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KASHMIR FLOODS 2014

Recovery to Resilience

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Resilient India - Disaster Free India

National Institute of Disaster Management
(Ministry of Home Affairs, Government of India)

Kashmir Floods 2014

Recovery to Resilience

2023

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Kashmir Floods 2014: Recovery to Resilience

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Disclaimer

The case study report is compiled based on the various published, unpublished literatures, reports, documents, and other secondary data resources, as well as through data and photographs collected by author while visiting the affected areas and meetings with the UT stakeholders at various timeframes after 2014 Flood. Since during 2014 Flood, the UT of Jammu & Kashmir was a State and later bifurcated as two UTs, Jammu and Kashmir UT and Ladakh UT from October 2019, hence most of the data compiled at regional scale refers Jammu & Kashmir as erstwhile state which includes Ladakh UT (earlier Ladakh division) in the document. Author gratefully acknowledge the contributors and their original sources wherever used in the document. The report may be freely referred, cited, translated, updated and reproduced in parts or whole for any academic and non-commercial purpose with appropriate citation, permission of authors and publishers of the institute.

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ताज हसन, भा. पु. से.
कार्यकारी निदेशक

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Executive Director

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आज़ादी का अमृत महोत्सव

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FOREWORD

Floods have been a recurring phenomenon in the entire north-western Himalayan region, especially in the Kashmir Valley. Hydro-geological settings of the UT of Jammu and Kashmir have made the area prone to floods since ancient times. However, recent trend of developmental activities has increased the exposure to flood hazard of the region. Increasing impact of these recurring events can be attributed to climate change, population growth, loss of wetlands, deforestation, and unrestrained land use and land cover changes, etc. The flood of 2014 in the Kashmir Valley was the worst flood in the last hundred year. The unprecedented rainfall was apparently the immediate cause of flooding in the Kashmir valley. However, it was aggravated by many other factors, for example, rapid urbanization, development activities like construction of railway line across the valley, poor management of flood spill channel, encroachment of wetlands and land adjoining river banks, the disappearance of wetlands, etc. These factors contributed towards blocking of the natural drainage patterns and increased the severity of the flood.

The flood caused 287 deaths, adversely affected around two million people. It paralyzed Srinagar city for several days. Central government, several States/UTs came forward to help the UT of Jammu and Kashmir.

The documentation of 2014 Kashmir flood has drawn lessons for future course of action and for managing similar events in a well-coordinated manner. This document has also suggested long-term measures that should be taken for building resilience. It is expected that this work will help other States/UTs in planning the flood preparedness, response and rehabilitation

efforts in a well-coordinated manner by following the principle of Building Back Better. The study will also help in bringing much needed awareness among vulnerable population of the UT of Jammu & Kashmir, and the administration will get benefitted in terms of analysing strengths weaknesses, threats and opportunities for managing disaster events in a holistic manner.

(Taj Hassan)

PREFACE

Kashmir Division of the Union Territory (UT) of Jammu and Kashmir is a mountainous region located in the Hindu Kush range of Himalayan Mountains. The ecology and environment of the UT are sensitive and plays an important role in overall development of the region. The Kashmir valley had faced widespread floods and landslides due to incessant rainfall and cloudbursts in September 2014, which led to localized destruction of property, public infrastructure and severe impact on life, communities, and communication etc. The city of Srinagar met with extensive damage due to haphazard and unplanned urban development leading to encroachment of eco-fragile areas. As many as, 60 major and minor roads have been cut off and over 30 bridges washed away, hampering the relief and rescue operations. This situation, in particular, has raised numerous questions related to preparedness at the national, state and community levels for facing severe disaster situations.

The document "Kashmir Floods 2014-Recovery to Resilience" seeks to present a comprehensive review of post-flood 2014 recovery in the UT of Jammu and Kashmir. The study emphasizes on documenting the Kashmir floods, 2014, and bring out the transition towards resilient recovery. The data collection is mostly based on secondary sources through online and offline sources and one visit immediately after the floods (2014) and another one during the pandemic (2021). Due to the ongoing pandemic and other limitations the study was restricted to the disastrous event that occurred in the Kashmir Division of the UT only.

While studying the disastrous event, the State was bifurcated into two Union Territories. However, majority of data and information that were used for this document, were from the former State of Jammu and Kashmir. The report is divided into three parts, i.e., pre-disaster context, disaster scenario, and post-disaster context. The pre-disaster context outlines the overall profile of the State/UT. The disaster scenario documented various aspects of the disastrous event and its immediate management. Lastly, the post disaster context brings out the post-disaster recovery, rehabilitation, and reconstruction programs that were undertaken by various stakeholders and emphasizing on building - back - better for resilient recovery.

It is a pleasure to express my gratitude to all those who have contributed towards finalization of this document. I take this opportunity to thank Mr. Taj Hassan, IPS, Executive Director, NIDM for his continuous encouragement and guidance for making useful documentation like this. Special thanks to Maj. Gen. Manoj Kumar Bindal, Former Executive Director, NIDM for his unwavering support to carry out the case study on Kashmir Floods 2014, including the field visits (March, 2021). I thank Shri Surendra Thakur, Joint Director for his constant encouragement and advices for successfully completing this document.

The Report has been reviewed by three eminent professionals working at UT/State level in the area of disaster risk reduction for long. Special thanks to all three of them for their time and efforts to go through the draft report and for useful insights. Efforts of Er. Aamir Ali, Nodal Officer, J&K State Emergency Operation Centre, Srinagar; Prof. M Sultana Bhat, former Head, Department of Geography and Regional Development, and former Dean, University of Kashmir; and Dr. G. M. Dar, Head, Centre for Disaster Management and Environment, J&K Institute of Management, Public Administration and Rural Development, are gratefully acknowledged in making the document meaningful. Special gratitude and thanks to the University of Kashmir and IMPARD for facilitating the field visits in Kashmir to complete the study.

Special thanks to Prof Chandan Ghosh, Faculty, NIDM; Shri Pandurang K. Pole, IAS, Divisional Commissioner, Kashmir; Prof. Talat Ahmad, Vice Chancellor, University of Kashmir; Er. Iftikhar A. Kakroo, Chief Engineer, Irrigation & Flood Control, Kashmir; Prof. Shakil A. Romshoo, Dean, Research, University of Kashmir; Prof. Shamim Ahmad Shah, Dean, School of Earth and Environmental Sciences and Head Department of Geography & Disaster Management, University of Kashmir; Prof. Pervez Ahmad, Department of Geography and Disaster Management, University of Kashmir; Mr. Sonam Lotus, Director, IMD Srinagar; Mr. M.G. Hassan Mukhtar, Srinagar Municipal Corporation; Mr. Shair Alamgir, JTRFP; Mr. Ghulam Nabi Lone, Department of Education and many more colleagues who had provided useful information and insights during the field visit to Srinagar in March 2021.

Last but not the least my sincere thanks to the team members, Mr. Thomas Krishna Pegu, Young Professional (2019-20); Ms. Yogita Garbyal, Young Professional; and Ms. Safia Khatoon, Intern, Resilient Infrastructure Division, NIDM for their support and dedicated hard work in compilation of the report to its final shape. Finally, I am grateful to NIDM team and other various stakeholders who have extended their support, cooperation and commitment by devoting time and expertise by making valuable contributions to bring out this document. Special thanks to Shri S K Tiwari, Librarian and Publication (I/C) and Ms Karanpreet Kaur Sodhi, Jr. Consultant for further assistant and help.

Amir Ali Khan
Associate Professor

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Abbreviations

ADDC	Additional District Development Commissioner
ADC	Additional Deputy Commissioner
ATF	Aviation Turbine Fuel
AAI	Airports Authority of India
BMTPC	Building Materials and Technology Promotion Council
BAUT	Boat Assault Universal Type
BRO	Border Roads Organization
CWC	Central Water Commission
CMRF	Chief Minister's Relief Fund
CEO	Chief Executive Officer
CUMECS	Cubic Meter Per Second
CGI	Corrugated Galvanized Iron
DDMA	District Disaster Management Authorities
Div. DMA	Divisional Disaster Management Authority
DMRRR	Disaster Management, Relief, Rehabilitation and Reconstruction
DDMF	District Disaster Mitigation Fund
DC	Deputy Commissioner
DPR	Detailed Project Report
DSS	Decision Support System
DRFI	Disaster Risk Financing and Insurance
EOC	Emergency Operation Centre
ERCP	Endoscopic Retrograde Cholangio Pancreatography
FCI	Food Corporation of India
F&ES	Fire and Emergency Services
GT Sheets	Geo Reference Topo Sheets
GSDP	Gross State Domestic Product
GDP	Gross domestic product
IGNOU	Indira Gandhi National Open University.
IMD	India Meteorological Department
IAF	Indian Air Force

ICDS	Integrated Child Development Services
J&K	Jammu and Kashmir
JRNA	Joint Rapid Needs Assessment
JTFRP	Jhelum and Tawi Flood Recovery Project
LULC	Land Use / Land Cover
MHA	Ministry of Home Affairs.
MOEF	Ministry of Environment, Forest and Climate Change
MsDP	Multi-sectoral Development Programme
MRI	Magnetic resonance imaging
NABARD	National Bank for Agriculture and Rural Development
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NGO	Non-Government Organization
NIMHANS	National Institute of Mental Health and Neuro Sciences
NIC	National Informatics Centre
NIDM	National Institute of Disaster Management
NIOS	National Institute of Open Schooling
NMARSAT	National Maritime Satellite Organization
NMDFC	National Minorities Development and Finance Corporation
NRDP	National Rural Development Program
NRHM	National Rural Health Mission
OFC	Outfall Channel
PIE	Project Implementing Executive
PMU	Project Management Unit
PIU	Project Implementation Units
PMNRF	Prime Minister's National Relief Fund
PWD (R&B)	Public Work Department (Roads and Bridges)
PHE	Public Health Engineering
PMNRF	Prime Minister's National Relief Fund
PCR	Polymerase Chain Reaction
PRI	Panchayat Raj Institutions
RCC	Reinforced Cement Concrete

SDMA	State Disaster Management Authority
SDMP	State Disaster Management Plan
SEC	State Executive Committee
SDRF	State Disaster Response Force
SDRF	State Disaster Response Fund
SMC	Srinagar Municipal Corporation
SOP	Standard Operating Procedure
STD	Subscriber Trunk Dialling
SEEDS	Sustainable Environment and Ecological Development Society
USTTAD	Upgrading the Skills and Training in Traditional Arts/Crafts for Development
ULB	Urban Local Bodies
UT	Union Territory
WASH	Water Sanitation and Hygiene

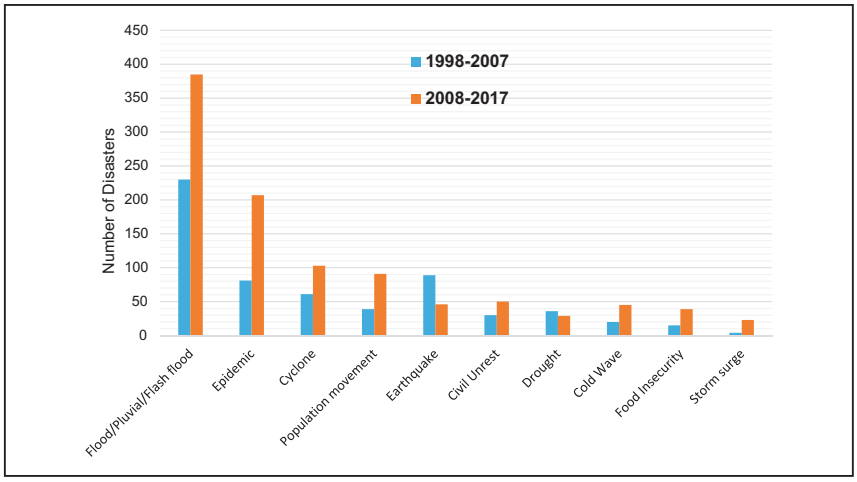
1. Introduction

INTRODUCTION

1.1 Background Study

With the beginning of the 21st century, the extent of recurrent natural disasters is increasing to an utmost scale. According to Centre for Research on the Epidemiology of Disasters (CRED), in 2018, 315 natural disaster events were recorded across the world, around 68 million people were affected and about US$ 131.7 billion loss to the global economy. Among all, the continents, Asia suffers the highest impact and account for about 45% of all the natural disaster events, 80% of deaths, and 76% of people were affected[1]. Out of the recorded 315 natural disaster events, flood accounts for about 40% (127) of all the recorded disaster events, and have the greatest impact[2].

Figure 1.1: Ten most common disaster (Two-decade comparison).



Source: - World Disasters Report 2018, International Federation of Red Cross and Red Crescent Societies, IFRC GO. Retrieved on 18th September 2019.

Figure 1.1, shows data for the ten most frequent disasters, where; flood, pluvial and flash floods have the highest share. During 2008-2017, around 385 hydrological (flood/pluvial/flash flood) related disaster events were recorded, an increase from 230 hydrological events recorded in the last decade (1998 - 2007). Both India and China account for the highest number of natural disasters that occurred in the year 2018 (Table 1.1). Climate change, high population growth, rapid urbanization, and environmental degradation, has led to a drastic increase in natural disasters in these countries.

[1]EM-DAT: Natural Disasters 2018 - Centre for Research on the Epidemiology of Disasters – CRED, https://www.emdat.be. Retrieved on 18th September 2019.
[2]Ibid 1, P3

The September flooding in Jammu and Kashmir was by far the largest flood event in the year 2014, with 300 dead, and about 2 million families affected[3]. This documentation of the Kashmir floods of 2014, gives an input on the post-disaster relief, recovery and reconstruction work carried out in the wake of the flood in 2014, and also tries to capture various learning points out of this disaster. This document will also provide a hazard profile of the region which will be helpful for planning any development related activities in the mountainous regions.

Table 1.1: Top 10 countries with the highest number of Natural disasters occurred in 2018.

SL. NO	COUNTRY	NO. OF DISASTERS	SL.NO	COUNTRY	NO. OF DISASTERS
1.	**India**	**22**	6.	Japan	7
2.	**China**	**22**	7.	Vietnam	7
3.	USA	19	8.	France	7
4.	Indonesia	15	9.	Afghanistan	6
5.	Philippines	10	10.	Myanmar	5

Source: - EM-DAT: Natural Disasters 2018 - Centre for Research on the Epidemiology of Disasters – CRED, https://www.emdat.be, Retrieved on 18th September 2019.

1.2 General Profile of Jammu and Kashmir

Kashmir, a place known to us as "Heaven on Earth", the term was made famous by the Mughal Emperor Jahangir on his visit to Kashmir in the 17th century. ''गर फिरदौस बर रुए जमी अस्त, हमी अस्तो, हमी अस्तो, हमी अस्त'' which literately translate in English as 'If there is a heaven on earth, it is here, it is here, it is here'.

The name Kashmir, derived from two Sanskrit words, 'ka' (water) and 'shimeera' (to desiccate), which means a land desiccated from water. According to Hindu mythology, the lake Satisar of Kashmir Valley, is known as the lake of the goddess Sati. It is often said that Sage Kashyap drained the erstwhile lake to produce the land of Kashmir[4].

1.2.1 Location and Size

Jammu and Kashmir is the northern most UT (erstwhile state) of India situated between 32°17' N and 37°6' N latitude and 73°26' E and 80°30' E longitude[5]. The erstwhile state occupies a position of strategic importance with its borders sharing with three countries, Afghanistan in the north-west, Pakistan in the west and China (Tibet) in the north-east and two Indian states of Punjab and Himachal Pradesh in the south. The erstwhile state comprised of three distinct regions, namely the Kashmir, Jammu, and Ladakh Divisions.

[3]Department of Disaster Management, Relief, Rehabilitation and Reconstruction, Jammu and Kashmir State Disaster Management Authority, http://www.jksdma.org/wp-content/uploads/2017/08/SDM-Policy-2017- Final.pdf. Retrieved on 18th September 2019.
[4]Jammu and Kashmir development report, the Planning commission of India, http://planningcommission.nic.in/plans/stateplan/sdr_Jammu and Kashmir/sdr_jkch1.pdf, Retrieved on 18th September 2019.
[5]Ibid 3, p.4.

Map 1: Location of Jammu and Kashmir

Source: Modified, from Maps of India

The total geographical area of the erstwhile state (currently UT) is 2,22,236 km^2 (1,01,387 sq. km excluding area under illegal occupation), which accounts for 6.93% of the total area of India. Out of the total geographical area of the state, the Ladakh division/UT covers an area of about 58.33%, the Jammu and Kashmir Divisions/UT covers an area of about 25.93% and 15.73% respectively. The erstwhile state/region comprised of 22 districts, of which both the Kashmir and Jammu Divisions/UT comprised of 10 districts each and the Ladakh division/UT comprised of 2 districts[6].

1.2.2 Physiography and Climate

1.2.2.1a Topography

The topography of the region is mostly mountainous. A large part of the area falls within the high mountain zone consisting of huge mountain masses constituting the Karakoram, the Great Himalaya, Ladakh (Zanskar), Pir Panjal and the Lesser Himalaya ranges. Mount K2 (8,611 m) and Nanga Parbat (8,126 m) are two of the highest peaks, along with numerous peaks exceeding 6,000 m dotting the area. Below these huge mountain ranges lie the fertile valleys of Gilgit, Shyok, Indus, and Jhelum[7].

[6]Socio Economic Demographic profile of Jammu and Kashmir, Mission Directorate, ICDS, Government of Jammu and Kashmir, https://jkicds.com/socio_jk.php. Retrieved on 18th September 2019.
[7]Ibid 6, P 5.

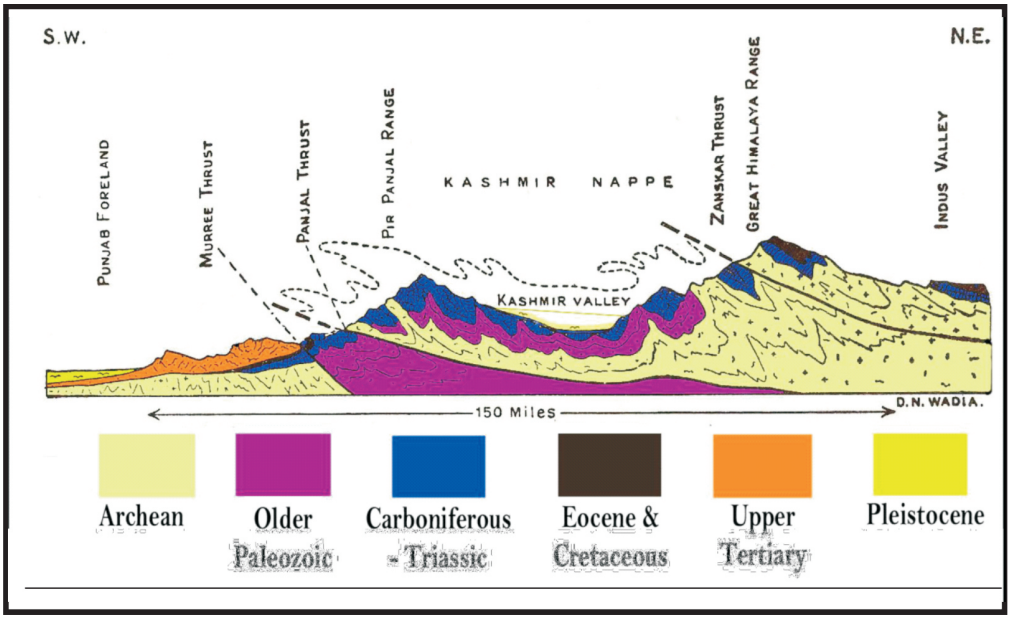
Figure 1.2: Nanga Parbat, peaks of Karakorum is seen in the background

Source: - Guilhem Vellut, https://www.flickr.com/photos/o_0/55899078/in/set-1211738/, Retrieved on 18th September 2019.

High-altitude snow-covered cold desert with an average altitude of above 3650m is prominent in the Ladakh Division/UT located on the north-eastern part of the erstwhile state. The Kashmir valley is enclosed by the Zanskar Range, North Kashmir Range and the Lesser Himalayas (Pir Panjal Range). The Zanskar Range runs on a southeast to northwest axis all along the northeast side of the valley. It is part of the Great Himalayan Range and before ending at Nanga Parbat, encloses the Kashmir Valley on its north, northwest, northeast and eastern sides. The North Kashmir Range forms the watershed between the Jhelum River and Kishanganga River which originates at the Zoji-La Pass, in a division of the Great Himalayan Range. The Lesser Himalaya mountains around the northeast side of Wular Lake consist primarily of Pir Panjal and Ratan Pir Ranges. Overlooking the Pir Panjal lies the Shivalik range having an average altitude of 1,500 to 2,000 m, moving further south lies a narrow strip of foothill plains which ultimately merges into the plains of Punjab[8].

[8]Jhelum and Tawi Flood Recovery Project, World Bank, http://jtfrp.in/jhelum-river-morphology/, Retrieved on 22nd October 2019.

Figure 1.3: Geological Cross-Section of the Kashmir Valley



Source: Jhelum and Tawi Flood Recovery Project, World Bank, http://jtfrp.in/jhelum-river-morphology/, Retrieved on 22nd October 2019.

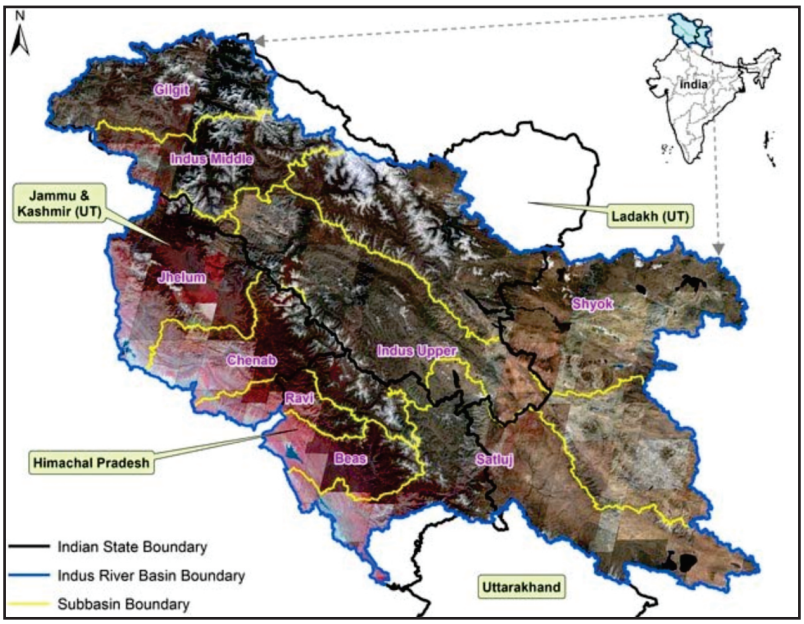
1.2.2.2 Drainage

Three major rivers flow through the region namely Jhelum, Chenab, and Indus, all part of the Indus River Basin. The principal river among them for Kashmir valley is the Jhelum River which originates from Verinag spring in Anantnag and after passing through Srinagar it flows into Wular lake and then passing through Baramula and Uri, it enters into Pakistan.

The Indus River rises from the lofty mountains of the Himalayas around Mansarovar Lake in Tibet at an elevation of 5,182 m. The total length of Indus from origin to its outfall in the Arabian Sea is 2,880 km, out of which 1,114 km flows through India. Its principal tributaries in India are Jhelum, Chenab, Ravi, Beas and Satluj, all joining from left. The river Indus flows through the middle of Zanskar mountain ranges and Ladakh range to the north[9].

[9]River basin atlas of India, Central Water Commission, Government of India Ministry of Water Resources, http://tamcnhp.com/wris/#/RiverBasin, Retrieved on 22nd October 2019.

Map 2: Location of Indus River Basin



Source: B. Simhadri Rao B S et al. 2020, Glacial Lake Atlas of Indus River Basin, National Hydrology Project, NRSC, ISRO DOI: 10.13140/RG.2.2.26121.67687/2 retrieved on Oct 12, 2022

1.2.2.3 The Jhelum River Basin

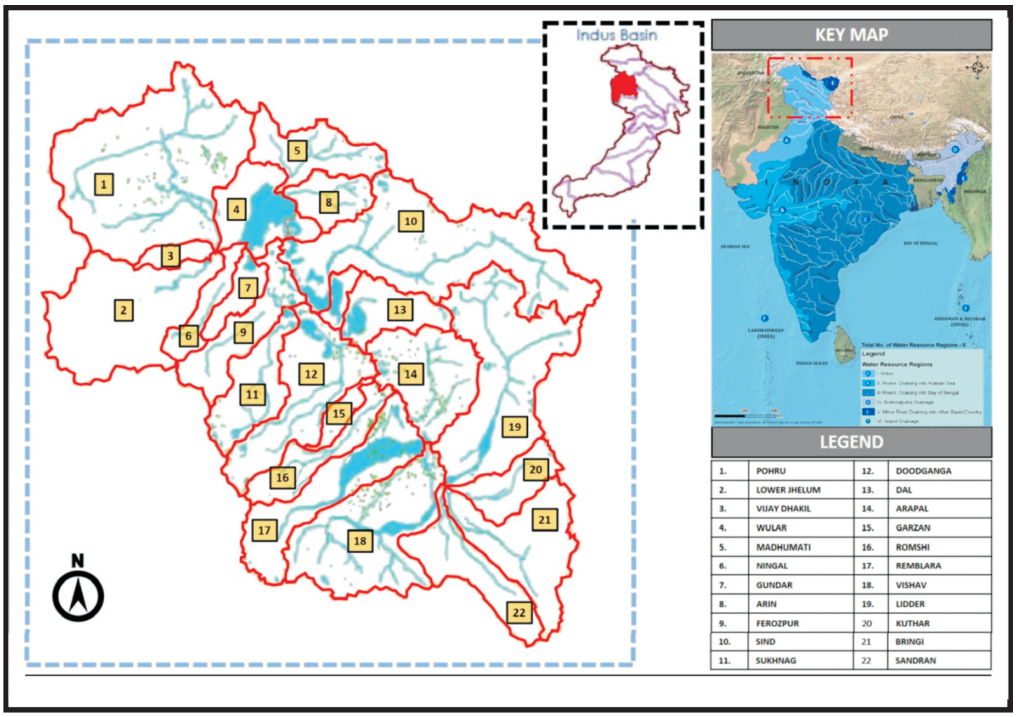
The Jhelum River Channel formed in the lower levels of the Kashmir Valley and became the main river channel conveying river discharge through all the length of the Kashmir Valley. The Jhelum sub-basin is an integral part of the overall Indus River System, which flows through Northern India and whole of Pakistan before merging with the Chenab River basin and subsequently into the Indus River before discharging into the Arabian Sea.

The Jhelum River originates at Verinag from a deep underground spring, located in the south-eastern end of the Kashmir Valley, at the foothills of the Pir Panjal Mountain ranges. The river widened and formed meander bends as it passes through Srinagar and continues to meander as it flows into Wular Lake. The Jhelum River channel emerges from the west end of Wular Lake upstream of Baramulla to form what is known as the Outfall Channel (OFC)[10].

The Jhelum River Outfall Channel continues in a westerly direction from Wular Lake to Pakistan. The total length of the river in the Kashmir valley is about 177 sq.km. There are 24 main tributaries and sub-basins that contribute to discharge to the Jhelum River Channel throughout the length of the Jhelum River Basin. There are about 103 major and minor tributaries in the Jhelum River Basin. The estimated total length of these tributaries is around 1876 km.

[10]Ibid 8, P 6

Map 3: Jhelum River Basin, major Sub-Basin, Lakes and Water Bodies



Source: Modified after National Wetland Atlas: Jammu and Kashmir, 2010

1.2.2.4 Lakes and Water Bodies

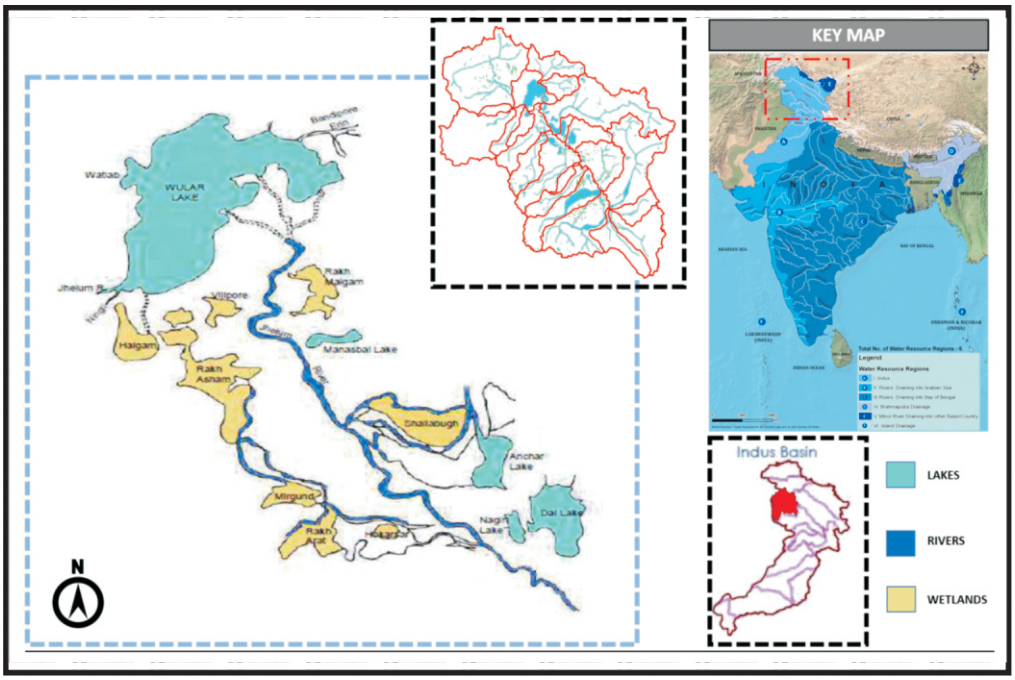
The region is dotted with many lakes and water bodies, especially in the Kashmir Valley, which is known for its wetlands. Most of these lakes and water bodies are located in the floodplains of the Jhelum River Channel. Wular, Dal, Anchar, and Mansbal Lakes are some of the major water bodies situated in the Kashmir region.

Geological records and marine deposits have shown the Kashmir Valley was a huge paleo-lake during the Pleistocene period; which drained through a rift in the mountain range downstream of Baramulla, forming the existing outlet channel of the Jhelum River. After the lake drained, a series of lakes, smaller water bodies and wetlands within the Kashmir Valley remained along the wide valley floor[11] .

Pangong lake, which is located in the Ladakh UT, is an important high-altitude lake situated 4350 m above sea level. The total catchment area of the lake is about 2000 sq.km. It is about 134 km long. The lake has been suggested as Ramsar site due to its biological, cultural and geological values. It is the largest and most brackish wetland in the cold desert ecosystem of the Trans-Himalaya.[12]

[11]Ibid 8, P6
[12]Ecology and biodiversity in Pangong Tso (lake) and its inlet stream in Ladakh, 20 July, 2011, International Journal of Biodiversity and Conservation), http://www.academicjournals.org/IJBC, Retrieved on 22nd October 2019.

Map 4: Wular Lake and other associated lakes and wetlands in Kashmir



Source: Wular Conservation and Management Authority Govt. of Jammu and Kashmir, http://wular.org/wp-content/uploads/2019/07/200crore-write-up.pdf, Retrieved on 22nd October 2019.

