



Source: Adapted from Modified Sustainable Livelihoods Framework (Majale 2002)

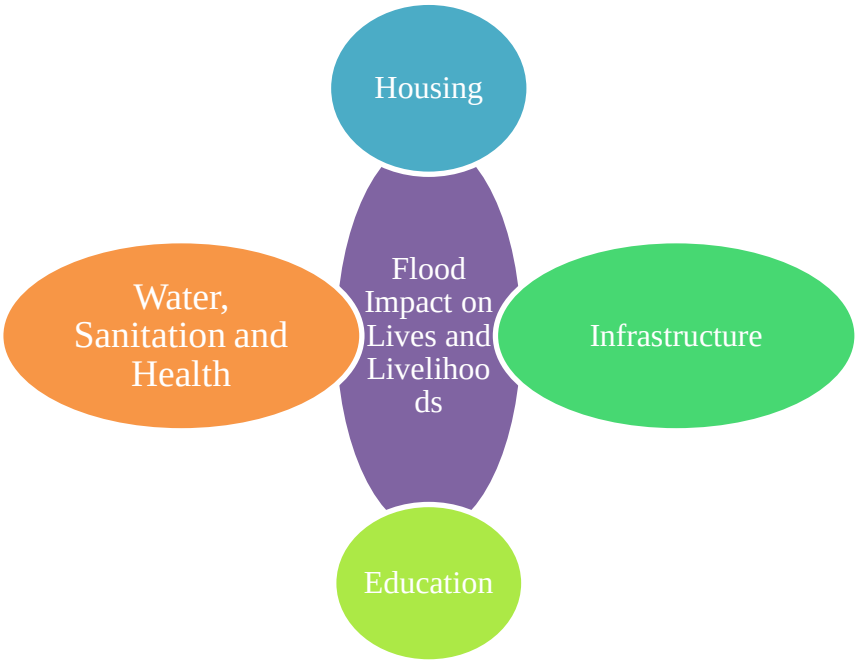
The sustainable livelihood structure (Majale, 2002) gives a helpful expository device to consider vulnerabilities and capacities with regards to a debacle. The system incorporates pathways that edify the impact of exclusionary structures and procedures on the helplessness setting of the investigated. It perceives the dynamic idea of the powers that influence employments. It factors in an assortment of entertainers, impacts, and results.

The manageable vocations idea incorporates a lot more extensive canvas, which incorporates the connection between destitution and condition. With regards to catastrophe inquire about, the dynamic focal point of the practical employments system is on family unit resources and possessions and helplessness with the changing structures and procedures is especially valuable. The piece of the system managing 'jobs' causes to notice the abilities, resources, and working, while the piece of the structure managing 'supportability' centers around adapting and recuperating from stresses and stuns, for example, debacles. The idea of feasible business goes past regular definitions or approaches in a fiasco look into, which concentrates just on the specialized powerlessness of nature or just on specific viewpoints or signs of helplessness, for example, low pay. It perceives the mind-boggling arrangement of advantages out of which individuals develop their living, including both substantial resources and assets, and impalpable resources, for example, claims and access.

The helplessness setting, as conceived by this model, envelops the outside condition of the network. These incorporate stuns, for example, rehashed examples of a dry spell and floods and occasional varieties which have profound ramifications for individuals' jobs. This defencelessness setting influences the family unit and network-level resources, which incorporate human, social, physical, budgetary and normal resources. These benefits additionally impact one another and help in improving different classes of advantages. For example, approaching money related resources could help in verifying one's regular resources, land, or the other way around. This could likewise help in upgrading one's social resources through expanded acknowledgement and connections inside the network. Human resources, for example, one's aptitudes and capacity to work could likewise help in upgrading one's budgetary resources and social resources. Having a home and approaching the safe house, water, sanitation, schools, medical clinics, streets, power and other physical resources could likewise encourage the upgrade of one's human resources.

The family unit and network-level resources with regards to defencelessness to floods additionally help in individuals' family debacle recuperation. The family unit fiasco recuperation is additionally adjusted the family unit and network-level resources. These family and network-level resources work in a setting of approaches and foundations, which change the benefits into logical results, for example, family catastrophe recuperation. These results are intervened through procedures, which are changed by the structures and procedures, and which work at various levels – from the smaller scale level (family unit) to large scale levels (worldwide structures and procedures). They incorporate both open

(Government) and private (all non-legislative including corporate, business and common society) on-screen characters. The introduction to various types of capital to job systems and complex bodies is determined by changing structures and procedures. They often determine the conditions of exchange between different forms of capital and have an effect on the income of various systems. The changing structures and procedures can impact the helplessness setting and either lessen its effect on the network or fuel its belongings.



The conceptual frame adapted from the modified sustainable livelihoods frame gave rise to the following key question: How does disaster recovery of households occur in the context of household and community level assets and vulnerability to floods in Srinagar city?

1.9 Significance of the Study

Academics, scholars, and emergency management professionals will benefit from the study's findings as a source of reference content. It will also contribute to awareness in the sense that the results will generate new ideas, suggestions, and strategies that can be used to address specific flooding issues.

Chapter II

Srinagar District: A Historical Background

2.1 History of its Birth

Srinagar, the valley's centre, is situated on both sides of the Jhelum River. It has a long and glorious history as well as a diverse natural heritage. It is Jammu and Kashmir's summer capital. However, because of its central location, it has an unique edge in the settlement system. With growing populations, it became the first metropolis and the fastest growing city in Jammu and Kashmir. In his work Rajtarangni, Kalhana mentions a country where the sun shines softly, as if Kashayapa built it for his own glory. In heaven, High School, Dwellings, Saffron, Iced Water, and Grapes are all plentiful. Kailasa is the best location in the three realms, Himalaya is the best part of Kailasa, and Kashmir is the best part of Himalaya (Dutt, 1879, p. 25). Sir Aurel Stein has written that the history of Kashmir has always been expressed, as it were, in the history of its capital, Srinagar, which has remained in the same location for over 13 centuries. When Hiun-Tsiang visited Srinagar in around 631 AD, he discovered it already in the location where the majority of the current city of Srinagar is located. It was on the bank of a large river, the Vitasta, which is now known as Jehlum, according to him. According to Hiuen-Tsiang, the Chinese measurement of 12 or 13 li corresponds to the length of the city within its ancient limits along the Vitasta's right bank, which is two and a half miles. Its width is estimated to be slightly less than one mile (4 or 5 li), and it is found to be accurate. To distinguish it from the old capital, which was located in Pandrethan, a village about 3.2 kilometres south of Srinagar, he calls it the new city. According to Kalhana, Ashoka the Great built Pandrathan at the south foot of a mountain spur that rises to a height of 3000 feet above the village, which was then known as Puranadhisthana (meaning the old capital of Srinagar). Despite the fact that Puranadhisthana had fallen out of favour in Hindu times, he claims that extensive remains of ancient structures can still be found on the terraced slopes rising immediately to the north and north-east of Pandrethan. These are located near the Aitgaj, a distance between the Takht-I-Sulaiman and the hills east of it. The advantages of Pandrethan as a location for a great city cannot be compared to those of Srinagar's location. The Vitasta (Jehlum proximity's) combined with the protection from floods provided by the nearby hill slopes, must have been appreciated at a time when the valley's river rains flats were possibly less drained. The name Srinagar, which means "city of Sri" or "Lakshmi," appears to have been given to the capital to honour Ashoka's Buddhist Monastery, which was built about 2 miles away between Pandrethan and a nearby steep hillside. The new city, on the other hand, is said to have been built by King Pravarasena-II around the middle of the sixth century. Kalhana referred to it as Pravarapura,

which is a short form of Pravarapura. Since the city was basically adjacent to the older Srinagar and had coexisted for centuries, it couldn't hold its official name for long and became known simply as Srinagar, just like the many new cities built by successive kings in the vicinity of Delhi remained known simply as Delhi, despite the fact that each of them was originally inte The location of the new capital was determined by a fascinating legend, according to Kalhana. When the king returned from his successful expeditions, legend has it that he wanted to establish a new capital in his honour. He set out at night from his palace in Puranadhistahana to determine the proper site and auspicious time for laying the foundation of the new city in a supernatural way. When he got to a stream, he discovered a terrifying demon on the other side. The demon promised him the fulfilment of his wish on the condition that the king cross over to his side with an embankment that the demon offered to build. The king agreed, and the demon stretched his knees, allowing the stream's water to split on both sides of the embankment. The king drew his sword and sliced steps into the demon's leg flesh before crossing over to the other side. The demon then told him that it was a good time to construct the capital, and that he should do so where he would find the measuring line the next morning. The king found the line the next day in the village of Saritaka, which was home to goddess Sarika and the demon Atta. He is said to have created the city and constructed the first shrine, Siva Pravaresvara, here. It is clear that the stream mentioned in the legend is the Tsunth-Kul canal, which flows through Dal Lake and into Vitasta (Jhelum). Saritaka Village has been totally obliterated and is no longer traceable. Its location is still discernible due to its association with goddess Sarika, a form of Durga who has been worshipped on the hill now known as Hariparbat since ancient times. Srinagar was originally restricted to the right bank of the Jehlum River, but it was later expanded to include the area bounded by the Kut-Kul canal, which branches off the river below Shergari and rejoins it near the 7th bridge. Srinagar's amazing natural strengths can be safely traced to the city's exceptional location. Because of its position near the valley's true heart, Srinagar offers connectivity that no other city can match. Before the advent of road transportation, At all times of the year, the city's river served as the most convenient route for trade and traffic up and down the valley, from Khanabal in Anantnag town to Khadanyar in Baramulla district. The lakes that flank Srinagar, such as Dal and Anchar, on the other hand, offered an abundant supply of goods that contributed materially to the city's subsistence.

Srinagar's history dates back to the dawn of time. However, earlier records show that Ashoka established the city of Srinagar as Sri Nagra in Purana Dishtina (Panderthan) in 272 BC. In

631 AD, King Parversena constructed Parverpora near Koh-i-Maran. In 720 AD, King Lalitaditya constructed Prihaspora in the vicinity of Srinagar. Following this growth, capitals were established at Kanishkapora, Juskapura, and Hushkapora. Both of these innovations contribute to the area's growth. In 1128 AD, however, Zulchu Khan invaded Kashmir and set fire to Lalitaditya. Muslim missionaries crossed passes and reached Kashmir's valley at this time. During this time, Rinchen shah built his city at Budhgair on the right bank of the Jhelum. During this period, Kashmir was introduced to Central Asian architecture. Sultan Ala-ud-Din founded a new town named Ala-ud-din Pora along the right bank of the Jhelum River, which is now known as Khankahi Mohalla and Malik Angan. Zainulabidenn ascended to the throne of Kashmir in 1429 AD. He called his capital Nav-Shahr and constructed a navigable channel (Nalla mar) between Dal and Anchar Lake three (3) kilometres to the north of the city. He also constructed the first bridge across the Jhelum River, known as Zana Kadal, which enabled the city to expand on the left bank. The Mughals built mosques, gardens, and fortifications around the central hillock of Kohi Maran, where King Akbar had established a township named Nagar-Nagari, from 1566 to 1752 AD. Amir Mohammad Khan, the Afghan ruler, built Shergarhi, a fort on the left bank of the river Jhelum, and Amira Kadal, a bridge across the Jhelum, in 1752. Sikh rule was established in Kashmir after the Muslim rulers left. After constructing Gurudwara Chatti Padshahi and Tsount Khul, a navigable flood spill channel connecting Ram Munshi Bagh and Basant Bagh, Mahan Singh renamed the city Srinagar in 1835. Sikh rule in Kashmir was succeeded by Dogra rule, which constructed palaces on the lakefront and used Shergarhi as their secretariat. In 1947, the Dogra rule in Kashmir came to an end. However, between 1947 and 1999, the city of Srinagar grew at a faster pace, albeit in a haphazard manner. Other small housing colonies arose, including Jawahar Nagar, Balgarden, Nur Singh Ghar, Sutra Shahi, Batamaloo, Chanapora, Bemina, Lal Bazar, Buchpora, and others. The city's physical and social infrastructure reflected this expansion, but it was unable to keep up with the city's population growth.

As a result, it is clear that Srinagar was dominated by various sects of citizens, resulting in the city's diverse community. These various cultures gave way to Srinagar's multi-ethnic community, which enhanced the city's heritage and development over time.

2.2 Srinagar District: Birth of a Primate City

Srinagar city grew and developed significantly after independence, with several five-year plans. Srinagar was designated as the state of Jammu and Kashmir's summer capital. The

city's shape, morphology, and composition were altered as a result of its prominence. In and around the city's central area, educational, industrial, and medical facilities arose. Planned residential colonies such as Jawahar Nagar, Gogji Bagh, Batamaloo, Nursing Ghar, as well as the development of a By-Pass road and satellite townships at Zakura in the city's northern suburbs, came into being. The Hindustan Machine Tools (HMT) factory in Zainakot, in the northwest, and the State Industrial Complex in Zewan and Khanmou, in the southeast, both contributed to the city's industrial growth. The tourism industry elevated the city's cultural and economic standing. All of these development projects attracted people from all over the Kashmir valley to Srinagar city, resulting in the city's haphazard growth (Srinagar Municipal Corporation, 2009). After the 1960s, however, the city's growth accelerated dramatically. Between 1961 and 1971, the population nearly doubled, from 0.286 million to 0.415 million. This increase is due to an increase in the number of migrants from neighbouring rural districts. This was the time in Srinagar's history when population growth was outstripped by migration. In Srinagar, this time marked the start of the urbanisation process. However, the population of Srinagar grew steadily over the years, resulting in the city's territorial expansion. Srinagar's municipal limit in 1971 was 103 square kilometres. In 1981, the cap was raised to 140 square kilometres. As a result, In order to develop Srinagar's future, the Department of Town Planning completed a Master Plan for the area, which included plans for the years 1971 to 1991. From 1971 to 1991, the Master Plan triggered development in Srinagar's west and southwest, primarily in low-lying areas, wetlands, and flood absorption basins along the Flood Spill Channel. Turbulence triggered a ten-year plan hiatus beginning in 1989, and insufficient regulatory frameworks of metropolitan regional bodies and local governments resulted in the rapid conversion of formerly colonised and industrial areas to commercial development (Kashmir, 2018). In the year 2000, Srinagar's municipal area consisted of 17 wards and 592 Mohallas/localities, covering an area of approximately 177 square kilometres. In the same year, 126 new villages were added to the district, bringing the total area to 234.46 square kilometres, divided into 68 electoral wards. As a result, a master plan for the next 21 years was planned for better growth in the enlarged area of Srinagar city (2000-2021). (Srinagar Municipal Corporation, 2000). The Srinagar Development Authority (SDA) took further measures in the preparation of the Second Master Plan for the period 2000-2021 in the year 2000, using satellite data. The strategy was rendered ineffective on the ground due to bureaucratic complications and weak execution by various stakeholders. This led to poor living conditions, making it difficult for city planners to provide a decent quality of life and climate for the residents (Srinagar Municipal Corporation, 2009). The Revised

Master Plan-2035 was prepared by the Town Planning Organization Kashmir under the supervision of the Srinagar Development Authority, taking into account the shortcomings of previous plans. This is the city of Srinagar's third legislative planning exercise in the last forty-five years. However, the issue of how much progress has been made on the ground in relation to these master plan goals over the expected span of more than four decades remains unanswered. On the ground, progress has been slow, not because of bad plans, but because of a lack of administrative zeal and political will. Long-term preparation is the only way to go like the Master Plan if we want to make our city more economically vibrant and environmentally friendly. By 2035, the Master Plan anticipates a population of about three million people. Srinagar's Local Area has grown from 416 square kilometres to 766 square kilometres, an increase of 84 percent over the current Master Plan boundaries. Through SRO-429 dated October 21, 2014, The Local Area Expansion was approved by the State Cabinet which includes the municipal areas of Srinagar Municipal Corporation, Budgam, Ganderbal, Pampore, and Khrew ULBs, as well as additional 160 villages as outgrowths in twelve Tehsils of six districts, namely Srinagar, Budgam, Ganderbal, Pulwama, Bandipore, and Baramulla (Kashmir, 2018).

As a result, despite the physiographic constraints, the growing population has resulted in an unplanned expansion of the city, resulting in haphazard residential growth, Congestion, narrow lanes, drainage issues, and filthy and dirty streets are all problems. The key source of water and communication route, the River Jhelum, has been polluted by sewage from houses draining directly into it. As a result, public health was jeopardised, and unsanitary conditions prevailed. The inefficiency of government agencies has paved the way for land banks to be built by developers and property dealers, resulting in a rise in land and property prices. Master plan 2035 is the need of the hour in this regard, and it must be introduced as soon as possible.

Srinagar district is located in the heart of the Kashmir valley, at an elevation of 1730 metres above sea level, between 33°14' and 38°25' north latitude and 74°38' east longitude. District Kargil borders it on the north, district Pulwama on the south, district Anantnag on the north-east, district Baramulla on the west, and district Budgam on the south-west. In the Kashmir zone, it occupies a nearly central position. It has a long and tumultuous history dating back to 250 BC, in addition to being the summer capital of the state of Jammu and Kashmir. Hemavar, Praverpora, and Praversenpur were other names for Srinagar. It has remained the seat of power throughout history, with various kings moving their capital from one location to another. In the east, the ominous mountain Hurmukh (16,903 feet) guards the Sindh valley.

Mahadeo, to the south, seems to be looking down on Srinagar. The district has a geographical area of 1979.00 square kilometres, placing it 16th out of 22 districts in Jammu & Kashmir in terms of area.

2.3 History of Floods in Kashmir Valley

Strong water release from the Jhelum river's tributaries during heavy western disturbances (November to April) and the monsoon season has a long history of flooding in Kashmir's valley (July- September). “Many devastating floods are noted in the vernacular history of Kashmir valley,” writes Sir Walter Lawrence (Lawrence, 1895). According to Lawrence's book, the flood in Kashmir valley in 879 AD was caused primarily by the blockage of the Jhelum River, and it submerged a large portion of Kashmir valley. He attributes the blockage to the slipping of Khadanyar Mountain in Baramulla, which clogs the main river's course and causes flooding in the middle and upper reaches. According to him, a massive flood struck the Kashmir valley in 1841, causing extensive damage to life and property. According to Sir Lawrence, a major flood was seen in the entire Kashmir valley in July 1893 as a result of 52 hours of continuous rainfall, which was dubbed a great calamity at the time. It resulted in significant loss of life and property. “The flood cost the state Rs.64,804 in inland revenue alone in 1893,” he writes, “25,426 acres of crops were submerged, 2,225 houses were destroyed, and 329 cattle were killed.” Lawrence noted an interesting practise in the aftermath of the 1893 floods, writing, "Marvellous tales were told of the efficacy of the flags of saints which had been set up to arrest the floods, and people believe that the rice fields of Tulamula and the bridge of Sumbal were saved by the presence of these flags, which were taken from the shrines as a last resort." They were dubbed the "greatest flood ever experienced," as on July 23, 1903, they swept down the Valley and flooded Srinagar, turning the city into "a whole lake." Floods in Kashmir were registered again in 1929, 1957, and 1992 as time passed. The floods nearly submerged valley plains, according to a newspaper from the time. “The floods reported in Jammu and Kashmir were the highest ever recorded in the state, and the damage caused by them was colossal,” Bakshi Ghulam Mohammad, the then-Prime Minister of Jammu and Kashmir, was quoted as saying (Ananth, 2014). Although floods occurred in the state over the next three decades, the one in 1992 was unparalleled in terms of ferocity. In terms of deaths, it was the most damaging. According to newspaper accounts from 1992, about 200 people died in the floods, and 60,000 people were stranded in many northwestern border districts. It's worth remembering, however, that the floods wreaked havoc on parts of Pakistan-occupied Kashmir, killing over 2,000 people (Ananth, 2014). Floods inundated

villages along the Jhelum River in 1996, according to a newspaper article from the time. However, the floods in the Kashmir valley in 2014 wreaked havoc on every aspect of life. As a result, flooding is not only a frequent occurrence in the Kashmir valley, but it has also become a part of it. (See Table 2.1 for more information.)

Table 2.1: Major Recorded Historical Flood Events in Kashmir Valley

Year	Major Floods	Source
879	Following the slipping of the Khadanyar mountain in Baramulla, the Jhelum Channel was blocked, and a significant portion of the valley was submerged.	Sir Walter Lawrence
1841	It "caused much harm to life and property," according to Lawrence.	Sir Walter Lawrence
1893	Beginning on July 18, 52 hours of nonstop rain resulted in "a great calamity."	Sir Walter Lawrence
1903	The floods of that day were dubbed the **"greatest flood ever recorded"** since they inundated Srinagar on July 23, 1903, transforming the city into "a whole lake."	Sir Walter Lawrence
1929	The portions of Pakistan Occupied Kashmir that are the most affected are now known as Pakistan Occupied Kashmir.	Sir Walter Lawrence
1957	Valley fields were almost submerged by the floods. "The floods reported in Jammu and Kashmir were the highest ever recorded in the state, and the damage caused by them was colossal," Bakshi Ghulam Mohammad, the then-Prime Minister of Jammu and Kashmir, was quoted as saying.	Newspaper Reports
1959	Four days of nonstop rain resulted in a glacial flood.	Newspaper Reports
1992	Over 200 people died in the floods, according to newspaper accounts from September 1992, and 60,000 people were stranded in several northwestern border districts.	Newspaper Reports
1996	Villages along the Jhelum River have been inundated, resulting in significant property damage.	Newspaper Reports

Source: The Valley of Kashmir (Sir Walter Roper Lawrence, 1895) and newspaper reports.

2.4 Causes of Flood in Srinagar City

Flood is a complicated phenomenon with a wide range of meanings and applications. It is a significant hydrologic and geomorphic phenomenon in the tropics, particularly in monsoon areas. Fluvial processes are most involved when rivers flood in certain areas, such as monsoon regions and seasonal tropics. The term "flood" has many different connotations. Technical hydrological definitions based on flow magnitude and frequency, as well as

environmental science concepts expressed as implications for biota, the ecosystem, and other environmental components (Baker, 1944, pp. 139-156). As a result, flooding is clearly a hydrological phenomenon that happens in every drainage basin as a result of heavy rainfall in its catchment area. The following are the major causes of the Jhelum River flood:

2.4.1 Heavy Rainfall:

The characteristics of floods are determined by rainfall patterns. On a global scale, heavy rain is the leading cause of floods. Flash floods, single-event floods, multiple-event floods, and seasonal floods are all examples of different types of flooding. The distribution and frequency of major floods are greatly influenced by the occurrence of heavy to extreme rainfall. Excessive rainfall in the Jhelum catchment area causes floods in the Kashmir valley (Refer Table No 2.2). The key cause of rainfall in the Kashmir valley is the Jhelum River's insufficient carrying capacity combined with high rainfall in its catchment area.

Table No 2.2: Rainfall in Kashmir Valley by station from September 3 to 6, 2014.

District	Station	Actual Rainfall Reported during 3-6 September 2014	Normal Rainfall during 3-6 September 2014 **	Deviation from Norm (%)
Anantnag	Kukernag	415	5.5	7449
	Pahalgam(AWS)	217	6.9	3045
Baramulla	Baramula (AWS)	185	1.9	9637
	Gulmarg	366.8	6.5	5543
Kulgam	Kulgam (AWS)	346	9.8	3431
	Qazigund	599.8	5.4	11007
Awantipur	Awantipur (IAF)	208.1	-	-
	Malangpura (AWS)	266	-	-
Shopian	Shopian	335	5	6600
Srinagar	Rambagh (AWS)	140	2.6	5285
Kupwara	Kupwara	131.8	3.1	4152

Source: Kamaljit Ray*, S. C. Bhan and B. K. Bandopadhyay, "The catastrophe over Jammu and Kashmir in September 2014: a Meteorological observational analysis, CURRENT SCIENCE, VOL. 109, No. 580 3, 10 AUGUST 2015

** Normal Rainfall of these stations has been calculated from 1970- 2000 for the same days.

2.4.2 Inadequate Drainage:

Geomorphic factors include channel migration, meandering formation, avulsion, and natural changes in the elevation of the channel bed. Flooding may occur in unusual ways as a result of these factors. Landslides and advancing glaciers can also obstruct rivers, resulting in

significant floods. In many parts of the Himalayan and sub-Himalayan regions, floods are normal. Floods in Kashmir are mainly caused by geological changes in the Jhelum river. The river Jhelum's insufficient carrying capacity from Sangam (Anantnag) to Khandanyar (Baramulla) is a major cause of recurrence of floods in the Jhelum basin, as is the basin's usual flat topography. The capacity of Srinagar's flood spill channel has been reduced from 17,000 cusecs to 5,000 cusecs due to illegal encroachment, the building of illegal structures, and continuous siltation. The Jhelum channel's capacity of 35,000 cusecs and the flood spill channel's capacity of 120,000 cusecs were unable to cope with the huge floodwater discharge in September 2014 (Floods in Kashmir, 2015). Due to breaches in the embankments, the city of Srinagar was inundated by floodwaters of such immense volume. For a long time, the Kashmir valley has neglected to maintain its embankments, banks, and river walls. At Sangam near Anantnag, four tributaries of the Jhelum simultaneously poured water down with tremendous force and speed.

2.4.3 Unabated urban expansion:

Srinagar urban agglomeration is rapidly developing, with many wetlands and water bodies being converted into housing units. In 1971, Srinagar's municipal boundaries were only 83 square kilometres. Srinagar's urban agglomeration now occupies more than 230 Sq.mms (Office of the Registrar General & Census Commissioner, 2018). Over the decades, Srinagar and its surrounding areas have lost many wetlands and water bodies as a result of urbanisation. In 1990, the state of Jammu and Kashmir had 291.07 square kilometres of wetlands, according to India's Ministry of Environment and Forests, while ISRO identified and mapped 42 wetlands in the state through its Space Application Centre in Ahmadabad. According to studies, between 1911 and 2004, approximately half of wetlands such as Batamaloo Nambal, Rekh-i-Gandakshah, Rakh-i-Arat, and Rakh-i-Khan, as well as the Doodh Ganga and Mar Nalla streams, were completely demolished by urbanisation, while other lakes and wetlands shrank significantly. The progression of urban growth is depicted in Map No. 4 below, which spans the years 1911 to 2004. Between 1911 and 2004, the map shows a rapid expansion of built-up areas (red colour spots). As a result of this development, flood spill channels have been encroached upon, and residential colonies have grown closer to water sources. These areas were the hardest hit by the September 2014 floods (Singh, 2015). Floodwaters followed the natural flow of the river and flooded everything in their course. Human encroachment, on the other hand, poses a threat to the wetlands in Jammu and Kashmir. With the passage of time, the number of wetlands in a given area has decreased. If it

continues unchecked, the Kashmir valley will face a massive flood catastrophe in the future, with unfathomable losses. The “Hokersar wetland,” for example, is suffering from social greed and government indifference. The wetland area had decreased from 18.75 square kilometres in 1969 to 12.8 square kilometres in 2015. Its open water surface area has shrunk from 1.74 square kilometres in 1969 to less than one square kilometre in 2015 (ISRO, 2010).

2.4.4 Excessive and unabated deforestation in the Jhelum and its tributary basin

During the last three decades of militancy, the Kashmir Valley has been largely deforested due to large-scale human activity. Excessive deforestation in the Jhelum and its tributary river basins has resulted in increased river erosive capacity and siltation in river channels and water bodies, resulting in higher water levels in these channels and bodies. Unfortunately, no attempts have been made to upgrade the Jhelum River's channel, desilt/dredge it, or to improve other water bodies such as wetlands, lakes, and so on. Lessons from history were not learned, which was obviously in line with flood management policies such as improving flood channels, strengthening embankments and floodwalls in Srinagar city, and restoring wetlands around the city to serve as sponges when the need arose.

2.4.5 Impact of Climate Change:

Climate change would trigger a 30% rise in the occurrence of severe rainfall in Asia, according to the IPCC 5th Assessment Report (IPCC, 2014). According to the NRAA study, Very unusual rainfall storms and shifting distributions are now a widely accepted symptom of climate change caused by indiscriminate industrialization, urbanisation, consumerism, and other factors. Due to an increase in the frequency of extremely high-intensity rainfall storms, floods have become more frequent outside of the typical flood-prone states of Bihar, Assam, Eastern Uttar Pradesh, and Orissa. Clouds entering valleys are often unable to escape due to high hills, causing them to accumulate and ultimately erupt into a powerful storm. In valleys surrounded by high hills, heavy rains and cloudbursts with rainfall intensities of over 100 mm/hr are normal. In comparison to other countries, rain that falls on hard and solid glaciers, as well as rocks, runs off as run-off, possibly causing flooding. Continuous rains can cause glaciers to melt and exacerbate floods and deluges. Encroachment on wetlands, the installation of a communication network, and other land-use-related growth practises all contribute to vulnerability and fragility. Since Kashmir is a closed valley, the only way to release floodwaters is through the Jhelum River, which has a narrow segment that flows through the Pir Panjal hills. This year's monsoon arrived six days late in Kerala, and its

progress northward was slow. Its northward migration was halted for about 15 days over central India, resulting in extreme drought in Punjab, Haryana, Gujarat, and Maharashtra (NRAA, 2014). J&K recorded 55 percent more rainfall than usual in the last week of monsoon withdrawal (week ending September 3, 2014), Western Rajasthan 33 percent, Eastern Rajasthan 34 percent, and Punjab (-63 percent) and Himachal Pradesh (-48 percent) (IMD, 2017). A confluence of three rain-bearing systems over Punjab created powerful monsoon currents that drew sufficient amounts of moisture into south Kashmir in a five-day spell that wreaked havoc in J&K from September 3-6, 2014, due to the development of a deep depression. The Shupiyan district of J&K received 29.53 percent more rainfall than average in the week ending September 9, 2014, followed by Kulgam (18.50 percent), Anantnag (16.87 percent), and Pulwama (23.80%). With the exception of Punch, both districts received a lot of rain. The actual rainfall received (1645mm) in the South Kashmir area was significantly higher than the normal rainfall, according to data collected by the Indian Metrological Department (IMD) for Jammu and Kashmir from the 28th of August to the 10th of September 2014. (124.9mm). The south catchments of the Jhelum River received a 650mm downpour on September 4th, according to TRMM results (TRMM, 2017). Because of the run-offs caused by the glaciers and hard rocks, the soil in the region was already saturated, resulting in unprecedented floods (NRAA, 2014). The Jhelum flood level at Sangam surpassed all previous records, rising to about 34.70 feet (danger level 21). The flood level in Ram Munshi Bagh rose to about 29.50 feet as a result of this (danger level 18). Heavy rains in the Sindh basin (105mm) caused a large discharge in the Sindh Nallah, which joins the Jhelum at Shadipora, causing an upward rush and restricting the free flow of Jhelum water into the Wular Lake, which at the time had the required detention capacity. Despite massive natural breaches at Kandizal, Chursu, Lelhar, Marwal, Khadermoh, and other locations, the flood inflow exceeded Jehlum's combined carrying ability and the flood channel. The data shows the scale of the September 2014 floods, which killed people, destroyed communication and other infrastructure, and killed livestock and wildlife. Thousands of people were stranded in the Kashmir valley after hundreds of villages were inundated, damaged, or burned.

2.5 The trends of Rainfall pattern in the Srinagar District

The average annual rainfall in Srinagar is around 660 millimetres, with a significant portion of this precipitation falling in the form of snow. From December to February, the city receives snow, but it rarely accumulates for longer periods of time. The relative humidity reaches its highest point in January, at 85 percent, and its lowest point in June, at 57 percent. The annual

temperature ranges from 38.3 degrees Celsius (100.9 degrees Fahrenheit) in July to 20.0 degrees Celsius (4.0 degrees Fahrenheit) in January. Therefore, the Srinagar district falls under a humid subtropical climate. This region is characterised by warm summer and cold winter. Rainfall occurs both in summer and winter from Monsoon as well as by Western Disturbances (originating from Mediterranean sea) respectively. However, from the seasonal point of view, the weather in the Kashmir valley has been divided into the following seasons (Hussain, 2000, pp. 56-78). Which are:

I) Sonth (Spring season) - March 15 to May 15.

II) Grisham (summer season) - May 15 to July 15.

III) Waharat (Rainy Season) - July 15 to Sept. 15.

IV) Harud (Autumn) - Sept.15 to Nov. 15.

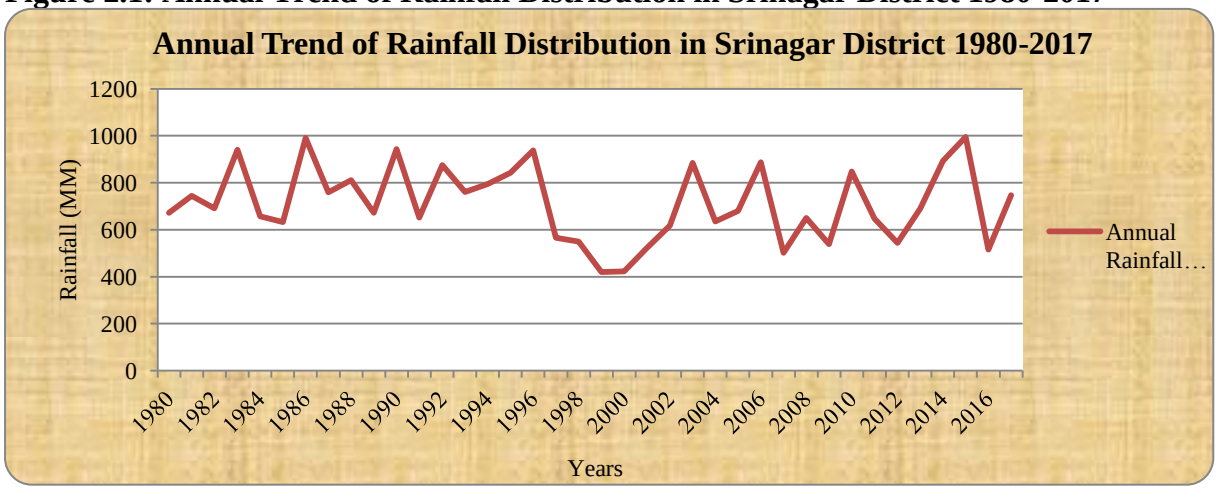
V) Wand (Winter) - Nov.15 to Jan 15.

VI) Sheshur (Ice Cold) - Jan. 15 to March 15.

2.5.1 Rainfall Distribution in Srinagar City:

Floods occur at different times and in different places across India. The months of July and August, on the other hand, are the months with the most occurrences and damage, which vary in time and space (Kapur, 2010, pp. 68-72,231,245-46). Srinagar's flood hazard vulnerability is increasing over time. As a result, in this context, Srinagar city rainfall data will be an important input for analysing flood inundation and water logging issues in Srinagar. Figure 2.1 shows the annual trend of rainfall distribution in Srinagar city from 1980-2017. It is clear from the given graph that there is a high fluctuation of rainfall in Srinagar city. However, the Rainfall pattern in these 37 years shows that in 1987 and 2014 that Rainfall touched 1000 Millimetres which led to the inundation of the middle and lower areas of the Jhelum basin and caused a flood that created havoc to human life and property.

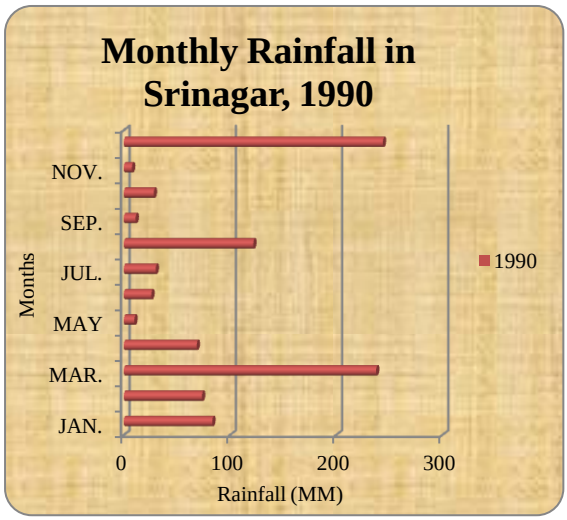
Figure 2.1: Annual Trend of Rainfall Distribution in Srinagar District 1980-2017

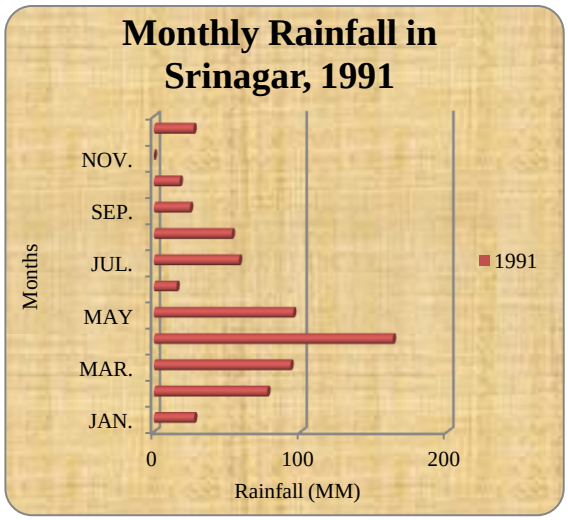


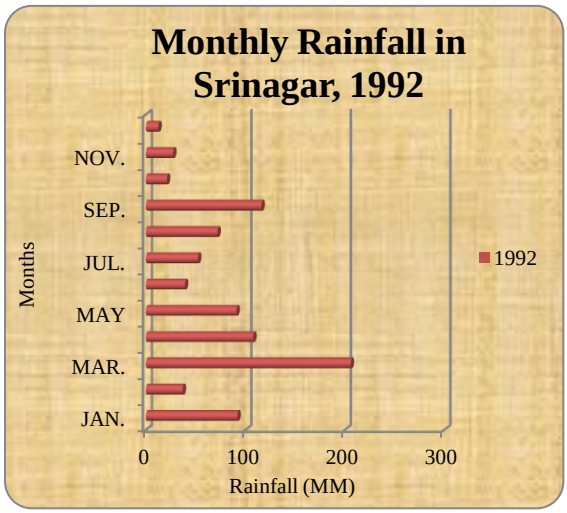
Source: Indian Meteorological Department (IMD), Rambagh Srinagar.

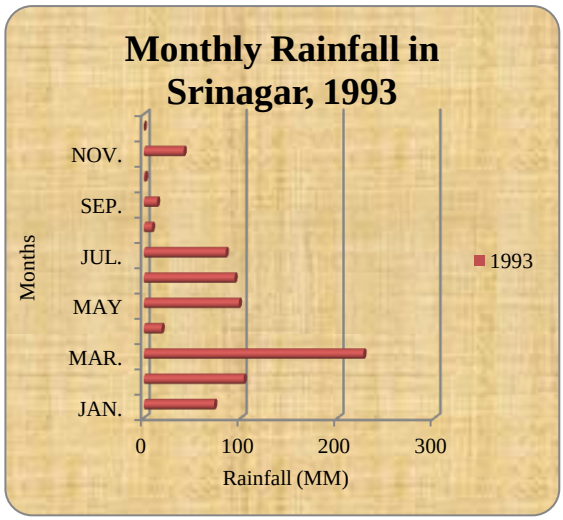
The monthly and yearly trend of rainfall in Srinagar city from 1980-2017 gives a clear picture of hazard timing in Srinagar city. The data shows the unusual behaviour of rainfall, particularly during the summer season and whenever there is an unusual amount of rainfall due to monsoon, it causes inundation in Jhelum and causes a flood (Refer Figure No 2.1).

Figure 2.2: Monthly Rainfall Pattern (in Millimetres) of Srinagar City 1990-2017






Monthly Rainfall in Srinagar, 1992
NOV.
SEP.
JUL.
MAY
MAR.
JAN.
Months
0
100
200
300
Rainfall (MM)
1992


Monthly Rainfall in Srinagar, 1993
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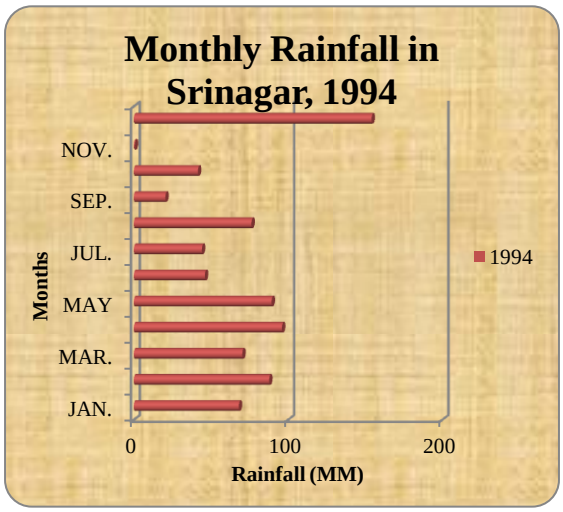
SEP.
JUL.
MAY
MAR.
JAN.
Months
0
100
200
300
Rainfall (MM)
1993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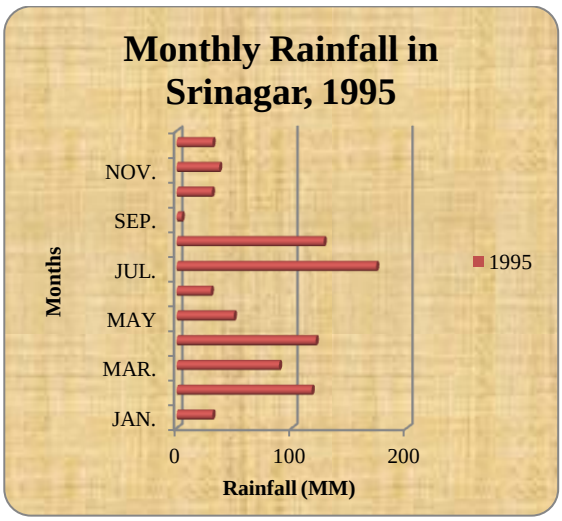
SEP.
JUL.
MAY
MAR.
JAN.
Months
0
100
200
Rainfall (MM)
1994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MAY
MAR.
JAN.
Months
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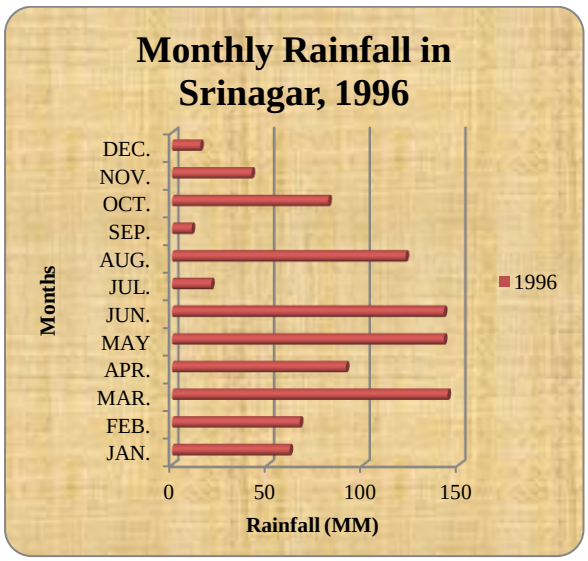
100
200
Rainfall (MM)
1995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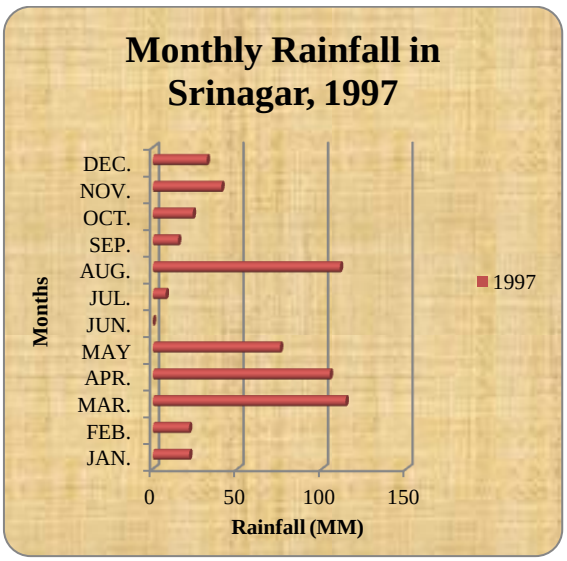
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
Months
0
50
100
150
Rainfall (MM)
1996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DEC.
NOV.
OCT.
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AUG.
JUL.
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MAR.
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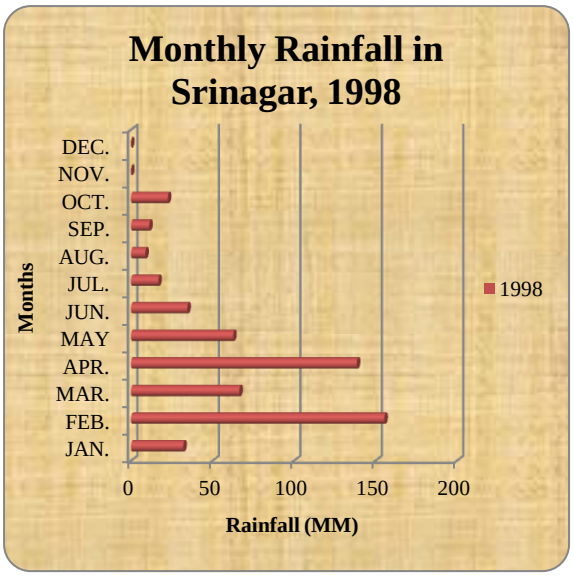
JAN.
Months
0
50
100
150
Rainfall (MM)
1997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DEC.
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OCT.
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AUG.
JUL.
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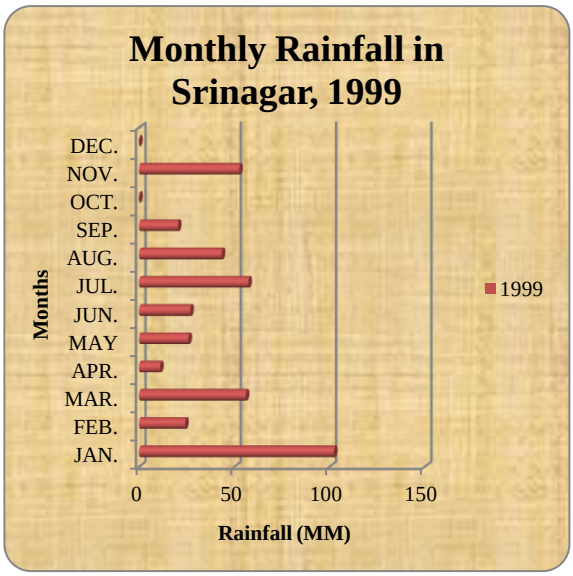
APR.
MAR.
FEB.
JAN.
Months
0
50
100
150
200
Rainfall (MM)
1998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MAR.
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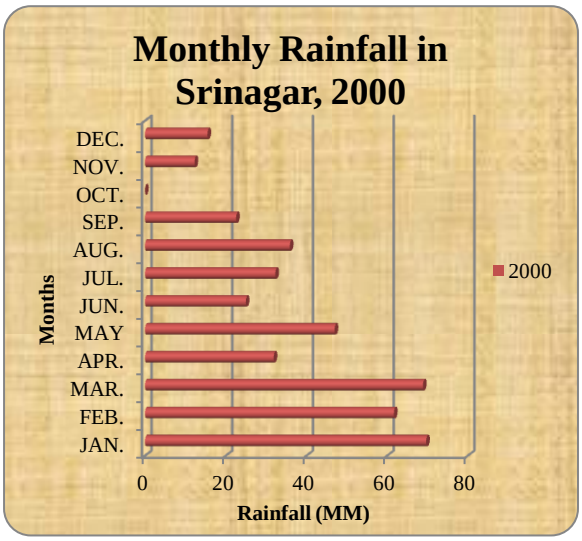
JAN.
Months
0
50
100
150
Rainfall (MM)
1999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DEC.
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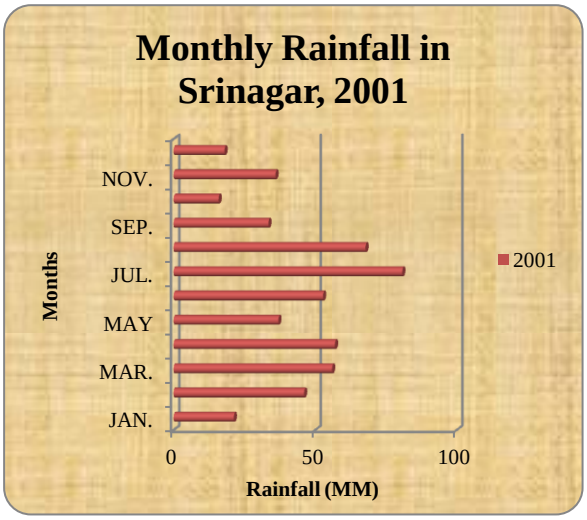
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
Months
0
20
40
60
80
Rainfall (MM)
2000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MAR.
JAN.
Months
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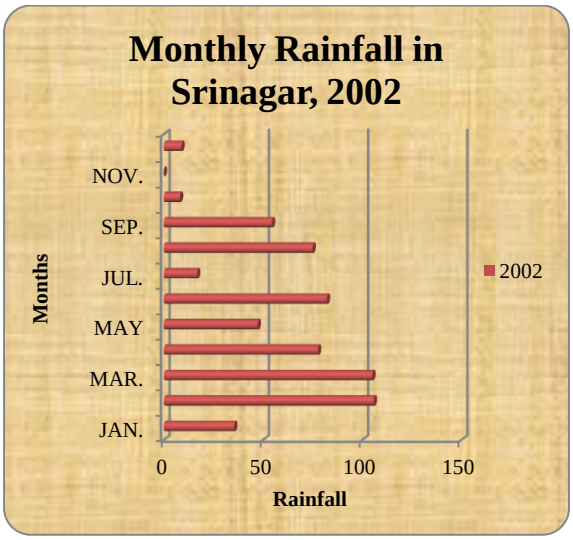
Rainfall (MM)
2001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MAR.
JAN.
Months
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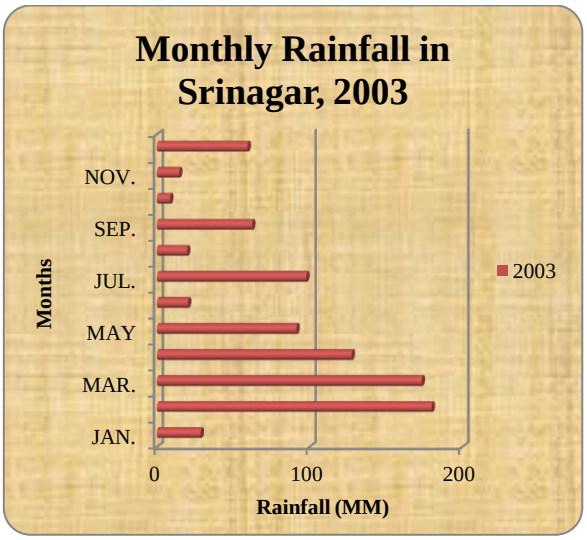
50
100
150
Rainfall
2002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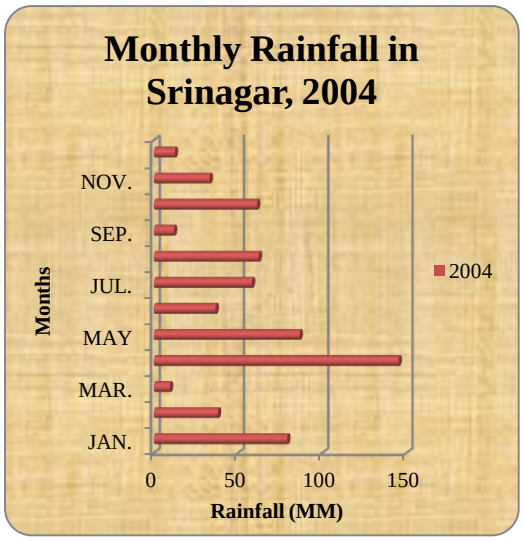
SEP.
JUL.
MAY
MAR.
JAN.
Months
0
100
200
Rainfall (MM)
2003


Monthly Rainfall in Srinagar, 2004
Months
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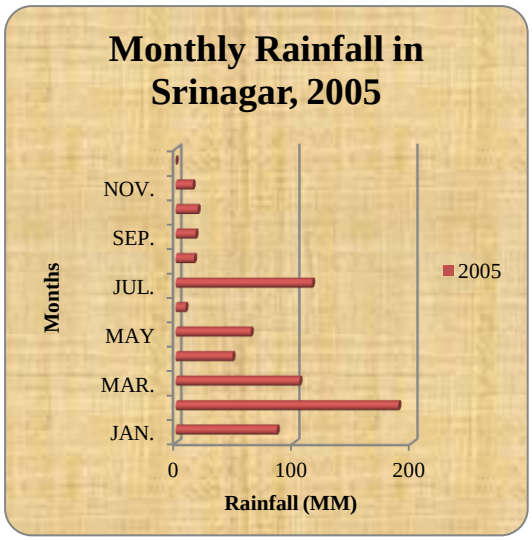
SEP.
JUL.
MAY
MAR.
JAN.
0
50
100
150
Rainfall (MM)
2004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Months
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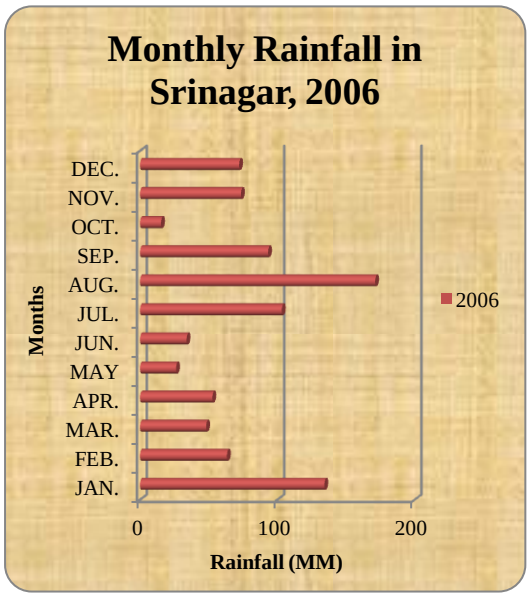
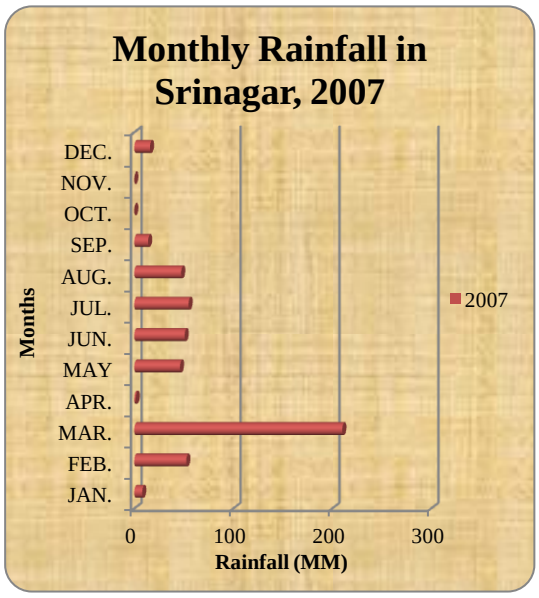
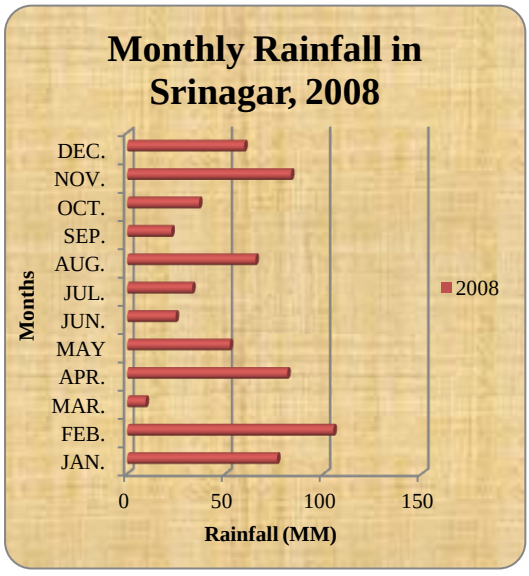
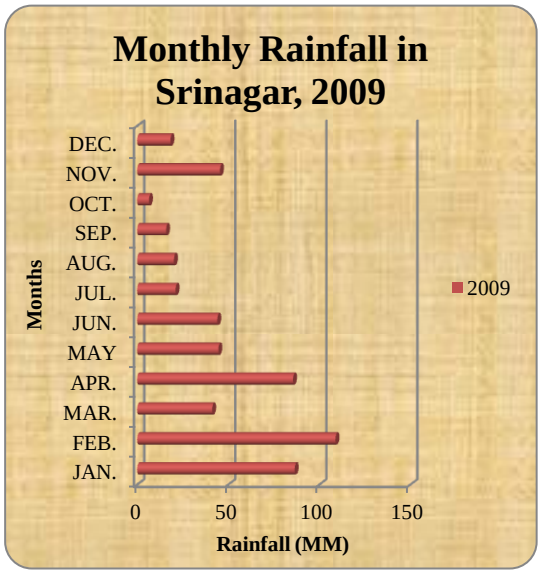
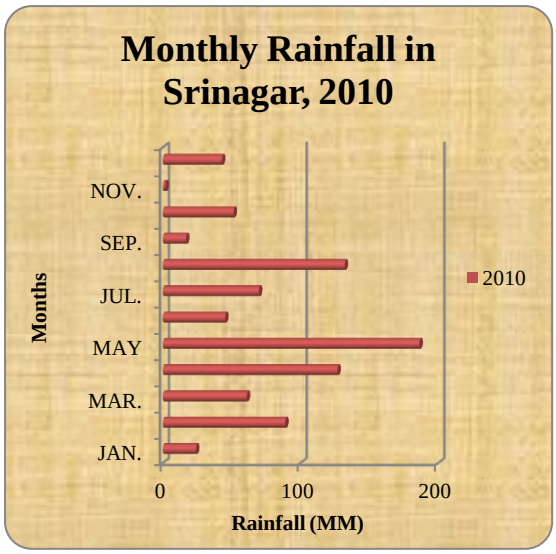
SEP.
JUL.
MAY
MAR.
JAN.
0
100
200
Rainfall (MM)
2005

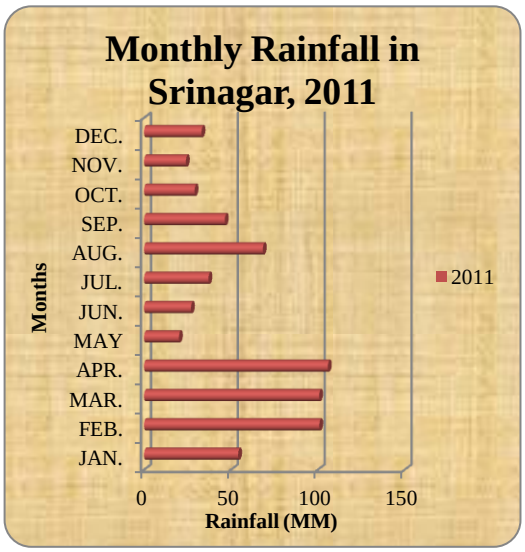

Monthly Rainfall in Srinagar, 2006
Months
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
0
100
200
Rainfall (MM)
2006

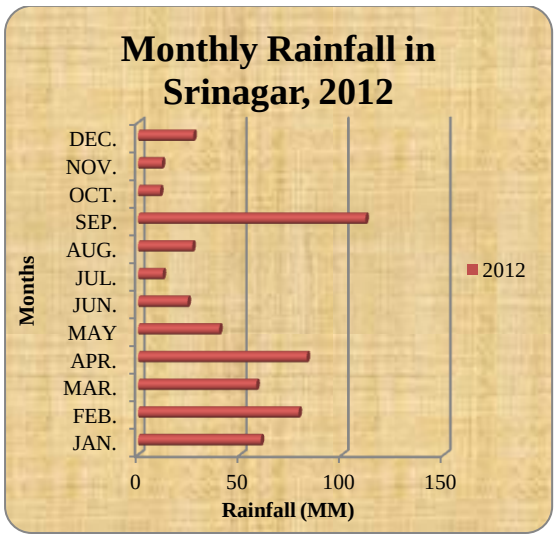

Monthly Rainfall in Srinagar, 2007
Months
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
0
100
200
300
Rainfall (MM)
2007

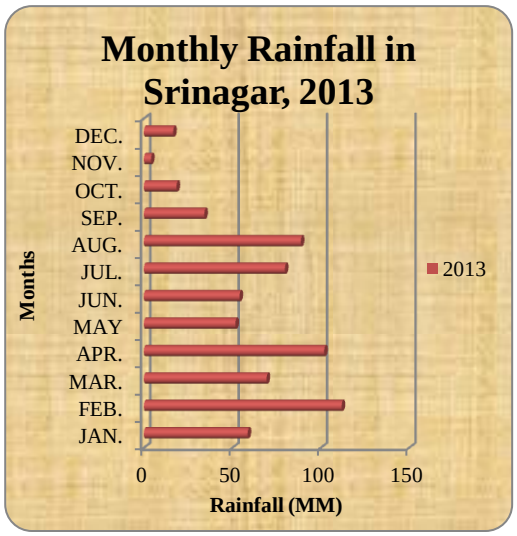

Monthly Rainfall in Srinagar, 2008
Months
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
0
50
100
150
Rainfall (MM)
2008

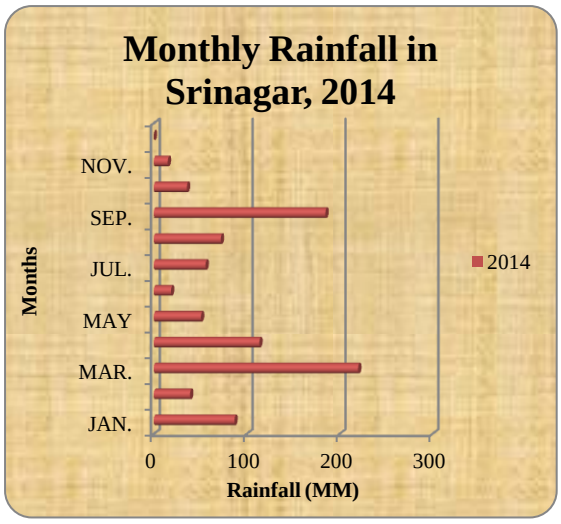

Monthly Rainfall in Srinagar, 2009
Months
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
0
50
100
150
Rainfall (MM)
2009

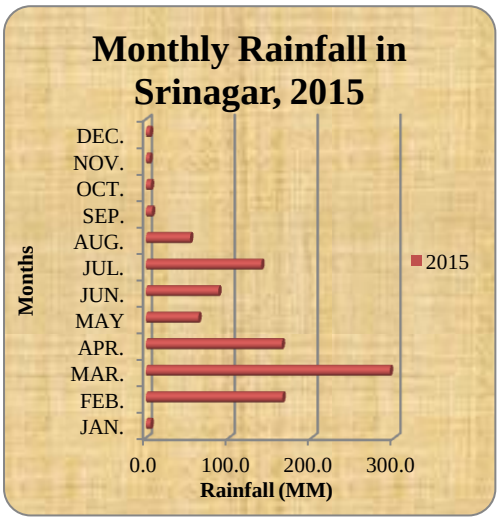

Monthly Rainfall in Srinagar, 2010
Months
NOV.
SEP.
JUL.
MAY
MAR.
JAN.
0
100
200
Rainfall (MM)
2010

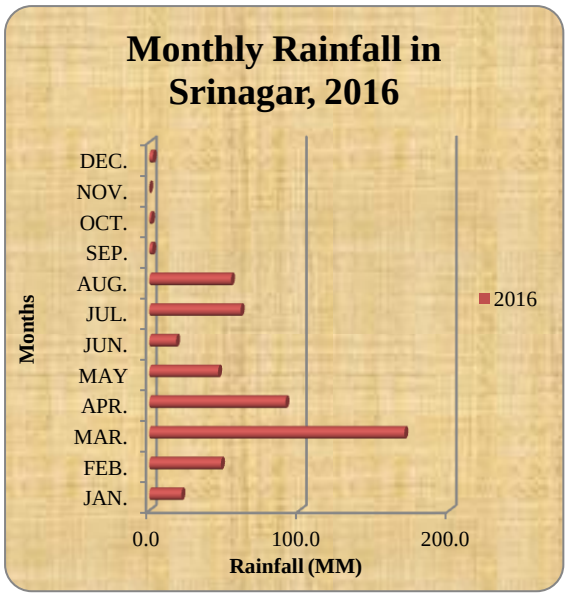

Monthly Rainfall in Srinagar, 2011
Months
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
0
50
100
150
Rainfall (MM)
2011

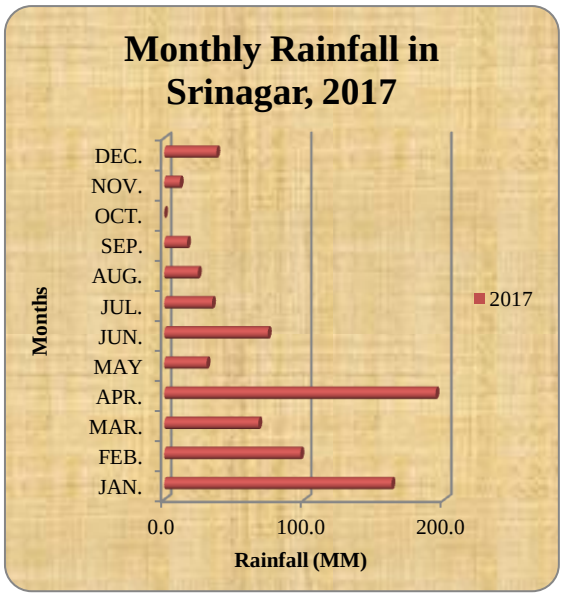

Monthly Rainfall in Srinagar, 2012
Months
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
0
50
100
150
Rainfall (MM)
2012


Monthly Rainfall in Srinagar, 2013
Months
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
0
50
100
150
Rainfall (MM)
2013


Monthly Rainfall in Srinagar, 2014
Months
NOV.
SEP.
JUL.
MAY
MAR.
JAN.
0
100
200
300
Rainfall (MM)
2014


Monthly Rainfall in Srinagar, 2015
Months
DEC.
NOV.
OCT.
SEP.
AUG.
JUL.
JUN.
MAY
APR.
MAR.
FEB.
JAN.
0.0
100.0
200.0
300.0
Rainfall (MM)
2015





Source: Indian Meteorological Department (IMD), Rambagh Srinagar.