Wular Lake

Wular Lake is one of the largest freshwater lakes in Asia and is located at a distance of about 50 km away from Srinagar at an altitude of 1,570 m above sea level, with an average depth of 5.8 m. The oval-shaped lake is about 16 km in length and 7.6 km in breadth. The lake is surrounded by high mountain ranges in the northern and eastern sides. The lake plays a significant role in shaping the hydrographic system in the valley. It acts as a huge sponge for the annual flood water. The lake is also an important source of fish and accounts for about 60% of the total fish catch in the state/UT. In 1986, the lake was declared as wetland of national importance by the Ministry of Environment and Forest under the wetlands programme, due to its socio-economic and hydrological value. In 1990, the lake got international recognition after that it was declared as a Ramsar Site in 1990[13].

The river Jhelum one of the important sources of the lake passes through it. The lake is also fed by two streams namely Madhumati and Erin. As per the directory of Wetlands in India (Ministry of Environmental and Forest), the area of the lake is around 189 sq.km, whereas as per the Survey of India maps of 1978, its area is around 58.7 sq.km during the lean period. However, the lake area appears empirically 173 sq.km during peak flow, recorded by

[13]Monitoring Of Wular Lake And Its Immediate Catchment Area Using Remote Sensing And GIS Under Wular Conservation Project, March 2016, http://wular.org/wp-content/uploads/2019/07/DERS-DRAFT.pdf, Retrieved on 19th September 2019.

Irrigation and flood control department, Kashmir in the same year. As per the revenue records, the area of the lake is shown to be around 130 sq.km.[14]

Dal Lake

Dal Lake is the second most significant lake in the Jhelum River Valley, since it is closely entwined with the highly urbanized area of Srinagar. The kidney shaped lake had an area of around 11.20 sq.km in 1994. The area determined through G.T. sheets (Geo Reference Topo Sheets) of 1965 survey is 15.86 sq.km.[15] The lake is currently connected to the Jhelum River Channel by a controlled cross-channel to help regulate flow between Dal Lake and the Jhelum River. Inflow to Dal Lake comes from Marsar Lake through Telbal Nallah. Outflows are regulated by Dal Gate and Nallah Amir Khan. There is a significant urban and commercial development along the periphery of the lake, which has led to the deterioration in water quality.

Ahansar Lake

Ahansar Lake is located at a distance of around 30 km away from the city of Srinagar. It is a freshwater wetland located in the flood plains of the Jhelum river basin. It is an oxbow type of water body and has probably originated by the meandering of the alluvial deposits. The exact age and origin of the lake are not yet known. Although it is believed that as a result of an earthquake, a crater was formed and meanwhile that crater got filled up with water from river Jhelum.[16]

Anchar Lake

Anchar Lake, a shallow water body which is located 10 kms in northwest of Srinagar city at an altitude of 1585 m above sea level. The lake is a typical sub-urban eutrophic water body with both rural and urban characteristics in a typical rural environment. The lake is a single basined, open drainage type water body fed by a network of channels from the Sind Nallah. A small channel connects Anchar Lake with Khushal Sar lake which in turn is connected with the Nigeen lake. The lake is also fed by the springs in the basin and along the periphery. Further, several channels from agricultural fields, effluents from the settlements and surface runoff from the catchment area, directly drains into it throughout the year. The lake outfalls in river Jhelum at Sangam in its northeast direction. The lake covers an area of 680 hectares, half of which has now completely become marshland. Both Anchar Lake and Dal Lake, are connected by the Nallah Amir Khan, although the Nallah Amir Khan channel is not consistently open to allow clear water passage between the two lakes. Similar to Dal Lake, the water quality in Anchar Lake has deteriorated significantly from organic pollution and sediment inflows.

[14]Directory of Lakes and Water bodies of Jammu and Kashmir State Using Remote Sensing and GIS Technology, Department of Environment and Remote Sensing, Forest Complex, Jammu, http://www.jkdears.com/eers/eers/orders/Directory%20Wetlands.pdf, Retrieved on 19th September 2019.
[15]Ibid 14, P 11
[16]Ibid 14, P 11

Manasbal Lake

It is situated about 30 kms north-west of Srinagar in the direction of Wular Lake and is connected with Jhelum River by a canal. It is oblong shaped, in east and west direction. It is about 4.5 kms in length and about 300 m in width.

Hokersar Lake

This wetland is located 16 kms from Srinagar on Srinagar-Baramulla Road National Highway, it is a permanent and relatively shallow water body. This wetland is famous for its game reserve and wildlife sanctuary.

1.2.2.5 Climate

The UT of Jammu and Kashmir, (the erstwhile state) has distinct climatic regions, subtropical in Jammu, semi-arctic cold in Ladakh (UT), temperate climatic conditions in Kashmir and few mountainous regions of Jammu. The erstwhile state has four seasons i.e., spring, summer, autumn and winter. The average rainfall in the state also varies from region to region. Due to variation in location and topography, the temperature of the state ranges from the scorching heats in the plains of Jammu to extreme cold in the high-altitude region of Ladakh. The total annual rainfall for the whole erstwhile state is around103 cm and total no. of rainy day is about 57 days. Leh district in Ladakh region (UT now), experiences the lowest rainfall, an average of 10 cm and Reasi district in Jammu division experiences the highest rainfall, an average of 205 cm.[17]

1.2.2.6 Forest Cover and Land Use Patterns

The forest cover in the erstwhile state is about 20,230 sq.km, which is about 19.90% of the total geographical area of the state excluding areas occupied by Pakistan and China.[18] About 2,551 sq.km of area come under reserve, 17,463 sq.km under protected area and around 36 sq.km under unclassified state forest land. The majority of the forest cover lies in Jammu and Kashmir UT. In the Ladakh region majority of the area constitutes high-altitude cold deserts.

Table 1.2: Erstwhile Division-wise Forest area of Jammu and Kashmir

DIVISION	GEOGRAPHICAL AREA IN SQ.KM.	FOREST AREA IN SQ.KM.	PERCENTAGE
Kashmir	15948	8128	50.96%
Jammu	26293	12066	45.89%
Leh and Kargil	59146	36	0.06%
Total	**101387**	**20230**	**19.90%**

Source: Jammu and Kashmir Forest Department, Govt. of Jammu and Kashmir, http://www.jkforest.gov.in/ geo_area.html. Retrieved on 19th September 2019.

[17]Climate of Jammu and Kashmir, IMD, Govt. of India. Retrieved on 18th September 2019

[18]Geographical Feature and Forest Area, Jammu and Kashmir Forest Department, Govt. of Jammu and Kashmir, http://www.jkforest.gov.in/geo_area.html. Retrieved on 19th September 2019

The erstwhile state has 4 national parks, 15 wildlife sanctuaries and 33 conservation reserves covering an area of 11,774.50sq.km. The Hygam Wetland Reserve located at Baramulla covers an area of 8900 ha of land. Hygam lake and the surrounding wetlands have been designated as Ramsar Site by the Convention of Wetlands.[19] As per land-use statistics, the total reporting area for land utilization is around 4012 ha which is around 39.56 % of the total geographical land area excluding the areas illegally occupied by Pakistan and China.

Figure 1.4: Hygam Wetland Reserve, Baramulla

Source: Parvez Shazoo, Forester, Resource Survey Division, http://www.jkforest.gov.in/images/slider5.jpg. Retrieved on 19th September 2019.

Table 1.3: Land Use Pattern in Jammu and Kashmir UT including Ladakh UT

LAND USE	AREA (Ha)	PERCENTAGE
Total geographical area	**2,22,23,600(Ha)**	**-**
Excluding area illegally occupied by Pakistan and China	**1,01,38,700 (Ha)**	**-**
Forests	22,54,000	56.20 %
Not available for cultivation	5,73,000	14.29 %
Permanent pastures and other grazing lands	1,14,000	2.84 %
Land under misc. tree crops and groves	65,000	1.62 %
Culturable wasteland	1,34,000	3.34 %
Fallow lands other than current fallows	16,000	0.40 %
Current fallows	114,000	2.84 %
Net sown area	7,41,000	18.47 %
Total reporting area for land utilization	**40,12,000**	**100 %**

Source: Land Use Statistics, India State of Forest Report, Ministry of Agriculture, GOI, 2013-14. http://fsi.nic.in/isfr2017/jammu-and-kashmir-isfr-2017.pdf. Retrieved on 20th September 2019.

[19]Indian State of Forest Report, 2011, Forest Survey of India, Ministry of Environment, Forest and Climate Change. http://fsi.nic.in/cover_2011/jammu_kashmir.pdf. Retrieved on 19th September 2019.

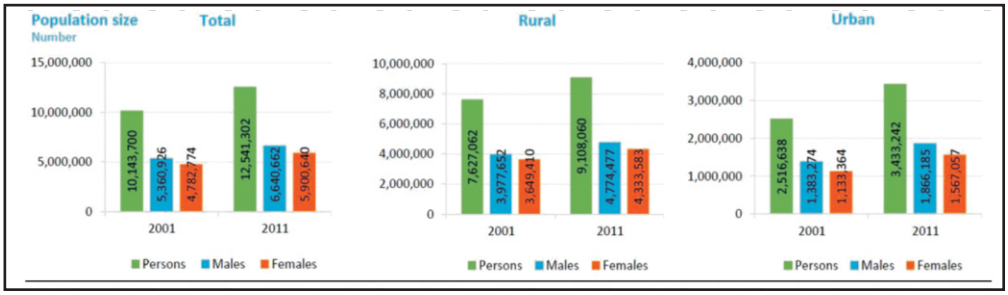
The total area for land utilization was about 4012 lakh ha in the year 2014 out of which the Net Sown area contributes to 18.47%. The Net Sown Area is about 7.41 lakh hectares out of which 3.09 lakh hectares, constitutes 41.70 %, which is being irrigated[20] .

1.2.3 Demographic and Socio-Economic Profile

As per the 2011 census, the total population of the erstwhile state was 1,25,41,302, out of which male accounts for 53% and female 47%. The decadal growth of the state was 23.64%, a decrease from 29.04% in 2001. The rural population accounts for 72.62 % and 27.38% was urban. The urban population has increased to 27.38% since the last decade. The population density of the erstwhile state is around 124 persons per sq. km. The sex ratio is 889 females per 1000 males in 2011, a decrease from 892 in 2001. The average literacy rate was 67.16% in 2011 an increase from 55.52%. Male and female literacy rate constitutes of 76.75% and 56.43% respectively.

The erstwhile state is particularly made up of various multi-ethnic and multilingual groups, such as the Kashmiris, Dogras, Dards, Ladakhis, Gujjars, Bakarwals and Hanjis. About 8% of the population constitutes of scheduled caste, which is lower than the national average of 16%. Scheduled Tribes constitute 11% which is higher than the national average of 8%.

Figure 1.5: Total population in comparison to Rural and Urban population



Source: - Census 2001, 2011.

Islam is the predominant religion in the erstwhile state where 68.31% of the population are Muslim, followed by Hindu which accounts for 28.44%. Sikhs and Buddhist account for 1.87% and 0.90% respectively. The three Divisions of the erstwhile state i.e. Kashmir, Jammu and Ladakh (now Jammu & Kashmir UT and Ladakh UT) have predominant populations of Muslims, Hindus and Buddhists respectively.

About 34.5% of the total population, is engaged in economic activities, out of which 61.2% i.e., 26,45,500 workers describe their work as main work (employment or earning more than 6 months), out of which 38.8% are involved in marginal activities (employment or earning less than 6 months).[21] The erstwhile state/ UT of Jammu and Kashmir is predominantly agrarian in nature with 70% of the population dependent on agriculture and allied activities contributing 27% of the Gross State Domestic Product (GSDP).

[20]Land Use Statistics, India State of Forest Report, Ministry of Agriculture, GOI, 2013-14. http://fsi.nic.in/isfr2017/jammu-and-kashmir-isfr-2017.pdf. Retrieved on 20th September 2019.
[21] Census 2011

Most of the Kashmir and Jammu region has a conservative agro-climatic condition and sub-tropical climate with fertile soil, which makes the region ideal for growing cereals, fruits, and cash crops. The major cereal products include wheat, rice, and maize. As a result of Intensive Agriculture Programme, 1971 and the introduction of high yield variety seeds, the agriculture sector in the state has registered a tremendous transformation. Kashmiri saffron, which is being cultivated mostly in the plains of Pulwama district is regarded as a high cash crop.

The UT is famous for its delicious horticultural products since ancient times and the fruit industry has been one of the sources of income. Apple, Cherry, and Pear are some of the popular products of the region along with Walnuts and Almonds. In 2016-17, total production of fruits in the erstwhile state was around 2.12 million metric tons, about 1.73 million metric tons was only for apples. About 20% of the total geographical area is under forests but it contributes less than 2% of the erstwhile state (J&K UT and Ladakh UT) GDP[22]. Some of the forest products and resources are Pines, Hazel, Wild Oak, Chinar, and Cedar trees.

Handicrafts is a highly lucrative and profitable industry in the region, well known throughout the world for its superior quality woollen manufacturing products, silverwork, Kashmiri Pashmina shawls, Kani shawls), silk and silk carpets (Kashmiri papier-mâché), copper work, walnut furniture and pottery. The industrial base has not been developed to its full potential mainly due to certain constraints related to lack of infrastructures, topography and civil conflicts. Few medium scale industries are dotted in and around the urban areas of Srinagar and Jammu. Tourism related activities have emerged as an important and major contributor to the economy of UT. According to the Tourism Development Department, 30% of the population of the erstwhile state is directly or indirectly involved in tourism allied activities.

[22]Economic Survey of Jammu and Kashmir, 2016, State Budget 2018-19 Department of Horticulture, Govt. of Jammu and Kashmir. http://ecostatjk.nic.in/ecosurvey/Economic%20Survey%202016%20PDF.pdf Retrieved on 24th September 2019

1.2.4 Infrastructure

1.2.4.1 Social Infrastructure

A large proportion of the population is still deprived of the basic necessities of life. Providing safe drinking water has been a challenge in the UT of Jammu & Kashmir, mostly for households depending on water procured from unsafe sources. As per State Budget 2018-19, the Government of Jammu and Kashmir allocated Rs. 200 crores under NABARD for taking up major water supply schemes and about 1,069 ongoing water supply schemes[23].

Education is one of the top priorities of the erstwhile state government/UT, as a consequence of sustained investment, there has been an exponential growth of the educational sector. The number of educational institutions in the public sector reached 24,265 and those in the private sector to 5,292 in the erstwhile state/UT. The total enrolment has also increased to 27.41 lakh out of which the enrolment in primary classes is 10.97 lakh, in middle is 7.06 lakh and in higher secondary schools is 9.38 lakh[24].

Figure 1.6: - Education of girls has been a high priority with the Government of Jammu and Kashmir

Source: Department of School Education, Jammu and Kashmir Govt. http://www.jkeducation.gov.in/, Retrieved on 25th Sep 2019.

The erstwhile state has 34 district hospitals, 627 primary health centres, 2,861 sub-centres and 131 community health centres[25]. The central government sanctioned Rs. 373 crores for constructing super-specialty hospitals in the cities of Jammu and Srinagar and as of March

[23]Economic Survey of Jammu and Kashmir, 2018-19, IBEF, https://www.ibef.org/download/Jammu-and- Kashmir-May-2018.pdf, Retrieved on 24th September 2019.
[24] Ibid 23, p 16
[25]Health Facilities, National Health Mission, State Health Society, Health and Family Welfare Department, Govt. of Jammu and Kashmir. http://www.jknhm.com/healthfacilities.php, Retrieved on 25th September 2019

2015, two recently established super-specialty hospitals have come up with central government assistance. The central government has also sanctioned Rs. 245.60 crores under National Health Rural Mission. Around Rs. 3911 crores were allocated for health and medical education under the State Budget of 2018-19[26].

1.2.4.2 Physical Infrastructure

The total road length of the erstwhile state is about 37,024 km out of which 2,264 km has been declared National Highway in the year 2018. The road maintained by the Public Works Department has enhanced from 18,368 km in 2008 to 34,412 km during 2016. In April 2017, the central government inaugurated new 10.8 km, Asia's longest 'Chenani-Nashri Highway Tunnel' on Jammu-Srinagar National Highway 44 which was renamed as 'Shyama Prasad Mookerjee Tunnel' on 24th Oct, 2019. A twin tube road tunnel of 8.45 km length named 'Banihal Qazigund Road Tunnel' opened in August 2021. It is located in the Lower Himalayas, on National Highway 44. It is one of the longest tunnel in India which reduces the distance between Srinagar and Jammu by 16 km.

The region is predominantly mountainous in terrain hence the railway network is largely underdeveloped. The railway network is connected up to the Udhampur district, under the ongoing 272km long Jammu-Udhampur-Srinagar-Baramulla Rail Link project. Out of 272 km length of Udhampur Srinagar Baramulla Rail Link Project (USBRL) project, 161 km has already been commissioned and operationalized. The main tunnel of T-49, the longest tunnel of Indian Railways, between Sumber and Arpinchala station of Katra-Banihal section of Udhampur- Srinagar-Baramulla Rail Link (USBRL) project has been connected successfully on 15 Feb 2022[27]. The world's highest arch railway bridge called the Chenab bridge is being built in Jammu and Kashmir's Reasi District. It is 1,315-metre long and at 359 metres above the river bed level, aims to boost connectivity to the Kashmir Valley.

Table 1.4: Road length of Jammu and Kashmir UT, the erstwhile state maintained by PWD, 2016

SL.NO	DIVISION	ROAD and BRIDGE (Km)	PRADHAN MANTRI GRAM SADAK YOJANA (PMAY) (Km)	TOTAL(Km)
1.	Kashmir	13489	2237	15726
2.	Jammu	10363	3894	14257
3.	Ladakh	4059	370	4429
Total		**27911**	**6501**	**34412**

Source: Economic Survey of Jammu and Kashmir, 2016, State Budget 2018-19 Department of Horticulture, Govt. of Jammu and Kashmir. http://ecostatjk.nic.in/ecosurvey/Economic%20Survey%202016%20PDF.pdf. Retrieved on 24th September 2019.

[26]Government of Jammu and Kashmir, Department of Finance, State Budget 2018-19. Retrieved on 24th September 2019 from India Brand Equity Foundation, www.ibef.org.

[27]Live Mint News Article, https://www.livemint.com/news/india/udhampursrinagarbaramulla-rail-link-project-longest-tunnel-t-49-connected-11644981574263.html Retrived on 21 Feb 2022.

Figure 1.7: Upper Sind Hydro Project- Stage II, build on the Jhelum River basin

Source: Jammu Kashmir State Power Development Corporation Limited, http://www.jkspdc.nic.in/, Retrieved on 25th September 2019

The need for power in the UT of Jammu and Kashmir has been growing. As of 2015 erstwhile state government power data, energy demand has gradually increased at an annual rate of 5% to 6%. The total demand for power in the erstwhile state is around 2650 MW and the total supply is around 2043 MW, with a deficit of around 23%. The peak deficit has decreased from 28% in 2012 to 23% in 2015[28]. The energy consumption also show increasing trend when observed from 2014 to 2021 as shown in Table 1.5.

Table 1.5: Region wise energy consumption w.e.f. 2014-15 to ending March 2020-21

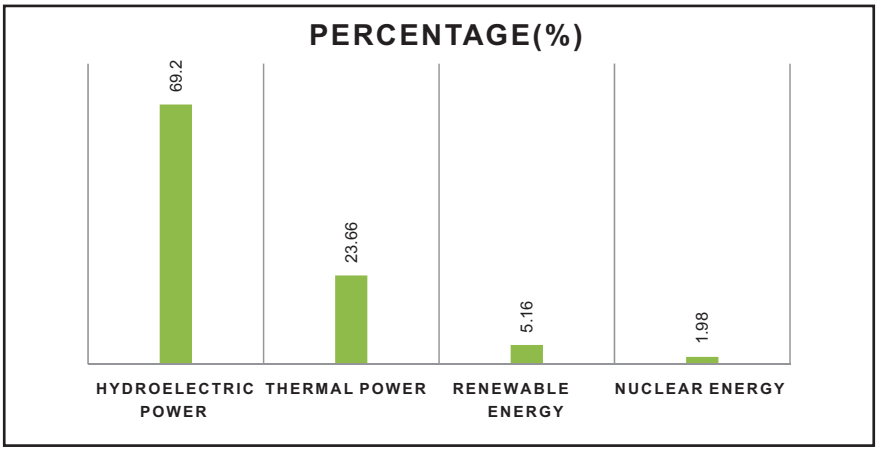
YEAR	JAMMU	KASHMIR	LADAKH	TOTAL
2014-15	5999.458	7589.624	415.608	14004.689
2015-16	6138.847	8142.807	405.631	14687.286
2016-17	6855.914	8369.778	463.461	15689.153
2017-18	7040.989	8688.256	495.059	16224.304
2018-19	7459.337	9286.365	430.103	17175.805
2019-20	7367.154	9252.582	459.932	17079.669
2020-21	7559.623	10162.137	369.625	18091.384

Source: - Jammu & Kashmir Power Development Department, Government of Jammu and Kashmir

[28]Power for all, Government of Jammu and Kashmir, Retrieved on 24th September 2019. https://powermin.nic.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_jammu_and_kashmir.pdf.

As of March 2018, the erstwhile state has about 14,146 MW of hydropower potentials, out of which only 25.47% has been harnessed and around 14.29% is under construction[29]. The total installed power generation of the erstwhile state is about 3,263.46 MW, out of which 2,009 MW is being procured from central utilities. Erstwhile state and private utilities contribute about 1,211.96 and 32.5 MW respectively. About 69.20% (2,369.48 MW) of the total installed power generation capacity is generated from hydroelectric power, followed by thermal power (23.66%), renewable energy (5.16%) and nuclear energy (1.98%)[30].

Figure 1.8: Source of power generation in the state



Source: JNNURM, Ministry of Urban Development, Government of India, Economic Survey of Jammu and Kashmir, 2014-15, Retrieved on 24th September 2019.

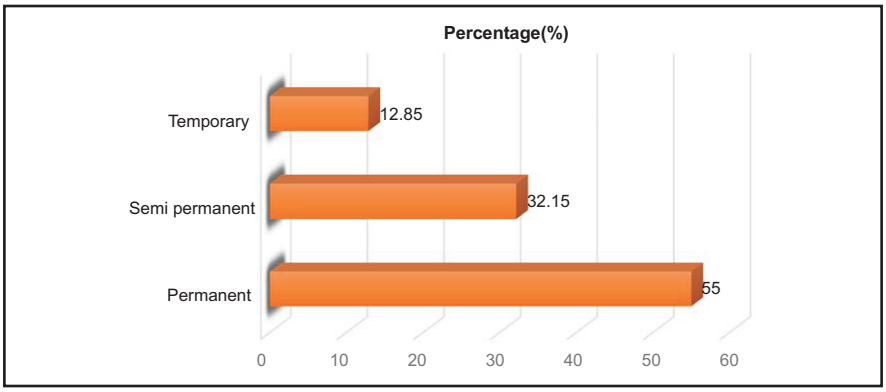
1.2.5 Housing and Settlement Patterns

According to the 2011 census, the total number of census houses was around 36 Lakhs which had seen a 30% increase in the housing stock from the past decade. The vacant housing stock of the erstwhile state was around 3 Lakhs which is about 8.4% of the total housing stock in the erstwhile state.

The total number of households excluding the institutional households is around 20 Lakhs. Around 55% of the households live in permanent houses, 32.15% live in semi-permanent and 12.85% in temporary houses respectively. Homeownership in the erstwhile state is predominantly high which comes around 96.73% of the share. Only 2.19% of the total households opted for rental accommodation[31].

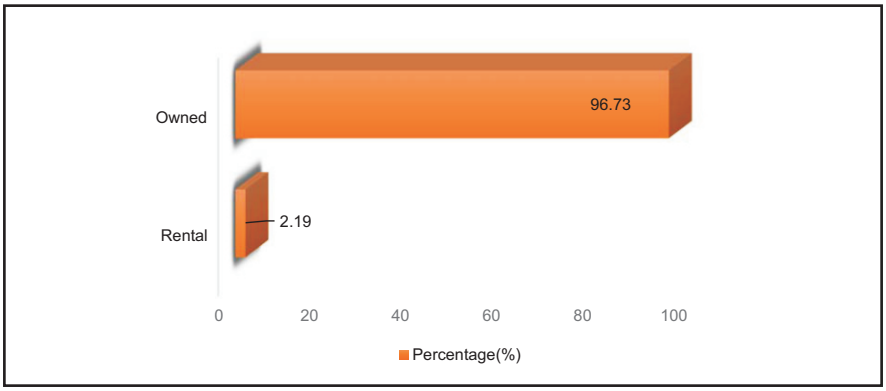
[29]Status of hydro-electric potential development, 31/07/2019, Center Electric Authority, Ministry of Power Govt. of India. http://cea.nic.in/reports/monthly/hydro/2019/hydro_potential_region-07.pdf. Retrieved on 24th September 2019
[30]Ibid 23, P 16
[31]Ibid 20, P 14

Figure 1.9: Housing Typology in Jammu and Kashmir



Source: - Census 2011.

Figure 1.10: Home ownership in Jammu and Kashmir



Source: - Census 2011.

Table 1.6: Building Materials for Roofs and Walls (Excluding Vacant/Locked Houses)

WALL / ROOF		CONTEXT	CENSUS HOUSES	
			NO. OF HOUSES	%
WALL	A1 - Mud and Unburnt Brick Wall	Rural	459,902	14.0
		Urban	79,006	2.4
		Total	538,908	16.4
	A2 - Stone Wall not packed with mortar	Rural	476,281	14.5
		Urban	18,222	0.6
		Total	494,503	15.1
	Total - Category – A		**1,033,411**	**31.5**

WALL / ROOF		CONTEXT	CENSUS HOUSES	
			NO. OF HOUSES	%
WALL	B - Burnt Bricks Wall and Stone Wall packed with mortar	Rural	1,275,084	38.9
		Urban	640,207	19.5
		Total	1,915,291	58.4
	Total - Category – B		**1,915,291**	**58.5**
	C1 - Concrete Wall	Rural	30,113	0.9
		Urban	37,899	1.2
		Total	68,012	2.1
	C2 - Wood Wall	Rural	144,032	4.4
		Urban	17,229	0.5
		Total	161,261	4.9
	Total - Category – C		**229273**	**7.0**
	X - Other Materials	Rural	76007	2.3
		Urban	21963	0.7
		Total	97970	3.0
	Total - Category – X		**97970**	**3.0**
	TOTAL HOUSES	**3,275,945**		
WALL / ROOF		**CONTEXT**	**CENSUS HOUSES**	
			NO. OF HOUSES	**%**
ROOF	R1 - Light Weight Sloping Roof	Rural	1,991,974	60.8
		Urban	467,995	14.3
		Total	**2,459,969**	**75.1**
	R2 - Heavy Weight Sloping Roof	Rural	53,752	1.6
		Urban	19,995	0.6
		Total	**73,747**	**2.2**
	R3 - Flat Roof	Rural	415,693	12.7
		Urban	326,536	10.0
		Total	**742,229**	**22.7**
	TOTAL HOUSES	**3,275,945**		

Source: Census of India, 2011 and Building Materials and Technology Promotion Council, Retrieved on 25th September 2019.

1.2.5.1 Vernacular housing in the region

The region is known for its earthquake resistance construction techniques and practices. The predominant construction techniques have been evolved over a period of time and evolved into three distinct vernacular styles, which have been shaped by the availability of local construction materials, rigid topography, climate conditions, numerous earthquakes and other related hazards which has occurred since time immemorial. The predominant vernacular architecture of the UT which incorporates earthquake safe construction practices has been discussed below: -

Dhajji Dewari

Dhajji Dewari is a traditional construction technique, basically a patchwork of timber wood with stone and earth infill profoundly found in the UT of Jammu and Kashmir. The name was derived from Persian word meaning 'quilt patchwork' commonly used by the carpet weavers. The Indian Standard Code refers Dhajji Dewari as 'Brick Nogged Timber Frame Construction'.

Figure 1.11: Exposed Dhajji Dewari seen on a dilapidated house, Kashmir

Source: Nishant Sharma, IIT Kharagpur, Retrieved on 28th September 2019

In this type of construction technique, the walls are made out of timber frames which are then filled with crisscrossed wooden panels. These are further filled with stones. These structures are earthquake resistant as each small panel is unique. Thus, dividing the earthquake load evenly over the whole structure. The friction between all the small elements breaks the energy thereby making the structure more resilient and suffer minimal damage as compared to modern RCC construction.

Dhajji Dewari can safely resist earthquakes in high seismic regions of the world when maintained adequately. This makes Dhajji Dewari a valid form of construction in seismic areas. The timber framing provides stable confinement to the infill masonry as long as it remains together. Strategic use of nails and metal straps improves the building performance.

Seismic energy is dissipated through friction between the masonry panels and the timber frame and within the yielding of the connections.

Increased levels of overburden acting on the masonry increase the energy absorption capacity of the assembly, which provides evidence that it is suitable for multi-storey dhajji dewari buildings. Shortening of the braces, which is disengaged from the timber frame leads to nominally improved seismic energy absorption of the system.

Taq Dewari

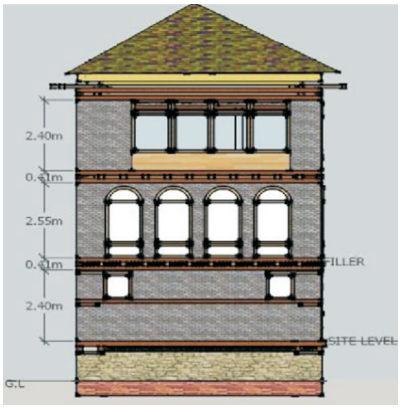
Taq Dewari is a traditional construction technique, basically a timber laced load bearing structure. In this technique, the piers and window bay are tied together with ladder-like timber lacings embedded at the plinth, floor and lintel levels. A Taq building can be several floors high, but still, withstand earthquakes thanks to the combined use of masonry and wood. The bearing wall masonry has horizontal ladder-like timber lacings embedded at plinth, floors and lintels levels. Taq walls were traditionally made of a mixture of brick and rubble stone or sun-dried bricks laid in thick mud mortar and faced with hard fired brick, with load bearing piers at regular intervals.

Figure 1.12: A vernacular Taq Dewari style dilapidated house

Source: Kashmir Life, May 4, 2015, https://kashmirlife.net/uncertain-times-issue-07-vol-07-78168/amp/, Retrieved on 8th October 2019.

The timber laced masonry is not tightly bound together hence create a ductile like behavior, which causes frictions within the various parts of the building system hence allowing to dissipate seismic loads. This type of structures is regarded as composite building systems in which all the parts are dependent on each other hence it works together in an organic manner which makes it an excellent earthquake resistant structure.

Figure 1.13: Elevation Drawing of a vernacular Taq Dewari style House



Source: Seismic Behavior of Timber-Laced Masonry Structures in the Himalayan Belt D. Dhandapany and Arun Menon, Department of Civil Engineering, Indian Institute of Technology Madras, https://www.researchgate.net/publication/327401756, retrieved on 26th September 2019.

Rammed Earth

Rammed earth is a type of low-cost construction technique which is based on compacting earth between flat panels called formwork, to make a homogenous wall[32] . This technique is widely used in the high-altitude mountainous regions especially in the cold deserts of the Ladakh region. Because of the harsh winter conditions and low precipitation in the region makes it ideal for constructing a house.

Figure 1.14: Traditional Ladakhi House, Old Town, Leh, Ladakh

Source: Tsomo Wangchuk, School of Planning and Architecture, New Delhi. Retrieved on 27th September 2019.