2.6 Rainfall Variability in Srinagar 1980-2017

Rainfall occurrences in India are characterised by seasonal and large-scale spatial-temporal variability. Climatic variability can be described as the pattern of change in climatic parameters over a typical averaging period. Climate change has been documented in various parts of the world. These climatic shifts last several decades and have far-reaching regional implications. The inter-annual to decadal-scale variability of rainfall, in particular, has been known to put a burden on the economic growth of South Asian countries. Table 2.3 shows the rainfall variability data of Srinagar city from 1980-2017, which gives out an interesting picture where the average annual rainfall of Srinagar city from 1980-2017 is 715.10 Millimetre. However, it shows a fluctuating monthly trend where the average annual rainfall of January is 53.79 Millimetre. This average annual rainfall increases in February and March to 89.19 Millimetre and 120.63 Millimetre respectively. This increase in average rainfall in these three months is mainly due to the strong prevalence of western disturbances over the northern part of India. However, this average monthly rainfall starts declining from April, which records 95.22 Millimetre rainfall. This further declines in May, June, July, August, September, October, November and December to 65.68 mm, 43.51 mm, 63.25 mm, 62.96 mm, 34.10 mm, 25.55 mm, 25.05 mm, and 40.18 mm respectively. The monsoon does not play a permanent role in the weather of Srinagar. The monsoon drought, on the other hand, is accentuated in the western Himalaya, bringing abundant rainfall to Srinagar and the surrounding areas, as well as strong disasters in the form of floods.

Table 2.3: Rainfall Variability in Srinagar 1980-2017

Monthly/Annual/Seasonal	Average	Standard Deviation	Coefficient of Variation
JANUARY	53.79	35.79	66.53
FEBRUARY	85.19	41.59	48.82
MARCH	120.63	82.15	68.10
APRIL	95.22	49.13	51.60
MAY	65.68	39.41	60.00
JUNE	43.51	28.62	65.77
JULY	63.25	41.70	65.92
AUGUST	62.96	39.13	62.15
SEPTEMBER	34.10	39.08	114.61
OCTOBER	25.55	26.19	102.51
NOVEMBER	25.05	26.41	105.45
DECEMBER	40.18	58.82	146.37
JFM	259.62	90.55	34.88
AMJ	203.27	78.31	38.52
JAS	160.32	72.55	45.25
OND	90.78	77.53	85.40
ANNUAL	715.1	158	22.1

Source: Indian Meteorological Department (IMD), Rambagh Srinagar.

The seasonal pattern of average rainfall in Srinagar city from 1980-2017 also gives an interesting picture of rainfall variability. It shows clearly that in the winter and early spring season, Srinagar receives 259.62 mm rainfall. This precipitation is mainly in the form of snowfall which does not last long while this average rainfall declines to 203.27 Millimetres in the late spring and early summer season. This type of rainfall is mainly caused due to local conditions. However, the late summer and early Monsoon period record 160.32 Millimetre of rainfall and the period of retreating Monsoon and early winter records 90.78 Millimetre of rainfall.

The annual coefficient of variation of rainfall in Srinagar city from 1980-2017 is 22.1, which shows that the annual variability of rainfall is stable. However, this variability across months is showing the fluctuating picture The coefficient of variation normally decreases with increasing rainfall amount up to about 100 cm and does not vary much above that. The coefficient of variance is much higher than 35 percent for rainfall amounts less than 50 cm (Narhari, 2000, pp. 1215-1230). The coefficient of variance of monthly rainfall shows that the variability is high in September, October, November and December, where it is 114.61, 102.51, 105.45 and 146.37 respectively. However, on the other hand, the rainfall in other months is more or less stable than these four months. The greater stability of rainfall from the

data of 37 years shows that April has more stability in Rainfall distribution where the value of variability is 51.60. Whereas in other months this stability decreases and the highest variability in rainfall is in December where this variability is 146.37.

2.7 Monthly Rainfall distribution in Srinagar city

The monthly rainfall data of Srinagar shows temporal variations from 1980-2017. These variations in rainfall are due to various physical and meteorological factors. The total rainfall was recorded highest in 1983, 1986 and 1990 when it was 941.3 Millimetres, 991.3 Millimetres and 942.8 Millimetres. Whereas on the other hand, the monthly rainfall pattern shows that March, April and May's month receive the highest rainfall. This is evident from the rainfall data of 1980-2017. However, this rainfall is least prone to cause flood whereas the rainfall in August, September and October has more propensity to cause flood even when the rainfall is lower than the rainfall in March, April and May (Refer Table No 2.4). This type of flood phenomena in the medium rainfall months can be attributed to various factors like Melting of glaciers along with Rainfall during summer months boosts the flow of discharge and causes a flood. Secondly, this is the time when Gujjars and Bakarwals are with their herds of sheep and cows in the mountainous pastures. Their herds loosened the soil, and whenever there is rain, it washes down the loosened particles and decreases the carrying capacity of Jhelum and its tributaries. Therefore, whenever there is a consistent rainfall for a few days, water starts inundates across the banks and causes disaster in the form of the flood in low lying and vulnerable zones. Finally, Because of the political unrest in Jammu and Kashmir, ruthless forest cutting has loosened the soil and has intensified siltation in the Jhelum and its tributaries. As a result, its carrying capacity has decreased, resulting in flooding if there is consistent rainfall for a few days. In most situations, however, the lack of micro-level observation and record poses a significant challenge to proper evaluation of potential flood hazard mapping.

Table No 2.4: Total and Mean Rainfall (in Millimetres) of Srinagar City 1980-2017

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total	Mean
1980	40.8	133.6	71.6	36.2	60.5	79.8	62.8	44.9	52.2	19.1	49.3	20.8	671.6	56.0
1981	84.8	90.9	207.7	68	46.6	48	123.4	37.2	1.7	15.5	19.2	0.8	743.8	62.0

1982	28.7	96.3	122.1	102.8	63.3	26.3	43.4	56.7	31.9	50.7	25.9	43.8	691.9	57.7
1983	30	34.5	365	161.6	85	32.3	33.1	92	70.9	23.1	10.1	3.7	941.3	78.4
1984	35.1	74.8	74.1	154.3	40	16.8	64	105	14	0	55.7	23.1	656.6	54.7
1985	45.2	34.2	32	58.5	86.1	19.6	65	23.7	0	52.8	5.2	210	632.2	52.7
1986	9	59.2	189.3	199.9	50.3	17.6	47.1	70.1	7.4	40.3	116	185	991.3	82.6
1987	12.3	99.2	57.9	112.7	190.5	91.8	39.6	2.7	14.5	128	0	10.4	759.5	63.3
1988	54.4	101.1	198.5	25.7	30.9	61.7	182.6	46.3	81	0.5	4.1	24.7	811.5	67.6
1989	13.3	70	94.4	90	72.8	34.8	94.6	69	7.8	48.6	32.5	44.3	672.1	56.0
1990	83.4	73.7	237.6	68.7	10	26	30.1	122	11.2	28.3	7.8	244	942.8	78.6
1991	27.4	77.3	93.1	162.9	94.9	15.4	58	53.1	24.6	17.6	0	27	651.3	54.3
1992	92.1	37	206	108	91.2	39.4	52.5	72.1	116	21.2	27.4	12.6	875.8	73.0
1993	72.6	103.1	226.6	18.3	98.1	93.6	84.5	8.4	13.6	1.3	41.1	0	761.2	63.4
1994	68.1	87.8	70.4	96.1	89.4	46.1	44.2	76.3	20.5	41.6	0.7	154	795.4	66.3
1995	31.1	117.3	89	120.8	49.7	29.7	173.4	128	4.4	30.6	37	31.2	842.0	70.2
1996	61.5	66.8	144	90.9	142.1	142.1	20.5	122	10.3	81.7	41.6	14.8	938.4	78.2
1997	21.5	21.4	114	104.7	75.2	31 . 5	7.6	111	14.9	23.6	40.5	31.9	566.0	51.5
1998	32.1	155.5	66.5	138.6	62.7	34.6	16.8	8.8	11.2	22.6	0	0	549.4	45.8
1999	102.3	24.2	56	11	25.9	26.9	57.4	43.4	20.4	0	52.6	0	420.1	35.0
2000	69.7	61.7	68.9	31.9	47	25	32.3	35.9	22.6	0	12.3	15.5	422.8	35.2
2001	21.3	46.1	56	57	37	52.8	80.8	67.8	33.5	15.9	36	18	522.2	43.5
2002	35.5	105.8	105.1	77.7	47.3	82.2	16.8	75	54.5	8.2	0	8.9	617.0	51.4
2003	28.7	180	173.4	127.6	91.4	20.4	97.9	19.8	62.4	8.7	14.6	59.4	884.3	73.7
2004	79.2	38.1	9.6	145.4	86.6	36.7	58.3	62.3	12	61.3	33.2	12.5	635.2	52.9
2005	85.6	188.5	104.8	48.1	63.6	8.3	115.5	15.6	16.8	18.6	14.4	0	679.8	56.7
2006	134.3	63.3	48.2	52.7	26.3	33.9	103.3	171	93.3	15.3	73.5	72.2	887.6	74.0
2007	8.1	52.6	210.3	1.5	46.2	50.9	54.9	47.4	14	0	0	15.9	501.8	41.8
2008	76.3	105	9.4	81.5	52.3	24.7	33.1	65.3	22.5	36.6	83.4	59.6	649.7	54.1
2009	86.5	108.9	41.2	85.6	44.6	44	21.1	20.2	15.9	6.5	45.5	18.3	538.3	44.9

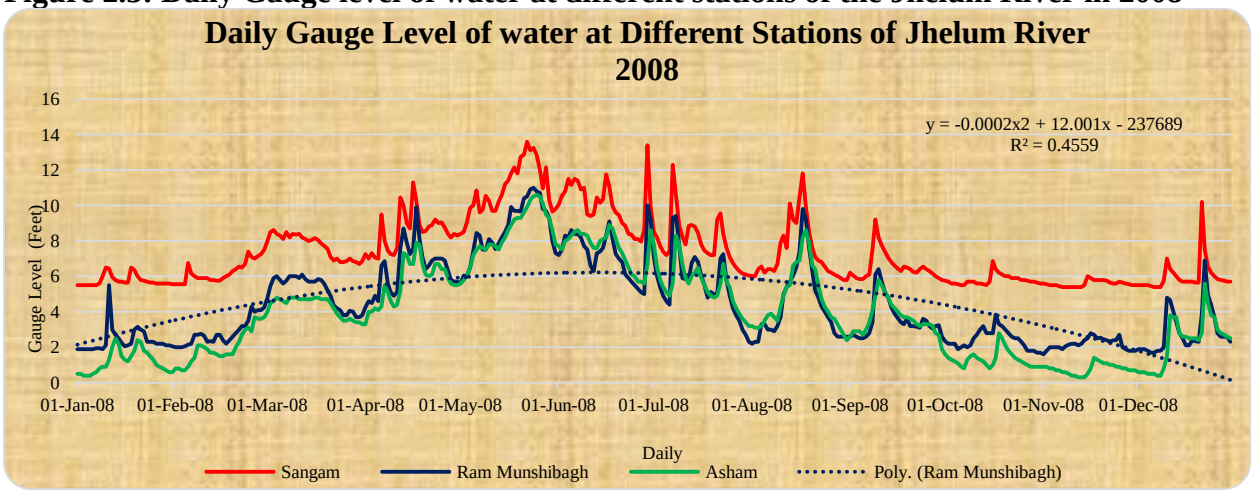
2010	24.1	88.9	61	126.8	186.4	45.3	69.8	132	16.9	51.4	2	43	847.7	70.6
2011	54.2	100.9	100.8	105.8	20.1	27	37.1	68.4	46.5	29.1	24.1	33.1	647.1	53.9
2012	60.2	78.7	58	82.7	39.8	24.3	12.1	26.6	112	10.8	11.7	27.1	543.5	45.3
2013	58.7	111.9	69.4	102	51.8	54.1	79.8	88.8	34.2	18.5	4.1	16.6	689.9	57.5
2014	86.9	39.1	220.1	113.7	50.9	18.6	55.8	72.2	185	35.7	15.1	0	892.9	74.4
2015	5.6	164.9	294.6	164.1	63.4	87.5	139.3	53.4	7.4	6.1	4.5	5	995.8	83.0
2016	21.4	47.8	170.1	90.8	45.9	17.9	60.9	54.5	2	1.2	0	2.4	514.9	42.9
2017	162.2	97.2	67.2	193.7	30.2	73.9	34.1	24	16.3	0	11.1	37.2	747.1	62.3

Source: Indian Meteorological Department (IMD), Rambagh, Srinagar.

2.8 The changing behaviour of the Jhelum River

Its source is the Verinag spring in the south Kashmir district of Anantnag, the Jhelum River and its tributaries form a well-developed drainage channel of Kashmir valley. It is a lifeline for the Kashmir valley, with half of the watersheds flowing from the Pir Panjal range on the left bank and the other half from the Great Himalayan range on the right bank. It flows from the south to the north. It is one of the most important tributaries of the Indus River. The Jhelum River is known for its unpredictability. It has been read from the daily discharge flow of Jhelum at three stations at Sangam, Ram Munshibagh Srinagar and Asham stations. This analysis gives an insight into changing the behaviour of Jhelum over time. The discharge flow of Jhelum has been analysed from 2008 to 2018. It shows clearly that the gauge readings at these three stations are fluctuating rapidly. In 2008, the fluctuation was evident in Jhelum at all three stations. However, the flow of discharge was higher at Sangam station followed by Ram Munshibagh and Asham all over the year. The polynomial trend line has been drawn for the Ram Munshibagh Station where the value of R square is 0.45 which clearly shows that the flow has not followed a particular path while it has shown high volatility over time (Refer Figure No 2.3).

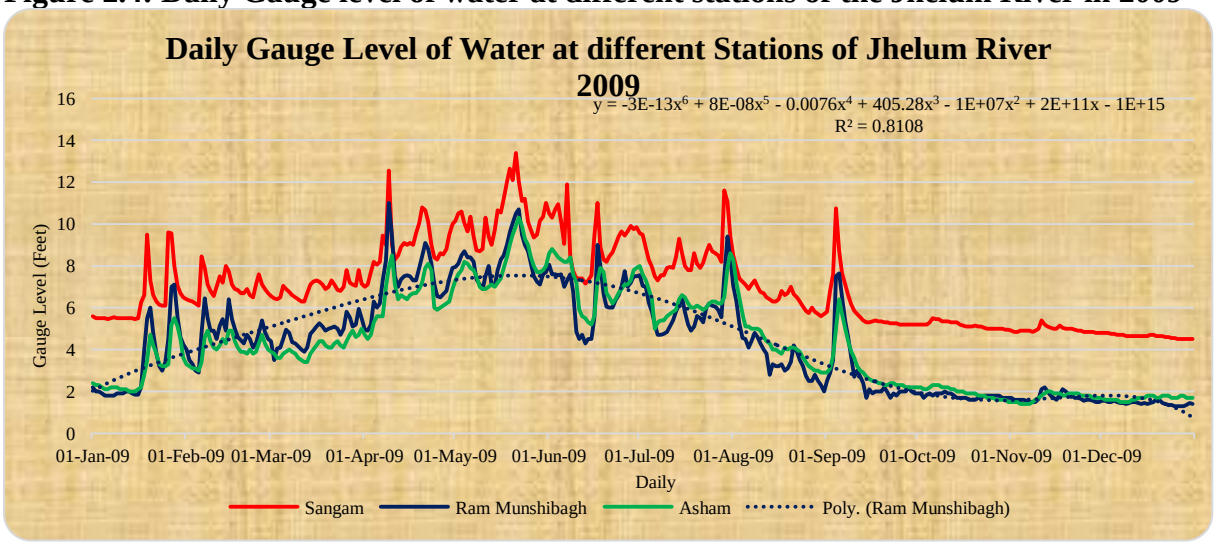
Figure 2.3: Daily Gauge level of water at different stations of the Jhelum River in 2008



Source: Irrigation and Flood control Department, Kashmir Division.

In 2009, the discharge flow of Jhelum at three stations had again shown that the Gauge level of Jhelum was higher at Sangam while it was more or less similar at Ram Munshibagh and Asham. The pattern of discharge flow shows clearly that from March, it starts increasing and reaches its peak in June and July and then starts declining with time. However, there are rapid fluctuations in its flow. The trend line of Ram Munshibagh is following the path of discharge flow and the value of R square is 0.81 which indicates that the discharge of Jhelum at Ram Munshibagh has followed a particular path and the volatility of flow was low. (Refer Figure No 2.4)

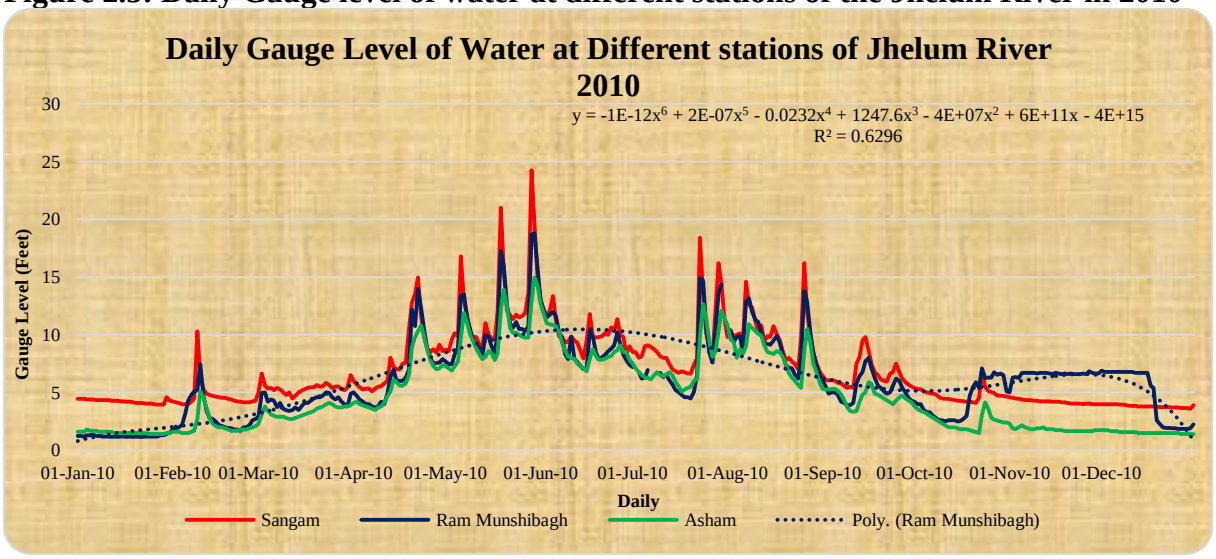
Figure 2.4: Daily Gauge level of water at different stations of the Jhelum River in 2009



Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.5 shows the discharge flow of Jhelum in 2010 was higher at Sangam station, followed by Ram Munshibagh station and Asham. The trendline has been drawn for the Ram Munshibagh station where the value of R square is 0.62.

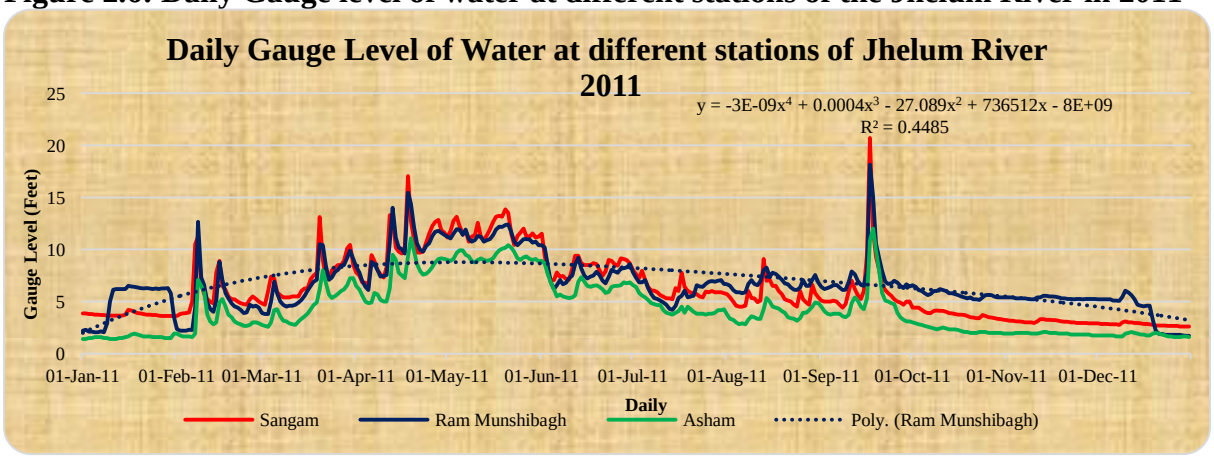
Figure 2.5: Daily Gauge level of water at different stations of the Jhelum River in 2010



Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.6 shows the discharge flow of the Jhelum River in 2011 where the discharge level of Ram Munshibagh station is higher than Sangham and Asham stations. The value of R square on the trend line of Ram Munshibagh station is 0.44, which shows a high degree of volatility.

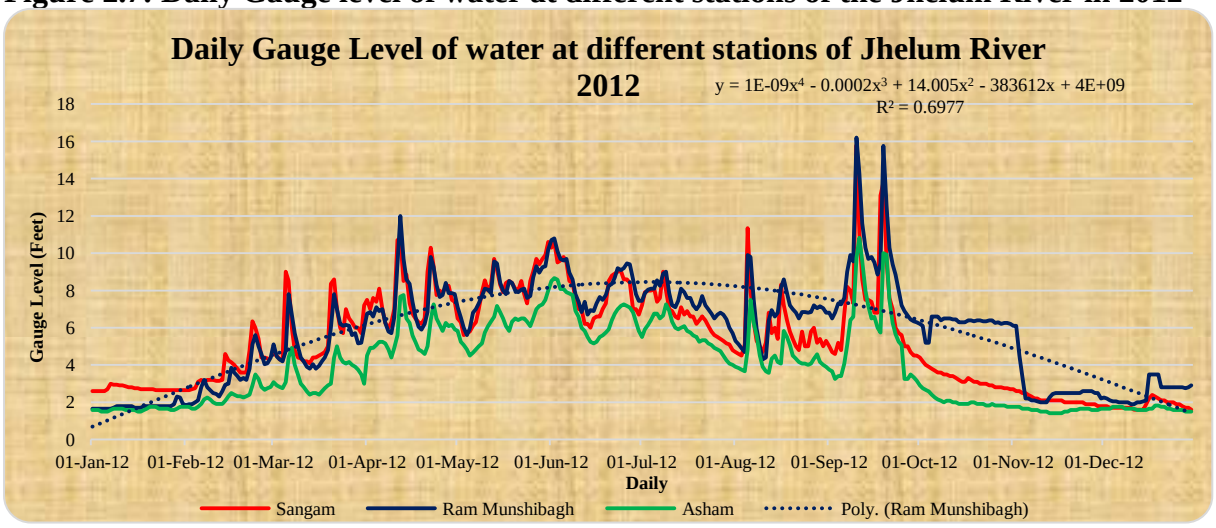
Figure 2.6: Daily Gauge level of water at different stations of the Jhelum River in 2011



Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.7 shows the discharge flow of the Jhelum River at three stations in 2012, where it is clear that the discharge flow of Ram Munshibagh station is higher than the discharge flow of Sangam and Asham stations. The polynomial trendline on Ram Munshibagh station is highly fluctuating. The value of R square is 0.69.

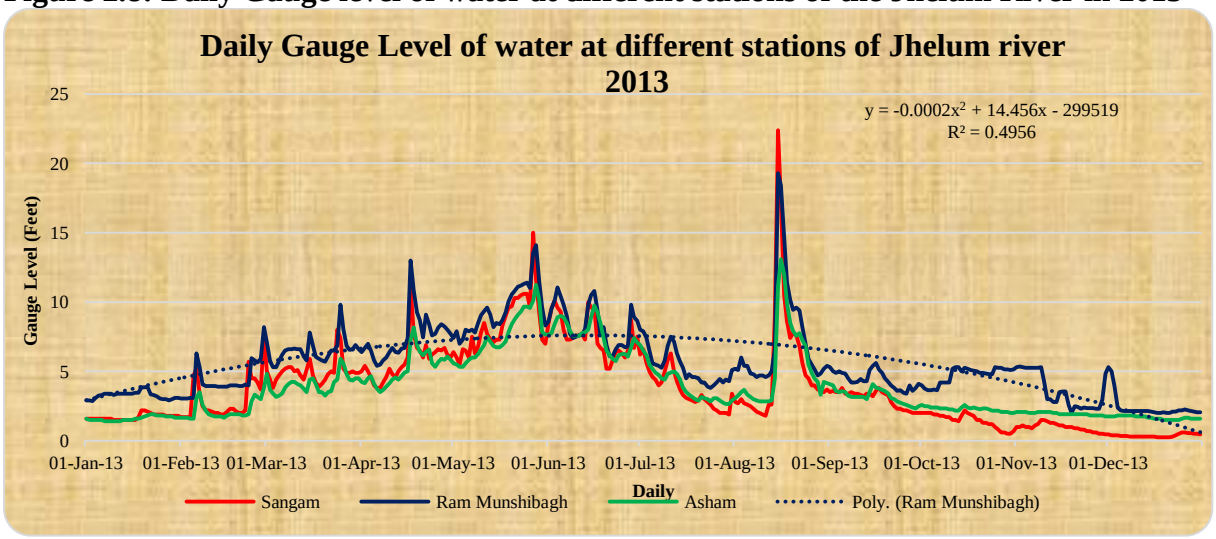
Figure 2.7: Daily Gauge level of water at different stations of the Jhelum River in 2012



Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.8 is showing the discharge flow of the Jhelum River in 2013 on three stations where the discharge level was recorded higher at Ram Munshibagh station followed by Sangam and Asham stations. The trendline clearly that the Jhelum has not followed its discharge flow at Ram Munshibagh station but has shown fluctuations which is clear from the value of R square, which is 0.49.

Figure 2.8: Daily Gauge level of water at different stations of the Jhelum River in 2013

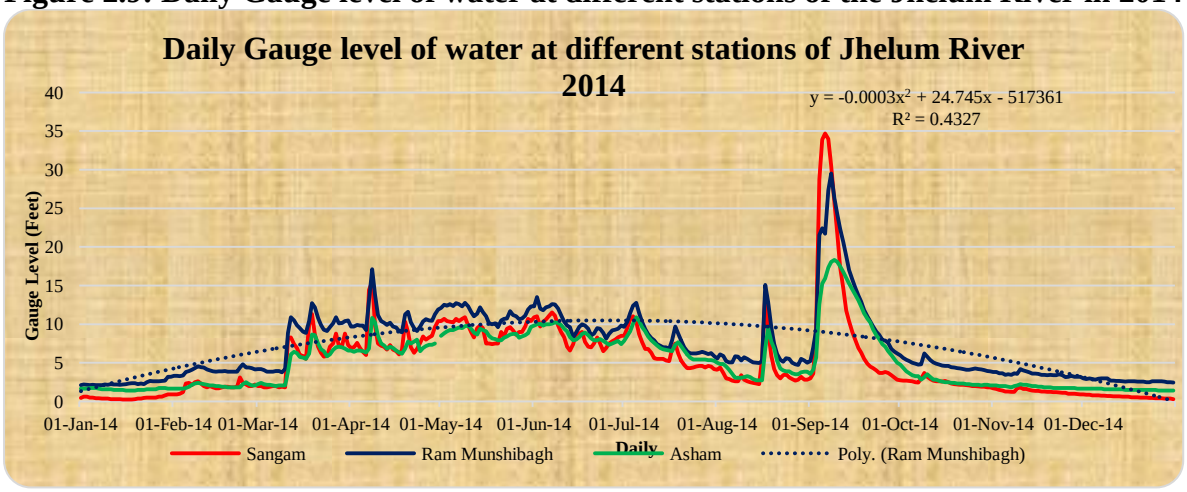


Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.9 depicts the discharge flow of the Jhelum at its three stations in 2014, with the flow remaining low at all three stations until August. In September, however, it rose quickly to 35.4 feet at Sangam station, followed by Ram Munshibagh Station and Asham. This causes the Jhelum River to overflow its embankments for a large portion of its length from south Kashmir to Srinagar, resulting in the worst flood in Kashmir's history.

Sangam's gauge crossed 35.4 feet on September 5, 2014, with floodwaters averaging about 1, 15,000 cubic feet per second and spilling 3–6 feet above the banks. On September 7, 2014, the gauge reading in Srinagar surpassed 30 feet, well above the danger mark of 22 feet, releasing over 70,000 cubic feet per second (cfs) of floodwaters against a drainage capacity of around 35,000 cfs. Many breaches along Srinagar's weaker embankments, as well as the Jhelum River overflowing 5 feet over its banks, enabled floodwaters to enter the city. However, due to the high magnitude of the floodwaters at Sangam and Srinagar stations, the gauge was repeatedly submerged during the flood case, and thus the gauge data for some time periods of flooding were unavailable.

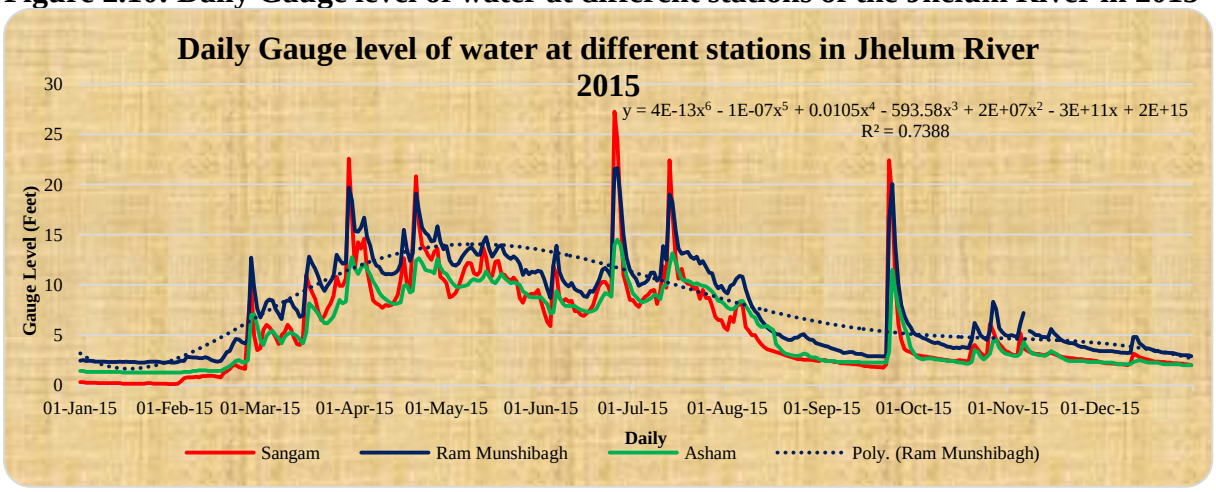
Figure 2.9: Daily Gauge level of water at different stations of the Jhelum River in 2014



Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.10 shows the discharge flow of the Jhelum River at three stations in 2015, where it is clear that discharge flow was higher at Ram Munshibagh Station followed by Sangam and Asham stations. The gauge readings were higher in July and October at all three stations. The trend line of Ram Munshibagh station shows a flow of discharge with low volatility where the value of R square is 0.73.

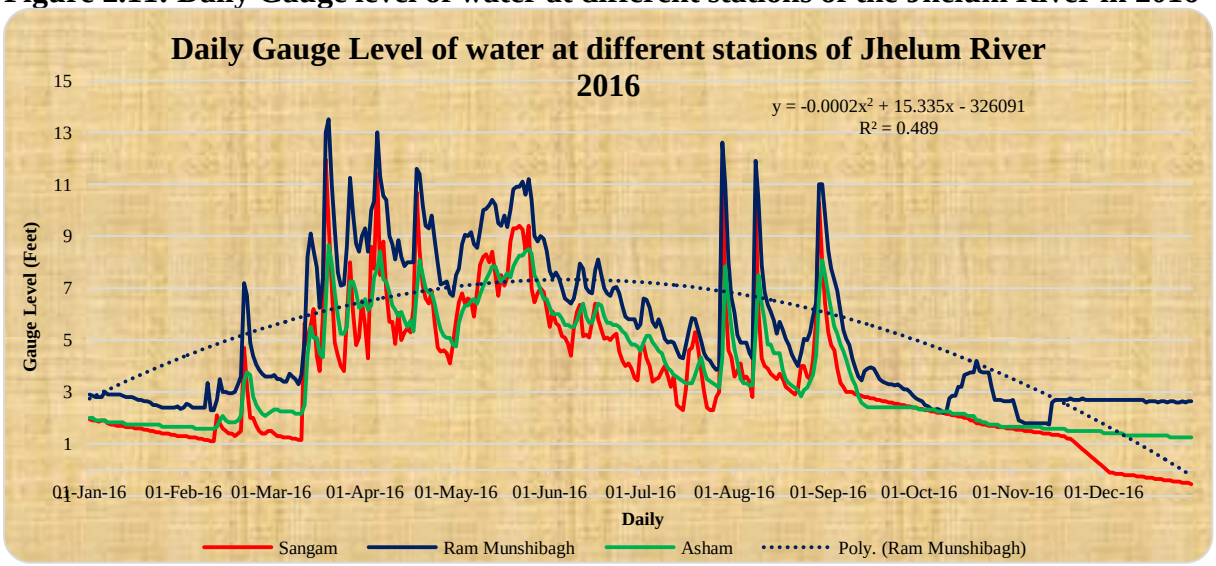
Figure 2.10: Daily Gauge level of water at different stations of the Jhelum River in 2015



Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.11 shows the discharge flow of the Jhelum River at three stations in 2016 where the Discharge flow was higher in Jhelum at Ram Munshibagh station all over the year and was followed by Sangam and Asham station. Jhelum River has shown high fluctuating in its flow at all the stations in 2015. The trendline of Ram Munshibagh station is also showing high fluctuation at this station where the value of R square is 0.48.

Figure 2.11: Daily Gauge level of water at different stations of the Jhelum River in 2016

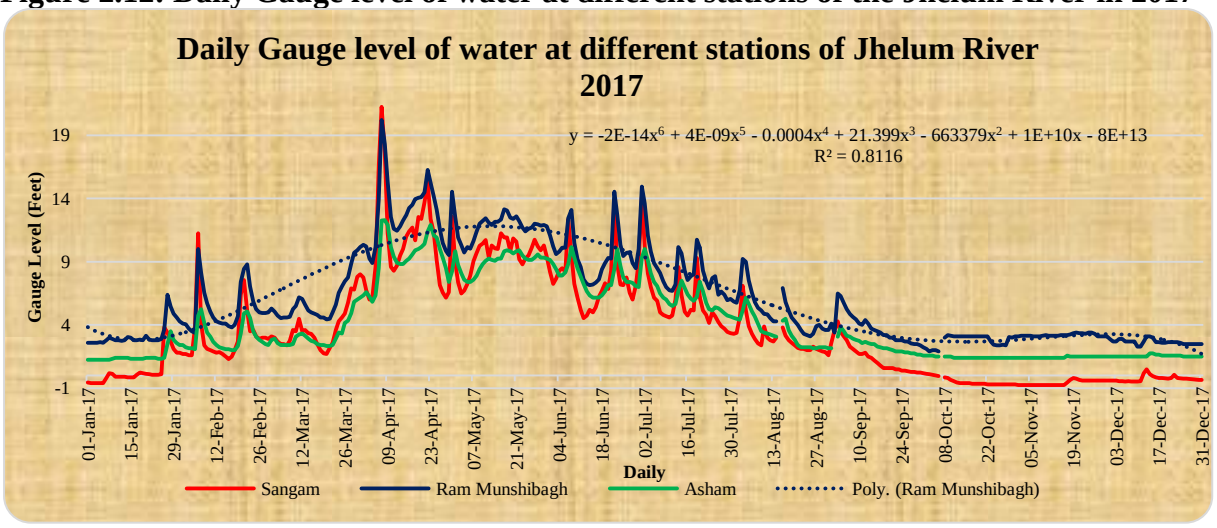


Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.12 shows the discharge flow of the Jhelum River at three stations in 2017, where the flow of discharge has been measured highest at Ram Munshibagh station, followed by Sangam and Asham station. The flow was highest in March and April while it remained low in other months. The trend line has shown less variability in the

discharge flow of the Jhelum River at Ram Munshibagh station, where the value of R square is 0.81.

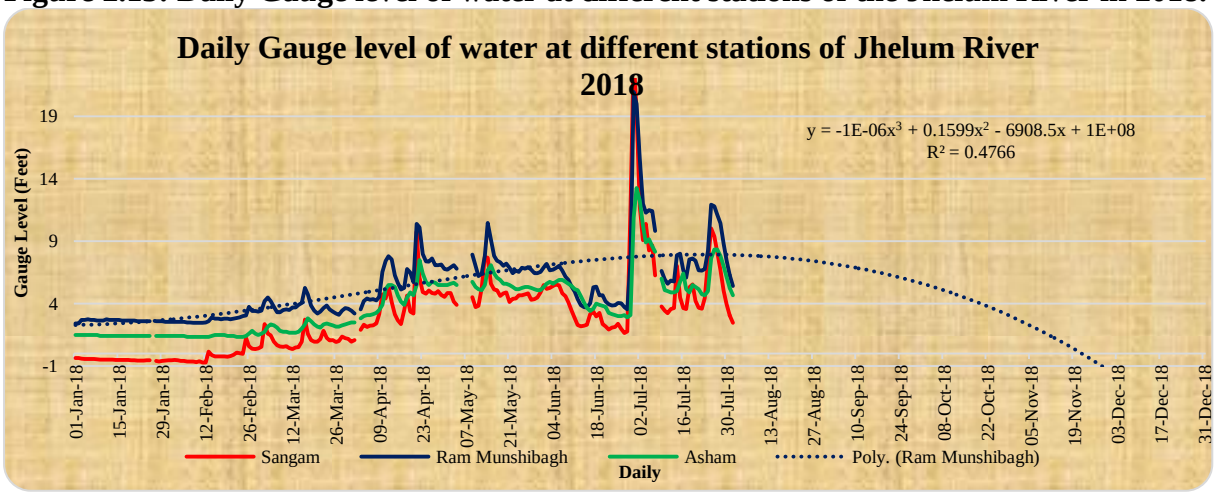
Figure 2.12: Daily Gauge level of water at different stations of the Jhelum River in 2017



Source: Irrigation and Flood control Department, Kashmir Division.

Figure 2.13 shows the discharge flow of the Jhelum River at three stations in 2018, where the discharge flow of the Jhelum River has been recorded high at Ram Munshibagh followed by Asham and Sangam stations. The Recording at Sangam and Ram Munshibagh Stations went high in July 2018 which created fear among people of the flood. However, the water level receded in a few days. The trend line of Ram Munshibagh station is showing a decline in the discharge flow for the coming months of the year. However, Jhelum is known for high volatility, and it is difficult to work out the future trend of the Discharge flow of the Jhelum River.

Figure 2.13: Daily Gauge level of water at different stations of the Jhelum River in 2018.



Source: Irrigation and Flood control Department, Kashmir Division.

The monthly and annual water flow in the Jhelum River does not follow any specific trend, as shown by the above study, but it does exhibit high volatility. The main cause of flood in Kashmir valley is the changing pattern of Jhelum River discharge flow, which is linked to a range of factors including increasing global temperatures, population growth and increased inhabitation in high slope areas, loss of wetlands, deforestation, and unrestrained land-use changes. Though heavy rains may be the immediate cause of floods in Kashmir, the problem has been exacerbated by a number of factors, including the valley's concretization, the encroachment of buildings on land adjacent to river banks, and the loss of wetlands. Dense settlement along the Jhelum's banks and within the valley, as well as roads that cross the valley, have obstructed the natural drainage network. Water remains stagnant in local depressions even after the Jhelum's water level drops, exacerbating the problem until it is drained out. This was a problem during the September 2014 floods, when the valley was engulfed in floodwaters for several days after the Jhelum waters receded. The city of Srinagar has also experienced massive horizontal sprawl, resulting in widespread encroachment and destruction of productive agriculture/horticulture land, life-sustaining wetlands, green spaces, and forest areas, all of which could have absorbed floodwaters. As a result, concrete measures must be taken to increase the Jhelum River's discharge flow while also judiciously managing population and infrastructure development.

2.9 Conclusion

The monthly rainfall records for Srinagar city clearly indicate that the city receives the majority of its precipitation during the winter season, which is brought in by western disturbances. These disruptions are most effective in the winter and early spring, and as summer progresses, their effectiveness decreases. The rainfall data for Srinagar city reveals this sort of pattern. However, rainfall in Srinagar city is low in the late spring and early summer, while the Kashmir valley is under the influence of the SW monsoon in the late summers, but its magnitude and intensity are low. The spring season, when the effect of western disturbances is at its peak, sees the most precipitation in Srinagar. Winter precipitation is fairly common, often in the form of snow. In Srinagar, July is the hottest month. The summer season in India lasts from June to September, but the Kashmir valley receives the least amount of rain during this period. However, according to an analysis of Srinagar's past rainfall records, September is usually the driest month of the year, with an average rainfall of 26.6 mm. The unusual combined effects of the western disturbances over Jammu and Kashmir and their association with the monsoon are primarily to blame for the widespread and heavy rains witnessed in the state in September 2014 (K Ray, 2015).

The need for more micro-level observatories cannot be ruled out in order to get a better database to map the rainfall-induced flood hazard inundation level, as seen in the above study. More micro-observatories can produce enough data on rainfall, resulting in better pre-hazard preparedness. The mighty Jhelum would cause flooding and waterlogging in lower-lying settlement zones of Srinagar city as the city's population grows horizontally. As a result, micro-level rainfall data will aid in the development of more efficient drainage and related measures on rainy days.

Chapter III

Land use/Land cover change with special reference to drainage Pattern

Land is the most basic natural resource for human survival. It provides habitat and food for all life on the planet. Land and land resources are defined by UNEP and FAO as a quantifiable region of the earth's terrestrial surface that includes all attributes of the biosphere immediately above or below the earth's surface, including those of the near-surface environment of habitable parts like landscape, soil, and surface hydrology (including Marshy and Swampy areas, Rivers, and shallow lakes), groundwater, and geo-hydrology (UNEP/FAO, 1997). However, with the growing population and increasing the value of land, the stress on the land has increased, and it has led to the degradation of land use and land cover. It's worth noting that while land use and land cover are often used interchangeably to research the distribution of land across various sectors such as agricultural, industrial, built-up, wasteland, and wetland, these two terms have distinct meanings when it comes to land distribution. The land cover dataset shows the area covered by different parameters like land covered by forests, wetlands, agriculture while the land use shows how people use the landscape whether they are using it for conservation, development or any other use. The worldwide rise in land use for horizontal expansion of human communities, infrastructure, and agriculture has resulted in changes in land use / cover. Human changes to the Earth's land surface have emerged at an unprecedented rate, size, and spatial-temporal distance, wreaking havoc on the planet. Two of the most important factors are changes in land cover and use (Turner, 1990). Despite advances in land-cover characterization created by Earth-observing satellites, global and regional land covers and land uses are still poorly reported (IPCC, 2000). Scientists, on the other hand, acknowledge that the magnitude of change is important. According to one study, global expansion has converted approximately 6 million km² of forest areas and 4.7 million km² of steppes/savannas/grasslands into croplands to feed the rising population since 1850. As a consequence, 1.5 and 0.6 million km² of cropland in these regions have been destroyed, respectively (Ramankutty & Foley, 1999). As a result, there is a need for more data on changes in land use and land cover; so that they can be compared with the primary causes to determine the cause of the transition (Committee on Global Change Research, 1999).

After the industrial revolution, humans have acted as active drivers of landscape transformation. To satisfy their rising demand for fruit, fodder, timber, and fuel wood, they have altered the landscape. This demand has increased over time with the high use of technology, improvement in the standard of living. This has led to the massive changes in land use and land cover all over the globe that has affected the cyclic flow of the biosphere

that is being considered one of the important causes of Biodiversity loss as well as climatic change.

The land use and land cover change have been seen in India due to its patriarchal setup. This has led to the shrinkage of landholding with time. The per capita availability of land in 1991 was 1.37 hectares which decreased to 0.33 hectares in 2000 (MINISTRY OF RURAL DEVELOPMENT, 2003). This type of fragmentation has lead to a decrease in the size of operational land, which affected agricultural productivity.

Land use/land cover transition in the Himalayan region's highly fragile climate has a broader effect on socioeconomic and demographic factors. But, more importantly, it will have far-reaching implications for the Himalayan ecosystem. Deforestation, increase in Built-up area, Haphazard Urbanisation, the encroachment of wetland and marshy tracts have a far-reaching effect on Ecology in particular and on the local population in general. Here it is important to note that Kashmir valley has recently experienced a disaster in the form of a flood which has caused vast devastation in its socio-economic and demographic arena. The valley is known for its beauty worldwide, but it is experiencing environmental devastation, both from natural and anthropogenic factors, for several decades which has put it on the back front and led to vast devastation to its socio-economic prosperity.

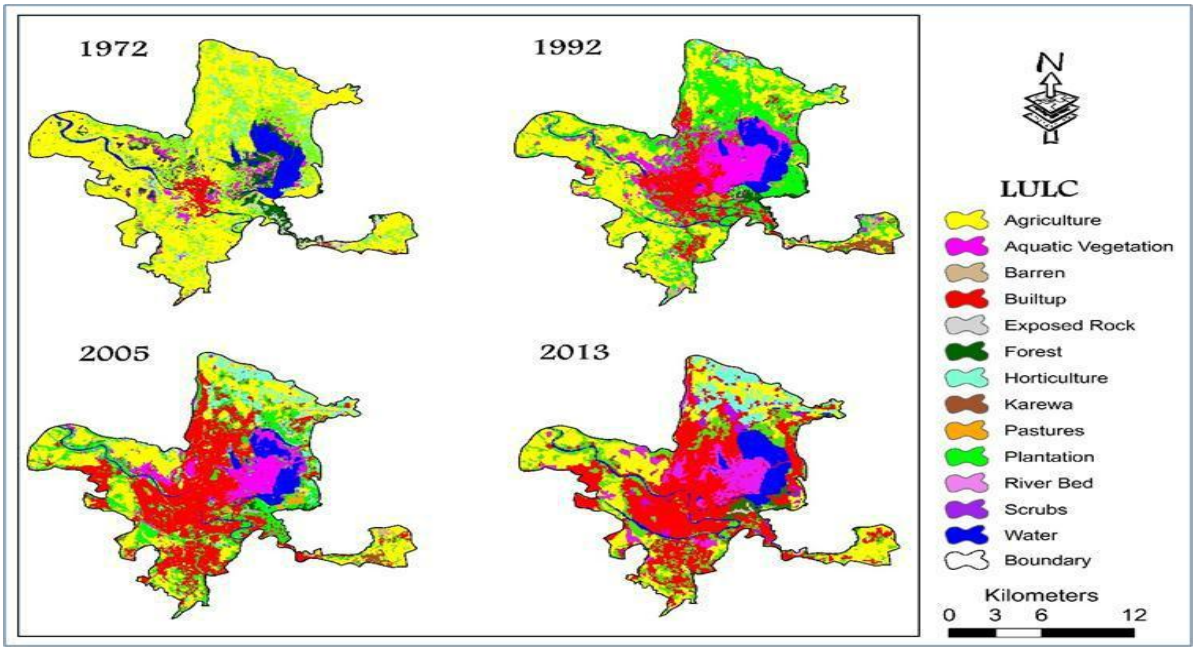
This chapter discusses the evolving land use/land cover paradigm in the study region and its effect on Srinagar's flood vulnerability. Secondly, its focus is on the assessment of drainage and water bodies and how their changing scenario is playing a role in increasing the trend of disasters in the study area. As sir Dudley Stamp(1937) has rightly said during his land use mapping of Britain that statistics of land use do not serve the real purpose of planning, unless and until their relations are not being shown on maps (Stamp, 1937). Srinagar city is the commercial hub of the Kashmir valley, attracting all actors and resulting in an unparalleled expansion of economic and other commercial activities in the form of horizontal growth of built-up territory, wetlands encroachment, and marshy areas. Therefore, it becomes evident that the land use pattern in Srinagar is bound to change with its geographic location and time.

3.1 General Land use pattern of the district

The analysis of the land use data of Srinagar city covers the thirteen (13) classes spread over 245.02 square kilometres area. These classes are Built-up area, Agriculture, Horticulture, Water Bodies, Plantation, Aquatic Vegetation, Forest, Barren area, Scrubland, Riverbed

Pastures and Karewa. With the increase in urbanisation, the area under the Built-Up area increased tremendously. (Refer to Figure 3.1)

Figure 3.1: Changing Area under different Land Use and Land cover classes Srinagar City 1971-2013



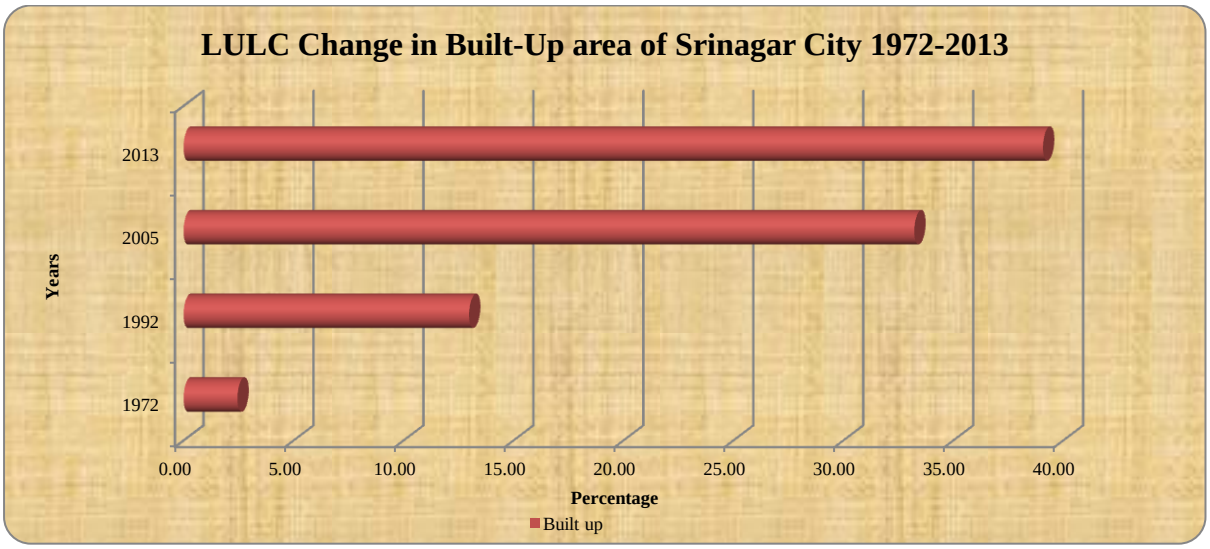
Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013.

3.1.1 Built-up Area:

The Built-up area includes commercial places, Industrial places, Educational institutions, Government offices, Hospitals, Religious Places, Residential Places as well as Scattered Settlements. The analysis of the data from 1972 has revealed that the area under these structures is increasing steeply with time. Analysis reveals that the area under Built-up was 6 square kilometres in 1971. It increased to 31.81 square kilometres in 1992. It registered a five times growth from 1971-1992. The growth from 1992-2005 was 81.42 square kilometres, and in 2013 the total area under built-up was 95.76 Square Kilometres. The built-up area has shown tremendous growth in Srinagar city. It is the result of increasing Population Pressure from other districts of Kashmir valley as well as due to the expansion of economic diversity. Both these factors led to tremendous growth in the Built-up area of Srinagar city. The total change in the built-up area of Srinagar city from 1971-2013 is 89.76 Square Kilometres area (Refer to Figure 3.1.1). The increase in Built-up area has led to a decrease in area under Agricultural land, pastures, wetlands, marshy tracts and River beds. There are an uneven density and distribution of the population in Srinagar City. The analysis shows that the central part of the city is highly congested and it has hardly any open space. The built-up area is

getting its pace in the western, northern, and southern regions of the Srinagar district. However, the eastern region of the city is dominated by the hilly terrain, and the far western part is the marshy area. The horizontal growth of settlements has increased the built-up area of Srinagar city which can be explained that since Jammu and Kashmir lies in the active seismic zone, so it hinders the vertical expansion of the built-up area.

Figure 3.1.1: Land use Land cover change in the built-up area of Srinagar city 1972-2013

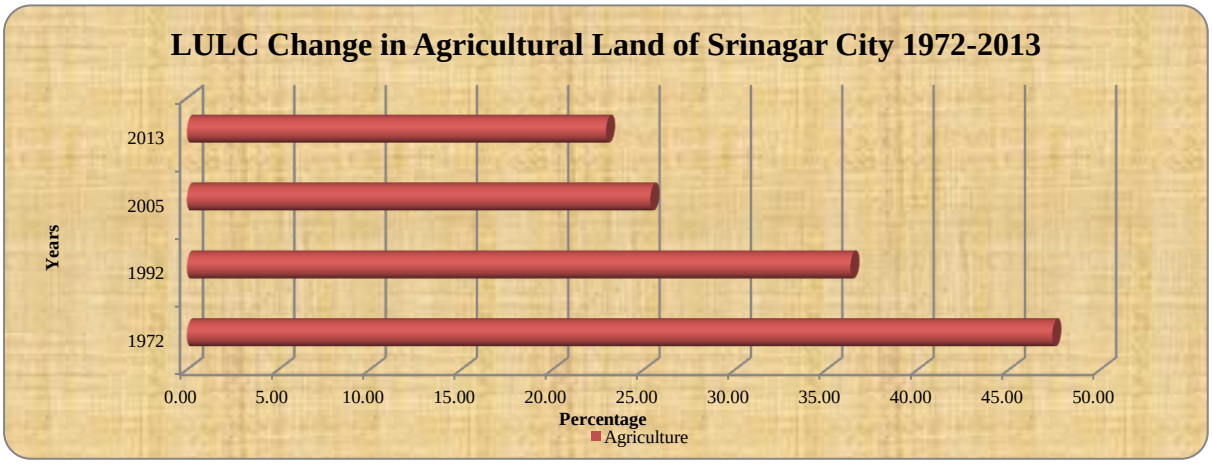


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.2 Agricultural Land:

The analysis shows that the land cover under agriculture in 1971 was 116.09 Square Kilometres which declined with time due to the increasing pressure of population. However, in 2013 the total area under agricultural land in Srinagar was only 56.22 square kilometres only. There has been a decline of 59.87 square kilometres area of Agricultural land in Srinagar city from 1972-2013. The dominant crop of agriculture is paddy. Now with the advent of technology, Agricultural land which was used earlier for paddy crops has been either converted to the built-up area or towards Horticulture and plantation agriculture. The areas where paddy crops are found in abundance are Zakura, Buchpora Alestang and Ahmad Nagar in the North, Zainkot, Malura, Lawaypora, Palpora nad Khumani Chowk in the west, Khanmou in the South-east and Humhama in the south. The areas in the North-East like Nishat, Harwan and New Theed are mainly hilly, and they are famous for Terrace Farming. (Refer to Figure 3.1.2)

Figure 3.1.2: LULC Change in Agricultural Land of Srinagar City 1972-2013

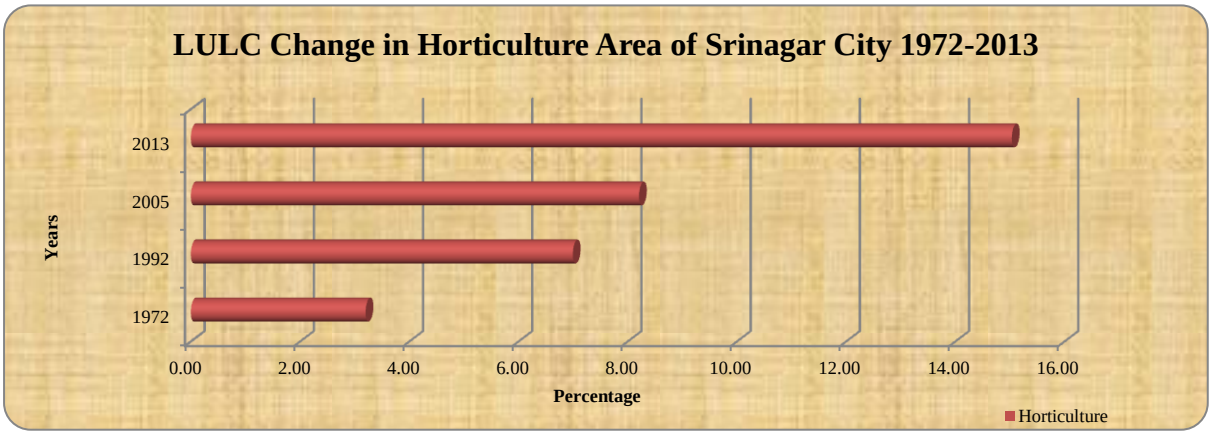


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.3 Horticulture:

Jammu and Kashmir has an advantage in the cultivation of temperate fruits and other important crops not only at the national level, but also at the international level, because it lies in a temperate region with unique climatic conditions from the rest of the country. Horticulture is still a vital part of Jammu and Kashmir's socioeconomic development. With severe constraints on area expansion and dwindling opportunities for other sources of agriculture production growth, a shift in agriculture toward non-food grains and high-value cash crops, as well as fruits and vegetables, that are well-matched to the area's comparative advantage, is recommended as a feasible and practical solution. It's critical to keep in mind that these high-value cash crops have the potential to increase income, create jobs, alleviate poverty, and promote exports. The opportunity and possibility of increasing output levels through diversification is greatest in the state of Jammu and Kashmir, where a 1% shift in the area from food grains to non-food grains results in a more than 3% increase in crop output (Chand, 1996). According to the data presented, the horticulture industry in Srinagar is expanding. Horticulture occupied 7.84 square kilometres of land in 1971. In 2013, the area beneath it, however, increased fivefold to 36.84 square kilometres. Between 1972 and 2013, this sector grew by 29 square kilometres (Refer to Figure 3.1.3). Horticulture is a broad term that covers the growing, processing, and selling of fruits, nuts, vegetables, ornamental plants, and flowers, as well as a variety of other services.

Figure 3.1.3 LULC Change in Horticulture Area of Srinagar City 1972-2013

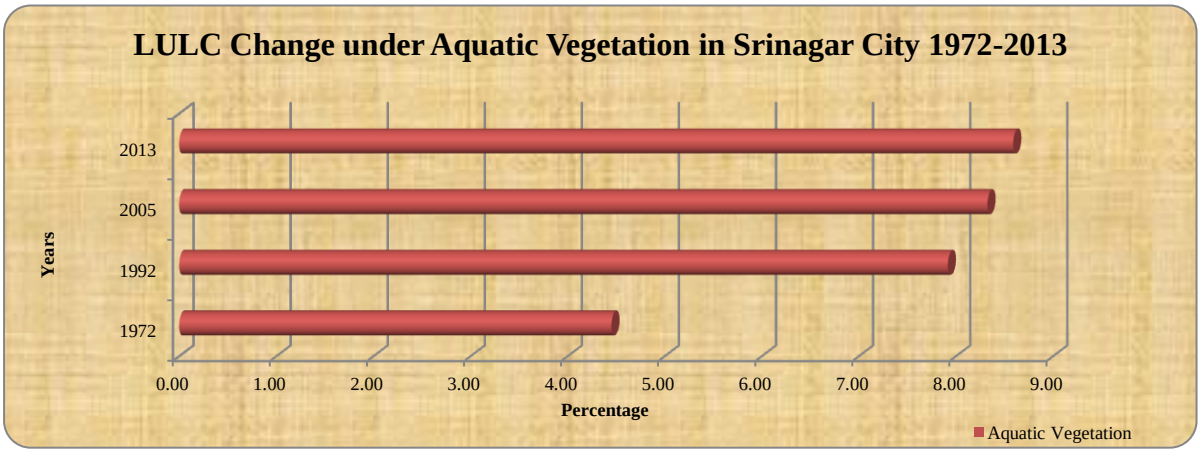


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.4 Aquatic Vegetation:

Aquatic Vegetation, locally known as Rad, is one of the dominant agricultural activities carried out by Hanjis (the people who live in Houseboats on water). This type of vegetation is mainly found in and around the water bodies and wetlands of Srinagar. The dominance of this activity is seen in the Western part of Dal Lake and Khushalsar wetland in the north. The analysis of LULC Data shows that it has registered a positive growth over time. The land under aquatic vegetation was 10.91 square kilometres in 1971, and it increased to 21.05 square kilometres in 2013. The area under aquatic vegetation has doubled from 1971-2013 (Refer to Figure 3.1.4). The other reason for this growth of vegetation in the water bodies is the increase in the level of weeds due to Eutrophication and related phenomena which have boosted the growth of vegetation in these water bodies and have increased the area of it over time.

Figure 3.1.4: LULC Change under Aquatic Vegetation in Srinagar City 1972-2013

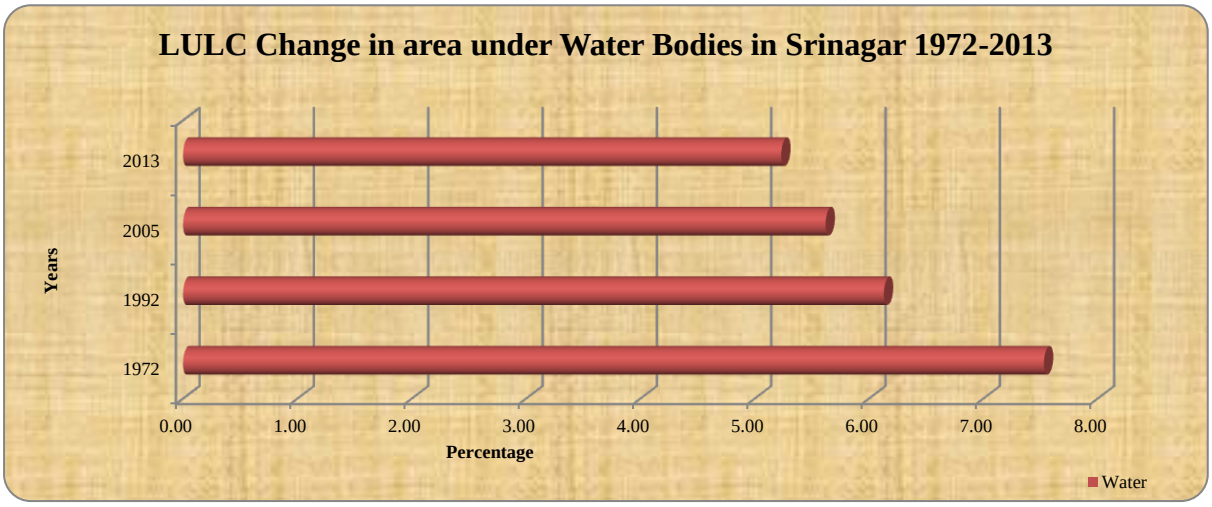


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.5 Water Bodies:

The study of the water body includes the area under rivers, lakes, and water reservoirs of the city. The analysis of LULC data reveals that the area under water bodies has decreased over time. In 1971, the water bodies included an area of 18.45 square kilometers in Srinagar city. However, this area declined to 12.82 square kilometres in 2013 (Refer to Figure 3.1.5). The decline in the area of underwater bodies is the result of siltation and encroachments of water bodies. This point also became evident during the primary survey that people have encroached the channels and beds of water bodies for settlements. Srinagar is endowed with numerous water bodies which include Dal Lake, Nigeen Lake, River Jhelum, Tailbal Nambal, Brari Nambal and Harwan water reservoir. These places are the point of attraction in Srinagar city. However, these water bodies are being polluted or get encroached with time.