[32]Paul Jaquin, A History of Rammed Earth in Asia, International Workshop on Rammed Earth Materials and Sustainable Structures and Hakka Tulou Forum 2011, https://pdfs.semanticscholar.org/be2f/f3ad3d6e7f95bf535e1b9811732aaec2ea21.pdf, Retrieved on 27th September 2019

Rammed earth is a construction material that is made by compacting the soil and layering it in a formwork. The thickness of each compacted layer is 10-15 cm. Rammed earth without adding binders is called "unstabilized rammed earth" and when a binder is added (cement, lime or geopolymer), it is called "stabilized rammed earth"[33] .

Rammed earth has several advantages over other buildings which includes low cost, easy availability, thermal comfort, and low intervention with surroundings. Rammed earth, like most types of earthen construction, is relatively stronger in compression than it is in bending and shear. Therefore, un-reinforced rammed earth should only be used for structural elements subject to primarily compressive loads, mainly vertical walls and to lesser extent, columns. It is generally considered to be well suited to passive solar design as its high mass and hygroscopic nature contributes to the regulation of internal temperature and humidity, reducing the need for active heating and air conditioning systems. It is important to note that the seismic behavior of a rammed earth building depends upon several parameters: Earthquake action (seismicity zone, soil type, site factors), the structure's dynamic characteristics (natural frequencies, modal shapes, damping), and the material's characteristics (compressive, tensile strengths, density). Hence for the same material (rammed earth), the seismic performance of each building may differ depending on its structural characteristics and the quality of execution.

From the view point of earthquake engineering, rammed earth material does not seem favorable. Indeed, the material works well in compression and has a very low tensile strength; the wall's mass is high, which can cause considerable inertial forces during earthquakes. However, according to the number of post-seismic investigations, RE walls present acceptable behaviour[34] .

1.2.5.2 Settlement Pattern

The settlement pattern in all of the three divisions of erstwhile J&K state has a distinct characteristic based on the topography of each region. In the erstwhile Jammu division, the dwelling units are scattered all along the unsymmetrical landform. Each dwelling unit is surrounded by a large agricultural patch, on which their livelihood is dependent. The houses are separated but bounded together as a close-knit to form a hamlet. Jammu is the largest populated city and also acts as the winter capital of the state located on the bank of river Tawi. The settlement pattern of the city can be divided into two parts, the old city, located on hillock on the right side of the river and the post-independent development part on the left side of the river[35].

[33]Assessing the Seismic Behavior of Rammed Earth Walls with an L-Form Cross-Section, 4 November 2018, file:///C:/Users/thoma/Downloads/sustainability-11-01296-v3.pdf, Retrieved on 27th September 2019.
[34]Assessing the seismic performance of rammed earth walls by using discrete elements, 14 June 2014, https://www.tandfonline.com/doi/pdf/10.1080/23311916.2016.1200835, Retrieved on 27th September 2019
[35]Jammu and Kashmir, ENVIS Center on Human Settlement's, Hosted by School of Planning and Architecture, Delhi, Sponsored by Ministry of Environment, Forests and Climate Change, Govt of India, http://spaenvis.nic.in/index3.aspx˙sslid=1378andsubsublinkid=104andlangid=1andmid=1, Retrieved on 27th September 2019

The erstwhile Kashmir division has one of the diverse settlement patterns, having its unique architecture. The housing morphology of the region is mostly shaped by the river Jhelum, hence linear and ribbon development can be observed along the river valley. A substantial number of house boats can also be found on the lakes and rivers. Srinagar is the first metropolis and the fastest growing city located on the banks of river Jhelum. Due to the close vicinity of the river, frequent floods are common in the city but the hill slope protects the city from these perennial phenomena.

Due to harsh climatic conditions and topography, the Ladakh region is sparsely populated. Usually, a cluster of more than ten to fifteen houses is grouped in close vicinity to each other to form Mohalla's. Radial expansion of the settlement is mostly seen but also depends on the nature of the landform. Due to the limited accessibility of water and resources, the distance between two rural communities is substantially large.

Figure 1.15: The Nallah Mar Canal, Srinagar, 1950

Source: The Jhelum riverfront in Sirinagar, News Letter, INTACH Jammu and Kashmir Chapter, December 2016, Retrieved on 27th September 2019.

Figure 1.16: Hierarchy of settlement, Thiksay Monastery, Leh

Source: Tsomo Wangchuk, School of Planning and Architecture, New Delhi. Retrieved on 27th September 2019.

1.2.6 Development (Urban) Perspective of the UT of Jammu & Kashmir (the erstwhile state)

The erstwhile state of Jammu and Kashmir from 2001 to 2011 recorded a growth rate of 23% exceeding the national growth rate of 17%. It has about 27% (3.4 million) of its population living in urban areas. The erstwhile state's urban population increased by 36.42% in the last decade, higher than the national average of 31.1% and much higher than the decadal growth rate (19.42%) in case of rural areas[36] .

The Kashmir region accounts for 63% of the total urban population of the erstwhile state, followed by Jammu region 35% and the Ladakh region with just 2%. Out of the total urban population of 3.4 million in the erstwhile state, Kashmir valley holds 2.2 million with Srinagar city alone accounts 55%, whereas Srinagar Metropolitan region i.e., the local planning area has more than 75% of the urban population of the valley presenting the case of highly skewed urbanization.

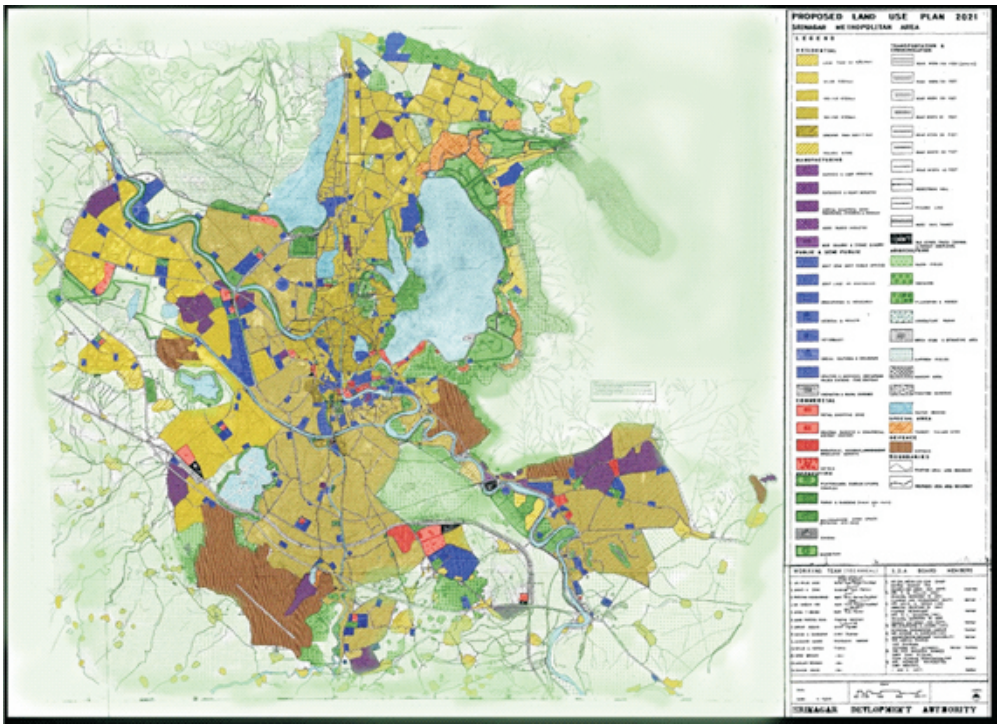
1.2.6.1 Srinagar

Srinagar has been growing very fast, mostly in a haphazard manner with an insignificant contribution of the planned development. Historically, the city has been on the path of planning trajectory much before 1947 when Mr. W.G. Harris, a British Engineer was hired by the erstwhile state during the reign of Maharaja Gulab Singh in the aftermath of devastating floods of 1902 for a comprehensive flood management plan for ensuring sustainable development of Srinagar city. The Srinagar Master Plan 1971-91 was the first comprehensive planning effort made by the erstwhile state Government post-Independence. The Master Plan

[36] Census of India, 2001, 2011, Retrieved on 25th September 2019

1971-91 triggered growth in the west and southwest directions of Srinagar mostly in low lying areas, wetlands and flood absorption basins adjacent to Flood Spill Channel. Turbulance from 1989 created an ineffective regulatory mechanism of the urban local bodies and local authorities led to the massive conversion of hitherto colonies and residential areas into commercial development[37] .

Map 5: Proposed Land Use Map of Srinagar Metropolitan Area 2021



Source: Srinagar Development Authority, http://www.sdasrinagar.com/wp-content/uploads/2017/03/land-use-map.jpg, Retrieved on 27th September 2019.

The Srinagar Master Plan 2035, has been prepared for a threshold population of around thirty lakhs. The Srinagar Metropolitan Planning area have been increased from 416 sq.km to 766 sq.km, approximately an increase of around 84% of the total area. The local area of Srinagar Development Authority as of 21st October 2014, includes the municipal areas of Srinagar Municipal Corporation, ULBs of Ganderbal, Khrew, Budgam, Pampore and additional 160 villages as outgrowths in twelve tehsils of six districts viz; Srinagar, Ganderbal, Budgam, Baramulla, Bandipora, and Pulwama.

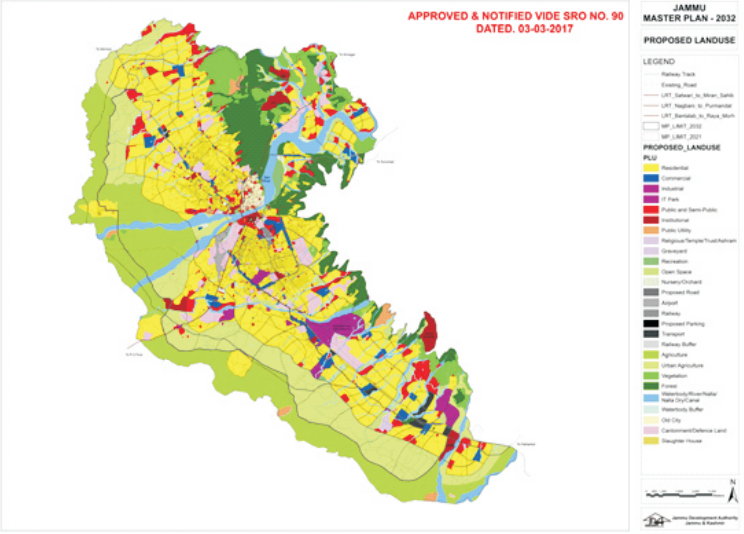
[37]Master Plan 2035, Srinagar Development Authority, http://www.sdasrinagar.com/wp- content/uploads/2019/03/Master-Plan-2035-ReportFinal.pdf, Retrieved on 27th September 2019

1.2.6.2 Jammu

The city of Jammu also known as the City of Temples, located on the bank of the river Tawi. The city was founded by Raja Jamboo Lochan, during the 14th century B.C. The modern city took its shape in 1962, and the municipal limits were spread over an area of 16.87 sq.km. As per the Jammu Master Plan 2021, the city limit has increased to 112 sq.km. In 1989, the city saw an influx of population mainly due to mass migration from the Kashmir valley, the scenario of the city changed drastically. Hence, the Master Plan was remodeled to meet the changing needs and aspirations of the city in 1994[38] .

In the early 1980s, the city experienced unprecedented growth of population and non-implementation of Zonal Plans. Encroachment on government land, non-availability of land for housing, violation of prescribed land use, absence of unified control, lack of timely review, poor enforcement of development controls and zoning regulations were some reasons due to which the Second Master Plan (SMP) for Jammu, was initiated in the year 1989. The Jammu Master Plan 2021 is still in operation and is being revised up to the year 2032.

Map 6: Proposed Land Use Map of Jammu Master Plan, 2032



Source: Jammu Development Authority, https://www.jdajammu.in/LUP2032.pdf, Retrieved on 27th September 2019

[38]Jammu Master Plan 2032, Jammu Development Authority, https://www.jdajammu.in/LUP2032.pdf, Retrieved on 27th September 2019.

With the rapid pace of urbanization and the development of economic activities in Jammu, the city's influence has been increasing in range and impact. The growth of Jammu Urban agglomeration has been rapidly increasing, mainly due to the trend of decadal change in the urban population in adjoining tehsils. Many villages in Bishnah, Samba, RS Pura, and Jammu tehsils have already been engulfed by the sprawl of Jammu city.

The proposed Local Planning area under the revised Jammu Master Plan 2032, spread over an area of 652.33 sq.km. About 355.113 sq.km is demarcated as Net-Proposed Area (54.43%) and 297.217 sq.km. is demarcated as Undeveloped Area (45.57%). The revised Master Plan 2032 includes the whole Municipal Corporation area of Jammu and the Municipal Committees of Ghomanhasan, Bishnah M.C, Bari Brahmana M.C, and Vijaypur. A total of 324 villages are included in JMP, also involve 103 villages of the extended local area of JDA[39] .

1.3 Hazard Profile of Jammu and Kashmir

1.3.1 Natural Hazard

The region is prone to various natural hazards attributing to its unique geographical and climatic conditions. The UT has experienced earthquakes, floods, landslides, droughts, incidents of fire and avalanches, etc., but both earthquake and flood have been posing the biggest threat as per the history of the region. Hydro-Meteorological, Industrial, and Biological Hazards are some other hazards prevailing in the UT.

1.3.1.1 Floods

All low-lying areas of the Kashmir valley along with parts of the Jammu region are prone to floods. Upper catchments of all the tributaries of the Jhelum, Indus, Chenab and Tawi rivers are prone to flash floods[40]. In the Kashmir valley, the flood has been a recurrent problem mainly due to the overflowing of embankments, breaching of channels, horizontal erosion, and flash flood in the river Jhelum and its tributaries. The encroachment of river water channels and siltation in water bodies due to erosion has further aggravated the vulnerability of flood hazards in the valley. In the Jammu region, flood hazards are mainly due to spilling of banks and embankment erosion by river Chenab and river Ravi[41] .

Jammu and Kashmir have had a long history of flooding due to its geographical structure and location. Floods in the Kashmir valley are linked to the Jhelum River and the frequency of floods has been very high since the formation of the valley. The Wular Lake and the Dal Lake came into being, the former one during the era of Raja Sundar Sen (2083-2042 BC) and the latter one during the era of Raja Durlab Dron (617-635 AD) mainly due to flood related disastrous events[42] . The first recorded history of floods was mentioned by Sir Walter Roper

[39]Ibid 25, P 17.
[40]Ibid 20, P 14.
[41]Dr. Ruheela Hassan, Disasters in Kashmir: Impact and Response, IOSR Journal of Humanities and Social Science (IOSR-JHSS) Volume 19, Issue 7, Ver. VI (July. 2014), PP 32-42 e-ISSN: 2279-0837, p-ISSN: 2279-0845.
http://www.iosrjournals.org/iosr-jhss/papers/Vol19-issue7/Version-6/F019763242.pdf, Retrieved on 1st October 2019
[42]Mohammad Ashraf Fazili, Kashmir Floods: A Chronology, December 9th 2017, Lost Kashmir History, https://lostkashmirihistory.com/history-of-floods/, Retrieved on 27th September 2019.

Lawrence in his book, The Valley of Kashmir (1895), "Many disastrous floods are noticed in vernacular histories, but the greatest was the terrible inundation which followed the slipping of the Khadanyar mountains below Baramulla in AD 879. The channel of the Jhelum River was blocked and a large part of the valley was submerged"[43] .

From last 10 decades, during 20th and 21st century, the intensity of floods in the erstwhile state has been more recurrent and devastating. The recent floods are, 2010 in Ladakh and 2014 in Kashmir. On 6th August 2010, the Ladakh region experienced one of its worst natural disaster in the form of a flash flood mainly caused due to cloudburst. The downpour only lasted for half an hour but the devastation caused was enormous. About 248 people were reported dead and 76 were missing. Around 1200 houses and 1400 hectares of agricultural land were damaged. Choglamsar, a new settlement was severely affected in terms of life and property.

Table 1.7: Chronology of Floods in Kashmir valley

SL.NO.	YEAR	EXTENT OF DAMAGES CAUSED
1.	2082-2041 B.C.	The city of Sandimat Nagar was rifted and water gushed out from the bottom and submerged the whole city (as per oral legends). This submerged city forms the bed of Wular lake.
2.	617-635 A.D.	The river Jhelum breached its bank and it changes its direction at Nawpopra and enter the valley of vital Marg and gave birth to the Dal Lake.
3.	715-752 A.D.	Hundreds of houses were washed away by the flood. The incessant rain submerged the whole city including the raj mahal.
4.	872-900 A.D.	The entire valley got submerged up to Bijbehara, causing famine. Manual dredging was carried out after breaching of the various artificial dams constructed on the river.
5.	923-934 A.D.	Huge loss to life and property. Most of the agricultural fields were destroyed causing a great famine.
6.	1103-1114 A.D.	Crop damage due to the flood causing famine.
7.	1360-1378 A.D.	2000 houses were destroyed in Srinagar, Sonawari and other low-lying areas.
8.	1570-1579	Whole valley got inundated, submerging all agricultural fields. Landsli de, Hundreds of houses damaged, Famine continued for three years.
9.	1678-1686	Continuous rain for one month caused devastating floods. The flood was known as ' *Tughyan-i-behad*' meaning flood without borders.

[43] Sir Walter Roper Lawrence, Chapter VIII – Physical History, P 2015, The Valley of Kashmir, https://www.rarebooksocietyofindia.org/book_archive/196174216674_10153460989311675.pdf, Retrieved on 4th October 2019

SL.NO.	YEAR	EXTENT OF DAMAGES CAUSED
10.	1709-1710	Torrential rainfall and winds ca used floods resulting in great damage to life and property, which was further enhanced when a devastating fire broke out in Mohalla Malchimar in Safakadal, which destroyed twenty adjacent Mohallas and 40,000 houses in them.
11.	1746-1748	One third of the population perished due to the flood and more were affected due to the aftermath famine.
12.	1771-1772	Destruction of the Dewan Khana. Sher Garhi had to be rebuilt.
13.	1841	Jhelum overflowed its bank due to incessant rain. Breach in the Qazizad bund and the flood water entered Srinagar. Rainawari and Khanyar area experienced the maximum damage. All the bridges from Fatehkadal to Sumbal were washed away.
14.	1893	52 hours of continuous rainfall, beginning 18 July, caused a great calamity.
15.	1903	The "*greatest flood ever known*", which came down the Valley and inundating Srinagar, converting the city into " *a whole lake*".
16.	1929	The Valley grappled with yet another major flood, which mainly affected parts of what is today known as Pakistan-occupied Kashmir.
17 .	1950	Nearly 100 people lost their lives. The flood was caused by the Jhelum's overflow.
18.	1957	The floods almost submerged the entire valley.
19.	1959	Massive "glacial" flood, perhaps worst ever at the time, when four days of incessant rains lashed the valley and Srinagar, triggering floods in the Jhelum.
20.	1992	The flood was unprecedented in terms of its fury. It was recorded as the heaviest rainfall since 1959. Over 200 people lost their lives and the floods left over 60,000 people marooned in several north-western border districts.

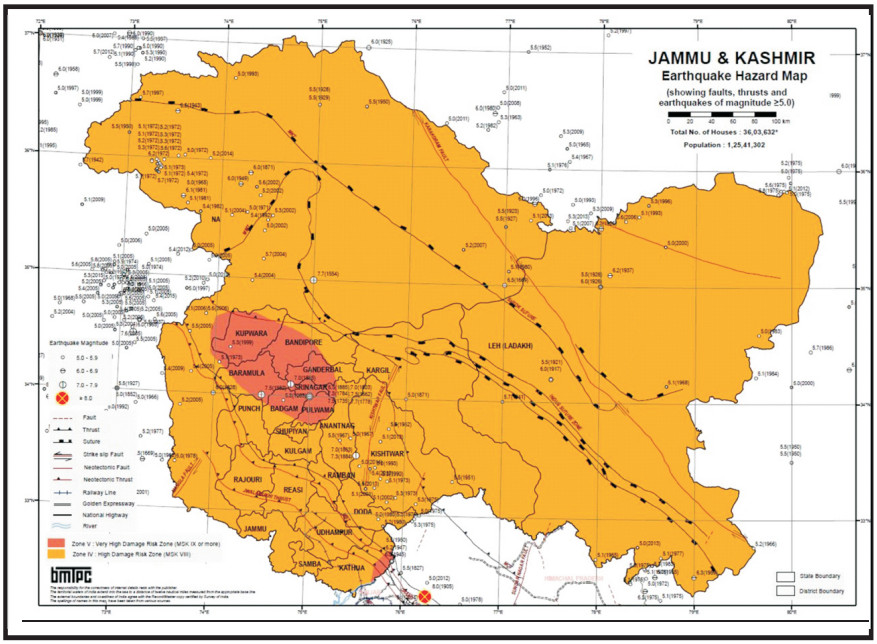
Source: Compiled from various sources, Ibid 30, Ibid 31, Ibid 32.

1.3.1.2 Earthquakes

The erstwile state of Jammu and Kashmir is the western most extension of the Himalayan Mountain range in India. The Himalayan Mountain ranges are the youngest and tallest mountain range which is still growing, due to the ongoing movements of the tectonic plates hence, uplifting along active faults making it very vulnerable to earthquakes.

About 15.3% of the area of the erstwhile state falls under Seismic Zone V, which is mostly considered as a very high damaged risk zone. Some parts of the Kashmir and Jammu division falls under this zone which poses a serious risk, as 50% of the total population lies in this part. The rest of the area falls under seismic zone IV, which is considered as a high damaged risk zone[44].

Map 7: Earthquake hazard map of UT of Jammu and Kashmir including UT of Ladakh



Source: Vulnerability atlas of India, BMTPC, Ministry of Housing and Urban Affairs, Govt. of India. http://www.bmtpc.org/DataFiles/CMS/file/VAI2019/eq-jk.html, Retrieved on 27th September 2019.

The earliest recorded history of earthquakes in the region dates back around 1505 AD. The earthquakes of 1555 and 1885 were considered the most devastating ones. The earthquake of 1555 was a catastrophic one but there was no data available to assign its magnitude or location. The 1885 earthquake which occurred near Srinagar killed around 3000 people and affected an area of 1,00,000 sq.km.

The Kashmir earthquake of 2005 was the major one with a magnitude of 7.6 being recorded at a depth of 26 km from the surface. The epicenter was located at 34.493°N, 73.629°E, 19 km northeast from Muzaffarabad, the capital town of the Pakistan Occupied Kashmir (POK) and 170 km west-northwest of Srinagar, Jammu & Kashmir, India (USGS). The earthquake left over

[44]Jammu and Kashmir State Disaster Management Policy (Revised: October 2017), Jammu and Kashmir State Disaster Management Authority Department of Disaster Management, Relief, Rehabilitation and Reconstruction, Government of Jammu and Kashmir, http://www.jksdma.org/wp-content/uploads/2017/08/SDM-Policy-2017-Final.pdf, Retrieved on 27th September 2019.

75,000 people dead and 3.5 million homeless, just before winter[45].

The Jammu and Kashmir is a region of major seismic activities. Some of the largest earthquakes in India have occurred in this zone. The table below shows the data of significant earthquakes that occurred in the Kashmir region.

Table 1.8: List of severe earthquakes that occurred in Kashmir

SL.	YEAR	EXTENT OF DAMAGE CAUSED
1.	2082-2041 B.C.	The earth in the middle of the city of Sandimat Nagar was rifted and water gushed out in a flood and submerged the whole city. This submerged city forms the bed of the Wular lake (as per oral legends).
2.	1555	A magnitude of 7.6 was recorded with significant damage to life and property. 600 deaths reported alone at Khandanyar.
3.	1662	This earthquake was also severe. Many houses were destroyed and many people perished. The shocks continued for a long period.
4.	1735	A severe shock of earthquake occurred which threw down thousands of houses and its shocks continued for three months. Buildngs of the city and hamlets razed to the ground.
5.	1778	Countless houses were razed to the ground. The shocks continued for one year during which the people were living out of their houses.
6.	1784	Loss of life was immense. The shocks continued for about three months.
7.	1803	Many houses were destroyed amongst which was the spire of the Shah -I-Hamdan mosque. Earth ripped apart and people were buried under walls.
8.	1828	The earthquake shook down some 1,200 houses and perhaps 1,000 persons were buried to death underneath them. Just before sunrise, another shock occurred accompanied by a terrific and lengthened explosion and 20 similar shocks followed in the course of the day.
9.	1863	The earthquake occurred in the close hours of the morning. Fissures were produced in different places, but no loss of life occurred. The shocks continued for three months.
10.	1873	The earthquake took nearly 3,000 lives and a few thousands of cattle heads.
11.	1873	Over 10,000 houses were destroyed, 3,400 human lives and 40,000 cattle heads were lost. The shocks continued for two and a half months. Many irrigation springs disappeared and a big landslide occurred on the sloping ground of Laridura.
12.	1878	16 houses together with their inmates were buried down into a chasm caused by an earthquake at Kundabal village near Manasbal.

[45]Effects of the 2005 Muzaffarabad (Kashmir) earthquake on built environment http://www.iitk.ac.in/nicee/RP/2006_KashmirEQ_Current_Science.pdf, Retrieved on 27th September 2019.

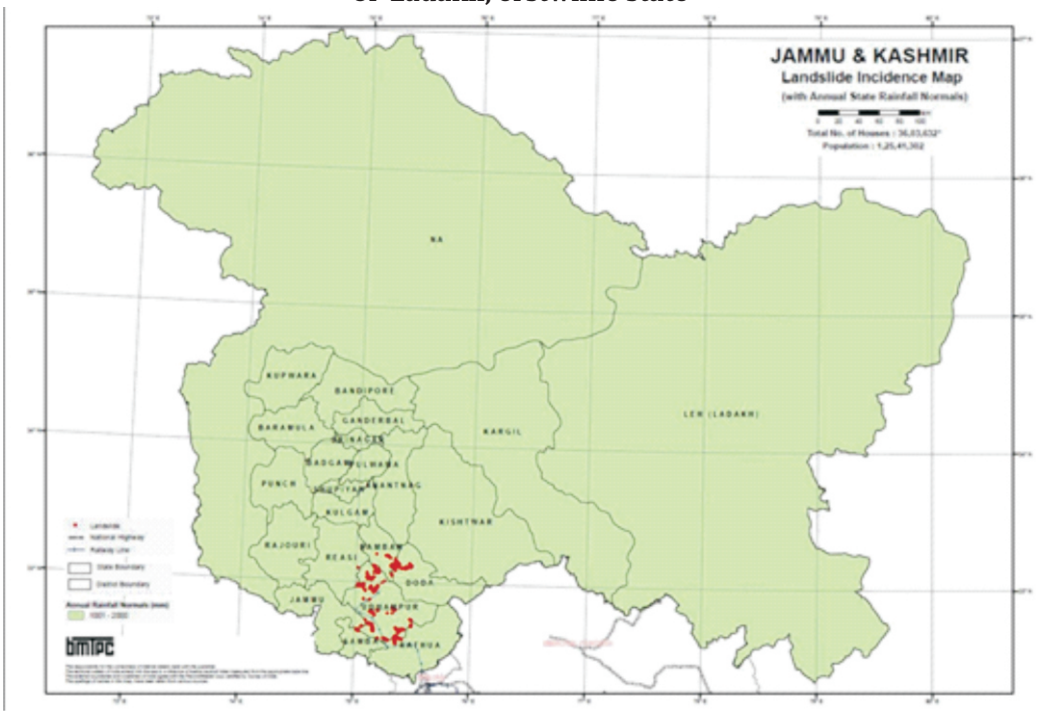
SL.	YEAR	EXTENT OF DAMAGE CAUSED
13.	1885	It was the most disastrous earthquake which was felt from Gilgit to Shimla with a magnitude of 6.3 was recorded. Its epicentre was a few miles to the west of Srinagar. Over 20,000 house s, 30,000 cattle and 3,000 human beings were destroyed.
14.	1902	The epicenter of this earthquake was near Hindukush and it was felt all over the Kashmir valley. It was also felt severely at Gulmarg and Drosh. The loss to life and property in this earthquake was insignificant.
15.	1905	A magnitude of around 7.8 was recorded. At least 20,000 people and 53,000 domestic animals were killed. As many as 100,000 buildings were reported to be damaged. There was also major damage to the network of hillside aqueducts that fed water to the affected area. The total estimated damage was to the tune of INR 2.9 million (1905 Rupees)
16.	1907 to 1999	Earthquakes of mild intensity were recorded.
17.	2005	This earthquake with a magnitude of 7.6 took place at 8:50 a.m. The epicenter of the earthquake was 34.493° North and 73.629° East, some 10 kilometers north east of Muzaffarabad, and very close to the Asian tectonic plates. Earthquake -triggered landslides destroyed many houses on hillsides and blocked the roads. In terms of death toll, this was the most fatal earthquake in the recorded history of the Himalaya, the death toll is estimated around 80,000.
18.	2015	This earthquake had a magnitude of 7.5 with its epicenter in the Hindukush mountain region of Afghanistan.

Source: History of Natural Disasters in Kashmir Valley, Jammu and Kashmir with Special Reference to Earthquakes, International Journal of Innovative Research in Science, Engineering and Technology, http://www.ijirset.com/upload/2016/september/110_54_History_new.pdf, Retrieved on 27th September 2019.

1.3.1.3 Landslides

Landslides are one of the geological hazards that is common and peculiar to the UT of Jammu and Kashmir. Every year the UT/erstwhile state is affected by landslides distressing the society in terms of loss to life, property, infrastructures, accessibility and communication. The region is highly vulnerable due to its geologically young, unstable and fragile rock formation. The intensity and frequency of landslides in the UT has increased drastically mainly due to huge loss in forest cover, deforestation, illegal mining, hazardous construction of roads, unregulated construction and encroachment.

Map 8: - Landslide hazard map of UT of Jammu and Kashmir including UT of Ladakh, erstwhile state



Source: Vulnerability atlas of India, BMTPC, Ministry of Housing and Urban Affairs, Govt. of India. http://www.bmtpc.org/DataFiles/CMS/file/VAI2019/eq-jk.html, Retrieved on 27th September 2019.

Table 1.9: Chronology of historical avalanche events

DATE	AFFECTED AREA	CASUALTY	IMPACT
1-Jun-95	Pani nallah,	6	Section of Jammu Srinagar highway badly damaged
	Kishtwar		
17-Dec-07	Ganderbal, Srinagar	2	6 injured, temple, bridge and army bunker damaged
10-Jan-08	Udhampur	15	-
8-Feb-08	Ramban,Banihal	3	15 injured, 400-500 trucks stranded
2-May-08	Kathua	8	Several missing
26-Oct-08	Leh	2	32 cattle killed
20-Nov-08	Kishtwar district	6	
17-Jun-09	Gurez	1	4,000 pilgrims stranded
29-Jul-09	Vaishnodevi cave shrine in Reasi	1	A female pilgrim was killed and two others were injured

DATE	AFFECTED AREA	CASUALTY	IMPACT
8-Feb-10	Kishtwar	1	6 injured, 5 houses damaged
22-Feb-10	Chairvani Village, Ganderbal	6	6 injured in Chairvani Village, Ganderbal District
27-Feb-10	Reasi	2	Casualty of two pilgrims. Location of landslide at Hathi Matha, in Reasi district triggered due to heavy rains
28-Apr-10			Heavy rains caused landslide along the Srinagar – Leh national highway, killing a BRO worker.
18-May-10	Leh-KaruTangtse axis in Ladakh	2	Location two km short of the 17,350 ft Chang La top on Leh-Karu-Tangtse axis in Ladakh region. The Indian Army rescued 73 trapped people
20-May-10	Leh	1	Army personnel was killed, hit by a heavy boulder during the landslide. Location near Siachen base camp Nobra, about 500 km from Srinagar, in Leh district
6-Jun-10	Uri	6	Traffic disrupted for several days

Source: Data inventory Report, Multi Hazard Risk Assessment for the state of Jammu and Kashmir, November 2018, Jhelum and Tawi flood recovery project, World Bank, http://jtfrp.in/wp- content/uploads/2019/01/JK_Data-inventory-Report_30Nov2018-RMSI.pdf, Retrieved on 17th October 2019.