Figure 3.1.5: LULC Change in the area under Water Bodies in Srinagar 1972-2013



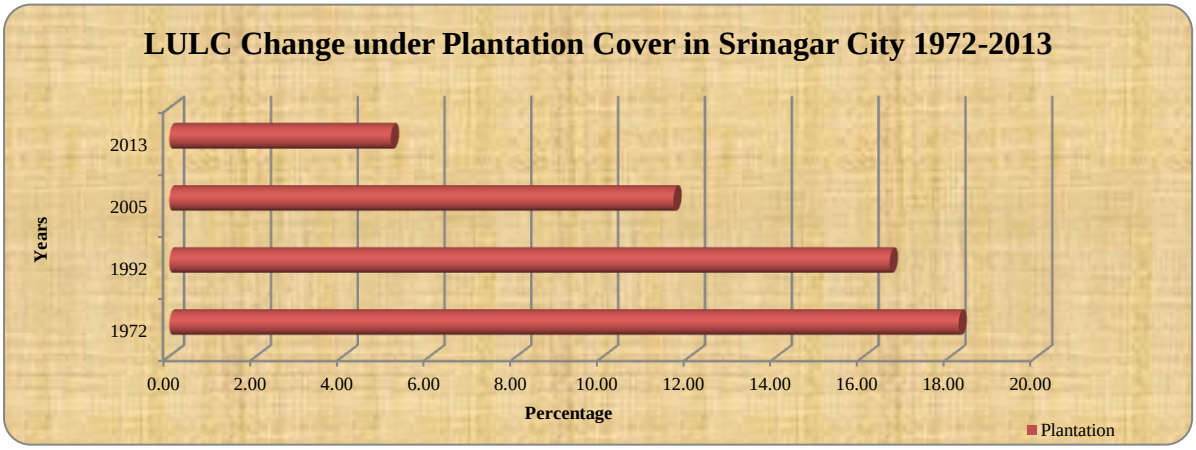
Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.6 Plantation:

Srinagar city was known for its orchards in the past. However, with the pressure of population, they have been converted into settlements and commercial areas. Srinagar has still many places which are known by Baghs like Raj Bagh, Gulab Bagh Wazir Bagh, Mandar Bagh, Ram Bagh, Magarmal Bagh and so on. Bagh is an Urdu word that means Garden. The orchards in Srinagar city have the plants of Apple, Almond, Walnut, Apricot, Cherry, Willow, and so on. The analysis shows that the area under Plantation agriculture has decreased over time due to various socio-economic reasons. In 1971, the area under plantation was 44.55 square kilometres which decreased to 12.5 square kilometres in 2013. The plantation has shown nearly four times decline in its area due to increasing pressure of population and

diversification of the horticulture sector. The main areas of plantation agriculture in Srinagar city are Alestang, Tailbal, Zakura, Khumani chowk, Humhama, Nishat, Harwan etc. (Refer Figure 3.1.6)

Figure 3.1.6: LULC Change under Plantation Cover in Srinagar City 1972-2013

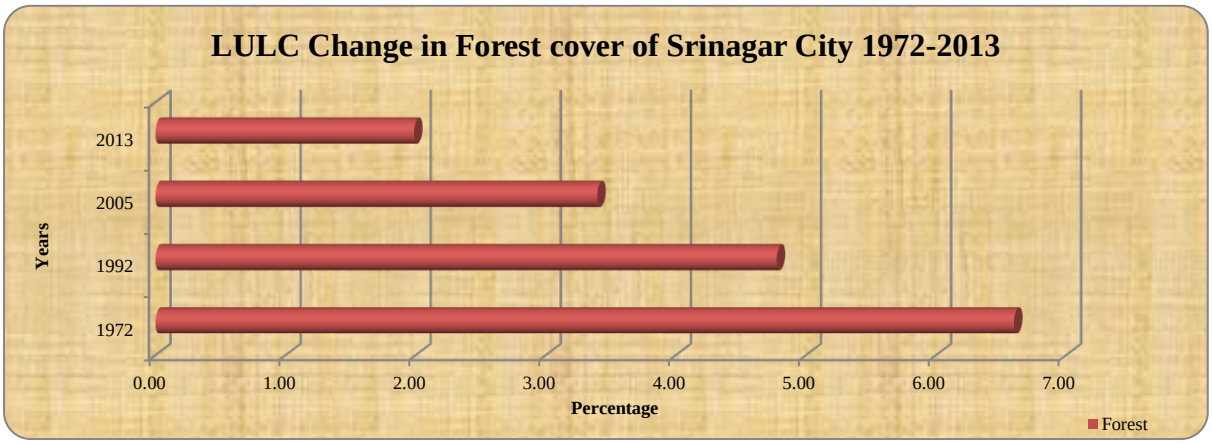


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.7 Forests:

"A nation that destroys its soils destroys itself. Forests are the lungs of our land, purifying the air and giving fresh strength to our people"(Franklin D. Roosevelt). Therefore, it is clear that the forest is the lifeline of the nation. The better human power is dependent on good forest cover because it gives it fresh air to breath which adds strength to its manpower. The analysis of LULC data reveals that the forest cover of Srinagar city was 16.17 sq. km in 1971, which declined to 4.87 sq. km in 2013 (Refer to Figure 3.1.7). This steep decline in the forest cover is an issue of concern and will have serious repercussions in future. The main forest areas of Srinagar are Koh-i-Maran, Koh-i-Sulaiman and the Zabarwan hills.

Figure 3.1.7: LULC Change in Forest cover of Srinagar City 1972-2013

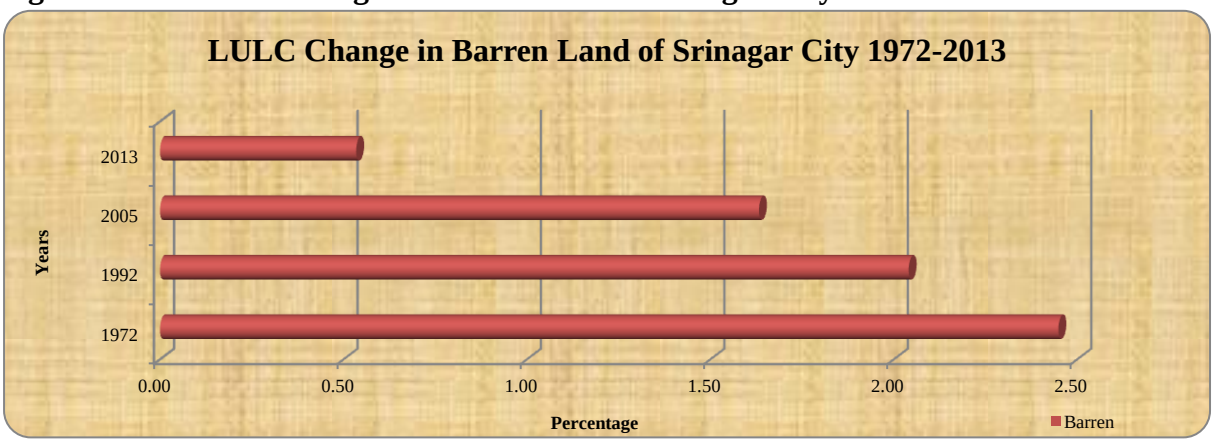


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.8 Barren:

Barren land is the part of the land area that is exposed like rocks that are particularly used for quarrying activities. These areas have minimal ability to support life. The barren land cover of Srinagar city has seen a drastic decline in its area. In 1971, the area under Barren land was 6 Sq.km while it has shown a consistent decline with time. It has declined to 1.31 Sq.km area in 2013. This decline of 4.69 Sq.km area of barren land is attributed to the growing pressure of urbanisation in Srinagar city (Refer to Figure 3.1.8). The important areas of barren land in Srinagar area Koh-i-Maran and Koh-i-Sulaiman hills, patches in Sharifabad, Alestang and New Theed as well as Khanmou Quarrying site.

Figure 3.1.8: LULC Change in Barren Land of Srinagar City 1972-2013

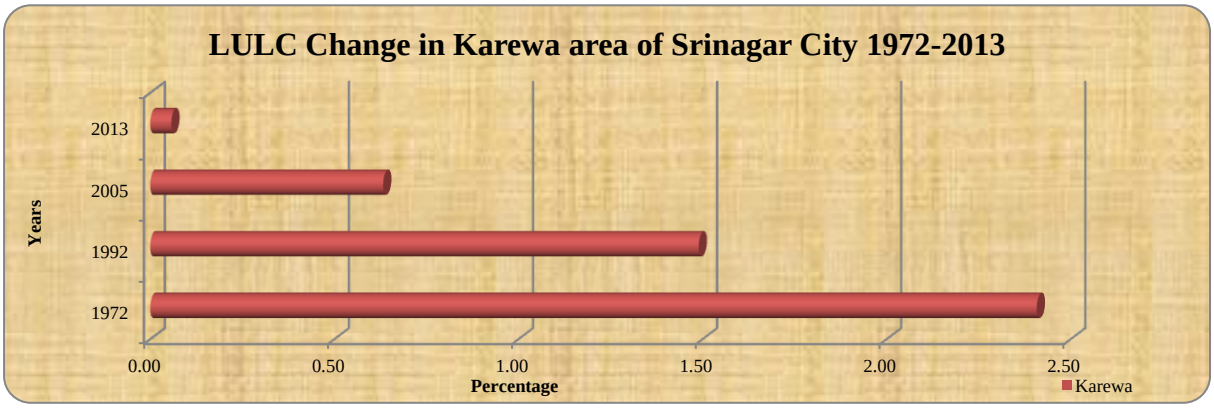


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.9 Karewa:

Karewa is the most important soil found in the Kashmir valley. This soil is made up of lacustrine deposits. Saffron is the world-famous crop grown on Karewa. The Land use land cover analysis reveals a decline in the area of Karewa in Srinagar city. In 1971, the land under Karewa in Srinagar was 5.90 Sq.km. However, this area declined over time and was recorded as a 0.14 Sq.km area only in 2013 (Refer to Figure 3.1.9). This sudden declined is a result of multidimensional factors among which population pressure is one of the dominant factors of its decline.

Figure 3.1.9: LULC Change in Karewa area of Srinagar City 1972-2013

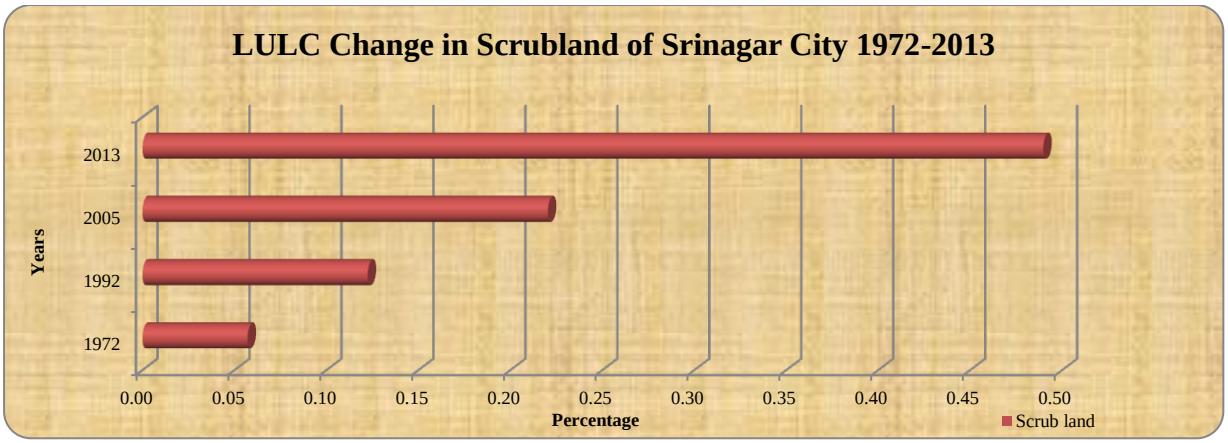


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.10 Exposed Rock:

The area under it has seen an increase in its land cover with time. The area underexposed rock was 0.40 Sq. km in 1971. However, it increased to 1 Sq.km area in 2013. This increase in exposed rock is evidence in the fact that the decline in the Agricultural land, forest cover has resulted in an increase in the area of exposed rock over time. (Refer to Figure 3.1.10)

Figure 3.1.10: LULC Change in Scrubland of Srinagar City 1972-2013

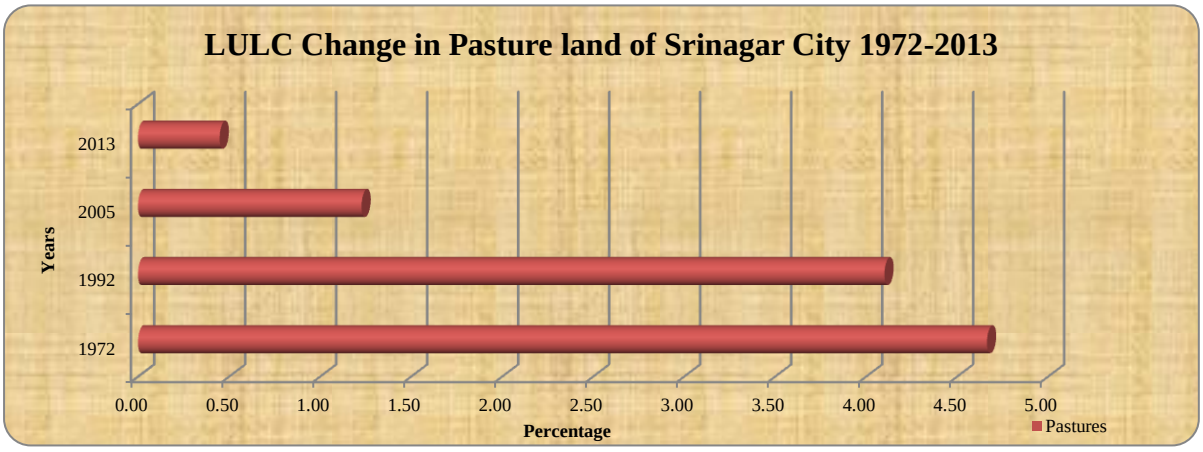


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.11 Pastures:

Pastures are areas of land that are covered with grass and other low species that are suitable for grazing animals such as cattle or sheep. The land use land analysis data of pastures show a decline in its cover in Srinagar city from 1971-2013. In 1971, the land under pastures in Srinagar was 11.43 Sq.km while it declined to 1.1 Sq.km area in 2013. This 10.33 Sq.km area decline in pasture land is showing a growing pressure of infrastructure and population in Srinagar city, which has caused catastrophes in Srinagar city. (Refer to Figure 3.1.11)

Figure 3.1.11: LULC Change in Pasture land of Srinagar City 1972-2013

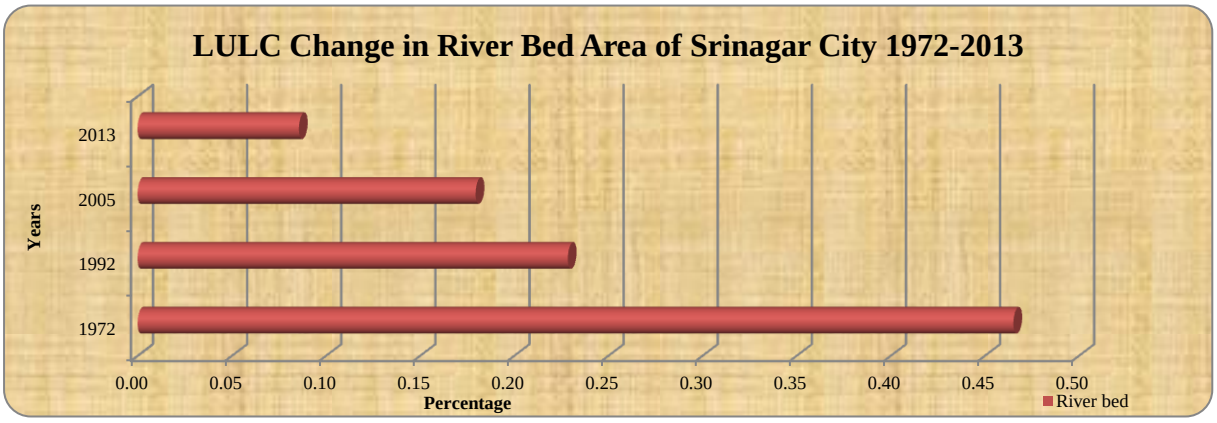


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

3.1.12 River Bed

The area under the river bed has shown a decline in its area in Srinagar from 1971-2013. In 1971, the area under the river bed was 1.14 Sq.km while it declined to 0.21 Sq.km areas in 2013. This sudden decline is the result of encroachment by a growing population. (Refer to Figure 3.1.12)

Figure 3.1.12: LULC Change in River Bed Area of Srinagar City 1972-2013



Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013.

Therefore, it is clear that the built-up area of Srinagar city was highly concentrated on its central part in 1972. Most of the peripheral part was dominated by agriculture and related sectors. The analysis shows that the water bodies in the east were less affected by aquatic vegetation. However, with time, the LULC analysis of Srinagar city shows a change in its use where it is clear that there is an expansion in the built-up area towards West, North and South of Srinagar city and its expansion towards East was limited by the presence of water Bodies. In 1992, the LULC analysis clearly showed the growth of aquatic vegetation in the water bodies. This growth of Built-up area in Srinagar city has led to the decline in area under agriculture, plantation, and other sectors whereas the growth of Aquatic

vegetation is the result of an increase in anthropogenic influence. The LULC analysis of Srinagar city in 2005 reveals the changing scenario of land use land cover in Srinagar city. The built-up area has increased to the north and south of Srinagar city at a very fast rate while to the western part the rate is limited by physical factors, on the other hand, the land use under agriculture sector is showing a constant decline in its area with the subsequent growth of the built-up area. The area under water bodies is also showing a clear decline in its extent in 2005. The growth of aquatic vegetation is clear now in its extent in and around water bodies. One of the most important things seen in the land use land cover analysis of Srinagar city in 2005 is the growth of Horticulture in the north and North-Eastern part of Srinagar city. This area was earlier under agriculture and plantation. The status of LULC in Srinagar city in 2013 is highly concerning it shows striking growth in the built-up area in Srinagar city. The growth has led clearance of agricultural patches in all directions. The trend line of the built-up area clearly shows that if the built-up area growth goes at this pace, then the built-up area will occupy 87 % area of Srinagar city by 2100. The decline in the area of water bodies is clear in 2013, whereas the growth of aquatic vegetation is on the rise in water bodies. The most interesting feature of LULC in Srinagar city in 2013 is its expansion of the built-up area on the eastward side. This growth of population and infrastructure on the Eastward side of Srinagar city is very disturbing as it will have a direct consequence on the precious water bodies of Srinagar. Therefore, it can be inferred from the above analysis that there is a huge change in land use and land cover of Srinagar city from 1972-2013 which has changed the landscape of the city and is the cause of various disasters among which Flood 2014 is a live example. This changing scenario will be serious repercussions on the future livability of the city.

3.2 Land Use Land Cover Comparison: 1971-2013

Based on satellite data and existing Toposheets, comparative statistics of the Srinagar city has been developed, and it reflects a drastic change in land use and land cover from 1971-2013. The data is represented in Table 3.1 under 12 classes of different land uses.

Table 3.1: Comparison of Land Use Land Cover in Srinagar City 1972-2013

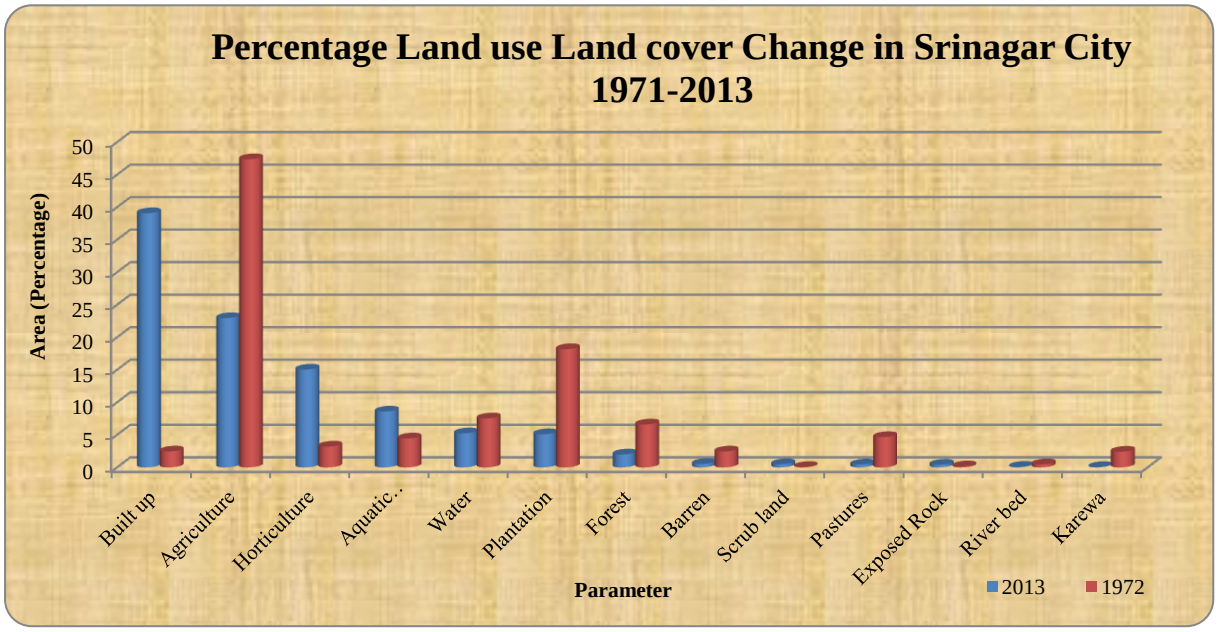
LULC	Area (%) 2013	Area (%) 2005	Area (%) 1992	Area (%) 1972	Percentage Change 1972-2013
Built up	39.08	33.23	12.98	2.45	36.63

Agriculture	22.95	25.37	36.32	47.38	-24.43
Horticulture	15.04	8.21	7.00	3.20	11.84
Aquatic Vegetation	8.59	8.33	7.92	4.45	4.14
Water	5.23	5.62	6.13	7.53	-2.30
Plantation	5.10	11.61	16.59	18.18	-13.08
Forest	1.99	3.40	4.78	6.60	-4.61
Barren	0.53	1.63	2.04	2.45	-1.91
Scrub land	0.49	0.22	0.12	0.06	0.43
Pastures	0.45	1.23	4.10	4.66	-4.22
Exposed Rock	0.41	0.34	0.30	0.16	0.24
River bed	0.09	0.18	0.23	0.47	-0.38
Karewa	0.06	0.63	1.49	2.41	-2.35
TOTAL	100.00	100.00	100.00	100.00	

Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013.

Based on the land use land cover data of Srinagar city from 1971-2013, various level of changes is seen in different segments of land use land cover. The analysis is a clear indication of land-use changes across different parameters which have resulted in various socio-economic and demographic problems in Srinagar city. (Refer Figure No 3.2)

Figure: 3.2: Land use and Land cover Change in Srinagar City 1971-2013

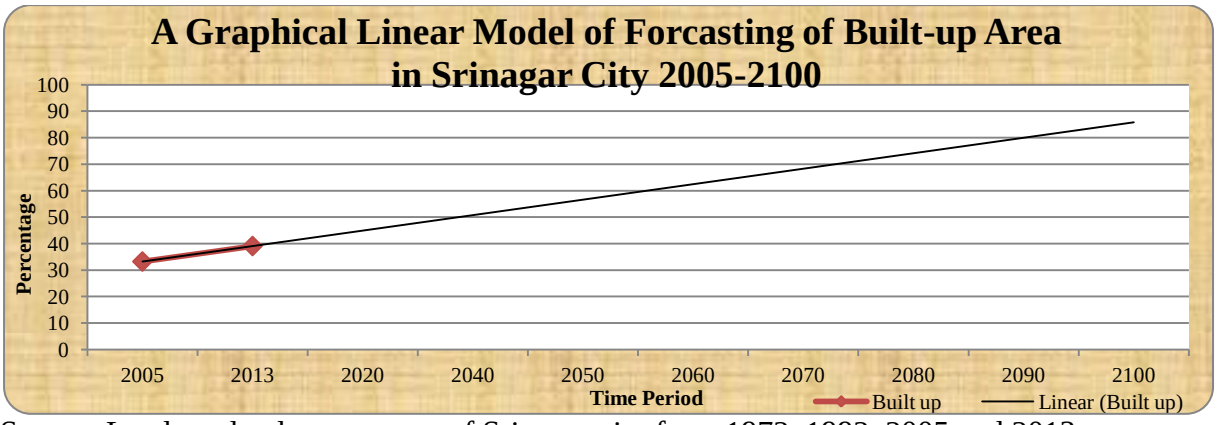


Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

Major Findings:

I) There is a drastic increase in the built-up area which has increased by 36.63 percent from 1971-2013. It may be attributed to the growing pressure of population as well as the expansion of infrastructure for the various economic activities. The built-up area in Srinagar city is increasing at a faster rate. With the decline of wetlands and marshy tracts, it can be justified with the fact that the built-up area in Srinagar city is expanding towards the low-lying areas which ultimately add the flood vulnerability in the city. The statistics show it clear that the increase in the built-up area takes the horizontal pattern despite the vertical pattern. Figure 3.3 shows the trend line of the built-up area, which makes it clear that the built-up area will go up to 80-90 percent at the present rate of growth.

Figure 3.3: Graphical Linear Model of Forecasting of Built-up Area in Srinagar City 2005-2100



Source: Land use land cover maps of Srinagar city from 1972, 1992, 2005 and 2013

II) There is a fall of agricultural land also from 1971-2013 in Srinagar city. It had declined by 24.43 % from 47.38 % in 1971 to 22.95 % in 2013. Its major cause is the conversion of agricultural land into a built-up area. The increasing population of Srinagar region, as well as influx of people from different districts, has resulted in an increase in land demand and a decrease in agricultural land area.

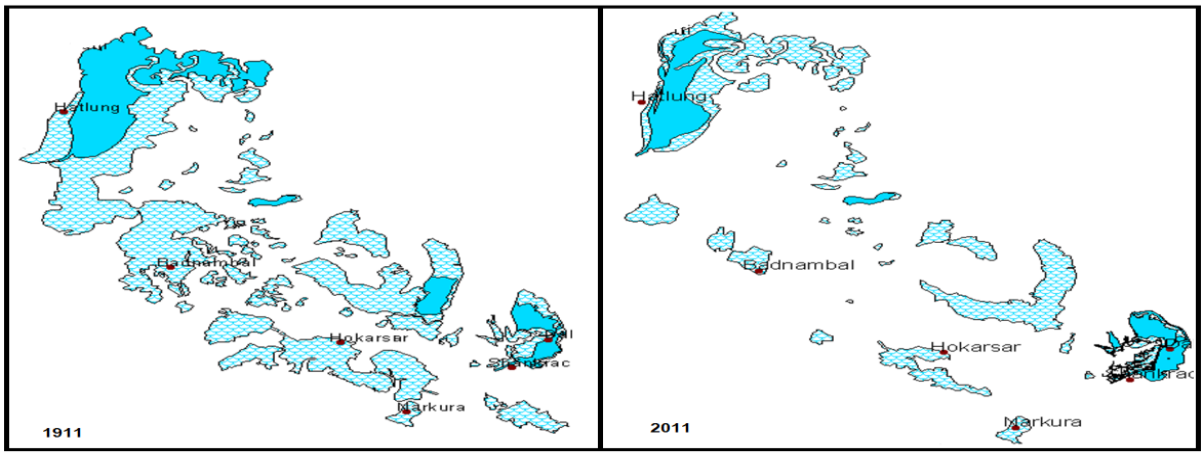
III) There is a sharp decline in areas underwater, forests, pastures, and river beds. This sharp decline is the result of increasing population pressure. From 1971-2013, there is a decline of 4.61 %, 2.30 %, 4.22 %, and 0.38 5 in Forests, water, pastures, and river beds area respectively. This threatening concern is shrinking the land area at a very fast rate.

Therefore, it is evident from the above study that Srinagar's land use and land cover have changed drastically. If this change goes with the present rate of growth, then the land use map of Srinagar city will be changed in the coming time, and it will have serious socio-economic and demographic repercussions on the people as well as for the well-being of the city.

IV) The sharp differences are observed in the built-up area, Agriculture, Plantation, and Horticulture sector. The differences in these sectors are in double digits. However, it is important to mention here that the change has been positive in the Built-up area and Horticulture sector from 1972-2013 whereas, on the other hand, the agriculture sector and plantation have registered a double-digit decline from 1972-2013 in Srinagar city.

V) The other threatening concern is the shrinking of waterlogged swamp marshy and wetland areas. These areas are presumably occupied by built-up areas and the Horticulture sector in and around Srinagar city. Statistically, 7.53 % area was under-water in 1972, which declined to 6.13 % in 1992 and 5.62 % in 2005, and 5.23 % in 2013. This continued decline in the area underwater is an issue of serious concern and may lead to vast ecological disturbances in the future. "During the past century, deforestation in the Jhelum basin led to excessive siltation in most of the lakes and water bodies of Srinagar and subsequent human greed brought about sustainable reclamation and land-use change in these assets of high ecological value." The J&K State Lakes and Waterbodies Directory was issued by the Department of Environment and Remote Sensing in Srinagar that highlights the sudden decline in the areas under Marshy and water bodies. It states that the area under Marshy land in Kashmir valley was 69.82 % whereas the area under water bodies was 67.44 % in 1911(Refer Figure 3.4). However, this area under Marshy and Water Bodies got declined to 30.18 % and 32.56 % respectively. (Keng, 2012).

Figure 3.4: Extent of Lakes and wetlands in Kashmir valley (1911-2011)



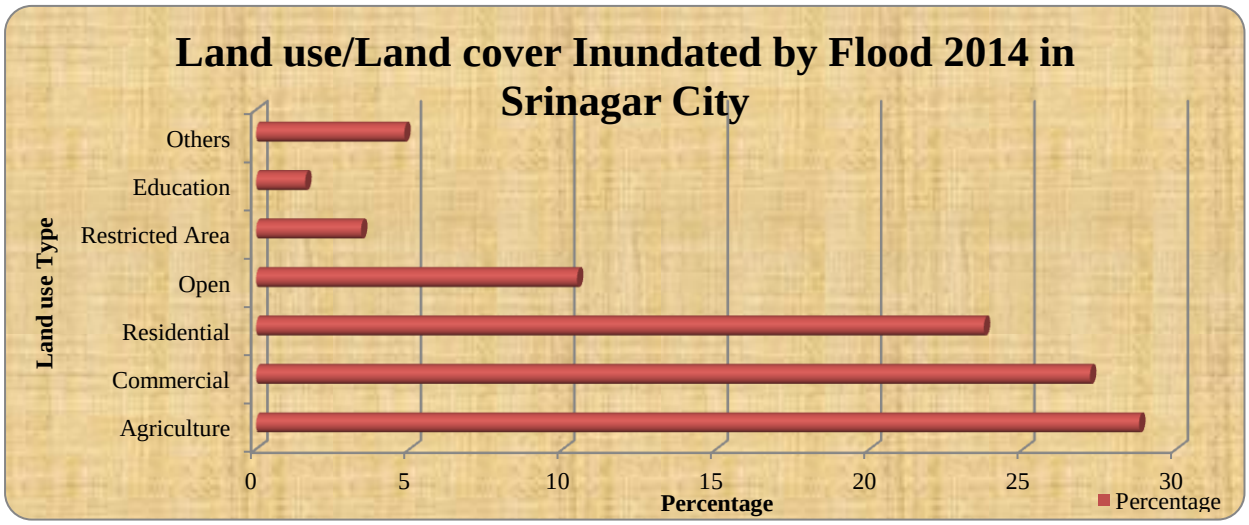
Source: Directory of Lakes and Water bodies in J&K State.

3.3 Land use and Flood Inundation of Srinagar city: A satellite-based observation.

During the first week of September 2014, Jammu and Kashmir experienced the worst floods in 60 years as a result of severe and heavy rainfall. "The alignment of the movement of westerly's in the extreme north with the passage of monsoon disturbances in the equatorial regions caused moderate to very heavy rainfall along the foothills of the Himalaya, and adjoining areas of Jammu & Kashmir" (Kamaljit Ray, 2015). This flood caused massive damage to the people of Kashmir valley's socio-economic stability. According to a briefing from India's Home Ministry, floods in September 2014 hit 2600 villages across the state of Jammu and Kashmir. According to the survey, 390 villages in Kashmir Valley have been fully submerged (The Times of India, 2014). According to a study published by the national Remote Sensing Centre (NRSC) and the Indian Space Research Organization (ISRO) in collaboration with the Department of Ecology, Environment, and Remote Sensing of the Government of Jammu and Kashmir, 2.2 million people, or 32 percent of the population in Kashmir Division (as per Census 2011 count), was affected by September. The total flood-affected area was 557 square kilometres, with 287 villages and urban areas in Srinagar and other cities (NRSC, 2014). The September 2014 floods impacted a total of 1.16 million people out of a total of 1.27 million people in the Srinagar Urban Agglomeration, accounting for 91 percent of the population (NRSC, 2014). 118.75 square kilometres, or 52 percent of the Srinagar city agglomeration's 227.41 square kilometres, were entirely flooded or submerged. In Srinagar district, totally flooded areas were distributed as follows: residential (28.11 Sq Km), agriculture (34 Sq Km), and industrial (34 Sq Km) (32.21 Sq Km) Rest areas, including restricted areas (military areas), hospitals, police stations, educational, and administrative

buildings (12.39 sq km). Agricultural, industrial, agricultural, and open areas made up 84 percent of the total area flooded (NRSC, 2014). The NRSC's study was satellite-based, with no post-flood ground tests. However, it is one of the most important works on the floods in Jammu and Kashmir, as it provides a brief overview of the magnitude and damage caused by the flood in 2014. For many days, even major educational facilities and hospitals were totally submerged. As a result, the flood victims were unable to be evacuated to safer places such as open areas and educational facilities. Unfortunately, emergency services were also halted, and patients who had already been admitted to hospitals were left isolated for several days without assistance (See Figure No 3.5)

Figure 3.5: Land use-Land cover area inundated by flood 2014 in Srinagar city.



Source: National Remote Sensing Agency.

- Others include Hills, Parks, Religious places, Playgrounds, Graveyards, Police Stations, Parking areas, and Slums.

3.4 Ward-Wise Extent of Flood Inundation

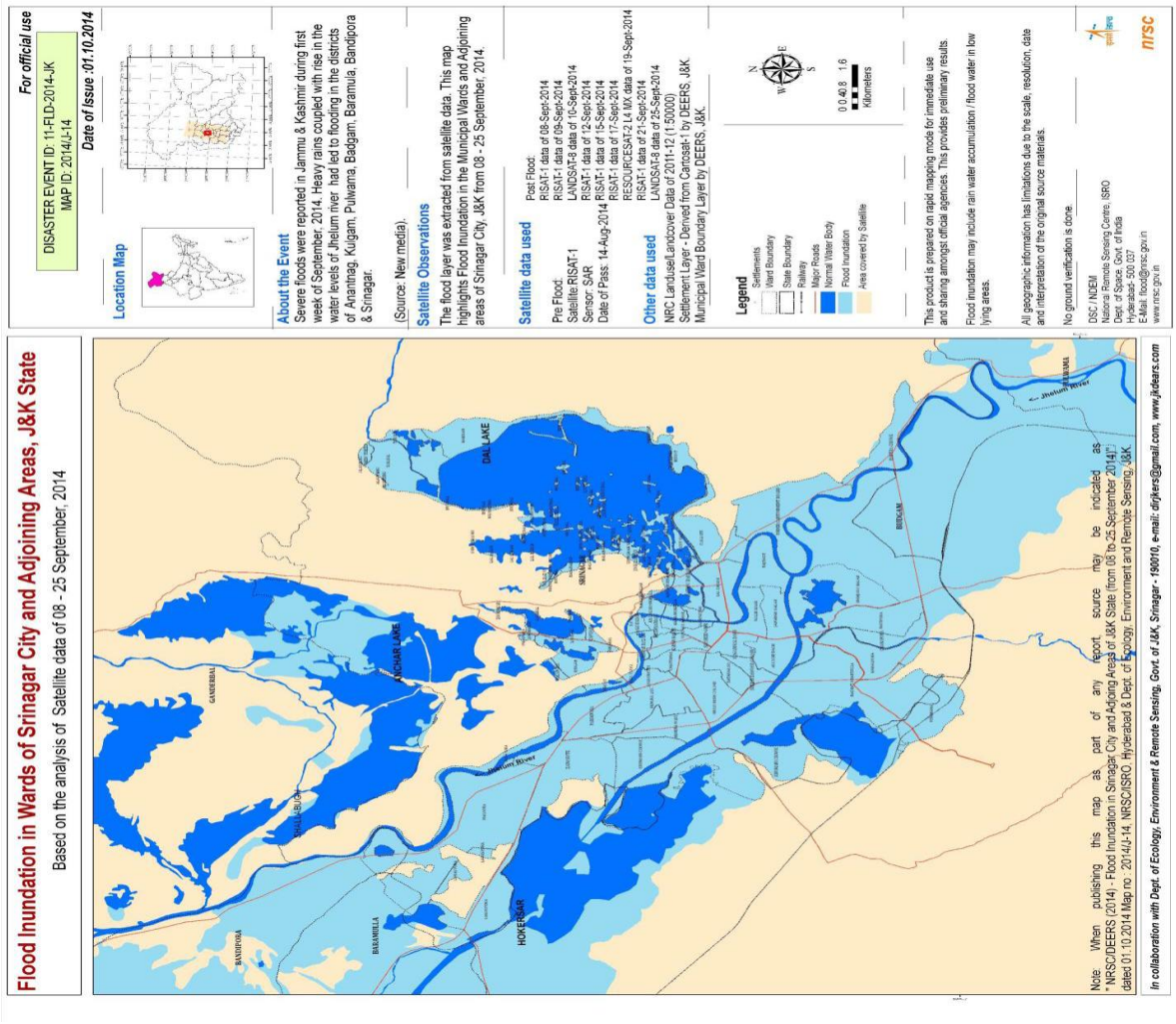
The scale of flood inundation by ward presents a rather bleak picture. The study conducted by the Natural Resources Defense Council and the Department of Ecology, Climate, and Remote Sensing clearly demonstrates that the degree of flood inundation varied over time and space. It reveals that the highest inundation was seen in Khumani chowk where it covered 9.70 Sq.km area followed by Maloora (9.46 Sq.km), Baghat-i-Barzulla (7.06 Sq.km). The other areas which were highly affected by the flood were the Cantonment area, Zainakote, Mehjoor Nagar, Tailbal, Lawaypora, Numndresh Colony, Humahana, Bemina East, Parimpora, Rawalpora, Pantha Chowk, Dalgate, Natipora, Harwan, Lal Chowk, Bemina West, Rajbagh, Iddgah, Nishat and so on (Refer Figure 3.5). The important feature of this analysis is that it

has given a loose estimate of areas inundated by the flood. The ground analysis reveals that the inundation was high in the low lying areas as well as in areas that make a part of the Jhelum plain. It is important to note here that the closeness to the Jhelum does not mean that these areas would have a greater inundation of water during a flood. The inundation of water in any place is greatly affected by various physical and socio-economic factors. However, the slope, elevation, type of drainage flow, level of the house has a dominant role to play in the level of inundation.

The flood inundated Srinagar city from September 8 to September 25, according to satellite imagery. The overflowing Jhelum River inundated the entire city of Srinagar in just a few hours after heavy rainfall because the city's water bodies were unable to absorb it. In the first week of September 2014, a major flood hit all of Srinagar's wards. The September 2014 floods affected 1.16 million people out of a total of 1.27 million people in the Srinagar Urban Agglomeration, accounting for 91 percent of the population. 118.75 square kilometres, or 52 percent of the Srinagar city agglomeration's 227.41 square kilometres, is totally flooded/ submerged. All the Residential, Agricultural, Industrial, Open areas, Military areas, Hospitals, Educational Institutions and Administrative buildings were among the completely inundated areas in Srinagar region. A total of 84 percent of the total inundated area was made up of agricultural, industrial, residential, and open areas. For many days, even major educational institutions and hospitals were totally submerged (Refer Figure 3.7). As a result, flood victims were unable to be evacuated to safer areas such as open areas and educational institutions. Unfortunately, emergency services were also suspended, and patients who had already been admitted to hospitals were left isolated for several days without assistance.

The flood was labelled "one of the worst floods in history." “I had no government for the first 36 hours as the seat of the establishment was wiped out,” Dr. Omar Abdullah, the then-Chief Minister of Jammu and Kashmir, had to admit.

Figure 3.7: Flood Inundation in-wards of Srinagar city and adjoining areas, J&K state



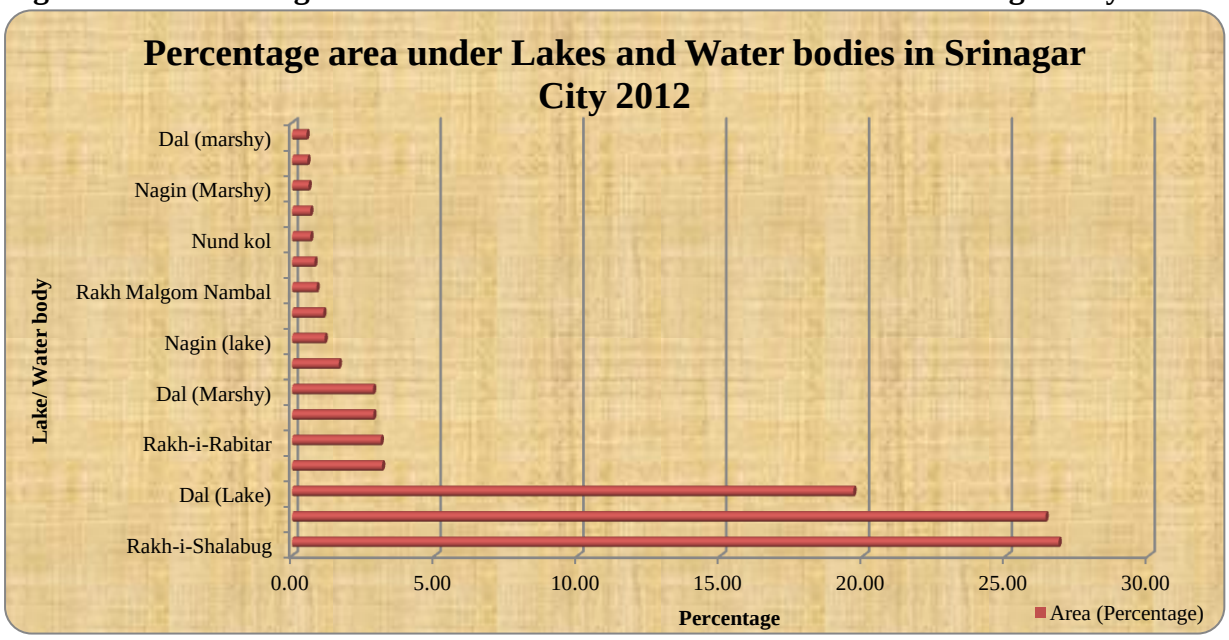
Source: Satellite Based Rapid Assessment report on Floods in Jammu and Kashmir

3.5 The changing scenario of lakes and waterways in Srinagar City.

The city of Srinagar is renowned for its beautiful scenery. Beautiful lakes and water bodies, as well as the River Jhelum, which flows through it, add to its allure. These lakes and bodies of water play an important role in people's lives on a socioeconomic level. They are the foundation of the country's ecology and economy. Unfortunately, over the last century, rapid urbanisation and increased human interference in the vicinity of these water bodies has resulted in pollution and siltation, putting these lakes and water bodies under severe stress. Many of them have shrunk to a fraction of their original size as a result of overexploitation. The rapid urbanisation of Srinagar and other major Kashmiri cities is depleting the region's wetlands. In the last century, nearly half of the water bodies in Srinagar and its environs have disappeared. Srinagar's area grew 23 times and its population grew 12 times in the same time

span. (Keng, 2012). Figure 3.7 shows that the Rakh-i-Shalabug water body accounts for 26.84 % of the area in Srinagar city followed by Rakh-i-Kujar(26.38 %), Dal Lake (19.65 %), Manasbal Lake (3.15%), Rakh-i-Rabitar (3.11 %), Gangabal Lake (2.85 %), Dal Marshy (2.84 %), Khusal Sar (1.64 %), Nagin Lake (1.14 %). The changing situation of these lakes and water bodies has placed a strain on their carrying ability, making Srinagar vulnerable to floods.

Figure: 3.7: Percentage-wise area under Lakes and Water bodies in Srinagar City 2012.



Source: Directory of Lakes and Water bodies in J&K State.

These lakes added to Srinagar's natural beauty. However, unbridled urban growth in recent decades has transformed the lake into a vast sewage trash heap that receives untreated sewage from old Srinagar district, depriving it of its pleasantness. The present status of these lakes and water bodies is also showing an alarming situation. Table 3.2 shows the water bodies like Khushal Sar, Kharbagh, Bab-e-Demb are wholly the marshy tracts whereas Gilsar is the water body which is Marshy, and as well as it also accommodates Habitation. On the other hand, the water bodies like Ahansar, Waskur, Khanpur, Shalimar, Rakhi Rabitar, Rakhi Kujar, Anchar Lake, Nageen, Nesbal Nambal, and Dal Lake have areas which have Habitation areas, Marshy Areas as well as the areas of agriculture. Therefore, it is clear that the marshy areas are getting encroached for Settlements as well as for Agriculture. All these encroachments and increasing Human stress on these water bodies will have serious repercussions and will make Srinagar city more vulnerable to disasters in general and Floods in particular.

Table 3.2: Present Status of Lakes and Waterways in Srinagar

Present Status of Lakes and Waterways in Srinagar	
Name of Water body	**Status of Water body/Lake**
Dal Lake	Marshy/Habitation Agriculture
Gilsar	Habitation/Marshy
Rakhi Rabitar	Agriculture
Ahansar	Marshy/Agriculture
Kharbagh	Marshy
Khanpur	Agriculture/Marshy
Anchar Lake	Plantation/Habitation/agriculture/ Marshy
Khushal Sar	Marshy
Babe Demb	Marshy
Rakhi Kujar	Marshy/Agriculture Plantation
Waskur	Agriculture/Marshy/Habitation
Nagin	Marshy/Habitation Agriculture
Nesbal Nambal	Agriculture
Shalimar	Marshy/Agriculture

Source: Directory of Lakes and Water bodies in J&K State.

3.6 Drainage and Water Bodies:

Srinagar city has witnessed huge growth in the last three decades. Data reveals that only 12.82 % of the land is underwater which includes the area under the river, Wetlands, Swamps, and Marshy Lands. The area under the water bodies was 18.45 % in 1972. Therefore, the proportion of land covered by water bodies is decreasing. As a result, the most pressing issue is the shrinking of waterlogged and swampy land at the expense of expanded built-up areas, especially in these marshy and swampy low-lying areas, which exacerbates Srinagar's flood vulnerability. The drainage pattern of the Jhelum River in Srinagar city clearly shows that Jhelum flows in a meandering space. The flood channels of the Jhelum River like

Doodhganga Flood Channel, Tsueth Kol, Soner Kol, Ram Bagh Flood Channel have been carved in the Srinagar to accommodate the rising water level during heavy rainfall. They serve as the absorbing channels of increasing water levels in Jhelum. However, with the growth of urbanization Deforestation, Siltation, and encroachment of wetland and marshy areas, the carrying capacity of these flood channels has decreased and has increased the flood vulnerability in Srinagar city. Therefore, proper drainage is a prerequisite for urban flood management. The flow of the Jhelum River is monitored at different locations by the Gauge readings. The Jhelum river has the gauge sites at Sangam, Ram Munshi-Bagh, and Asham.

When the gauge reading at Sangam reaches 18 feet, the central flood committee issues a first alert to all district headquarters and engineering wings of zonal committees, and when the level reaches 21 feet at Sangam, the concerned authority begins flood duty in Anantnag and Pulwama districts. At Ram Munshi-Bagh, the flood alert sound for Srinagar and Budgam is sounded at the gauge reading of 16 Feet while the flood duty starts at the Gauge reading of 18 Feet. However, the flood duty in Sumbhal and Sonawari starts when the Gauge reading at Asham station is 14 Feet but, if the water level in the Wular lake is found high, then the duty may start at a lower gauge in consultation with Central Flood Committee.

The flood channels of the Jhelum River are as:

3.6.1 Doodhganga Flood Channel:

The Doodhganga flood channel (Chouzeh-Kol) is a 10-kilometer-long flood diversion channel that runs from Mouchewa, Bag-e-Mehtab, through Rawalpora, Peerbagh, Nadirgund, Narkara Wetland, and Bemina, and connects to the city's main Flood Spill Channel (FSC). The Doodhganga Nallah was designed to absorb the Jhelum River's excess flow of water. The remains of the Doodhganga Nallah are now overflowing with plastic waste and garbage from government offices and residential buildings, according to the field survey. Subhan Dar, 95, recalls that in the 1970s and 1980s, the area behind the Shergardhi Police station was a stream that ran from Batmaloo to Ram Bagh. Locals in the surrounding areas claim that this channel was in good shape until the 1990s, since which time the Nallah has encroached and heavy structures have been built in the Flood channel for residential and government projects. The government has been found to be complicit in the encroachment of these channels and wetlands in Srinagar. As a result, the Jhelum River and its flood channels were unable to cope with the massive water flow in 2014, resulting in a flood that affected the entire city of Srinagar. To alleviate the flood problem in Srinagar, the government began dredging and

desilting the Doodhganga Channel. The unauthorised buildings in the channel area are demolished. According to the Central Water Commission expert committee investigating the 2014 Kashmir floods, the state government should prioritise the conservation of wetlands, water bodies, and the demolition of encroachments in flood spill channels. The capacity of the flood spill channels in Srinagar had also been reduced from 17,000 cusecs to 5,000 cusecs, according to the expert committee. The Jhelum channel's (35,000 cusecs) and flood spill channel's capability were inadequate to handle the massive floodwater discharge in September 2014.

3.6.2 Ram Bagh Flood Channel:

The Rambagh Flood Channel starts from Padshahi Bagh and traverses through Mehjoor Nagar, Solina, Rambagh, Barzulla, Gangbugh, Batmaloo, Bemina and goes up to Mujgund. This channel serves as a drainage outlet to these areas as well as a nerve channel of the Jhelum River to accommodate the excess flow during heavy rainfall. However, due to siltation, the capacity of the channel, which runs from Padshahibagh to the outskirts of Srinagar in north Kashmir, has been reduced to less than 4,000 cusecs. This reduction in carrying ability is also one of the causes of significant damage in the affected region. According to government documents, the Rambagh flood-spill channel's carrying capacity has been increased from 4,000 to 10,000 cusecs between Padshahibagh and Bemina. It will be critical in regulating water flow in the Jhelum River as water levels in the river rise, posing a flood risk. The irrigation and flood control department tries to maximize the channel's capacity to 60,000 cusecs in future phases.

3.6.3 Sonar Kol:

The Sonar Kol is an offshoot of Tsueth Kol which starts from Kani Kadal through Karan Nagar, Nawa Bazaar, Safa Kadal and joins the Jhelum river at Chattabal. This channel has also seen huge encroachments over time, and its carrying capacity has lowered over time. The government has started the drive of drudging and desilting the channel as well as removing the illegal structures along the channel (Kol)

3.6.4 Narbal Flood channel:

Following the 2014 flood, work on restoring the Narbal flood spill channel to increase its water carrying capacity has started in order to keep Srinagar safe from flooding. Authorities have acquired more than 1570 kanals, compared to the target of 1758 kanals, according to

official statistics. The government wants to increase the channel's capacity from 4000 to 20,000 cubic seconds.

3.6.5 Tsueth Kol:

The Tsueth Kol starts from the Sheed Gunj and traverses through Kani Kadal, Zaldagar, and merges again with Jhelum at Nawa bazaar. This flood channel, as well as the drainage outlet, is one other most important channel of the Jhelum river. it is situated in that course of Jhelum river where it has a meandering shape. This shape hinders the free flow of water and lowers its speed of flow. Therefore, in this case, Tsueth Kol can act as an alternative channel of flow to the Jhelum river during the excess water flow periods. The government should focus on the drudging and desilting of this channel also.

3.7 Overview of Land Use/Land Cover of Srinagar City

Srinagar, which is situated on the banks of the Jhelum River, has a unique land use and land cover pattern compared to other Indian cities. This peculiarity is due to the unique soc-economic, environmental and demographic characteristics. These unique characteristics give a picturesque look to the city. Srinagar city is located at an elevation of 1583 Meters and is the center of Kashmir valley which adds an advantage to the city of Srinagar. This advantage has attracted people from all corners of the Kashmir valley, which enables it to accommodate nearly 1 million people. However, the concerning issue of Srinagar city is its profound change in land use/land cover. The recent years have seen an increase in the extent of the built-up area and the decline in marshy and wetland areas. This type of haphazard urbanization and decline in water-absorbing sources will have serious repercussions. The physiographic limitation of Srinagar city has played an important role in shaping its landscape. On the other hand, the location of Srinagar city in the high seismic zone has also limited the vertical development of the Built-Up area. It is the issue of concern that has put policymakers to think about the sustainability of Srinagar city. Keeping in view all these limitations, the development of Srinagar should focus on these limitations.

Chapter IV
Population Characteristics in Relation to Flood Vulnerability Pattern

Unless something catastrophic happens, a rise in the world's population from 7 to 8.8 billion people by mid-century is unavoidable. High fertility rates in Sub-Saharan Africa, whose population is expected to more than double in the next 40 years, and a modest increase of 23% in Asia's massive population are driving this increase (Cleland, 2013). This rapid increase in global population, especially in developing countries, has resulted in not only a drastic increase in settlement density, but also a shift in settlement distribution and land use patterns (Rao, 2010). This chapter attempts to highlight various aspects of population dynamics in Srinagar's vulnerable region. Furthermore, the study area's demographic profile was compared to the state's overall demographic profile.

4.1 Ward wise population of Srinagar City

Unlike the majority of the Kashmir valley districts, the Srinagar district has experienced unparalleled population growth over the decades. In 2011, the urban population of Jammu and Kashmir was 27.38 percent, while the share of the urban population in Srinagar was 99 percent. Similarly, in contrast to the state population density of 124 people per square kilometre, Srinagar city has a population density of 4141 people per square kilometre, which is 34 times higher than the state average (Office of the Registrar General & Census Commissioner, 2018). It is clear from the above statistics that the pressure of population on Srinagar city over the years has made it vulnerable to disasters in general and the flood and earthquake vulnerability in particular.

Table 4.1: Ward wise population distribution in Srinagar City 2001-2011

Name of the Ward	Area (sq km)	Total Population 2001	Percent (%)	Total Population 2011	Percent (%)	Decadal Growth Rate 2001-2011
Harwan	9	18285	1.84	27884	2.43	0.59
Nishat	11	22348	2.24	19795	1.72	-0.52
Dalgate	5	15062	1.51	16582	1.44	-0.07
Lal-chowk	2	9005	0.9	9919	0.86	-0.04
Rajbagh	2.2	9856	0.99	10142	0.88	-0.11
Wazir-bagh	1.2	7699	0.77	14807	1.29	0.52
Sarai-Balla	2.1	17586	1.77	3084	0.27	-1.5

Mehjoor nagar	3.5	24129	2.42	25294	2.2	-0.22
Natipora	2.2	25708	2.58	14372	1.25	-1.33
Chanapora	1.9	24585	2.47	21779	1.9	-0.57
Baghat-Barzulla	8	18934	1.9	29937	2.61	0.71
Rawalpora	7.5	16573	1.66	13727	1.2	-0.46
Sheikh Dawood colony	1	35825	3.6	9830	0.86	-2.74
Batmallo	1	32278	3.24	15732	1.37	-1.87
Allochi-Bagh	1	26858	2.7	16824	1.47	-1.23
Magarmal-Bagh	1	28600	2.87	7456	0.65	-2.22
NundReshi colony	3	29858	3	11819	1.03	-1.97
Qamerwari	1	15047	1.51	8830	0.77	-0.74
Parimpora	2.2	8578	0.86	17022	1.48	0.62
Zainakot	3.5	10926	1.1	21065	1.84	0.74
Bemina (A)	2.2	8598	0.86	14143	1.23	0.37
Bemina (B)	6	21509	2.16	26590	2.32	0.16
Shaheed Gunj	1	15850	1.59	9375	0.82	-0.77
Karan Nagar	1.5	22582	2.27	11120	0.97	-1.3
Chattabal	1	18257	1.83	17152	1.49	-0.34
Syed Ali Akbar	0.5	11258	1.13	16229	1.41	0.28
Nawab Bazar	0.5	17857	1.79	14469	1.26	-0.53
Islamyarbal	0.5	35438	3.56	11494	1	-2.56

Ali Kadal	0.5	24522	2.46	8765	0.76	-1.7
Ganpathyar	0.5	17406	1.75	13132	1.14	-0.61
Malik-Agan	0.3	19858	1.99	15,622	1.36	-0.63
Barbarshah	1.2	25850	2.6	20,527	1.79	-0.81
Khan-khai-Moulla	0.8	23858	2.4	15,724	1.37	-1.03
S.R.Gunj	0.3	18578	1.87	18,121	1.58	-0.29
Aqil-Mir-khanyar	0.5	15875	1.59	18,043	1.57	-0.02
Khawaja-Bazar	1.3	21634	2.17	17,429	1.52	-0.65
Safakadal	1.1	13589	1.36	19907	1.73	0.37
Eid-Gah	2.2	14863	1.49	26564	2.31	0.82
Tarabal	1.3	13586	1.36	9,168	0.8	-0.56
Jogilankar	2	17475	1.75	21,949	1.91	0.16
Zindshah-sahib	0.5	4028	0.4	12,421	1.08	0.68
Hassanabad	1.3	13846	1.39	17,286	1.51	0.12
Jamia-Masjid	0.2	3548	0.36	8,215	0.72	0.36
Mukhdoom sahib	2.1	29821	2.99	18,755	1.63	-1.36
Kawdara	2	12055	1.21	23,141	2.02	0.81
Zadibal	2	13282	1.33	15128	1.32	-0.01
Madin-sahib	2.2	8958	0.9	13155	1.15	0.25
Now-shera	1	7808	0.78	11441	1	0.22
Zoonimar	1.6	2857	0.29	15401	1.34	1.05

Lal-Bazar	3.5	7848	0.79	22140	1.93	1.14
Umarcolony	4.5	2588	0.26	26754	2.33	2.07
Soura	1	1525	0.15	11629	1.01	0.86
Buchpora	2.7	3545	0.36	23119	2.01	1.65
Ahmad-Nagar	7	1124	0.11	30511	2.66	2.55
Zakura	15	1438	0.14	11114	0.97	0.83
Hazratbal	3	1544	0.16	17218	1.5	1.34
Tail-bal	6	1986	0.2	17369	1.51	1.31
Bud-Dal	13	3204	0.32	13,233	1.15	0.83
Locut-Dal	9	1252	0.13	19,985	1.74	1.61
Dara	13	7511	0.75	23943	2.09	1.34
Alesteng	11	8365	0.84	18928	1.65	0.81
Palpora	22	15482	1.55	26160	2.28	0.73
Maloora	7	6803	0.68	21374	1.86	1.18
Laweypora	10	10990	1.1	12419	1.08	-0.02
Khumani Chowk	15	7105	0.71	25194	2.2	1.49
Humhama	17	20035	2.01	18925	1.65	-0.36
Pandrathan	4	9469	0.95	17324	1.51	0.56
Khanmoh	7	11645	1.17	13908	1.21	0.04

Source: Census of India.

Table no 4.1 shows the ward-wise distribution of the population in Srinagar city from 2001-2011. It becomes clear here that there is a wide variation in the distribution of the population in Srinagar city with time and space. The table clearly shows the wards like Sheikh Dawood Colony, Islamyar bal, Batamaloo, Nundreshi Colony, Mukhdoom Sahab, Magarmal Bagh, Allochi Bagh, Barbarshah, Natipora, Chanapora, Ali Kadal, Mehjoor Nagar, Khan Khai

Moulla, Karan Nagar, Nishat, Khawaja Bazaar, Bemina B and Humhama had a very high population in 2001. The population percentage in these wards was more than 2 percent in 2001 while in Wards like Malik Agan, Baghat Barzulla, S.R Gunj, Harwan, Chattabal, Nawab Bazar, Sarai Balla, Ganpathyar, Jogilankar, Rawalpora, Shaheed Gunj, Aqil Mir Khanyaar, Palpora, Dalgate, Qamarwari, Eid Gah, Hassanabad, Safakadal, Tarabal, Zadibal, Kawdar, Khanmoh, Syed Ali Akbar, Zainakot and Laweypora have a population between one to two percent in 2001. The wards with less than one percent of the population in 2001 were Rajbagh, Pandrathan, Lal Chowk, Madin Sahib, Parimpora, Bemina A, Alesteng, Lal Bazaar, Nowshera, Wazir Bagh, Dara, Khumani Chowk, Maloora, Zindshah Sahib, Jamia Masjid, Buchpora, Bud Dal. Zoonimar, Umar Colony, Tail Bal, Hazratbal, Soura, Zakura, Lokut Dal, and Ahmad Nagar. On the other hand, in 2011, the wards like Ahmad Nagar, Baghat Barzulla, Harwan, Umar colony, Bemina B, Eid Gah, Palpora, Mehjoor Nagar, Khumani Chowk, Dara, Kawdara, Buchpora have a high population of more than two percent. While the wards with a population between one to two percent are Lal Bazaar, Jogilankar, Chanapora, Maloora, Zainakot, Barbarshah, Locut Dal, Safakadal, Nishat, Alesteng, Humhama, Mukhdoom sahib, S.R Gunj, Aqil Mir Khanayar, Khawaja Bazaar, Hassanabad, Tailbal, Pandrathan, Hazratbal, Chattabal, Parimpora, Allochibagh, Dalgate, Syed Ali Akbar, Batmaloo, Khankhai Moula, Malik Agan, Zoonimar, Zadibal, Wazir Bagh, Nawab Bazaar, Natipora, Bemina A, Khanmoh, Rawalpora, Madin Sahib, Bud Dal, Ganpathyar, Zindshah Sahib, Laweypora, Nundreshi Colony, Soura, Islamyar bal, and Nowshera. These wards registered medium growth in 2011 from one percent to two percent. However, the low population was registered in Karan Nagar, Zakura, Rajbagh, Lal Chowk, Sheikh Dawood Colony, Shaheed Ganj, Tarabal, Qamerwari, Ali Kadal, Jamia Masjid, Magarmal Bagh, and Sarai Balla. The population in these wards was registered as less than one percent in 2011.

The decadal growth rate of population from 2001-2011 clearly shows that the positive growth was experienced in Harwan, Wazir Bagh, Bagha Barzulla, Parimpora, Zainakot, Bemina a, Bemina B, Syed Ali Akbar, Safakadal, Eid Gah, Jogilankar, Zindshah Sahib, Hassanabad, Jamia Masjid, Kawdara, Madin Sahib, Nowshera, Zoonimar, Lal Bazaar, Umar Colony, Soura, Buchpora, Ahmad Nagar, Zakura, Hazratbal, Tail bal, Bud Dal, Locut Dal, Dara, Alesteng, Palpora, Maloora, Khumani Chowk, Pandrathan and Khanmoh. These wards have seen an increase in the population from 2001-2011 while all other wards registered a decline in population from 2001-2011. Therefore, the main reasons for this population change are Birth Rate, Death Rate, and Migration. The population distribution in any area is one of the

indicators of its social vulnerability. The ward-wise distribution of population highlights its uneven distribution which has added its vulnerability. The areas with low population distribution will show low vulnerability to any calamity while the areas with high population distribution on the static land area will have a higher vulnerability in case of disaster. Therefore, it is a positive indication of greater vulnerability in those wards where the population growth has remained high between 2001-2011. The flood in 2014 is a living example of it. The areas which had higher population growth registered great damage in socio-economic terms. Wards like Rajbagh, Mehjoor Nagar, Solina, and Jawahar Nagar saw huge damage during the flood 2014. Therefore, it becomes clear that a higher population in any area exposes it to the wrath of various urban hazards like Floods and Earthquakes while the wards with low population distribution have a low vulnerability in terms of hazards.

4.2 Ward wise Population Trend in Srinagar City

Since its inception, Srinagar's city has gone through numerous phases of development, deformation, and reformation. Srinagar city had 14 wards at first, but it later grew to 68. In 2011, six more wards were added, bringing the total number of wards to 74. However, the 68 wards of Srinagar city are considered for this debate.

Srinagar City has a long history of urbanisation and has long been impacted by high population density. The key reason for the city's increase in population is migration from other areas of the valley. Since Srinagar is the centre of all operations, it functions as a magnet, attracting people from all over the Kashmir valley. Table 4.2 and figure 4.1 display the overall population growth pattern in Srinagar. The data clearly shows that the city of Srinagar's urban growth momentum has increased. During field surveys, it was also discovered that the population of Srinagar city has grown at an alarming pace, raising serious concerns about the city's rising pattern of urban hazards. As a result, the following three phases can be used to examine population growth patterns in Srinagar. They are:

I) Stage of slow growth rate (1901-1951).

II) Stage of medium growth rate (1951-1981).

III) Stage of Rapid growth rate (1981-2011).

IV) Stage of projected growth rate (1981-Present.)

Table: 4.2: Population trend and Decadal Growth of the population in Srinagar city (1901-2011)

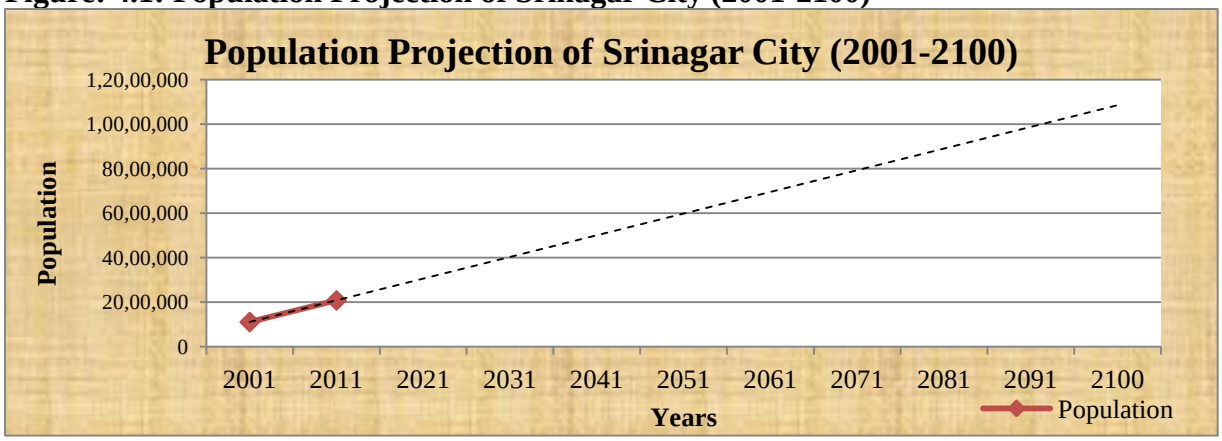
Census Year	Population	Absolute Growth	Decadal Growth Rate
1901	1,22,618	-	-
1911	1,26,344	3726	-9.15
1921	1,41,735	15,391	12.18
1931	1,73,873	32,138	22.67
1941	2,03,787	29,914	17.2
1951	2,46,522	42,735	20.97
1961	2,85,257	38,735	15.71
1971	4,57,511	1,72,254	60.38
1981	6,06,002	1,48,491	32.45
1991	N.A	N.A	N.A
2001	11,10,467	5,04,465	83.62
2011	20,84,119	9,73,652	87.67

Source: Census of India.

The stage of the slow growth of population can be seen from 1901-1921. During this period the population in the Srinagar district showed slow growth. The decadal growth of population was -9.15 and 12.18 in 1911 and 1921 respectively. The growth rate starts showing a dynamic pattern then. However, it becomes clear that the population with time starts increasing at a dynamic rate. The decadal growth rate of the population was 22.67, 17.2, and 20.97 in 1931, 1941, and 1951 respectively. This period is the stage of slow growth in population in Srinagar city. Thereafter, from 1951 the growth of population in Srinagar city starts increasing with time. The growth rate of the population starts increasing with time, and the figure shows that the growth rate in 1951, 1961, 1971, and 1981 was 20.97, 15.71, 60.38, and 32.45 respectively. However, the growth rate from 2001 shows an increasing trend with time. The growth rates in 2001 and 2011 were 83.62 and 87.67 respectively. This increase in the growth rate is an issue of concern and policies and programs should be introduced to restrict the further increase in population growth of Srinagar city. This stage is the stage of rapid

population growth. However, based on the growth rates of 2001 and 2011, the projected growth of Srinagar city has been worked out.