1.3.1.4 Avalanches and Snow Blizzards

The western Himalayan region is highly known for the occurrence of avalanches and snowstorms. The major roads in the higher reaches of Kashmir, Gurez Valley, Kargil, and Ladakh are highly vulnerable. It is very difficult to predict avalanches as they are observed closely and they normally occur within a short period, i.e., one or two minutes.

According to the report on 'Multi-Hazard Risk Assessment for the state' prepared by the World Bank, about 29 historic events related to avalanches were reported in the erstwhile state of Jammu & Kashmir during the period of 14 years (2005 to 2018). Out of the 29 reported events, 13 were reported to have more than 5 causalities. The majority of these casualties reported are of military personnel.

Table 1.10: Chronology of historical avalanche events (Over 5 Causalities)

DATE	AFFECTED AREA	CASUALTY	IMPACT
07-Mar-05	Udhampur	15	-
08-Feb-10	Gulmarg	17	17 soldiers were killed and the event injured an equal number of soldiers
08-Feb-10	Vaishno Devi	17	-
24-Jan-12	Kupwada	7	Casualty of five army men and two personnel of Border Security Force (BSF)

DATE	AFFECTED AREA	CASUALTY	IMPACT
23-Feb-2012	Ganderbal and Bandipora districts	16	All sixteen causalities were army personnel and many were injured.
24-Feb-12	Gurez Sector	13	All casualties related to army personnel
14-Mar-16	Kupwada	10	As many as 73 civilians were rescued by the Army from the Kupwara district. People were stranded in vehicles on the Tangdhar-Nasta Chhun road.
25-Jan-17	Gurez sector	24	20 Military personnel and 4 civilians died.
26-Jan-17	Gurez Sector	10	All casualties were soldiers and four other soldiers were injured in a camp at Sonmarg in Ganderbal district.
06-Apr-17	Ladakh	5	All casualties were soldiers and two were rescued.
13-Dec-17	Gurez Sector	5	All causalities were military personnel.
06-Jan-18	Tangdhar district	11	A passenger vehicle was hit by a huge avalanche of snow at Khooni Nallah near Sadhna top on the Kupwara- Tangdhar road.
16-Feb-18	Gulmarg	5	One overseas tourist and 4 Indian nationals.

Source: Data inventory Report, Multi Hazard Risk Assessment for the state of Jammu and Kashmir, November 2018, Jhelum and Tawi flood recovery project, World Bank, http://jtfrp.in/wp-content/uploads/2019/01/JK_Data-inventory-Report_30Nov2018-RMSI.pdf, Retrieved on 17th October 2019.

On 18th Feb 2005, a snow blizzard occurred in villages Waltengu Nad, Pachgam and Nigeenpora that affected 128 families consisting of 618 people. During the incident, 175 lives (54 men, 48 women and 73 children) were lost. In many cases, full families were wiped out and 183 sheep/goats, 308 cows, 54 buffaloes and 5 horses also perished.

1.3.1.5 Cloudbursts and Hailstorms

The hilly terrain of the region is highly favourable for the formation of cumulonimbus cloud. This leads to the shedding of larger droplets of water at a higher rate, resulting in the higher impact on the ground. The high impact areas in UT of Jammu and Kashmir due to cloudbursts are Budgam, Udhampur, Ramban, Doda, Reasi, Bandipora, Kulgam, Rajouri, and Srinagar districts.

A cloudburst occurred at Bagger in District Doda on 8th June 2011, where 17 structures damaged and three people died. Eight people died and 11 got injured because of multiple cloudbursts hit Thathri town of Doda district of Jammu and Kashmir at 2:20a.m. during the intervening night of July 19, 2020, five of the victims were women. The flash flood inundated the Batote-Kishtwar highway, as well. Six houses, two shops and one private school building were also damaged. A separate cloudburst flooded the parts of the Gujara, Johra and Khara areas. Large areas of agricultural land were also affected.

Hailstorm creates great devastation to the standing crops in the state/UT. Every year, thousands of acres of crops are being affected due to the hailstorm resulting in the loss of crop yield. The government of Jammu and Kashmir has imparted crop insurance schemes to support the agrarian population, who has been affected by natural disasters such as hailstorm, drought, lightning, etc. The insurance schemes are meant to support Rabi crops such as wheat, mustard, and potato. Udhampur, Ramban, Doda, Kishtwar, Bandipora, Srinagar, Baramulla, Kupwara, Anantnag, Pulwama, Budgam, Jammu, Kathua, Rajouri, Poonch districts in Jammu and Kashmir are highly vulnerable to hailstorms.

1.3.1.6 Droughts

The southwest monsoon plays a significant role in determining the sustenance of drought in the UT. Drought is often caused due to the deficiency of monsoon rain, hence affecting mostly affecting the majority of the rural population whose livelihood are dependent on agricultural and allied activities. More than 70% of the population in Jammu and Kashmir are directly or indirectly dependent on agriculture for livelihood. Once in every three years, deficiency in rainfall is usually observed in the erstwhile state. As per the recorded history of drought in the erstwhile state, Shopian, Leh, Pulwama, Bandipora, Srinagar, Udhampur, Ramban, Kathua, Kishtwar, Ganderbal, and Doda districts are highly vulnerable, whereas Samba and Rajouri districts are relatively less vulnerable.

1.3.1.7 Urban Fires and Forest Fires

All the densely populated urban areas, across the UT, are highly vulnerable to urban fire incidents, especially Gurez, Doda, Kishtwar and other dilapidated areas. Many urban settlements in Srinagar and Jammu are susceptible to fire accidents, hence there is a need to take appropriate mitigation measures. During the dry spells, a forest fire in the UT is a common scenario especially in the autumn season and in the month of May and June. The forest cover in the state is about 20,230 sq.km., which is about 19.90% of the total geographical area of the erstwhile state (including Ladakh UT). Human allied activities such as militancy activities, timber smuggling, and burning of agricultural fields hold a huge responsibility for the onset of the fire, hence enhancing the already vulnerable forest in the dry seasons. Some of the districts in the UT which are highly prone to forest fire are Ramban, Kishtwar, Udampur, Reasi, Samba, Doda, Kathua, Srinagar and Kupwara.

Urban fire is a common phenomenon, predominantly in the city of Srinagar. The first recorded fire incident was during the 18th century A.D., a devastating fire broke out in Mohalla Malchimar in Safakadal, which destroyed twenty adjacent Mohallas including 40,000 houses. It was one of the greatest urban fire of Srinagar. In 1993, fire incident happened in Lal Chowk, Srinagar, which was one of the worst urban fire incidents which killed 125 people. In total, around 59 houses, 190 small shops, 59 stores, 5 huge commercial building, 2 office buildings, 2 schools and a shrine were burned down by the blaze. In June 2012, a 200-year- old shrine of

[46]Ibid 22, P 15.

Dastager Sahib in the old city was destroyed. In November 2012, 52 houses and cowshed were burned downed in Frislan, a Mohalla located on the periphery of village Pahalgam. In February 2013, 24 houses and several domestic animals died in Kishtwar district. During June 2013, a major fire broke out in the annex of Civil Secretariat, the seat of Jammu and Kashmir government. In May 2014, hotel Neelam in Jammu, killed 4 people and dozens were injured. In 2017, thirty-eight persons lost their lives while property worth Rs. 64.33 crore was destroyed in total of 2938 fire incidents which involved which involved 2596 structures across Kashmir as shown in the table 1.11 below.

Table 1.11: Fire Statistical Data of the Kashmir UT from 2015 to 2021

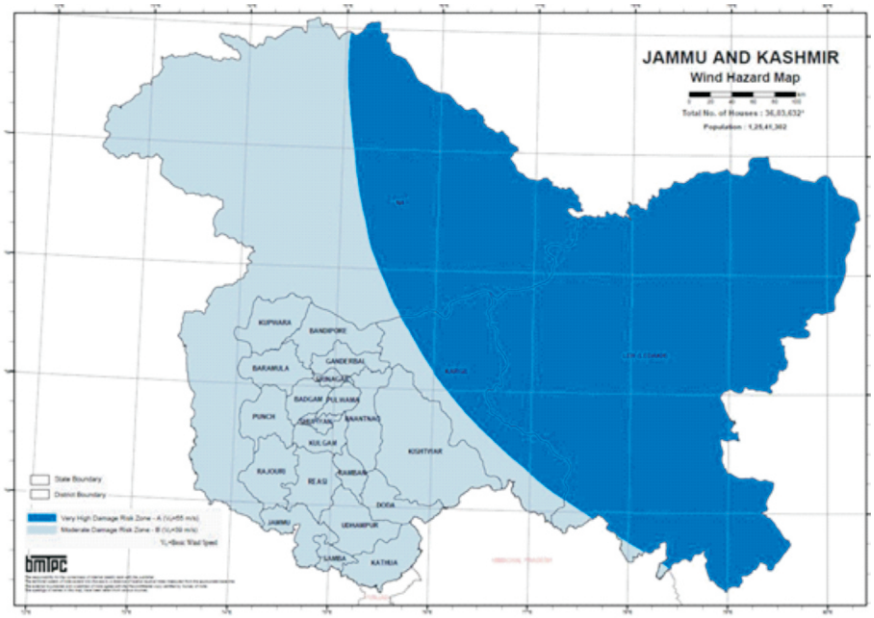
YEAR	NO. OF FIRE INCIDENTS	HUMAN CAUSALITIES	INJURED	DAMAGE TO STRUCTURE/SHOPS/ VEHICLES /ELECTRIC TRANSFORMER	PROPERTY DAMAGED
2015*	3710	79	236	3764	92.67
2016	3576	37	39	3033	87.41
2017	2938	38	35	2596	64.33
2018	2754	64	11	2471	67.02
2019	1821	46	08	2042	65.14
2020	2350	64	05	2157	53.95
2021	2258	75	21	2299	70.61

Source: - Fire and Emergency Services, Kashmir Range, Srinagar, received on 1 March 2022.
*Fire and Emergency Services, Jammu and Kashmir, http://fireandemergency.jk.gov.in/pdf/Statistical%20data%20Booklet%20%20for%20the%20year%202015.pdf, retrieved on 17th October 2019.

1.3.1.8 Windstorms

Occasional wind storms in different parts of the UT in different seasons, destroy roof-tops and crops. As per the wind hazard maps of erstwhile Jammu and Kashmir state, the Ladakh region and some parts of Gilgit Baltistan are highly vulnerable to windstorms while the Jammu & Kashmir divisions are moderately vulnerable to high winds. Wind speed more than 55 km per hour is usually observed in the region. Windstorm occur in the erstwhile state/UT mostly during spring and summer season and often leads a negative impact on lives and property. The main reasons for the catastrophe are lack of early warning procedures, preparedness measures, unsafe construction, deficiency in the implementation of building codes, lack of technical experts in building windproof structures, putting the lives and property at risk.

Map 9: Wind hazard map of Jammu and Kashmir



Source: Vulnerability atlas of India, BMTPC, Ministry of Housing and Urban Affairs, Govt. of India. http://www.bmtpc.org/DataFiles/CMS/file/VAI2019/eq-jk.html, Retrieved on 27th September 2019.

1.3.1.9 Others

Several parts of the UT face human induced and biological hazards like dam bursts, heavy snowing, human epidemics, livestocks epidemics and pest attacks time to time; few of them sometimes convert into a disaster like situation.

1.4 State-level Institutional Mechanisms for DRR

1.4.1 Evolution of the Disaster Management

Jammu and Kashmir is one the first erstwhile state now UT to enact legislation for natural calamities. The Jammu and Kashmir Natural Calamities Destroyed Areas Improvement Act 1955, was enacted for the improvement of towns, villages and other areas destroyed by natural calamities. However, not much was achieved through this Act. The situation remained as such till 2005, when the Government of India enacted the Disaster Management Act 2005, which provides for the establishment of Disaster Management Authorities, Executive Committees, Institutes of Disaster Management, Disaster Mitigation and Response Funds at the National and State/UT level. After adopting the Disaster Management Act of 2005, the erstwhile State Govt. formulated the Jammu and Kashmir Disaster Management Rules in the year 2007, constituting under State Disaster Management Authority (SDMA), State Executive Committee (SEC) and the District Disaster Management Authorities (DDMAs).

Many initiatives were started to mitigate natural disasters after the adaptation of the Act. The erstwhile State government revamped and notified the SDMA (State Disaster Management Authority), SEC (State Executive Committee), Div. DMA (Divisional Disaster Management Authority), and DDMA (District Disaster Management Authorities). The State Disaster Management Authority and the State Executive Committee were constituted under the chairpersonship of Hon'ble Chief Minister and Chief Secretary, respectively.

The State Disaster Response Force (SDRF) was established to prepare for field duties and deployment which consists of two Battalions. Existing facilities of the Fire and Emergency Services (F and ES) and SDRF were strengthened by the provision of capacity building in terms of equipment and training and are being made functional by taking appropriate measures like deploying personnel, establishing offices, provision of budgetary resources, etc.

Earlier, the Revenue Department of the erstwhile State Government was responsible for the management of disaster in the UT/erstwhile state. Though a separate Department for Relief and Rehabilitation was created in December 2016. The same had not been created at the district level, hence the implementation of disaster related activities continued to be under the Revenue Department.

1.4.2 Disaster Management Mechanism at State/UT Level

1.4.2.1 Jammu and Kashmir State/UT DM Plan

The Jammu and Kashmir Disaster Management Plan documented and envisaged the accurate assessment of the risk and vulnerability of disasters in the erstwhile state/UT. The plan was prepared only after the creation of an independent department of Disaster Management; Relief, Rehabilitation and Reconstruction (DMRRR) on 21st December 2016 and was approved on 22nd May 2017. A significant thematic component of the plan is mainstreaming of disaster management and concerning development plans, projects, and programs.

The plan proposes, to achieve its stated goals by enhancing capacities and designing preparedness measures that are rooted in socio-cultural, economic, ecological, and technological determinants of risks and uncertainties, which affect the diverse population of the erstwhile state/UT. The plan also outlines the strategies for proper coordination and allocation of roles and responsibilities of each government department and stakeholders involved. The plan also has provisions for reviewing and updating annually.

The objective of the Plan is to protect and minimize the suffering of the vulnerable populations in the region, along with reducing the loss of movable and immovable property. It attempts to achieve maximum efficiency in reducing the vulnerability of people to disasters by promoting a culture of disaster resilience in the state/UT. The plan designs, an appropriate prevention and mitigation strategies across various levels of stakeholders in the erstwhile state/UT and enhance the capacities of all relevant stakeholders in disaster risk reduction. It undertakes the disaster risk reduction as an integrated component of development plan and

helps in nurturing and establishing an efficient disaster response and relief mechanism in the erstwhile state/UT. It also provides clarity on roles and responsibilities for all stakeholders concerned with disaster response and recovery. The plan ensures coordination and promotes constructive partnerships with all other agencies related to disaster management.

1.4.2.2 Jammu and Kashmir State /UT Disaster Management Policy

Jammu and Kashmir State (now UT) Disaster Management Authority approved the State Disaster Management Policy in February 2012 and was revised in October 2017.

The aim of the policy is to mainstream Disaster Risk Reduction into all developmental initiatives and ensuring the sustainability of investments while minimizing the losses due to disasters by taking all necessary measures. The policy takes a holistic and integrated multi-hazard approach towards disaster management with a focus on building strategic partnerships at various levels. It is based on inter-sectoral coordination, cooperation, capacity development and community participation among various stakeholders. The policy identifies that hazard is inevitable, which need not necessarily to convert into disasters, and the risk can be mitigated by appropriate measures.

The objective of the policy is to institutionalize Disaster Risk Reduction into governance, hence promoting and mainstreaming DRR into development plan by building capacities and promoting effective institutional mechanisms. The policy works on promoting community-based DRR to reduce vulnerabilities and effective responses through awareness generation, capacity building, research and development through appropriate disaster prevention, mitigation and preparedness measures and strategies, while establishing a framework for post-disaster recovery and reconstruction.

1.4.2.3 District Disaster Management Plans

The vision of these plans is to enable disaster resilient development and continuity of essential services of citizens during post and pre-disaster situations in all the districts of Jammu and Kashmir.

The objective of the DDM plan is to analyze the geographical, social, political and economic context of the district from disaster management perspective. The plan helps in understanding the underlying risks and to develop an action plans for stakeholders for risk reduction and also builds awareness among stakeholders by their direct engagement with the development of disaster management plans and establishing a process for regular upgradation of it in future. It helps in introducing innovative and good practice in the institutional mechanism at the district level to make it an integrated and coordinated plan at all levels, and developing an action plan for stakeholders for disaster risk reduction, emergency response, and recovery actions. So far, the District Disaster Management Plans have not been formulated in the majority of the districts. The District Disaster Management Plan of Leh District of erstwhile state was approved in May 2011 and was one of the first district level plan to be approved in Jammu and Kashmir.

1.4.2.4 State/UT Disaster Management Authority (SDMA)

The role of the State Disaster Management Authority is to lay down policies and plans for disaster risk reduction. The Honorable Lieutenant Governor is the chairperson of SDMA and Honorable Advisor of Disaster Management, Relief, Rehabilitation and Reconstruction (DMRRR), is the Vice-Chairperson of Jammu and Kashmir SDMA. Three other Honorable Advisors serve as the members with Chief Secretary as CEO/member and Administrative Secretary of DMRRR also as member.

The SDMA is assisted by the State Executive Committee (SEC) headed by the Chief Secretary. Its main role is to implement the National Plan, State Plan, and to lay down guidelines for the preparation of disaster management plans, and to act as a coordinating and monitoring body for the management of disaster in the state. SEC acts as the link among NDMA, MHA and other National and International agencies. The State Executive Committee mainly consists of experts in the field of disaster management for making recommendations on various aspects.

1.4.2.5 The Divisional Disaster Management Authority (Div. DMA)

Due to having a setup of shifting capital between Srinagar and Jammu, every six months, which led to the formation of two Divisional Disaster Management Authority (Div. DMA). Div. DMA is headed by the Divisional Commissioner of both Kashmir and Jammu Divisions of the UT. Additional Commissioner is the Chief Executive Officer of the Divisional Disaster Management Authority. Div. DMA acts as the planning, coordinating, and implementing body for disaster risk reduction and management at the Divisional level, working under the guidelines laid down by the NDMA and SDMA.

1.4.2.6 The District Disaster Management Authority (DDMA)

The District Disaster Management Authorities (DDMA), are headed by the Deputy Commissioners as the Chairman and the Additional Deputy Commissioner (ADC) of that district is the Chief Executive Officer of the DDMA. DDMA was constituted in all 22 districts of erstwhile state (including Ladakh UT now). Its role is to prepare the District Disaster Management Plan and to coordinate and monitor the implementation of the National and the State Policies and Plans. DDMA ensures that the guidelines laid down by the NDMA and the SDMA are being followed by all the line departments of the respected districts.

The local authorities including Urban Local Bodies, Panchayats, Development Authorities, etc. ensures the capacity building of their officers and employees for managing disasters, carry out relief, rehabilitation and reconstruction activities.

1.4.2.7 State/UT Disaster Response Force

The erstwhile State Government established the State Disaster Response Force out of the existing two battalions of Auxiliary Police in February 2012. The role of the Force is to deploy troops in disaster-like situations, search/rescue operations and assisting with the civil administration in the relief and rehabilitation process.

In June 2016, the Commandant General Home Guards/ Civil Defence issued instructions for reversion of all personnel of the Force who were posted for law and order duties in district units to Disaster Response Force components and utilization of Force personnel exclusively for rescue operations.

1.4.2.8 Financial Arrangements

The Disaster Management Act, 2005, states that the State Government should establish a State Disaster Mitigation Fund (SDMF) and District Disaster Mitigation Fund (DDMF) for prevention and mitigation of disasters and capacity building, planning, training and procurement of equipment, etc. as part of disaster management.

Disasters cause extensive strain on financial resources due to activities undertaken under relief, rehabilitation and reconstruction programs. In addition, activities relating to the prevention, mitigation and preparedness measures require funds. The UT Government of Jammu and Kashmir is committed to allocate funds in the long term to ensure the sustainability of disaster management activities.

The Government plans to have a budgetary allocation for the activities related to disaster management. SDMA shall explore additional sources of funding through aid, grants, loans, etc. The SDMA shall also explore means of sharing the costs associated with disaster management through risk sharing and risk transfer. Disaster Response funds shall be utilized for Rescue, Relief, Rehabilitation, and Response, etc.

1.4.2.9 Stakeholders in Disaster Risk Reduction and Management

The UT Government acknowledges the set of institutional stakeholders that play key roles in disaster risk reduction and management and call for a well laid down framework of operations under the leadership of Jammu and Kashmir State Disaster Management Authority (SDMA).

All concerned departments of the State/UT Government and Central Government agencies, present in the state/UT are: The State/UT Divisional and District Disaster Management Authorities, Local authorities such as Urban Local Bodies (ULBs), Panchayat Raj Institutions (PRIs), Fire and Emergency Services, Health and Medical Education Department, Public sector undertakings, Corporate Sector, Hoteliers and other allied organizations.

1.4.2.10 Nodal Departments

A separate department formed as Disaster Management Department in the erstwhile State/UT Secretariat that has been set up for management of all types of natural disasters that includes Hydrological, Climatological, and Geological disasters.

Department of Home is the nodal department for the management of manmade and human-induced disasters. The Department of Health & Medical Education is the nodal department for health-related disasters. Agricultural & Horticulture Department is the nodal department to deal with Pest attacks & Hailstorms. Animal & Sheep Husbandry Department is the nodal department to handle livestock epidemics. Irrigation & Flood Control (IFC) Department is assigned as the nodal department for disasters related to Floods and Dam bursts.

Public Works Department (Road and Building) is designated as the nodal department for disasters related to infrastructure damage. Forest Department is designated as the nodal department for disasters related to forest fire. Power Development Department (PDD) is designated as the nodal agency for the management of disasters related to Electric power plants, Grid networks, transmission lines, etc. Revenue Department serves as the nodal department for disasters related to avalanches and landslides, droughts, windstorms, and earthquakes. The concerned nodal department prepares its own plan for handling these disasters and mandate to regularly update the plans. The nodal department can seek assistance from any other department, agency/organization, etc. as and when it is required.

1.5 Flood Protection Measures in Kashmir

1.5.1 Historic Development of Flood Management

The flood history of the Kashmir valley goes back millennia, and several rulers have undertaken flood control programs over many centuries. Many examples of flood measures can be found throughout the history of the Kashmir valley. During the 15th century A.D., Sultan Zainul Aabideen Budshah, constructed the Mar Channel, joining Bari Nambal to the river Jhelum. In the 19th century, interior channels were constructed near Noor Bagh, mainly to divert the excess water discharged from the river Jhelum. In the early 20th century, a flood spill channel was constructed by Maharaja Pratap Singh to divert the excess flood water discharged from the river to the low-lying wetlands of Batamaloo and Hokarsar[47].

One of the major flood control work was the construction of the Flood Spill Channel (FSC) in 1903, following the major flood of 1893. The FSC was designed to carry about 500m^3/s (17,500 cusecs), but its current capacity is only about 50% of that time due to sedimentation and construction of low-level crossings[48].

Since then, several reports have been prepared including a range of suggestions. The Purves report on the hydrologic problems of Kashmir, 1915, recommended the partial diversion from the Jhelum River at Gagazu into Anchar Lake returning to the Jhelum River at Shadipora and diversion of the Pohru Nallah into Wular Lake. In 1928, Das a Divisional Engineer of Irrigation Department, suggested that the capacity of the existing FSC can be increased to 22,000 cusecs by the construction of subsidiary flood spill channel. The report even suggested the diversion

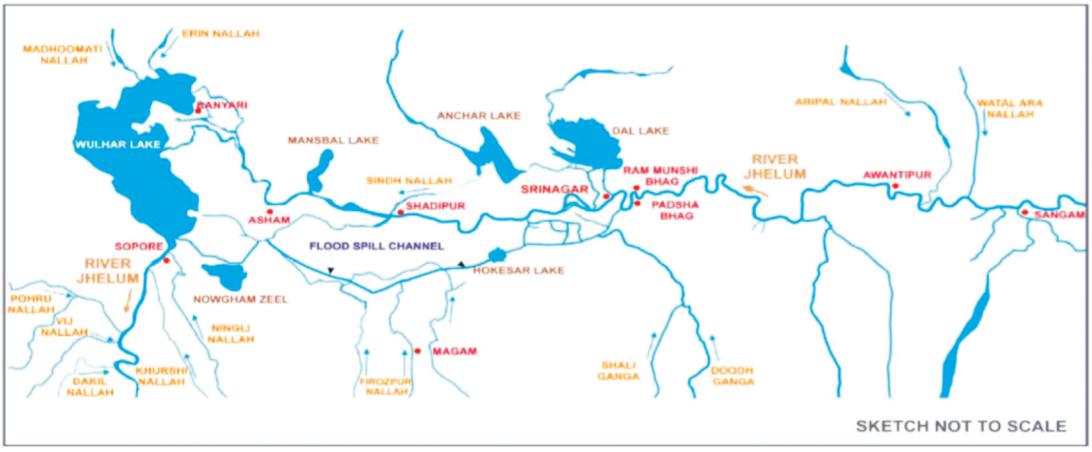
[47] Retrospective and Prospective of 2014 Floods for Building Flood Resilient Kashmir, Centre for Dialogue and Reconciliation, April 2015, University of Kashmir, https://www.cdr- india.org/retrospective_and_Prospective_of_2014_Floods_15.pdf. Retrieved on 4th October 2019.
[48] Ibid 47, P46.

of the Jhelum from Asham to Ningli, dredging and possible diversion of the Pohru Nallah, increasing the height of the river bunds through Srinagar and controlling the spill from the Jhelum River upstream of Srinagar by controlled openings in the bunds between Khanabal and Padshahi Bagh.

The Central Water and Power Commission (Central Water Commission) in 1953 recommended enlargement and excavation of the existing FSC from Padshahi Bagh to Wular Lake, along with diversion of the Ningli Nallah into the Haigum Jheel. The commission even suggested the construction of a supplementary channel from Marval about 30 km downstream of Dogripora to Padshahi Bagh and full diversion of the Pohru into the Wular Lake or into the OFC near Baramulla.

The Master Plan for Flood Control and Drainage in the Kashmir valley in 1958 recommended that the two low-lying areas on the left bank floodplain upstream of Padshahi Bagh can be used as detention basins to increase the capacity of the FSC to 566m^3/s (20,000 cusecs), to reopen the Shadipora Nallah opposite to the mouth of the Sindh Nallah and to connect it to the FSC. Diversion of the Doodh Ganga Nallah into the Narkura Nambal, the Pohru Nallah into Wular Lake, the Ningli Nallah into the Haigham Jhee and widening and deepen the OFC from Wular Lake to Khadnyar were also recommended.

Map 10: The main components of the current Jhelum River system



Source: Jhelum and Tawi Flood Recovery Project, http://jtfrp.in/reconstruction-and-strengthening-of-critical-infrastructure/, Retrieved on 16th October 2019

1.6 Early Warning System

Every type of hazard has its own dynamics. The duration of the phenomenon will vary for each hazard type and the event type. There are various stages associated with the development of the event. Broadly, the stages can be categorized as follows: Embryonic stage can be linked to the manifestation of those conditions that may give rise to these events or as the events begin to emerge; preliminary phase of the event; Growth stage is when the event gradually evolves in terms of its magnitude or area of influence; Mature stage would represent the event as being capable of provoking a disaster in a particular geographical location; mature event triggers impact and effects on communities and regions near its path; Decaying stage indicates when the event loses its strength and is dissipating. In the context of early warning, the time-lapse between the embryonic and the mature stage is determinant to the capacity of issuing warnings. If this time lapse is large enough, hierarchical phases, could be identified allowing for the establishment of several alerts or warning levels. Early warning system usually has four key components: Risk knowledge, monitoring and warning services, dissemination and communication and response capability. Various ministries and departments at the central level promote and undertake climate change related research in the country.

To improve preparedness for flash floods, the India Meteorological Department is working on a flash flood guidance system to predict flash floods up to six hours in advance and alert disaster relief forces and residents. India in 2018 has been designated as a nodal department for preparing flash-flood forecasts by the World Meteorological Organization (WMO) for other South Asian countries as well. IMD is working to customize a weather model, developed by the United States and donated to the WMO, to warn of flash floods at least six hours in advance. Using a combination of satellite mapping and ground-based observation, this system is called the Flash Flood Guidance System (FFGS). The Central Water Commission, which monitors India's dams, warns rising of water levels in the reservoirs, which are usually taken as sign of imminent floods. The organization has recently tied up with Google to develop a software to visualize rising water levels during heavy rains.

1.6.1 Early Warning Management in the UT

On the receipt of a warning or alert from any such agency which is competent to issue such warnings, or on the basis of reports from the District Collector of the occurrence of a disaster, the response structure of the erstwhile state/UT Government will be put into operation. The Secretary (Disaster Management) will be given the role of the Chief of Operations during the emergency situations. The details of agencies which are competent enough for issuing warning or alert pertaining to various types of disasters in Jammu and Kashmir are given in the table below:

Table 1.12: Agencies involved in issuing Early Warnings in Jammu and Kashmir

SL.NO.	DISASTER	NODAL AGENCIES
1.	Earthquakes	IMD, ISR, GSI
2.	Floods	IMD, Irrigation Department
3.	Windstorm/ Rains/ Cloudburst/ Heat waves/ ColdWaves	IMD, Disaster Management
4.	Avalanche	IMD, ISR, SASE
5.	Drought	Agriculture Department
6.	Epidemics	Health and Family Welfare Department
7.	Industrial and Chemical Accidents	Industry, Labour and Employment Department
8.	Fire	Fire and Emergency Services

Source: Jammu and Kashmir State Disaster Management Plan, Jammu and Kashmir State Disaster Management Authority-JKSDMA, 22nd May 2017, http://www.jksdma.org/wp-content/uploads/2017/08/Plan.pdf, Retrieved on 3rd October 2019.

The EOCs (Emergency Operation Centre) and ERCs (Emergency Response Centre) are put on full alert and expanded to include branch arrangements, with responsibilities for specific tasks, depending on the nature of the disaster and its impact. The number of branches to be activated is decided by the Chief of Operations. i.e., Secretary (Disaster Management and Relief Commissioner at the UT level and respective Deputy Commissioners / District Collectors at the District level. All line departments and nodal officers work under the overall supervision and administrative control of the Chief of Operations.

All the decisions are taken in the EOC and approved by the Chief of Operations. Immediate access to the disaster site through various means of communications such as mobiles, VSAT, wireless communication and hotline contact is established and maintained. The EOCs and ERCs in its expanded form will continue to operate as long as the need for emergency relief and operations continue and the long-term plans for rehabilitation are finalized. For managing long-term rehabilitation programmes, the responsibilities are undertaken by the respective line departments through a well-structured Rehabilitation and Reconstruction Programme.

2. Kashmir Floods of 2014

KASHMIR FLOODS OF 2014

2.1 The Disaster

During the initial week of September 2014, Jammu and Kashmir encountered one of its worst flood events in the north-western part. This calamitous event in the erstwhile state/UT is considered as one of the worst floods in the past 60 years. Unprecedented rains lasted from 2nd to 6th September 2014, added considerably to an increased run-off from the tributaries of River Jhelum.

Figure 2.1: Local residents using makeshift rafts for transportation during the flood, Srinagar

Source: Reuters India, 20th Sep 2014, https://in.reuters.com/article/india-kashmir-flood-insurance/kashmir- flood-sparks-wave-of-property-insurance-sales-idINKCN0PN1CE20150713. Retrieved on 3rd October 2019.

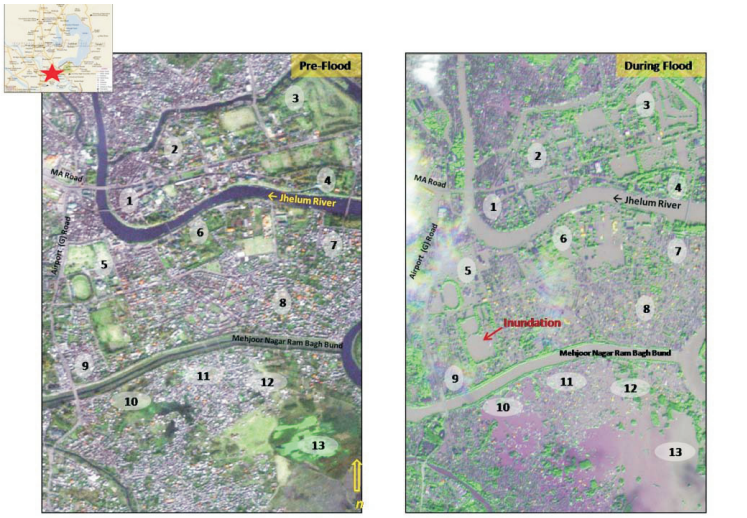
The flood affected nearly two million people and claimed over 287 human lives and caused huge damage to property, assets, economy, ecology and both social and physical infrastructure. Overall, 5.5 Lakhs population were displaced and over 6.51 lakh hectares of cropped areas were affected. Ten districts were severely affected by the floods and other associated disasters. Anantnag, Kulgam, Pulwama, Srinagar, Budgam in the Kashmir Division, and Jammu, Rajouri, Poonch, Udhampur, Reasi districts in the Jammu Division. As of 13th September 2014, a total of 1673 villages from 10 districts were affected. About 5,390 houses were fully damaged and 12,125 are partially (excluding Poonch District) in the Jammu region[49].

[49]Joint Rapid Needs Assessment Report: Jammu and Kashmir Floods 2014, https://sphereindiablog.wordpress.com/, Retrieved on 3rd October 2019.

2.1.1 Chronology of Events

On 2nd September 2014, the Indian Meteorological Department announced moderate rain with thunder showers at most of the places for the next four days. On the 3rd of September, the water levels in the river Chenab, Jhelum, Tawi, and Sind rose to a significant level prompting the government to issue a flood alert on 4th September. Major streams such as Lidder, Vaishav, Rambiara, and Ferozepur flowed above the danger mark, thus affecting hundreds of villages. On 5th September, the flash floods had already started in south Kashmir and by midnight, the western side of the state capital got flooded.

Map 11: Representing flooding progression in part of Srinagar and Umrabad



Source: Department of Ecology, Environment and Remote Sensing, Jammu and Kashmir, http://www.jkdears.com/eers/pdf/Floods%20in%20Jammu%20and%20Kashmir.pdf, Retrieved on 3rd October 2019.

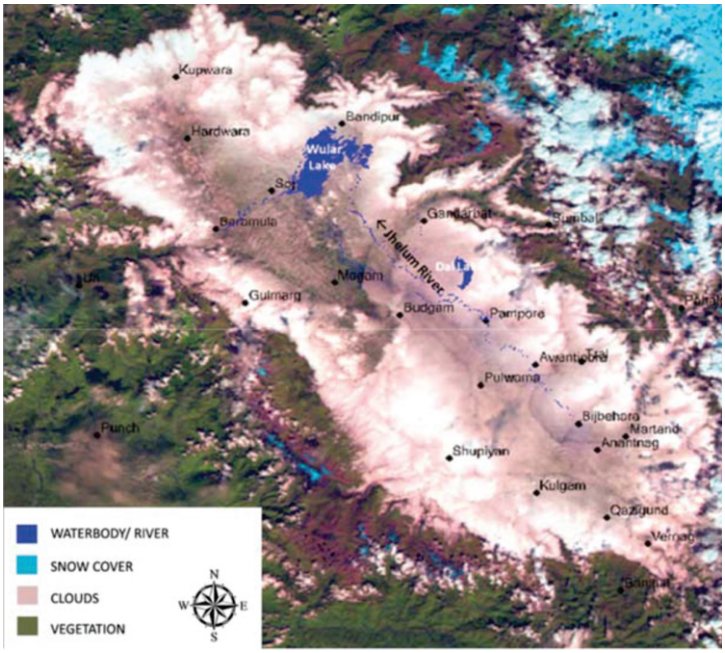
By 7th September, the entire communication and connectivity network snapped. While the flood fury in Srinagar remained the centre of attention for media and its responders, but the areas of Baramulla and Bandipora were highly neglected. Later, a devastating toll to life and property was seen as the areas were on the brink of the flood and finally was struck by the flood on the evening of 7th September. By the 19th of September, the death toll had climbed to 277 with the numbers still on the rise as bodies were still being recovered from different areas of Kashmir and many people were still missing[50]. By the 25th of September, the death toll had climbed to 285. According to other sources, the death toll had crossed 300 by the end of the month.

[50]Jammu and Kashmir Floods: Death toll climbs to 277. Indian Express, 19th September 2014, http://indianexpress.com/article/india/india-others/jk-floods-death-toll-climbs-to-277/, Retrieved on 3rd October 2019.

2.1.2 Rainfall Analysis

As per the analysis of the archived meteorological data for the last 125 years for the Srinagar city, September is the least rainy month for the valley with the mean rainfall of 26.6 mm, but the summer capital of Jammu and Kashmir recorded about 173 mm of rainfall in the first week of September crossing its 25 years record of 151.9 mm preceding the 1992 floods[51]. Some parts of the UT experienced more than 650 mm of rainfall in just three days. It was observed that South Kashmir received rainfall almost twice that of Central and North Kashmir, generating enormous surface runoff and base flow, leading to severe flooding in the basin.

Map 12: Dense cloud cover in the valley on 7th Sep 2014



Source: Satellite-based assessment of the catastrophic Jhelum floods of September 2014, Jammu and Kashmir, India, Geomatics, Natural Hazards and Risk, (2017), retrieved on 3rd October 2019. https://www.tandfonline.com/doi/full/ 10.1080/ 19475705.2016.1218943.

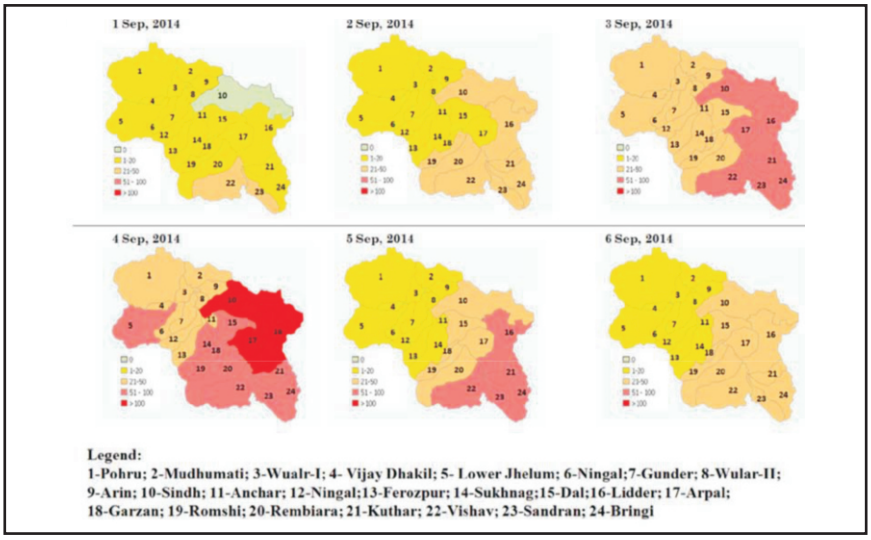
Between 1st and 6th September 2014, catchments in the southern part of the Jhelum Basin received more than 200 mm of rainfall. Most of the catchments in the central part of the basin received between 100 and 200 mm of rainfall over the same period. Catchments in the northern part received relatively less precipitation, varying between 45 and 85 mm. The

[51]Shakil A. Romshoo, Sadaff Altaf, Irfan Rashid and Reyaz Ahmad Dar (2017): Climatic, geomorphic and anthropogenic drivers of the 2014 extreme flooding in the Jhelum basin of Kashmir, India, https://www.researchgate.net/publication/322081697, Retrieved on 3rd October 2019

Indian Meteorological Department also had similar observations, showing that Jammu and Kashmir had a rainfall deficit of 308 mm as of 3rd September 2014. However, the state received 250 mm rainfall in the next three days (3-6 September 2014) to feature in the category of excess rainfall[52].

From the map below, it can be observed that on 2nd September 2014, eight catchments located in the southern and north-eastern part of the Kashmir valley received rainfall in the range of 20-50 mm. Subsequently, the rainfall increased to 50-100 mm in these eight catchments. On 4th September 2014, the catchments received more than 100 mm of rainfall[4].

Map 13: Spatial variation in rainfall for Jhelum basin between 1st and 6th September 2014



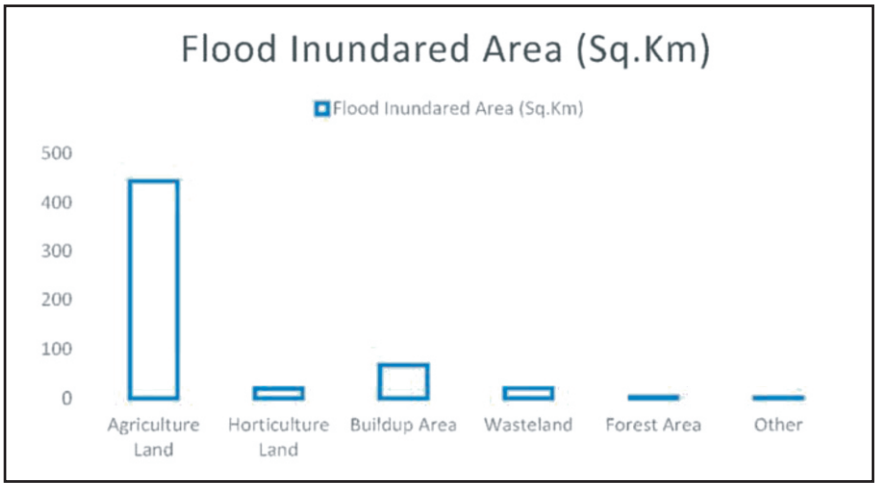
Source: Satellite-based assessment of the catastrophic Jhelum floods of September 2014, Jammu and Kashmir, India, Geomatics, Natural Hazards and Risk, 2017, https://www.tandfonline.com/doi/full/10.1080/19475705.2016.1218943, Retrieved on 3rd October 2019.

2.1.3 Flood Inundation Spatial Analysis

Map 14, shows the flood inundated areas, about 557 sq.km. area was flooded out of which about 444 sq.km of agriculture land, 20 sq.km. of horticulture land, 67 sq.km. of built-up land, 21 sq. km. of wasteland, 3 sq. km of forest area, and 2 sq.km. of remaining land were found affected.

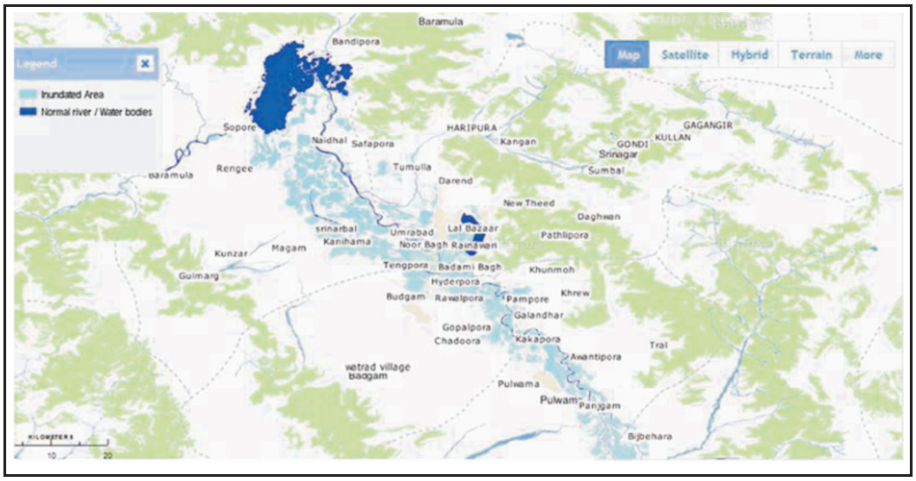
[52]Satellite-based assessment of the catastrophic Jhelum floods of September 2014, Jammu and Kashmir, India, Geomatics, Natural Hazards and Risk, 2017, https://www.tandfonline.com/doi/full/10.1080/19475705.2016.1218943, Retrieved on 3rd October 2019

Figure 2.2: Flood Inundation Area in Jammu and Kashmir, 10th September 2014



Source: Historical Floods, Disaster Management Support Service, Bhuvan, National Remote Sensing Centre, ISRO, https://bhuvan-app1.nrsc.gov.in/disaster/disaster.php˙id=flood, Retrieved on 9th October 2019.

Map 14: Flood inundated area 10th September 2014

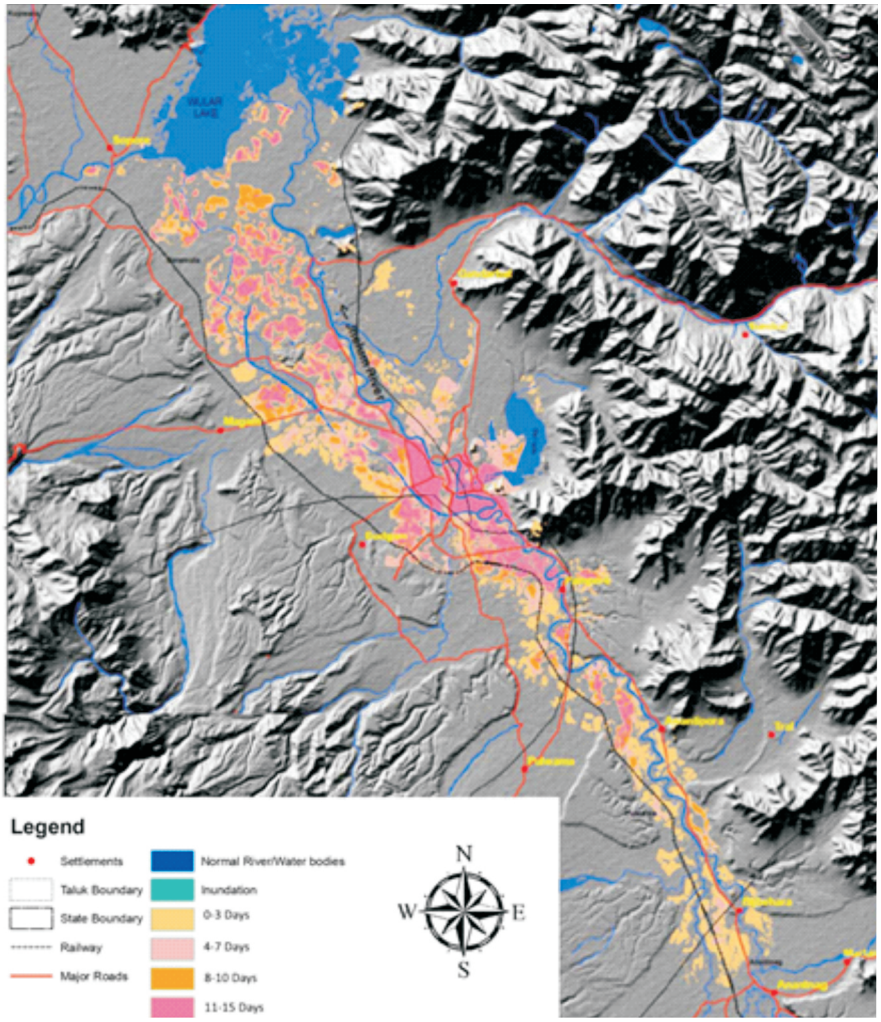


Source: Historical Floods, Disaster Management Support Service, Bhuvan, National Remote Sensing Centre, ISRO, https://bhuvan-app1.nrsc.gov.in/disaster/disaster.php˙id=flood, Retrieved on 9th October 2019.

The floodwater overflowing the banks of the Jhelum River breached its embankments at several places along the entire valley. The embankment breaches and inundation were due to the overflowing of Jhelum water along the left and right of bank in the Gandabal, Soitang, Pandrethan and Batwara areas that is captured on the high-resolution IRS Cartosat-2A image

of 9th September 2014[53]. The map 15 shows the flood persisted within the valley from 8th September to 23rd September 2014, showing most of the central part of the Kashmir valley, including Srinagar city, being flooded for almost 15 days, while the northern part inundated for more than 10 days and the southern parts for less than a week. In Srinagar, about 998 colonies in 59 wards were flooded[54].

Map 15: Flood persistence within the valley from 8th to 23rd September 2014



Source: Satellite-based assessment of the catastrophic Jhelum floods of September 2014, Jammu and Kashmir, India, Geomatic, Natural Hazards and Risk, (2014), Retrieved on 3rd October 2019. https://www.tandfonline.com/doi/full/10.1080/19475705.2016.1218943.

[53]Ibid 20, P 14.
[54]Ibid 20, P 14.

2.1.4 Hydrological Analysis

Three hydrological stations on the bank of Jhelum River had detected that the river was flowing above the danger level on 3rd September 2014. Less than 50 km upstream of Srinagar, the Sangam station, which has been operated by the Central Water Commission (CWC), indicated that the water levels had risen from 5.7m on 3rd September to about 10.13m on 4th September. Both, Ram Munshi Bagh and Safapora hydrological stations near to the capital registered an increase of 3m in the water level during the same period. The information about the abnormal rise in water level was passed on to the local administration, but they did not take this warning seriously as these CWC stations were not supposed to be flooded.

By the evening of the 6th, the Sangam station has shot up to 34.70 ft and began to spill over the river banks. The discharge of 3262 cumecs caused 84 breaches due to spill-over, eroding the outer slope of the embankments. The field survey carried out by the Irrigation and Flood Control Department revealed that, due to the floodwaters, the average width of the river in the south Kashmir region increased to about 2-3 km compared with the 'normal' width of 100-200 m. The carrying capacity of Jhelum in Srinagar city is about 35,000 cusecs and another 15,000 in the supplementary channel but on 6th September, the discharge at Sangam had recorded about 1,35,000 cusecs which were one of the highest ever recorded. The flood inflow was more than the combined carrying capacity of Jhelum and flood channel, despite the natural breaches.

2.1.5 Possible Causes of Flood

The main causes of flood disasters in the Kashmir valley are mainly due to increasing global temperature, climate change, population growth, loss of wetlands, deforestation and unrestrained land-use changes. Although heavy rainfall was the triggering factor of floods in the Kashmir valley, the impact of the disastrous event was aggravated by other factors, including the rapid urbanization in the valley, encroachment of waterbodies and land adjoining river banks, the disappearance of wetlands, etc. has blocked the natural drainage patterns making the situation worse. Extremely urbanized and mismanaged flood plains gave an impetus to the situation which attained disastrous dimensions due to prolonged and extremely heavy rainfall. The presence of railway line aligned through flood plains also made a difference in the observed inundation patterns during 2014 flooding and might be responsible for the higher levels of inundation observed in Kakapora, Nowgam, Lasjan and Srinagar City.

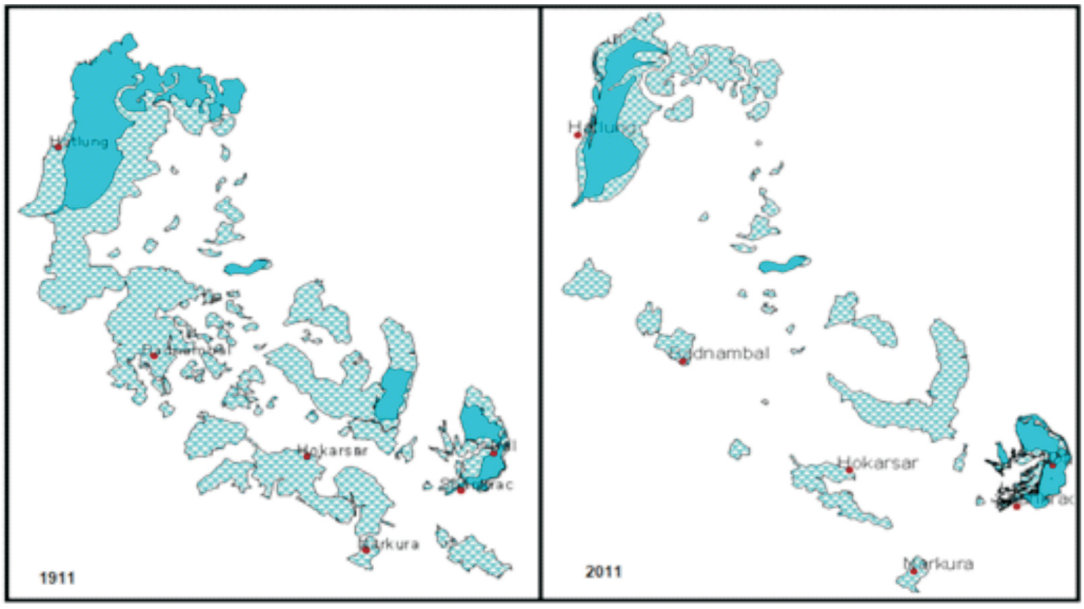
Table 2.1: Reduction in the area of water bodies and Marshy land in Kashmir valley (1911-2011)

SL.No	YEAR	CATEGORY		TOTAL AREA (Sq.Km)
		MARSHY	WATER BODY	
1.	1911	271.70	85.15	356.85
2.	2011	117.43	41.11	158.54
Loss of Spatial Extent		**154.27**	**44.04**	**198.31 (44.4%)**

Source: A Satellite Based Rapid Assessment on Floods in Jammu and Kashmir – September, 2014, National Remote Sensing Centre Indian Space Research Organization, Hyderabad-37. Retrieved on 3rd October 2019.

The Kashmir valley has a vast network of wetlands and waterways locally called 'Dembs' which acted as a natural sponge during the floods and shared the Jhelum waters. About 44.4% of the lakes and wetlands have been lost in the suburbs of Srinagar during the turn of the 21st century and has affected the micro climate of the city, besides exposing them to the incurrent floods. The wetland has receded consistently and undergone tremendous land-use change owing to siltation coupled with floods and human interference. The Hokarsar wetland has experienced fragmentation and changes in land use/land cover due to excessive siltation and biotic interference over the last four decades.

Map 16: Extent of Lakes and wetlands in Kashmir valley (1911-2011)



Source: A Satellite Based Rapid Assessment on Floods in Jammu and Kashmir – September, 2014, National Remote Sensing Centre Indian Space Research Organization, Hyderabad-37. Retrieved on 3rd October 2019.

With regard to the adjacent marshes of Wular Lake, there is a remarkable alteration and the area has got reduced by more than 41 sq.km. during the past 100 years. As per the Survey of India map 1911, the open water area of Wular Lake was 91.29 sq.km. which got reduced to 9.82 sq. km area in 1965. As per the Survey of India map of 1965 and presently the open water area of the lake is 75.23 sq.km. Similarly, the wetland areas surrounding the lake body and in the adjacent area was 66.45 sq.km. and 58.67 sq.km. respectively in 1911 out of which we have lost 54.97 sq.km. in and around the Wular Lake and 41 sq.km. in its surrounding marshes to agriculture/horticulture and plantation etc. during the past 100 years.

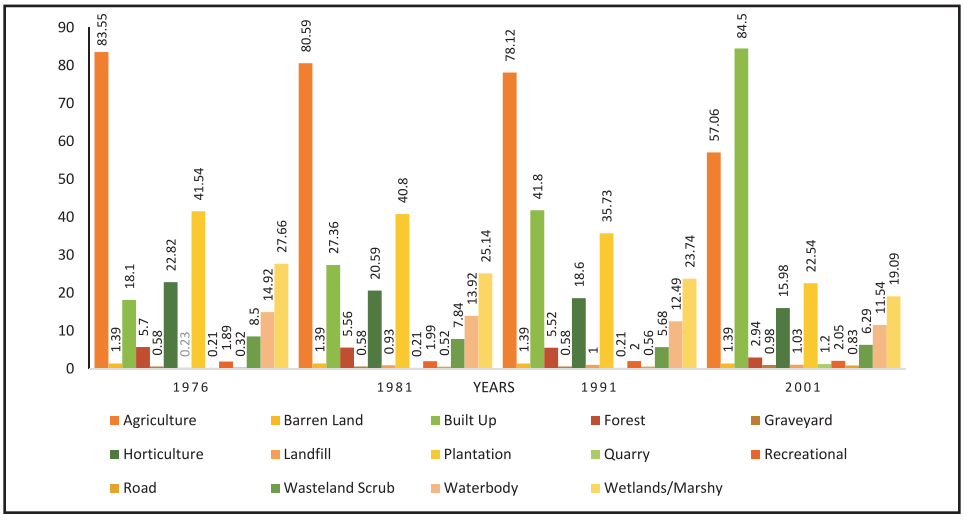
The rapid urbanization and population growth have encroached the wetlands causing a substantial reduction in their size. The build-up area within Srinagar city limits has grown from 18.10 sq.km. in 1972 to 84.50 sq.km in 2004, showing an increase of about 29.20%. This depletion and degradation of these wetlands have crippled the efficiency of the wetlands to retain the floodwaters during peak discharge of water and flash floods, thus endangering the lives and property of the Srinagar city and its suburban areas.

Table 2.2: Summarized Land use over the years and percentage change in Land use

SL.NO	Land Use (in Sq.km	YEARS				PERCENTAGE CHANGE (1976-2001)
		1976	1981	1991	2001	
		Land Use Area (in Sq.km)				
1.	Agriculture	83.55	80.59	78.12	57.06	-11.65
2.	Barren Land	1.39	1.39	1.39	1.39	0.00
3.	**Built-up**	**18.10**	**27.36**	**41.80**	**84.50**	**29.20**
4.	Forest	5.70	5.56	5.52	2.94	-1.21
5.	Graveyard	0.58	0.58	0.58	0.98	0.18
6.	Horticulture	22.82	20.59	18.60	15.98	-3.01
7.	Landfill	0.23	0.93	1.00	1.03	0.35
8.	Plantation	41.56	40.80	35.73	22.54	-8.35
9.	Quarry	0.21	0.21	0.21	1.20	0.44
10.	Recreational	1.89	1.99	2.00	2.05	0.07
11.	Road	0.32	0.52	0.56	0.83	0.22
12.	Wasteland Scrub	8.50	7.84	5.68	6.29	-0.97
13.	Waterbody	14.92	13.92	12.49	11.54	-1.49
14.	Wetland/Marshy	27.66	25.14	23.74	19.09	-3.77

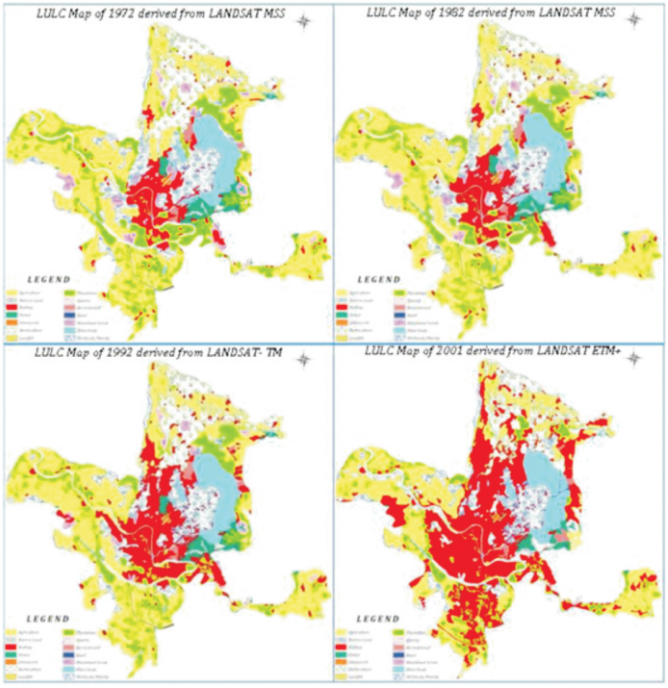
Source: A Satellite Based Rapid Assessment on Floods in Jammu and Kashmir - September, 2014, National Remote Sensing Centre Indian Space Research Organization, Hyderabad-37. Retrieved on 3rd October 2019.

Figure 2.3: Variation in Land Use Pattern in Srinagar City (1976-2001)



Source: - A Satellite Based Rapid Assessment on Floods in Jammu and Kashmir – September, 2014, National Remote Sensing Centre Indian Space Research Organization, Hyderabad-37. Retrieved on 3rd October 2019.

Figure 2.4: Land use/Land cover changes in Srinagar City (1972-2001)



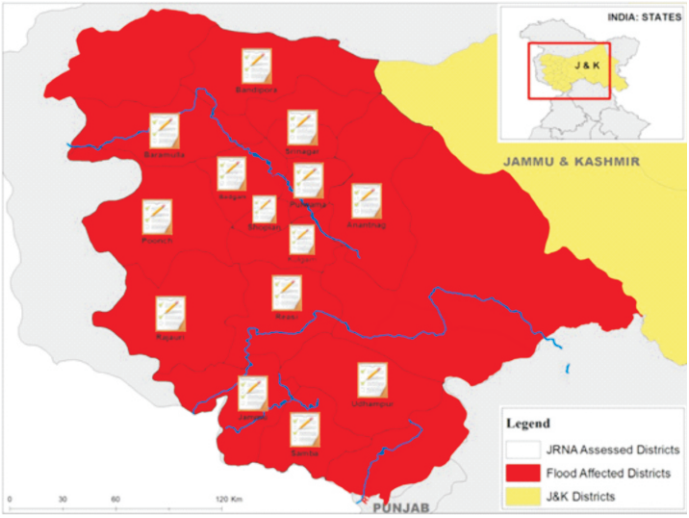
Source: A Satellite Based Rapid Assessment on Floods in Jammu and Kashmir – September, 2014, National Remote Sensing Centre Indian Space Research Organization, Hyderabad-37. Retrieved on 3rd October 2019.

2.2 Impact/ Effects of the Disaster

2.2.1 Joint Rapid Needs Assessment

The Joint Rapid Needs Assessment (JRNA) of the flood was carried out between 9th September to 21st September, 2014. The JRNA was initiated with 10 teams, deployed in the Kashmir division and 6 teams in the Jammu division covering 108 villages in 16 districts. The team reported that 86% of the wards were affected and major damages were to shelter, water and sanitation facilities, agriculture land and education.

Map 17: JRNA Assessed Districts Jammu and Kashmir, India (September, 2014)



Source: Sphere India, https://sphereindiablog.wordpress.com/, Retrieved on 22nd October 2019.