Figure: 4.1: Population Projection of Srinagar City (2001-2100)



Source: Census of India

The analysis in figure 4.1 clearly shows that if the population grows at the current rate then the population of Srinagar city will cross one crore by 2100. This increasing trend of the population is an issue of concern and will make Srinagar more vulnerable to various Physical, socio-economic, and demographic problems. It is important to note here that the growth of population in Srinagar city is increasing with the increase in its area also. Srinagar city has expanded its influence in Budgam, Pulwama, and Ganderbal districts. The fringe areas of these districts were included under the influence of Srinagar with time. The growth of population is also correlated with the decline in areas of Wetlands and swampy areas of the Srinagar district. These areas act as absorbers of excessive water during heavy rainfall. However, the growth of population and the decline in wetlands has increased the flood vulnerability of Srinagar city, which is an issue of concern.

4.3 Ward-wise population Density and Vulnerability

The ward-wise population density is the clear indication of several people residing per Sq.km of land. The areas with high population density have a higher pressure of people to the limited set of resources and are indicative of high vulnerability in the future. Table 4.3 shows the density of Srinagar city in 2001; it shows that 37 wards had a population density of fewer than 7,000 persons per Sq.km these wards were Zakura, Locut Dal, Ahmad Nagar, Bud Dal, Tailbal, Khumani Chowk, Hazratbal, Umar colony, Dara, Palpora, Alesteng, Maloora, Laweypora, Humhama, Buchpora, Soura, Khanmoh, Zoonimar, Harwan, Nishat, Rawalpora, Lal Bazaar, Baghat-Barzulla, Pandrathan, Dalgate, Zainakot, Bemina B, Parimpora, Bemina

A, Madin Sahib, Rajbagh, Lal Chowk, Kawdara, Wazir Bagh, Zadibal, Eid Gah, Mehjoor Nagar. While the wards with a population density between 7,000-14,000 were 10 in number and these were Nowshera, Zindshah sahib, Sarai Bala, Jogilankar, NundReshi Colony, Tarabal, Hassanabad, Natipora, Safakadal, Chanapora. However, the wards with population density from 14,000 to 21,000 were 7 in number, and these wards were Mukhdoom Sahab, Qamerwari, Karan Nagar, Shaheed Gunj, Khawaja Bazar, Jamia Masjid, Chattabal. While the wards with a population density above 21,000 persons per Sq.km were 14 in number and these wards were Barbarshah, Syed Ali Akbar, Allochi Bagh, Magarmal Bagh, Khan Khai Moula, Aqil Mir Khanyar, Batmaloo, Ganpathyaar, Nawab Bazaar, Sheikh Dawood Colony, Ali Kadal, S.R Gunj, Malik Agan, Islamyarbal.

Table 4.3: Ward-Wise population Density of Srinagar City 2001

	Population Density	**No of Wards**	**Name of the Wards**
Very Low	Below 7,000	37	Zakura, Locut Dal, Ahmad Nagar, Bud Dal, Tailbal, Khumani Chowk, Hazratbal, Umarcolony, Dara, Palpora, Alesteng, Maloora, Laweypora, Humhama, Buchpora, Soura, Khanmoh, Zoonimar, Harwan, Nishat, Rawalpora, Lal Bazaar, Baghat-Barzulla, Pandrathan, Dalgate, Zainakot, Bemina B, Parimpora, Bemina A, Madin Sahib, Rajbagh, Lal Chowk, Kawdara, Wazir Bagh, Zadibal, Eid Gah, Mehjoor Nagar.
Low	7,000-14,000	10	Nowshera, Zindshah sahib, Sarai Bala, Jogilankar, NundReshi Colony, Tarabal, Hassanabad, Natipora, Safakadal, Chanapora.
Medium	14,000-21,000	7	Mukhdoom Sahab, Qamerwari, Karan Nagar, Shaheed Gunj, Khawaja Bazar, Jamia Masjid, Chattabal.
High	21,000-28,000	3	Barbarshah, Syed Ali Akbar, Allochi Bagh.
Very High	Above 28,000	11	Magarmal Bagh, Khan Khai Moula, Aqil Mir Khanyar, Batmaloo, Ganpathyaar, Nawab Bazaar, Sheikh Dawood Colony, Ali Kadal, S.R Gunj, Malik Agan, Islamyarbal.

Source: Calculated by the Researcher.

On the other hand, the analysis of Table 4.4 reveals that there is a fall in density in several wards with a density below 7,000 in 2011. There are only 31 wards whose density is below 7,000, and these wards were Zakura, Bud Dal, Humhama, Palpora, Laweypora, Sarai Balla, Khumani Chowk, Alesteng, Nishat Rawalpora, Dara, Khanmoh, Locut Dal, Tailbal, Maloora, Harwan, Dalgate, Baghat Barzulla, Nund Reshi Colony, Pandrathan, Ahmad Nagar, Bemina B, Rajbagh, Lal Chowk, Hazratbal, Umar colony, Madin Sahib, Zainakot, Lal Bazaar, Bemina A, Natipora while the wards with a density between 7,000 to 14,000 persons per Sq.km have shown an increase in their number. They are 21 in number and the area as Tarabal, Mehjoor Nagar, Karan Nagar, Magarmal Bagh, Zadibal, Parimpora, Buchpora, Qamerwari, Mukhdoom Sahib, Shaheed Gunj, Zoonimar, Sheikh Dawood Colony, Jogilankar, Nowshera, Chanapora, Kawdara, Soura, Eid Gah, Wazir Bagh, Hassanabad, Khawaja Bazaar. The population density from 14,000 to 21,000 per Sq.km has been seen in 7 wards which have remained unchanged with the 2001 census. These wards are Batamaloo, Alloch Bagh, Barbarshah, Chattabal, Ali Kadal, Safakadal, Khan Khai Moula. However, the population density above 21,000 persons per Sq.km has been seen in 10 wards which are Islamyarbal, Zindshah sahib, Ganpathyaar, Nawab Bazaar, Syed Ali Akbar, Aqil Mir Khanyar, Jamia Masjid, Malik Agan, S.R Gunj. Therefore, from the above analysis of ward-wise population density of Srinagar city, it becomes clear that the density of population is increasing in Srinagar city. There is an increase in the density of population in low-density areas and this increase in density will lead to severe repercussions to Srinagar city if the population will not be redistributed to the periphery areas as well as there is a need to restrict the further increase in density of already dense areas of Srinagar city. Population density is a good indicator to access the vulnerability of a place to various hazards and disasters like earthquakes and floods.

Table 4.4: Ward-wise population Density of Srinagar City 2011

	Population Density	**No of Wards**	**Name of the Ward**
Very Low	Below 7,000	31	Zakura, Bud Dal, Humhama, Palpora, Laweypora, Sarai Balla, Khumani Chowk, Alesteng, Nishat Rawalpora, Dara, Khanmoh, Locut Dal, Tailbal, Maloora, Harwan, Dalgate, Baghat Barzulla, Nund Reshi Colony, Pandrathan, Ahmad Nagar, Bemina B, Rajbagh, Lal Chowk, Hazratbal, Amar colony, Madin Sahib, Zainakot, Lal Bazaar, Bemina A,

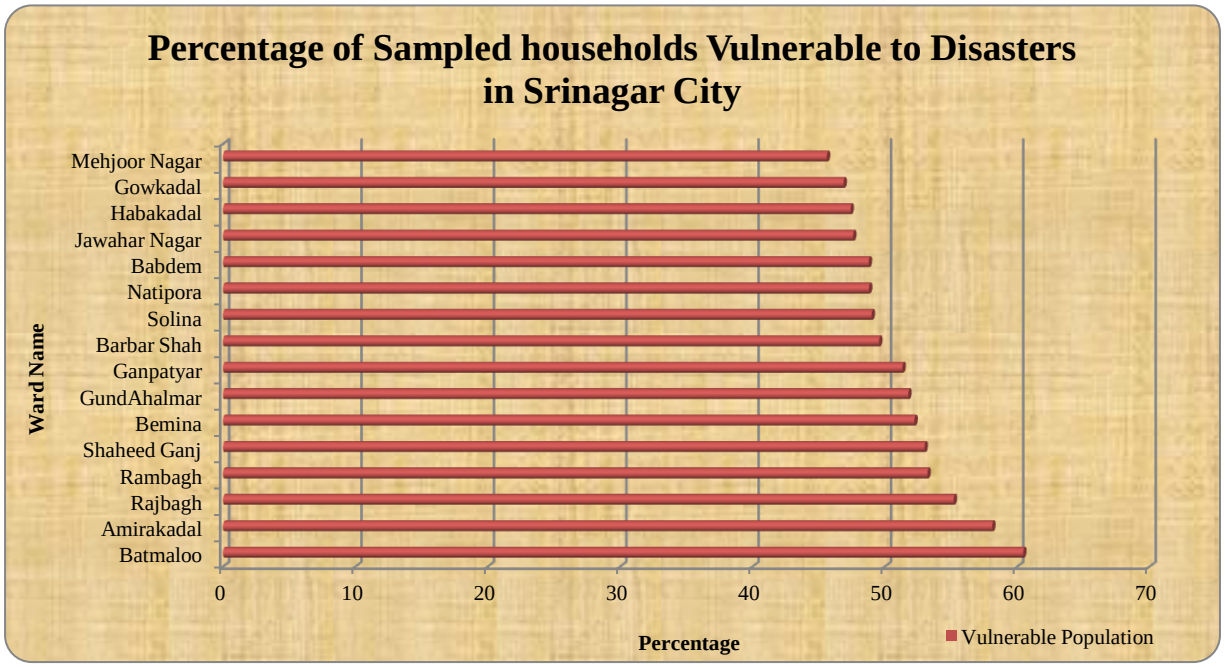
			Natipora.
Low	7,000-14,000	21	Tarabal, Mehjoor Nagar, Karan Nagar, Magarmal Bagh, Zadibal, Parimpora, Buchpora, Qamerwari, Mukhdoom Sahib, Shaheed Gunj, Zoonimar, Sheikh Dawood Colony, Jogilankar, Nowshera, Chanapora, Kawdara, Soura, Eid Gah, Wazir Bagh, Hassanabad, Khawaja Bazaar.
Medium	14,000-21,000	7	Batamaloo, Alloch Bagh, Barbarshah, Chattabal, Ali Kadal, Safakadal, Khan Khai Moula,
High	21,000-28,000	3	Islamyarbal, Zindshah sahib, Ganpathyaar,
Very High	Above 28,000	6	Nawab Bazaar, Syed Ali Akbar, Aqil Mir Khanyar, Jamia Masjid, Malik Agan, S.R Gunj.

Source: Census of India

4.4 Growth of Vulnerable population

This is one of the most important aspects of current research; it recognises the vulnerable population. Women and children are the most vulnerable parts of society during and after disasters, according to studies conducted by various institutes such as the Tata Institute of Social Sciences and the National Institute of Mental Health and Neuro Sciences in India. Women and children made up 79 percent of the total killed during disasters in India between 1977 and 2002, with 34 percent of women and 45 percent of children. (Kapur, 2010). In figure 4.2, the analysis of vulnerable populations has been worked out based on the interviews with 400 households in 16 wards of the study area. It is clear from the given figure that Batamaloo has the highest population vulnerable to floods followed by Amirakadal, Rajbagh. Rambagh, Shaheed Gunj, Bemina, GundAhilmar, Ganpatyar, Solina, Natipora, Babdem, Jawahar Nagar, Habbakadal, Gowkadal and Mehjoor Nagar. The vulnerable section of the population includes an Entire female population of all ages as well as the under six years of a male child. It has been found during the field survey also that they have suffered a lot during the flood 2014 in the study area.

Figure 4.2: Percentage of Sample Households Vulnerable to Disasters in Srinagar City



Source: Calculated by the Researcher.

4.5 Sex Ratio Analysis

The sex ratio is the most important component of population change and is the best indicator of the status of women in society. Sex Ratio is the basic index to analyze the socio-economic status in any area. Table 4.5 shows the sex ratio of Jammu and Kashmir and that of Srinagar district. It shows the comparative sex ratio of J&K and Srinagar at Rural, Urban well as at Total levels.

Table 4.5: Sex Ratio of Jammu and Kashmir and Srinagar 1901-2011

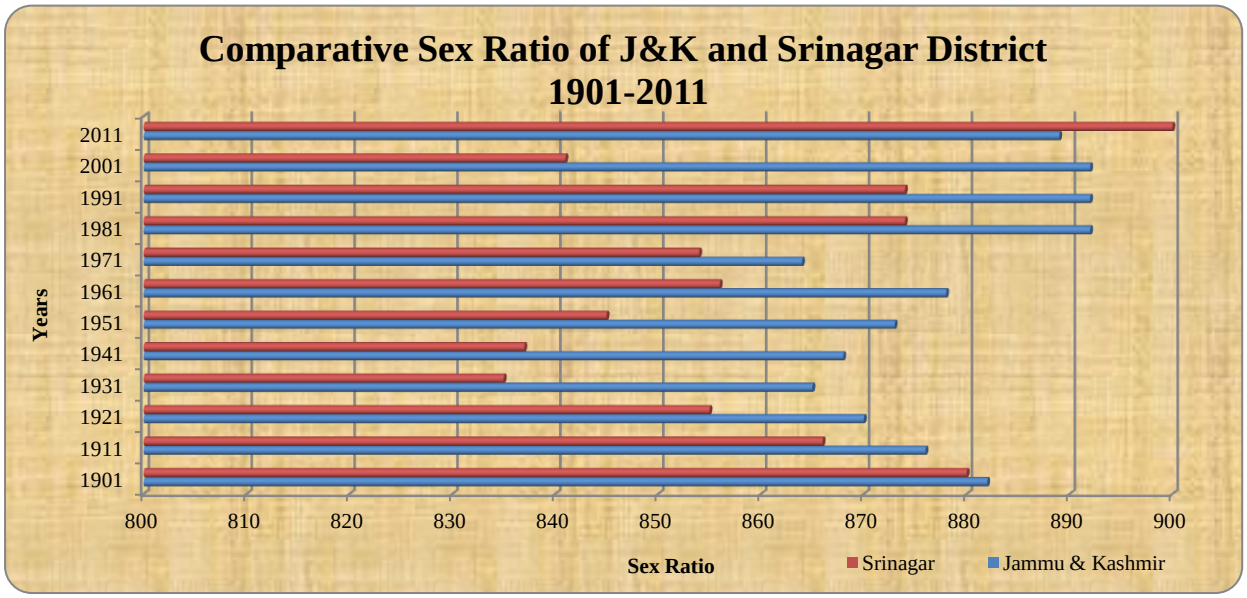
Census Year	Jammu & Kashmir			Srinagar		
	Total	Rural	Urban	Total	Rural	Urban
1901	882	888	809	880	897	871
1911	876	884	810	866	896	848
1921	870	877	814	855	864	850
1931	865	876	785	835	854	826
1941	868	881	790	837	832	839
1951	873	882	823	845	824	853

1961	878	884	844	856	834	863
1971	864	865	860	854	854	854
1981	892	897	875	874	1341	870
1991	NA	NA	NA	NA	NA	NA
2001	892	917	818	841	906	834
2011	889	908	840	900	942	899

Source: Census of India.

Based on the above table, certain observations have been made on the sex ratio of Srinagar city. Figure 4.3 shows the comparative figure of the sex ratio of Jammu and Kashmir as a whole and that of Srinagar district from 1901-2011. The figure clearly shows that the sex ratio of Srinagar city is lower than the sex ratio of Jammu and Kashmir. From 1901-2001, the sex ratio of Srinagar has remained lower than that of Jammu and Kashmir. However, the Srinagar district has surpassed the sex ratio of Jammu and Kashmir in 2011. The sex ratio of Srinagar in 2011 was 900 while that of Jammu and Kashmir is 889. This argument is supported by various surveys where it has been found that a large number of girls in Srinagar district or either single or have crossed the marriageable age (Greater Kashmir, 2018)

Figure 4.3: Comparative Sex Ratio of J&K and Srinagar District 1901-2011

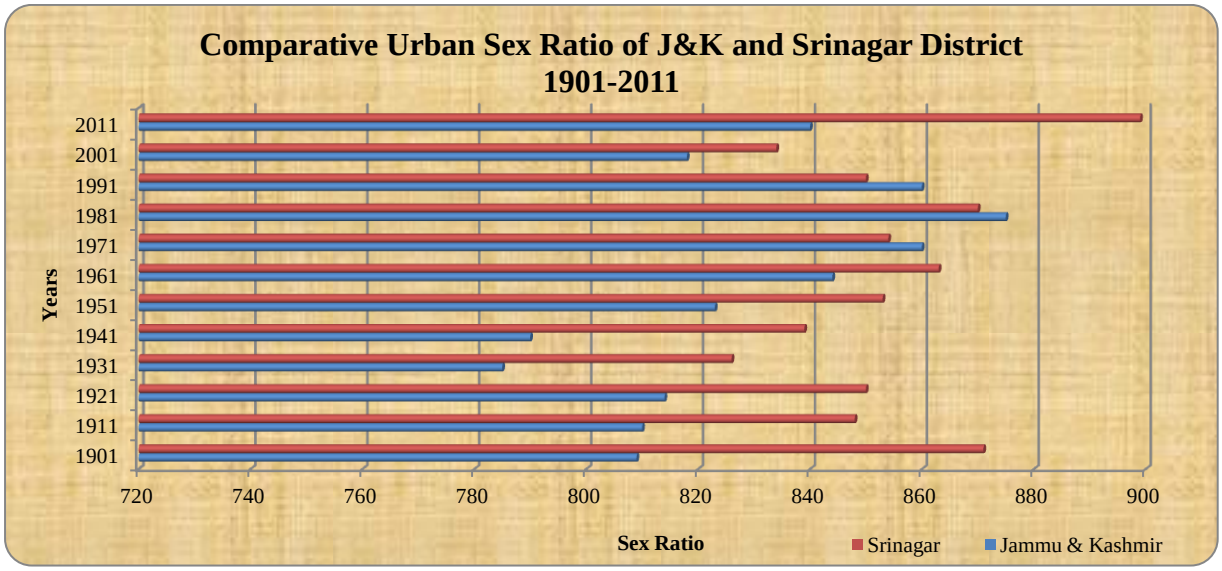


Source: Census of India.

Figure 4.4 shows the comparison of the urban sex ratio of Jammu and Kashmir and that of Srinagar district. The analysis shows that the urban sex ratio of Srinagar has remained higher

than that of the urban sex ratio of Jammu and Kashmir from 1901-1961. This fact is validated by the fact that urban areas have a very high level of literacy which has minimized the discrimination towards the girl child. Education is considered a basic weapon to fight all social evils. Education is crucial in reducing the severity of gender inequality (Clark, 2000). However, After 1961, the urban sex ratio of Jammu and Kashmir surpassed that of Srinagar, according to the results. Jammu and Kashmir's urban sex ratio in 1971, 1981, and 1991 was higher than Srinagar's urban sex ratio. This is the product of positive changes in other Jammu and Kashmir cities. The increase in the sex ratio in other areas of Jammu and Kashmir is due to an increase in the level of education. Various studies have shown that people with more schooling are more likely to acquire values that prioritise neither sex nor gender (PNM Bhat, 2003). However, between 2001 and 2011, the urban sex ratio in Srinagar was higher than the urban sex ratio in Jammu and Kashmir. The rise in the sex ratio is an indication that cultural and social influences are having a positive impact on people's demographic behaviour.

Figure 4.4: Comparative Urban Sex Ratio of J&K and Srinagar District 1901-2011

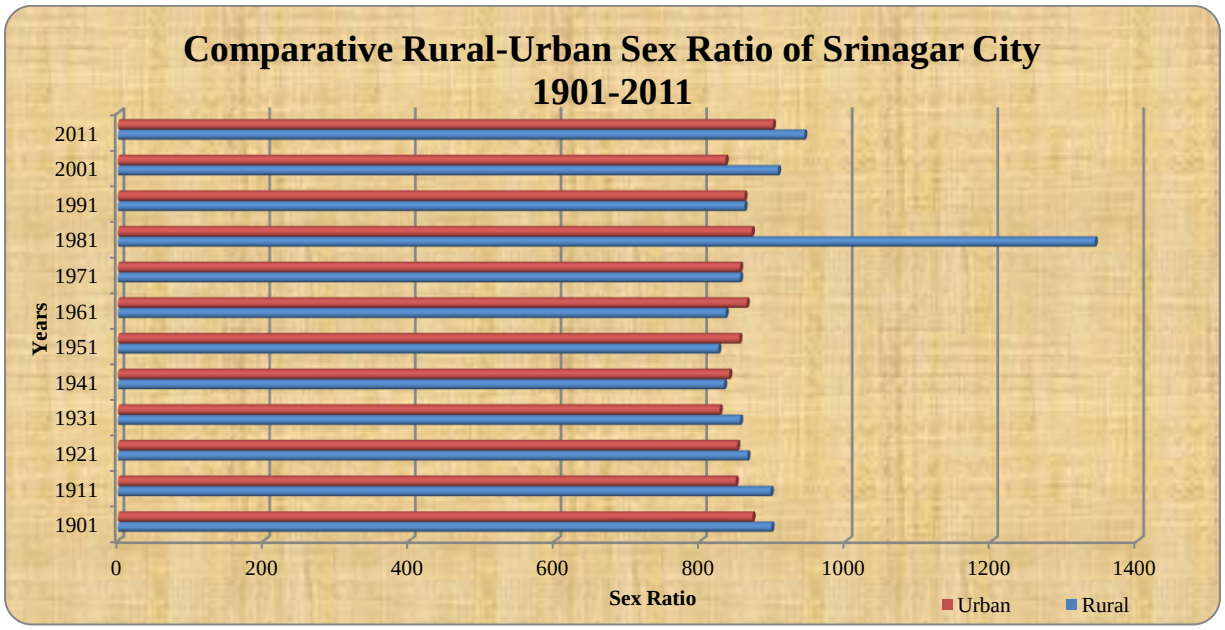


Source: Census of India

Figure 4.5 shows the decadal comparative picture of the Rural-Urban Sex ratio of Srinagar district from 1901-2011, which clearly shows that the sex ratio in Srinagar district is high in rural areas than in urban areas. Right from the launch of census operations, the sex ratio in Srinagar city is unfavourable to women. For clear reasons, the sex ratio is lower in towns. Interestingly, it has suffered a constant decline all through the present century except during the decades of 1931-41, 1941-51, 9151-61, and 1981-91. The trend of rural-urban sex ratio shows that Srinagar district has a sex ratio high in rural areas than in urban areas in 1901, 1911, 1921, and 1931. However, the analysis also reveals that the rural sex ratio in 1981 was

1341 females per thousand males while it showed a sudden decline in successive surveys. The important reasons for this decline are the social, economic, cultural, demographic, and political factors that are responsible for the varying level of sex ratio in Jammu and Kashmir in general and in Srinagar city in particular.

Figure 4.5: Comparative Rural-Urban Sex Ratio of Srinagar City 1901-2011

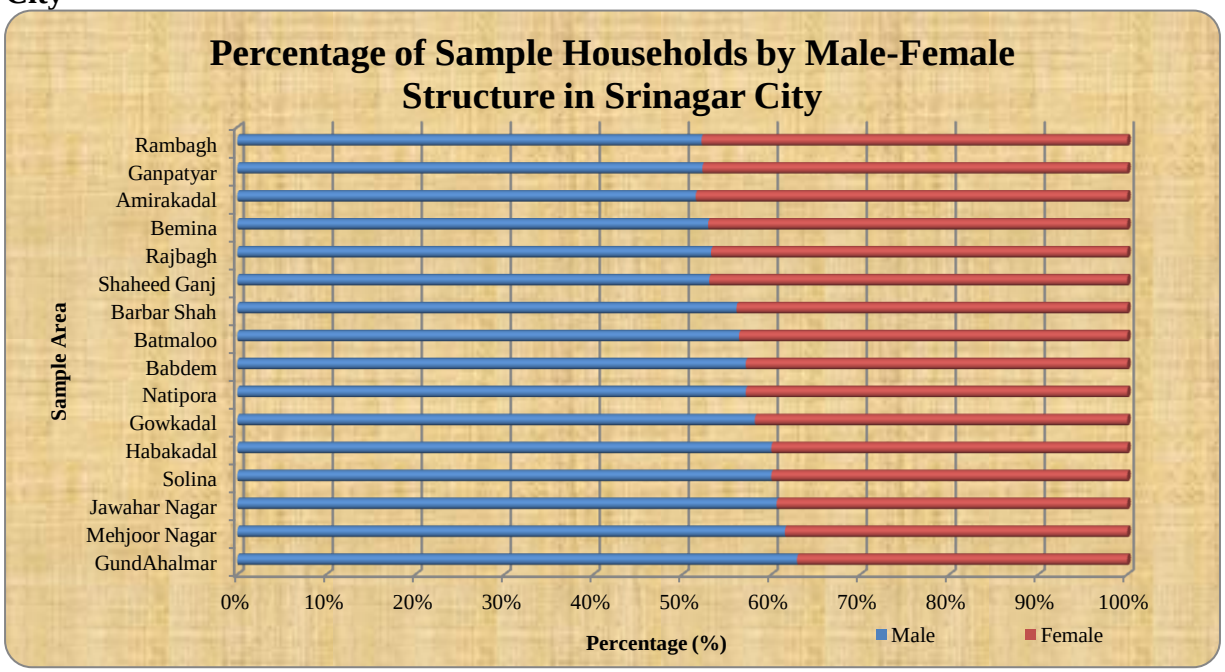


Source: Census of India

4.6 Ward-Wise Male Female structure

The ward-wise analysis shows the male-female structure in the given wards. The survey was conducted in 16 wards of Srinagar city. From the analysis of data, it becomes clear that society has remained male-dominated. All the sample wards show the dominance of males. The ratio of females is less than 50 % in all wards. Figure 4.6 shows that among the sample households GundAhilmar ward has a male population of 62.90 5 followed by Mehjoor Nagar(61.54 %), Jawahar Nagar (60.61%), Solina (60%), Habbakadal (60%), Gowkadal (58.16%), Babdem (57.14%), Natipora (57.14 %), Batmaloo (56.385), Barbar Shah(56.10%), Rajbagh (53.25%), Shaheed Gunj(53.04%), Bemina (52.91%), Ganpatyar (52.27%), Rambagh (52.17%) and Amirakadal (51.52%). These figures are a clear indication of the low and declining sex ratio that is the issue of concern.

Figure 4.6: Percentage of Sample Households by Male-Female Structure in Srinagar City



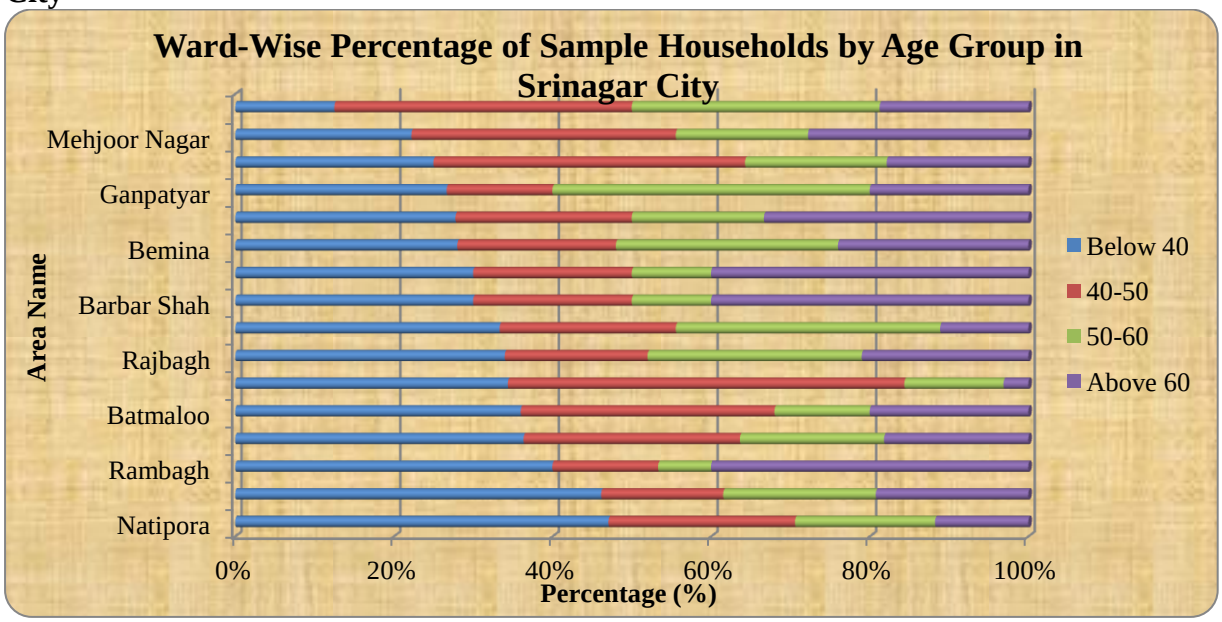
Source: Field Survey by Researcher

4.7 Age group of sample household owner

Age group is population is an indicator of vulnerability to any phenomena. The population group below 6 years and above 60 years is considered more vulnerable to disasters than the working and young population. This section of the population is dependent on the working population for social, economic aspects. Figure 4.7 shows the age group of heads of sample households which clearly shows that Natipora has 47.06% of household heads below 40 years of age while 23.53% of its household heads have 40-50 age and 17.65% are 50-60 years of age and 11.76% are with age above 60. Gowkadal ward has 46.15% of its household heads with age below 40 years while 15.385 have age between 40-50 and 38.46% have to age above 50 years. Similarly, Rambagh has 40% of its household heads with age below 40 years followed by Babdem(36.36%), Batmaloo(36%), Amirakadal (34.38%), Rajbagh(34%), HabbaKadal (33.33%), Barbar Shah(30%), Solina(30%), Bemina(28%), GundAhilmar(27.78%), Ganpatyar(26.67%), Shaheed Gunj(25%), Mehjoor Nagar(22.22%) and Jawahar Nagar(12.50). on the other hand, Rambagh, Barbar shah and Solina have 40 % of their household heads with age above 60 years followed by GundAhilmar (33.33%), MehjoorNagar (27.78%), Bemina (245), Rajbagh(21%), Ganpatyar and Batmaloo (20%), Gowkadal(19.23%), Jawahar Nagar(18.75%), Babdem(18.18%), Shaheed Gunj(17.86%),

Habbakadal(11.11%) and Amira Kadal(3.13%). The given analysis is an important indicator to show the family structure of households. The households with a head below 40-year-old will have their population in the vulnerable section while the households with a head above 60 years old will have their population less vulnerable but the elderly people are themselves prone to vulnerability.

Figure 4.7: Ward-Wise Percentage of Sample Households by Age Group in Srinagar City



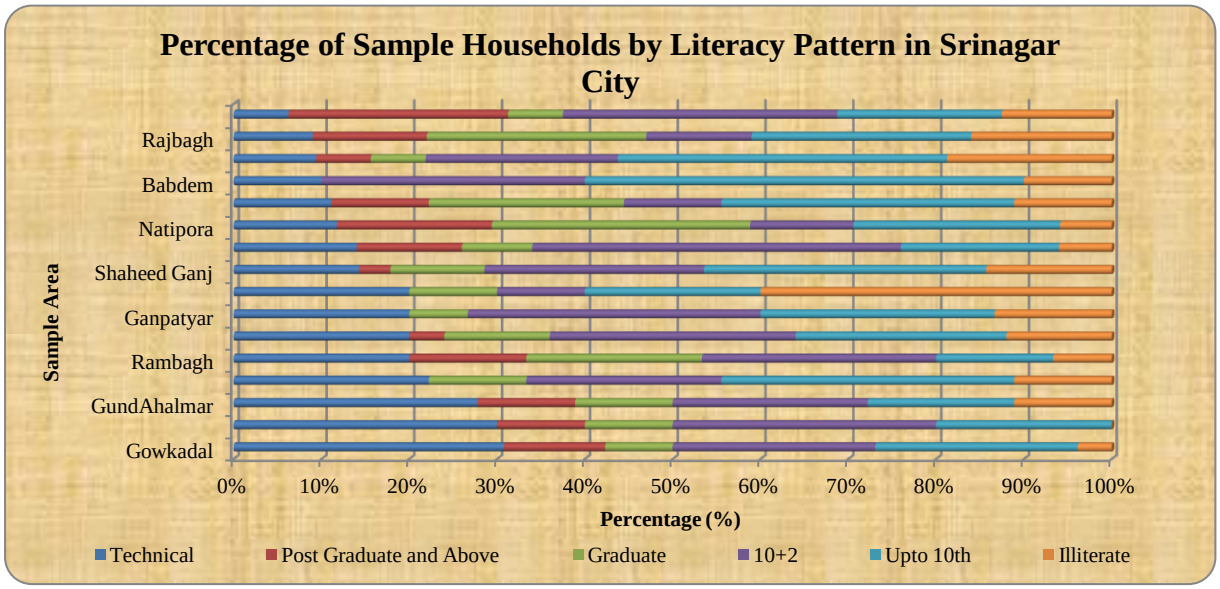
Source: Calculated by the Researcher

4.8 Literacy trend

Literacy is the key to socio-economic development. The growth and development of a nation are directly dependent on the literacy rate. Figure 4.8 shows the literacy pattern among the sample households in 16 wards of Srinagar city. It has been observed that the literacy pattern varies with the ward. Gowkadal has shown a 30.77 % of its sample households with technical education followed by Solina (30%), GundAhilmar (27.78%), Habbakadal (22.22%), Rambagh(20%), Batmaloo (20%), Ganpatyar (20%), Barbar Shah (20%), Shaheed Gunj(14.29%), Bemina (14%), Natipora (11.76%), Mehjoor Nagar (11.11%), Babdem(10%), Amirakadal(9.38%), Rajbagh (9%) and Jawahar Nagar (6.25%). While the status of wards of the population with post-graduation and above shows Jawahar Nagar has 25% of its population with education with post-graduation and above followed by Natipora (17.65%), Rambagh (13.33%), Rajbagh (13%), Bemina (12%), Gowkadal (11.54%), GunAhilmar and Mehjoor Nagar (11.11%), Solina(10%), Amira Kadal (6.25%), Batmaloo (4%) and Shaheed Gunj(3.57%). The population with graduation have been seen higher in Natipora (29.41%)

followed by Rajbagh (25%), Mehjoor Nagar (22.22%), and Rambagh(20%) while the lower percentage has been seen in Babdem where 0 % population are Graduates followed by Ganpatyar (6.67%). The status of the illiterate population shows that Barbar Shah has 40% of its population which is illiterately followed by Amirakadal (18.75%), Rajbagh (16%), Shaheed Gunj(14.29%), Jawahar Nagar (12.50%), Batamaloo (12%), GundAhilmar, Habba Kadal, Mehjoor Nagar (11.11%), Rambagh (6.67%), Bemina (6%), Natipora (5.885), Gowkadal (3.855) while Solina has 0 % of its population which is illiterate.

Figure 4.8: Percentage of Sample Households by Literacy Pattern in Srinagar City



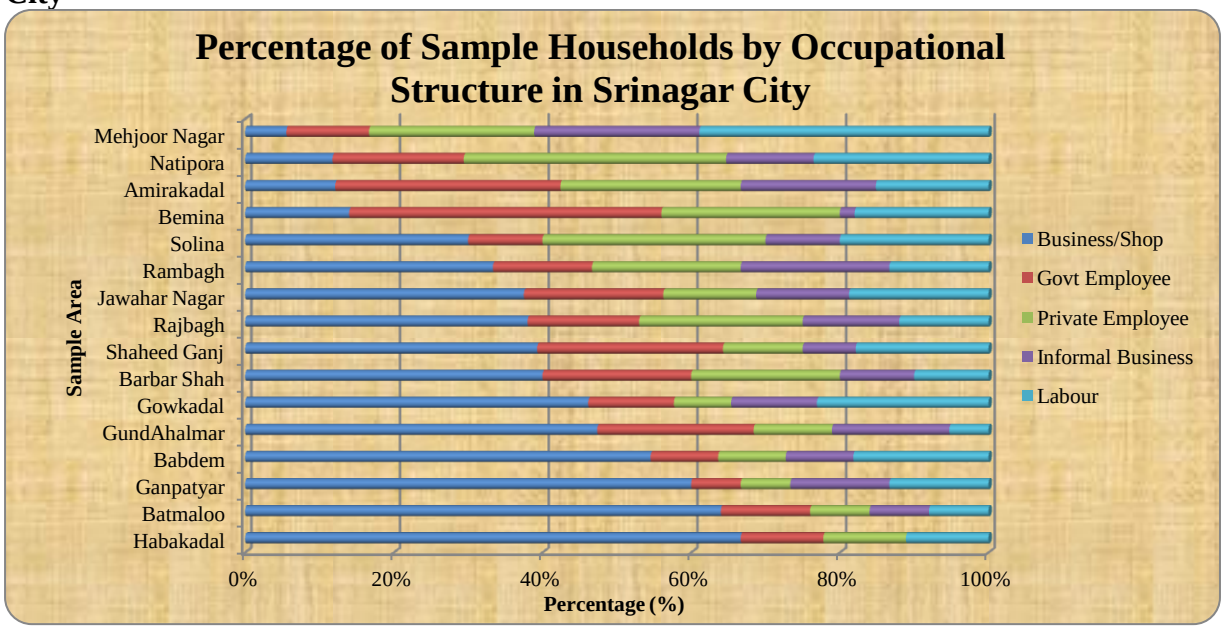
Source: Calculated by the Researcher

4.9 Occupational pattern of sample households

Occupational structure refers to the division of the workforce engaged in different economic activities. Therefore, for the study of economic aspects in any area, it is important to be familiar with the occupational structure of its economy. Figure 4.9 shows the occupational structure of sample households wherein it has been observed that Habakadal has 66.67% of its sample households engaged in business activities followed by Batmaloo (645), Ganpatyar (60%), Babdem (54.55%), Gowkadal (46.15%), Barbarshah(40%), Shaheed Ganj(39.29%), Rajbagh (38%), Jawahar Nagar(37.50%), Rambagh (33.33%), Solina (30%), Bemina (14%), Amirakadal(12.12%), Natipora (11.76%) and Mehjoor Nagar (5.56%). While the Bemina has shown a higher percentage of the population as government employees (42 %) followed by Amirakadal (30.30%), GundAhilmar (21.05%), Barbar Shah (20%) while the lowest percentage of the population engaged in the government sector has been seen in Ganpathyar(6.67%). On the other hand, the highest percentage of the population engaged in

the private sector has been seen in Natipora (35.29%) followed by Amirakadal (24.24%), Bemina (24%), Rajbagh (22%), Barbarshah(20%) while the lowest percentage was seen in Ganpatyar (6.67%). However, the informal and labor class has shown its highest percentage in Mehjoor Nagar(61.11%) followed by Natipora (35.29%), Gowkadal (34.62%), Amirakadal (33.33%), Jawahar Nagar (31.25%), Solina (30%), Babdem (27.27%), Ganpatyar (26.67%), Shaheed Gunj and Rajbagh (25%), GundAhilmar (21.05%), BarbarShah and Bemina (20%), Batmaloo (16%) and Habbakadal (11.11%).

Figure 4.9: Percentage of Sample Households by Occupational Structure in Srinagar City



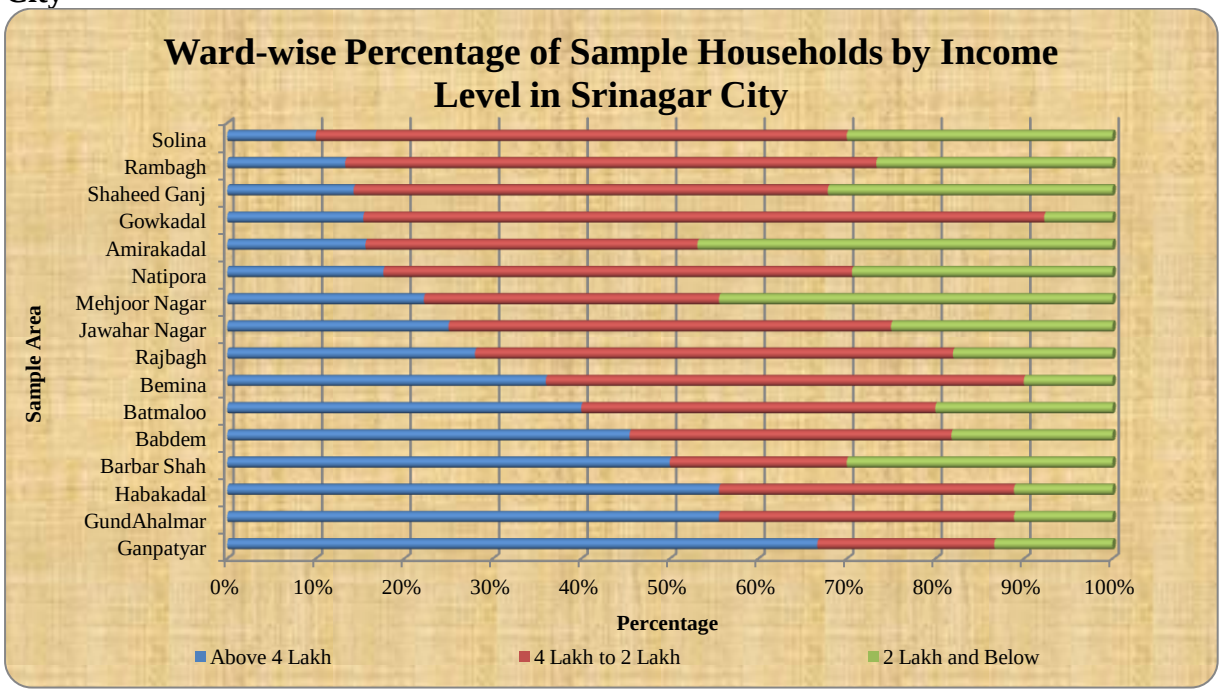
Source: Calculated by the Researcher

4.10 Income Range of Sample Households

The smoothness or equality in which income is distributed among society's members is known as income distribution. The income distribution in a society is completely fair if everybody receives the same sum. However, this is a very rare occurrence in any culture. Various social, economic, cultural, and demographic factors affect the basis of income distribution in any society. Figure 4.10 shows the income pattern of sample households in the 16 wards of Srinagar city. From the analysis, it is clear that Ganpatyar has 66.67% of its population with income from all sources above 4 lakh per year followed by GundAhilmar (55.56%), Habbakadal (55.56%), Barbarshah (50%), Babadem(45.45%), Batmaloo (40%), Bemina (36%), Rajbagh (28%), Jawahar Nagar (25%), Mehjoor Nagar (22.22%), Natipora (17.65%), Amira Kadal (15.63%), Gowkadal (15.38%), Shaheed Gunj(14.29%), Rambagh (13.33%) and Solina (10%). While the data shows, that Gowkadal has 76% of its sample

households with income between 4 Lakh to 2 Lakh followed by Rambagh (60%), Solina (60%), Bemina (54%), Rajbagh (54%), Shaheed Gunj (53.57%), Natipora (52.94%), Jawahar Nagar (50%), Batmaloo (40%), Amirakadal (37.50%), Babdem (36.36%), GundAhilmar (33.33%), Habbakadal (33.33%), Mehjoor Nagar (33.33%), Ganpatyar (205) and Barbarshah (20%). On the other hand, the higher households with income less than 2 lakh per year have been seen in Amira Kadal (46.88%) followed by Mehjoor Nagar (44.44%), Shaheed Gunj (32.145), Solina (30%), Barbar Shah (30 %), Natipora (29.41%), Rambagh (26.67%), Jawahar Nagar (25%), Batmaloo (20%), Babdem (18.18), Rajbagh (18%), Ganpatyar(13.33%), Habbakadal (11.11%) and GundAhilmar (11.11%). The analysis of the income parameter shows the socio-economic status of the household. The households with a high-income level will also have a good house to like in while the household with a low-income level will have a weak structure to live in. Therefore, it can be inferred that income is a good indicator to know the vulnerability status of the household. It has also been seen that poor people were more affected than rich people during the flood 2014 in Srinagar city. They had to bear a huge loss due to their high vulnerability.

Figure 4.10: Ward-wise Percentage of Sample Households by Income Level in Srinagar City

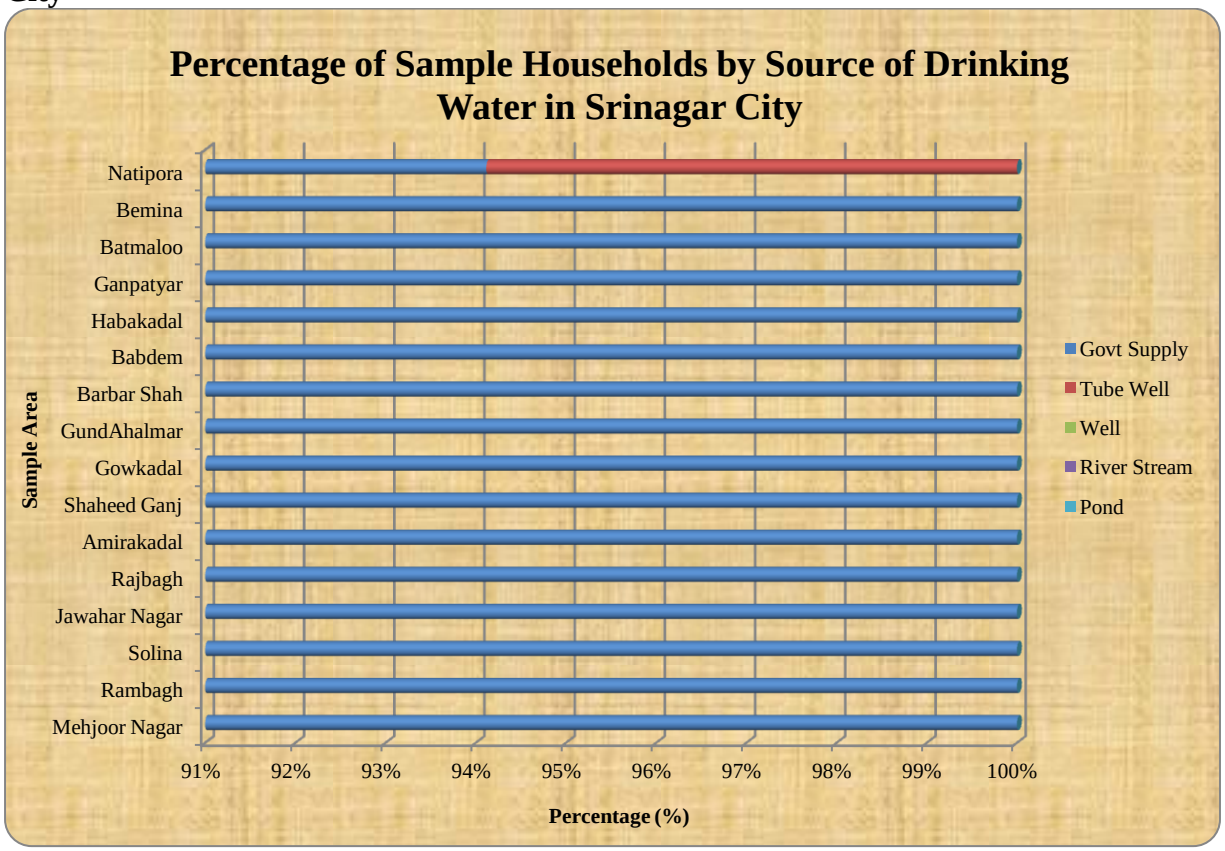


Source: Calculated by the Researcher

4.11 Source of potable water of the sample location.

Water is an essential part of life on Earth's sustainability. It is a fundamental resource that has enabled life to flourish on this planet. A simple measure of human progress is the availability and accessibility of a better source of drinking water. It is directly related to health and well-being, and hence is symbiotically connected to the Millennium Development Goals' achievement (MDGs). Figure 4.11 shows the samples households by sources of their drinking water it clearly states that in 15 wards all the sample households have tap water as their main source of water while in Natipora 5.88% of sample households still have tube well as their main source of water and 94 % have Tape water as their main source. These tapes are clean sources of water. This treated water supply in Srinagar is monitored by the Public Health and Engineering Department (PHE).

Figure 4.11: Percentage of Sample Households by Source of Drinking Water in Srinagar City



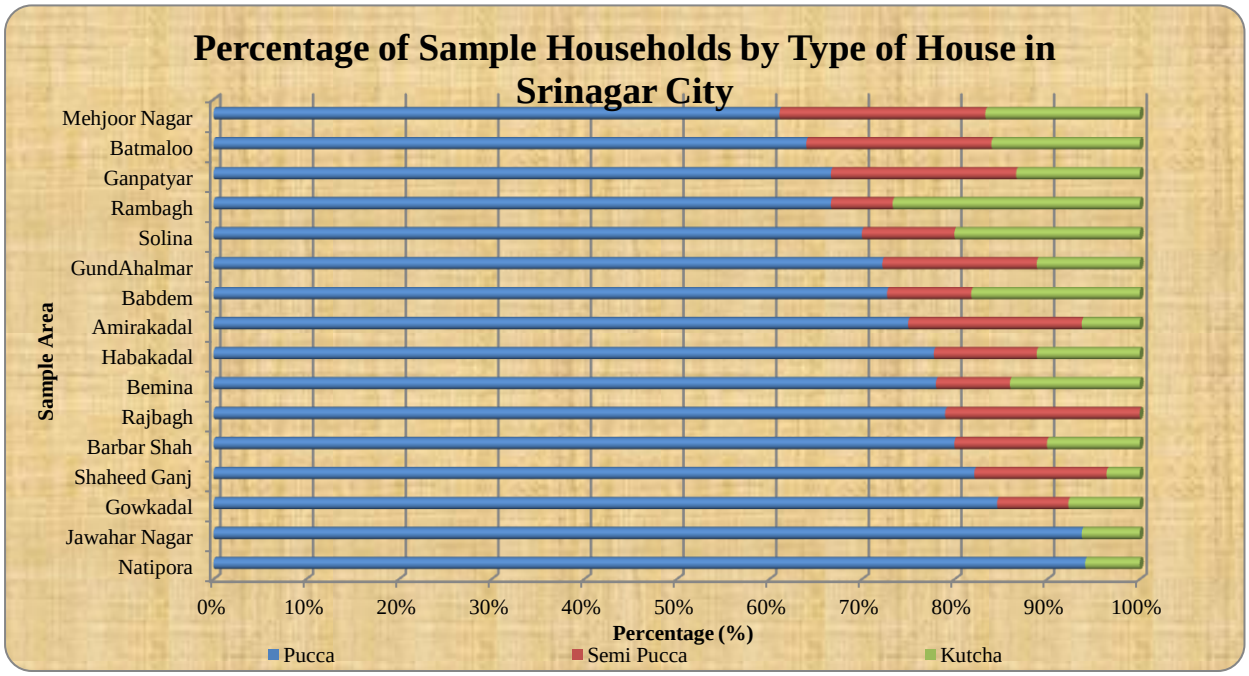
Source: Calculated by the Researcher

4.12 House type of sampled Households

Housing is one of the three essential human needs, and it is a key predictor of a better life. Every person requires a place to live. A roof over one's head is the most important thing for

survival after food and clothes. The quality of life of the people who live in a house is reflected in the materials used to build it. The durability of the materials used in the house's construction reflects its ability to withstand harsh climatic conditions, such as extreme heat and rain, and other environmental factors, as well as the residents' protection against robbery, fire, and other threats. Geographically, a region's housing stock is primarily determined by locally available building materials, which are influenced by the region's physical and climatic characteristics. Housing is also a barometer of people's economic and social well-being. The standard of housing in which a person lives is determined by his or her economic status. Clay, bamboo, wood, thatch, leaves, and other non-durable, low-quality building materials are used to construct the homes of the poor. Low housing standards in poor households cause not only socioeconomic but also medico-psychological stress. As a result, the construction of a house for the economically vulnerable is informed by locally available building materials and climatic conditions. Figure 4.12 shows the ward-wise percentage of sample households in Srinagar city where it is clear that Natipora has 94.12% of its households with pucca houses followed by Jawahar Nagar (93.75%), Gowkadal (84.62%), Shaheed Gunj(82.14%), Barbarshah (80%), Rajbagh (79%), Bemina (78%), Habba Kadal (77.78%), AmiraKadal (75%), Babdem (72.73%), GundAhilmar (72.22%), Solina (70%), Rambagh (66.67%), Ganpatyar (66.67%), Batmaloo (64%) and Mehjoor Nagar (61.11%). While Mehjoor Nagar has 22.22% of its households with semi-pucca households followed by Rajbagh(21%), Batmaloo (20%), Ganpatyar (20%), AmiraKadal (18.75%), GundAhilmar (16.67%), Sheed Gunj(14.29%), Habbakadal (11.11%), Solina (10%), Barbarshah (10%)Bemina (8%), Gowkadal (7.69%), Rambagh (6.67%), Natipora (0%) and Jawahar Nagar (0%). On the other hand, the highest percentage of households with Kacha Structures have been found in Rambagh (26.67%) followed by Solina (20%), Babdem (18.18%), Mehjoor Nagar (16.67%), Batmaloo (16%), Bemina (14%), Ganpatyar (13.33%), GundAhilmar(11.11%), Habbakadal (11.11%), Barbarshah (10%), Gowkadal (7.69%), Amirakadal (6.25%), Jawahar Nagar (6.25%), Natipora (5.88%), Shaheed Gunj(3.57%) and Rajbagh (0%). These analyses give a good insight into the social, economic structure of Srinagar city. The areas with Kuccha structures are inhabited by the lower sections of society. These areas are more vulnerable to hazards and disasters in the future.

Figure 4.12: Percentage of Sample Households by Type of House in Srinagar City

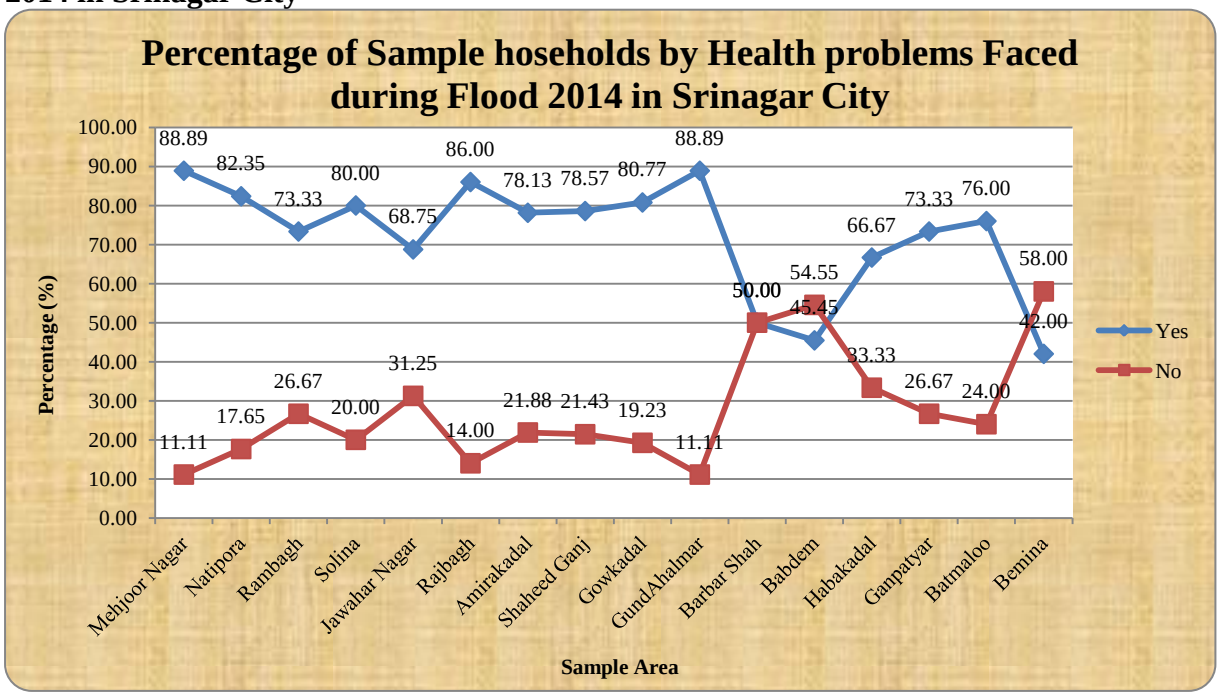


Source: Calculated by the Researcher

4.13 Health problem faced by people

Homes, industrial structures, agricultural and pastoral lands, public goods, and other physical resources may all be destroyed by flooding. However, there are risks to one's health and safety during the flood and its aftermath. People in Srinagar city in 2014 faced a variety of health issues as a result of a flood. The majority of the health issues were caused by water-borne diseases including diarrhoea, dysentery, cholera, and typhoid. Owing to a lack of access to clean drinking water, drugs, and hygienic food, these issues have a direct effect on the poor and disadvantaged sections of society. Figure 4.13 shows the ward-wise percentage of households in the sample area by health problems faced by them during flood 2014 in Srinagar city. The picture is a clear indication that the health was affected in all the wards of Srinagar city. however, Mehjoor Nagar and GundAhilmar have 89 % of their population affected by water-borne diseases followed by Rajbagh (86%), Natipora (82.35%), Gowkadal (80.77%), Solina (80%), Shaheed Gunj (78.57%), Amirakadal (78.13%), Batmaloo (76%), Rambagh (73.33%), Ganpatyar (73.33%), Jawahar Nagar (68.75%), Habbakadal (66.67%) and Bemina (42%). This picture shows the lack of health preparedness to face the disaster. Floods can lead to heavy human loss once they struck any area. Therefore, there is a need to improve the health infrastructure which is resilient to disasters. It will be of great advantage during disasters.

Figure 4.13: Percentage of Sample households by Health problems Faced during Flood 2014 in Srinagar City



Source: Calculated by the Researcher

4.14 The issue of Demographic Vulnerability in Srinagar city

The most significant factor determining an area's future is population growth. We don't live in a world of limitless size and wealth where population increase is an unqualified blessing, in which case the problem of multiple disasters and hazards does not exist. But the earth's surface is finite with limited resources. However, it has been seen that whenever there is a huge demand for limited resources with the unprecedented growth of population. It leads to various disasters and hazards, among which flood is the one which is the focus of this work. Demographic vulnerability is the term that takes into account the population growth rate and related indicators to focus on various stresses associated with the increase and decrease of population growth. The further increase in population growth rate can magnify the Srinagar city's demographic vulnerability. The constant growth of population in Srinagar city has led to heavy encroachment of wetlands, marshy areas, and river bunds which has put increased pressure on fixed land and has resulted in the flood in Srinagar city in 2014. This type of horizontal growth of population is the best example of demographic vulnerability. As there are no magic formulae for measuring the demographic vulnerability, but its analysis makes an important underlying reality. Therefore, in this direction, the analysis has been done about the ward-wise demographic vulnerability of Srinagar city. The important indicators that have been taken into consideration are Growth Rate, Population Density, and Number of

Households. Based on these indicators, the ward-wise demographic index has been prepared through a light on the growing trends of vulnerabilities due to the demographic pressure. Table 4.6 and map 4.1 shows the ward-wise demographic vulnerability of Srinagar city in 2001 where 12 wards in Srinagar registered high demographic vulnerability, and these wards are like Barbarshah, Khan Khai Moula, Mukhdoom Sahib, Nund Reshi Colony, Allochi Bagh, S.R Gunj, Magarmal Bagh, Ali Kadal, Malik Agan, Batmaloo, Sheikh Dawood Colony, Islamyarbal. The composite score in these wards is above 0.80, and they account for 18 % of total wards in Srinagar while the medium vulnerable wards have composite value in between -0.33-0.80 and they are 27 in number as Zadibal, Dalgate, Palpora, Tarabal, Hassanabad, Safakadal, Eid Gah, Syed Ali Akbar, Rawalpora, Harwan, Qamerwari, Jogilankar, Sarai Balla, Shaheed Gunj, Baghat Barzulla, Humhama, Bemina West, Chattabal, Nishat, Aqil Mir Khanyar, Khawaja Bazaar, Mehjoor Nagar, Karan Nagar, Ganpatyar, Nawab Bazaar, Natipora, Chanapora. On the other hand, the demographic vulnerability of 29 wards have been registered below -0.33, and they are as Ahmad Nagar, Locut Dal, Zakura, Hazratbal, Soura, Tailbal, Umar Colony, Zoonimar, Bud-Dal, Buchpora, Zindshah Sahib, Maloora, Khumani Chowk, Dara, Jamia Masjid, Lal Bazaar, Alesteng, Wazir Bagh, Bemina East, Nowshera, Parimpora, Madin Sahib, Lal Chowk, Pandrathan, Rajbagh, Laweypora, Zainakot, Khanmoh, Kawdara.

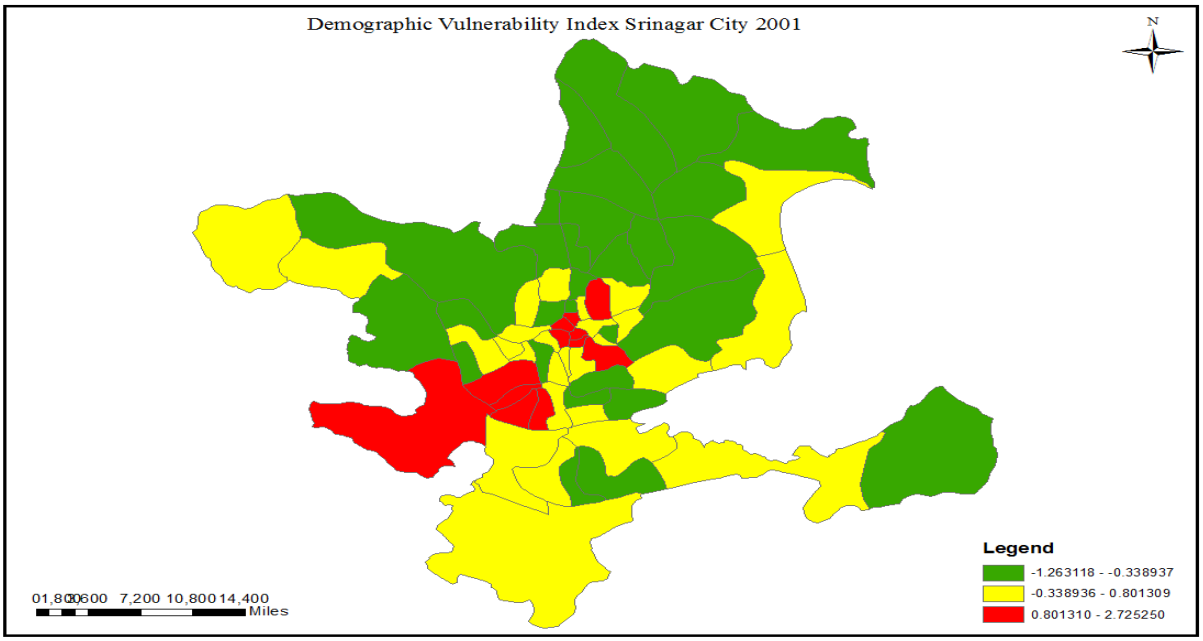
Table 4.6: Demographic Vulnerability Index of Srinagar City 2001

Category	Composite Score	No of Wards	Percentage of Wards	Name of the Wards
High	Above 0.80	12	17.65	Barbarshah, Khan Khai Moula, Mukhdoom Sahib, Nund Reshi Colony, Allochi Bagh, S.R Gunj, Magarmal Bagh, Ali Kadal, Malik Agan, Batmaloo, Sheikh Dawood Colony, Islamyarbal.
Medium	-0.33-0.80	27	39.71	Zadibal, Dalgate, Palpora, Tarabal, Hassanabad, Safakadal, Eid Gah, Syed Ali Akbar, Rawalpora, Harwan, Qamerwari, Jogilankar, Sarai Balla, Shaheed Gunj, Baghat Barzulla, Humhama, Bemina West, Chattabal, Nishat, Aqil Mir Khanyar, Khawaja Bazaar, Mehjoor Nagar, Karan Nagar, Ganpatyar, Nawab Bazaar,

				Natipora, Chanapora.
Low	Below -0.33	29	42.65	Ahmad Nagar, Locut Dal, Zakura, Hazratbal, Soura, Tailbal, Umar Colony, Zoonimar, Bud-Dal, Buchpora, Zindshah Sahib, Maloora, Khumani Chowk, Dara, Jamia Masjid, Lal Bazaar, Alesteng, Wazir Bagh, Bemina East, Nowshera, Parimpora, Madin Sahib, Lal Chowk, Pandrathan, Rajbagh, Laweypora, Zainakot, Khanmoh, Kawdara.

Source: Calculated by the Researcher

Map 4.1: Demographic Vulnerability Index of Srinagar City 2001



However, the analysis of data of 2011 shows the ward-wise growth of demographic vulnerability in Srinagar from 2001-2011. Table 4.7 and map 4.2 show the demographic vulnerability of Srinagar city in 2011, where the picture is clear that there is an increase in the demographic vulnerability among wards from 2001-2011. The wards with a composite index below -0.51 have been seen in 19 wards, and they fall in the low vulnerability category which is as Sarai Balla, Magarmal Bagh, Qamerwari, Rajbagh, Tarabal, Zakura, Lal Chowk, Laweypora, Shaheed Gunj, Karan Nagar, Sheikh Dawood Colony, Ali Kadal, Nund Reshi Colony, Nowshera, Soura, Bud Dal, Khanmoh, Madin Sahib, Rawal Pora while the wards with a composite value between -0.51 to 0.26 are 28 in number, and they fall under medium

vulnerability and are Bemina East, Natipora, Zadibal, Islamyarbal, Zoonimar, Pandrathan, Dalgate, Tailbal, Parimpora, Wazir Bagh, Jamia Masjid, Alesteng, Zindshah Sahib, Humhama, Hazratbal, Ganpatyar, Khan Khai Moula, Nishat, Hassanabad, Khawaja Bazaar, Chattabal, Locut Dal, Nawab Bazaar, Mukhdoom Sahib, Allochi Bagh, Maloora, Zainakot. On the other hand, the wards with a composite value above 0.26 are 21 in number and fall in the highly vulnerable category. They are 21 in number and areuygb6 Dara, Lal Bazaar, Safakadal, Syed Ali Akbar, Khumani Chowk, Barbarshah, Palpora, Jogilankar, Buchpora, Kawdara, Chanapora, Aqil Mir Khanyar, Mehjoor Nagar, Umar Colony, Malik Angan, Bemina West, Harwan, Eid Gah, Baghat Barzulla, Ahmad Nagar, S.R Gunj. The analysis is the best indication of the fact that there is an abrupt increase in the demographic vulnerability across wards from 2001-2011. Srinagar city has experienced high vulnerability in the medium and high category wards from 2001-2011.

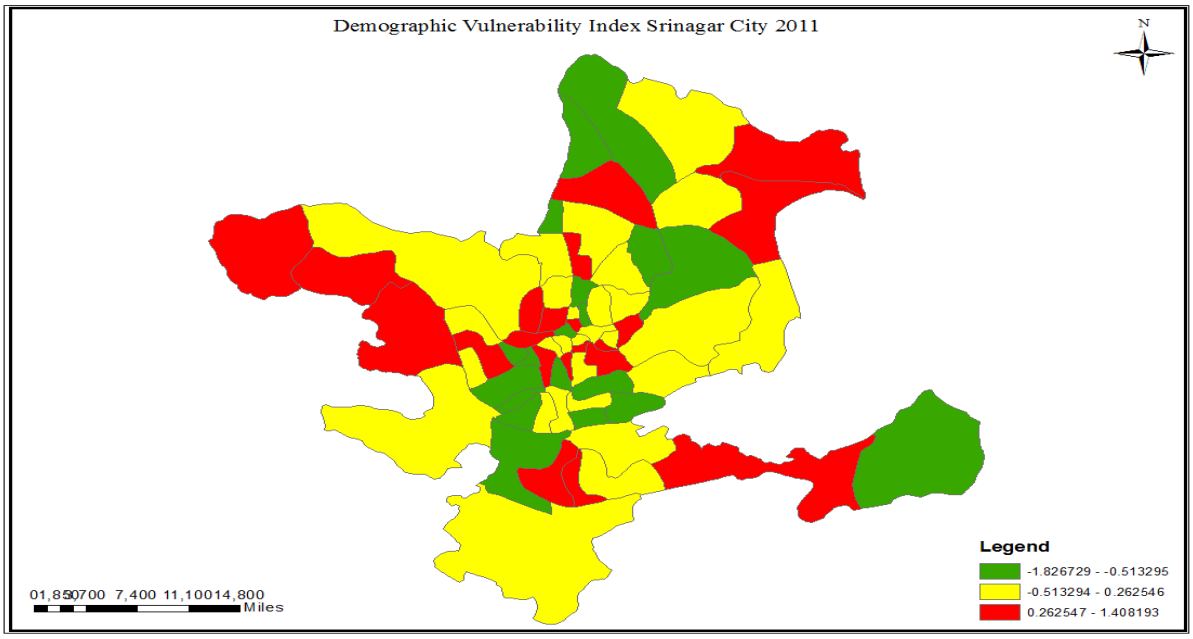
Table 4.7: Demographic Vulnerability Index of Srinagar City 2011

Category	Composite Score	No of Wards	Percentage of Wards	Name of the Wards
High	Above 0.26	21	30.88	Dara, Lal Bazaar, Safakadal, Syed Ali Akbar, Khumani Chowk, Barbarshah, Palpora, Jogilankar, Buchpora, Kawdara, Chanapora, Aqil Mir Khanyar, Mehjoor Nagar, Umar Colony, Malik Angan, Bemina West, Harwan, Eid Gah, Baghat Barzulla, Ahmad Nagar, S.R Gunj.
Medium	-0.51-0.26	28	41.18	Bemina East, Natipora, Zadibal, Islamyarbal, Zoonimar, Pandrathan, Dalgate, Tailbal, Parimpora, Wazir Bagh, Jamia Masjid, Alesteng, Zindshah Sahib, Humhama, Hazratbal, Ganpatyar, Khan Khai Moula, Nishat, Hassanabad, Khawaja Bazaar, Chattabal, Locut Dal, Nawab Bazaar, Mukhdoom Sahib, Allochi Bagh, Maloora, Zainakot.
Low	Below -0.51	19	27.94	Sarai Balla, Magarmal bagh, Qamerwari, Rajbagh, Tarabal, Zakura, Lal Chowk, Laweypora, Shaheed Gunj, Karan Nagar, Sheikh Dawood Colony, Ali Kadal, Nund Reshi Colony, Nowshera, Soura, Bud

				Dal, Khanmoh, Madin Sahib, Rawal Pora.

Source: Calculated by the Researcher

Map 4.2: Demographic Vulnerability Index of Srinagar City 2011



Conclusion:

Increasing disaster risks expose not just the onset of events like floods and earthquakes, but also the population's diverse demographic and socioeconomic characteristics. A massive, violent flood passing through a sparsely populated area, for example, would pose little risk. A relatively weak flood event, on the other hand, can pose a significant risk to human life and cause significant economic loss in densely populated areas. Due to the magnitude of a disaster, the growth of a population whose demographic and socioeconomic characteristics may put its occupants at high risk of harm before, during, and after a disaster demonstrates its effects. The study of Srinagar city's population characteristics reveals that the city's population has been steadily increasing. From 1901 to 1961, the population of the United States grew at a relatively steady pace. However, the rate of growth accelerated, resulting in haphazard urbanisation in Srinagar. The population's vulnerability has increased as a result of this form of development. Vulnerability is characterised as "a person's or group's characteristics and state that influences their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard." (Piers Blaikie, 2004). Natural disasters pose a danger of differential vulnerability, i.e. varying populations face different levels of risk and vulnerability, as observed during the field survey. Natural disasters can become more expensive in the future as more people develop expensive infrastructure in flood-prone areas such as wetlands, swampy and marshy areas, low-lying areas prone to flooding, riverbanks, and so on. As a result, when a flood happens, its effect is not limited to individuals alone; it has a significant impact on social, economic, and cultural factors, with long-term consequences. The demographic parameters of population growth and distribution, population density, and housing density all contribute to the area's vulnerability to disasters. (Perrow, 2007). Srinagar's urban population accounts for 98.60 percent of the total population, and the city's rapid population growth has resulted in an unprecedented rise in population, resulting in dense infrastructure, increased population density, and population expansion into flood-prone areas, both of which have increased the city's vulnerability. The demographic vulnerability index is a strong indicator of a vulnerability map of Srinagar city, showing how changes in demographic characteristics are rising the city's potential exposure to floods and earthquakes. As a result, if disasters have a greater effect today, the culprit is not Mother Nature, but human nature, which is ruthlessly manipulating it. To ensure the earth's long-term viability and reduce the impact of disasters, rigorous planning is needed to monitor population distribution, growth, and density in order to mitigate and minimise future vulnerability. If

appropriate steps are not taken now, it will result in future disasters and serve as a foundation for significant harm to demographic, social, economic, and cultural capital.

Chapter V

Flood Hazard Vulnerability of Srinagar city in 2014 in terms of Preparedness, Response, Recovery and Rehabilitation.

According to UN space-based disaster management and emergency response details, flood is a state of partially or completely inundation of normally dry land areas caused by overflow of inland or tidal waters from the unexpected and sudden accumulation or drainage of surface waters from any source. Floods can be beneficial as well as harmful. They can provide much-needed relief to people and habitats affected by prolonged drought, but they are often the most expensive natural disaster. Flooding is most often caused by heavy rain when natural watercourses are unable to handle the excess water. Floods, on the other hand, are not necessarily exacerbated by heavy rainfall. A storm surge associated with a tropical cyclone, a tsunami, or a high tide coinciding with higher-than-normal river levels both can cause flooding, particularly in coastal areas where a storm surge associated with a tropical cyclone, a tsunami, or a high tide coinciding with higher-than-normal river levels can all cause flooding. Even in dry weather, a dam failure can result in flooding in the downstream region.

Flooding is one of the most common natural disasters, wreaking havoc on people's lives and property. Floods and droughts are said to be common in India. It has become a national phenomenon that can be found in any part of the world. With human greed, the severity, frequency, and propensity of hazards and vulnerability have increased over time. The devastation caused by these disasters has compelled India to look into combining various interventions to lessen their effect. There are two types of interventions: hard interventions and soft interventions. Soft approaches include techniques for capacity building and adaptation of people to deal with flooding, such as modifying land-use practises, cropping patterns, flood-resistant homes, and the construction of emergency shelters for people and animals. These flood-fighting techniques are now considered best practises around the world (Malik, 2006).

Any process, event, or human activity that raises the risk of death, injury, or other negative health effects, property damage, structural damage, or environmental degradation is described as a flood hazard (UNISDR, United Nations Office for Disaster Risk Reduction, 2018). A disaster, on the other hand, is an occurrence that results in significant loss of human life and property. When the danger is active and no longer poses a threat,

Physical Exposure and Human Vulnerability are the two factors that determine if it becomes a catastrophe. Various studies have shown, however, that these influences are growing in time and space across the globe, increasing people's vulnerability to disasters.

The word weakness has a number of different connotations depending on who you ask. In layman's terms, it's any condition caused by physical, social, economic, and environmental factors that makes a person, a community asset, or a system more vulnerable to the effects of hazards (UNISDR, United Nations Office for Disaster Risk Reduction, 2018). As a result, the effect of the same form and severity of danger varies depending on the population's social, demographic, economic, and other factors. The effects of these factors were also visible during the field survey, with flood having a particularly strong impact on households with a weak social and economic structure. The household's vulnerability can be assessed on a variety of levels, including Social Vulnerability, Economic Vulnerability, Personal Vulnerability, and Living Vulnerability, among others. As a result, given the rising trend and pattern of vulnerability, it is imperative that we improve our understanding of vulnerability. The degree of vulnerability determines the level of its effect. Despite increased awareness of vulnerability, however, flood risk remains widespread. As a result, concerns about the effectiveness of vulnerability assessments and their impact on flood mitigation and adaptation are being raised (Khan, 2012). It's difficult to quantify flood vulnerability because it depends on a variety of social, economic, political, and environmental factors. However, it is measured using a variety of social, economic, and demographic metrics, which offers some insight into its growing severity over time. Population development, a lack of knowledge, insufficient funding, poor regulation, poverty, a lack of education, and obsolete disaster-fighting practises are all factors that increase vulnerability.

With the passage of time, the topic of urban vulnerability is gaining traction. Year after year, Indian cities face the disaster of floods, which has become a characteristic of Indian cities. Poor urban planning can cost a country 3% of its GDP, according to the green economy report (UNEP, 2011). The planning process in Indian cities is considered to be faulty on many levels. The growth of the urban population and infrastructure was not anticipated, but both of these factors contributed to haphazard planning, which increased the impact of disasters in urban areas. In recent years, the severity and frequency of floods in Indian cities has increased. Floods have wreaked havoc on the social, economic, and demographic infrastructure of cities such as Mumbai, Chennai, Jaipur, Chandigarh, Bengaluru, Srinagar, and Agartala. As a result, Emergency Preparedness is an integral part of Urban Hazard Management in this regard. With the constant growth of population, the problem of waterlogging in these cities is a result of inadequate planning, which is the primary cause of flooding in these cities.

Flooding in Srinagar is caused by a number of factors, including a rise in the built-up area, the encroachment of Riverbeds, Wetlands, and swampy areas, haphazard urbanisation, ill drainage networks, deforestation in Jhelum River catchment areas, and river channel siltation. The river Jhelum flows from south to north, receiving water from both its left and right bank tributaries. However, as a result of environmental pollution and encroachment in its catchment area, the river's flow has shifted, and it now flows above its banks, causing massive harm to life and property. During the field survey, the dilapidated state of the flood channels and urban drainage system was also observed, which has an effect on not only people's health but also on the Jhelum river's flow discharge. The respondents revealed this inadequate and inappropriate management of the Flood Channels and drainage system during the household survey.

Multiple factors contribute to Srinagar's flood vulnerability, including shifting land use and land cover, constant population growth, rising housing density, and changing phenomena in the Jhelum river's catchment area. In Chapters III and IV, these considerations were thoroughly explored. However, the issues of Srinagar city's flood hazard vulnerability in 2014 in terms of preparedness, response, recovery, and reconstruction will be discussed in this chapter.

5.1 A Brief History of Natural Hazards of the district

Floods have a long history in Kashmir's valley due to excessive water release from the Jhelum river's tributaries during heavy western disturbances (November to April) and the monsoon season (July- September). “Many devastating floods are noted in the vernacular history of Kashmir valley,” writes Sir Walter Lawrence. (Lawrence, 1895) According to Lawrence's book, the flood of 879 in Kashmir valley was caused primarily by the blockage of the Jhelum River, and it submerged a large portion of the valley. He attributes the blockage to the slipping of Khadanyar Mountain in Baramulla, which clogs the main river's course and causes flooding in the middle and upper reaches. According to him, a massive flood struck the Kashmir valley in 1841, causing extensive damage to life and property. According to Sir Lawrence, a major flood was seen in the entire Kashmir valley in July 1893 as a result of 52 hours of continuous rainfall, which was dubbed a great calamity at the time. It resulted in significant loss of life and property. “The flood cost the state Rs.64,804 in inland revenue alone in 1893,” he writes, “25,426 acres of crops were submerged, 2,225 houses were destroyed, and 329 cattle were killed.” “Marvellous tales were told of the effectiveness of the

flags of saints which had been set up to arrest the floods, and people believe that the rice fields of Tulamula and the bridge of Sumbal were saved by the intervention of these flags, which were taken from the shrines as a last resort," Lawrence wrote after the 1893 floods. Lawrence goes on to say that the floods struck again in 1903. They were dubbed the "greatest flood ever experienced," as they swept down the Valley and flooded Srinagar on July 23, 1903, turning the city into "a whole lake." Floods in Kashmir were registered again in 1929, 1957, and 1992 as time passed. The floods nearly submerged valley plains, according to a newspaper from the time. "The floods reported in Jammu and Kashmir were the highest ever recorded in the state, and the damage caused by them was colossal," Bakshi Ghulam Mohammad, the then-Prime Minister of Jammu and Kashmir, was quoted as saying (Ananth, 2014). Although floods occurred in the state over the next three decades, the one in 1992 was unparalleled in terms of its severity. The 1992 floods were the most destructive in terms of deaths, with the worst rainfall since 1959. About 200 people died in the floods, according to newspaper accounts from 1992, and 60,000 people were stranded in many northwestern border districts. It's worth remembering, however, that parts of Pakistan-occupied Kashmir took the brunt of the floods, with over 2,000 people killed (Ananth, 2014). Floods inundated villages along the Jhelum River in 1996, according to a newspaper article from the time. However, the floods in the Kashmir valley in 2014 wreaked havoc on every aspect of life. As a result, flooding is not only a frequent occurrence in the Kashmir valley, but it has also become a part of it.

Srinagar, which sits on the banks of the Jhelum River and is surrounded by five districts, has always been vulnerable to floods and earthquakes, which have wreaked havoc on the district's people and property. As a result, the district administration saw the need for a disaster management plan to reduce the effects of natural disasters on people and property. The plan includes prevention measures, action plans, budgets, and financial allocation plans, disaster management committees at the district, tehsil, and village levels, and finally, it has a chapter on precautionary measures. Based on flood history, Srinagar city is affected by multiple hazards like Floods and Earthquakes. As per the latest seismic zoning map of India, the Srinagar district falls under the High-Risk zone (V) of the earthquake. Therefore, the measures for the mitigation and prevention of various hazards in Srinagar city will be different from other areas. The geological, physical, cultural characteristics made us think about planning that will take care of its earthquake-prone character as well as of other factors. The constant population growth, increasing housing density as well as housing characteristics

will have serious repercussions on the life and property of people in Srinagar city. On the other hand, the flood vulnerability is the result of the overflow of Jhelum and its tributaries which causes inundation in low-lying areas and causes huge damage to life and property. From this analysis, vulnerability emerged as the key theme of the hazard analysis. There are many areas in the Srinagar district which are susceptible to natural calamities like earthquakes, landslides, floods, and erosion. A high-intensity earthquake in the congested locality can cause huge damage to life and property due to a lack of planning and engineering techniques applied to the built infrastructure. Therefore, in this direction, to plan and identify the vulnerability of Srinagar city a household level primary survey was conducted to study the various dimensions of flood preparedness, response, recovery, and rehabilitation in the study area.

5.2 Ward-wise Flood Vulnerability Pattern of Srinagar city

Urban flood is different from the rural flood in terms of loss, mainly due to its overcrowding population and hub of economic activities. In 2001, the urban population of Srinagar was 97.8 Percent, which rose to 98.60 percent in 2011. This type of tremendous growth has witnessed the expansion of population in low-lying areas, across drainage lines and one riverbed by their encroachment which has paved the way to the frequent floods in these cities. Srinagar is the best example of this disaster. The problem is further aggravated by improper sewerage and expansion in the built-up area. Therefore, based on this haphazard urbanization, National Disaster Management Authority has outlined the guidelines for the identification of chronically flooded areas. Based on those guidelines, the flood problem in Srinagar city is the result of constant population growth and haphazard urbanization.

The government began emphasizing on disaster management after the devastating cyclone in Orissa in October 1999 and the Bhuj earthquake in Gujarat in January 2001, both of which highlighted the need for a multi-dimensional approach involving diverse science, technical, financial, and social processes; the need for a multidisciplinary and multi-sectoral approach, as well as the integration of interdisciplinary and multi-sectoral approaches; and the need for interdisciplinary and multi-sectoral approaches. As a result, the Indian government implemented the Disaster Management Act on December 23, 2005, which established the National Disaster Management Authority (NDMA), whose focus and goals have shifted over time. The Indian government, on the other hand, has made a conceptual change in disaster management in the last two years. The new approach is based on the assumption that long-

term construction cannot be accomplished unless disaster avoidance is taken into consideration during the planning stage. Mitigation must be multidisciplinary, encompassing all aspects of development, according to another tenet of the strategy. The current plan also suggests that mitigation investments are much more cost-effective than relief and recovery efforts.

Preparedness, prevention, response, early warnings, visibility, and capacity-building interventions are the key priority of urban flood management techniques at the national level. However, a ward-by-ward assessment of vulnerability in cities, involving the population, is needed (NDMA, Management of Urban Flooding, 2010).

5.3 Ward wise extent of the flood in Srinagar City in 2014

Srinagar city is prone to floods, and this trend is now increasing with time. The main cause is the overflow of the Jhelum River during high rainfall in its catchment area which flows through the center of the city. Besides, the flow of Jhelum is obstructed time, and again by encroachments, garbage dumps in the centre of flood channels as well as illegal constructions. All these activities reduce the carrying capacity of the river and its channels and eventually led to flooding in Srinagar city during heavy rainfall.

The recent unplanned and haphazard urbanization in Srinagar city has increased the trend and pattern of hazards in Srinagar city. This type of planning will benefit in the short run, but it will add the vulnerability pattern in the long term. The flood of 2014 has affected Srinagar city heavily. The NRSC report on the assessment of floods in Jammu and Kashmir states that out of 68 wards in Srinagar city 59 were affected by the flood. It caused huge damage to the life and property of people in Srinagar city. Therefore, there is a need for effective, futuristic, and scientific land use planning to enrich the future of Srinagar city with resilient measures to fight any hazard in the future.

Table 5.1: Ward wise extent of the flood inundation in Srinagar city 2014

Ward Name	Area (KM^2)
khumani Chowk	9.7044
Maloora	9.461
Baghat-i- Barzulla	7.0602
Under Cantonment Board	4.6205

Zainakote	4.1127
Mehjoor Nagar	3.3414
Tailbal	3.1299
Lawaypora	3.048
Nund Resh Colony	2.9802
Humhama	2.3993
Bemina East	2.3295
Parimpora	2.2496
Rawalpora	2.242
Pantha Chowk	2.1747
Dalgate	2.1492
Natipora	2.093
Harwan	1.9571
Lal Chowk	1.9357
Bemina West	1.9162
Rajbagh	1.5545
Iddgah	1.4912
Palapora	1.4645
Nishat	1.3288
Lout Dal	1.2512
Allochibagh	1.2393
Jawahar Nagar	1.2193
Wazir Bagh	1.071
Batamaloo	0.9277
Chanapora	0.8964
Sathoo Barbarshah	0.8851
Karan Nagar	0.8434
Magarmalbagh	0.8249

Shaheed Gunj	0.6106
Sheikh Dawood Colony	0.5963
Bud Dal	0.584
Chattabal	0.5684
Qamarwari	0.5488
Hazratbal	0.4851
Syed Ali Akbar	0.3651
Nawab Bazar	0.3607
Khankha I Moulla	0.3389
Ganpatyar	0.3132
Islamyarbal	0.2736
Khonmoh	0.2601
Bana Mohalla	0.2549
Hasanabad	0.2533
Kawdara	0.2238
Zind Shah Sahib	0.2183
New Theed	0.2169
Zadibal	0.2103
Aqilmir Khanyar	0.1876
Zoonimar	0.155
Safa Kadal	0.1262
Lal Bazar	0.1092
Jogi Lankar	0.0991
Madin Sahab	0.0777
Khawja Bazaar	0.0146
Tarabal	0.0048
S.R Gunj	0.004

Source: NRSC Report

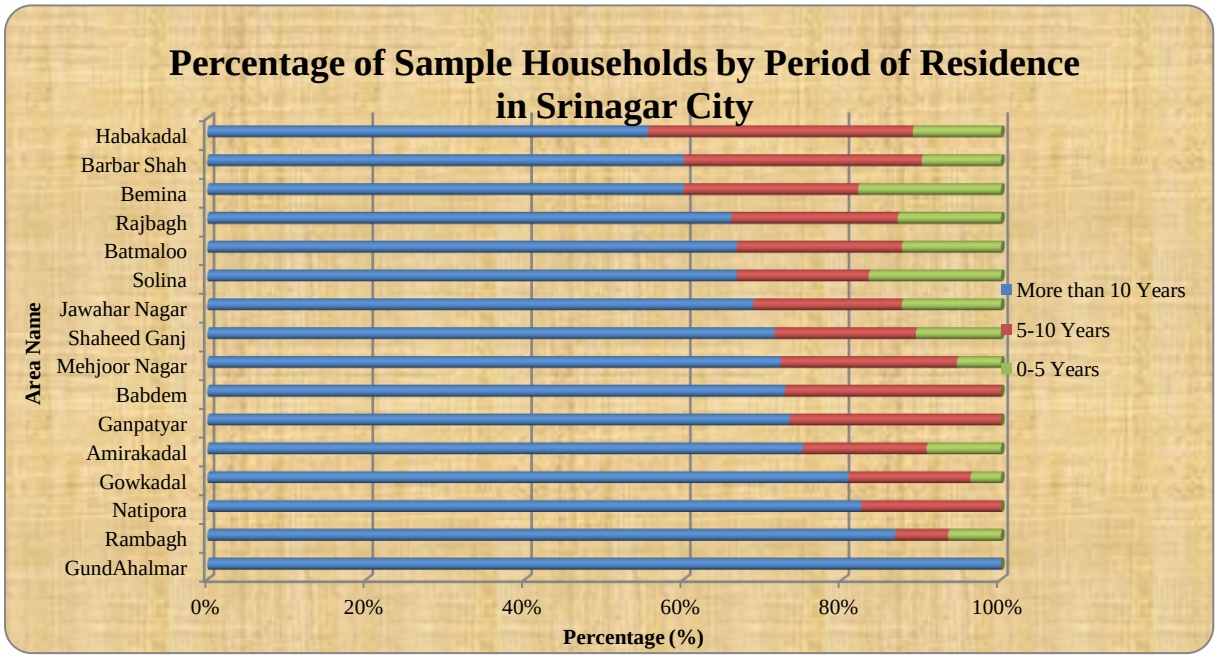
5.4 Hazard Identification of the sample households

Hazard identification of the sample households is based on a field survey where the questions based on the parameters of Sendai Framework were asked to the households by simple random sampling. Therefore, based on the parameters of the Sendai Framework like preparedness, response, recovery, and rehabilitation, a sample survey of 400 households was conducted.

5.4.1 Percentage of Households by a period of Residence

Looking at figure 5.1, the period of residence of households can be assessed. The period of residence of the household is one of the most important indicators to assess the land-use change. The households with a residence of more than ten years have been found high in GundAhalmar (100%) followed by Rambagh (86.67%), Natipora (82.35%), Gowkadal (80.77%), Amirakadal (75%), Ganpatyar (73.33%), Babdem (72.73%), Mehjoor Nagar (72.22%), Shaheed Gunj (71.43%), Jawahar Nagar (68.75%), Solina (66.67%), Batmaloo (66.67%), Rajbagh (66%), Bemina (60%), Barbarshah(60%) and Habbakadal (55.56%) while Habbakadal has 33.33 Percent of its households with the period of residence varies from 5-10 years followed by Barbarshah (30%), Babdem (27.27%), Ganpatyar (26.67%), Mehjoor Nagar (22.22%), Bemina (22%), Rajbagh (21%), Batmaloo (20.83%), Jawahar Nagar (18.75%), Shaheed Gunj (17.86%), Natipora (17.65%), Solina (16.67%), Amirakadal (15.63%), Gowkadal (15.38%), Rajbagh (6.67%) and GundAhilmar (0%). On the other hand, the percentage of households with a period of residence from 0-5 years have shown its higher value in Bemina (18%) followed by Solina (16.67%), Rajbagh (13%), Batmaloo (12.50%), Jawahar Nagar (12.50%), Habbakadal (11.11%), Shaheed Gunj (10.71%), Barbarshah (10%), Amirakadal (9.38%), Rambagh (6.67%), Mehjoor Nagar (5.56%), Gowkadal (3.85%) and GundAhilmar, Natipora and Babdem with zero percentage. It becomes clear from the above analysis that the wards which have seen growth in households in the last 10 years were highly affected during flood 2014. This has also been verified during the field survey in 2017.

Figure 5.1: Percentage of sample households by period of residence in Srinagar city



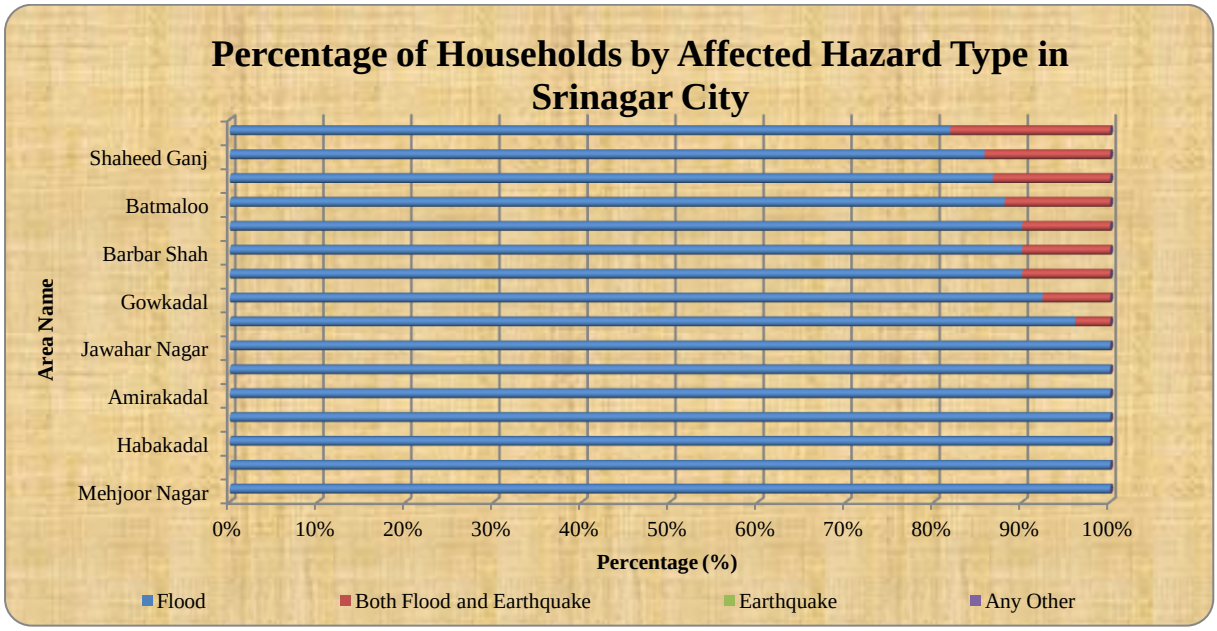
Source: Field Survey by Researcher.

5.4.2 Type of Hazard

Hazard is one of the important indicators to assess the vulnerability of a place. Once the hazard crosses its limit, it becomes a disaster and creates havoc on the life and property of people. As it is clear, Srinagar city is prone to floods and earthquakes. These hazards have clutched the people on their web. So the study of hazards is important for future planning. Therefore, figure 5.2 shows the Percentage of Households by Affected Hazard Type in Srinagar City where out of 16 surveyed wards, 100 percent of households in Mehjoor Nagar, Natipora, Habakadal, Ganpatyar, Amira Kadal, GundAhilmar, and Jawahar Nagar have indicated flood as a major hazard while in Rajbagh 96 Percent have indicated flood as a major Hazard followed by Gowkadal (92.31%), Solina (90%), Barbarshah (90%), Batmaloo (88%), Rambagh (86.67%), Shaheed Gunj(85.71%) and Babdem (81.82%). While 18 Percent of households in Babdem have indicated Flood and Earthquake as a major Hazard followed by Shaheed Gunj (14.29%), Rambagh (13.33%), Batamaloo (12%), Solina, Barbabshah, Bemina (10%), Gowkadal (7.69%) and Rajbagh (4%), during the field survey, respondents were asked to share their experiences regarding the highest and lowest flood water levels which they experience during the flood 2014. In some cases, the water level was also judged by existing marks on the mosques, public places by the researcher.it has been observed from all these sources that Rajbagh, Mehjoor Nagar, Jawahar Nagar experienced the highest water levels where the water level was above 20 Feet, and it stayed for a long time, and this area is also

very prone to an urban flood of Jhelum river. the installation of pump sets to take out the flooded water was also in the process, but they did not work well as they were not placed in proper places.

Figure 5.2: Percentage of Households Affected by Hazard Type in Srinagar City



Source: Field Survey by Researcher.

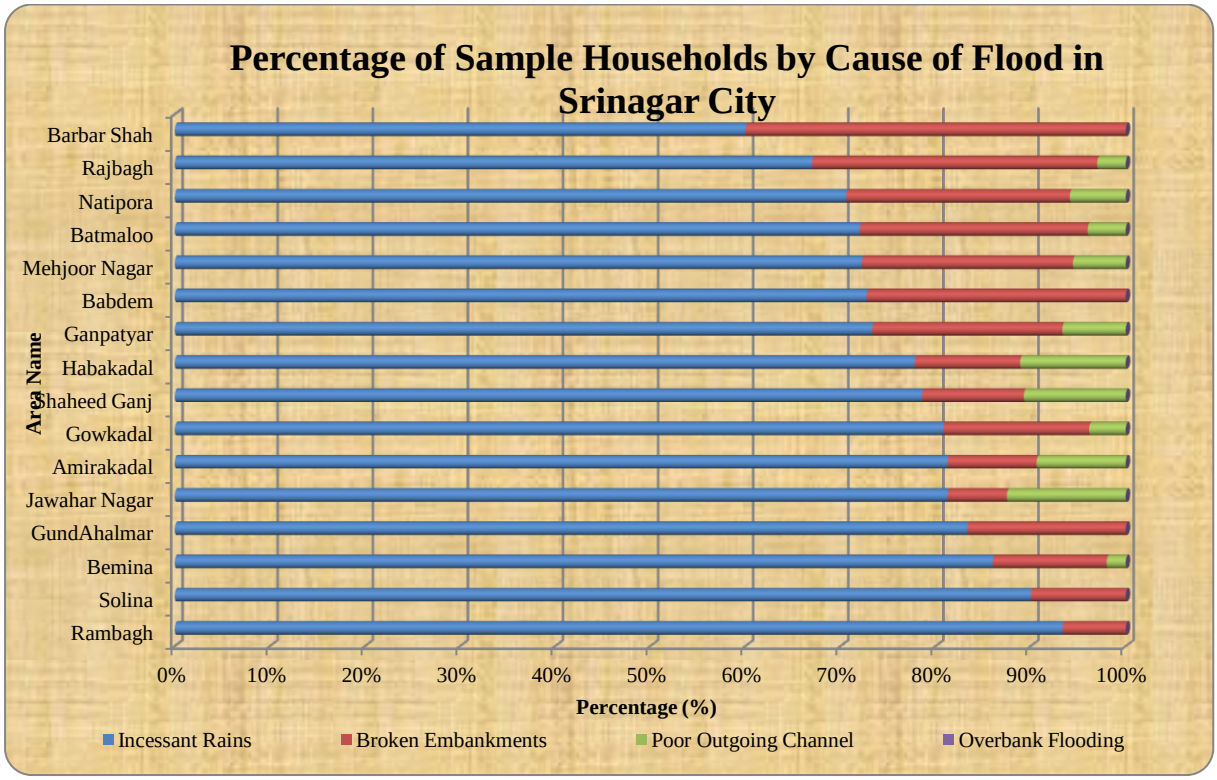
5.4.3 Cause of Hazard

Floods and earthquakes are natural hazards, and they occur since time immemorial. However, with the growth of the human population and its interference with the environment, their frequency and trend are increasing with time. Since the industrial revolution, the pace of these disasters has increased manifold. These disasters are seen in every part of the world as a threat to human survival as they cause huge damage to human life and property.

Srinagar city is prone to these disasters since time immemorial, and it has now become a burden to its people and economy. Heavy rainfall, cloudbursts were the main causes of these disasters; however, with the growth of population, anthropogenic factors have taken dominance as a cause of these disasters. The analysis of figure 5.3 shows the causes of hazards in Srinagar city where it has been found that 93.33 % of respondents in Rambagh have indicated incessant rains as the main cause of flood in Srinagar city in 2014 followed by Solina (90%), Bemina (86%), GundAhilmir (83.33%), Jawahar Nagar (81.25%), GowKadal (80.77%), Habbakadal (77.78%), Ganpatyar (73.33%), Babdem (72.73%), Mehjoor Nagar (72.22%), Batmaloo (72%), Natipora (70.59%), Rajbagh (67%), and Barbarshah (60%) while 40% of respondents in Barbarshah indicated broken embankment as a cause of flood in 2014

in Srinagar city. The broken embankment was also listed as a cause from respondents of Rajbagh (30%), Babdem (27.27%), Batmaloo (24%), Natipora (23.53%), Mehjoor Nagar (22.22%), Ganpatyar (20%), GundAhilmar (16.67%), Gowkadal (15.38%), Bemina (12%), Habbakadal (11.11%), Shaheed Gunj (10.71%), Solina (10%), Amirakadal (9.38%)Rambagh(6.67%) and Jawahar Nagar(6.25%). On the other hand, 12.50 percent of respondents from Jawahar Nagar responded poor outgoing channel as the main cause of flood in Srinagar city in 214 followed by Habbakadal (11.11%), Shaheed Gunj (10.71%), Amirakadal (9.38%), Ganpatyar (6.67%), Natipora (5.88%), Mehjoor Nagar (5.56%) and Batmaloo (4%). The above analysis shows that people have identified the main causes of disasters in Srinagar, and this will be highly beneficial to participatory planning for the management of such vital natural issues.

Figure 5.3 Percentages of Sample Households by Cause of Flood in Srinagar City



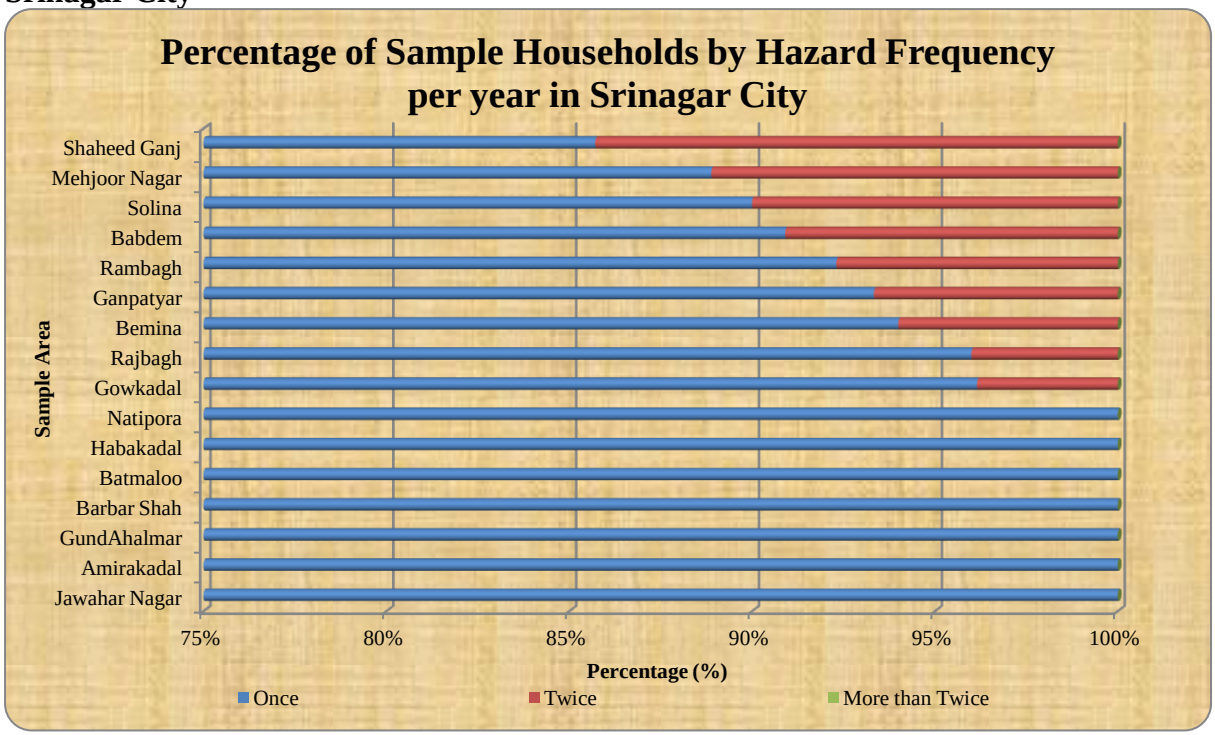
Source: Field Survey by Researcher.

5.4.4 Frequency of Hazard

Hazard frequency is also an important indicator of flood vulnerability. The frequency calendar is the basic criteria for the assessment of hazards per year. However, figure 5.4 shows that out of 16 wards surveyed, all the respondents in 7 wards have answered that the hazard occurs once a year and these wards are Jawahar Nagar, Amira Kadal, GundAhilmar, Barbarshah, Batmaloo, Habbakadal, and Natipora while 96.15 Percent in Gowkadal have responded that

the hazard occurs once in a year followed by Rajbagh (96%), Bemina (94%), Ganpatyar (93.33%), Rambagh (92.31%), Babdem (90.91%), Solina (90%), Mehjoor Nagar (88.89%) and Shaheed Gunj (85.71%). On the other hand, 14.29% of respondents in Shaheed Gunj have responded that the hazard occurs twice a year followed by Mehjoor Nagar (11.11%), Solina (10%), Babdem (9.09%), Rambagh (7.69%), Ganpatyar (6.67%), Bemina (6%), Rajbagh (4%) and Gowkadal (3.85%). This analysis is very important from the point that people have know-how about the frequency of disasters, and this knowledge can be channelized by imbibing the fruits of technical capacity-building measures among people.

Figure 5.4: Percentage of Sample Households by Hazard Frequency per year in Srinagar City



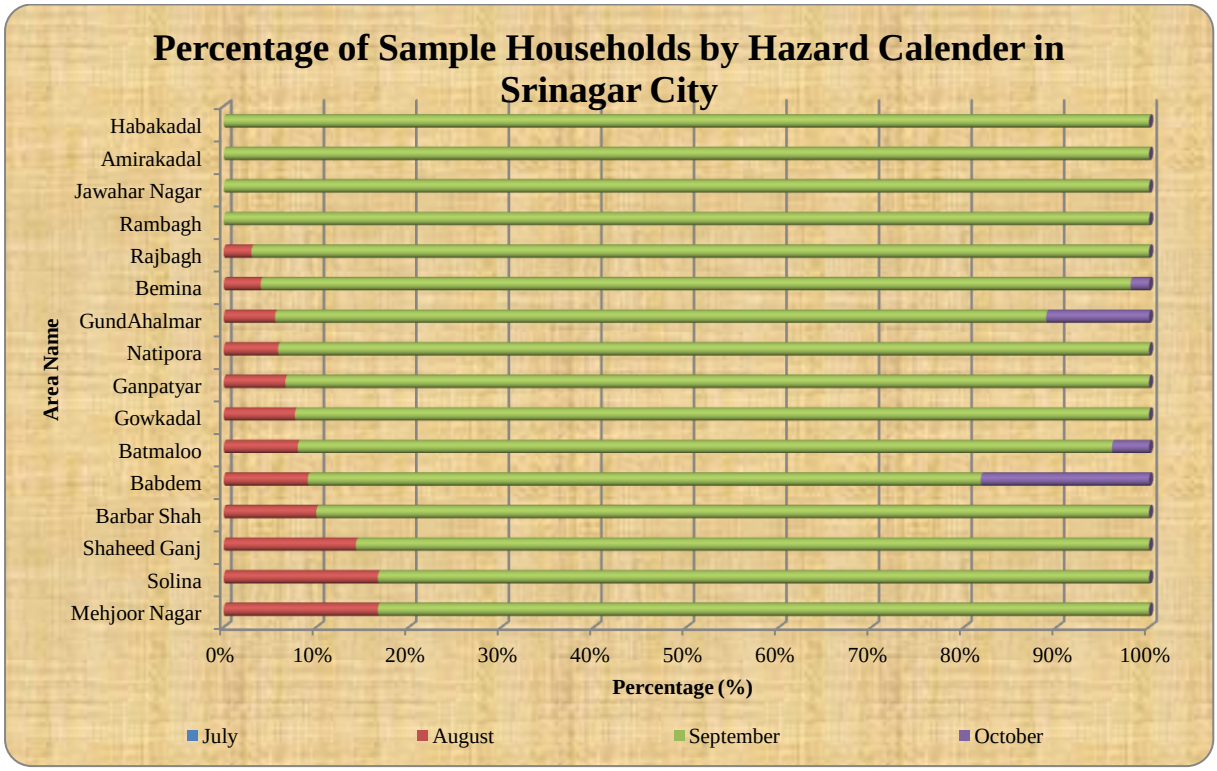
Source: Field Survey by Researcher.

5.4.5 Hazard Calendar

The preparation of the hazard calendar based on community response has revealed the identical factors of the flood as indicated by the meteorological observation. This type of knowledge with people is of great importance for participatory planning while there is a lack of tools and techniques to tap this knowledge for the better future of Srinagar city. It has been observed that most of the respondents in the study area have responded to September as the month of disasters in Srinagar city. The flood history of Srinagar city cites that most of the floods in Srinagar city have occurred in August and September. On the other hand, the meteorological observations also held it valid that most of the floods in the Kashmir valley

occur in August and September. This is the period when the south-west monsoon is becoming weak, and there is the flow of western disturbances. However, whenever these two types of winds merge, they augment the rainfall in the Kashmir valley and cause a heavy flood. Figure 5.5 shows the percentage of respondents by their response to hazard calendar where the wards like Gowkadal, Ganpatyar, Natipora, GundAhilmar, Bemina, Rajbagh, Rambagh, Jawahar Nagar, Amira Kadal, and Habakadal have more than 90% respondents indicated September as a month of Floods in Srinagar city while in Mehjoor Nagar, Solina, Shaheed Gunj, Barbar Shah, Babdem, Batmaloo have more than 80% respondents who indicate September as a month of floods in Srinagar city. The month of August was indicated as a flood-prone month by 16.67% of respondents in Mehjoor Nagar and Solina while October was indicated flood-prone by 11.11% of respondents in GundAhilmar.

Figure 5.5 Percentages of Sample Households by Hazard Calendar in Srinagar City



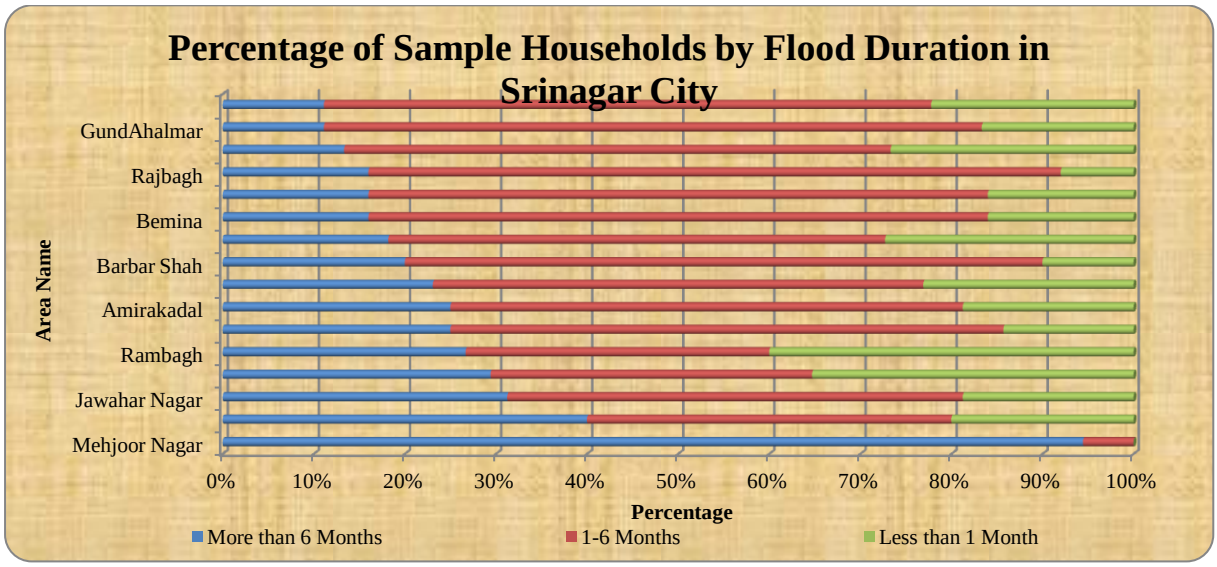
Source: Field Survey by Researcher.

5.5.6 Hazard Duration

Hazard is a component that shows the prevalence of effects of the disaster at any place. The duration of its prevalence can be used as an indicator to assess its socio-economic, cultural, psychological impact at a given place. The respondents were asked a question on hazard duration in their areas. However, 94.44% of respondents in Mehjoor Nagar have responded that the flood hazard stayed here for more than six months while in other wards of Srinagar

city, the proportion of respondents is 40% in Solina, 31.25% in Jawahar Nagar, 29.41% in Natipora, 26.67% in Rambagh, 25% IN Shaheed Gunj and Amirakadal, 23.08% in Gowkadal, 20% in Barbarshah, 18.18% in Babdem, 16% in Bemina, Batmaloo, and Rajbagh, 13.33% in Ganpatyar, 11.11% in GundAhilmar and Habbakadal. While the Hazard duration in between one to six months was recorded high in Rajbagh (76%) followed by GundAhilmar (72.22%), Barbarshah (70%), Bemina and Batmaloo (68%), Habbakadal (66.67%), Shaheed Gunj, and Ganpatyar (60%), Amirakadal (56.25%), Babdem (54.55%), Gowkadal (53.85%), Jawahar Nagar (50%), Solina (40%), Natipora (35.29%), Rambagh (33.33%) and Mehjoor Nagar (5.56%), on the other hand, 40 % respondents in Rambagh indicated that the hazard duration was less than one month followed by Natipora (35.29%), Babdem (27.27%), Ganpatyar (26.67%), Gowkadal (23.08%), Habbakadal (22.22%), Solina (20%), Jawahar Nagar and Amira Kadal (18.75%), GundAhilmar (16.67%), Bemina and Batmaloo (16%), Shaheed Gunj (14.29%) and Rajbagh (8%). It was also observed during the field survey that Mehjoor Nagar was highly devastated by a flood in 2014. Several households are still in the slumber of the flood. (Refer to Figure 5.6)

Figure 5.6: Percentage of Sample Households by Flood Duration in Srinagar City



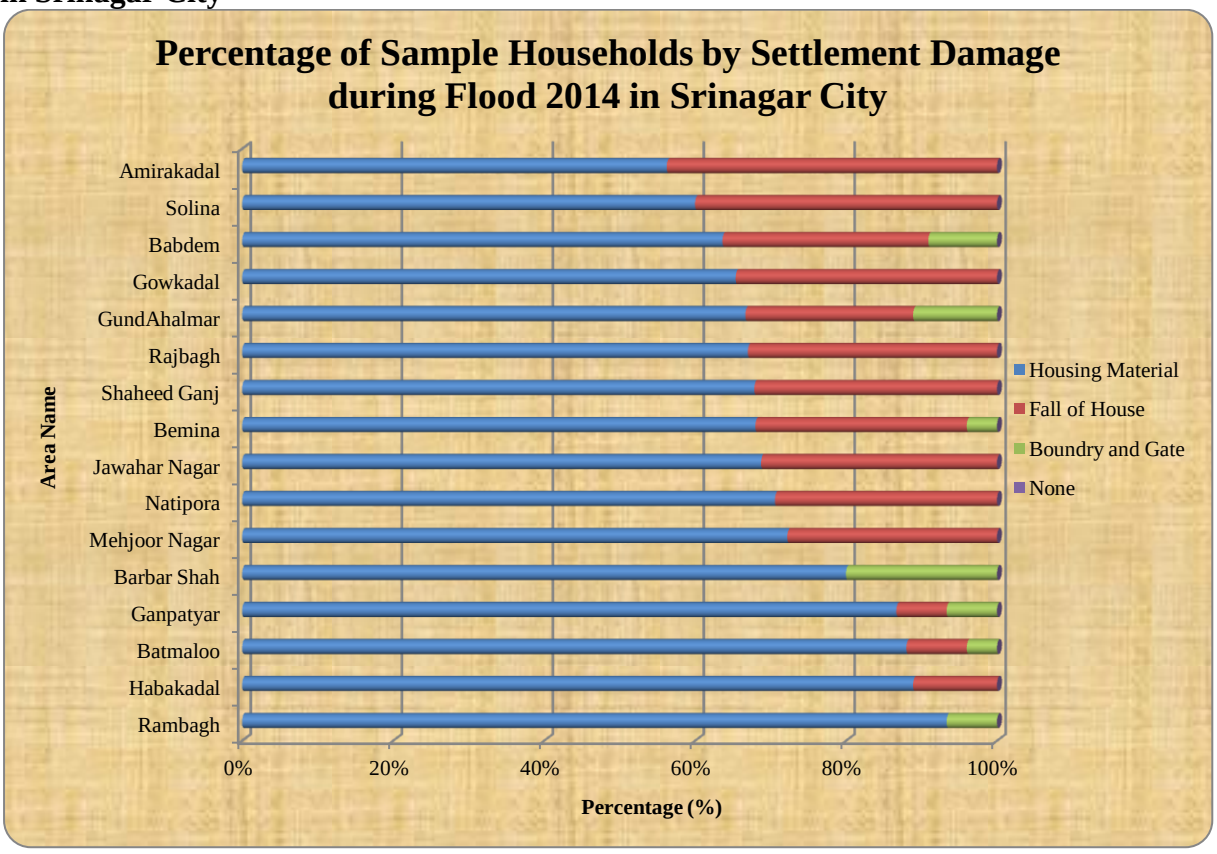
Source: Field Survey by Researcher.

5.4.7 Damage Impact of Hazard

Damage effect is an effective disaster predictor for developing an overall recovery plan as well as a stronger disaster risk mitigation strategy for the future. It involves determining the extent of the disaster's impact. As a result, respondents were asked a series of questions about the flood damage in 2014. According to a study published jointly by the Centre for Research on the Epidemiology of Disasters and UNISDR, India has lost 79.5 billion US dollars due to

floods between 1998 and 2017 (UNISDR C. A., 2018). In the last 20 years, international attempts to reduce the effects of disasters have been particularly centred on human vulnerabilities. The millennium declaration, issued in 2000, acknowledged the unique threat of disasters to development and urged the international community to "intensify our collective efforts to reduce the number and consequences of natural hazards and man-made disasters" (UN, United Nations Millennium Declaration, 2010). Although disaster preparedness, response, and early warning systems have improved over time, most countries have made little progress in managing underlying risks such as poverty, environmental degradation, rapid urbanisation, and population growth in hazard-prone areas. As a result, at the third United Nations World Conference on Disaster Risk Reduction in Japan in 2015, the Sendai Framework was adopted in this direction. It has seven strategic priorities and 38 targets to monitor the progress of disaster loss reduction. The Sendai Framework's implementation is consistent with the United Nations' global Sustainable Development Goals (SDGs) and the Paris Climate Agreement through these indicators (UNISDR C. A., 2018). A household-level analysis of 16 vulnerable wards is carried out to assess the extent of damage caused by the flood in 2014. The assessment has been carried out to identify the influence of floods on settlements as well as on other economic valuable goods. The data in Figure 5.7 reveals that 93.33% of respondents in Rambagh revealed that the immediate impact of the flood was the damage of housing material while in other wards, more than 50% of respondents have revealed that their housing material was affected by the flood. The floodwater inundated inside settlements and stayed for a long time and it influenced the walls, floors, and other basic things of settlement. The stagnant water weakened the settlement structures which develop cracks with time and are not safe for habitation. On the other hand, 43% of Respondents in Amirakadal revealed that their houses fall due to flood and this percentage was 40% in Solina, 34.62% in Gowkadal, 33% in Rajbagh, 32.14% in Shaheed Gunj, 31.25% in Jawahar Nagar, 29.41% in Natipora, 27.78% in Mehjoor Nagar, 22.22% in GundAhilmar, 11.11% in Habba Kadal, 8% in Batmaloo and 6.67%% in Ganpatyar. However, zero Percent of respondents with no fall of the house was found in Rambagh and Barbarshah. However, Barbarshah has 20% respondents who indicated that the flood of 2014 had affected the boundary and gate of their settlement while this percentage was less than 10% in Rambagh, Batmaloo, Ganpatyar, Bemina, GunAhilmar, and Babdem.

Figure 5.7: Percentage of Sample Households by Settlement Damage during Flood 2014 in Srinagar City

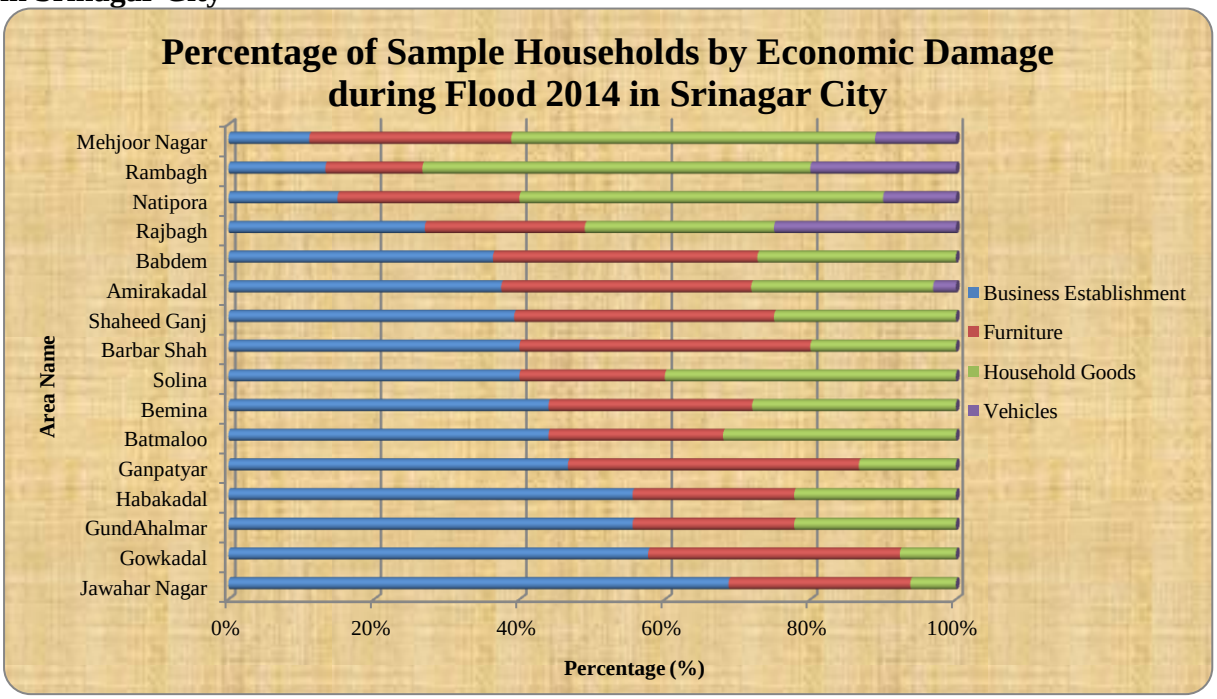


Source: Field Survey by Researcher.

Figure 5.8 reveals the economic damage caused by the flood in Srinagar city. The respondents were asked questions about economic losses due to floods. Srinagar is the hub of business establishments and is the summer capital of Jammu and Kashmir all the major economic activities are concentrated here. However, 68.75% of respondents in Jawahar Nagar stated that they lost their business establishments due to flood in 2014 while this proportion was 57.69% in Gowkadal, 55.56% in Habbakadal and GundAhilmar, 46.67a % in Ganpatyar, 44% in Batmaloo and Bemina, 40% in Solina and Barbarshah, 39.29% in Shaheed Gunj, 37.50% in Amirakadal, 36.365 in Babdem, 27% in Rajbagh, 15% in Natipora, 13.33% in Rambagh, 11.11% in Mehjoor Nagar. This analysis clearly shows that areas like Jawahar Nagar, Gowkadal, GundAhilmar, Habbakadal, Ganpatyar, Batmaloo, Bemina, and Solina are the hubs of business activities and they have registered huge damage due to flood while the areas like Mehjoor Nagar, Natipora, and Rambagh have registered low damage as they are the residential areas of low and middle-income people and these areas lack the business establishments. The data also shows that 40% of respondents in Barbarshah revealed damage to their household furniture also due to flood 2014 and this figure was 36.365 in Babdem, 35.71% in Shaheed Gunj, 34.62% in Gowkadal, 34.38% in Amirakadal, 285 in Bemina,

27.78% in Mehjoor Nagar, 24% in Batmaloo, 22.22% in GundAhilmar and Habbakadal. It is clear here that flood has more damage on furniture in those areas which are mostly residential places of people while the respondents with of heavy damage in household goods have shown 53% in Rambagh, 50% in Natipora and Mehjoor Nagar, 40% in Solina and 32% in Batmaloo. On the other hand, 25% of respondents in Rajbagh have revealed that the flood caused damage to their vehicles and this ratio was 20% in Rambagh, 11.11% in Mehjoor Nagar, and 3.13% in Amirakadal. The extent of economic losses and the ongoing high number of people affected and sometimes internally displaced by disasters is evident from the above review. As a result, capacity-building initiatives as well as participatory preparation are needed to ensure that these activities are completely inclusive of the needs of the most vulnerable populations.

Figure 5.8: Percentage of Sample Households by Economic Damage during Flood 2014 in Srinagar City



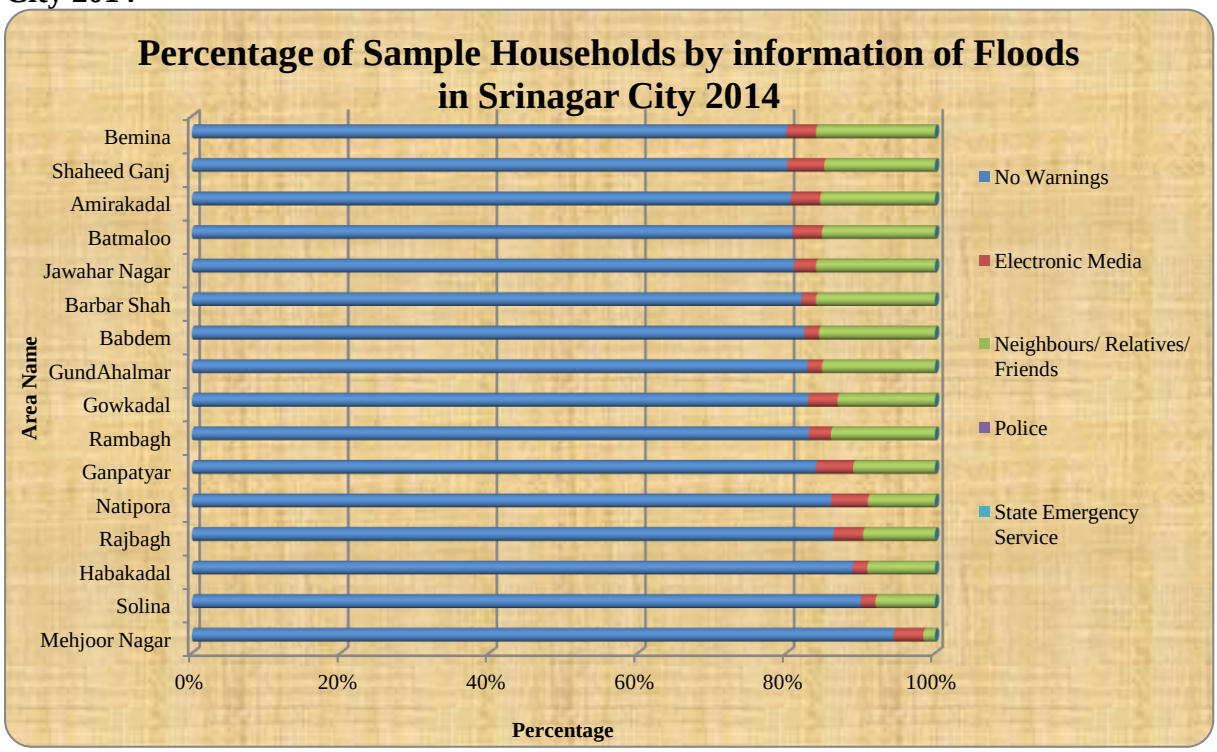
Source: Field Survey by Researcher.

5.3.8 Sources of Pre-Hazard Awareness

The most critical parameter in reducing the impact of catastrophe is pre-hazard knowledge. Increase people's pre-hazard knowledge by dramatically raising the availability of and access to multi-hazard early warning systems, disaster risk information, and assessments by 2030, according to one of the Sendai framework's goals for disaster reduction (UN, 2015). The distribution of disaster information at the household level is critical because it aids in the development of a disaster-prepared community. It's also important to get the word out to women, children, and the elderly about the pre-hazard awareness steps. During disasters,

these areas are the most vulnerable (NDMA, Management of Urban Flooding, 2010). Individuals, neighbourhoods, and businesses must be given hazard warnings in order to respond quickly and appropriately to hazards and minimise the risk of death, injury, property loss, and harm. Warnings are important, and they must motivate those who are at risk to act (Tsirkunov, 2011). However, it has been found that flood damage can be reduced if flood alerts are issued to those who are at risk and they are aware of how to respond accordingly (Heidi Kreibich, 2017). The early warning information can be disseminated through mass drills, education, training programs and they are the foundation to mitigate the influence of disaster. The global targets are to reduce mortality, settlement, and economic loss, minimize damage to public infrastructure and prevent the spread of water-borne diseases during a disaster by 2025. Therefore, in this direction during the field survey, households were asked questions on sources of pre-hazard warnings where most of the respondents in all the wards indicated that either no warning was provided by the government officials or the concerned departments. The data shown in figure 5.9 shows that 94.44% of respondents in Mehjoor Nagar had indicated that no warning was provided by government agencies and they all came to know through their observation when the water reached their courtyards. Above 80% of respondents in all the wards have reported that none of the government agencies provided any information on the disaster. They would have taken all the precautionary measures to shift their belongings to safer areas. However, they made their observations once the flood knocked on their doors. On the other hand, below the 5 %, respondents answered that they came to know about the flood situation through the electronic media while the neighbors and relatives also made aware the vulnerable households about the flood. In Bemina, Jawahar Nagar, and Barbarshah, 16 % of respondents reported that they were made aware of the flood situation either by their neighbors or by relatives. However, the percentage of households made aware about flood by neighbors and relatives was 15.60% in Babdem, 15.45% in Amirakadal, 15.20% in Batmaloo and GundAhilmar, 14.89% in Shaheed Gunj, 14% in Rambagh, 13.10% in Gowkadal, 11% in Ganpatyar, 9.67% in Rajbagh, 9.10% in Habbakadal, 9% in Natipora, 8% in Solina and 1.56% in Mehjoor Nagar (Refer Figure 5.9). It is very important to note here that the pre-hazard awareness means are a week in the state. These measures are the basis of preparedness to fight the disaster. The responses from the residents provide a gloomy picture and show the poor state of disaster management means in the state. There is a need for a robust mechanism of early warning systems to make people aware of hazards and disasters.

Figure 5.9: Percentage of Sample Households by the information on Floods in Srinagar City 2014



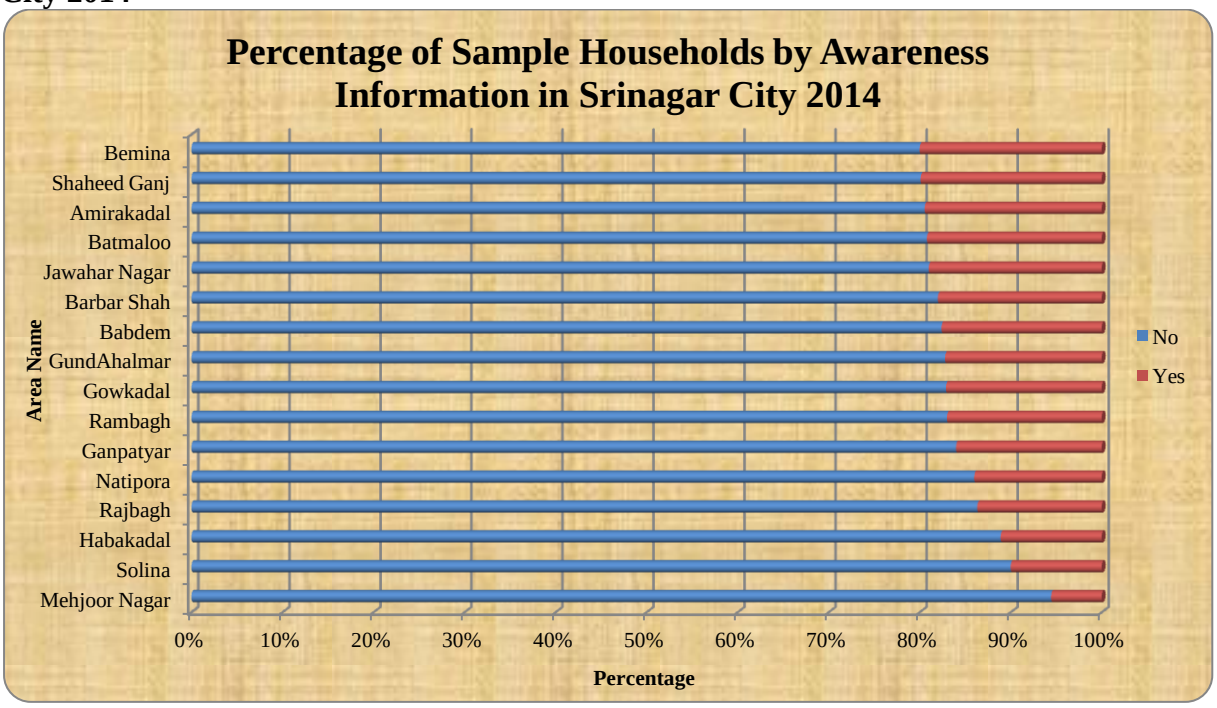
Source: Field Survey by Researcher.