Table 2.3: Impact of Flood Data at a glance (Flood 2014)

S.N.	ISSUES	IMPACT
1.	Population Affected: Communication, Accessibility, Availability of Supplies, Agriculture, Livestock, Assets Losses	10,136,063 out of which 8,186,273 indirectly affected and 1,949,790 directly affected (tangible and intangible)
2.	Direct loss of household assets, livelihood, Psychosocial	14,06,311
3.	Houses fully damaged	67,934+
4.	Houses partially damaged	66,220+
5.	Population displaced by flooding and shelter damage	543,379+
6.	Houses un-inhabitable	121,124+
7.	Deaths	280+
8.	Persons injured/ sick	53,082+
9.	Evacuated	226,000+

Source: Joint Rapid Needs Assessment Report: Jammu and Kashmir Floods 2014, Retrieved on 22nd October 2019., https://sphereindiablog.wordpress.com/

According to the Joint Rapid Needs Assessment report, around 1.01 crore population were affected out of which 81,86,273 were indirectly affected and 19,49,790 were directly affected including both tangible and intangible loss. More than 280 were reported dead and around 53,082 people were injured. About 14 lakh people had lost household assets and livelihood. About more than 67 thousand houses were fully damaged and more than 66 thousand were partially damaged.

2.2.2 Food Security and Livelihood

The agriculture sector suffered a huge loss impacting the livelihood of the people depending on this sector. According to the reports, severe damage to vegetable and maize crops was recorded, hence reducing the yield of the crops. Potential loss of seeds, tools, supply routes and transportation networks have been severely affected, hence leading to a reduction in the availability of food stocks and increase in prices.

The flooding had a major impact on the food stocks. The erstwhile state/UT saw a decrease in food consumption after the floods since the water logging has damaged the dry rationed and most of the household assets washed away. The marginalized community survives by buying and cooking food daily, maintaining limited storage of food supplies hence will be severely affected especially during the coming winter months. Only about 8.3% of the market were in functioning; out of which most of them were running out of stock which also increased the cost of food items tremendously. Flooding has also contributed to huge loss of livestock, 43% of the total livestock were lost in the Kashmir division. In the Jammu division, around 730 livestock were reported to death.

According to an estimate three lakh migrant labourers come to Kashmir every year to earn livelihood. Many of the migrant workers, were reported to have left the Kashmir valley during the flooding. The shortage of labourers has resulted in a nearly 30 to 50% hike in the daily wages of skilled and unskilled labourers. While the skilled labourers hiked their daily wage rates from Rs 400 to Rs 600, the unskilled labourers have increased it from Rs 330 per day to Rs 420 per day.

Table 2.4: Impact caused by the floods on food security and livelihood

SL.NO	ISSUES	FINDINGS
1.	Stocks severely destroyed	82.3%
2.	Decrease of food consumption after floods in Kashmir	86%
3.	Food consumption level decreased after the floods in 5 districts.	100%
4.	Completely destroyed in the floods	17,426 acres of land
5.	Paddy to be one of the most important crops in 68 villages	57%
6.	Cost of food has increased tremendously	62.7%

SL.NO	ISSUES	FINDINGS
7.	Markets functioning in the village and markets running out of stock	8.3% and 81.5 %
8.	Loss of livestock	43% in Kashmir and 7% in Jammu
9.	Availability of fodder adversely affected	74% in Kashmir and 55% in Jammu

Source: Joint Rapid Needs Assessment Report: Jammu and Kashmir Floods 2014, Retrieved on 22nd October 2019. https://sphereindiablog.wordpress.com/,

2.2.3 Water Sanitation and Hygiene (WASH)

The majority of the water sources were inundated and mostly contaminated. Water supply through tube well, piped water supply, and open wells have been adversely damaged forcing the affected population to depend on ponds, open water bodies and few tube wells as their primary source of water. Even the toilet facilities were damaged in all the villages. Community latrine and open defecation were being practiced in few of the villages. Though the floodwater receded, waterlogging was seen for more than a week in the low-level areas, hence the chance of water contamination became very high. Overflow of pit latrines and sanitation practices continued to put communities at risk. Once the water started receding, government sources also indicated that groundwater was contaminated which requires treatment for continue water supply.

Table 2.5: Findings of the Impact caused by the floods on WASH

SL.NO.	ISSUES	IMPACT
1.	Water source damaged	53%
2.	Before the flood, villages with piped water as the primary source of water	63%
3.	After the flood the availability of water was	13% of villages use wells, 29% ponds, 30% tube-wells, and 12% other sources.
4.	Damaged sanitation facilities	85%
5.	Primarily practicing open defecation	59%

Source: Joint Rapid Needs Assessment Report: Jammu and Kashmir Floods 2014, Retrieved on 22nd October 2019. https://sphereindiablog.wordpress.com/,

Due to the severity of the floods, carcasses of animals marooned by the floodwaters and polluted most of the sources of drinking water. In addition to that, poor hygiene and sanitation, lack of medical supplies, lack of drinking water and defunct hospitals added to the possibility of epidemics spreading in the aftermath of the flood event.

2.2.4 Health

Overall, around 102 institutions of the Directorate of Health Services, in Kashmir division across all the categories were affected, among them major hospitals like the District Hospital

Anantnag, Gousia Hospital Srinagar, SDH Magam, SDH Bijbehara, CHC Zainpora, PHC's at Palpora, Kralpora, Batmaloo, Lasjan, and Samboora were affected. Excluding the Gousia Hospital Srinagar and SDH Magam, all District Hospitals and Sub-district Hospitals remained functional as a result of the instructions that were issued to District and Block level officers on 3rd September which included keeping the staff stationed at their respective places of posting.

Out of the five major hospitals located in Srinagar, four of them were shut down due to the flooding. Government Medical College Srinagar was inundated by flood waters and remained same for nearly three weeks. Shri Maharaja Hari Singh hospital, one of the largest premier hospitals in Jammu and Kashmir was completely defunct for over two weeks as the hospital beds, medical and diagnostic equipment, hospital transport were all rendered useless due to the floodwater.

The Lalla Ded Maternity Hospital, GB Pant Hospital, Bone and Joint Hospital, and SKIMS Medical College, were all severely affected by the floodwater and were forced to shut down. Most of the diagnostic and laboratory equipment along with other basic infrastructure were destroyed in the floods. There was a huge shortage of medical supplies in hospitals[55].

Table 2.6: Findings of the Impact caused by the floods on the Health Sector

SL.NO.	ISSUES	IMPACT
1.	Death of neonates before reaching to hospitals	20%
2.	District Hospital overloaded	From 10 delivery per day to 100 deliveries per day
3.	Status of GB Pant Hospital, the flood waters, which stayed on for 10 days:	Damaged key equipment, especially ventilators, radian warmers, incubators and oxygen concentrator. Disruption of electricity led to failure of most systems

Source: Joint Rapid Needs Assessment Report: Jammu and Kashmir Floods 2014, Retrieved on 22nd October 2019. https://sphereindiablog.wordpress.com/,

There was a risk of the outbreak of waterborne disease due to the shortage of safe drinking water. So, significant impacts on access to medical facilities and operation of facilities were seen. Affected people were suffering from injuries including lacerations, broken limbs, water inhalation and ingestion. Overcrowding in displacement camps led to an increased risk of transmission of communicable diseases.

As the flood was unprecedented and this was the worst flooding experienced by the region in many decades, the population was under a state of shock. Many needed psychosocial support. In Srinagar, most hospitals were inundated. Doctors were in urgent need of more medicines and equipment to cater to the patients, who were even being treated on the floor because of lack of enough beds.

[55]Epic Tragedy: Jammu & Kashmir Floods: A Clarion Call, Tabish and Nabil, Emerg Med (Los Angel) 2015, https://www.longdom.org/open-access/epic-tragedy-jammu-and-kashmir-floods-a-clarion-call-2165- 7548.1000233.pdf, Retrieved on 3rd October 2019.

2.2.5 Education

The floods had adversely affected the education infrastructure in almost all flood-ravaged districts. The deluge had destroyed the school building while others have been partially damaged, rendering them unfit for schooling. The majority of the schools were used as relief camps with temporary shelters and community kitchens being set up within the school premise.

Out of 11,526 primary and middle school buildings, 1,986 had collapsed while 2,685 were partially damaged. As per the departmental survey, 2,397 students enrolled in different primary and middle schools were left without schools. Around 1,500 private schools had also reported heavy loss to infrastructure[8]. The school remain affected for a period of upto three months even after flood. Table 2.7 provides a brief outline of the schools damaged due to the floods in 2014.

Table 2.7: Number of schools damaged due to the Kashmir floods 2014

S. No.	District	Number of schools damaged		Period for which schooling remained affected
		Fully	Partially	
1	Baramulla	46	8	-
2	Srinagar	0	24	1 month
3	Kulgam	1	116	1 month
4	Anantnag	0	17	1 month
5	Budgam	18	31	3 months
6	Ganderbal	1	13	-
7	Pulwama	11	15	10 days
8	Bandipora	0	31	1 month
9	Kupwara	12	57	2 weeks
10	Shopian	5	0	20 days

Source: Directorate of Education, Kashmir

Figure 2.5: A damaged government boys high secondary school, Batamaloo, Srinagar

Source: Author (A.A.K.).

2.3 Security and Protection

Incidents of the breakdown of law and order were reported in Bandipora and Baramulla villages, where violence between the locals and the migrant groups were reported in 3 villages. Gender violence was common after the flood, with huge risks of human trafficking. Vulnerable groups such as women headed households, elderly, persons with disability, were severely affected. In the relief camps, there were limited privacy for women and children. The forced relocation of the affected communities was reported in few villages. Loss of legal documents created havoc among the affected community as it hampers their recovery process[56].

2.3.1 Impact on Housing

The housing sector in Kashmir has suffered losses of over Rs. 30,000 crores. More than 3,50,000 structures, mostly residential houses were damaged in the floods. Out of which more than 83,000 'concrete' houses were fully damaged while 96,089 such houses were partial damaged. Similarly, 21,162 'kuccha' houses were damaged while 54,264 such houses were partially damaged[57].

[56]Joint Rapid Needs Assessment Report: Jammu and Kashmir Floods 2014, https://sphereindiablog.wordpress.com/, Retrieved on 22nd October 2019.
[57]Ibid 54, P 62

Figure 2.6: Damaged house on Dal Lake

Source: Author (A.A.K.).

2.4 Emergency Management (Rescue and Relief)

2.4.1 Rescue Operations

The Indian Military deployed around 30,000 troops along with 224 BAUT (Boat Assault Universal Type) for rescue and relief operations conducted in the erstwhile state. Two MARCOS teams of the Indian Navy and a team of deep divers were also deployed who were actively involved in rescue operations at Watlab, Widipura and Tankpura. About 22,428 stranded passengers airlifted and 7406 people were evacuated from Srinagar. 15 Engineer Task Force were also deployed with necessary engineer equipment.

By 12th September 2014, around 90,155 persons were rescued, out of which around 72,050 were rescued by the Indian Army. The Indian Air Force and the Navy rescued around 17,105 and 1,000 respectively. The Indian Air Force had also deployed about 64 helicopters and 34 Transport aircraft for the rescue and relief operation on 12th September 2014. The Army Air division had also deployed around 16 helicopters for the rescue operations. About 1379 sorties had been carried out by IAF on 11th September 2014 and were increased to 2633 sorties, dropping about 3887 tons of relief materials on 15th September[58]. The Indian Army assisted around 12,000 people through its search and rescue operations.

[58]Press Release, Ministry of Defense Press Information Bureau, Government of India, https://pib.gov.in/newsite/archiveReleases.aspx, Retrieved on 3rd October 2019Ibid 11

National Disaster Response Force (NDRF) deployed around 22 teams, which consist of 955 personnel along with 148 boats for the operation for rescuing the trapped people. As of 12th September 2014, more than 36101 persons were rescued and retrieved 14 dead bodies. Around 25 ton of relief materials were distributed at Karan Nagar, Charsu, Begumpura, and Awantipora. As of 15th September, over 2,37,000 persons were rescued by the Armed Forces and NDRF from different parts of the Jammu and Kashmir[59].

Figure 2.7: Patrol boats were used for providing humanitarian relief

Source: Author (A.A.K.).

2.4.2 Relief Operations

Indian Army established 6 relief camps in Kashmir valley (BB Cantt, Awantipora, Old Airfield, Sumbal, Chattargam, Jijamata Mandir) and 13 camps in the Jammu division. Relief camps were organized at different places and various provision of relief materials were distributed. 55 essential commodities including food packets were airdropped. As of 12th September, around 8,200 blankets, 704 tents and 320 Red Cross tents were distributed by the Army.

[59] Ibid 55 P 60

About 533 tons of ready-made food, 298 tons of water, 31,500 food packets, 2.6 tons of biscuits, 1400 pouches of extra shelf-life milk of 500 milliliters, 5 metric tons of skimmed milk powder, 7 tons of baby food etc. were also delivered.

Figure 2.8: Signage directing affected persons, September 2014

Source: Dr. Amir Ali Khan, Assistant Professor, NIDM, Ministry of Home Affairs, Retrieved on 30th October 2019.

As the floodwater started receding, the demand for filtered water started increasing, around twenty RO plants with a filter capacity of 4 lakh liter per day from Hyderabad and four RO plants from Delhi with a filter capacity of 1 lakh liter per day were transported to Srinagar. Thirteen tons of water purifying tablets and six water filtration plants with a filter capacity of 1.2 lakh bottles per day were also provided. Heavy-duty suction pumps were also airlifted from Jodhpur and Raipur. Sewage pumps from Delhi were dispatched to the valley. Thirty generator sets of 3 to 5 KVA capacity were also sent to Srinagar to augment the continuous power supply in relief camps and field hospitals.

2.4.3 Medical Help

The Indian Army deployed 80 medical teams for providing medical aid to the affected people. Four Army Field Hospitals were established in Awantipora, Pattan, Anantnag and Old Airport Road, for providing medical aid to the ailing people. By the 12th of September, they had treated around 75,254 patients. Two additional fully-equipped field hospitals, with a laboratory testing equipment facility, were established in Srinagar. One rapid action medical team from the Air Force was deployed in the valley, for providing medical aid to 2,684 patients.

A team of Special DGHS, Additional Secretary, Joint Secretary and Additional DDG Director (EMR) of the Ministry of Health and Family Welfare were deployed to Srinagar. Two Public Health Teams were positioned on 8th September 2014, in Jammu and Srinagar for Rapid Health Assessment and to prevent and control public health exigencies. Another 20 doctors were sent to Srinagar to provide medical relief. A clinical team of 29 members comprising of Physicians, Pediatricians and Gynecologists from Central Government hospitals (Dr. RML Hospital, Safdarjung Hospital and Lady Harding Medical College) were posted in Kashmir on 11th September, 2014 and were involved in providing specialized care in the District hospitals of Anantnag, Phulwama, Kulgam, Shopian, Badgam, and Bandipur. A group of 20 specialist doctors from Delhi Medical Association volunteered to serve the flood affected areas of Jammu and Kashmir.

2 Psychosocial teams from the National Institute of Mental Health and Neuro Sciences (NIMHANS) Bangalore, were deployed for conducting Psychosocial Need Assessment. Around 23 medicines were requested by the Government, out of which 5 medicines have been supplied in full, 13 medicines were supplied in partial and the remaining 5 drugs were procured by the Ministry of Health and Family Welfare. About 80 tons of specified drug and non-drug items of medical supplies were delivered to the erstwhile state. Around 60 lakh chlorine tablets, 5600 kg of ORS, 150,000 tablets of doxycycline, 65,800 bottles of paracetamol syrup, and 72,000 ranitidine injections were provided. Two large water purification units, each having a capacity of 40,000 liters of water per day, were provided by the Indian Red Cross Society. One lakh doses of Measles vaccine for Srinagar and fifty thousand doses of Measles vaccine for Jammu was transported on 16th September 2014. 25 metric tons of Bleaching Powder were also mobilized to Jammu.

2.4.4 Telecommunication

The Kashmir valley faced a communication blackout during the initial period of the flooding. By 7th September, BSNL communication connectivity was partially restored in the erstwhile state. As of 11th September, 373 sites had been restored by various operators. As a result of this Ompura, New Railway Station, Hajam Mohalla, Humhama, Ganai mohalla, Eidgah, RTC camp, Barzulla, Noorani Colony, Peerbagh Rangreth entire, Wanbal, Sanat Nagar, Parray Pura, Old Airport Road, Rangrt, Budgam Railway Station area were covered. Coverage was also available at the Airport relief camp and Gurudwara Relief Camp. AIRCEL network was already working partially. For restoring 2G connection AIRCEL, a 250 KVA generator was airlifted by IAF. 130 handheld radio sets, 14 INMARSAT and one Exchange (ex-Leh) were provided by the Army for rescue and relief operations. NDRF had also deployed 26 INMARSAT phones for communication. 9 STD Booths were established, 3 in base camps and 6 in relief camps.

2.4.5 Power and Fuel

Three transmission lines were severely damaged, out of which two were restored by 13th September, and the remaining one was restored after two months. The electrical supply distribution network was also severely affected and took long time, manpower, and capital to

restore it to normal condition. There was an adequate stock of diesel and ATF fuel at Srinagar which enabled the relief and rescue operation to be done more efficiently. The city of Srinagar faced a shortage of LPG cylinders, an additional supply of LPG was needed which was supplied from Leh.

2.4.6 Connectivity and Accessibility

Restoration of communication was an urgent task. Five task forces comprising 5700 personnel from the Border Roads Organization, were deployed in Srinagar, Rajouri, and Akhnoor districts. As of 10th of September 2014, the connectivity from Srinagar to Sonamarg was reopened for all, while connectivity between Srinagar and Baramulla, the road was only opened for light motor vehicles. Jammu to Poonch road was also cleared for traffic and the restoration work for the road connectivity between Batote and Kishtwar- Sinthan Pass was restored. As of 11th September, BRO personnel cleared up to 172 km. of road, reaching up to Ramsu in the Jammu Srinagar Highway.

The Jammu Srinagar National Highway (NH-1A), was reopened for traffic on 15th September, by the sustained efforts of the Border Roads Organization and Army Engineers. The major impediment to open the National Highway was a massive landslide at Ramsoo near Ramban, where over 300 meters of the road had been entirely washed away, leaving a sheer cliff of 80 degrees slope. Undeterred, the engineers worked day and night to make a new passage through the mountain slope. This led to the crossing of more than 150 stranded vehicles that moved from Banihal to Jammu. Srinagar to Baramulla train route was also cleared. The army, on 16th September, restored communication between Rajouri and Budhal by constructing a 180 feet bailey bridge over Ans river at Kot Ranka. Heavy road construction equipment used included 400 bulldozers, excavators and JCBs, and 300 tippers and dumpers, to restore and repair roads damaged in over 1000 places.

2.4.7 Airlifting of Stranded People

To monitor the relief work, the Civil Aviation Ministry had established a control room in Srinagar. By the 17th of September, around 35,014 passengers had been lifted by airlines, 114 tons of relief material were transported including medicine and food materials, 500 portable mobile chargers were delivered and three free of cost STD booths were also established. The Civil Aviation Ministry also provides 24 hours DG sets for uninterrupted power backup, along with providing night shelter facilities to passengers, provision of storage of relief aid materials, free landing and parking facilities to airlines and ensured full functional aids at airports. Air India also stationed two aircraft, especially to lift the passengers and patients free of cost. All private airlines were requested to assist in relief work by providing possible assistance in form of operating special flights for stranded pilgrims, sick and injured, requiring immediate medical attention. Air India deployed some of its doctors in flood-affected areas for providing all possible assistance to the victims. No cancellation charges were charged from the pilgrims and arrangement for transporting food packets and medicines from different parts of the country to Srinagar was made, free of cost. Airport Authority had also established help desks at Srinagar and Jammu airports. AAI under its

corporate social responsibility provided portable mobile chargers to the relief personnel of Jammu and Kashmir in coordination with the erstwhile State Government.

The staff of the Ministry of Civil Aviation had contributed their one-day salary to Prime Ministers Relief Fund. The contribution of AAI was about Rs. 3 crores. With the efforts of the Airport Authority, all flight operations from Srinagar Airports, Jammu and Kashmir, and Leh airports were back to normal despite adverse conditions in the region. Ministry officials were in constant touch with state machinery for providing all possible assistance. Additional flights were arranged for the evacuation of flood victims in Leh most of them were children.

2.4.8 Food Corporation of India (FCI)

FSD Srinagar was seriously affected by the floods, making the depot inaccessible for the concerned officials. FCI ensured the release of food grains to the erstwhile state Government as per their requirement without advance payment, on a top priority basis.

2.4.9 Financial Help

The erstwhile state Government had an amount of Rs. 1105.6 crores available in their SDRF, for meeting the expenditure for rescue and relief works. The Prime Minister also had announced additional special project assistance of Rs. 1000.0 crores by the Union Government to the erstwhile state for flood relief and rehabilitation.

The Prime Minister had announced ex-gratia assistance of Rs. 2.0 lakh each to the next of kin of the deceased and Rs. 50 thousand each to the person who is grievously injured from the Prime Minister Relief Fund. Rs. 865.29 crore were released by the Ministry of Finance to erstwhile State Governement of Jammu and Kashmir on 11th September 2014, out of which Rs. 344.10 crore were allotted from Special Central Assistance, Rs. 174.60 crore for non-plan deficit and Rs. 346.59 crore for the Devolution of taxes. The Ministry of Drinking Water and Sanitation (Ministry of Jal Sakti) had allotted around Rs. 252.51 crore to Jammu and Kashmir which was made available under central share from NRDWP Programme.

2.4.10 Information on Missing Persons

The information system for missing persons was started on the lines similar to Uttarakhand disaster of 2013. For these purposes, senior officials from Uttarakhand Government along with the NIC team were deployed to make the system operational on 10th September 2014.

2.4.11 Coordination among Stakeholders

The Home Minister visited the UT of Jammu & Kashmir (erstwhile state) on 6th September 2014 and made an on-the-spot review of rescue and relief measures. The Prime Minister visited the erstwhile state on 7th September 2014 and reviewed the progress with the Chief Minister on regular basis. The National Crisis Management Committee had been reviewing the situation in the erstwhile state on day-to-day basis from 6th-12th September 2014 along with representatives of erstwhile state Government. A team of senior officials including Joint Secretary (DM), MHA were camping at Srinagar since 8th September 2014, to assist the erstwhile state Government. The Home Secretary was stationed at Srinagar since 11th September 2014, for reviewing the flood rescue and relief works.

3. Post Flood Recovery and Rehabilitation

POST FLOOD RECOVERY AND REHABILITATION

Post-disaster rehabilitation and recovery encompass support strategies that are geared towards the restoration of human-centered services and infrastructure, as well as the restoration of the physical and ecological integrity of the affected ecosystem. Proper assessments of damage and the determination of appropriate rehabilitation and recovery measures are the best ways to mitigate the effects of disasters and enable communities to be better prepared to deal with future similar events.

After the severe impact of floods affecting 10 districts of the UT of Jammu & Kashmir (erstwhile state) the consequences are, of course the most obvious and immediate, loss of life, property and infrastructure. The more long term and difficult outcome increased vulnerability to elements, loss of livelihoods, increased poverty, economic recession, malnutrition, enhanced social disparities and strife. The Indian State Government and Central Government along with other stakeholders as well as the international community were quick to respond to the crisis that followed this disaster. Devoting massive financial and human resources, many long term recovery initiatives have been started in the UT of Jammu & Kashmir (erstwhile state). This chapter is a compilation of such initiatives that capture the many facets of Kashmir's complex long term recovery process to "Build Back Better".

3.1 Post-disaster Initiatives taken by the UT of Jammu & Kashmir (erstwhile State) Government

There were several immediate to long term measures taken by the Government after the flood impact. The initiatives however lacked a good assessment of damages which unfortunately were completed in only three out of the six test-checked districts while Need Assessment had not been conducted in six districts. This resulted in partial or inaccurate damage assessment as well as consequential delays in arranging materials and procurement of supplies that adversely impacted the provision of timely assistance to the affected persons.

Table 3.1: Assessment of Damages and Need Assessment in Six Test-checked Districts

DISTRICT	ASSESSMENT OF DAMAGES	NEED ASSESSMENT	STATUS OF DISBURSEMENT OF RELIEF
Srinagar	Inaccurate assessment of casualties and damaged houses. Non-assessment of losses to livestock, crops and agricultural land	Not conducted	40 deaths declared and relief sanctioned. 20 death cases pending finalization.
			Initial assessment (October 2014) of damage to 40,678 houses was increased (January 2015) to 76,045 houses which was further increased (March 2015) to 92,289 and 96,579 (October 2015).

DISTRICT	ASSESSMENT OF DAMAGES	NEED ASSESSMENT	STATUS OF DISBURSEMENT OF RELIEF
Anantnag	Inaccurate assessment of casualties and damaged houses. Non-assessment of losses to livestock, crops and agricultural land	Not conducted	Initial assessment (October 2014) of damage to 11,874 houses which was increased to 16,933 (March 2015) and further increased to 21,053 (November 2015) houses.
Budgam	Inaccurate assessment of casualties and damaged houses. Non-assessment of losses to livestock, crops and agricultural land	Not conducted	Initial assessment (October 2014) of damage to 16,651 houses which was increased (December 2014) to 18,439 and further increased (October 2015) to 18,545.
Jammu	conducted	Not conducted	-
Poonch	conducted	Not conducted	-
Udhampur	conducted	Not conducted	-

Source: Performance Audit of Disaster Management in the State of Jammu and Kashmir, 31 March 2016, Comptroller and Auditor General of India, https://cag.gov.in/content/report-no4-2016-performance-audit- disaster-management-state-jammu-and-kashmir-government, Retrieved on 16th October 2019

3.1.1 Evacuation Plan and Relief Camps/ Centres

According to the Disaster Management Act, 2005, the SDMP need to prepare an evacuation plan and identification of relief centres /camps by the district authorities. It is noticed that none of the affected districts had formulated evacuation plans in case of any disaster. No evacuation/relief centres/camps prior to flood had been installed in any of the flood affected districts. In the absence of a response and evacuation plan, rescue, evacuation and relief were managed in an ad hoc manner and with minimal controls.

3.1.2 Temporary Shelters

The erstwhile State Government authorized the Jammu and Kashmir Industries Limited (JKI) for procurement of tents for providing temporary shelters to the families whose houses were fully damaged. JKI procured about a total of 20,345 tents at a cost of Rs. 13.26 crore. They also procured about a total of 50,000 blankets of approved specification at a rate of Rs. 290 per blanket from two firms. Of these, 36,000 blankets were issued to the Additional DC Srinagar during September 2014 and 14,000 blankets were issued to Rajouri, Poonch, Udhampur, Reasi and Jammu districts during October 2014. Additional 19,105 blankets valuing Rs. 0.50 crore were also procured by the erstwhile State Government.

Figure 3.1: Temporary camp setup in Srinagar.

Source: Author (A.A.K.).

3.1.3 Gratuitous Assistance

Guidelines for operation of SDRF envisage payment of gratuitous relief of Rs. 1,300 per family for the loss of clothing and Rs. 1,400 for the loss of utensils/household goods to families whose houses were either washed away/ inundated for more than a week or fully damaged. The gratuitous relief was to be provided within 15 days from the occurrence of a natural calamity but delays ranging up to more than six months in providing gratuitous relief in the test-checked districts.

Table 3.2: Delay in providing Gratuitous Relief

District	Total cases	Within prescribed period of 15 days	Period of payment			
			15-30 days	one to three months	three to six months	More than six months
Srinagar	96,622	-	-	76,083	16,246	4,293
Anantnag	21,053	-	190	12,678	4,065	4,120
Budgam	18,554	-	4	18,440	110	-
Jammu	27,123	3,513	7829	14,647	1,134	-
Udhampur	8,182	1	1,865	5,491	786	39
Poonch	8,516	-	2317	5,732	467	-
Total	**180050**	**3514**	**12205**	**133071**	**22808**	**8452**

Source: Performance Audit, 31 March 2016, CAG, https://cag.gov.in/content/report-no4-2016-performance- audit-disaster-management-state-Jammu-and-Kashmir-government, Retrieved on 16th October 2019.

From above table, it can be seen that only 1.95% of the total cases registered were provided gratuitous relief within 15 days. About 75% of total cases registered, received their gratuitous relief funds only after a period of three to six months.

3.1.4 Distribution of Free Ration to Flood Affected Families

The erstwhile State Government sanctioned free ration for six months to flood affected families at the rate of 35 kgs per family per month. The Revenue Department based on information from DC, approved 4,26,640 flood affected families in the six test-checked districts. However, the District Administration subsequently communicated 7,21,275 families to Consumer Affairs & Public Distribution (CAPD) Department for free ration as detailed in table 3.3 below:

Table 3.3: Distribution of Ration in Six Test-checked Districts

District	No. of families approved by the revenue department	No. of families communicated	Excess families provided free ration
Srinagar	2,52,097	2,52,097	-
Anantnag	28,204	1,64,912	1,36,708
Budgam	91,414	1,57,538	66124
Jammu	33,763	79,562	45799
Poonch	11,504	50,339	38835
Udhampur	9,658	16,827	7169
Total	**4,26,640**	**7,21,275**	**294365**

Source: Performance Audit, 31 March 2016, CAG, https://cag.gov.in/content/report-no4-2016-performance- audit-disaster-management-state-jammu-and-kashmir-government, Retrieved on 16th October 2019.

Out of the total 11.83 Lakh quintals of rations, only 40.13% were provided within a period of three months. However, the ration distribution during the months of September and October 2014 was limited to various obvious reasons.

Table 3.4: Delay in providing ration

District	Total ration provided (In quintals)	Time taken for providing Ration			
		Provided within three months (In quintals)	Provided within six months (In quintals)	Provided within nine months (In quintals)	Ration provided after nine months (In quintals)
Srinagar	4,00,529	1,70,455	2,02,737	27,337	-
Anantnag	3,14,567	1,27,784	1,37,346	49,437	-
Budgam	2,97,867	1,14,662	1,41,844	41,361	-
Jammu	79,190	42,798	32,380	2,667	1,345
Poonch	72,932	17,020	29,082	26,830	-
Udhampur	18,200	2,238	3,349	8,714	3,899
Total	**1183285**	**474957**	**546738**	**156346**	**5244**

Source: Performance Audit, 31 March 2016, Comptroller and Auditor General of India, https://cag.gov.in/content/report-no4-2016-performance-audit-disaster-management-state-jammu-and-kashmir-government, Retrieved on 16th October 2019

3.1.5 Cleanliness and Hygiene in Srinagar City

The Government provided Rs. 2.14 crore under the SDRF to the Srinagar Municipal Corporation (SMC) for the collection of garbage and its disposal at the landfill site located at Acchan (District Srinagar) and for disposal of carcasses after the floods of September 2014. The Corporation incurred an expenditure of Rs. 1.37 crore on collection of 73,435 Metric Ton (MT) of garbage and its disposal at landfill site from 17th September 2014 to 15th November 2014.

3.1.6 Relief for Damages to Houses

According to the SOPs for disaster management, claims in respect of damage to private property (immovable) was assessed by a Committee under the Chairmanship of Additional District Development Commissioner (ADDC) along with the Assistant Commissioner (Revenue), concerned Tehsildar and Executive Engineer, PWD (R&B) as members.

Cases filed relating to fully, severely and partially damaged houses containing application of the victims, recommendations of the sarpanch, reports of the patwari, girdawar, naib-tehsildar and tehsildar, copies of First Information Report filed, and photographs of damaged houses were prepared for Poonch and Udhampur Districts. In other four districts of Jammu, Srinagar, Anantnag and Budgam districts, cases were finalized on the basis of lists prepared by the Revenue Department. Non-formulation of SOPs for categorization of fully, severely and partially damaged houses resulted in irregularities in assessment of damages to the houses such as change of status of damaged houses and assistance paid in unapproved cases.