5.4.9 Awareness Information Received

Dissemination of awareness information to the households about any hazard is an important component of disaster preparedness. It is evident that societies with good awareness measures in force experience minimal damage due to disaster, while societies with no means of awareness mechanisms in a position experience heavy damage due to disasters. The Odisha cyclone of 1999 is a living example of weak awareness mechanisms in place due to which it created large havoc to life and property in Odisha. The early warning systems made relevant and timely information available to people in a systematic way before the disaster to make informed decisions and take action. The data in figure 5.10 shows a gloomy picture of pre-hazard awareness measures disseminated by the state agencies. It shows that more than 80 % of respondents in all the Wards show that they did not receive any information of flood occurrence from the state officials to take future action to move towards safe areas. While 20% of respondents in Bemina have indicated that they received awareness information from the state officials and this percentage of respondents are 19.89% in Shaheed Gunj, 19.45% in Amira Kadal, 19.20% in Batmaloo, 19% in Jawahar Nagar, 18% in Barbar Shah, 17.60 % in Babdem, 17.20% in GundAhilmar, 17.10% in Gowkadal, 17% in Rambagh, 16% in Ganpatyar, 14% in Natipora, 13.67% in Rajbagh, 11.10% in Habbakadal, 10 % in Solina and

5.56% in Mehjoor Nagar. From the above data, it is clear that the disaster management department in Jammu and Kashmir is in deep slumber. There is a need to increase the monitoring, response capability, and warning communication strong so that timely and proper information is being disseminated to people to make decisions and future actions in case of a flood.

Figure 5.10: Percentage of Sample Households by Awareness Information in Srinagar City 2014



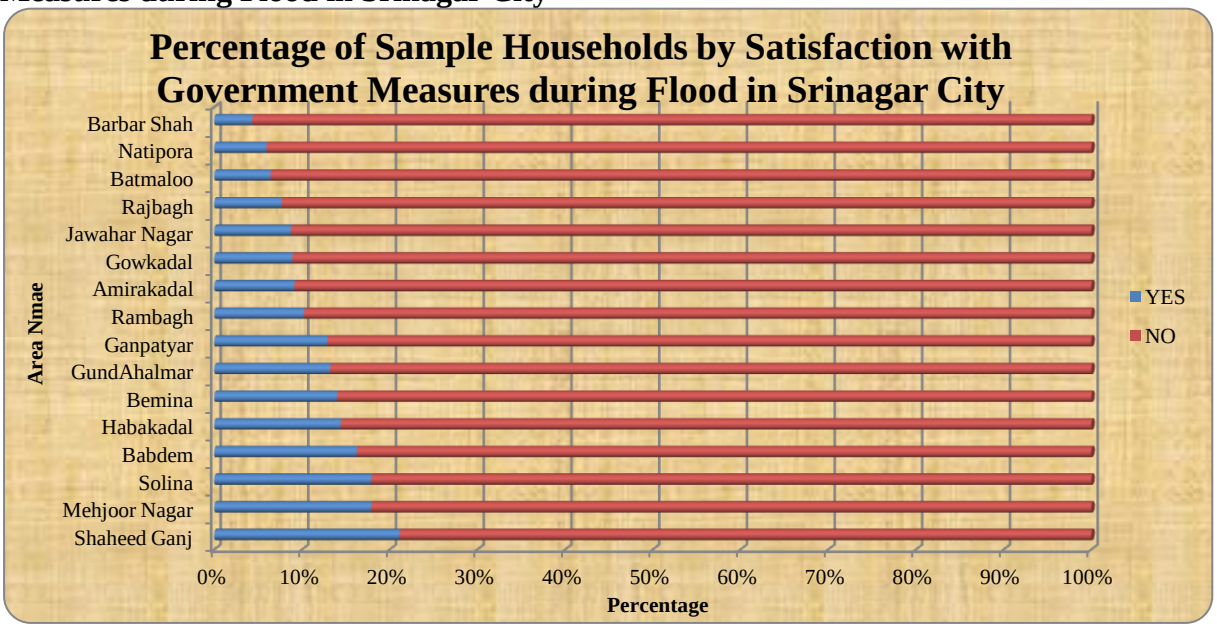
Source: Field Survey by Researcher

5.4.10 Satisfaction with the Government Measures during Flood

Srinagar city was badly affected by the floods in 2014. Out of 227.41 Sq.km area of Srinagar city agglomeration, 118.75 Sq.km (52%) of it was completely inundated/submerged. Agricultural, commercial, residential, and open areas constituted 84% of the total inundated area. Even major educational areas and hospitals were completely submerged for several days. This created huge damage to the life and property of the people, so the respondents were asked questions on the government intervention during the flood. The people are still on anger with the government of that time because they have not taken adequate measures to help people to fight the disaster. The role of government, as per respondents, was zero. They were totally in slumber for the help of people. This is further validated by the then Chief Minister of Jammu and Kashmir who said at that time **"I had no government for the first 36 hours as the seat of the establishment was wiped out".** The data in table 5.11 clearly states that more than 78 percent of respondents in all the wards show non-satisfaction with the

government measures taken during the flood. However, Shaheed Gunj has 21.11% of respondents who were satisfied with the measures taken by the government at that time. Therefore, it can be said that the government is the most important institution which can properly handle complicated issues and will guide the people for future actions during the time of disaster while the situation was opposite in Jammu and Kashmir during the floods of 2014.

Figure 5.11: Percentage of Sample Households by Satisfaction with Government Measures during Flood in Srinagar City



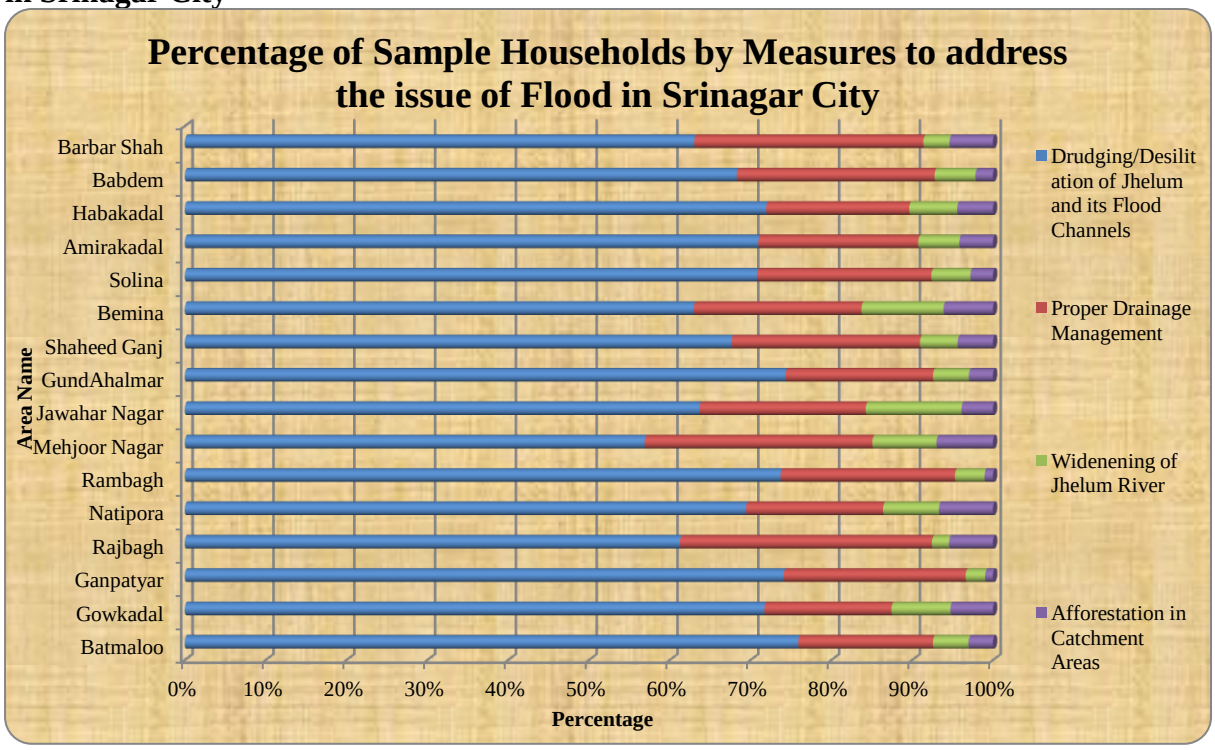
Source: Field Survey by Researcher.

5.4.11 Suggestions to address the issue

Natural disasters are becoming more common around the world. Weather and climate-related threats have become more frequent and serious, exposing more people and properties to disasters. Climate-related disasters are becoming more common and have a negative effect on global growth. The important causes of the flood in the study area are the encroachments of Riverbeds and wetlands and Swampy areas, decreasing carrying capacity of Jhelum due to siltation, Sewerage in flood channels, and massive deforestation in the catchment area of the Jhelum River. Therefore, the respondents were asked questions regarding their suggestions to address the issue of the flood in Srinagar city. The data shows that 52% of respondents in Batmaloo have indicated that removal of encroachments will help to mitigate the influence of disaster in the future while in other Wards, the percentage of respondents indicated that removal of encroachment from riverbeds and swampy and marshy areas would mitigate the flood influence is 42%. On the other hand, Drudging and De-Siltation have also been

indicated as an effective measure by most of the respondents to minimize the influence of floods in the future. The percentage of respondents in all wards, who said that drudging and de-siltation of Jhelum and its Flood Channels is effective to mitigate the influence of flood in the future, is above 30 while the respondents who responded that management of drainage is also an effective measure to minimize the influence of flood in future and its percentage in all the wards is above 8 Percent. However, the widening of the Jhelum River and Afforestation in catchment areas has been given less prominence by the respondents during the field survey. It becomes clear that people are well aware of various measures that can be used to make Srinagar resilient to disasters in the future. However, people lack the infrastructure and institutional support to work forward in these areas. Therefore, there is a need for inclusive participation of people from all sectors to come forward and sustainably address the issue. (Refer Figure No 5.12)

Figure 5.12: Percentage of Sample Households by Measures to address the issue of Flood in Srinagar City

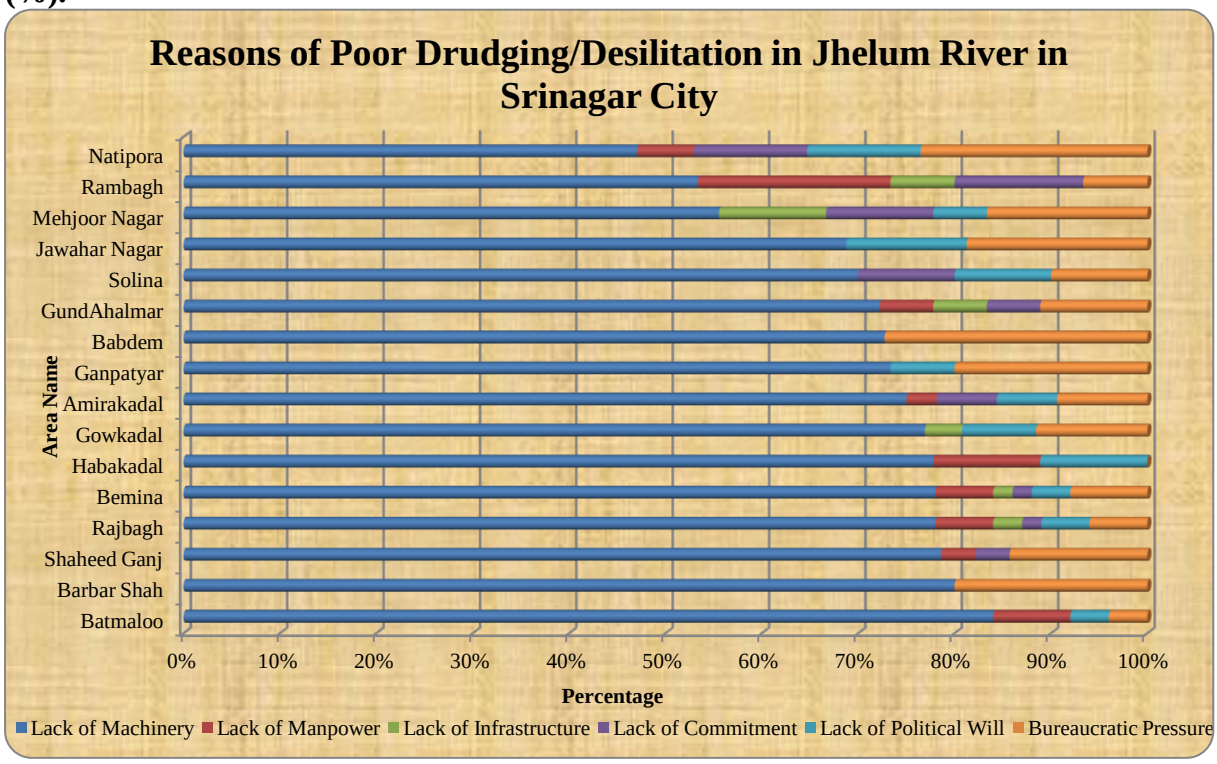


Source: Field Survey by Researcher

5.4.12 Reasons for Lack of Drudging and De-siltation in Jhelum River

The role of drudging and de-siltation of river bodies is very important. It increases the carrying capacity of the rivers and lowers down the flood threat in an area. To carry out Drudging and de-siltation, a good type of machinery along with infrastructure and manpower is the basis of drudging activity. All these measures are possible with good political will and bureaucratic commitment. As the inundation of water and the breakdown of the Bunds along the Jhelum River was the main cause of floods in Srinagar city. The carrying capacity of the River is lowered over time and Drudging and De-siltation are considered as a measure to mitigate the flood threat in the future. Therefore, the respondents were asked questions on the reasons for poor drudging activities in Jhelum post Flood 2014. The survey was conducted in November 2014, and it has given a good insight into various reasons which remain a hurdle in drudging and increase the risk of disasters in the future. Figure 5.13 clearly shows that more than 70 percent of the respondents in 12 wards have revealed that Lack of Machinery is the main reason for the lack of Drudging and desiltation in the Jhelum river and its flood channels. These wards are Batmaloo, Barbarshah, Shaheed Gunj, Rajbagh, Bemina, Habbakadal, Gowkadal, AmiraKadal, Ganpatyar, Babdem, GundAhilmar, Solina. The respondents also stated that lack of Manpower is the secondary reason for the lack of pace to carry out dredging in the Jhelum River. On the other hand, respondents have also revealed that the lack of political will and Bureaucratic commitment are the other reasons for the slow pace of drudging in the Jhelum River. However, during the interview with the head of state irrigation and flood control department, it has been cleared that the dredging of about 6.80 lac cubic meters had been completed out of a target of 7 Lakh cubic meters in Srinagar.

Figure 5.13: Reasons for Poor Drudging/Desiltation in Jhelum River in Srinagar City (%).



Source: Field Survey of Researcher.

5.4.13 Role of Non-Government Agencies

Natural disasters are unpredictable occurrences that necessitate a coordinated approach and joint effort to effectively deal with them at all levels. When governmental and non-governmental agencies work together in crises, the likelihood of being exposed to hazards is greatly reduced. The growing importance of non-governmental organisations (NGOs) during disasters is commendable. NGOs are in a unique position to engage groups at the grassroots level in order to implement mass-awareness campaigns. The Disaster Management Act of 2005 has stressed the importance of NGOs, and as a result, state executive committees have been charged with assisting, advising, and coordinating the activities of NGOs involved in disaster management. The role of NGOs in disaster management was also highlighted in the national disaster management policy of 2009. It states that non-governmental organisations (NGOs) will be encouraged to use their institutional mechanisms to inspire the community and raise awareness (NDMA, 2018). Therefore, in this direction, the role of Non-Governmental organizations during Kashmir Flood 2014 is important to mention here. They assisted the communities in need during the flood. The important organizations involved in the response, recovery and rehabilitation measures in Kashmir valley were Goonj, AmeriCares, Indian Red Cross, SEEDS, Oxfam, Athrout Kashmir, Darul Khair. Basic relief

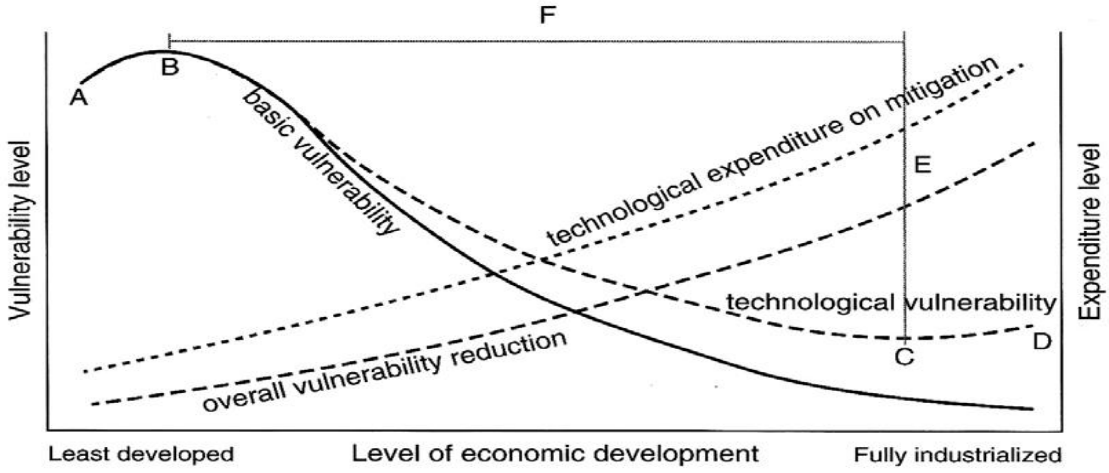
materials such as safe drinking water, packed food, warm clothing, temporary shelter, medical assistance, sanitation facilities in relief camps, and education for displaced children were provided by these organisations. The respondents were asked about the position of non-governmental organisations (NGOs) during a flood in Srinagar. However, in all wards, more than 60% of respondents suggested the existence of non-governmental organisations in their respective regions. They are, however, up against an uphill battle due to a lack of capital. People have also received assistance from the Darul Khair organisation in the rebuilding of their homes. Several respondents benefited from their assistance in the house's reconstruction.

5.5 Hazard Vulnerability of the wards in Srinagar City

Hazards are risks that can result in death, injury, destruction of property, social and economic disturbances, and environmental degradation (Kaplan, 2005). Hazards can be natural and Man-Made. The hazards caused due to natural factors are called natural hazards, while those caused by anthropogenic activities are called Man-Made hazards. A hazard becomes a disaster when it causes huge damage to life and property. With time, the intensity, pattern of natural hazards have been intensified by human activities which had boosted the frequency of these disasters with time. Hazard is an external factor that affects the society or the elements at risk while the vulnerability is an internal factor that affects the transformation of hazards into disasters. Therefore, The household's poverty is linked to vulnerability. Although poverty is related to wages, the poorest households have the fewest resources and opportunities to minimise vulnerability. As a result, the definition of vulnerability is broad, encompassing social, economic, cultural, and demographic factors. Development is also an indicator to measure vulnerability. Various studies show that societies that have planned proper development in social, economic, demographic, and economic components have low issues to vulnerability while those societies which have poor planning in these indicators are the worst sufferers of disasters (Alexander, 2000).

Alexander, in his book, has shown an interrelation between vulnerability and development in different types of countries. Figure 5.14 shows that the level of vulnerability is high in the least developed countries, while the vulnerability level is low in the fully industrialized country. This difference in the level of vulnerability is due to the differences in expenditure levels on mitigation indicators of vulnerability.

Figure 5.14 Vulnerability with the level of economic development and mitigation Gap (ALEXANDER 2000)



Source: Confronting catastrophe: new perspectives on natural disasters by David Alexander

In the diagram, ‘A' represents the poorest communities with little resources and little opportunities, while ‘B' represents countries with a slightly higher level of economic growth, where risk assets rise faster than risk reduction efforts. The letter ‘C' denotes an advanced society with a high level of economic development and a low level of insecurity, whereas the letter ‘D' denotes a highly developed society where economic growth puts assets at risk before risk can be minimised. He points out that if progress occurs, there would be a specific reduction in vulnerability that can be accomplished with current technologies (represented by line E). The disparity between high levels of vulnerability in developing countries and low levels of vulnerability in developed countries is referred to as the "mitigation divide" by him (represented by line F). It should be remembered, however, that the process of societal development can exclude certain social or cultural groups. This is especially true in cases where rapid national economic growth, as measured by indicators like GNP, can obscure the fact that a portion of the population is still poor and has a low level of development. These individuals are also more likely to be found in high-risk environments. As a result, belonging to a particular social or cultural community can have consequences for an individual's vulnerability. Indicators developed specifically for measuring growth, such as the commonly used HDI and HPI, are available globally but only occasionally at a sub-national scale, making them insufficient for finer-grained vulnerability assessments. The study of Srinagar city under this model shows that the development which has taken place has not taken under its ambit all the sections of society. All the developmental aspects took place

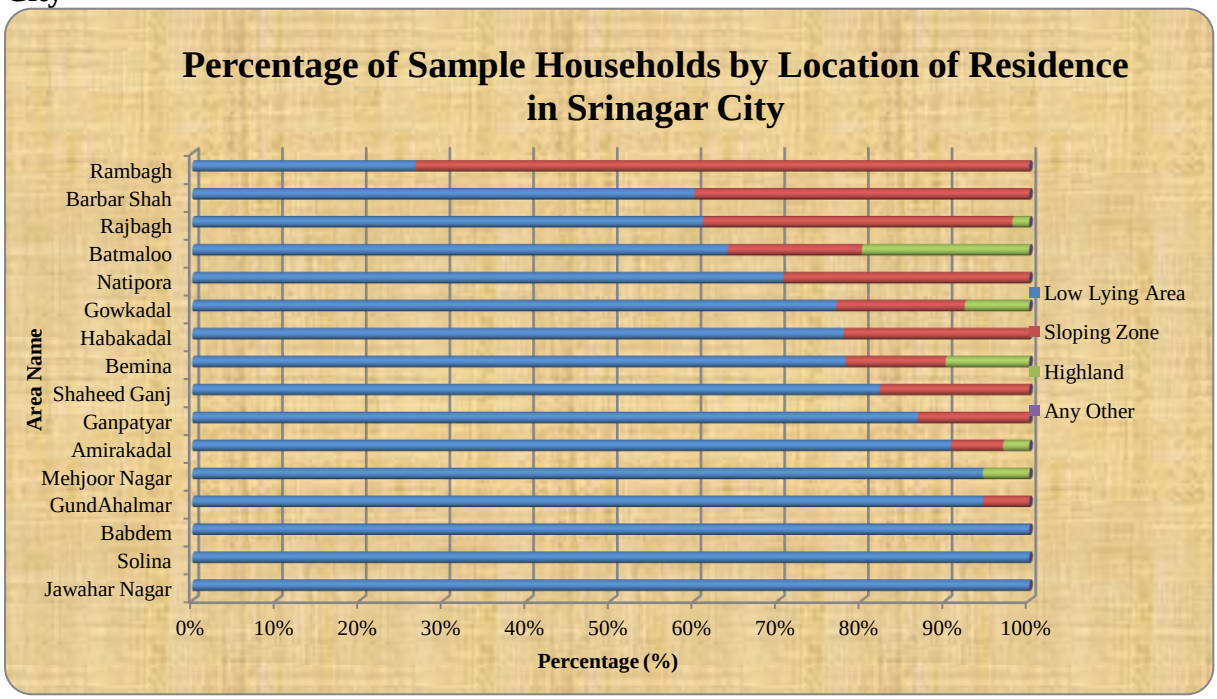
in Srinagar without proper planning. The issue of vulnerability remained with the use of technology. The areas which acted as absorbers of hazard shocks were converted into a built-up area. Physical development has taken place, i.e. the growth of infrastructure while the addition in the vulnerability of this built-up area has not been put under consideration. All this haphazard development has increased the vulnerability of social, economic, cultural, and demographic indicators. During the field survey, various types of vulnerabilities were seen in the study area. In the Kudsoo Rajbagh area, various households are still living on the banks of the Jhelum River. These settlements have come up due to illegal encroachments with time. Abdul Rashid Dar of Rajbagh, during the interview, said that there was not any settlement along the bank of Jhelum River in the 1970s. However, due to political instability in the state in the 1990s, the people started encroaching the land along the banks of Jhelum and built heavy settlements. This led to heavy cutting down of trees along the banks of the river. This type of development along the Jhelum River and its flood channels has not increased the vulnerability of these people but also the people living far away from the river. The decline in the area of the river as well as in its depth has increased the susceptibility of vulnerability in Srinagar city. Therefore, based on this state of development, during the field survey households were asked questions on various factors of vulnerability and their responses give a good idea of the level of vulnerability prevalent in the area.

5.5.1 Location of the residence

The location of a place is an important indicator to analyze the vulnerability of a place. However, the vulnerability of a place may vary from one type of disaster to another. The highland location of a structure may be low vulnerable to floods, but at the same time that it may be very highly susceptible to another disaster. Therefore, based on the location of the household, direct observation was made to access the location of the household in the study area. Figure 5.15 shows that all the sample households in Jawahar Nagar, Solina, and Babdem are living in low-lying areas. They are more prone to the threat of floods while in Gund Ahilmar, Mehjoor Nagar and Amirakadal more than 90% of the respondents have their settlements in low-lying areas. On the other hand, more than 60% of the respondents in Ganpatyar, Shaheed Gunj, Bemina, HabbaKadal, Gowkadal, Natipora, Batmaloo, Rajbagh, Barbarshah, and Rambagh have their settlements in the low lying areas. The respondents having settlements on sloping zone area higher in Rambagh(73.33%) followed by Barbarshah(40%), Rajbagh (37%), Natipora (29.41%), Habbakadal (22.22%), Shaheed Gunj (17.86%), Batmaloo (16%), Gowkadal (15.38%), Ganpatyar (13.33%) and Bemina (12%).

The respondents with settlements on highland have been found 20% in Batmaloo, 10% in Bemina while in other wards it is below it. It has been seen during field surveys that the wards in low-lying areas have experienced huge damage to life and property than the areas lying on Highland. Therefore, it can be said that it is an important indicator to access the vulnerability status of an area, and it can be further used for the planning process in infrastructure development to make it resilient to floods.

Figure 5.15: Percentage of Sample Households by Location of Residence in Srinagar City



Source: Field Survey by Researcher

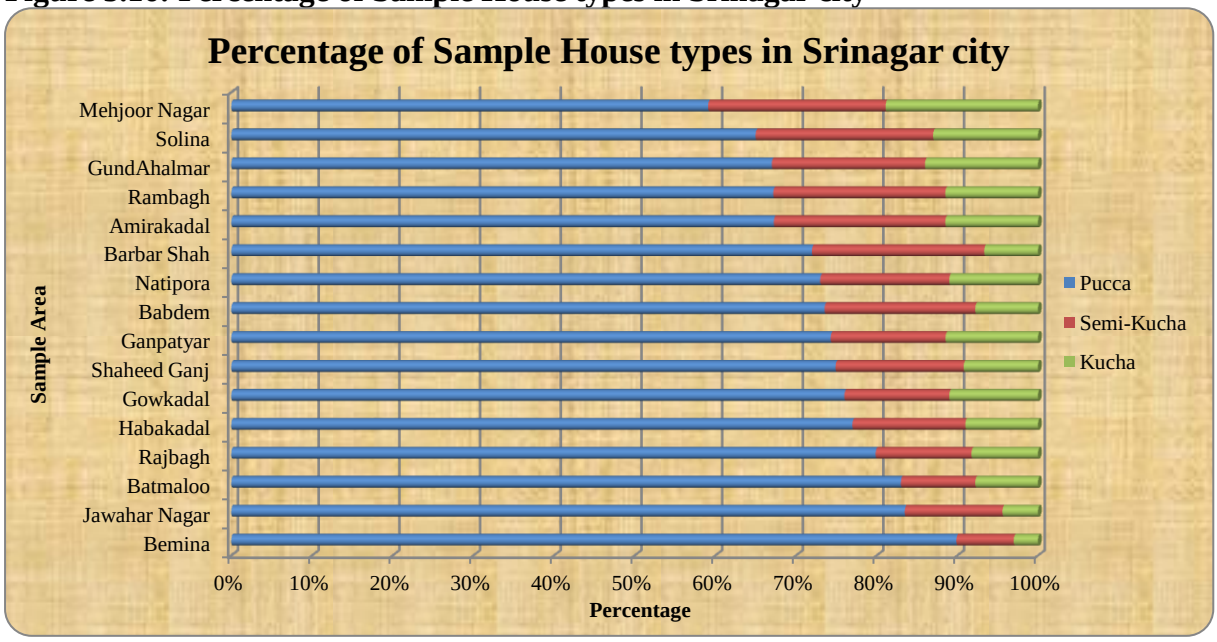
5.5.2 Ward-wise assessment of the vulnerable structures

Urban areas are characterized by the high growth of population, high population density, and upsurge of built-up areas. This type of pressure on the limited area can lead to a decline in the wetlands, marshy and swampy areas, as well as pressure on the flood plains of the river. Therefore, urban development may disrupt the natural flow of the river and can lead to disasters. On the other hand, the type of house also increases susceptibility to vulnerability. During the field survey, direct observation was made to assess the vulnerable structures in the study area. It has been found that the settlements of the households were more vulnerable structures to floods in 2014. There was huge damage to the household structures. The worst damage of floods were on walls, the floor of the houses. These houses still show the characteristics of floods like moisture from walls and floor, the paint did not work on them, development of cracks. It can be said that the flood has made these structures weak for future

resilience. Since Srinagar city is located in a high-intensity seismic zone, there is a need to boost awareness of building structures that are resilient to both disasters. The other structures which were affected by floods in 2014 were Business establishments, Shops, Roads, Livestock as well as public property.

The census of India has classified the settlement into Kucha, Semi Kucha, and Pucca based on the material used to build it. The respondents were asked questions on the type of structure they had for their living. Figure 5.16 shows that more than 60% of the respondents in the study area have revealed that they have pucca houses for living while 7% to 22% have revealed that they have semi-pucca structures to live in. on the other hand, it has been found that Mehjoor Nagar has 19% of its respondents with Kucha houses while the respondents with Kucha houses in Gund Ahilmar, Solina, Amirakadal, Rambagh, Ganpatyar and Natipora are 14%, 13%, 11.48%,11.46%, and 11% respectively. There is a need to disseminate awareness among people to build their structures in safe places as well as make them resilient to disasters so that it will result fruitful for the future life and property of Srinagar.

Figure 5.16: Percentage of Sample House types in Srinagar city

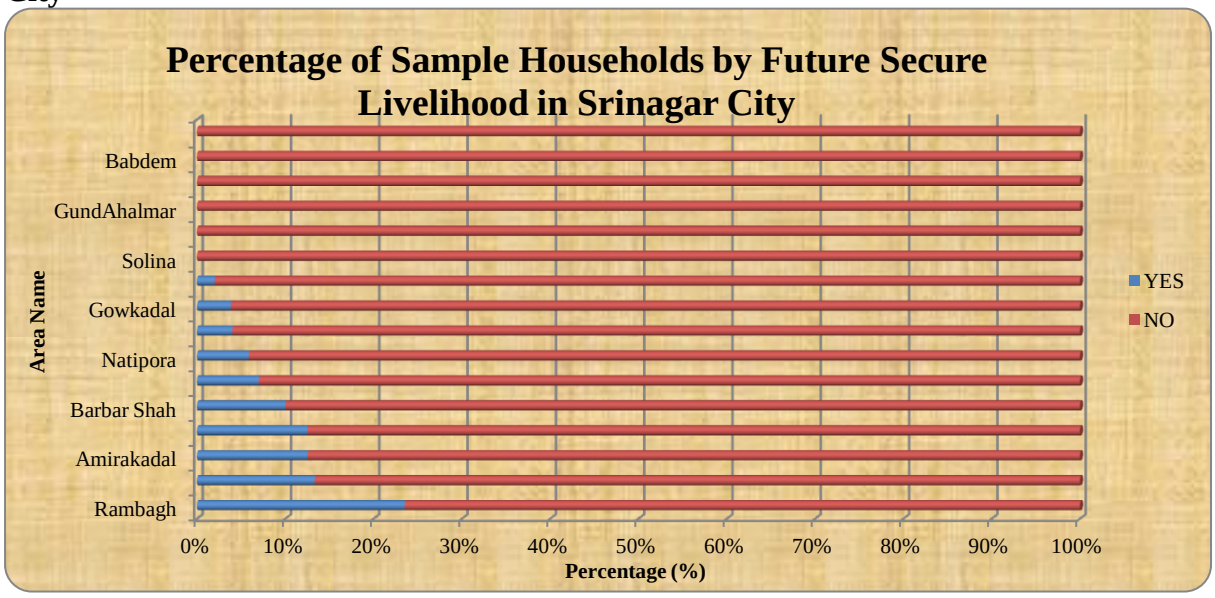


Source: Field Survey by Researcher.

5.5.3 Livelihood Security of the household

The city of Srinagar is considered to be the most prone to flooding. Over the last century, the frequency and intensity of floods in Srinagar have increased dramatically. Floods have a variety of impacts. The key effect of flooding in the most urbanised and industrial centre has been the loss of economic bases, life, and property of households. As a result, in the event of a flood, livelihood protection is the most important component of a household's disaster-resilient strategy. The households were polled on their prospects for a stable future. Figure 5.17 shows that more than 75% of the respondents in the study area have revealed that they did not have any secure livelihood in case of flood in the future. In the Wards like Solina, Shaheed Gunj, GundAhilmar, Mehjoor Nagar, Babdem, and Habbakadal, all the respondents have not indicated any secure livelihood in case of flood in the future. On the other hand, 23.53% of respondents in Rambagh have revealed that they have a secure livelihood in case of flood in the future. They have their house either on a highland, or they have another house in the distant area while the percentage of respondents who have a secure livelihood in Ganpatyar, Amirakadal, Jawahar Nagar, BarbarShah, Rajbagh, Batmaloo, Gowkadal, and Bemina is 13.33%, 12.50%, 12.50%, 10%, 7%, 5.88%, 4%, 3.85%, and 2% respectively.

Figure 5.17: Percentage of Sample Households by Future Secure Livelihood in Srinagar City



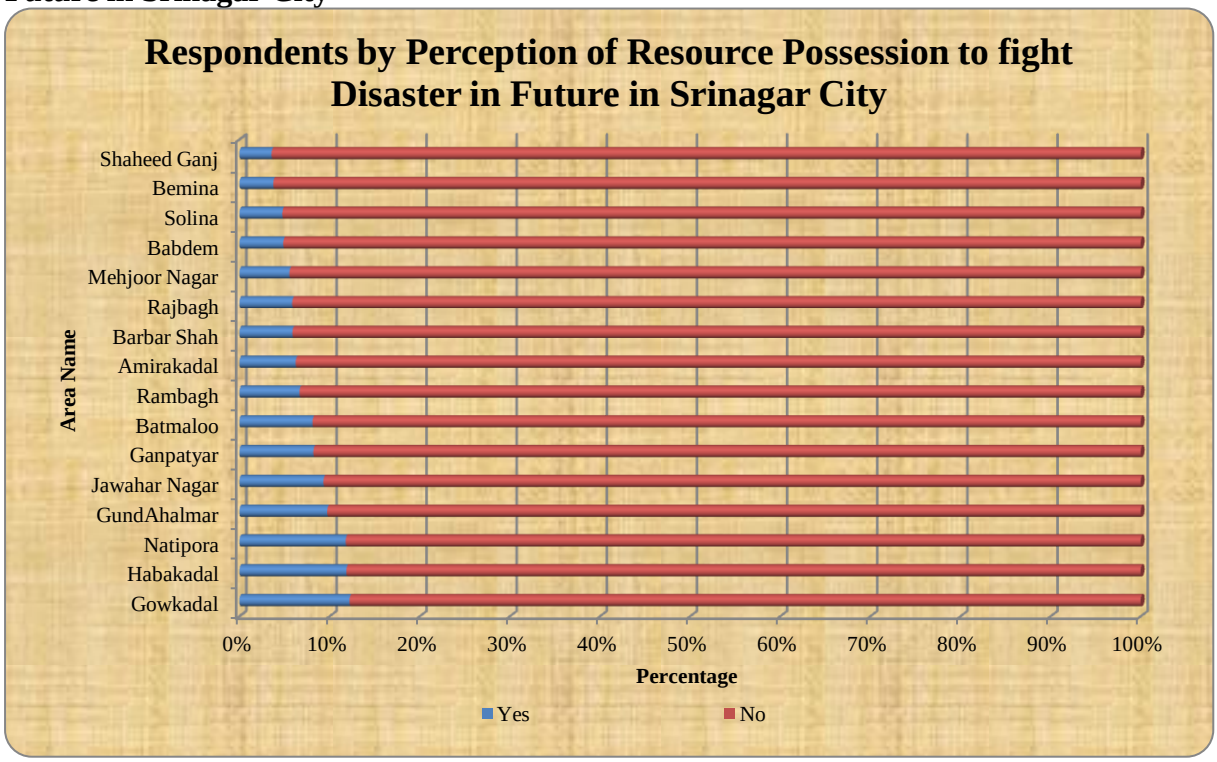
Source: Field Survey by Researcher.

5.5.4 Resources to tackle hazard

A secure livelihood also includes resources in possession that can be used to fight disasters in the future. These resources vary from one disaster to another. The items need to fight flood

may not work to fight the disaster. Therefore, along with the secure livelihood, households were asked questions on the resources they possess to fight disaster in the future. Figure 5.18 shows that less than 12 percent of the respondents in all areas have indicated the possession of resources to fight the floods in the future. Their resources were Boats, Life-Saving Jackets, and Installation of Generators at the top Storey of the house, Waterproof Paints to houses, etc. On the other hand, more than 88 percent of respondents in all the wards have revealed that they do not possess the resources to face the disaster in the future. They are highly vulnerable to disasters. It has been seen during the field survey that little efforts have been taken by the government to disseminate awareness among people about various techniques and tool which can be used to fight the flood.

Figure 5.18: Respondents by Perception of Resource Possession to fight Disaster in Future in Srinagar City



Source: Field Survey by Researcher

5.5.5 The issue of shelter during flood

Under normal times, a shelter is a place where people go to survive. When a natural disaster strikes, however, these buildings are harmed, and people are forced to flee to safer areas. In this situation, an emergency shelter is a critical location for people to seek refuge during a disaster. In the event of a natural disaster such as a flood or earthquake, this form of shelter is typically offered by groups or government emergency management departments. They usually use tents or other basic structures or buildings that would otherwise be used for other

purposes, such as schools, Panchayats, or government agencies. These settlements may be occupied for the duration of the reconstruction period, and they should be thought of as settlements rather than shelters, with sanitation/water and livelihoods in mind. A common thread was discovered during a research survey in Srinagar after the city was flooded in September 2014. Many of the people who responded said they were not prepared for a flood. This tragedy struck out of nowhere. They didn't have enough time to evacuate both themselves and their property. However, disasters do not necessarily necessitate mandatory evacuations, and even though they do, many people opt out. The flood in Srinagar prevented people from fleeing to safer areas. The majority of people were trapped in their homes, so numerous organisations initiated relocation services to transport them to safer areas. Sewers were destroyed, roads were blocked, power lines were downed, and telecommunication services were disrupted across the Kashmir valley in 2014. Floods are perversely egalitarian, unlike flash floods, which selectively level one region while leaving another unaffected. The floods in Srinagar in 2014 affected all households equally. Most people of flood-prone areas are aware of the importance of storing food and making evacuation plans. However, it was discovered that only a small percentage of households were prepared for disruptions in infrastructure services. During the field study, the most troublesome disruptions during the flood were sewage backing up into homes from overburdened municipal water systems. People in Srinagar were also affected by a lack of potable water, which affected sanitation, drinking, and food preparation during the floods of 2014. People in Srinagar city have been affected by power outages, telecommunications outages, and road closures caused by fallen trees, debris, and flooding during and after the flood. Basic services such as electricity, telecommunication, potable water, and road connectivity have been found to be impacted for a long time after the flood.

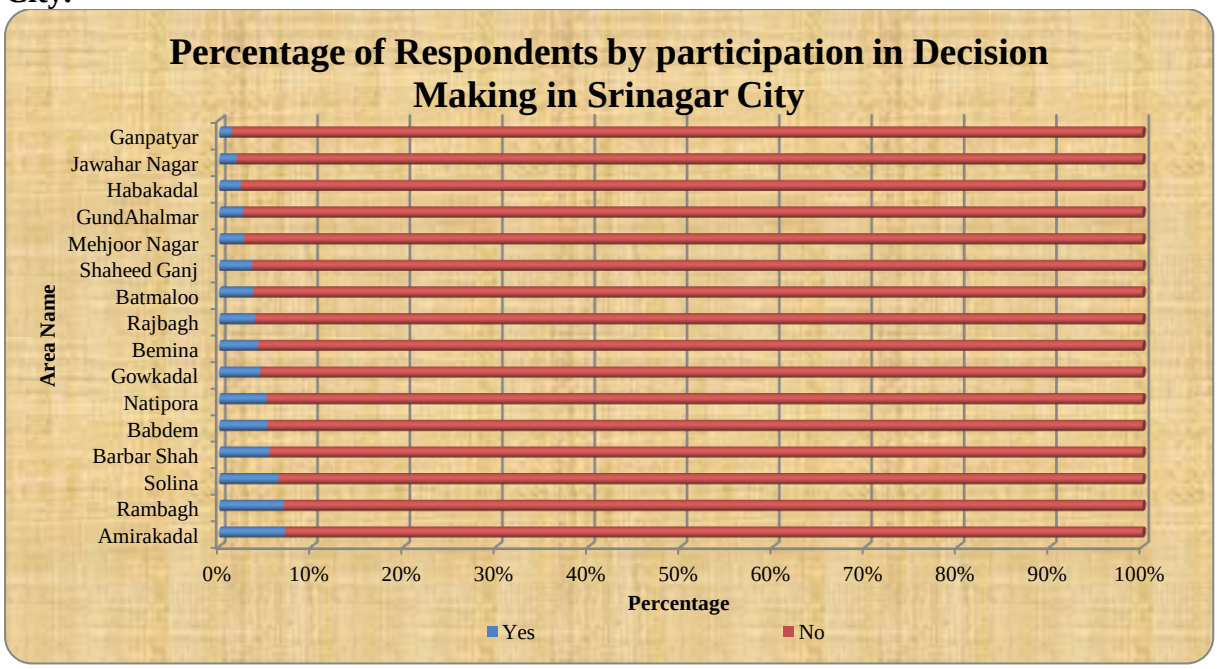
Service delays are unavoidable during and after major disasters, regardless of how well cities harden their infrastructure. Even if their homes are not in the disaster's course, their lives will be disrupted for a prolonged period of time. Poor households were found to be more vulnerable to floods during the survey because they are more vulnerable to hazards and disasters as a result of their poverty. They live in shaky structures that can't survive a catastrophe. Children and women were also found to be more vulnerable to flooding than their male counterparts. As a result, it is necessary to harden the infrastructure by placing people at the middle. The emergency shelter is urgently needed so that the flood-affected people can be relocated to these safe areas.

5.5.6 Participation in decision making

During the course of a catastrophe, communities are the first responders. They are the first to be affected by natural disasters. Disasters can wipe out years of growth and livelihood in a couple of minutes, putting people at greater risk of extreme poverty, illness, and poor health. It is necessary to note that disasters cannot be avoided; but, by taking appropriate risk mitigation steps, the severity of harm can be significantly reduced, and previous development gains can be protected. Risk reduction is a problem that no single individual can solve. It can be made more successful by taking into account multiple stakeholders. As a result, community engagement is seen as a positive step in the war against disasters at the local level. The target of risk reduction management should be good cooperation between civil society, government, and the private sector, according to the UNDP's global report on disaster risk reduction from 2004. Local community participation is critical for understanding local needs and empowering residents to overcome risks (UNDP, 2005). The third United Nations World Conference on Disaster Risk Reduction adopted the Sendai System for Disaster Risk Reduction 2015-2030, which calls for society-based approaches to disaster risk reduction. It encourages governments to explore active participation and feedback from specific stakeholders in the creation and implementation of disaster risk mitigation policies for women, children and youth, people with disabilities, the disabled, and the elderly (UN, 2015). As a result, the international community's collective aim is to ensure community-based engagement in disaster risk reduction activities. It has been observed that in the past, disaster-prevention steps were taken at the government level without the participation of the local community. As a result of the failure of the Top-Down strategy in reducing the underlying risk of catastrophe, there has been a renewed interest in community engagement in disaster risk management (Shaw, 2012). Disaster risk reduction efficacy is determined by the ability to meet the most disadvantaged and impacted people and implement different services for them as a result of their participation in disaster risk reduction governance (Yuki Matsuoka, 2012). As a result, it can be said that involving the society in disaster risk reduction makes DRR more sustainable because it empowers and self-resilient the population at risk. During the field survey, respondents were questioned about their position in the risk reduction decision-making process. Figure 5.19 indicates that less than 8% of respondents in all wards are interested in disaster risk reduction decision-making, while more than 90% of respondents in all areas of the survey reported that they are not even asked to express their opinions on flood risk reduction. In its strategy, the NDMA states that societies are not only the first to be

affected by disasters, but also the first responders. Community participation maintains collective influence, addresses common needs, and promotes volunteerism and mutual help to prevent and mitigate harm. The elderly, mothers, children, and people with disabilities, it goes on to state, all deserve special consideration. Women and youth will be allowed to participate in disaster management decision-making committees and action groups, according to the study. Communities will be trained in a variety of emergency response skills, including first aid, search and rescue, community shelter management, psycho-social counselling, relief distribution, and receiving government/agencies' assistance, among other items. The Panchayat, Block, and District plans will be integrated with the community plans. Unfortunately, formally expressed support for disaster risk mitigation at the group level has not always been translated into tangible actions. States have often passed disaster recovery legislation that encourages community-based disaster risk reduction, often with little follow-up. According to the UNISDR's Global Assessment Report on Disaster Risk Reduction, which was adopted in 2015, community-based approaches have become mainstream and widespread at all levels, while community empowerment in disaster risk reduction has become more symbolic than actual(UNISDR, Global Assessment Report on Disaster Risk Reduction, 2015).

Figure 5.19: Percentage of Respondents by participation in Decision Making in Srinagar City.

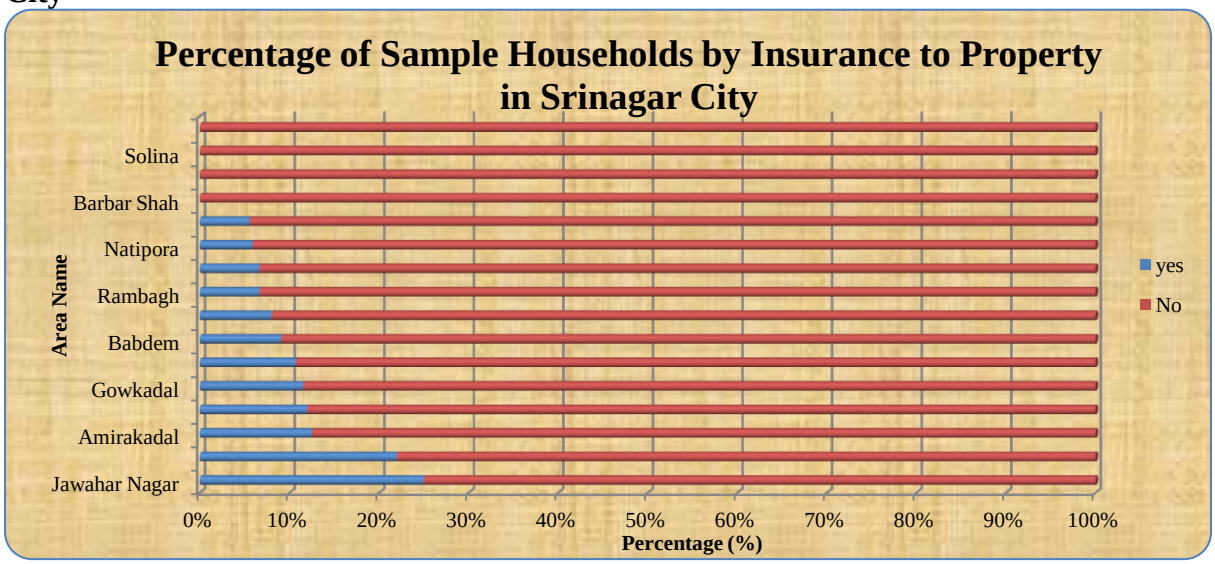


Source: Field Survey by Researcher

5.5.7 Asset Insurance

Insurance is the foundation for financial loss insurance in the event of a catastrophe. It's a fundamental method of risk management that's mainly used to protect against the risk of a speculative loss. However, in the event of a tragedy, when he loses everything, insurance is the lifeline of the family. It is critical in developing countries that are susceptible to a variety of hazards. In India, the flood has had a major economic effect. It has a major negative impact on the country's economy. The recent data released by UNISDR has made it clear that India has lost 76 Billion $ economy due to floods from 1990-2017 (UNISDR C. A., 2018). Therefore, being a developing country, insurance can play an important role to give some support to low and middle-income people during disasters. However, it has been seen that insurance is directly related to the income of the household. The people with high income have insurance cover to their life and property while the poor people are devoid of this scheme. They don’t have access to means to cover their life and property under the insurance scheme. Whenever the disaster struck, it affects mostly the poor who are most vulnerable to physical and social disasters. Therefore, during the field survey, the questions were asked to respondents on the insurance schemes. It has been seen that the majority of the people have not insured their property. Figure 5.20 shows that 25 percent of the respondents in Jawahar Nagar have revealed that their property was insured and they have received the insurance amount for the rehabilitation while this percentage was 22% in Rajbagh, 12.50% in Amirakadal, 12% in Batmaloo, 11.54% in Gowkadal, 10.71% in Shaheed Gunj, 9.09% in Babdem, 8% in Bemina, 6.67% in Rambagh and Ganpatyar, 5.88% in Natipora and 5.56% in Gund Ahilmar. On the other hand, The respondents in Barbar Shah, Habbakadal, Solina, and Mehjoor Nagar have revealed that their property was not insured at the time of the flood. it is clear here that the insurance level is very low in Srinagar although the district has a high urban population.

Figure 5.20: Percentage of Sample Households by Insurance to Property in Srinagar City



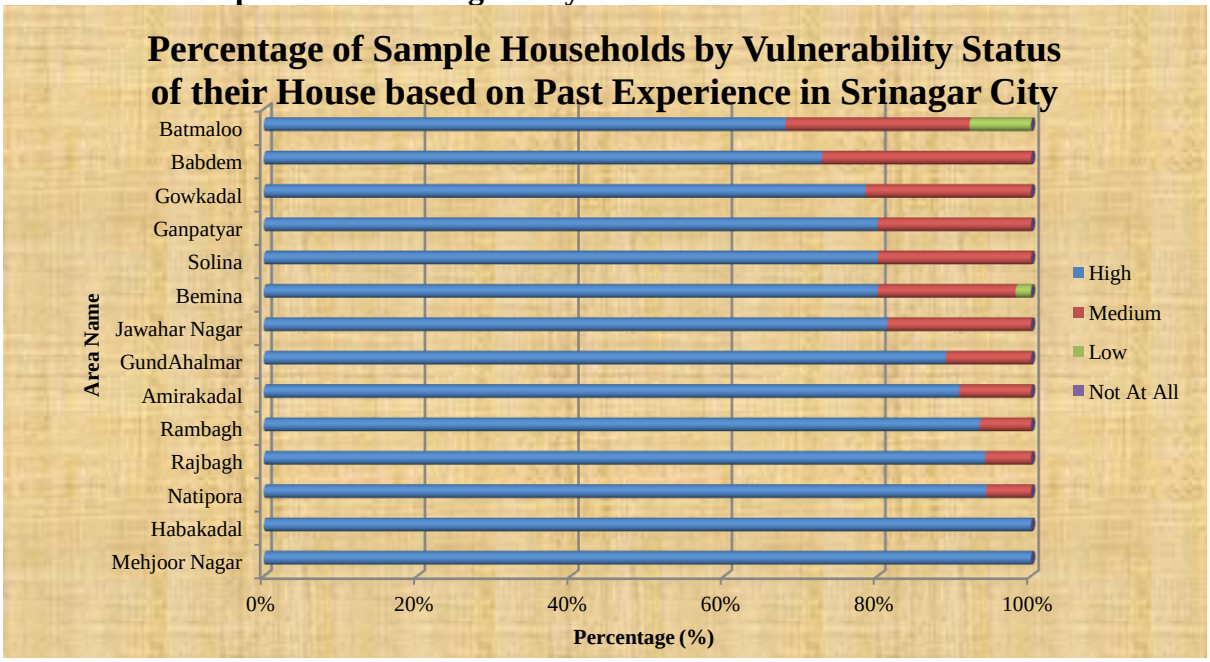
Source: Field Survey by Researcher.

5.5.8 Vulnerability Assessment of the Houses

Housing is one of the most critical sectors in the event of a disaster. Every year, disasters strike millions of homes. Nearly 92 million homes, schools, clinics, hospitals, and educational facilities were destroyed or damaged by storms and floods, accounting for nearly 98 percent of all houses damaged (EM-DAT, 2018). The effects of disasters on society and the environment will be measured by the quality of housing, poverty levels, infrastructure conditions, and public understanding of disaster risks and preparedness (F B Olorunfemi, 2008). There is a horizontal growth of houses in the study area, which has resulted in congestion. This urbanisation has occurred in areas that are unfit for human habitation. This area is particularly occupied by the urban poor who are more vulnerable to floods. This type of defective urban fabric and unregulated constructed houses is one of the key drivers in these areas. Srinagar residents are exposed to hazards like floods and earthquakes, and they cause huge damage to their housing structures. During the field survey, the vulnerability assessment of the house was noted down. The vulnerability status of the house was divided into High, Medium, Low, and Not and All categories based on the Material and Location of the structure. Figure 5.21 shows that all the respondents in Mehjoor Nagar and Habbakadal have indicated the high vulnerability status of their houses to floods while this percentage was 94.12 % in Natipora, 94% in Rajbagh, 93.33% IN Rambagh, 90.63% in Amira Kadal, 88.89% in GundAhilmar, 81.25% in Jawahar Nagar, 80% in Bemina, Solina and Ganpatyar, 78.40% in Gowkadal, 72.73% in Babdem and 68% in Batmaloo. On the other hand, 27 % of respondents in Babdem have indicated the medium vulnerability status of their house to

floods and this percentage is 24% in Batmaloo, 21.60% in Gowkadal, 20% in Solina and Ganpatyar, 18.75% in Jawahar Nagar, 18% in Bemina, 11.11% in GundAhilmar, 9.38% in Amirakadal, 6.67% in Rambagh, 6% in Rajbagh and 5.88% in Natipora. It is clear here that in all the sample areas, more than 68 percent of respondents have indicated their settlements are highly vulnerable to floods. These settlements are either located in low-lying areas, or they are made up of Kucha and semi kuchha materials. Urban planning policies and building codes that regulate land use in Srinagar have been observed not being periodically updated and strictly implemented to suit the city's new growth direction. Local planning bodies in Srinagar are inefficient and underequipped when it comes to enforcing planning regulations to reduce disaster risks. As a result, it is necessary to examine these problems and provide guidance to people on how to grow sustainably such that disaster risk is reduced to a great extent.

Figure 5.21: Percentage of Sample Households by Vulnerability Status of their House based on Past Experience in Srinagar City

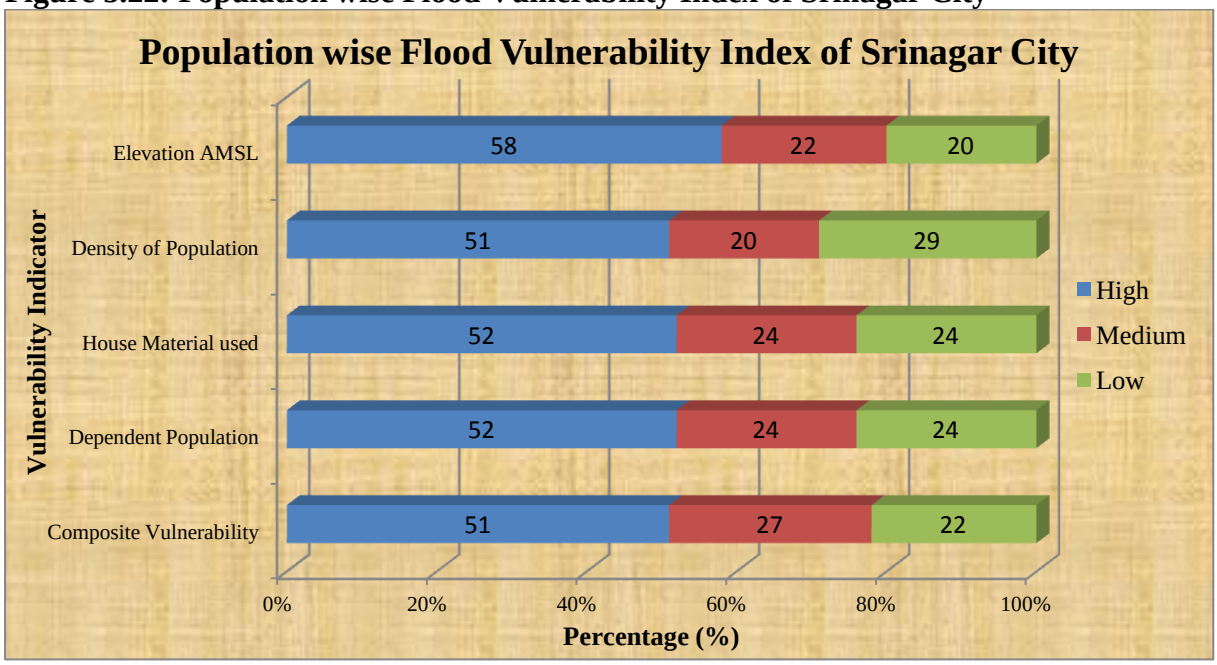


Source: Field Survey by Researcher.

The statistical models used to derive various vulnerability indexes in Srinagar city show that the susceptibility of flooding is high in Srinagar city. The index of house material used for construction shows that 42 % of the area, 50 % of wards & 52 % of the population are highly vulnerable to flooding in Srinagar city. The terrain elevation vulnerability index shows that 45 % of the area, 62 % of the wards, and 58 % of the population in Srinagar city are highly susceptible to high flood vulnerability. The density indicator used to derive flood vulnerability also shows high flood vulnerability with 51 % of the population is susceptible to high flood vulnerability. The index of composite flood vulnerability depicts that 44 % of the wards, 35 %

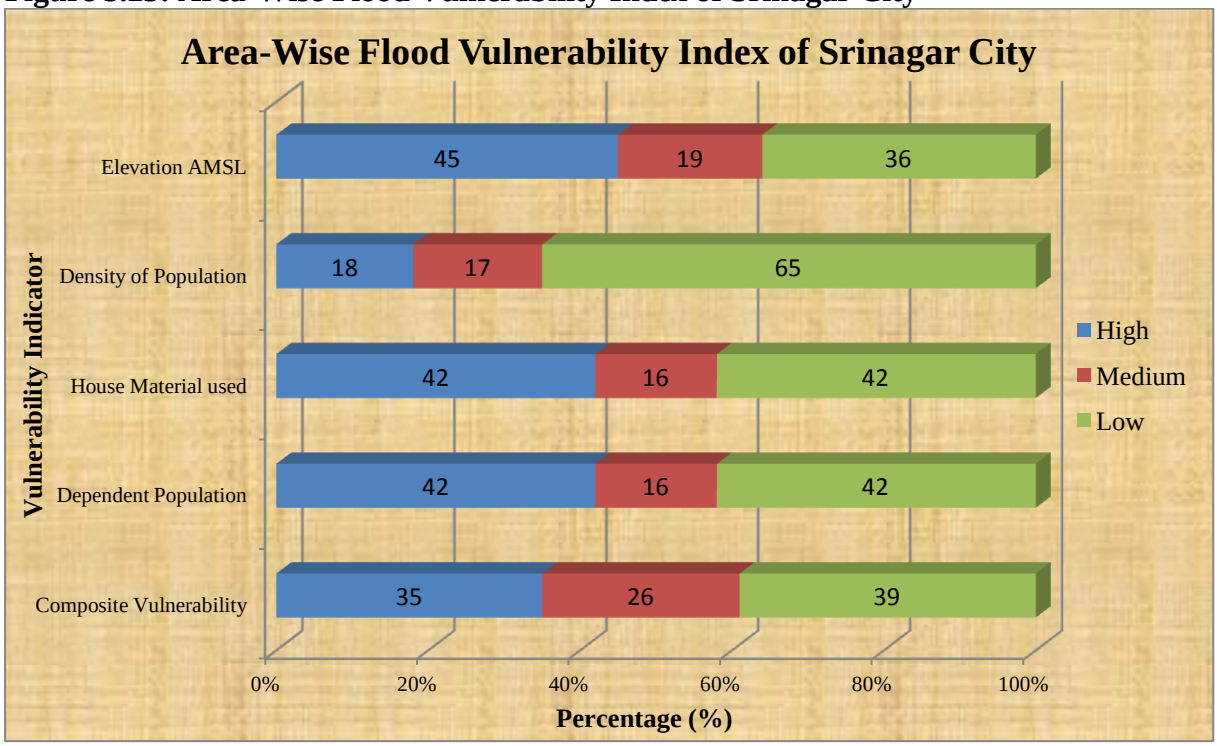
of the area, and 51 % of the population are highly susceptible to floods in Srinagar city. Thus it is clear from the analysis of the above indicators that a significant proportion of area and population is affected by the issue of flooding and the haphazard and unplanned development has made them vulnerable to flood in Srinagar city. (Refer Fig. No 5.22, 5.23 & 5.24)

Figure 5.22: Population wise Flood Vulnerability Index of Srinagar City



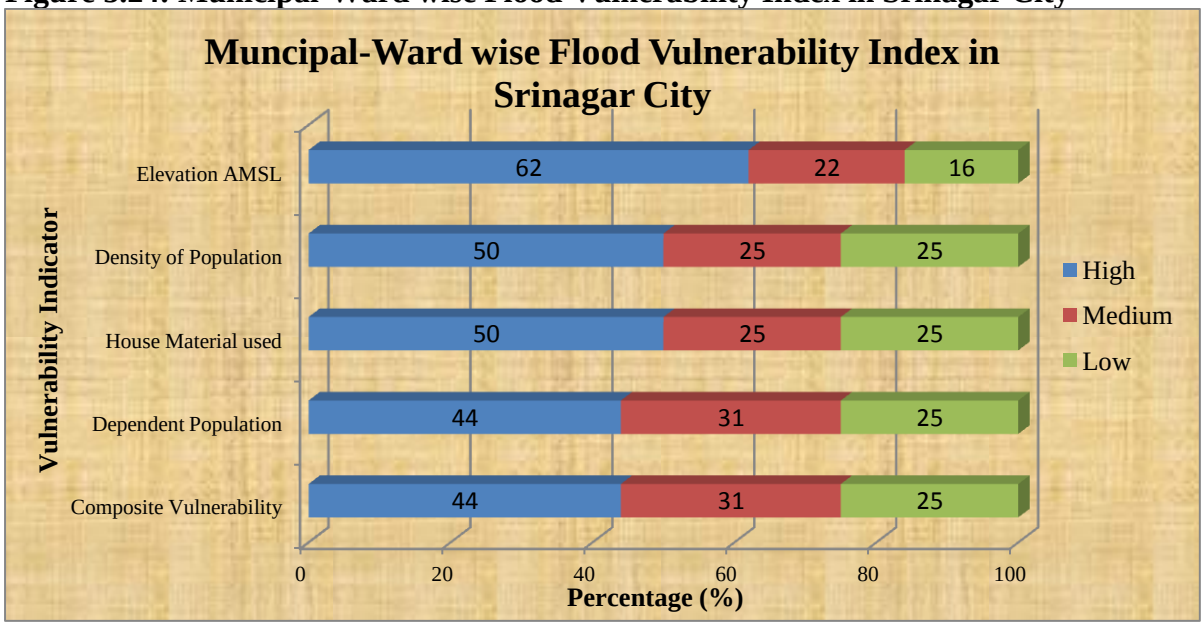
Source: Census of India.

Figure 5.23: Area-Wise Flood Vulnerability Index of Srinagar City



Source: Census of India.

Figure 5.24: Municipal-Ward wise Flood Vulnerability Index in Srinagar City



Source: Census of India.

5.5 The issue of social vulnerability to flood in Srinagar city

Flood risk management and flood damage assessment are also based on vulnerability research. Flood vulnerability has been identified as the primary cause of disasters. It seems that we need to work on our vulnerability awareness (J.T.Klein, 2006).

The subject of vulnerability is also a good tool to research disasters. For the majority of the twentieth century, the emphasis of vulnerability was on physical vulnerability, stressing infrastructure and technology. However, as catastrophe patterns, patterns, and trends change, and as the population grows, the idea of social responsibility becomes more important. In the 1970s, vulnerability was first used in the context of disaster management, when it was realised that vulnerability also includes socioeconomic factors that affect community resilience (Juntunen, 2006). We are all aware that disasters have affected Jammu and Kashmir at a certain level. Hazards that cause these disasters are likely to occur in the future. Earthquakes and flooding are large-scale threats, while flash floods and landslides are small-scale hazards. When a hazard causes significant loss of life and property, it is called a catastrophe. As a result, disasters can have catastrophic effects on the social, economic, and health aspects of affected areas and their inhabitants.

The following formulae demonstrate the significance of risk indicators in disaster management:

Risk = Hazard * (Vulnerability – Resources)

Where

* Risk is the expectation or likelihood of loss;

*Hazard is the condition posing the threat of harm;

*Vulnerability is the extent to which a person to a thing is likely to get affected; and

*Resources are those assets in place that will diminish the effects of hazards.

The problem of exposure to hazards has become increasingly prevalent over time. The changing Man-Environment relationship has complicated disaster risk mitigation initiatives over time. As a result, disaster risk mitigation requires an understanding of the complexities of disaster vulnerability.

Floods and earthquakes, as we all know, are major disaster threats to Srinagar region, and they are among the oldest and most well-known disasters. Historical data also shows that the frequency, intensity, and length of floods in Srinagar have increased since 1960, causing severe human suffering and significant economic harm. Human vulnerability to flooding has increased as a result of rapid population growth and changes in land use and land cover. Natural disasters triggered disasters in the past, but anthropogenic influences such as population growth, population density, encroachment, and housing density have changed the frequency, pattern, and trend of disasters over time. As a result, it appears that assessing an area's vulnerability in the sense of socioeconomic vulnerability is important. Srinagar's social vulnerability is being investigated to determine ward-by-ward social vulnerability in the area. Total population, population density, housing density, female population, female literacy, primary working population, and elevation are some of the main indicators used to assess social vulnerability in Srinagar. A social vulnerability index for Srinagar has been created based on these indicators. To show the degree of vulnerability, this index is divided into three categories: high, medium, and low. The social vulnerability scores for all 68 Wards of Srinagar city were determined by combining individual variable scores, as shown in Table 5.2 and Map No. 5.1. It indicates that 33.82 percent of wards (23) are socially vulnerable, while 38.24 percent of wards (26) are socially vulnerable. However, 27.94% of wards (19) have a high level of social insecurity.

Table 5.2: Social vulnerability to floods in Srinagar city

Category	Composite Score	No of Wards	Percentage of Wards	Name of the Ward
High	0.401 – 2.389	19	27.94	Nawab Bazar, Barbarshah, Ganpatyar, Bemina West, Chanpora, Nundreshi Colony, Khan Khai Moula, Mehjoor Nagar, Makdoom Sahab, Natipora, Magarmal Bagh, Nishat, Aloochi Bagh, S.R Gunj, Aali Kadal, Malik Angam, Batmaloo, Sheikh Dawood colony, Islamyarbal.
Medium	-0.382 – 0.401	26	38.24	Zainakot, Kawadara, Dalgate, Zadibal, Safa kadal, Hassanabad, Alastang, Khonmoh, Tarabal, Syed Ali Akbar, Baghat Barzulla, Lawey pora, Rawal Pora, Wazir Bagh, Sheaheed Gunj, Idd Gah, Palpora, Harwan, Qamarwari, Humhama, Jogi Lankar, Karan Nagar, Aqil Mir Khanyar, Dara, Khawja Bazar, Chattabal.
Low	-1.064 - -0.382	23	33.82	Ahmad Nagar, Tealbal, Hazratbal, Soura, Ummer Colony, Bud Dal, Zakura, Zoonimar, Buchpora, Zind Shah Sahab, Khumani Chowk, Jamia Masjid, Lal Chowk, Jawahar Nagar, Lal Bazaar, Maloora, Madin Sahab, Bemina East, Nowshera, Lokut Dal, Pandrathen, Rajbagh, Parimpora.

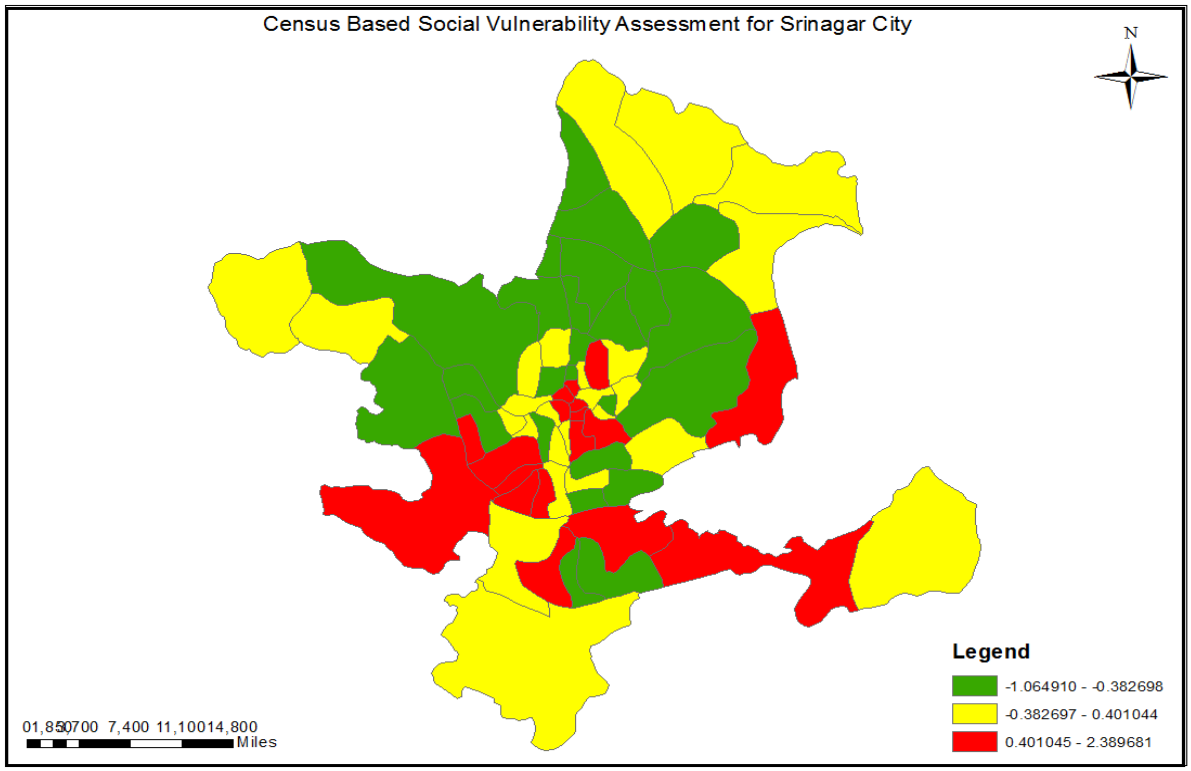
Source: Calculated by the Researcher

One of the most significant developments made by this study is the selection criteria for social vulnerability variables, which has provided an idea of the degree of people's vulnerability to disasters. To come up with place-specific variables for Srinagar, a participatory approach was combined with literature. During the field survey, respondents were the first to identify the variables before being used in the analysis of the SVI. The ward-wise analysis of the Social

vulnerability index in Srinagar presents interesting results. It shows that 19 wards in Srinagar city are socially more vulnerable to disasters which can experience huge damage at the time of disaster while 26 wards are medium vulnerable to disasters. On the other hand, 23 wards are low vulnerable to disasters. The detailed analysis of the ward-wise social vulnerability of Srinagar city is as:

High Social Vulnerability: The analysis shows that nineteen wards have high levels of social vulnerability to floods and earthquakes. The vulnerability value of these wards varies from 0.401 – 2.389. these wards are Nawab Bazar, Barbarshah, Ganpatyar, Bemina West, Chanpora, Nundreshi Colony, Khan Khai Moula, Mehjoor Nagar, Makdoom Sahab, Natipora, Magarmal Bagh, Nishat, Aloochi Bagh, S.R Gunj, Aali Kadal, Malik Angam, Batmaloo, Sheikh Dawood colony, Islamyarbal. These vulnerability issues are likely to remain the same and will increase over time unless policy interventions are made. These wards account for 27.94 Percent of Srinagar city. However, this high vulnerability of these wards is the result of changing demographics, social and economic attributes. The socially vulnerable wards are in the lower parts of the district where the physical exposure to flood hazards is very high, and their socioeconomic conditions are also worse than other parts.

Map 5.1: Census Based Social Vulnerability Assessment for Srinagar City



Source: Census of India.

Medium Social Vulnerability: The analysis of Map No 5.1 shows clearly that twenty-six (26) wards are in the medium social vulnerable index, which accounts for 38.24 Percent of the Srinagar city. The Vulnerable weight of these wards varies from -0.382 – 0.401. these wards are as Zainakot, Kawadara, Dalgate, Zadibal, Safa Kadal, Hassanabad, Alastang, Khonmoh, Tarabal, Syed Ali Akbar, Baghat Barzulla, Laweypora, Rawal Pora, Wazir Bagh, Shaheed Gunj, Idd Gah, Palpora, Harwan, Qamarwari, Humhama, JogiLankar, Karan Nagar, Aqil Mir Khanyar, Dara, Khawja Bazar, Chattabal. It is clear here that population growth is the basic indicator that increases the vulnerability of the area to various disasters. The growth of population in these wards has led to growth in population and housing density which has led to their vulnerability to disasters in general and flood and earthquake in particular whereas the other indicators which have increased their vulnerability area low literacy level, medium elevation, and engagement of people in the primary sector.

Low Social Vulnerability: The analysis shows that 23 wards have a low social vulnerability to disasters, and they account for 33.82 Percent of Srinagar city. The vulnerability weight of these wards varies from -1.064 - -0.382. These wards are as Ahmad Nagar, Tealbal, Hazratbal, Soura, Ummer Colony, Bud Dal, Zakura, Zoonimar, Buchpora, Zind Shah Sahab, Khumani Chowk, Jamia Masjid, Lal Chowk, Jawahar Nagar, Lal Bazaar, Maloora, Madin Sahab, Bemina East, Nowshera, Lokut Dal, Pandrathen, Rajbagh, Parimpora. It is important to mention here that the elevation of a place is not the sole indicator to divide the vulnerability criteria of an area. However, it is the function of various Demographic, social, and economic factors that are the basis to assess the social vulnerability of a place. A place's low elevation does not necessarily make it vulnerable to flooding, and other factors such as population density and housing density are critical in determining an area's vulnerability status.

SVI can serve as a potential predictive power for state and local disaster management staff to target certain groups that may be socially vulnerable before, during, and after a danger case, as seen in the above study. The social vulnerability index can be used to assist and direct state and local authorities in their efforts to ensure the safety and well-being of their residents, since they are the most educated about the people in their neighbourhoods. The social insecurity index will assist agencies at all levels of the crisis cycle. In disaster preparedness, response, recovery, and rehabilitation, it plays a critical role.

5.6 Conclusion:

Flooding is clearly caused by a number of factors, including the expansion of the built-up region, the encroachment of Riverbeds, Wetlands, and swampy areas, haphazard urbanisation, ill drainage networks, deforestation in Jhelum River catchment areas, and river channel siltation. The river Jhelum, which receives water from its left and right bank tributaries, flows from the south to north direction. however, environmental degradation and encroachment in its catchment area have changed its flow, and it starts flowing above its banks and cause huge damage to life and property. During the Field survey also, the dilapidated condition of the flood channels and urban drainage system was observed which affects not only the health of people but is also the important reason in decreasing the flow discharge of the Jhelum river. this poor and improper maintenance of the Flood Channels and drainage system was also revealed by the respondents during the household survey.

From this analysis, vulnerability emerged as the key theme of the hazard analysis. There are many areas in the Srinagar district which are susceptible to natural calamities like earthquakes, landslides, floods, and erosion. A high-intensity earthquake in the congested locality can cause huge damage to life and property due to a lack of planning and engineering techniques applied to the built infrastructure. Therefore, in this direction, to plan and identify the vulnerability of Srinagar city a household level primary survey was conducted to study the various dimensions of flood preparedness, response, recovery, and rehabilitation in the study area.

SVI can serve as a potential predictive power for state and local disaster management staff to target certain tracts that may be socially vulnerable before, during, and after a danger case, as seen in the above study. The social vulnerability index will serve as a design to aid and guide state and local agencies in their attempts to ensure the protection and well-being of their constituents, as they are the most informed about their people in their neighbourhoods. At all stages of the crisis cycle, the social vulnerability index will help agencies. It has an important role to play in disaster preparedness, response, recovery, and rehabilitation.

Chapter VI

Strategies and Measures taken by different stakeholders in the Mitigation of Flood.

Floods cause massive damage and loss of life and property all over the world. From 1995 to 2005, the total annual flood damage was $753.17 million, compared to $ 286.51 million in the previous ten years (EMDAT, 2019). Increased population, rapid urbanisation, increased construction activities in flood plains, encroachment of wetlands, and climate change are all contributing to an increase in the severity and frequency of floods. Recent events in Srinagar city (1996, 2000, 2014) highlighted the vulnerability of people to flooding. The flood of 2014 in Srinagar city caused huge damage to life and property. The database shows that the 2014 floods in Jammu and Kashmir killed 298 people, affected 275000 and damaged 16000000000 US $ worth of property (EMDAT, 2019). It cut off the link of Kashmir valley with the rest of the country, and the main roads were affected by it as well as more than 30 bridges were affected which hindered the rescue and relief operations. The state of preparedness for response, rescue, and rehabilitation in Srinagar city was negligible.

The role of various agencies in livelihood resilience during and after a flood is critical in reducing vulnerability. During floods, all food products are lost, and households' livelihoods are reliant on relief from outside sources, which is dependent on cooperation between various actors to get it to the affected region. On the other hand, the structure was destroyed quickly, and its reconstruction will take longer than anticipated, depending on the pace and expediency at which external agencies provide relief. As is well established, floods do not affect only one person; they affect the entire community, necessitating coordinated flood mitigation efforts, as any group response to disaster effectively reduces the impact on the affected households' livelihood resilience. Three of the Sendai Framework's goals for disaster risk reduction are strengthened disaster risk governance, resilient investment, and effective preparedness for effective response and to Built Back Better in recovery, restoration, and reconstruction (UNISDR, 2015). As a result, emergency recovery necessitates a deep political commitment to putting in place an efficient preparation and coordination mechanism at both the governmental and societal levels. As disaster management preparation is a sequential and continuous process, preparedness plans should be detailed in size and activity. Effective disaster preparation necessitates systematic diagnosis, resource assessment, and ongoing input in order to achieve disaster mitigation objectives. It becomes clear that all stakeholders must be involved in disaster management at all stages: disaster preparedness and prevention, disaster incident phase, response phase, and recovery phase, which includes restoration and reconstruction processes. As a result, the aim of this chapter is to investigate the degree of preparedness of various agencies to deal with floods in Srinagar region, as well as the steps

taken by various stakeholders following the flood of 2014 to mitigate the impact of future floods in the Kashmir valley.

6.1 Role of State during Floods in Srinagar city

Disaster management comes under the state list, in accordance with the country's federal structure. As a result, it is primarily the responsibility of the state government to deal with natural disasters. The central government plays a supporting role. It augments the state governments' physical and financial capabilities. Despite the fact that Jammu and Kashmir has a long history of flood control, the state has remained a blind spot in the monitoring and flood forecasting systems of both the Central Water Commission and the Indian Meteorological Department. The Central Water Commission (CWC), India's premier water management body responsible for flood forecasts and related advisories to states, had no flood forecast for any position in Jammu and Kashmir during the September 2014 floods. On September 6, 2014, the CWC's flood forecast list included 18 level forecasts and eight inflow forecasts, but none for Jammu and Kashmir (CWC, 2017). The hydrographs of the Jammu and Kashmir rivers are not even included in the Centre Water Commission's flood prediction (CWC, 2017). Despite the fact that the India Meteorological Department's website suggested that the state was experiencing heavy rainfall (South Asia Network on Dams, 2013). The September 2014 floods impacted a total of 1.16 million people out of a total of 1.27 million people in the Srinagar Urban Agglomeration, accounting for 91% of the population (NRSC & ISRO, 2014). 118.75 square kilometres, or 52 percent of the Srinagar city agglomeration's 227.41 square kilometres, is totally flooded/ submerged. Residential, industrial, agricultural, Hospitals, Military Bases & Administrative buildings were among the completely inundated areas in Srinagar region. A total of 84 percent of the total inundated area was made up of agricultural, industrial, residential, and open areas. For many days, even major educational institutions and hospitals were totally submerged. As a result, flood victims were unable to be evacuated to safer areas such as open areas and educational facilities. Unfortunately, emergency services were also suspended, and patients who had already been admitted to hospitals were left isolated for several days without assistance. The preparedness of the state to deal with the flood was negligible.

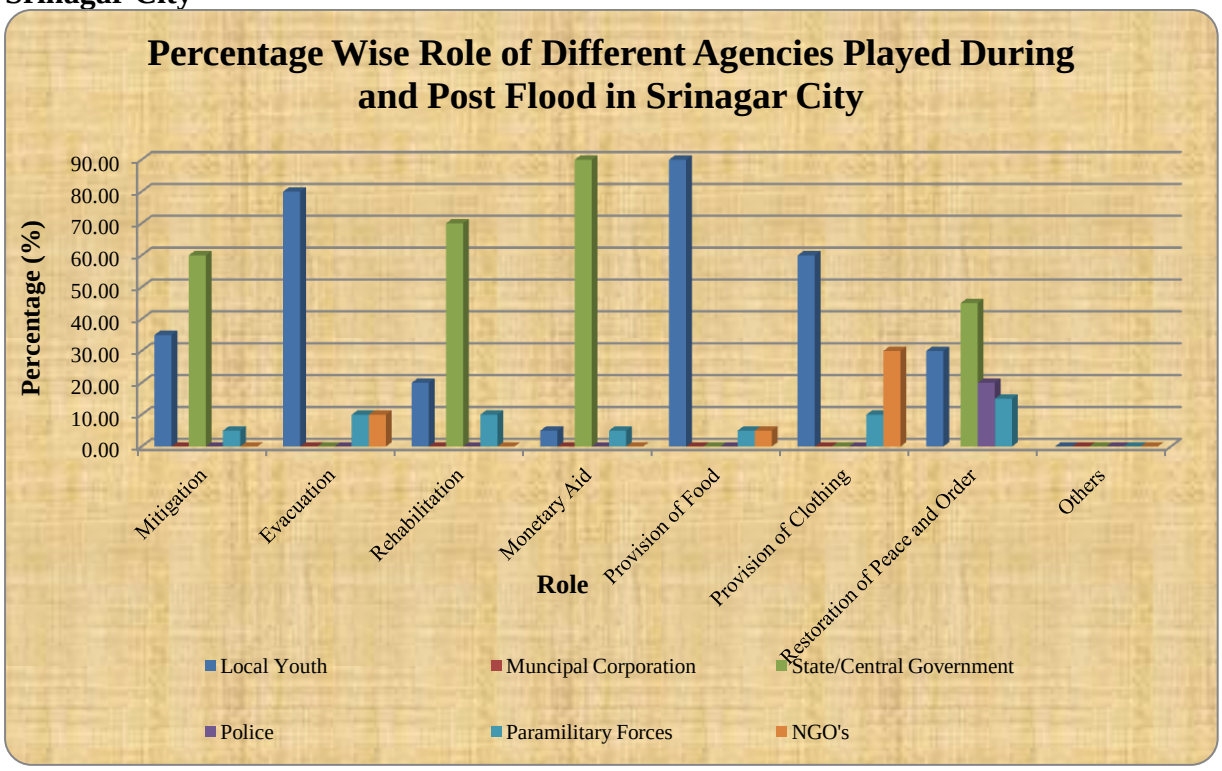
The flood was dubbed "one of the worst floods in history." “I had no government for the first 36 hours as the seat of the establishment was wiped out,” Dr. Omar Abdullah, the then-Chief Minister of Jammu and Kashmir, had to admit.

6.1.1 Assessment of the role of different agencies during flood

Despite the advances made in flood risk mitigation engineering over the last 15 years, flooding remains a major problem that poses a danger to life and property. Flood risk management now includes both systemic and non-structural interventions. Furthermore, international and regional treaties such as the Sendai Framework (2015), which encourages public engagement in disaster reduction, acknowledge the importance of stakeholder participation in decision-making as well as during response and recovery. However, emergency management was in a bad condition. During the primary survey respondents were asked questions related to the role played by various agencies during flood 2014 in flood mitigation, Evacuation, Rehabilitation as well as in Monetary Aid, Provision of Food, Clothing, and Restoration of peace and order. As is evident from figure 6.1, respondents reveal that 60 Percent of flood mitigation was done by the government followed by local youth which is 35 Percent who played all over an important role in flood mitigation while the rest of the 5 Percent mitigation was done by paramilitary forces. The respondents revealed that 80 Percent of the Evacuation of people from flood-stricken areas was done by the local youth while 10 Percent reach was done by Paramilitary Forces and Non-Governmental Organisations. There was no role of government during the flood as the seat of power was wiped by the flood. In the rehabilitation process, the role of government has played an important role. Financial assistance has been provided by the government to all those damaged by the flood. The respondents reveal that 70 Percent of help in the rehabilitation process was granted by the central/state government while 20 Percent and 10 Percent were provided by Local youth and paramilitary forces respectively. Regarding monetary aid to the people during and post-flood 2014 in Srinagar, the respondents reveal that 90 Percent of monetary aid was granted by the Central/State government while 5 Percent each Aid was provided by paramilitary forces and local youth. During the flood, local youth played an important role in the provision of food made available to affected people. During the field study, respondents reveal that 90 Percent of food was made available by the local youth to the people affected by the flood while 5 Percent each was made available by Paramilitary forces and Non Governmental Organisations. The respondents were also asked about the provision of clothing and other basic utilities made available during and after the flood in Srinagar city. It was revealed that 60 Percent of clothes and other utilities were made available by local youth to the affected people, 30 Percent were made available by Non Governmental organizations, and the rest 10 Percent were made available by the paramilitary forces. The

respondents revealed that the government played a very important role in the restoration of peace and order after the flood in Srinagar city. 45 Percent of respondents revealed that the government played an important role in the restoration of peace and order after floods while 30 Percent revealed that local youth played a role in restoration followed by police (20%) and paramilitary forces (15%). It becomes clear that there is a scope for various stakeholders to play during disasters and proper coordination among various stakeholders will play an important role in the mitigation of disasters in the future.

Figure 6.1: Percentage Wise Role of Different Agencies Played During and Post Flood in Srinagar City



Source: Field Survey by Researcher.

6.1.2 Respondent's Perception of Protective Measures, Preparedness and Disaster Management

Flood victim respondents were asked questions related to their perception of preparedness of disaster management in Kashmir valley during the September floods of 2014 and in November 2017. As is evident from Table No 6.1, disaster preparedness was absolutely nil, during the September floods of 2014. No steps had been taken by the government as well as a civil society towards disaster management issues related to the early warning system, mock drills for disaster risk- reduction, protective measures like de-siltation/ drugging, removal of encroachments like trees, constructions in the river channels, maintenance of river channels, bund walls in Srinagar city, adaptation of safety audits, etc. during September 2014 floods.

In November 2017, flood disaster victims reported that disaster prevention, safety measures, and preparedness had dramatically improved. The Hon'ble High Court of Jammu & Kashmir's directives have bolstered government agencies' ability to enforce effective protective measures, such as removing encroachments (both trees and illegal structures) on river channels. The national government has also created an atmosphere conducive to implementing rules and regulations, especially zero tolerance for illegal encroachments in river channels. The rules and regulations about river and flood channel encroachment have been properly communicated to the community. Also people and civil society organisations have a greater understanding of disaster-risk reduction techniques. They've seen a major change in the methods used to reduce disaster risk, protect people, and plan for disasters. Government agencies have taken successful measures such as de-silting, drugging, bund wall maintenance, and river channel clearing. However, initiatives to raise awareness, such as safety assessments, building code enforcement, and the development of emergency resettlement centres, are not being considered. People are unaware of how often warning will be provided and what measures will be taken during the advance warning, despite the installation of early warning system equipment. More mock drills, as well as sufficient capacity building for the community, individuals, and other stakeholders, are needed (For more information, see Table No. 6.1.)

Following the September 2014 floods in Srinagar, respondents' attitudes toward disaster management and disaster risk mitigation have improved significantly, especially in terms of protective measures and government preparedness. Civil societies have also stepped up their efforts to raise disaster awareness in their communities. However, additional government and civil society actions are needed to make disaster risk mitigation a reality and to build disaster-resilient communities. (See Table No. 6.2 for more information.) Dredging, de-silting, and bunding for strengthening flood walls, strengthening embankments, removing illegal constructions, protecting and restoring wetlands, and strict implementation of rules and regulations related to maintenance are all major protective measures needed to avoid such flood disasters in the future, according to both government agencies, civil society organisations, and the community. Village and city local residential area committees should be given the authority to implement capacity-building initiatives. The most vulnerable groups, especially children, women, and the elderly, should be protected and evacuated as quickly as possible. In the event of an emergency, volunteerism should be promoted to help the victims.

Table 6.1: Percentage of Sample Households by their Perception of Preparedness of Disaster Management in Srinagar City in September 2014 and November 2017.

Indicator	September 2014 (%)		November 2017 (%)	
	Yes	No	Yes	No
Early Warning System	1.00	99.00	27.50	72.50
Awareness about flood eventually by Government	0.75	99.25	14.25	85.75
Awareness about flood eventually by Civil Society/ NGOs	1.75	98.25	21.75	78.25
Awareness through mock drills by Government	0.00	100.00	17.00	83.00
Knowledge of local rules and regulations, such as not building along river/flood channels.	11.25	88.75	45.00	55.00
Implementation status of such rules	0.00	100.00	8.00	92.00
Awareness of the government's de-silting and dredging operations for River Channels/Flood Spell Channels	0.75	99.25	24.00	51.00
Implementation of De-Silting and Drudging activities by Government for River Channels/ Flood Spill Channels	0.25	99.75	22.50	52.50
Your opinion on the enforcement of rules and regulations for the clearance of unregulated and illegal development along flood channels and river channels	0.75	99.25	24.25	50.75
Do you know if the government conducts any safety checks to prevent flooding in flood-prone areas?	0.00	100.00	20.00	55.00
Have you seen or heard about the government's efforts to reinforce flood defence walls/bunds? If you answered yes, how would you rate its execution?	1.25	98.75	27.75	72.25
Do you know (or did you know) that the government has designated secure evacuation zones in the event of a	0.00	100.00	0.00	100.00

disaster?				
How well do you think the government is prepared to deal with a situation like this in the future?	1.50	98.50	8.75	91.25
How well do you think the society is prepared to cope with a similar scenario in the future?	0.50	99.50	0.75	99.25

Source: Field Survey by Researcher

Table 6.2: Percentage of Sample Households by Level of Satisfaction related to Preparedness/ Capacity Building to meet the challenges of Flood disaster in Future.

Indicator	Level of Satisfaction (Percentage)		
	High	Medium	Low
Early Warning System	15	40	45
Awareness has given about flood eventually by Government	35	45	20
Awareness about flood eventually by Civil Society/ NGOs	70	25	5
Awareness through mock drills by Government	20	25	55
The knowledge of the rules and regulations for not building along river/flood channels was imparted.	30	50	20
Implementation status of such above rules	35	25	40
Awareness of government de-silting and dredging operations for river channels/flood spillways	55	35	10
Implementation of government de-silting and dredging operations for river channels/flood spillways	55	35	10
Laws and legislation are being enforced to demolish unregulated and unauthorised structures along river/flood channels.	60	25	15
Safety audits in place by the government to	0	5	95

avoid flooding in flood-prone areas			
Knowledge of steps taken by the government to strengthen flood protection walls/ strengthen bunds	45	30	25
The knowledge that the government has identified safe areas of evacuations in case of an emergency at the time of disasters	0	5	95
Government's overall readiness to deal with such a situation in the future	45	25	30
Overall community preparedness to deal with such a situation in the future	60	15	25

Source: Field Survey by Researcher.

6.1.3 Disaster Recovery and Rehabilitation

Disaster recovery and rehabilitation is an important aspect of disaster management that helps to restore normalcy and enable affected people to resume their everyday lives. Given the large-scale devastation, both state government and central government sanctioned relief to the victims of flood disaster for houses damaged and separately for shopkeepers and traders. The financial assistance to the affected households was mainly provided from the state disaster relief fund, Prime Ministers national relief fund, and Prime ministers development fund. Based on the level of damage, as shown in figure 6.3, households were divided into five classes with the varying amount sanctioned for the damage.

Table No 6.3: Flood Relief Amount Sanctioned to the affected Households (Amount in Indian Rupees)

	State Disaster Relief Fund	**PM National Relief Fund**	**PM Development Fund 2015**	**Total**
Fully damaged pucca	75,000	100,000	250,000	425,000
Fully damaged kutcha	17,600	50,000	100,000	167,600
Severely damaged kutcha	12,600	50,000	125,000	187,600
Severely damaged pucca	3800	10,000	50,000	63,800

Partially damaged pucca	3800	25,000	20,000	48,800

Source: State Disaster Management Authority.

The Revenue Department has released orders for the payment of financial assistance under the State Disaster Relief Fund (SDRF), Prime Ministers Relief Fund (PMNRF), and Prime Minister's Development Plan (PMDP) 2015 to the owners of houses destroyed by the September 2014 floods, following approval by the State Administrative Council. As per the information was given by the Divisional Commissioner's office, Kashmir Division, the total number of 6,161 houses (both pucca and kutcha) were identified as fully damaged, 25,504 Houses were identified as severely damaged, and 61,871 houses were identified as partially damaged. (Refer to Table No. 6.4). The relief amount has been distributed among the victims in installments from all three financial supporters. Up to November 2017, 80-90 Percent of the sanctioned relief money has been already distributed.

Table No 6.4: Statement of Details of Ex-Gratia Relief Sanctioned/ Disbursed to the flood victims of Sep. 2014.

Level of Damage	Type of House	Compensation is given by various agencies	No of Households
Fully Damaged	Pucca	Total Number of Households Damaged	6,048
		Total Number of Households paid under SDRF	5,839
		Total number of Households paid under PMNRF	5,537
		Total Number of Households paid under PMDP	5,495
	Kutcha	Total Number of Households Damaged	113
		Total Number of Households paid under SDRF	112
		Total number of Households paid under PMNRF	101
		Total Number of Households paid under PMDP	95
	Pucca	Total Number of Households Damaged	25,426
		Total Number of Households paid under SDRF	24,759
		Total number of Households paid under PMNRF	20,359

Severely Damaged		Total Number of Households paid under PMDP	19,588
	Kutcha	Total Number of Households Damaged	78
		Total Number of Households paid under SDRF	62
		Total number of Households paid under PMNRF	58
		Total Number of Households paid under PMDP	54
Partially Damaged	Pucca	Total Number of Households Damaged	61,798
		Total Number of Households paid under SDRF	58,402
		Total number of Households paid under PMNRF	53,021
		Total Number of Households paid under PMDP	49,751
	Kutcha	Total Number of Households Damaged	73
		Total Number of Households paid under SDRF	73
		Total number of Households paid under PMNRF	55
		Total Number of Households paid under PMDP	55

Source: Divisional Commissioner's office, Kashmir division.

6.1.4 Level of Satisfaction in the assessment of damage by a government agency.

Assessment of damage post-disaster is one of the most important works done by the state. Sendai's framework for disaster risk reduction emphasizes the role of government and other relevant stakeholders for a collective effort in response and recovery post-disaster. During the field survey, respondents were asked questions on the level of assessment done by government officials to access the level of damage to houses, household goods, crops, and livestock as well as respondents were also asked whether they have received compensation amount from the government for their damage. From the analysis of a primary survey in table 6.5, it has been found that 99 percent of the respondents have stated that the government officials have assessed the damage done by flood in 2014 in Srinagar city. However, the level of high satisfaction of assessment is 45 percent, 35 percent having a medium level of satisfaction, and 25 percent have a low level of satisfaction. However, the respondents revealed that household items damaged by the flood were not assessed properly by government officials. 98 percent of respondents have stated that the damage assessment of

household items was not done properly while the level of satisfaction of respondents with the government official's assessment of household items is very low. They said that no attention was given to assess the damage to households by the government. Similarly, in the assessment of damage to the livestock sector, the respondents revealed that government did not make a proper assessment of damage to the livestock sector and the level of satisfaction of respondents is also low in the assessment of damage in the livestock sector in Srinagar city. It is important to note that there is a need to increase the ethnic conduct of officials to conduct a proper assessment of any damage caused by any disaster. It will give people timely compensation to built back better infrastructure.

The study of financial assistance received by affected households post-disaster shows that about 75 percent of households have revealed that they have received more than 75 percent of the compensation sanctioned to them, 10 Percent of households have received about 50 – 75 Percent of their sanctioned amount and 15 percent of households have received less than 50 Percent of their sanctioned amount. The data collected from the divisional commissioner's office also revealed that some affected families have not yet received the whole amount of damage due to the delay of funds by various agencies.

Table 6.5: Level of Satisfaction in the assessment of damage by a government agency

Particular	**Damages Assessment Done (%)**		**Level of Satisfaction of assessment (%)**			**Money Received for the Damages (%)**		
	Yes	**No**	**High**	**Medium**	**Low**	**< 50**	**50-75**	**>75**
House	99	1	45	30	25	15	10	75
Household Goods	2	98	10	30	60	100	0	0
Crops	0	0	0	0	0	100	0	0
Livestock	10	90	10	15	75	95	0	5

Source: Field survey conducted by the researcher.

6.1.5 Assessment of insurance cover and state of disbursal of insurance amount.

Natural disaster costs have risen dramatically in recent decades, with floods being the most frequent and costly threat. Owing to sea-level rise and more severe precipitation events, flood-related damage is likely to increase in the future (Knutson, et al., 2010). As a result, flood

insurance in Jammu and Kashmir is significant and relevant to homeowners, policymakers, and other stakeholders. During the field survey, it has been seen that the insurance penetration in Srinagar city has been minimal, and there is a very minimal proportion of households having insurance cover to their houses and belongings. The state of insurance is directly related to the income of people. The households with a high-income level are more likely to insure their property than the households who are socially vulnerable and have low income. It has been found that out of 400 households surveyed during the field survey only 15 percent of households have insurance of their houses while 85 Percent of the households have not insured their houses (Refer to table 6.6). The state of financial disbursal by insurance companies shows that out of this 15 Percent, 95 Percent have received about 75 Percent money claimed by insurance while 5 Percent have received the insurance amount from 50-75 Percent of the amount claimed. It has also been found that none of the households has insured their household goods of daily use. The significance of insurance is further confirmed by a report released by the United Nations Office for Disaster Risk Reduction (UNISDR), which found that India lost $76 billion in economic losses between 1998 and 2017. In terms of absolute economic losses, India is among the top five countries in the world. Globally, catastrophe damages are estimated to have totaled $3 trillion over this time span. As compared to the previous two decades, these losses have risen by more than 120 percent in the last 20 years (1978-1997). As a result, victims were pleased with the insurance companies' prompt payment of insurance compensation. The victims praised the role of the judiciary in providing adequate guidance to the insurance firms. While few people had insurance for their homes, a large number of people had insurance for their businesses. People in the Kashmir valley have realised the importance of insurance due to the services provided by insurance companies (both life, property, and agricultural). The timely disbursement of insurance funds, according to the victims, aided their quick resettlement. Some citizens now choose to apply for insurances, so discussions with insurance providers supplemented the responses.

Table No 6.6: Assessment of insurance cover and state of disbursal of insurance amount

Particular	**Whether Property Houses Insured**		**If Insured % Received Money**		
	Yes	No	< 50	50-75	Above 75
House	15	85	0	5	95

Household Goods	0	100	0	0	0
Livestock	0	100	0	0	0
Agriculture Crop	0	100	0	0	0

Source: Field Survey by Researcher

6.1.6 Respondent's Level of Satisfaction towards Recovery and Rehabilitation Post Flood in Srinagar City

Recovery from a disaster is typically a slow process with the primary goal of restoring the place's organisation to its pre-disaster state. The Sendai System for Disaster Risk Mitigation has placed a premium on disaster preparedness in order to provide a more efficient response and improve recovery, restoration, and reconstruction (UNISDR, 2015). The steep increase in disaster risk, as well as the increased exposure of people and properties, combined with lessons learned from previous disasters, lead to the need to enhance disaster preparedness for response, act in advance of incidents, integrate disaster risk mitigation into response preparedness, and ensure that capacities are in place for successful response and rapid recovery. Women and people with disabilities must be encouraged to assume public leadership positions, and gender-equitable and widely available response, recovery, rehabilitation, and reconstruction interventions must be made available. Disasters also shown that the recovery, reconstruction, and rebuilding process, which must be prepared in advance, is a vital opportunity to "Build Back Better," particularly by integrating disaster risk reduction into planning measures and making nations and communities more disaster resilient. Respondents were also asked about the government's post-flood 2014 recovery and reconstruction efforts in Srinagar city during the primary survey. Table 6.7 indicates that 45 percent of respondents have a high level of satisfaction with government measures in the installation of emergency services such as electricity and water connections, whereas 40% have a medium level of satisfaction and 15% have a low level of satisfaction with government measures. In terms of the volume of relief, After the flood, 55% of respondents had a low level of satisfaction with the government, 35% had a medium level of satisfaction, and 10% had a high level of satisfaction, according to a survey conducted after the flood. It demonstrates that residents of Srinagar city are dissatisfied with the inadequate compensation they got following the flood. Similarly, 65 percent of respondents expressed high satisfaction with the government's effort in identifying flood victims for relief, while 25% expressed

medium satisfaction and 10% expressed low satisfaction with the government's effort in identifying flood victims. The respondents expressed high levels of satisfaction with the time it took to identify victims and distribute relief. As a result, it is clear that a large proportion of respondents were satisfied with the procedures used to identify victims for relief and compensation; however, they felt that it took longer, and that as a result, victims were unable to receive assistance when it was most needed. The victims were generally pleased with the distribution methods used, especially Direct Bank Transfer (DBT), which significantly reduced corruption and pilferage of the approved funds.

Table 6.7: Percentage of Sample Households by Level of Satisfaction related to Recovery and Rehabilitation measures taken by the government.

Indicator	Satisfaction Level (Percentage)		
	High	Medium	Low
Installation of Emergency Services like Electricity, water connections, etc.;	45	40	15
Amount Relief Sanctioned	10	35	55
Identification of victims for relief	65	25	10
Time taken for identification of victims	55	30	15
Distribution of Relief and Compensation	25	60	15
Time taken for distribution of relief and compensation to victims	55	25	20
Methods of distribution of relief/ compensation – Direct bank transfer	84	10	6

Source: field survey conducted by the researcher.

6.1.7: Respondent's level of satisfaction towards Government/Community/Civil society Strategies adopted to prevent disaster In future.

The study of measures taken by government/community/civil society in the mitigation of disasters in the future has shown a positive response from the respondents where 60 Percent of respondents have shown a high level of satisfaction with the maintenance programs of government/community/civil society to clear creeks of vegetation and debris which impede the flow of water while 25 Percent of respondents have shown a medium level of satisfaction and 15 Percent of respondents have shown a low level of satisfaction.

Regarding the enlargement of creeks/stream channels by the government/community/ civil society, 45 percent of the respondents have revealed a high level of satisfaction while 35 Percent of the respondents have revealed a medium level of satisfaction and 20 Percent of the respondents have revealed low level of satisfaction. Similarly, regarding the construction of detention basins on the flood plain by the government/community and civil society 50 Percent of the respondents have shown a low level of satisfaction while 30 Percent have shown a medium level of satisfaction and 20 Percent of respondents have shown a high level of satisfaction. Similarly, the measures are taken to improve the stormwater system of the Jhelum floodplains also showed high satisfaction among the respondents while the construction of permanent levees along the creeks/ streams to contain the floodwaters show a low level of satisfaction among the residents. The residents were asked about the funding or subsidies provided by the government to raise houses above major flood level in low hazard areas has shown a low level of satisfaction among the respondents. The respondents revealed that no such measures were taken by the government. Regarding flood warning and evacuation procedures followed before and during a flood by various agencies, 16 Percent of respondents reveal a high level of satisfaction while 35 Percent of respondents revealed a medium level of satisfaction and 49 Percent of respondents had shown a low level of satisfaction. The measures are taken by different stakeholders regarding imparting community education, participation, and flood awareness programs among the people have shown a high level of satisfaction. The respondents have revealed that various measures were taken by the government to disseminate flood awareness information through various programs, including mock drills. The respondents have also shown a low level of satisfaction with the government measures taken to provide a certificate to purchasers in flood-prone areas stating that the property is flood-affected and there are chances of the flood in the future also. The above study shows that measures were not taken on all fronts to educate and adopt strategies to prevent loss due to disaster in the future.

Table No 6.8: Respondent's level of satisfaction towards Government/Community/Civil society Strategies adopted to prevent disaster In Future.

Indicator	Satisfaction Level (%)		
	High	Medium	Low
Maintenance Programs to Clear Creeks of Vegetation and Debris Impeding Flows.	60	25	15

Enlarge the Creek/Stream Channels.	45	35	20
Construct Detention Basins on the Flood Plains	20	30	50
Improve the Storm Water System of The Jhelum Flood Plains.	55	30	15
Construct permanent levees to contain floodwaters along creeks and streams.	10	25	65
Raise Houses Above Major Flood Levels in Low-Hazard Areas with Funding or Subsidies.	0	15	85
Improve Flood Warning and Evacuation Procedures Both Before and During a Flood.	16	35	49
Community Education, Participation, and Flood Awareness Programs.	45	35	20
Provide buyers in flood-prone areas with a certificate specifying that the property is flooded and to what extent.	20	35	45

Source: Field survey conducted by researcher

6.1.8 Measures taken post-September 2014 floods for disaster risk reduction

6.1.8.1 Installation of Early Warning Systems

- In 2015, the Srinagar meteorology office installed a high-tech weather forecasting system from Japan (Doppler radar). It has a 100-kilometer coverage area and will be able to accurately predict the amount and form of precipitation for up to six hours. Pulse-Doppler radars are used in this weather radar technology, which can track the motion of rain droplets as well as the severity of the precipitation. Both types of data can be processed and analysed to figure out how strong storms are, how they travel, and how much damage they can do. As a result, in the event of natural disasters such as cloudbursts and flooding, the Doppler weather radar will be able to warn people ahead of time, reducing the loss of life and property.
- In addition to weather forecasting, IFC Kashmir has created an android mobile application, "IFC KASHMIR," in collaboration with Dream Code Developers, that allows people to see the water levels at various gauges with a single click and keeps them updated on the situation on the ground.

- The weather forecasting station will be able to track the state's weather patterns 24 hours a day, 7 days a week.
- It will be able to include regular forecasts twice a day (10:00 AM and 8:00 PM). The forecast will be posted on the website as well (www.imd.gov.in).
- The forecast office will also use the services of Doordarshan Television (DD), Radio Kashmir, and other stakeholders to communicate the information to the public via email and phone.
- The IFC KASHMIR will be able to provide weather predictions for the Srinagar-Jammu and Zojila highways.
- Its services will also be used to provide weather forecasting to the state government in order for the Amaranth Yatra to be safe and fruitful.

Other weather Services of the Meteorological Office in Srinagar will include:

Bi-weekly weather forecasts for farmers in Jammu and Kashmir divisions separately, in collaboration with Sheri-Kashmir University of Agricultural Science and Technology (SKUAST), environmental monitoring and air quality monitoring for Srinagar

The Srinagar and Jammu seismological observatories will provide earthquake data for these two cities.

Supply of meteorological data to various users for research

Any information related to the weather of Jammu & Kashmir and general weather forecasting

It is critical to ensure that adequate and prompt notification reaches target audiences, as well as that the local public understands how to respond and what to do in the event of an emergency. This is dependent on how decentralised the alert systems are. Realigning alert systems to meet community needs necessitates community engagement in order to understand those needs, identify people's contacts, evaluate risks, and manage public perceptions of the warning system.

The State Disaster Management Authority (SDMA) of Jammu and Kashmir announced that all possible measures would be taken to raise public awareness so that people can respond quickly. The preparedness aspect of an imminent disaster early warning system should be as transparent, ready, and well-known to end-users as possible. Through IEC (information, education, and communication) initiatives, public awareness of early warning systems,

including response mechanisms, improves the success of warning messages. When the public has been informed and sensitised about the danger, and people have worked out a response plan ahead of time, alert responses are most appropriate and effective, though the concerned agencies will have to work closely with the IMD in both Srinagar and Jammu. Early warning systems must be people-centred in order to be successful, and they must include the following elements: knowledge of the threats, technological monitoring, and awareness of the warning service. The immediate and rapid distribution of meaningful alerts to those at risk through the media is needed. Failure of any one of these elements will indicate failure of the entire early warning system.

6.1.8.2 Drudging and de-siltation

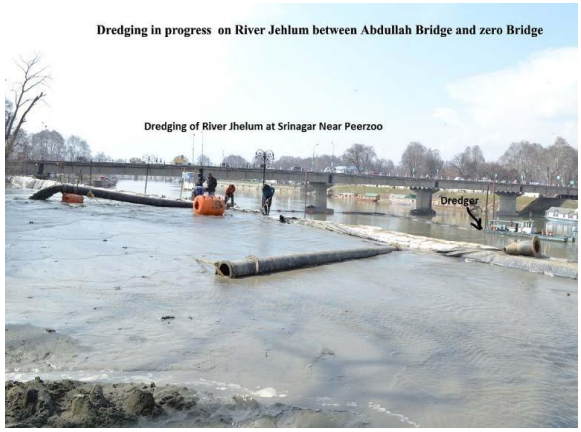
The increasing flow of sediments in the Jhelum River has reduced the depth of the river Jhelum in the Valley of Kashmir, therefore the carrying capacity of water discharge has reduced drastically. One of the possible measures which have been used from historical times to reduce the probability of recurrent floods has been drudging and desiltation. Unfortunately, both these measures were forgotten by the flood management authorities due to lethargy for a long period. The flood disaster 2014 gave a clear warning to the state administrators, community, and individuals that unless these steps are taken seriously, such floods can continue. The state administration has been ordered to dredge and desilt the main course of the Jhelum River in the plains of Kashmir Valley by the High Court of Jammu and Kashmir. The dredging goal was 7 million cubic metres, according to the irrigation and flood control department, with approximately 6.80 million cubic metres achieved. The plan's second step is projected to boost the Jhelum's water carrying capacity to "its full capacity of 60,000 cusecs [cubic feet per second] in South Kashmir." This capacity will be increased to 35,000 cusecs in

Srinagar. The remaining 25,000 cusecs will be routed into the flood spill channel, which will have its discharge capacity expanded as well. Dredging in the flood spill channel from Padshahibagh in Srinagar to Wular in Bandipore district of north Kashmir has been completed to the tune of 25,720 cubic metres, compared to a target of 38,100 cubic metres, according to the irrigation and flood control department. The dredging and desiltation works were carried out by a number of reputable companies.

Dredging/Desilting of river Jhelum was carried through REACH Dredging limited Kolkatta (CCCCGDCL-JV).

- BELLMOUTH OF FSC PANZINARA: The work from RD 68.60 KM-68.88KMS was completed and now has been started from RD69.355-70.650KM. Quantity dredged till date June 2016 was 7000 cubic meters
- OUTFALL CHANNEL BARAMULLA: The said company has started operation at Sopore on 28-04-2016; however at Khadanyar the dredging operations have been halted due to increased water level. Quantity dredged till June 2016 was 10,000cum.

Figure: 6.2: Drudging and desiltation of Jhelum river in Srinagar



Widening of Jhelum River at Soitung Srinagar

The planting of a tree along the river course, which obstructed the free flow of water discharge, was also reported as a major cause of the reduction in the carrying ability of discharge water during heavy floods. The High Court of Jammu and Kashmir constituted a high-level committee, headed by the Divisional Commissioner, Kashmir, on February 24,

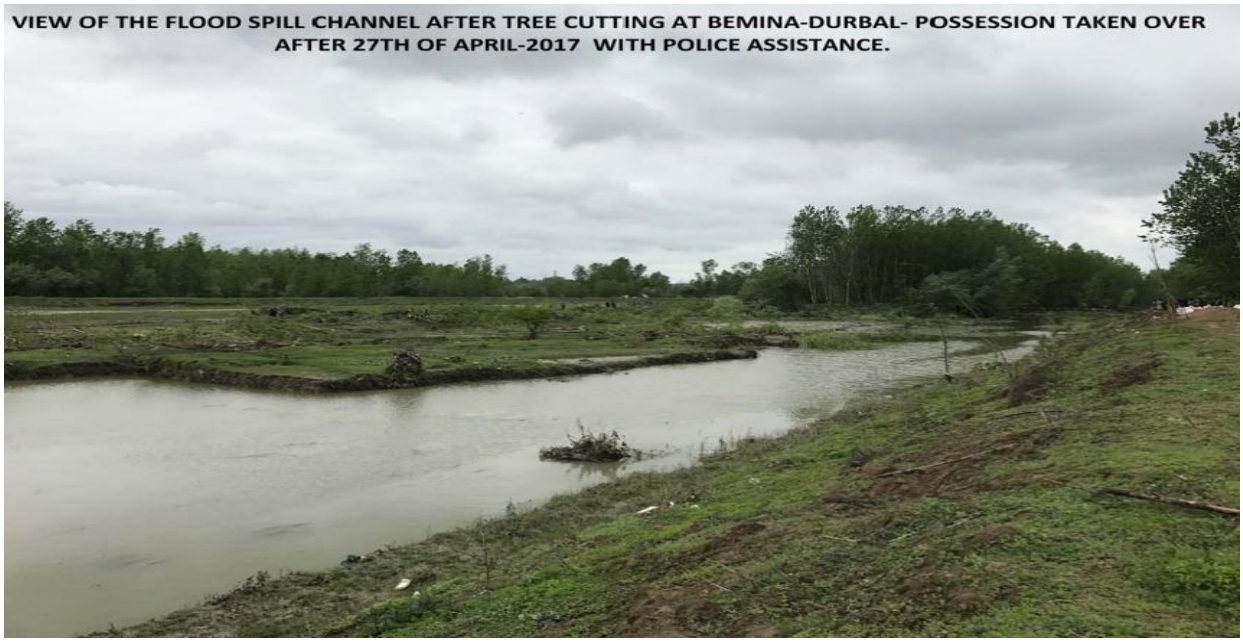
2015, with the mission of removing all encroachments from the banks of the Jhelum River and other water bodies in a one-week drive. The state authorities and the concerned department were given strict orders by the High Court of Jammu and Kashmir to clear the river course of such tree plantations so that the free flow of water is not obstructed. As a result, 357,127 trees have been cut from tributary river courses in Kashmir division. (Refer to Table No.6.8)

Table No 6.9: Number of Trees and unauthorized construction removed from river courses.

District	Trees removed from river banks	Structures for Removal		Structures Demolished		
		Identified	Removed	Pucca	Kucha	Boundary Wall
Pulwama		213				
Srinagar		816	687			
Bandipore		84				
Baramulla		33				
Kashmir Division	357,127	1146		130	410	560

Source: Local newspapers reported on the State Government's deposition before the Hon'ble High Court.

Figure 6.3: Removal of Encroachments from River Course



6.1.8.3 Removal of Encroachment

The Jammu and Kashmir High Court has issued all district magistrates in Kashmir the authority to demolish any structures seen being constructed within the Jhelum River's and its tributaries' prohibited area. All riverbank construction from the river's source in Verinag, South Kashmir, to Uri, North Kashmir, was also halted by the Court. These orders were given in response to an advisory group's inquiry into how encroachments on the Jhelum River and its tributaries led to the devastating flood. Only one-fifth of the river Jhelum's total width has been left un-encroached, according to the Deputy Commissioner Anantnag, who cited the expert committee report, and all embankments have been breached, especially in Anantnag, Bijbehara, and villages of other Tehsils in South Kashmir. According to the survey, breaches have occurred due to encroachment by way of plantations and constructions, resulting in a deluge that has resulted in a disaster in Kashmir. According to the survey, the District Magistrate ordered all encroachers along the river Jhelum and its tributaries—Lidder, Arpath, Brengi, Vaishav, Sandran, and Veth—to remove plantations and constructions within 15 days. He also mentioned that if the encroachers do not dismantle the encroachments, the Department of Irrigation and Flood Control would do so at the cost of the encroacher. The High Court previously halted construction within 200 metres of Lidder Nallah in south Kashmir and Dal Lake in Srinagar, as well as 100 metres on either side of the Sindh River's bank.

The deposition before the Hon'ble High Court showed that the Srinagar district had 1146 illegal structures. Six hundred and eighty-seven of the 687 illegal structures identified have

been demolished (in both Kutch and Pucca), as well as 560 boundary walls that were obstructing the rivers' main course (Refer to Table No.6.8).

Figure: 6.4: Removal of illegally constructed houses from the river course

6.1.8.4 Afforestation in catchment areas as flood mitigation measure

Studies have shown that massive deforestation in the catchment areas of the river and its tributaries results in the topsoil gets washed away, along with the runoff, during heavy rains results in the accumulation of huge deposits of silt in the river and tributaries, contributing towards flooding of the river. Therefore, in this direction, the ministry of forests, Environment, and Ecology have issued directions to the concerned field agencies to undertake a massive Afforestation drive in the catchment areas of the tributaries of the Jhelum river so that it can slow down the run-off and thereby help in flood mitigation.

6.1.8.5 Preparedness for Evacuation in case of Disaster Eventuality

As previously mentioned, during the 2014 floods, the state government and the state Disaster Management Authority were not at all prepared for rescue and evacuation. Since rescue vessels were not able to evacuate flood victims, no attempts were made to evacuate the flood victims. Because of the magnitude of the damage and the large number of people stranded, only a few helicopters were used for evacuation. For the first three or four days, even basic relief facilities such as drinking water, medications, food, and clothing were unavailable. There were also no emergency operations centres (EOCs) established for victim assistance. People were only spared from the disaster because of community solidarity and support from civil society and the army. After the floodwaters recede, Omar Abdullah, the then-chief minister, admitted that the spread of diseases is the primary concern, as polluted water, a shortage of clean drinking water, and people living in close quarters in ill-equipped relief camps are a recipe for disease disaster. "We are preparing ourselves for diarrhoea and

measles, which is natural when people live in clusters," Dr. Salim Rehman, Director of Health Services for the State's Health Department, was quoted as saying.

“In the event of a potential emergency, the state has named a few Emergency Operation Centers (EOC'S) that will serve as Multi-Purpose and Multi-Disaster Utility Shelters to resettle people in the event of such a calamity.” Listed Emergency Operation Centers (EOC) serving as Multi-purpose and Multi-Disaster Utility Shelters have been in the works at various levels, According to SDMA authorities.

While EOC locations have been established, building and service provision are moving at a snail's pace. Many construction projects are yet to begin. Basic services must be made available in these EOCs in addition to the identification of services, which necessitates immediate fund allocations. (Refer to Table No.6.10).

Table No 6.10: Identified Emergency Operation Centers for Relief and Evacuation in Kashmir Division

Disaster	**Location of Emergency Operation Center for Multi-purpose and Multi-disaster Utility Shelter**	**Remarks**
Pulwama	Old Development Commissioner office	Has sufficient facilities
Baramulla	Sangribala site located at the hillock	Well connected with other areas
Srinagar	Sanat Nagar (SMI Convention Center) Humhama (GO’S Mess) Khimber.	All Centers have requires services and facilities
Kupwara	Nagnihal Pura	Mooted as a spot for EOC but not developed as yet.
Budgam	Rangreth	State of the art EOC proposed but construction yet to start.
Ganderbal	Office Building of I&FC Dignibal (identified as a new site)	Very less space Construction yet to start
Bandipore	Guest House Bandipore	Identified but facilities yet to start
Shopian	Padpanen	Land identified

Source: SDMA Authorities of Kashmir Division, May 2016.

6.1.8.6 Awareness Preparedness

The most important method for mitigating disaster vulnerabilities is training and capacity building. The government, non-governmental organisations, and community-based organisations should cooperate to establish a trained cadre of police, administrators, and personnel from different agencies that are directly involved in disaster management. Since disaster management requires several stakeholders and must be treated appropriately, the positions of different organisations in this regard must be highlighted. Universities, Engineering Colleges, Polytechnic Colleges, Medical Colleges/Regional Institutes of Health and Family Welfare, Revenue Training Institutes, Police Academy/Police Training Centres, Universities, Engineering Colleges, Polytechnic Colleges, Medical Colleges/Regional Institutes of Health and Family Welfare, Revenue Training Institutes, Police Academy/Police Training Centres and other educational institutions should be enlisted to provide training to various stakeholders. Besides this, disaster management should be included in the school, college, and university curricula, and should be taught by both experienced and qualified teaching staff.

Following the flood disaster of 2014, SDMA reported that several steps had been taken to improve the capacities of NGOs and community-based organisations (CBOs) so that they could launch disaster awareness campaigns and programmes among the general public and other stakeholders. The Disaster Management Centre of Jammu and Kashmir, as well as the Institute of Management and Public Administration (IMPA), a premier training institute for government employees, have been strengthened/upgraded in this regard.

The following were some of the most effective strategies for raising awareness:

- Promotion of Kashmiri folk theatre, such as Bhand-Pather, with an emphasis on disaster risk reduction.
- Launch an awareness campaign about possible hazards using newspapers, campaigns, the creation and distribution of a leaflet, posters, meetings, and a workshop on a priority basis.Creating multi-hazard IEC materials for shipment and publication.
- Create Do's and Don'ts for building construction codes in local/vernacular languages.

- Upgraded seismic-resistant building construction is being disseminated.
- Educate the public on basic response procedures in the event of natural and man-made disasters.
- Educate the masses against potential hazards and their preventive measures through awareness generation.
- Sharing expertise and best practises on appropriate approaches with the community and the relevant authority.
- Sharing information on the anticipation hazard with accuracy

Following the flood disaster of 2014, the Jammu and Kashmir State Disaster Management Authority announced that various training and refresher courses, as well as capacity-building initiatives, were conducted by various Disaster-related institutions to equip stakeholders with technical knowledge and sensitise them about disaster management and disaster risk reduction measures. The following are some of the capacity-building training programmes that were organised:

- The National Institute of Disaster Management (NIDM), Ministry of Home Affairs, New Delhi, held a training programme on “Flood Disaster Management” from the 23rd to the 27th of March 2015.
- The IMPA (Institute of Management and Public Administration) Srinagar organised a training course on "Disaster Management for Divisional Level Officers" from March 17-18, 2015 for officers from the concerned departments of Revenue, CAPD, R&B, SMC, and others; the course was funded by the 13th Finance Commission Award.
- NIDM, New Delhi, is hosting a Training of Trainers (ToT) course on "Community Based Disaster Risk Reduction (CBDRR)" from May 5-8, 2015.
- IMPA Srinagar Kashmir held a training course on "Post Disaster Risk Reconstruction and Rehabilitation."

Figure 6.5: Conduct of various Awareness Programmes on disaster preparedness post-2014 floods.

6.1.8.7 Financial Assistance by World Bank

Under the "Jhelum and Tawi Flood Recovery Project," the World Bank has approved $250 million (roughly Rs 1600 crore) for flood-affected infrastructure and bolstering the J&K government's natural disaster response capability. According to the official description of the World Bank project, "will help to restore and enhance connectivity that has been hampered by damaged roads and bridges. According to the most recent official design guidelines, the infrastructure will be redesigned to withstand earthquakes and floods. Another important aspect of this project would be to improve and reinforce the current flood control system, which is fragile and vulnerable. The majority of the investments will go into the rehabilitation/renovation of stormwater pumping stations in a variety of locations." All of these steps are in line with India's National Disaster Management Plan, which is in turn in line

with the Sendai Framework for Disaster Risk Reduction's priorities and targets (SFDRR). Both approaches emphasise the need to "Build Back Stronger," which in theory implies restoring all properties lost in a catastrophe or emergency in a way that allows them to survive similar adversity in the future.

6.2 Role of Non-Governmental Organisations during Flood in Srinagar City

NGO's are non-profit organizations with a common interest to assist people affected by various Social, Economic, Cultural, and Developmental activities of state and non-state actors. These organisations are incorporated under Indian laws such as the Societies Registration Act 1860, Section 25(1) of the Companies Act 1956, or state-specific charitable trust acts. NGOs are typically organizations that depend on charitable donations and voluntary service. Volunteerism and social services are the main focuses of Non Governmental organizations. Volunteerism has a long history in India, dating back to the independence struggle. Gandhi Ji emphasised the idea of Shramdaan, which entails providing free labour for a noble cause such as rural development, social asset construction, and public infrastructure. Health, education, water supply, sanitation, shelter and infrastructure, food security, nutrition, and the environment are among the areas where non-governmental organisations (NGOs) have increased their presence in post-independence India. In the case of disasters in India, non-governmental organisations have played a critical role in providing humanitarian aid to disaster victims. In disasters such as the Latur Earthquake (1993), the Odisha super cyclone (1999), the Bhuj Earthquake(2001), the Indian Ocean Tsunami(2004), the Kashmir Earthquake(2005), the Barmer Floods(2006), the Kosi Floods(2008), the Leh cloudburst(2010), the Kashmir Floods(2014), and the Kerela Floods(2014), non-governmental organisations (NGOs) played an important role (2018). The NGO's mission has expanded over time to include both post-disaster relief and improving disaster preparedness. They play an important role in disaster reduction through capacity building, public awareness, mock exercises, workshops, and conferences.

In accordance with its mandate as outlined in the Disaster Management Act 2005, the national disaster management authority (NDMA) has circulated national disaster management Guidelines on the role of NGOs in Disaster Management, which describe the role of NGOs in disaster management. It expressly notes that non-governmental organisations (NGO's) will be allowed to use their institutional structures to inspire the group and raise awareness. Efforts to foster voluntary participation would be welcomed. Similarly, the Sendai mechanism for risk

mitigation emphasises the importance of enhancing local cooperation to disseminate disaster risk information by including community-based organisations and non-governmental organisations. In the aftermath of the floods in Jammu and Kashmir in 2014, non-governmental organisations (NGOs) played a critical role at various stages of the disaster. They sent out teams to help the communities that were in need. However, they face an uphill battle because of inaccessibility and a lack of money. Goonj, AmeriCares, Indian Red Cross, SEEDS, Oxfam, Athrout, and Darul Khair are some of the significant NGOs that helped during the Kashmir floods. Basic relief materials such as clean drinking water, canned food, warm clothes, and temporary shelters were provided by these organisations. They also held medical camps in various parts of Kashmir to provide medical assistance to those in need. These non-governmental organisations have contributed significantly to the expansion of sanitation facilities in relief camps. Aside from that, they were critical in the distribution of education to displaced children.

As a result of the numerous roles that NGOs perform prior to, during, and after disasters, it is clear that they play a critical role in disaster management strategy. Their main distinguishing feature is rapid response time, and the strong relations they have with the community make them ideal candidates for disaster-related activities. To fully capitalise on the nongovernmental sector, it is essential to streamline and document its structure. At the same time, the government's position in relation to NGOs must be established and systematised so that appropriate disaster management systems can be put in place quickly after a disaster occurs. Because of their proximity to the community and the versatility of their procedural matters, the nongovernmental sector has an advantage over government agencies when it comes to community engagement.

6.3 Role of Paramilitary forces during Floods in Srinagar City

Indian armed forces play an important role during disasters. They are always available in the service of the country. Their role during disasters has increased many folds with the increasing frequency and intensity of disasters with time. They played an important role during floods in Jammu and Kashmir. Their role was highlighted laudable by various sections of society. Their role has been seen during the response, recovery, and rehabilitation stages of the Kashmir flood. they rescued trapped people in Srinagar city during floods in September 2014. As already stated in figure 6.1, it has been seen during field survey that Army and paramilitary forces played an important role in Mitigation, Evacuation, Rehabilitation,

Monetary Aid, Distribution of food, clothing and other necessities to the affected families as well as they played an important role in the restoration of peace and order after floods in Jammu and Kashmir.

6.4 Relevance of Community Participation.

The community is one of the most strong and established disaster management organisations. In the event of a catastrophe, the society is both the first to be impacted by the disaster and the first to respond. As a result, community understanding of disaster prevention measures will significantly reduce the harm caused by the disaster. In areas where disasters occur frequently, community education, awareness, and training are especially beneficial. As first responders to any disaster, populations should be well trained in various aspects of emergency response, such as First Aid, search and rescue, management of community shelters, psycho-social counselling, and so on. In certain cases, the community's contributions are commendable. They've created organisations that take the lead in times of tragedy. They provide mutual help and encouragement to everyone impacted by the tragedy, as well as bolstering people's resilience in the face of adversity. The Sendai System for Disaster Risk Reduction focuses on disaster governance while also stressing better citizen cooperation at the local level to disseminate disaster risk information with the active involvement of community-based organisations and non-governmental organisations, enabling disaster impact to be greatly reduced. It also emphasises the importance of legal structures in enhancing the position of community members in decision-making. Similarly, the State Disaster Management Authority 2017 focuses on improving community-based disaster management systems. It notes that all attempts will be made at the local level to sensitise and train volunteers. Community engagement is also prioritised in the 2009 national disaster management strategy, which states that they are the first to be affected as well as the first responders during any disaster. As a result, community involvement helps to prevent and mitigate harm by ensuring collective control, addressing local needs, and encouraging volunteerism and mutual aid. It becomes clear that community involvement is beneficial to disaster management. It has the ability to perform miracles in the event of a catastrophe. It will pay particular attention to elderly women, infants, and people with disabilities who are particularly vulnerable to disasters. Participation of women and children in decision-making committees should be promoted. During a field survey in Srinagar city in November 2017, it was discovered that the state had taken few steps to provide training and information to the people about disaster resources and techniques. The flood has hit Srinagar city for the majority of the days. Since two floors of

their houses were already flooded, they went to the rooftops. The army was instrumental in the evacuation process, rescuing people by sea and airlifting them. The rescue operations were hampered by people's lack of information. During a disaster, however, youth from both rural and urban areas played an active role in the Evacuation, Mitigation, and Rehabilitation of impacted families. Their evacuation process is hampered by a shortage of available vessels. People expressed their dissatisfaction with the lack of resources available to cope with disasters. As a result, it is critical to emphasise the importance of maintaining a sufficient stock of boats in each ward so that, if tragedy strikes in the future, it can be mitigated to a large degree thus hitting the impact as soon as possible.