3.1.7 Relief for Livestock and Assistance to Farmers

Assessment of livestock loss and damage to agricultural land and crops had not been conducted in any of the test-checked districts of Kashmir division even after a lapse of 18 months from the occurrence of the floods. Funds amounting to Rs. 0.84 crore was paid for the loss of 730 animals in Jammu district without verification of death of livestock by the Competent Authority.

SDRF norms envisage payment of input subsidy to small and marginal farmers who had suffered crop loss of 50% and above with cash assistance for damage to agricultural land. Rs. 4.20 crores assessed for land damage in Poonch District was not provided to affected persons as of August 2015. Rs. 1.83 crores released in March 2015 to five tehsildars for payment of assistance to the affected farmers, which was not paid to them even after lapse of five months as of August 2015. The amount was lying unutilized in the official bank accounts of the tehsildars. Assistance of Rs. 2.37 crores assessed for landowners of the Tehsil Haveli could not be provided due to the non-availability of the funds.

3.1.8 Restoration of Essential Public Utilities and Infrastructure

The Manual for Administration of SDRF envisaged payment of financial assistance for repair/restoration of specific infrastructure of immediate nature under the term 'damage to

infrastructure'. Such expenditure is normally incurred within a period of 30/45 days in plain areas and 45/60 days in hilly areas from the occurrence of the disaster.

2,035 restoration works involving an expenditure of Rs. 15.96 crores were commenced after a gap of two to four months after occurrence of the floods. Divisional authorities prepared reports of damaged infrastructure of various sectors such as Public Health Engineering (PHE), Public Works (Roads and Bridges), Power Development (Electric Maintenance and Rural Electrification) and Irrigation and Flood Control departments.

3.1.9 Restoration of Damages

Damage report prepared by the PWD (R and B) Division, Poonch, projected the requirement of 1,049.60 feet span of bailey bridges. 25 restoration works of water supply schemes were started by the Water Works Division Srinagar between 8th September and 24th December 2014 and were completed at a cost of Rs. 23.54 lakh between 10th October and 30th December 2014. The Irrigation and Flood Control Division Srinagar executed 215 temporary restoration works at a cost of Rs. 29.40 crores.

3.2 Post-Disaster Initiatives taken by the Central Government

3.2.1 Special Plan Assistance (SPA)

The Prime Minister during his visit to Srinagar on 7th September 2014 and 23rd October 2014 announced financial assistance from the GoI as well as from Prime Minister's National Relief Fund (PMNRF). It was decided to provide Rs. 2 lakh to the next of kin of the deceased and Rs. 50 thousand to each person who is grievously injured. Special project assistance of Rs 1,000 crore was made available by the Union Government to the erstwhile state for flood relief and rehabilitation under the Prime Minister's package for floods subjected to the following conditions:

- Only such projects/schemes would be taken up for restoration which would cost Rs. 10 lakh and above;
- Execution of work should be carried out after completing all codal procedures;
- All the work should be executed within the proposed amount and there shall be no cost escalation;
- Only such schemes/projects will be taken up which have not been funded under the SDRF/State Plan/CSS flexi fund or any other source.

3.2.1.1 Irrigation and Flood Control

Total 57 works sanctioned under SPA in four divisions i.e., Irrigation Division-II Jammu, Flood Control Divisions Jammu, Anantnag and Srinagar, at an estimated cost of Rs. 14.04 crores. Nine Irrigation Schemes estimated cost of around Rs. 2.06 crores in Akhnoor were sanctioned under SPA.

3.2.1.2 Roads and Bridges

Seven projects had been included in the damage report. An expenditure of Rs. 12.38 crores was incurred on these projects and five projects completed as on March 2016.

3.2.1.3 Public Health Engineering Department

Eight works were sanctioned for the Jammu district under SPA at an estimated cost of Rs. 11.49 crores. An expenditure of Rs. 7.86 crores was incurred on these works among which six works were completed as on March 2016.

3.2.1.4 Power

Out of Rs. 1,000 crores released to the erstwhile state under SPA for re-building damaged infrastructure, the erstwhile state Government sanctioned (June 2015) Rs. 178.42 crores for rebuilding of infrastructure in the Power Sector for permanent restoration of flood damaged infrastructure in Jammu and Kashmir, subject to the stipulation that: -

- The fund would be utilized as per DPR/Project Reports approved by the competent authority,
- There would be no diversion of funds from one scheme/component to another,
- The works are carried out after having photographs of the site before and after the execution and if the works/ projects are not funded from any other funds/source.

3.2.1.5 Estates Department

Expenditure of Rs. 4.95 crores were incurred (March 2016) on 14 projects of renovation of government residential quarters at Jammu and civil works at Civil Secretariat, Jammu which were not necessitated by floods.

3.2.2 Ministry of Minority Affairs

Dr. Najma Heptulla, the then Union Minister for Minority Affairs announces Rs. 120 Crores Relief and Rehabilitation Package for Jammu and Kashmir Flood Victims on 17th September 2014. Besides this special initiative, the Ministry had re-oriented its strategy for minorities in tune with the priorities of the new Government. The priorities were - Education, particularly girl education; Equal opportunities in education and employment; Livelihood and Entrepreneurial opportunities; Modernization of Madrasas; Strengthening of Waqf Boards; Augmentation of skills in traditional arts/crafts; Preservation of rich heritage of minorities and Development of inter-faith consultative mechanisms. The Ministry focused on educational empowerment with skill development. As to conserve traditional arts/crafts of the minority communities, a new scheme "USTTAD (Upgrading the Skills and Training in Traditional Arts/Crafts for Development)" had been formulated. This scheme on one hand, it will conserve the traditional arts/crafts of the country and on the other hand, it will ensure dignity of labour.

The Ministry gave focus on the skill development of minorities by giving priority to "Seekho aur Kamao (Learn and Earn)" scheme. This scheme guaranteed minimum of 75% employment of trained minority youths and out of them, 50% is from the organized sector. Ministry had sanctioned skill development training for more than 24,364 minority youths in 29 States through 51 selected expert skill development organizations. Under Multi-sectoral Development Programme (MsDP) also, which is implemented through State Governments, skill development of 1.00 lakh minority youths was targeted during 2014-15. Under MsDP, Ministry sanctioned the Skill Development training programmes for more than 95,000 minority youths during the current financial year. Under MsDP, Ministry started implementation of a new project called "Cyber Gram Yojana" to promote digital literacy of minorities. Ministry had taken an initiative to develop 100 Cyber Madrasas for digital literacy of minorities during 2014-15. Ministry had also formulated a new scheme "Hamari Dharohar", to preserve the rich heritage of minority communities of India under the overall concept of Indian culture.

To provide an avenue to the students of Madrasas for mainstream education, Ministry had formulated a new scheme "Nai Manzil" which may bridge the gap between Madrasa Education and mainstream education.

Table 3.5: Package provided by the Ministry of Minority Affairs

SL.NO	NAME OF THE SCHEME	PHYSICAL TARGET	FINANCIAL IMPLICATIONS (RS. IN CRORE)
1.	Seekho aur Kamao (For Employment of Youths)	2000	5.0
2.	Skill Training under Jan Vikas Yojana (MsDP)	1000	2.50
3.	Scholarships (Pre -Matric, Post -Matric, Merit -cum-Means)	Demand driven	30.00
4.	Concessional Finance for Setting up of Micro Enterprises Nation al Minorities Development and Finance Corporation (NMDFC)	2000	1.20
5.	Constructions of Health Centres, Govt. Schools/Madarsas, ITIs, Colleges, Polytechnics etc. under Jan Vikas Yojana (MsDP)	All eligible beneficiaries	50.00
6.	Constructions of Health Centres, Govt. Schools/Madarsas, ITIs, Colleges, Polytechnics etc. under Jan Vikas Yojana (MsDP)	Need Based	25.00
7.	Up-gradation of Skills and Training in Traditional Arts/Crafts for Development (USTTAD)	1000	2.50
8.	Bridge Courses for Madarsas Students under Nai Manzil	Need Based	1.50
	Total		**117.70**

Source: Press release, 17th September 2014, Press Information Bureau of India, https://pib.gov.in/newsite/archiveReleases.aspx, Retrieve on 12th September 2019.

3.3 Assistance from the World Bank

After the repercussion event, Government of India requested assistance from the World Bank and an emergency project was framed out named the Jhelum and Tawi Flood Recovery Project (JTFRP). The project was approved by the World Bank Board on 2nd June 2015, for reconstruction and recovery support to flood affected areas in which public infrastructure and livelihood were impacted severely. The project focused on 20 districts of Jammu and Kashmir. The project's main target was on restoring critical infrastructure using international best practices on resilient infrastructure and the planning and designing of the infrastructures based upon resilient features and contingency planning for future disaster events.

The objective of the project was to support the recovery and increase disaster resilience in Project Areas and increase the capacity of the Project Implementing Entity to respond promptly and effectively to an eligible crisis or emergency. The primary beneficiaries would be the communities in the districts that were affected by loss of public service infrastructure that will be restored and improved under this project. By strengthening disaster risk management systems and institutions, the project benefited the entire affected region.

Another key component of this project was to strengthen and reinforce existing weak and vulnerable flood control infrastructure and investing in rehabilitation/renovation of storm water pumping stations in several areas. Apart from reconstruction, the project focuses on disaster risk mitigation. It will strengthen the capacity of government entities in managing disaster risks, enhancing preparedness, and achieving resilient recovery through the preparation of a Hydro-Meteorological Resilience Action Plan with a focus on extreme weather events; River Morphology study for some key rivers impacted by the disaster; and an urban vulnerability assessment among others. Seven major components of work were allotted under this project.

3.3.1 Component 1– Construction and Strengthening of Critical Infrastructure

The objective of this component was to support the reconstruction/restoration of damaged public buildings, such as hospitals, schools, higher and technical education buildings, fire stations, and selected block and district offices, and other important public buildings. It included the restoration of partially damaged structures and the reconstruction of fully damaged structures, including equipment and furniture. A total of Rs. 360 crores were allotted for this component.

Construction of 120 bedded new IPD/OT block with spinal care centre at Bone and Joint Hospital in Srinagar had been allotted with an estimated cost of around Rs. 89 Crore.

Five fire service buildings damaged during 2014 flood was approved for restoration at an estimated amount of Rs. 7.566 crore. Ultrasonic non-destructive tests conducted in all the five fire service buildings.

Design for Superstructure was completed for construction of Lal Ded Hospital in Srinagar. All foundation tests had been completed and the foundation Trench plan had been prepared and released.

Table 3.6: Representation of construction and strengthening of critical infrastructure

S. NO	NAME OF THE WORK	ESTIMATED COST (IN CRORE)
1.	Construction of 120 bedded new IPD/OT block with spinal care centre at Bone and Joint Hospital Srinagar	89.00
2.	Restoration of Fire Service damaged buildings (5 Nos)	7.566
3.	Construction of 10 Higher Education buildings	34.42
4.	Construction of damaged school buildings:	50.43
5.	Construction of Lal Ded Hospital in Srinagar (Extension block at Lal Ded hospital Srinagar for gynaecology ward block and service block).	74.00
6.	Construction of Jawahar Nagar Higher Secondary School in Srinagar	4.17
	Total	**259.586**

Source: Jhelum and Tawi Flood Recovery Project, http://jtfrp.in/reconstruction-and-strengthening-of-critical-infrastructure/, Retrieved on 16th October 2019.

3.3.2 Component 2 - Construction of Roads and Bridges

The objective of this component is to restore and improve the connectivity disrupted due to the disaster through the reconstruction of damaged roads and bridges. The infrastructure is designed to withstand earthquake and flood forces as per the latest design guidelines. This component finances the reconstruction of damaged roads, bridges and associated drainage and slope stabilization works, retaining walls, breast walls and other structures to increase resilience.

Table 3.7: Representation of work for construction of roads and bridges

S. NO	NAME OF THE WORK	ESTIMATED COST (IN CRORE)
1.	Construction of 12 roads and 8 bridges in Kashmir region	300.00
2.	Construction of 17 roads and 4 bridges in Jammu region	160.00
3.	Construction of 150 mtr 2 lane trussed bridge over Romshi Nallah connecting Rohmoo to Pakherpora Charar-i-sharief at Pulwama	21.25
4.	Construction of 300 mtr, 02 lane trussed girder over Rambiara Nallah at Trenz Sheikhpora Shopian.	34.50
5.	Bridge at Waza Mohalla Kreeri at Baramulla, Bridge at Wagila Wagoora (50x11.80), Bridge at Wahidna (25.20x11.80), Bridge at Shrakwara (50x11.80), Bridge at Gogidaji (19.2x11.80), Bridge at Trikolbal Pattan (25.20x11.80)	39.47

S. NO	NAME OF THE WORK	ESTIMATED COST (IN CRORE)
6.	Construction/ upgradation of Amerpora Haritar Road Hygam Sopore (2.45 Km restricted)	8.375
7.	Construct ion/ Up -gradation of Halmullah, Punchora, Kralkut road at SangamBijbehara, Anantnag (3.34 Km)	4.98
8.	Construction/ Up -gradation of Litter, Sepan Chowder Bagh, Chakoorard, Pulwama (3.25 km)	3.36
	Total	**571.935**

Source: Jhelum and Tawi Flood Recovery Project, http://jtfrp.in/reconstruction-of-roads-and-bridges/, Retrieved on 16th October 2019.

3.3.3 Component 3 – Restoration of Urban Flood Management Infrastructure

The objective of this component is to strengthen and reinforce existing weak and vulnerable flood control infrastructures. Investments will primarily include rehabilitation/renovation of stormwater pumping stations in the Srinagar municipal area. Replacement of the power equipment, switch/panel boards at elevated places, and related investments for improvement and resilience with assessment of urban flood management interventions in other project areas.

Table 3.8: Representation of work for the restoration of urban flood management infrastructure

SL. NO.	NAME OF THE WORK	ESTIMATED COST (IN CRORE)
1.	Construction of 49 storm water pumping stations including replacement of equipment	102.98
2.	Procurement of 12 no. trolley mounted high-capacity pumps of capacity (a) 51 0 CuM/Hr- 06 No's and (b) 714 CuM/Hr- 06 No's	2.75
3.	a) Procurement of 8 no. of towing vehicles	0.85
	b) Body fabrication of vehicles	0.46
4.	Procurement of mobile waste water testing equipment for monitoring the quality of water in pumping stations	0.58
5.	Installation of SCADA system for 80 no. of storm water pumping stations including construction central control building and store	40.00
6.	Central Building at Humhama	25.00
7.	Drainage Scheme Nadroo, Hyderpora	18.04
8.	Drainage Scheme Naaz Colony, Panthachowk	16.50
9.	Drainage Scheme Bonpora Padshahibagh	65.00
10.	Storm water Drainage Scheme, Missing Links Zone II	10.50
11.	Storm water Drainage Scheme, Missing Links Zone I	25.50
	Total	**308.16**

Source: Jhelum and Tawi Flood Recovery Project, http://jtfrp.in/restoration-of-urban-flood-management-infrastructure/, Retrieved on 16th October 2019.

3.3.4 Component 4 – Restoration and Strengthening of Livelihood

The floods resulted in damage to infrastructure and assets, which severely impacted non-farm livelihood in urban centres. In addition, to the direct impact on livelihood, non-farming sectors is an important contributor to tourism in the region. This component supports restoration of physical and productive assets to finance the restoration of the training workshop and display building within the premises of the main handicraft and handloom market in Srinagar and the School of Design, as well as damaged productive assets in livelihood, training institutions and affected craftsman families. It provides technical assistance for risk proofing, proofing, finance vulnerability. assessment of non- farm livelihood and to identify opportunities for increasing resilience that were being carried out. It further helps in developing options to increase access to finance and insurance for non-farm livelihood.

Table 3.9: Representation of work for restoration and strengthening of livelihoods

SL. NO.	Name of the Work	Estimated cost Crore INR
1.	Composite market centre for whole chain silk activity, Govt. Silk Factory Rajbagh	23.68
2.	Composite market centre for whole chain wool activity, Govt. Woollen Mills Bemina.	12.29
3.	E-Commerce portal for Handicrafts and Handlooms	4.6
4.	Development of comprehensive database for Artisans of Jammu and Kashmir.	2.5
5.	Development of Kashmir Haat and International Trade Centre	43
6.	Development of 3 Handicraft clusters in flood affected areas	16
7.	Development of 2 handloom clusters in flood affected areas	10
8.	Brand Building and communication campaign for products of region	11
9.	Experiential cum retail and sale centre at Rajbagh Silk Factory	5.5
10.	Renovation of existing common facility centre for cricket bat manufacturing cluster at Sethar, Anantnag.	4.32
11.	Engagement of CDI as a Regional Sector Expert Consultancy for providing regional support towards the implementation of the livelihood component of JTFRP	1
12.	Consulting service for Rajbagh/ Bemina (Civil works)	2
13.	Training of Artisans in Product Development Cycle for International Market Linkages in Willow Wicker, Paper Mache, Crewel stitch embroidery and Wool in Jammu and Kashmir	0.5
14.	Consultancy for preparation of dossier for inclusion of Srinagar city on UNESCO creative city network	0.75
15.	Consultancy for providing technical support for declaring Rajbagh and Solina as UNESCO heritage sites	8.81
	Total	**134.83**

Source: Jhelum and Tawi Flood Recovery Project,http://jtfrp.in/restoration-and-strengthening-of-livelihoods/, Retrieved on 17th October 2019.

3.3.5 Component 5– Strengthening Disaster Risk Management Capacity

The objective of this component is to enhance the capabilities of the implementing entities in managing disaster risks, enhancing preparedness, and achieving resilient recovery. The first sub-component deals with the capacity building for disaster management and to finance the strengthening of the disaster management systems in the region by augmenting the capacity of stakeholders and institutions. The activities included capacity building of the State/UT Disaster Management Authority by strengthening its institutional and organizational structure, increasing staff, and resources and funding of training programs and regular drills for the emergency operations, centre staff and Disaster Management Officers at various levels. It also helps in setting up of a Decision Support System (DSS) and Emergency Operation Centres (EOC) to integrate and analyse information from multiple sources in an integrated geospatial system.

Table 3.10: Representing work for Capacity Building for Disaster Management

S.NO.	NAME OF WORK	ESTIMATED COST IN CRORE
1	Training and Capacity Building	30.00
2	Strengthening Disaster Response Force.	41.72
3	Setting up of UT EOC (Emergency Operation Centre) /DSS (Decision Support System)	30.00
	Total	**101.72**

Source: Jhelum and Tawi Flood Recovery Project, http://jtfrp.in/strengthening-disaster-risk-management- capacity/, Retrieved on 17th October 2019.

The second sub-component deals with the technical support for risk reduction and response preparedness to finance activities such as preparation of a Hydro-meteorological Resilience Action Plan, River morphology study for some key rivers impacted by the disaster, Urban Vulnerability Assessment study, upgrading design guidelines and building codes and Disaster Risk Financing and Insurance (DRFI).

Table 3.11: Representing work for technical support for risk reduction and response preparedness.

S.NO.	NAME OF WORK	ESTIMATED COST IN CRORE
1.	Procurement of Consultancy for river morphology study of both Jhelum and Tawi river basin.	34.05
2	Multi-Hazard Risk Assessment.	20.61
3.	Procurement of consultancy for preparing the building code.	1.99
	Total	**55.65**

Source: Jhelum and Tawi Flood Recovery Project, http://jtfrp.in/component-5-2/, Retrieved on 17th October 2019.

3.3.6 Component 6 – Contingent Emergency Response

Following an adverse natural event that caused a major natural disaster, the concerned authorities may request the Bank to re-allocate project funds to support response and reconstruction. This component drew resources from the unallocated expenditure category and/or allowed the PIE (Project Implementing Executive) to request the Bank to re-categorize and reallocate financing from other project components to partially cover emergency response and recovery costs.

3.3.7 Component 7 – Implementation Support

This component would finance incremental operating costs of the Project, including the operation of the Project Management Unit (PMU) and Project Implementation Units (PIUs). In addition, the component will include consultancies required for the preparation and supervision of specific activities, trainings, exposure visits and knowledge exchange programs, etc.

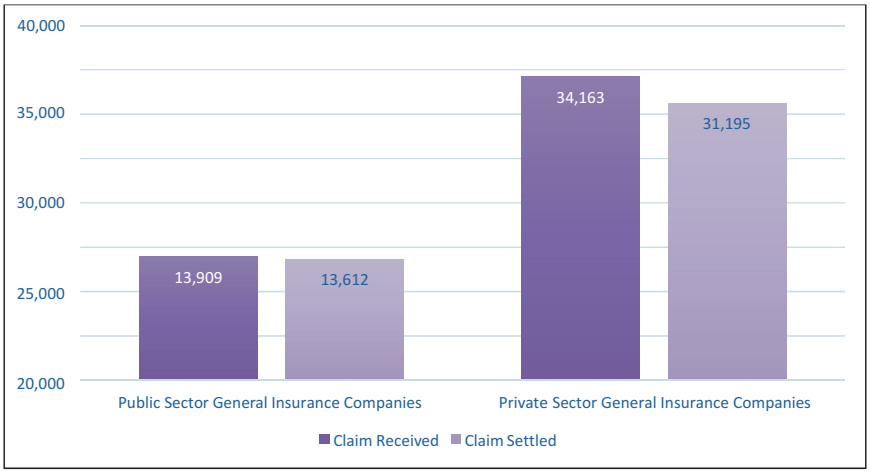
3.4 Role of the Insurance Sector

Insurance has an important role to play in disaster and climate risk management. The insurance sector played a key role in the long-term post disaster recovery in Jammu and Kashmir. In a major relief to flood-affected businessmen, Jammu and Kashmir High Court directed the insurance companies to pay 50% of the insured amount for policies above Rs 25 lakh and 95% for policies below Rs 25 lakh as interim relief and the policy decision of General Insurers Public Sector Association (GIPSA) should be strictly complied with.

By 18th June 2015, the Public Sector General Insurance Companies such as Life Insurance Corporation of India, General Insurance Corporation of India, The New India Assurance Company Limited, United India Insurance Company Limited, The Oriental Insurance Company Limited, National Insurance Company Limited, and Agriculture Insurance Company of India Limited received 13,909 claims, out of which 13,612 claims had settled for a total amount of Rs 729.75 crores. The Private Sector General Insurance Companies received 34,163 claims, out of which 31,195 claims had settled for an amount of Rs 1076.12 crores. The Life Insurance Corporation of India and the Private Sector Life Insurance Companies also settled 7 and 24 death claims respectively[60].

[60] Ministry of Finance, Press Information Bureau, Government of India, https://pib.gov.in/newsite/PrintRelease.aspx˜relid=122606, Retrieved on 30th October 2019

Figure 3.2: Post Disaster Insurance claimed in Jammu and Kashmir



Source: Ministry of Finance, Press Information Bureau, Government of India, https://pib.gov.in/newsite/ PrintRelease.aspx˙ relid=122606, Retrieved on 30th October 2019

Table 3.12: Different insurance schemes in India

SCHEMES	YEAR OF INITIATION	IMPLEMENTING INSURANCE COMPANY	FINANCIAL SUPPORT FROM
Ministry of Agriculture			
National Agricultural Insurance Scheme	1999-2000	AIC	Centre and States (50:50)
Weather Based Crop Insurance Scheme	2007-08	AIC	Centre and States (50:50)
Livestock Insurance	2005-06	Varies across States	Centre
Group Accident Insurance Scheme for Active Fishermen	1997-2002	Four subsidiaries of GIC	Centre and States (50:50)
Ministry of Textiles			
Mahatma Gandhi Bunkar Bima Yojna	2005-06	LIC	Centre
Health Insurance Scheme	2005-06	ICICI Lombard	Centre
Bima Yojna for Handicrafts Artisans	2003-04	LIC	Centre
Rajiv Gandhi Shilpi Swasthya Yojna	2006-07	ICICI Lombard	Centre
Sheep Breeders Insurance Scheme	2007-08	LIC	Centre
Sheep Insurance Scheme	2007-08	OIC	Centre
Group Insurance Scheme for Power Loom workers	2003-04	LIC	Centre
Ministry of Micro Small and Medium Enterprises			
Khadi Karigar Janashree Bima Yojna	2003-04	LIC	Centre
Coir Workers Group Personal Accident Insurance Scheme	2005-06	UIIC	Centre

SCHEMES	YEAR OF INITIATION	IMPLEMENTING INSURANCE COMPANY	FINANCIAL SUPPORT FROM
Ministry of Women and Child Development			
Anganwadi Karyakarti Bima Yojna	2004-05	LIC	Centre
Ministry of Health and Family Welfare			
Family Welfare Linked Health Insurance Plan	2005-06	ICICI Lombard	Centre
Ministry of Labour and Employment			
Rashtriya Swasthya Bima Yojana	2007-08	Varies across States	Centre and States (90:10) in N.E States and J and K (75:25) in others
Ministry of Finance			
Aam Aadmi Bima Yojana	2007-08	LIC	Centre and States(50:50)
Universal Health Insurance Scheme	2003-04	Four subsidiaries of GIC	Centre
Janashree Bima Yojana	2000-01	LIC	Social Security Fund

Source: National Institute of Public Finance and Policy, New Delhi, March 2011, https://nipfp.org.in/media/medialibrary/2013/08/insurance_report_final.pdf, Retrieved on 21st October 2019.

3.5 Role of NGOs and Community

To address the disastrous event, various NGOs, collaborated and established coordination among each other to mobilize resources from India and abroad to support the relief, reconstruction and resettlement programme of the UT of Jammu & Kashmir (erstwhile state). The NGOs worked hand-to-hand with the local authorities and communities to assess the flood situation, engaging in the distribution of relief items, providing health care, establishing emergency shelters and construction of transitional shelters and help in building back a resilient community.

Figure 3.3: Banner of an NGO seen aftermath the flooding, 26th September 2014

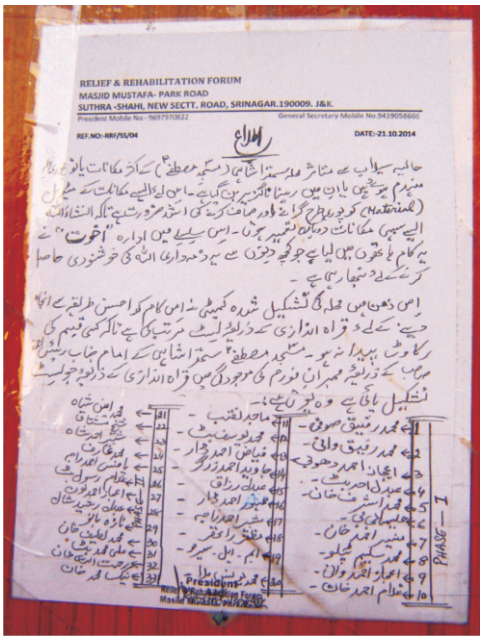
Source: Author (A.A.K.).

Based on the initial assessment by the NGO partners, and local administration officials, identification of the needs of the people was done. Some of the immediate and short-term needs were the establishment of medical camps till the restoration of the local health infrastructure; distribution of health and hygiene kit; providing household items specially to cope with the harsh winter; providing school kits for school going children to help in continuing with their education; and lastly construction of emergency and transitional shelters for the affected families. In the long-term recovery plan efforts were made upon improving healthcare services, livelihood restoration, educational enhancement, and skill development. Indo Global Social Service Society (IGSSS) responded in all the areas where it had projects and ongoing programmes. They readily sanctioned 10 lakh rupees for emergency response for flood affected people in the Srinagar, Bandipora and Baramulla districts of Kashmir. The response framework was readily accepted by the Misereor, Germany; Islamic Relief India, Shabana and Faizal Foundation and they supported it with financial resources.

The first coordination meeting of NGOs was held on 14th September at Rawalpora, Srinagar by Sphere India to chart out the response strategy. The meeting was attended by many local, national and international NGOs and paved the way for increasing coordination and sharing between all the formal responders. Organizations including Caritas India, Red R, Handicap International, Save the Children, Care India, Action Aid, IGSSS, CEEO, DFY, JKWDC, Police, Civil Defence, Aman Trust, etc. actively shared their inputs in collective advocacy for rights in crisis.

The participation of the community towards the early recovery from the disaster was enormous. The local communities engaged themselves with the clearing of debris and salvaging of building materials as soon as the flood water got recede. One such initiative was taken by the local community of the Suthra Shahi in Srinagar, where the community engaged themselves at the Mohalla level. The list of volunteers was shorted out by the Majid Mustafa and they were engaged in clearance of the demolished sites and taking part in the rebuilding of the community. An organization named "Akhuwwat" also came forward to engage themselves with the community.

Figure 3.4: Notice Board displaying list of volunteers engaging themselves in Mohalla level



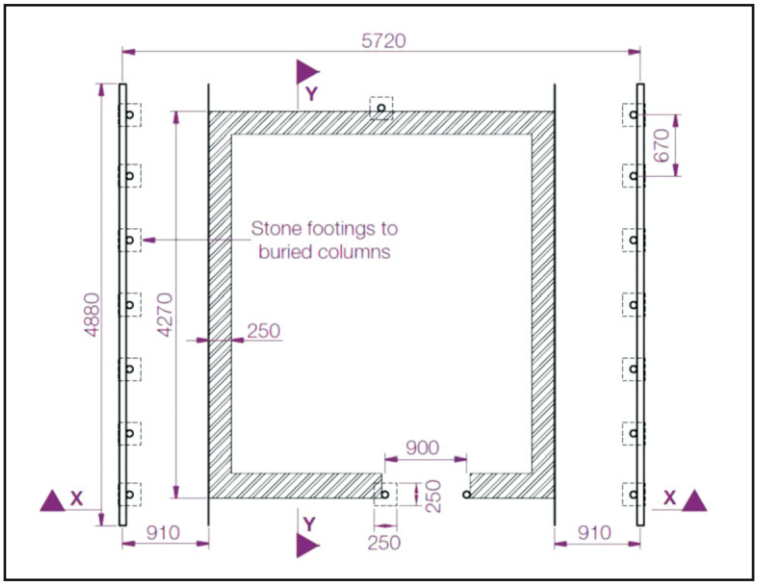
Source: Author (A.A.K.).

Some efforts were made for the construction of 100 transitional buildings in two of the most affected districts in Pulwama and Anantnag with the support from the fund-raised by various initiatives. The transitional plan was adopted, based on the design provided by the International Federation of the Red Cross and Red Crescent Societies.

Figure 3.5: Representation plan of the proposed transitional shelter

Source: A sprit of partnership, Annual report 2014-15, SEED India, https://www.seedsindia.org/wp-content/uploads/2018/07/Annual_Report_2014-2015_final_MC_230216.pdf, Retrieved on 21st October 2019.

Figure 3.6: Plan of the Transitional Shelter

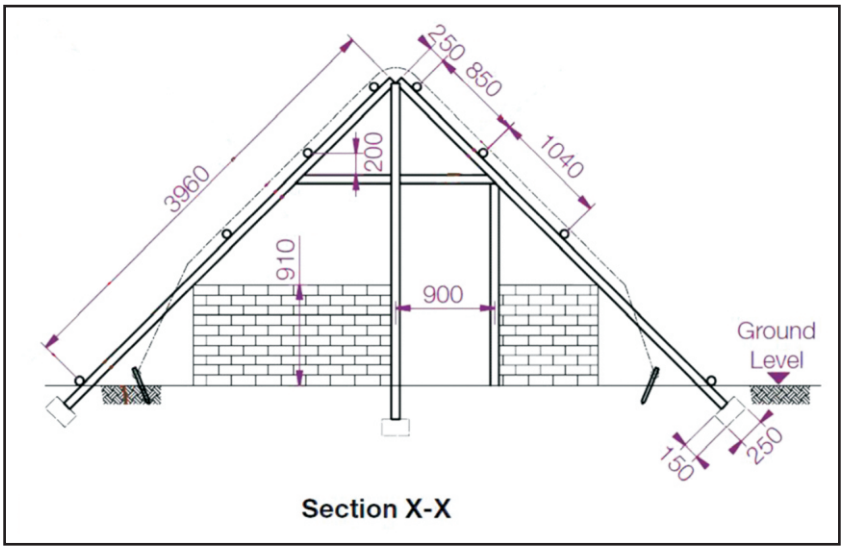


Source: Transitional shelters Eight designs, International Federation of Red Cross and Red Crescent Societies, Geneva, 2011,https://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf, Retrieved on 30th October 2019.