Summary and Conclusion

Under the disaster risk mitigation model, the analysis of flood vulnerability is a new dimension. Multiple danger forms coexist in various geographical regions in India, which can have a catastrophic impact at times due to the country's diverse physical and climatic characteristics. Jammu and Kashmir has a long history of natural disasters dating back to time immemorial. Kalhana, in his epitome ‘Rajtarangni,' has detailed descriptions of several disasters that have resulted in significant loss of life and property. These disasters were caused by both natural and man-made causes. Jammu and Kashmir has suffered greatly as a result of disasters due to its unique topography, rough terrain, harsh weather conditions, and underdeveloped economy.

Floods are becoming more common in the Kashmir valley of Jammu and Kashmir, among other disasters. The network of mountain structures that spread out of the Pamir Knot in various directions across the valley, clearly distinguishing the watersheds and basins, has a natural inherited relationship with the Kashmir valley. The Jhelum River and its numerous tributaries, which flow down from the mountains and are supported by the abundant day-off precipitation in those elevated districts, cut through the valley like a bowl, with grandiose mountains on either side and an enormous alluvial tract in the centre. From east to west, the level alluvial bowl extends 150 kilometres and from west to east, 42 kilometres. The land grain runs from south to north on the level plain, which ranges in height from 1500 to 1800 metres above sea level. Flooding has a long history in Jammu and Kashmir. The Jhelum River is linked to floods in the province, and it has a history marked by the intersection of the danger label, thus submerging the Valley. In his book The Valley of Kashmir (1895), Sir Walter Roper Lawrence writes, "The worst was the terrible immersion that followed the slipping of the Khadanyar mountains beneath Baramulla in AD 879, according to vernacular chronicles. The Jhelum waterway's channel was blocked, and a large portion of the valley was submerged." The other major flood to affect Kashmir was in 1841, when "a lot of damage life and property" was caused, according to Lawrence. The primary wave of crushing extents to reach the state came 50 years later, in 1893, when 52 hours of continuous precipitation, beginning on July 18, caused "an unprecedented disaster," as Lawrence describes it. When the new century arrived, the Valley experienced major floods as well, with the most devastating one occurring ten years after the 1893 disaster. The floods of that day were dubbed the "highest flood at any point recorded," as they swept through the Valley on July 23, 1903, submerging Srinagar and turning the city into "an entire lake." The Valley did not experience major flooding for the next quarter-century, owing largely to the creative drills that were

taught and the remedial steps that were put in place. Regardless, the Valley considered another major flood in 1929, which largely affected parts of what is now known as Pakistan-occupied Kashmir. Furthermore, a flood struck Kashmir once more in 1948. After two years, another major flood struck the state in September 1950, claiming the lives of nearly 100 people. The Jhelum's flood was, unsurprisingly, the cause of the flood. Another major flood struck Jammu and Kashmir in August-September 1957, with the Valley feeling the brunt of the damage. The floodwaters almost flooded the entire valley. In July 1959, the state was struck by yet another monstrous "frosty" flood, probably the worst ever at the time, when four days of nonstop rain battered the valley and Srinagar, causing floods in the Jhelum. Despite the fact that the state was subjected to floods for the next three decades, the one in 1992 was especially devastating. According to newspaper accounts from 1992, more than 200 people died in the flooding, and 60,000 people were stranded in a few north-western fringe areas. Floods were seen in 1996, and even more recently in 2006. Massive floods were triggered by a torrent in Jammu and Kashmir's Leh-Ladakh district on August 6, 2010, which triggered glimmer floods in the area after a night of heavy rain. The destruction caused by the downpour was massive, and it lasted for thirty minutes. It levelled a number of buildings in the city of Leh." Heavy rainfall began in Jammu and Kashmir on September 2, 2014, triggering unprecedented widespread flooding and landslides across the state. Many streams were flooded, including the Jhelum, Chenab, and Tawi. The worst-affected districts were Srinagar, Anantnag, Baramulla, Pulwama, Ganderbal, Kulgam, Budgam, Rajouri, Poonch, and Reasi. The bulk of the city of Srinagar was submerged underwater. Sonwar Bagh, Shivpora, Batwara, Pandrathan, Lal Chowk, Rajbagh, Jawahar Nagar, Gogji Bagh, and Wazir Bagh were all flooded when the river Jhelum overflowed.

Floods in 2014 wreaked havoc on lives and property, exposing flaws in flood mitigation and preparedness policies that could have significantly reduced the destructive effects of floods. Despite the state's successful introduction of the disaster management programme in 2011, the state was hit by a massive flood in 2014, resulting in significant loss of life and property. This is a live illustration of the state's ineffective mitigation and preparedness strategies. As a result, there is an urgent need for short-term interventions to supplement long-term strategies for dealing with the negative effects of floods. Our study, on the other hand, is based on the urban flood in Srinagar, the valley's heart and soul. The experience of floods in Kashmir valley demonstrates that if a flood occurs, Srinagar is the first place to be severely impacted in terms of human loss and property damage. Srinagar has a population of 99 percent who live in

towns, many along the Jhelum River's banks. The people have limited capacity to monitor the hydrological events resulting from the Jhelum River due to its geographical position, which is in a low-lying region. As a result, during the rainy season, Srinagar experiences heavy flooding in one or more parts of the city. The effect of floods in urban areas is becoming increasingly serious, with significant loss of life and property. As a result, managing urban flooding must be given top priority. Urban flooding is becoming a global phenomenon, posing a major challenge to urban planners all over the world. The concerns associated with urban flooding range from minor to major events, resulting in communities being flooded for hours or days. As a result, the repercussions may be widespread, resulting in temporary relocations, public facility delays, water quality deterioration, and the possibility of epidemics. As a result, the study aims to evaluate the urban flood in Srinagar City, with a focus on flood of 2014.

The idea of disaster risk reduction is a new disaster management concept that focuses on reducing the risk factor associated with a disaster rather than immediately managing it. Vulnerability analysis is an integral part of determining the level of risk associated with a catastrophe in this context. Vulnerability refers to the degree of vulnerability to a catastrophe and the affected people's ability to cope. Vulnerability analysis at the household level, on the other hand, is a difficult challenge. Nonetheless, since the problem of danger vulnerability, as well as the related preparedness and mitigation drive, is increasingly emphasising people's involvement in various stages of the process, it is essential to establish a databank where people's voices can be included. This study aims to comprehend the impact of floods in Srinagar, as well as the different methods that have been used to minimise their impact in the future. The Srinagar urban agglomeration is rapidly developing, with many wetlands and water bodies being converted into housing units. Srinagar's municipal limits were just 83 square kilometres (sq. km) in 1971, but they now occupy over 230 sq. km. Srinagar and its surrounding areas have lost many wetlands and water bodies as a result of urbanisation, making them more vulnerable to natural disasters in general and floods in particular. According to the Ministry of Environment and Forests, the state of Jammu and Kashmir had 291.07 square kilometres of wetlands in 1990, but that number has now dropped to 266.45 square kilometres. On the other hand, due to urban sprawl, impervious concrete surfaces in the southern areas of Srinagar city have risen from 34% in 1992 to over 65% today, seriously affecting hydrological processes in the Jhelum basin as well as the encroachment of major wetlands in Srinagar city. According to different reports, between

1911 and 2004, about half of wetlands such as Batamaloo Nambal, Rekh-i-Gandakshah, Rakh-i-Arat, and Rakh-i-Khan, as well as the Doodh Ganga and Mar Nalla streams, were completely destroyed by urbanisation, while other lakes and wetlands shrank significantly. Also flood spill channels have been encroached upon, and residential colonies have grown closer to water sources as a result of this development. Wetland is the first victim anywhere there is a need for land. Floods in Srinagar have become more frequent and intense as a result of this type of development strategy. The 2014 floods in Srinagar city were the product of this form of development strategy, which resulted in massive destruction of life and property. Man is a direct cause of such disasters since he is an active agent. In the one hand, his greed contributes to wetlands encroachment and deforestation, while on the other hand, his actions increase the frequency of floods. Building infrastructure in the form of highways, bridges, buildings, electricity, water supply, communication lines, and factories, among other things, takes years and a large sum of money, but when disaster occurs, it is razed to the ground in a matter of minutes, causing massive damage to the affected area. As a result, catastrophe risk must be reduced to a large degree in order to maintain the current rate of sustainable growth. It is impossible to completely eradicate disasters. Their influence and strength, on the other hand, can be greatly reduced. Floods and earthquakes are the most active threats to Srinagar's growth and development, as the city is located in Seismic Zone V, which means that if a high-intensity earthquake occurs, it will undoubtedly result in significant loss of life and property. Similarly, there is a high risk of flooding in Srinagar, which, when it occurs, causes significant damage to life and property. As a result, there is a greater need to investigate Srinagar's vulnerability to floods and related disasters so that risk mitigation measures can be implemented in a timely manner.

The entire research project is broken down into seven chapters, with a review and conclusion at the end. The first chapter covers the problem's context, goals, and research issues, as well as references to relevant literature. To justify the seriousness of the issue, the database of India's disaster situation over the last 116 years (1900-2016) has been diagrammatically explained in terms of total flood incidents, death, and affected in terms of injury and homeless people. In addition, separate data on the occurrence of flood events in Asia, spanning the years 1900 to 2018, has been added. The situation of urban floods in India over the last 20 years is also highlighted in this chapter. All of the information is based on the International Disaster Database, which was created by the Centre for Research on Disaster Epidemiology and prepared in accordance with United Nations guidelines.

Chapter two focuses on the district's historical history, with particular attention paid to its prehistorical legacy, growth as a primate city, and post-independence phases of development. The causes of floods in Srinagar have received a lot of attention. To visualise the history of the problem under investigation, the chapter includes special data analysis of pattern and trend, distribution and variability of rainfall in the district, and history related to threat. In addition, the city's rainfall fluctuations from 1980 to 2017 as well as the shifting actions of the Jhelum river have been addressed in order to comprehend the fundamental issue.

The third chapter discusses the evolving land use/land cover paradigm in the study area and its role in Srinagar's flood vulnerability. Second, it focuses on the evaluation of drainage and water bodies, especially flood channels, and how their changing scenario is contributing to the increase in disasters in the study region. Sir Dudley Stamp (1937) correctly stated during his land use mapping of Britain that land use figures do not serve the true function of planning unless and until their relationships are depicted on maps (Stamp, 1937). Srinagar is the commercial centre of the Kashmir valley, making it a magnet for all actors. Horizontal development of built-up territory, Encroachment of wetlands, and Marshy areas are all examples of this haphazard growth, which contributes to an unparalleled expansion of economic and other commercial activities. As a result, it is clear that Srinagar's land use pattern has changed over time and with its geographic position.

The district's demographic character is discussed in the fourth chapter, with particular attention paid to the growth of the vulnerable population segment, the sex ratio, and other aspects of vulnerable places. Since its inception, Srinagar's ward system has gone through numerous phases of development, deformation, and reformation. Srinagar city had 14 wards at first, but it later grew to 68. In 2011, six more wards were added, bringing the total number of wards to 74. The study of Srinagar city's population characteristics reveals that the city's population has been steadily increasing. From 1901 to 1961, the population of the United States grew at a relatively steady pace. However, the rate of growth accelerated, resulting in haphazard urbanisation in Srinagar. The population's vulnerability has increased as a result of this form of development. Vulnerability is characterised as "a person's or group's characteristics and state that influences their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard." Natural disasters pose a danger of differential vulnerability, i.e. varying populations face different levels of risk and vulnerability, as observed during the field survey. Natural disasters can become more expensive in the future as more people develop expensive infrastructure in flood-prone areas such as wetlands,

swampy and marshy areas, low-lying areas prone to flooding, riverbanks, and so on. As a result, when a flood occurs, its effect is not limited to individuals alone; it has a significant impact on physical, economic, and cultural factors, causing the community to regress. The demographic parameters of population growth and distribution, population density, and housing density all contribute to the area's vulnerability to disasters. Srinagar's urban population accounts for 98.60 percent of the total population, and the city's rapid population growth has resulted in an unprecedented rise in population, resulting in dense infrastructure, increased population density, and population expansion into flood-prone areas, both of which have increased the city's vulnerability. The demographic vulnerability index is a strong indicator of a vulnerability map of Srinagar city, showing how changes in demographic characteristics are rising the city's potential exposure to floods and earthquakes. To ensure the earth's long-term viability and reduce the impact of disasters, rigorous planning is needed to monitor population distribution, growth, and density in order to mitigate and minimise future vulnerability.

The fifth chapter is primarily concerned with Srinagar's Flood Hazard Vulnerability in 2014 in terms of Preparedness, Response, Recovery, and Rehabilitation, for which a household level sample survey of selected ward locations of the district was conducted, and their appropriate understanding clarified. It consists of three sections of data collection in a formal questionnaire, which are annexed in the appendix: 1. The general profile, identification of types of hazards and hazard assessment, vulnerability status of the sample study location based on respondent's perceptions, and the problem of Srinagar city's social vulnerability have all been investigated. At the household level, indicators such as male-female composition, age of the house owner, literacy, occupation, source of potable water, house form, health issues, and so on are evaluated to determine the respondent's overall profile. Flooding in Srinagar is caused by a number of factors, including a rise in the built-up area, the encroachment of Riverbeds, Wetlands, and swampy areas, haphazard urbanisation, ill drainage networks, deforestation in Jhelum River catchment areas, and river channel siltation. The river Jhelum flows from south to north, receiving water from both its left and right bank tributaries. However, as a result of environmental pollution and encroachment in its catchment area, the river's flow has shifted, and it now flows above its banks, causing massive harm to life and property. During the field survey, the dilapidated state of the flood channels and urban drainage system was also observed, which has an effect on not only people's health but also on the Jhelum river's flow discharge. The respondents revealed this inadequate and

inappropriate management of the Flood Channels and drainage system during the household survey.

The sixth chapter is concerned primarily with Strategies and Steps taken by various stakeholders in the aftermath of the 2014 floods in the Mitigation of Floods, including a household-level sample survey of post-flood mitigation measures as well as measures taken by state and non-state actors to mitigate vulnerability in the future. The floods of 2014 in Srinagar city claimed many lives and destroyed a lot of land. According to the database, the 2014 floods in Jammu and Kashmir killed 298 people, displaced 275,000 people, and caused $1600,000,000 in property damage (EMDAT, 2019). Three of the Sendai Framework's goals for disaster risk reduction are strengthened disaster risk governance, resilient investment, and effective preparedness for effective response and to Built Back Better in recovery, restoration, and reconstruction (UNISDR, Global Assessment Report on Disaster Risk Reduction, 2015). As a result, the aim of this chapter is to investigate the degree of preparedness of various agencies to deal with floods in Srinagar region, as well as the steps taken by various stakeholders following the flood of 2014 to mitigate the impact of future floods in the Kashmir valley. During the field research, it was also discovered that the group is one of the most powerful and developing disaster management organisations. In the event of a catastrophe, the group is both the first to be impacted by and the first to respond to the disaster. As a result, community understanding of disaster prevention measures will significantly reduce the harm caused by the disaster. In areas where disasters occur frequently, community education, awareness, and training are especially beneficial. As the first witnesses to any catastrophe, populations should be well trained in various aspects of emergency response, such as First Aid, search and rescue, management of community shelters, psycho-social counselling, and so on. The community's efforts are commendable in some situations. They've created organisations that take the lead in times of tragedy. They provide mutual help and encouragement to everyone impacted by the tragedy, as well as bolstering people's resilience in the face of adversity. The Sendai Framework for Disaster Risk Reduction emphasizes on disaster management while also stressing better citizen cooperation at the local level to disseminate disaster risk information with the active involvement of community-based organisations and non-governmental organisations, enabling disaster impact to be greatly reduced. It also emphasises the importance of legal structures in enhancing the position of community members in decision-making. Similarly, the State Disaster Management Authority 2017 focuses on improving community-based disaster management

systems. It notes that all attempts will be made at the local level to sensitise and train volunteers. Community participation is also prioritised in the 2009 national disaster management plan, which states that they are the first to be affected as well as the first responders during any disaster. As a consequence, community engagement helps to avoid and minimise damage by maintaining collective influence, addressing local needs, and promoting volunteerism and mutual aid. It becomes clear that community involvement is beneficial to disaster management. It has the ability to perform miracles in the event of a catastrophe. It will pay particular attention to elderly women, infants, and people with disabilities who are particularly vulnerable to disasters. Participation of women and children in decision-making committees should be promoted. During a field survey in Srinagar city in November 2017, it was discovered that the state had taken few steps to provide training and information to the people about disaster resources and techniques. The flood has hit Srinagar city for the majority of the days. Since two floors of their houses were already flooded, they went to the rooftops. The army was instrumental in the evacuation process, rescuing people by sea and airlifting them. The rescue operations were hampered by people's lack of information. During a disaster, however, youth from both rural and urban areas played an active role in the Evacuation, Mitigation, and Rehabilitation of impacted families. Their evacuation process is hampered by a shortage of available vessels. People expressed their dissatisfaction with the lack of resources available to cope with disasters. As a result, it is critical to emphasise the importance of maintaining a sufficient stock of boats in each ward so that, if tragedy strikes in the future, it can be mitigated to a large degree thus hitting the impact as soon as possible.

The study confirms that disaster risk reduction and community engagement are critical factors in reducing deaths and injuries in the event of potential disasters. The following are some of the study's main concerns and findings:

- Despite the implementation of the Disaster Act 2005, the state lacks a disaster management programme and the institutionalisation of disaster risk mitigation approaches and preparation. There is no Disaster Management Authority to prepare a disaster management policy framework or develop a disaster risk mitigation plan.
- The flood control system in the state was found to be lacking in terms of protection and preparedness. Owing to siltation, the carrying capacity of river tributaries, as well as main river channels, flood channels, and wetlands, has been limited (because of heavy erosion due to deforestation and road cutting in the catchment areas). The levels of river beds are rising due to sedimentation. Srinagar's urbanisation is unplanned,

with little regard for city planning zonation rules and land-use and land-cover norms. The free flow of rivers is being hampered by encroachment of river channels, wetlands, nearby reservoirs, and flood channels.

- Floods and disasters have resulted in horizontal and unplanned urbanisation in the flood plains of the Jhelum River in Srinagar region.
- Planting trees on a large scale for commercial purposes along river channels obstructs the free flow of water during floods.
- Lack of comprehensive flood control planning and fragmented administrative management of water bodies, as well as the government's noncommittal approach to flood vulnerability management assessment.
- Due to a limited network of hydro-meteorological observation stations and a shortage of high-resolution quality spatial data to track early warning systems and flood forecasting, there is an insufficient supply of modern equipment and technological capacity to predict floods.
- Owing to the lack of community-based emergency preparedness plans, governments were unable to deal with the magnitude of the 2014 flood disaster.
- Failure of information and coordination at a crucial period when it was most important, as well as a lack of community knowledge of flood vulnerability
- Poor feasibility analysis of development projects, especially the construction of railways, highways, and other development projects, without understanding the implications and considerations for designing appropriate structural designs to resolve the vulnerability components.
- The decreasing number of wetlands has decreased floodwater absorption potential, resulting in high groundwater levels in the valley basin.
- The likelihood of breaches in Srinagar city has increased due to poor maintenance of river channels, floodwalls, and bunds.
- The flood control systems have been damaged due to unscientific mining of bed material from the Jhelum river.
- There aren't enough disaster-resilient measures in place, especially in terms of building practises and land-use policy.
- In the beginning, the government machinery was totally absent. Only the community, immediate families, NGOs, civil society groups, and defence forces were able to provide immediate rescue and relief. Some respondents were also pleased with the

army's and security services' positions. During the initial days of the flood disaster, the assistance rendered by the NDRF and SDRF, two major rescue and relief providing government stakeholders, was not made available.

- Complete administrative failure during the emergency time to rescue flood victims and provide emergency services such as secure and rapid evacuation, safe shelters, medical care and assistance, food, clothes, and safe drinking water, among other things.
- After the September 2014 floods in Kashmir valley, respondents' satisfaction levels and perceptions of disaster management and disaster risk mitigation have improved significantly, especially in terms of protective measures and government preparedness. Civil societies have also stepped up their efforts to raise disaster awareness in their communities. However, additional government and civil society actions are needed to make disaster risk mitigation a reality and to build disaster-resilient communities.
- In May-June 2016, flood disaster victims' perceptions suggest that disaster management protective measures and preparedness have substantially improved since September 2014. The Hon'ble High Court of Jammu & Kashmir's directives have bolstered government agencies' ability to enforce effective protective measures, such as removing encroachments (both trees and illegal structures) on river channels. The state government has also created an atmosphere conducive to implementing rules and regulations, especially zero tolerance for illegal encroachments in river channels.
- The public has been properly advised about the laws and regulations about encroachment on river and flood channels. Also people and civil society organisations have a greater understanding of disaster-risk reduction techniques. They've seen a major change in the methods used to reduce disaster risk, protect people, and plan for disasters. Government agencies have taken successful measures such as de-silting, drugging, bund wall maintenance, and river channel clearing.
- Programs to raise awareness, such as safety audits, building code compliance, and the establishment of emergency resettlement centres, are, however, not being considered.
- People are unaware of how much alert will be provided and what measures will be taken during the warning time, despite the implementation of early warning system equipment. More mock drills, as well as sufficient capacity building for the community, individuals, and other stakeholders, are needed.
- The level of satisfaction with the damage assessment differed among the victims. Damage assessments for houses were generally well received, and satisfaction with

the amount of money received in cases of house and property damage was high. Shopkeepers, on the other hand, were dissatisfied with the damage assessment process. Except for those who had insured their household goods, the satisfaction level for damage assessment for household goods was very low, and victims received no compensation. The damage assessment for crops was rated as the least satisfactory by the public.

- Waterlogging for several days caused extensive damage to Kucha and semi-pucca houses and shelters. Since the majority of the houses were built with mud and stones rather than cement and iron, many were washed away or fully collapsed. For many days, people were without shelter. Displacement of disadvantaged groups, such as women-headed households, the elderly, and people with disabilities, who were unable to be evacuated due to a lack of adequate support systems. Furthermore, many households have lost vital documents, which the government must now investigate in order to make them accessible to victims as soon as possible.
- A sizable percentage of respondents were satisfied with the procedures used to identify victims for relief and compensation. However, they believed that since it took more time, the victim would not be able to receive assistance when it was most needed. The victims were generally pleased with the distribution methods used, especially Direct Bank Transfer (DBT), which significantly reduced corruption and pilferage of the approved funds.

Recommendations:

- Setting up of structured State Disaster Management Authority as per the norms and mandate of the Disaster Management Act 2005 with a full-fledged chairperson and approved members from departments, civil society, and academia. The SDMA must ensure to build the capacity of the state to prepare appropriate protective and risk-disaster reduction strategies with participative and disaster-resilient communities.
- Institutionalize the disaster management in the state with necessary professional human resources, state-of-the-art equipment for early warning system forecasts, and appropriately designed strategies for information and communication of the early warning systems.

- Flood infrastructure in the Jhelum river basin and its tributaries is being strengthened. This includes designing an integrated Disaster Prevention and Recovery Plan for the development of an alternative flood channel from Dogripora to Wular lake, raising the carrying capacity of the main Jhelum, dredging the current flood channel, dredging wetlands like Hokersar, Narkara, Nowgam Jheel, and Wular lake, and reinforcing flood walls, as well as breached and weak embankments.
- Since the Jhelum Basin is a single catchment area served by a single watershed, the basin's water bodies/lakes and wetlands should be managed by a single regulatory authority to ensure coordinated management.
- The government should consider conducting a scoping study with the assistance of academia/research institutes to determine the likelihood of flooding in the near future based on the knowledge gained from the interactions of ground water, surface water, and glacier melt in the Jhelum Basin.
- The Srinagar meteorology office installed a high-tech weather forecasting system from Japan (Doppler radar) in 2015. It should be checked on a regular basis, and stakeholders should be informed and communicated about the early warning system for both the Jhelum and Chenab basins.
- The State Government should take immediate steps (with the aid of leading academic institutions) to conduct transparent flood zonation and flood vulnerability assessments of citizens and places at the village level, so that flood risk mitigation is included in all District Development Plans.
- • A priority for knowledge-driven all-inclusive multidisciplinary flood planning is to engage technocrats with specialized expertise to gain insights into flooding processes in the Jhelum Basin, building on robust existing studies. The government should consider tasked technocrats and researchers with identifying scientific studies on various aspects of flooding in Kashmir, especially the feasibility study of new development projects such as railway and highway construction.
- Flood-resistant crops that can endure water logging for a few days should be developed by agricultural scientists.

- Launching a massive capacity-building campaign to raise public awareness and encourage public participation in flood risk mitigation.
- Significant reforestation of the Jhelum catchment under CAMPA, IWMP, and other existing government schemes should be improved to stop river catchment erosion and minimize siltation of the catchment's watercourses. Furthermore, in high gradient tributaries, both structural and non-structural erosion management steps must be enforced immediately.
- Mining of riverbeds is strictly controlled, with consideration for river/channel morphology and other required hydrologic and geologic criteria.
- Flood disaster preparedness and mitigation at the national, state, and local levels must be strengthened so that, despite the difficulties and limitations, a well-practiced mechanism for a rapid response to reduce the impact of flooding on residents and property is in place. Also, incorporate Sendai Framework related to community-based disaster risk reduction plans.
- Because of the lessons learned, revisit the current land use policy and building codes, and strictly enforce these policies to reduce human and economic damage in the event of a natural disaster.
- Improvements to the drainage system in the Jhelum Basin's urban areas, including natural drainage restoration and the protection and regeneration of polluted water bodies and wetlands

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Appendices 1:

QUESTIONAIRE FOR FIELD SURVEY

Questionnaire No: …….

Household General Information:

Name of the Respondent: Occupation:

Area Name: Elevation:

General Information:

Family and Occupational Details:

Name of the family member	Occupation	Age	Physically Challenged (Y/N)	Sex	Education	
					Literacy	Status

1) Income and livelihood details:

Annual income of the family:

Source of Income	Amount
Government Employee	
Private Employee	
Labour	
Business/ Shops	
Informal Business	
Any Other	

2) Source of potable water:

Source	Yes/No	Type
Tube well		
Well		
River stream		
Pond		
Govt supply		

3) Type of house: (please tick)

a) Kutcha b)Semi Pucca c) Pucca

4) Type of Floor: (please tick)

a) Kutcha b) Semi Pucca c) Pucca

5) Type of Roof: (please tick)

a) Kutcha b) Semi Pucca c) Pucca

6) Type of Wall: (please tick)

a) Kutcha b) Semi Pucca c) Pucca

7) Type of Drainage Connectivity:

a) Closed Drainage b) Open Drainage c) No Drainage

8) Drainage Outflow:

a) Underground Sump b) Nearby Nalla's c) Jhelum River

9) Name of the Assets you have:

◯ Vehicle ◯ Mobile ◯ TV ◯ Refrigerator

◯ Motorcycle ◯ Others_____

10) Nearness To The River:

◯ Less than 500 m ◯ 500 m- 1 Km

◯1 km-5 km ◯More than 5 km

Preparation and Response:

11) How long have you owned or lived at this address? (one tick)

◯ 1 Year To 5 Years ◯ 5 Years To 20 Years ◯ More than 20 Years

12) what is the location of your place of residence?

◯ Low Lying Area ◯ Sloping Zone ◯ Highland ◯ Any other

13) What is the type of disaster that you normally face?

◯ Flood ◯ Earthquake ◯ Any Other

14). Identify the vulnerable structures in your locality?

A)…… B)…….. C)……
D)……..

15) What is the exact month of occurrence of flood?

……
……

16) Was your House affected by 2014 Flood. If yes, what was the loss?

…… …… ……
…… …… ……
…… …… ……

17) Do you face health problems during or after a hazard? If Yes then what is the type of problem.

◯ Health & Safety Were Not Impacted ◯ Few Injuries / No Fatalities
◯ Many Injuries/ No Fatalities ◯ Fatalities Occurred
◯ Waterborne Diseases ◯ Other, Please Describe: _____

18) Do you feel that you have a secured source of livelihood? Yes/No

19) Do you have adequate access to the resources to fight the Hazard?

◯ Yes ◯ No ◯ No Idea

20) What according to you is the flood vulnerability status of your Home?

◯ Low ◯ Medium ◯ High ◯ Not at All

21) Did you receive any warnings about the flood? If Yes, What are the sources (multiple ticks)

◯ No Warning Whatsoever ◯ Television ◯ Radio
◯ Own Observations ◯ State Emergency Service (SES) ◯.Police
◯ Neighbours, Relatives or Friends ◯ Other

22) How much were you affected by the floods and what was the level of loss? (multiple ticks)

◯ Less	◯ Loss of Life And Property
◯ Moderate	◯ Injury to Family Member
◯ High	◯ Loss of House/Property
◯ Very High	◯Others_____

23). Where did you get water and how deep did it get? (one tick)

◯ In Basement (If Applicable): _____ Feet Deep
◯ In Crawl Space (If Applicable): _____ Feet Deep
◯ Over First Finished Floor: _____ Feet Deep
◯ On Land Only: _____ Feet Deep
◯ On the First Floor: _____Feet Deep

24) What do you feel was the cause of the flooding? (multiple ticks)

◯ Incessant Rains ◯ Overbank Flooding
◯ Broken Embankments ◯ Siltation ◯ Others_____

25) What has been the impact of this flood event on infrastructure (roads, bridges, lift stations, etc)?

26) What has been the environmental impact of this flood event? (One tick)

◯ Little or No Environmental Damage
◯ Resources Damaged W/Short-Term Recovery Practical
◯ Resources Damaged W/Long-Term Recovery Feasible
◯ Resources Destroyed Beyond Recovery

* Please describe the environmental impact of this flood event on your community:

27) What has been the economic impact of this flood event on your community/ personal level? (One tick)

◯ No Economic Impact ◯ Low Direct and/or Indirect Costs
◯ Low Direct and High Indirect Costs ◯ High Direct and Low Indirect Costs
◯ High Direct and High Indirect Costs

28) What kind of immediate help did you receive? (Multiple ticks)

◯ Cash ◯ Food Supplies ◯ Medical Aid
◯ Clothing.

29) Who helped you initially? (one tick)

◯ Army ◯ Local People ◯ Government Officials ◯ NGO's

30) What was the Role of different agencies during and Post Flood?

Role	Agency					
	Local Youth	Municipal Corporation	State/Central Government	Police	Paramilitary Forces	NGO's
Mitigation						
Evacuation						
Rehabilitation						
Monetary Aid						
Provision of Flood.						
Provision of Clothing and Other Basic Utilities						
Restoration of Peace and Order after Flood						
Others						

31).What were the sources of support during and after the Floods?

◯ Government (Central and State) ◯ NGO's ◯ United Nations

◯ Religious Bodies ◯ Local support ◯ Others

32). What items you lost in flood and what was the gross value of them? (multiple ticks)

◯ Monetary……. ◯Property…….
◯ Cattle…….. ◯ House Destruction……
◯ Loss of Work……...

33) How many days did it take you to get back to work? (one tick)

◯ 1-5 Days ◯ 6-10 Days ◯ 10-20 Days
◯ 20-30 Days ◯ 1 Month- 6 Months ◯ More Than 6 Months

34). What kind of strategy will you adopt to prevent future floods at household level?

35) Are you satisfied with the measures the government has undertaken to tackle the situation? (one tick)

◯ Yes ◯ No ◯ Can't Say ◯ May be

36) How long did it take you to fully cope up the losses? (one tick)

◯ 1-5 Days ◯ 6-10 Days ◯ 10-20 Days
◯ 20-30 Days ◯ 1 Month- 6 Months ◯ More Than 6 Months

37) How have you seen Srinagar developing as an urban space?

……

38) How has the urbanization of Srinagar increased the risk of flooding? (multiple ticks)

◯ Decreasing Lake Area in Floor Area ◯ Construction of Dam ◯ Encroachment of Catchment Area ◯ Urban Sprawl

** Others:_____

Explain:

39). Why is the process of effective distillation not taking place for the Jhelum River? (multiple ticks)

◯ Lack of Man Power ◯ Lack of Machinery
◯ Lack of Infrastructure ◯ Lack of Commitment
◯ Bureaucratic Pressure ◯ Lack of political will

40) Why was Srinagar not able to cope up with the floods even though it took three days longer to flood the city than from where it first started? (multiple ticks)

◯ Lack of Infrastructure
◯ Lack of Awareness about the Impending Flood
◯ Warnings Not Taken into Great Consideration
◯ Faulty Urbanization
◯ Lack of Preparedness after the Flood
◯ Others:_____

41) Please Rate the Level of preparedness and Mitigation Strategies in force at the time of Disaster and at present time .

Indicator	September 2014	November 2017
Early Warning System		
Awareness about flood eventually by Government		
Awareness about flood eventually by Civil Society/ NGOS		
Awareness through mock drills by Government		
Knowledge of Rules and Regulations in place like not to construct around river channels/ flood channels		
Implementation status of such rules		
Knowledge of de-silting and drudging activities of government for river channels/ flood spill channels		
Implementation of de-silting and drudging activities of government for river channels/ flood spill channels		
Your perception on implementation of rules and regulations for the removal of unauthorized and illegal constructions around river channels/ flood channels		
Do you have any knowledge of any safety audits in place by government to avoid flooding in the flood prone areas		
Did you observe or have knowledge of steps taken by government to strengthen flood protection walls/ strengthen bunds Yes / No If yes how would you rate its implementation		
Do you have/ had any knowledge that government has identified safe areas of evacuations in case of emergency at the time of disasters		
How would you rate the overall preparedness of Government to face any such eventuality in future		
How would you rate the overall preparedness of community themselves to face any such eventuality in future		

1: Not at all 2: Partially 3 Basic level 4. Fully

42) What measures have the flood control department undertaken since the flood, in case a future flood takes place?

43) What is the response of the people, namely individual households? What kind of traditional knowledge or new innovations did they apply to cope up with the floods?

44) What do you think/suggest should be the best way to prevent flooding in future?

45) Have you installed any flood protection measures on your property post this flood?

◯ Sump Pump ◯ Backup Power System/Generator
◯ Overhead Sewers, Backup Valve ◯ Sewer Plug or Standpipe
◯ Waterproofed Walls ◯ Moved Things out of the Basement
◯ Regraded Property to Keep Water away from Building
◯ Purchase of Boats ◯ Building an Extra Storey
◯ Other: _____

46) Boatmen made fortunes during the floods. Did you take any help from boatmen? Tell us about the evacuation process and also how much did they charge you?

47) Please mention measures/ Strategies that Government/ Community/ Civil Society needs to Adopt in order to reduce the losses due to flood disasters in future.

◯ Maintenance Programs to Clear Creeks of Vegetation and Debris Impeding Flows.
◯ Enlarge the Creek/Stream Channels.
◯ Construct Detention Basins on the Flood Plains
◯ Improve the Storm Water System of The Jhelum Flood Plains.
◯ Construct Permanent Levees Along the Creeks/Stream to Contain Floodwaters.
◯ Provide Funding or Subsidies to Raise Houses above Major Flood Level in Low Hazard Areas.
◯ Improve Flood Warning and Evacuation Procedures Both Before and During a Flood.
◯ Community Education, Participation and Flood Awareness Programs.
◯ Provide a Certificate to Purchasers in Flood Prone Areas, stating that the Property is Flood Affected and to What Extent.

48) What is your satisfaction level about the preparedness and capacity building of stakeholders to meet the challenges of such disasters in future?

49) What responses should be done immediately after such disasters by local government/ Central government/ community/ Civil Society/ NGOs

Recovery and Rehabilitation status

50) Are you satisfied with the post flood disaster recovery plan of government Yes/No. If No please give details of your dissatisfaction reasons

……
……
……
……
….....

51) Whether your property (house/ household goods/ shops/ items in the shops) were insured by you : Yes/No

52) If yes, did you receive the insured amount, If yes how much did you receive and when was the amount received

……
…

53) Is any payment still pending from the insurance company; Yes/ No. If yes, how much and when are you expected to get it.

……
……....

54) Was assessment done by government machinery for your damages during the 2014 floods Yes/ NO.? If yes, state damage assessment details separately for house/ crops/ household goods/ shops/ items in the shops.

Assessment of Damage	Amount
House	
Household Goods	
Crops	
Shops	

Items in Shop	

55) Was the damage assessment done transparently as per your satisfaction: Yes/ No. If No, state your reasons

……
……..
.....

56) Have you received payments from the government: Yes/ No. If yes, how much and When?

……..……

……..

57) Do you expect more money from government as per the assessment survey? Yes/ No. If yes how much…….. and when do you expect to receive the amount……..

58) Was any interim relief given post flood disaster period in terms of food, clothes, temporary shelter, any other please state:

◯ Food ◯ Clothes ◯ Evacuation

◯ Drinking Water ◯ Temporary Shelter

59) Which agency was most supportive immediately after the floods in terms of relief supplies, give ratings (1-5) 1 is least supportive and 5 is highly supportive.

Agency	Local Govt	Central Govt	Local Community	NGO/Civil Society	Police Forces	Army	NDRF	SDRF	Any Other
Rating									

60) Are you satisfied with the relief given? Yes/ No. If No, state reasons for your Dissatisfaction.

61) Suggestion/Opinions, If Any:

Appendices 2:

INTERVIEW GUIDE FOR KEY INFORMANTS (GOVT)

Questionnaire No:

Date: Time:

Name: Contact given by:

Contact details:

Agency/ Department/ Municipality:

Designation:

Areas of responsibility:

In the present position since:

Discussion points

1) What is the mandated responsibility of your agency in relation to disasters?

.....
.....

2) What interventions were initiated by the agency/ department/ Municipality in the floods of September 2014?

.....
.....

.....

4) Who are the partners, networks, other facilitating agencies in your disaster related work? How do you divide your responsibilities?

.....
.....

5) Can you describe the role of flood affected people, different levels of State agencies, NGOs, others?

.....
.....

6) What are the factors facilitating your intervention?

.....

7) What are the obstacles in intervention?

.....
.....

8) Any suggestions for effective intervention?

.....
.....
.....

Appendices 3:

INTERVIEW GUIDE FOR NGOs

Questionnaire No:

Name: Date:
Designation: Contact details:
Name of NGO:
Areas of responsibility:
In the present position since:
Chief functionary of NGO:
Chief functionary's contact details:
Area of operation (NGO):

Discussion points

1) Does your organization have prior experience of responding to disasters? If yes, how did it help you in the flood response?

2) What were the reasons for you to get involved in intervention?

3) Describe the nature of your organisation's interventions in the floods of September 2014?

4) Who are the partners, networks, other facilitating agencies in your disaster related work? How do you divide your responsibilities?

5) Can you describe the role of flood affected people, different levels of State agencies, NGOs, others?

6) Any suggestions for effective intervention?

Note:

- Ask for any document/ guidelines/ reports/ maps/ pictures/ any other media regarding disasters/ disaster response.
- Ask for contact details of other agencies/ organizations/ key persons in relation to disaster response.

Appendices 4:

List of Tables

Figure 3.7: Area under Lakes and Water Bodies in Srinagar City 2012

Name of the Water body	Area In Hectares
Rakh-i-Shalabug	1508.2
Rakh-i-Kujar	1482.4
Dal (Lake)	1104.4
Manasbal lake	177.2
Rakh-i-Rabitar	174.5
Gangabal lake	160
Dal (Marshy)	159.4
Khushal Sar	92
Nagin (lake)	64.2
Sudarkut Bala Namba	61.7
Rakh Malgom Nambal	48.2
Marsar lake	44.2
Nund kol	36.1
Khanpur(Marshy)	35.9
Nagin (Marshy)	32.5
Babadam(Marsh)	30.4
Dal (marshy)	28.5
Zinipura Nambal	27.6
Ajas Nambal	26.7
Waskur Sar(Marshy)	21.5
Waskur Sar (Lake)	20.1
Ahan Sar (Marshy)	14.8
Nesbal Nambal	14.8
Lolgul sar	14.7
Chak Sudarkut Bala Namba	13.1
Chak Sudarkot Bala Nambal	11.4
Kaul sar	11.3
Andurun sar	11.2
Ahan Sar (Lake)	9.9
Yamhar Sar	9.9
Nagin (lake)	9.5
Dal (Lake)	9.1
Anchar (lake)	8.2
Shalhar Sar	8
Nambal	7.6
Babadam (Lake)	7.5
Dal (Lake)	7
Nilnag	6.8
Kilchol Sar	6.4

Khanpur (lake)	5.1
Kana sar	5
Dal (Lake)	4.5
Dal (Lake)	4.4
Gumbur Sar	4.3
Gil Sar (Marshy)	4.2
Masthokar Sar	4
Kan Sar	4
Sona sar	3.5
Kharpora Sar	3.4
Bod Mengandoob Sar	3.3
Satsaran Sar	3.2
Hakabor Nambal	3.1
Nagin (Marshy)	3.1
Nambal	3
Gil Sar (Lake)	3
Hoka sar 3	2.1
Shutiyan Nag	2.1
Nambal	2
Hoka sar 1	1.9
Salma Sar	1.8
Lokut Mengandoob Sar	1.7
Khamti lake	1.7
Sar	1.5
Darin Sar	1.5
Nambal	1.4
Bazipura Nambal	1.4
Hoka Sar	1.4
Hoka sar 2	1.3
Krim Sar	1.3
Bod Dandloo Sar	1.2
Baribal sar	1.2
Naupura Nambal	1.1
Nagaberan Sar	1.1
Sona sar	1.1
Nambal	1
Sar	0.9
Lokut Sar	0.9
Sar	0.9
Doth Sar	0.9
Waskur Sar (Lake)	0.9
Pahilpura Nambal	0.8

Babadam(Marsh)	0.8
Nambal	0.7
Sadunara Nambal	0.7
Zadipura Nambal	0.7
Khanpur (lake)	0.7
Nambal	0.6
Sar	0.6
Braham Sar	0.5
Lokut Dandloo Sar	0.3
Zadipura Nambal	0.2
Sar	0.2

Figure 4.6: Percentage of Sample Households by Male-Female Structure in Srinagar City

S.no	Municipality Ward	Male (%)	Female (%)
1	Mehjoor Nagar	61.54	38.46
2	Natipora	57.14	42.86
3	Rambagh	52.17	47.83
4	Solina	60.00	40.00
5	Jawahar Nagar	60.61	39.39
6	Rajbagh	53.25	46.75
7	Amirakadal	51.52	48.48
8	Shaheed Ganj	53.04	46.96
9	Gowkadal	58.16	41.84
10	GundAhalmar	62.90	37.10
11	Barbar Shah	56.10	43.90
12	Babdem	57.14	42.86
13	Habakadal	60.00	40.00
14	Ganpatyar	52.27	47.73
15	Batmaloo	56.38	43.62
16	Bemina	52.91	47.09

Figure 4.7: Ward-Wise Percentage of Sample Households by Age Group in Srinagar City

S.No	Muncipality Ward	Age Group			
		Below 40	40-50	50-60	Above 60
1	Mehjoor Nagar	4	6	3	5
2	Natipora	8	4	3	2
3	Rambagh	6	2	1	6
4	Solina	3	2	1	4
5	Jawahar Nagar	2	6	5	3
6	Rajbagh	34	18	27	21
7	Amirakadal	11	16	4	1
8	Shaheed Ganj	7	11	5	5
9	Gowkadal	12	4	5	5
10	GundAhalmar	5	4	3	6
11	Barbar Shah	3	2	1	4
12	Babdem	4	3	2	2
13	Habakadal	3	2	3	1
14	Ganpatyar	4	2	6	3
15	Batmaloo	9	8	3	5
16	Bemina	14	10	14	12

Figure 4.8: Percentage of Sample Households by Literacy Pattern in Srinagar City

S.No	Muncipality Ward	Educational Status					
		Illiterate	Upto 10th	10+ 2	Graduat e	Post Graduate and Above	Technica l
1	Mehjoor Nagar	2	6	2	4	2	2
2	Natipora	1	4	2	5	3	2

3	Rambagh	1	2	4	3	2	3
4	Solina	0	2	3	1	1	3
5	Jawahar Nagar	2	3	5	1	4	1
6	Rajbagh	16	25	12	25	13	9
7	Amirakadal	6	12	7	2	2	3
8	Shaheed Ganj	4	9	7	3	1	4
9	Gowkadal	1	6	6	2	3	8
10	GundAhalmar	2	3	4	2	2	5
11	Barbar Shah	4	2	1	1	0	2
12	Babdem	1	5	3	0	0	1
13	Habakadal	1	3	2	1	0	2
14	Ganpatyar	2	4	5	1	0	3
15	Batmaloo	3	6	7	3	1	5
16	Bemina	3	9	21	4	6	7

Figure 4.9: Percentage of Sample Households by Occupational Structure in Srinagar City

S.No	Muncipality Ward	Occupational Structure				
		Labour	Private Employee	Govt Employee	Business/Shop	Informal Business
1	Mehjoor Nagar	7	4	2	1	4
2	Natipora	4	6	3	2	2
3	Rambagh	2	3	2	5	3
4	Solina	2	3	1	3	1
5	Jawahar Nagar	3	2	3	6	2

6	Rajbagh	12	22	15	38	13
7	Amirakadal	5	8	10	4	6
8	Shaheed Ganj	5	3	7	11	2
9	Gowkadal	6	2	3	12	3
10	GundAhalmar	1	2	4	9	3
11	Barbar Shah	1	2	2	4	1
12	Babdem	2	1	1	6	1
13	Habakadal	1	1	1	6	0
14	Ganpatyar	2	1	1	9	2
15	Batmaloo	2	2	3	16	2
16	Bemina	9	12	21	7	1

Figure 4.10: Ward-wise Percentage of Sample Households by Income Level in Srinagar City

S.no	Muncipality Ward	Level of Income		
		Below 2 Lac	2 -4 Lac	Above 4 Lakh
1	Mehjoor Nagar	8	6	4
2	Natipora	5	9	3
3	Rambagh	4	9	2
4	Solina	3	6	1
5	Jawahar Nagar	4	8	4
6	Rajbagh	18	54	28
7	Amirakadal	15	12	5
8	Shaheed Ganj	9	15	4
9	Gowkadal	2	20	4
10	GundAhalmar	2	6	10
11	Barbar Shah	3	2	5
12	Babdem	2	4	5
13	Habakadal	1	3	5
14	Ganpatyar	2	3	10

15	Batmaloo	3	6	6
16	Bemina	5	27	18

Figure 4.11: Percentage of Sample Households by Source of Drinking Water in Srinagar City

S.No	Municipality Ward	Source of Drinking Water				
		Govt Supply	Tube Well	Well	River Stream	Pond
1	Mehjoor Nagar	18	0	0	0	0
2	Natipora	16	1	0	0	0
3	Rambagh	15	0	0	0	0
4	Solina	10	0	0	0	0
5	Jawahar Nagar	16	0	0	0	0
6	Rajbagh	32	0	0	0	0
7	Amirakadal	32	0	0	0	0
8	Shaheed Ganj	28	0	0	0	0
9	Gowkadal	26	0	0	0	0
10	GundAhalmar	18	0	0	0	0
11	Barbar Shah	10	0	0	0	0
12	Babdem	11	0	0	0	0
13	Habakadal	9	0	0	0	0
14	Ganpatyar	15	0	0	0	0
15	Batmaloo	25	0	0	0	0
16	Bemina	50	0	0	0	0

Figure 4.12: Percentage of Sample Households by Type of House in Srinagar City

S.No	Municipality Ward	House Type		
		Kutcha	Semi Pucca	Pucca

1	Mehjoor Nagar	3	4	11
2	Natipora	1	0	16
3	Rambagh	4	1	10
4	Solina	2	1	7
5	Jawahar Nagar	1	0	15
6	Rajbagh	0	21	79
7	Amirakadal	2	6	24
8	Shaheed Ganj	1	4	23
9	Gowkadal	2	2	22
10	GundAhalmar	2	3	13
11	Barbar Shah	1	1	8
12	Babdem	2	1	8
13	Habakadal	1	1	7
14	Ganpatyar	2	3	10
15	Batmaloo	4	5	16
16	Bemina	7	4	39

Figure 4.13: Percentage of Sample households by Health problems Faced during Flood 2014 in Srinagar City

S.No	Municipality Ward	Health Problems faced During Flood	
		Yes	No
1	Mehjoor Nagar	16	2
2	Natipora	14	3
3	Rambagh	11	4
4	Solina	8	2
5	Jawahar Nagar	11	5
6	Rajbagh	86	14

7	Amirakadal	25	7
8	Shaheed Ganj	22	6
9	Gowkadal	21	5
10	GundAhalmar	16	2
11	Barbar Shah	5	5
12	Babdem	5	6
13	Habakadal	6	3
14	Ganpatyar	11	4
15	Batmaloo	19	6
16	Bemina	21	29

Figure 5.1: Percentage of sample households by period of residence in Srinagar city

Ward	>10 Years	5-10 Years	0-5 Years
GundAhalmar	100.00	0.00	0.00
Rambagh	86.67	6.67	6.67
Natipora	82.35	17.65	0.00
Gowkadal	80.77	15.38	3.85
Amirakadal	75.00	15.63	9.38
Ganpatyar	73.33	26.67	0.00
Babdem	72.73	27.27	0.00
Mehjoor Nagar	72.22	22.22	5.56
Shaheed Ganj	71.43	17.86	10.71
Jawahar Nagar	68.75	18.75	12.50
Solina	66.67	16.67	16.67
Batmaloo	66.67	20.83	12.50
Rajbagh	66.00	21.00	13.00
Bemina	60.00	22.00	18.00
Barbar Shah	60.00	30.00	10.00
Habakadal	55.56	33.33	11.11

Figure 5.2: Percentage of Households Affected by Hazard Type in Srinagar City

	Flood	Both Flood	Earthquake	Any Other

Ward No		and Earthquake		
Mehjoor Nagar	100.00	0.00	0.00	0.00
Natipora	100.00	0.00	0.00	0.00
Habakadal	100.00	0.00	0.00	0.00
Ganpatyar	100.00	0.00	0.00	0.00
Amirakadal	100.00	0.00	0.00	0.00
GundAhalmar	100.00	0.00	0.00	0.00
Jawahar Nagar	100.00	0.00	0.00	0.00
Rajbagh	96.00	4.00	0.00	0.00
Gowkadal	92.31	7.69	0.00	0.00
Solina	90.00	10.00	0.00	0.00
Barbar Shah	90.00	10.00	0.00	0.00
Bemina	90.00	10.00	0.00	0.00
Batmaloo	88.00	12.00	0.00	0.00
Rambagh	86.67	13.33	0.00	0.00
Shaheed Ganj	85.71	14.29	0.00	0.00
Babdem	81.82	18.18	0.00	0.00

Figure 5.3 Percentages of Sample Households by Cause of Flood in Srinagar City

	Cause of Flood			
Ward	Incessant Rains	Broken Embankments	Poor Outgoing Channel	Overbank Flooding
Rambagh	93.33	6.67	0.00	0.00
Solina	90.00	10.00	0.00	0.00
Bemina	86.00	12.00	2.00	0.00
GundAhalmar	83.33	16.67	0.00	0.00
Jawahar Nagar	81.25	6.25	12.50	0.00
Amirakadal	81.25	9.38	9.38	0.00
Gowkadal	80.77	15.38	3.85	0.00
Shaheed Ganj	78.57	10.71	10.71	0.00
Habakadal	77.78	11.11	11.11	0.00
Ganpatyar	73.33	20.00	6.67	0.00
Babdem	72.73	27.27	0.00	0.00

Mehjoor Nagar	72.22	22.22	5.56	0.00
Batmaloo	72.00	24.00	4.00	0.00
Natipora	70.59	23.53	5.88	0.00
Rajbagh	67.00	30.00	3.00	0.00
Barbar Shah	60.00	40.00	0.00	0.00

Figure 5.4: Percentage of Sample Households by Hazard Frequency per year in Srinagar City

Ward	Hazard Frequency in Srinagar		
	Once	Twice	More than Twice
Jawahar Nagar	100.00	0.00	0.00
Amirakadal	100.00	0.00	0.00
GundAhalmar	100.00	0.00	0.00
Barbar Shah	100.00	0.00	0.00
Batmaloo	100.00	0.00	0.00
Habakadal	100.00	0.00	0.00
Natipora	100.00	0.00	0.00
Gowkadal	96.15	3.85	0.00
Rajbagh	96.00	4.00	0.00
Bemina	94	6	0
Ganpatyar	93.33	6.67	0.00
Rambagh	92.31	7.69	0.00
Babdem	90.91	9.09	0.00
Solina	90.00	10.00	0.00
Mehjoor Nagar	88.89	11.11	0.00
Shaheed Ganj	85.71	14.29	0.00

Figure 5.5 Percentages of Sample Households by Hazard Calendar in Srinagar City

Ward	Hazard Calendar			
	July	August	September	October
Mehjoor Nagar	0.00	16.67	83.33	0.00
Solina	0.00	16.67	83.33	0.00
Shaheed Ganj	0.00	14.29	85.71	0.00
Barbar Shah	0.00	10.00	90.00	0.00
Babdem	0.00	9.09	72.73	18.18
Batmaloo	0.00	8.00	88.00	4.00
Gowkadal	0.00	7.69	92.31	0.00
Ganpatyar	0.00	6.67	93.33	0.00

Natipora	0.00	5.88	94.12	0.00
GundAhalmar	0.00	5.56	83.33	11.11
Bemina	0.00	4.00	94.00	2.00
Rajbagh	0.00	3.00	97.00	0.00
Rambagh	0.00	0.00	100.00	0.00
Jawahar Nagar	0.00	0.00	100.00	0.00
Amirakadal	0.00	0.00	100.00	0.00
Habakadal	0.00	0.00	100.00	0.00

Figure 5.6: Percentage of Sample Households by Flood Duration in Srinagar City

Ward	Flood Duration			
	More than 6 Months	**1-6 Months**	**15-30 Days**	**Less than 15 Days**
Mehjoor Nagar	94.44	5.56	0.00	0.00
Solina	40.00	40.00	20.00	0.00
Jawahar Nagar	31.25	50.00	12.50	6.25
Natipora	29.41	35.29	35.29	0.00
Rambagh	26.67	33.33	40.00	0.00
Shaheed Ganj	25.00	60.71	14.29	0.00
Amirakadal	25.00	56.25	15.63	3.13
Gowkadal	23.08	53.85	19.23	3.85
Barbar Shah	20.00	70.00	10.00	0.00
Babdem	18.18	54.55	27.27	0.00
Bemina	16.00	68.00	14.00	2.00
Batmaloo	16.00	68.00	12.00	4.00
Rajbagh	16.00	76.00	6.00	2.00
Ganpatyar	13.33	60.00	26.67	0.00
GundAhalmar	11.11	72.22	16.67	0.00
Habakadal	11.11	66.67	22.22	0.00

Figure 5.7: Percentage of Sample Households by Settlement Damage during Flood 2014 in Srinagar City

Ward	Extent of Damage			
	Housing Material	**Fall of House**	**Boundary and Gate**	**None**
Rambagh	93.33	0.00	6.67	0.00
Habakadal	88.89	11.11	0.00	0.00
Batmaloo	88.00	8.00	4.00	0.00
Ganpatyar	86.67	6.67	6.67	0.00
Barbar Shah	80.00	0.00	20.00	0.00
Mehjoor Nagar	72.22	27.78	0.00	0.00
Natipora	70.59	29.41	0.00	0.00

Jawahar Nagar	68.75	31.25	0.00	0.00
Bemina	68.00	28.00	4.00	0.00
Shaheed Ganj	67.86	32.14	0.00	0.00
Rajbagh	67.00	33.00	0.00	0.00
GundAhalmar	66.67	22.22	11.11	0.00
Gowkadal	65.38	34.62	0.00	0.00
Babdem	63.64	27.27	9.09	0.00
Solina	60.00	40.00	0.00	0.00
Amirakadal	56.25	43.75	0.00	0.00

Figure 5.8: Percentage of Sample Households by Economic Damage during Flood 2014 in Srinagar City

Ward	Extent of economic Damage			
	Business Establishment	Furniture	Household Goods	Vehicles
Jawahar Nagar	68.75	25.00	6.25	0.00
Gowkadal	57.69	34.62	7.69	0.00
GundAhalmar	55.56	22.22	22.22	0.00
Habakadal	55.56	22.22	22.22	0.00
Ganpatyar	46.67	40.00	13.33	0.00
Batmaloo	44.00	24.00	32.00	0.00
Bemina	44.00	28.00	28.00	0.00
Solina	40.00	20.00	40.00	0.00
Barbar Shah	40.00	40.00	20.00	0.00
Shaheed Ganj	39.29	35.71	25.00	0.00
Amirakadal	37.50	34.38	25.00	3.13
Babdem	36.36	36.36	27.27	0.00
Rajbagh	27.00	22.00	26.00	25.00
Natipora	15.00	25.00	50.00	10.00
Rambagh	13.33	13.33	53.33	20.00
Mehjoor Nagar	11.11	27.78	50.00	11.11

Figure 5.9: Percentage of Sample Households by the information on Floods in Srinagar City 2014

Ward	Source of Information					
	No Warnings	Own Observation	Electronic Media	Neighbours/ Relatives/ Friends	Police	State Emergency Service
Mehjoor Nagar	94.44	5.56	0.00	0.00	0.00	0.00
Solina	90.00	10.00	0.00	0.00	0.00	0.00
Habakadal	77.78	22.22	0.00	0.00	0.00	0.00
Rajbagh	69.00	31.00	0.00	0.00	0.00	0.00

Natipora	64.71	35.29	0.00	0.00	0.00	0.00
Ganpatyar	60.00	40.00	0.00	0.00	0.00	0.00
Rambagh	60.00	40.00	0.00	0.00	0.00	0.00
Gowkadal	57.69	42.31	0.00	0.00	0.00	0.00
GundAhalmar	55.56	44.44	0.00	0.00	0.00	0.00
Babdem	54.55	36.36	9.09	0.00	0.00	0.00
Barbar Shah	50.00	40.00	10.00	0.00	0.00	0.00
Jawahar Nagar	50.00	50.00	0.00	0.00	0.00	0.00
Batmaloo	44.00	56.00	0.00	0.00	0.00	0.00
Amirakadal	40.63	59.38	0.00	0.00	0.00	0.00
Shaheed Ganj	39.29	60.71	0.00	0.00	0.00	0.00
Bemina	20.00	72.00	8.00	0.00	0.00	0.00

Figure 5.11: Percentage of Sample Households by Satisfaction with Government Measures during Flood in Srinagar City

Ward	Level of Satisfaction with govt measures during Flood	
	Yes	No
Ganpatyar	20.00	80.00
Babdem	18.18	81.82
Jawahar Nagar	12.50	87.50
Natipora	11.76	88.24
Gowkadal	11.54	88.46
GundAhalmar	11.11	88.89
Habakadal	11.11	88.89
Barbar Shah	10.00	90.00
Solina	10.00	90.00
Batmaloo	8.00	92.00
Bemina	8.00	92.00
Rambagh	6.67	93.33
Amirakadal	6.25	93.75
Rajbagh	6.00	94.00
Mehjoor Nagar	5.56	94.44
Shaheed Ganj	3.57	96.43

Figure 5.13: Reasons for Poor Drudging/Desiltation in Jhelum River in Srinagar City (%).

Ward	Lack of Machinery	Lack of Manpower	Lack of Infrastructure	Lack of Commitment	Lack of Political Will	Bureaucratic Pressure
Batmaloo	84.00	8.00	0.00	0.00	4.00	4.00

Barbar Shah	80.00	0.00	0.00	0.00	0.00	20.00
Shaheed Ganj	78.57	3.57	0.00	3.57	0.00	14.29
Rajbagh	78.00	6.00	3.00	2.00	5.00	6.00
Bemina	78.00	6.00	2.00	2.00	4.00	8.00
Habakadal	77.78	11.11	0.00	0.00	11.11	0.00
Gowkadal	76.92	0.00	3.85	0.00	7.69	11.54
Amirakadal	75.00	3.13	0.00	6.25	6.25	9.38
Ganpatyar	73.33	0.00	0.00	0.00	6.67	20.00
Babdem	72.73	0.00	0.00	0.00	0.00	27.27
GundAhalmar	72.22	5.56	5.56	5.56	0.00	11.11
Solina	70.00	0.00	0.00	10.00	10.00	10.00
Jawahar Nagar	68.75	0.00	0.00	0.00	12.50	18.75
Mehjoor Nagar	55.56	0.00	11.11	11.11	5.56	16.67
Rambagh	53.33	20.00	6.67	13.33	0.00	6.67
Natipora	47.06	5.88	0.00	11.76	11.76	23.53

Figure 5.15: Percentage of Sample Households by Location of Residence in Srinagar City

	Location of Residence			
Ward	**Low Lying Area**	**Sloping Zone**	**Highland**	**Any Other**
Jawahar Nagar	100.00	0.00	0.00	0.00
Solina	100.00	0.00	0.00	0.00
Babdem	100.00	0.00	0.00	0.00
GundAhalmar	94.44	5.56	0.00	0.00
Mehjoor Nagar	94.44	0.00	5.56	0.00
Amirakadal	90.63	6.25	3.13	0.00
Ganpatyar	86.67	13.33	0.00	0.00
Shaheed Ganj	82.14	17.86	0.00	0.00
Bemina	78.00	12.00	10.00	0.00
Habakadal	77.78	22.22	0.00	0.00
Gowkadal	76.92	15.38	7.69	0.00
Natipora	70.59	29.41	0.00	0.00
Batmaloo	64.00	16.00	20.00	0.00
Rajbagh	61.00	37.00	2.00	0.00
Barbar Shah	60.00	40.00	0.00	0.00
Rambagh	26.67	73.33	0.00	0.00

Figure 5.16: Percentage of Sample House types in Srinagar city

Ward	House Type		
	Pucca	Semi Pucca	Kutcha
Natipora	94.12	0.00	5.88
Jawahar Nagar	93.75	0.00	6.25
Gowkadal	84.62	7.69	7.69
Shaheed Ganj	82.14	14.29	3.57
Barbar Shah	80.00	10.00	10.00
Rajbagh	79.00	21.00	0.00
Bemina	78.00	8.00	14.00
Habakadal	77.78	11.11	11.11
Amirakadal	75.00	18.75	6.25
Babdem	72.73	9.09	18.18
GundAhalmar	72.22	16.67	11.11
Solina	70.00	10.00	20.00
Rambagh	66.67	6.67	26.67
Ganpatyar	66.67	20.00	13.33
Batmaloo	64.00	20.00	16.00
Mehjoor Nagar	61.11	22.22	16.67

Figure 5.17: Percentage of Sample Households by Future Secure Livelihood in Srinagar City

Ward	Future Secure Livelihood	
	YES	NO
Rambagh	23.53	76.47
Ganpatyar	13.33	86.67
Amirakadal	12.50	87.50
Jawahar Nagar	12.50	87.50
Barbar Shah	10.00	90.00
Rajbagh	7.00	93.00
Natipora	5.88	94.12
Batmaloo	4.00	96.00
Gowkadal	3.85	96.15
Bemina	2.00	98.00
Solina	0.00	100.00
Shaheed Ganj	0.00	100.00
GundAhalmar	0.00	100.00
Mehjoor Nagar	0.00	100.00
Babdem	0.00	100.00
Habakadal	0.00	100.00

Figure 5.19: Percentage of Respondents by participation in Decision Making in Srinagar City.

Ward	Respondents by participation in Decision Making	
	Yes	No
Amirakadal	7.11	92.89
Rambagh	6.99	93.01
Solina	6.44	93.56
Barbar Shah	5.46	94.54
Babdem	5.22	94.78
Natipora	5.11	94.89
Gowkadal	4.44	95.56
Bemina	4.21	95.79
Rajbagh	3.86	96.14
Batmaloo	3.67	96.33
Shaheed Ganj	3.56	96.44
Mehjoor Nagar	2.66	97.34
GundAhalmar	2.55	97.45
Habakadal	2.33	97.67
Jawahar Nagar	1.88	98.12
Ganpatyar	1.33	98.67

Figure 5.20: Percentage of Sample Households by Insurance to Property in Srinagar City

Ward	Property Insurance	
	YES	NO
Jawahar Nagar	25.00	75.00
Rajbagh	22.00	78.00
Amirakadal	12.50	87.50
Batmaloo	12.00	88.00
Gowkadal	11.54	88.46
Shaheed Ganj	10.71	89.29
Babdem	9.09	90.91
Bemina	8.00	92.00
Rambagh	6.67	93.33
Ganpatyar	6.67	93.33
Natipora	5.88	94.12
GundAhalmar	5.56	94.44
Barbar Shah	0.00	100.00
Habakadal	0.00	100.00
Solina	0.00	100.00
Mehjoor Nagar	0.00	100.00

Figure 5.21: Percentage of Sample Households by Vulnerability Status of their House based on Past Experience in Srinagar City

Ward	Vulnerability Status			
	High	Medium	Low	Not At All
Mehjoor Nagar	100.00	0.00	0.00	0.00
Habakadal	100.00	0.00	0.00	0.00
Natipora	94.12	5.88	0.00	0.00
Rajbagh	94.00	6.00	0.00	0.00
Rambagh	93.33	6.67	0.00	0.00
Amirakadal	90.63	9.38	0.00	0.00
GundAhalmar	88.89	11.11	0.00	0.00
Jawahar Nagar	81.25	18.75	0.00	0.00
Bemina	80.00	18.00	2.00	0.00
Solina	80.00	20.00	0.00	0.00
Ganpatyar	80.00	20.00	0.00	0.00
Gowkadal	78.40	21.60	0.00	0.00
Babdem	72.73	27.27	0.00	0.00
Batmaloo	68.00	24.00	8.00	0.00

Figure 6.1: Percentage Wise Role of Different Agencies Played During and Post Flood in Srinagar City

	ROLE OF DIFFERENT AGENCIES DURING AND POST FLOOD					
Role	Agency					
	Local Youth	Muncipal Corporation	State/Central Government	Police	Paramilitary Forces	NGO's
Mitigation	35.00	0.00	60.00	0.00	5.00	0.00
Evacuation	80.00	0.00	0.00	0.00	10.00	10.00
Rehabilitation	20.00	0.00	70.00	0.00	10.00	0.00
Monetary Aid	5.00	0.00	90.00	0.00	5.00	0.00
Provision of Food	90.00	0.00	0.00	0.00	5.00	5.00
Provision of Clothing and other Basic Utilities	60.00	0.00	0.00	0.00	10.00	30.00

Restoration of Peace and Order after Flood	30.00		45.00	20.00	15.00	
Others	0.00	0.00	0.00	0.00	0.00	0.00