The transitional shelter had designed to meet the emergency needs of the affected families which can be constructed into permanent shelters once the winter is over. This transitional shelter offered the opportunity to rebuild stronger, safer, and more disaster-resilient infrastructure and systems thus fulfilling Building Back Better of the Sendai Framework. These transitional shelters are easy to construct, less time-consuming, uses low-cost construction technology and uses of extensive locally available construction materials.

The construction technique involves addition of A-bracing in the triangular frame and more robust foundations to increase the seismic performance and snow load. The plan of the shelter is 4.3 m x 5.7 m and consist seven triangular frames each connected by a ridge pole and it's supported by two 2.74 m high vertical columns at each end. The foundation of the shelter is provided by burying the triangular frames and the vertical columns approximately 0.3 m into ground on top of stone footing. The plinth height is about 0.9 m which is made of brick masonry. The roof is pitched at 44 degrees and covered with two layers of CGI sheets, providing 6 mm of insulation materials in between them which mostly is salvage material. Guy wire and ropes over the roof sheeting for additional strength, prevents from uplift of the roof by heavy wind loads.

Figure 3.7: Elevation of the Transitional Shelter



Source: Transitional shelters Eight designs, International Federation of Red Cross and Red Crescent Societies, Geneva, 2011, https://www.ifrc.org/PageFiles/95186/900300-Transitional%20Shelters-Eight%20designs-EN-LR.pdf, Retrieved on 30th October 2019.

4. Post Flood Long Term Resilience Building Measures

POST FLOOD LONG TERM RESILIENCE BUILDING MEASURES

4.1 Defining Resilience

Resilience in general stands for the ability and strength of someone or something to bounce back or respond promptly to a situation. As defined by UNDRR, "Resilience is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management"[61].

As described by the United Nations, resilience involves planning and reducing disaster risks in order to protect people, communities and countries, their livelihoods, health systems, socio-economic systems, and ecosystems, etc[62].

Disaster Resilience is determined by the degree of preparedness, organization and ability of individuals and communities to face any future disaster adequately through taking valuable lessons and actions from the past disasters and simultaneously reduce their risk to future calamities at local, regional, national and international level.

Nevertheless, resilience is a complex proposition and its assessment requires detailed study of several components of a community and system; such as, economic status, growth pattern, physical, economic and social vulnerabilities, technological capacity, performance of environmental and natural resource management institutions, infrastructure, livelihood assets, level of innovation, skills, education levels, political structure and processes, etc.[63]. All of these components combined together can result in effective measurement and assessment of the level of resilience present in a region/community/nation.

4.1.1 Types of resilience

There can be many types of resilience as discussed in the following[64] :

- ***Environmental Resilience*** - This type of resilience aims to protect the environment and related activities at times of disasters and to make them sustainable, when a future disaster occurs. Environmental resilience ensures minimum damage to the natural environment.
- ***Economic resilience-*** A region's economic resilience depends on its ability to face and absorb the financial losses effectively when a disaster strike. It is made sure,

[61]UNDRR Terminology, 2017. Retrieved from https://www.undrr.org/terminology/resilience#:~:text= The%20ability%20of%20a%20system,and%20functions%20through%20risk%20management.
[62]United Nations. 2015. https://www.preventionweb.net/disaster-risk/concepts/resilience/
[63]UNDRR, Prevention Web. "Resilience". Retrieved from https://www.preventionweb.net/disaster-risk/concepts/resilience/
[64]Ibid 63 P 99.

that a region can bear the losses effectively, and there is minimum economic damage, then we can assure that the respected region is economically resilient.

- ***Social Resilience*** **-** Social resilience is concerned with the communities and making them more strengthened. In other words, it refers to the enhanced ability of a social unit or a group to collectively cope up with and respond to the external emergencies that result in social, political and environmental changes. Since the community is always the first responder, it needs to be more resilient, to be more able to cope with, adjust to, recover from, and bounce back at such times.

Other forms of resilience are physical resilience which refers to one's own capability to cope, adjust and recover; health resilience which focuses on making communities more robust, and physically and psychologically healthy, so that when a shock or a time of distress occurs, they're able to respond effectively and cultural resilience, etc.

4.1.2 Positive aspects of building resilience

Resilience considers a comprehensive view of all the components of disaster management, such as exposure, risk, vulnerability and capacity, etc. With all of them together, resilience can help to enhance responses to disaster risk and can even make the whole system better if implemented effectively. Disaster resilience aims at saving people's lives and protecting infrastructure, livelihoods, social systems and the environment at the same time. Apart from this, it also draws together the components of disaster risk reduction and aims to enhance the disaster response, climate change adaptation and poverty reduction, etc.

Resilience is most vital in the field of disaster risk reduction and management. It marks a change on regional behavior when a disaster strikes again; as compared to how it did before. In this chapter, the Kashmir region's attempts towards building resilience to several prevailing hazards/disasters after the devastating floods of 2014 have been discussed.

4.2 Recovery to Resilience-an attempt towards better disaster management in Kashmir

The term recovery is very closely linked with building resilience in a system or a community. The goals of any recovery programme must emphasize on the resilience building of a community so that effective management of the future shock is assured. Linking short-term relief and recovery measures to long-term resilient recovery strategies proves to be beneficial for building resources and skills required to reduce the impact of future disasters. Somewhat, similar attempts were observed in Kashmir after the deluge of 2014, wherein several resilience building steps were taken and plans were executed with the help of integration of Disaster Risk Reduction strategies.

In the wake of 2014 floods in Kashmir, several post-disaster activities, projects and actions were initiated to build resilience at the State/UT level, with the involvement of many departments/organizations. The lead role was played by the Kashmir Divisional Commissioners' office, Srinagar. The major objective of such ingenuities was to make the

State/UT resilient to face the future disasters like 2014 floods. The State/UT government through the Divisional Commissioners office in Srinagar has taken several initiatives in this direction; however, a few of the prominent agencies/departments/projects involved in post flood resilience building includes the following:

1. Irrigation and Flood Control Department, Divisional Office, Srinagar
2. Srinagar Municipal Corporation, Srinagar
3. Jhelum Tawi Flood Recovery Project (JTFRP) by Economic Reconstruction Agency
4. Directorate of Health Services, Kashmir Division, Srinagar
5. Directorate of Education, Kashmir Division, Srinagar
6. Wullar Conservation and Management Authority (Wullar Lake Project)
7. Indian Meteorology Department (IMD) Regional Office, Srinagar
8. State/UT Emergency Operation Centre, Srinagar
9. Public Works Department (Road and Building)
10. TAMEIR/PMDP, etc.
11. Other agencies

Various activities carried out by these organizations to build the resilience at State/UT level have been discussed in detail in the following sections.

4.2.1 Irrigation and Flood Control Department

At the national level, the Union Ministry of Water Resources has the primary responsibility of developing, conserving and managing water resources along with irrigation management and flood control. However, water is regarded as a state subject, the management of which has been allotted to the respective state governments through various departments and corporations[65]. Irrigation and Flood Control Department (IFCD) is one such department of State/UT Government. In general, IFCDs are given the responsibility to provide the irrigation facilities to the farmers, create more irrigation potential while maintaining the existing irrigation infrastructure at the same time, managing the rivers through the implementation of flood control measures in those rivers and streams to counteract the pernicious effects of floods. In this direction, the Irrigation and Flood Control Department of UT of Jammu and Kashmir took many initiatives to prepare the region for any future flood disaster occurrences. Some of the initiates of the IFCD are as following[66]:

1. Restoration of damaged spots under State Disaster Response Fund.
2. Stock Position/Utilization of Empty Cement Bags During and After Floods of September 2014.

[65]Das, S.K. et al. 2007. "Flood and Drought Management through Water Resources Development in India", World Meteorological Organization. Retrieved from https://public.wmo.int/en/bulletin/flood-and-drought-management-through-water-resources-development-india on April 30, 2021

[66]Irrigation and Flood Control Department, Rajbagh, Srinagar

3. Desilting and construction of intake channels and canals in Baramulla district.
4. Procurement of units to provide logistic support for deepening and excavation works of irrigation canals in Kupwara district.
5. Strengthening of weak embankments.
6. Restoration of breaches and toe protection.
7. Re-sectioning and widening of River Jhelum.
8. Removal of shoal from River Jhelum.
9. Construction of boulder bunds.
10. Land acquisition of flood spill channels.
11. Dredging of river Jhelum.

However, the initiatives taken by the department can be divided into structural and non-structural measures and further into immediate, short-term, and long-term measures.

4.2.1.1 Immediate measures

Under immediate measures, the department plugged all the breaches and restored a total of 3316 spots under temporary and 1235 spots under permanent restoration at a cost of Rs. 163.11 crores and Rs. 96.78 crores respectively.

Table 4.1: Immediate measures taken by the Department of Irrigation and Flood Control after 2014 floods

Immediate measures	Restoration of Spots	Cost (INR Crore)
Temporary restoration	3316 spots	163.11
Permanent restoration	1235 spots	96.78

Source: Department of Flood and Irrigation Control, Kashmir

4.2.1.2 Short term measures-Phase I

Immediately after the floods, a priority-based flood management project "Priority Works-Comprehensive Plan for Flood Management Works on Jhelum-Phase I", by Central Water Commission (CWC) was formulated for relief from the floods. The main aim of this project was to remove the immediate and major bottlenecks in the river Jhelum and Flood Spill Channel to provide instant relief from medium to lower magnitude floods. Under this project, the department took measures such as land acquisition and compensation of the flood spill channel, re-sectioning of the flood spill channel, construction of bridges, flood protection and anti-erosion measures, etc. The details of the main works under this project and of land acquired for the same can be found in tables 4.2 and 4.3 respectively.

Table 4.2: Works done under Phase-I of short-term measures

Description of main works	Area	Progress achieved/Area covered	Unit	Remarks
Land compensation of flood spill channel (FSC)	Sharifabad and Naidkhai	85.70 hectares		This was done to acquire land within the flood channel in these areas.
Re-sectioning of Flood Spill Channel	Sharifabad and Naidkhai	30.38 Lac Cum	16.11 Lac Cum	Re-sectioning was undertaken in the land compensated areas.
Dredging of river Jhelum	Srinagar and Baramullah reaches		14.27 Lac Cum	
Construction of bridge on Flood Spill Channel	Sharifabad and Naidkhai	2 in numbers		
Flood protection and anti -erosion works on river Jhelum at vulnerable spots	Khannabal to Baramulla including Sunri and KutteKhuls in Srinagar city.	9358 RM of Toe/Ret. Walls & 4865 RM of Revetment		

Source: Department of Flood and Irrigation Control, Kashmir

Table 4.3: Details of land acquired on Flood Spill Channel under Phase -I of short-term measures

S. No.	District	Land to be acquired	Possession taken over ending
1	Srinagar	241 K-11M	241K-11M
2	Budgam (Private Land)	975 K-7M	975 K-7M
3	Budgam (Forested Land)	300K-0M	300K-0M
4	Bandipora	242K	PNC completed
Total		1785 K – 7 M	1516 K-18 M

Source: Department of Flood and Irrigation Control, Kashmir

Removal of trees/plantation drive: An intensive drive for the removal of the plantation from Bemina, Durbal, Sharifabad, and Khushipora areas under the short-term measures was launched with the help of divisional administration. Under this drive, as many as 43,800 trees were cut for the land acquisition process. Along with the removal of vegetation on the flood spill channel, demolition of houses was also undertaken for the cause.

Increased Flood Spill Channel and Carrying Capacity of the river Jhelum

Flooding in the rivers is caused by the inadequate capacity of the river banks to contain the high flows of water brought down at times of heavy rainfall or some other reasons. This is

when the carrying capacity of the river channels is reduced, which is further accelerated by process of erosion and silting of river beds. This is one of the most crucial factors that was taken into the consideration during long-term flood management. The Irrigation and Flood Control Department made many notable attempts in this regard, including increase in discharge carrying capacity of the river Jhelum. This task was carried out in two phases.

Phase-I: In this phase, the carrying capacity of the river Jhelum was expected to increase to an adequate extent to carry the flood discharge. The highest increase in the carrying capacity of about 9200 cusecs shows 28.93% increase from its normal carrying capacity from Sangam to Padhshahibagh, followed by 18.5% (5000 cusecs) increase at Ram Munshibagh, 117.5% (4700 cusecs) at the Flood Spill Channel of Padhshahibagh (Srinagar), 12.90% (4000 cusecs) at Sopore, and lastly, 13.5% (2700 cusecs) at the Flood Spill Channel at Ningli in Wullar (Baramulla). The anticipated carrying capacities of river Jhelum at all the five locations during phase-I can be observed from table 4.4 as well.

Table 4.4: Carrying Capacity of River Jhelum and the Flood Spill Channel before and after execution of Phase-I

Location		Carrying Capacity			
		Before September 2014	After Phase -I	Increase in cusecs	Increase (%)
River Jhelum from Sangam to Padhshahibagh		31800 cusecs	41000 cusecs	9200	28.93%
River Jhelum at Ram Munshibagh		27000 cusecs	32000 cusecs	5000	18.51%
Flood Spill Channel	Offtake at Padhshahibagh (Srinagar)	4000 cusecs	8700 cusecs	4700	117.5%
	Outlet at Ningli in Wullar (Baramulla)	20000 cusecs	22700 cusecs	2700	13.5%
River Jhelum at Sopore		31000 cusecs	35000 cusecs	4000	12.90%

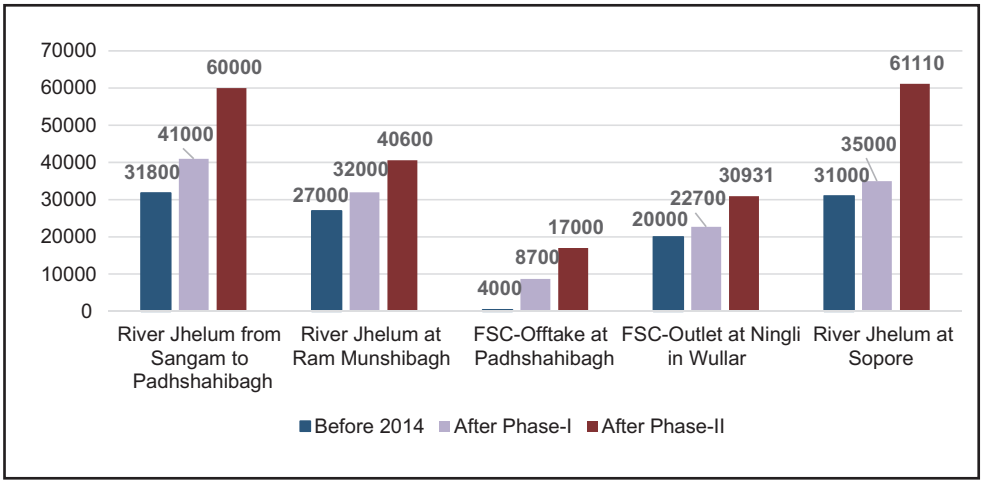
Source: Department of Flood and Irrigation Control, Kashmir

Phase-II: After the completion of Phase-I and improvements in carrying capacities of river Jhelum at the five locations as mentioned in the table 4.4, Central Water Commission suggested, the Department to take necessary measures in order to increase the carrying capacities of river Jhelum to 60,000 Cusecs at Sangam and 61,110 Cusecs at Ningli and Sopore.

Following up the recommendations, the discharge carrying capacities of the river at all five locations had been envisaged to increase as per Fig 4.1. It can be observed from Fig 4.1 that the highest increase of 97.12% (61110 cusecs) achieved at Sopore during phase-II as compared to 12.90% (35000 cusecs) in phase-I, followed by Sangam at 88.67% (60,000 cusecs) increase compared to 28.93% (41000 cusecs) earlier, Ram Munshibagh at 50.37% (40600 cusecs)

compared to 18.51% (32000 cusecs), Flood Spill Channel offtake Padhshahibagh at 325% (17000 cusecs) contrasting to 117.5% (8700 cusecs), and finally FSC outlet in Ningli in Wullar at 54.65% (30931 cusecs) compared to 13.5% (22,700 cusecs) increase during Phase-I. To carry out the aforementioned works, dredging in Outfall Channel and Flood Spill Channel to a tune of 129.45 Lac cum and 79.75 Lac cum[67] respectively had been proposed in Phase-II which was expected to substantially increase the carrying capacity of the whole river.

Figure 4.1: Comparative carrying capacity of River Jhelum and Flood Spill Channel after the execution of FMP works



Source: Department of Flood and Irrigation Control, Kashmir

4.2.1.3 Short-term measures-Phase II

The Irrigation and Flood Control Department started the work for Phase-II by first carrying out the mathematical model studies of River Jhelum through Central Water Power Research Station, Pune. The DPR of "Comprehensive Flood Management works on River Jhelum & its tributaries Phase-II" was framed at an estimated cost of Rs. 5411.54 crores. Part-A of the project under which Rs. 1623.43 crores was approved by CWC, involved numerous structural measures such as construction of bunds, embankment raising, building of revetments and crate walls, channel widening, re-sectioning of the Flood Spill Channel, and construction of various bridges and buildings, etc. The details of the project involved in this DPR can be observed from the table 4.5.

[67]Cum = Cubic Meter

Table 4.5: Work completed under short term measures Phase-II

S. No.	Project Head/Items of Works	Approved Quantity	Units	Physical Target for 2020-2021	Approved Cost (in crores)
1	A - Preliminary	-			5.95
2	B - Land	739.76	Kanals	295.90	298.87
3	C - Works				
	a) Stone Pitching with T/wall	3661	Mts	732.20	30.26
	b) Stone pitching with L/Apron	4448	Mts	889.60	67.70
	c) Guide walls (Ret./wall in Conc./RRM)	6731	Mts	1346.122	92.85
	d) Revetment	2337	Mts	467.40	23.50
	e) Embankment Raising	21	KM	4.1738	17.78
	f) Spurs /Ghats	17		0	1.66
	g) Crate walls	25748	Mts	5149.614	84.51
	h) Earth work		Lac. Cum		
	i) Outfall Channel (Widening)	129.45	Lac. Cum	12.945	502.10
	j) Flood Spill Channel (Re - sectioning)	79.75	Lac. Cum	15.949	363.86
	k) River Jhelum (Re-sectioning)	2.24	Lac. Cum	-	5.53
	l)Tributaries	0.36	Lac. Cum	-	1.44
4	D - Regulators				
	a) Flood Spill Channel	3.00		0.60	38.07
	b) Outfall Channel	1.00			36.84
5	G - Bridges	14.00		2.80	18.15
6	K - Buildings		-	-	8.50
7	O - Miscellaneous		-	-	0.52
8	P - Maintenance		-	-	3.23
9	Tools & Plants; Audit & Account Charges		-	-	21.75
		Total			1623.43

Source: Department of Flood and Irrigation Control, Kashmir

Steps taken for safety and security of bunds and embankments of river Jhelum

After the construction of bunds, embankments and other necessary structures, there was need of their security and safety, which was realized and several other departments of flood control were given this responsibility. These departments include the Flood Control Divisions at Anantnag and Kakpora, and Irrigation & Flood Control Divisions at Srinagar, Sumbal, Sopore and Baramulla. These departments have the responsibility of routinely looking after the safety and security of bunds/embankments of River Jhelum and its tributaries[68].

Furthermore, under structural measures, the department is working on the creation of flood storage dams on tributaries of river Jhelum, studying the feasibility of additional flood spill channel from Dogripora to Wullar, river management for flood protection through bank protection, strengthening of existing embankments and planning the construction of new ones, and channel dredging[69] etc.

4.2.1.4 Non-Structural/Long-term measures

The Irrigation and Flood Control Department with the help of the project management unit of Jhelum and Tawi Flood Recovery Project (JTFRP) has undertaken a morphological study of River Jhelum under long-term measures to mitigate 1 in a 100-year flood. The study is currently going on (as of March 31, 2021) wherein a 2D-Hydrodynamic model is being made and the various possible structural and non-structural measures are being studied. Another study under JTFRP is also being carried out presently, for flood hazard risk assessment wherein an integrated forecasting system together with a Decision Support System (DSS) will be present. This integrated forecasting system is expected to present an effective, swift and instantaneous response for any flood disaster occurrence in the future. Moreover, the department is also planning to formulate a comprehensive DPR for the same.

Automation of Flood Monitoring System: Establishment of Automatic Water Level Recorders (AWLRs) and Automatic Rain Gauges (ARGs)

The Department of Flood and Irrigation further aims at strengthening its flood monitoring system. In this regard, it had completed the installation of 14 Automatic Water Level Recorder (AWLR) and 9 Automatic Rain Gauge Stations at various important sites throughout the valley to record hourly gauges round the clock and to communicate for the same to central control room by SIM connectivity through GSM modem.

These stations are expected to assess real-time hydraulic data, issue flood warnings and offer provision of upgrading the system from SIM connectivity to V-Sat connectivity. The connectivity with State/UT EOC in Srinagar has been established, these networks helps in proper monitoring, issuing necessary forecasts and early warning. The details of AWLRs and ARGs can be observed from the table 4.6.

[68]Kashmir Irrigation & Flood Control Department, Rajbagh, Srinagar. Retrieved from http://www.ifckashmir.com/replyjksic.htm
[69]Adopted from a presentation by the Jal & Shakti Department of Jammu & Kashmir during a webinar organized by NIDM

Table 4.6: Details of AWLRs and ARGs established under departmental flood forecasting system

S.No.	Station	AWLR	ARG	Remarks
1	Sangam	Installed	Installed	On river Jhelum
2	Ram Munshibagh	Installed	Installed	
3	Pampore	Installed	-	
4	Asham	Installed	Installed	
5	Ningli (Wullar)	Under progress		
6	Khudwani	Installed	Installed	On Vishow
7	Batkoot	Installed	Installed	On Lidder
8	Wachi	Installed	-	On Rambiara
9	Barzullah	Installed	-	On Doodhganga
10	Arizal	Under progress		On Sukhnag
11	Aglar	Installed	Installed	On Romshi
12	Doderhama	Installed	Installed	On Sindhi
13	Drung	Under progress		On Ferozpora
14	Seolu	Under progress		On Pohru
AWLR: Automatic Water Level Recorders; ARG: Automatic Rain Gauges				

Source: Adopted from a presentation by the Jal & Shakti Department of Jammu& Kashmir during a webinar organized by NIDM.

Figure 4.2: Automatic Water Level Recorder (AWLR) at Ram Munshibagh

Source: Presentation by the Jal Shakti Department of Jammu & Kashmir during a webinar organized by NIDM.

Further, the department is planning to expand its network of flood forecasting and management through the installation of 11 AWLRs stations on river Jhelum and 23 AWLRs on its various tributaries, 13 ARGs in different catchments to record the real time rainfall data, 20 Acoustic Doppler Profilers (ADPs) to record and communicate the real-time discharge (flow) of Jhelum at 9 Stations and its various tributaries at 11 stations, and an establishment of a well-equipped Central Flood Control Room, etc. These initiatives are certainly expected to increase the resilience of the department and regions concerned.

In order to make the system more fruitful and prompt, a department level, mobile application named "Kashmir Flood Alert" has been developed by National Information Centre (NIC) wherein real-time information gets automatically updated. The development of this application is a very upstanding initiative on behalf of the department as it can easily disseminate the flood warning to reach local and concerned people on time.

Moreover, under the non-structural measures, the department had worked on the identification and utilization of low-lying areas that act as detention basins during high floods, flood plain zoning of the low-lying areas, watershed management for increased detention and reduced sediment yield, and designing a flood forecasting model for Jhelum basin[70] etc.

Figure 4.3: Mobile App (left) and monitoring station (right) set up by Irrigation and Flood Control Department

Source: Department of Flood and Irrigation Control, Kashmir

[70]Adopted from a presentation by the Jal & Shakti Department of Jammu & Kashmir during a webinar organized by NIDM.

More works undertaken by the Irrigation and Flood Control Department (I&FC) to prepare the region for a future flood disaster

Jal Shakti Department had taken a host of steps to prepare the region for any upcoming flood-like disaster, such as; storage of Empty Cement (EC) bags, sandbags, Geo and mega bags, aluminium boats, rubber boats, required machineries; mapping of hydrological systems; construction of drainage channels, mapping and zonation of vulnerable areas; and storing water equipment, etc.

EC bags, sandbags, geo bags, and mega bags, etc. provide support and act as a solution to protect hydraulic structures and riverbanks from extreme erosion and scouring. Thus, at the time of floods, their presence in sufficient numbers is more than necessary to effectively manage the disaster. The status of these bags in many divisions of the departments can be observed from table 4.7.

Table 4.7: Status of empty cement, sand, geo, and other bags at different divisions of the department

Division	Number of E.C. bags available	Number of sand bags
ID Ompora	40,000	-
FSC Narbal	50,000	30000
I&FC Sopore	10,000	-
I&FC Sumbal	50,000	7000
ID Kulgam	31,000	-
I&FC Srinagar	35,000	70000
FC Kakapora	40,600	10000
FC Anantnag	51,000	40000
ID Tral	26,000	24000
I&FC Ganderbal	50,000	4000
I&FC Kupwara	40,000	-
I&FC Handwara	4,000	-
ID Shopian	20,000	-
Hyd. Div Bandipora	50,000	-
Total	**4,97,600**	**1,85,000**

Source: Presentation by the Jal & Shakti Department of Jammu & Kashmir during a webinar organized by NIDM.

Table 4.8: Status of water related equipments at the Central Store of Srinagar

S.No.	Equipments at the Store	Numbers
1	E.C. bags	43,0002
2	Geo bags	54,00010
3	Mega bags	3,480
4	Dewatering pumps	2
5	Aluminium boats	10
6	Rubber boats	10

Source: Presentation by the Jal & Shakti Department of Jammu& Kashmir during a webinar organized by NIDM.

Another long-term measure undertaken by the Department of Flood Mitigation and Resilience building is the construction of a drainage channel across Hokersar wetland along the old age alignment of the flood spill channel. The drainage channel at the location was constructed and improved as per the need along with additional construction of hydraulic gates and chain fences, etc. The total authorized amount for this work was 5826.94 in lacs. Complete details of the work can be observed from the table 4.9.

Table 4.9: Various Construction and improvement across Hokersar Wetland

Outline of work	Authorization (in lacs)	Expenditure (in lacs)
Construction of channel along old alignment of Hokersar from 11950 m to 16713 m of Flood Spill Channel. Side slope protection of channel with the help of geo-mega bags at spots.	3848.37	2257.00
Construction and improvement of drainage channels flowing into Hokersar Wetland on each side.	1183.38	
Construction of hydraulic gates at inlet & exit points of Hokersar of Flood Spill Channel	495.19	
Provision for chain link fencing along right and left embankments of Flood Spill Channel.	300.00	21.00
Grand total	5826.94	2278.00

Source: Adopted from a presentation by the Jal & Shakti Department of Jammu & Kashmir during a webinar organized by NIDM.

Water rescue equipments with SDRF stationed in Kashmir

One of the additional long-term resilience building measures taken by the department was building up of necessary equipments for calamitous times. The storage of rescue and relief boats of different types, different types of kits, and other materials needed at that time was done. The details of the boats and other water rescue equipments with State Disaster Response Force (SDRF) in the Kashmir division can be found in the tables 4.10 to 4.11.

Table 4.10: Available water rescue equipment with SDRF at Srinagar and Jammu

S. No.	Equipments	SDRF at Srinagar	SDRF at Jammu	Total
1	Lifesaving jackets	289	120	409
2	Lifebuoy	532	214	746
3	Rubber dingy	01	01	2
4	Inflatable rubber boat (manual)	-	02	2
5	Inflatable Motor Rubber Boat 4 stroke, 25HP OBM (*Outboard* Motor)	34	17	51
6	Fiber Boats with 75 HP/50 HP, 04 Stroke OBM	24	01	25
7	Fiber boats manual (chapu type)	05	02	7
8	Inflatable rubber (raft type) boats	40	30	70

S. No.	Equipments	SDRF at Srinagar	SDRF at Jammu	Total
9	Underwater personal diving kit	10	08	18
10	Portable dewatering pump	16	16	32
11	Rope delivery guns	25	25	50
12	Fast Act pressurized Cylinder 02 Kgs	04	04	8
13	Portable trailer pumps	02	02	4

Source: Adopted from a presentation by the Jal & Shakti Department of Jammu& Kashmir during a webinar organized by NIDM

Table 4.11: Boats with SDRF stationed in Kashmir division

S.No.	Districts/Areas	Inflatable motor boats	Fiber motor boats	Raft boats	Manual Fiber boats
1	Headquarters Srinagar	17	-	10	02
2	Dal Lake	-	06	-	03
3	Jhelum River, Zero Bridge (Peerzu)	-	09	-	-
4	Anantnag	02	03	05	-
5	Baramulla	02	03	05	-
6	Bandipora	02	-	05	-
7	Pulwama (Awantipora)	03	-	02	-
8	Kupwara	01	-	02	-
9	Shopian	01	-	02	-
10	Ganderbal	02	02 (Manasbal lake)	05	-
11	Budgam	03	-	02	-
12	Kulgam	01	-	02	-
Total		34	23	40	05

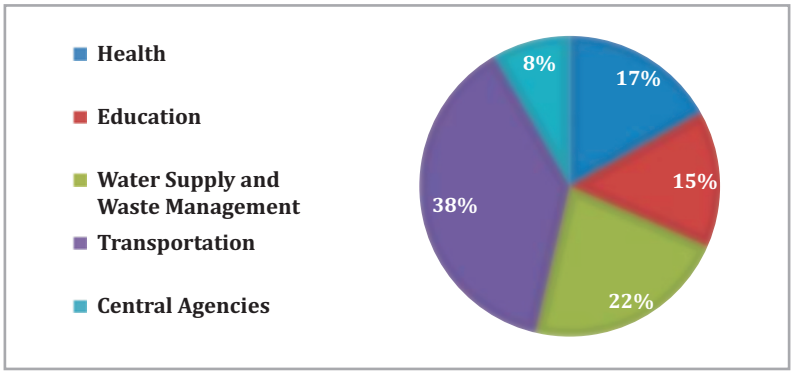
Source: Adopted from a presentation by the Jal & Shakti Department of Jammu& Kashmir during a webinar organized by NIDM.

4.2.2 Jhelum and Tawi Flood Recovery Project (JTFRP)

The JTFRP project[71] was one of the major steps taken for the restoration and reconstruction of critical infrastructure to minimize the future damages. It was commenced in the year 2015 with an aim to restore the partially damaged infrastructure and to reconstruct the fully damaged essential infrastructure using international best practices on resilient infrastructure. One of the objectives of the project was to reduce region's vulnerability to both floods and earthquakes with improved and resilient infrastructure and contingency planning for future disaster events as well as increasing the capacity of the state/UT to respond swiftly and efficiently at times of emergencies. Figure 4.4 shows the weightage given to different sectors of critical infrastructure under JTFRP-2015 project work.

[71]http://jtfrp.in/

Figure 4.4: Weightage given to different sectors of critical infrastructure under JTFRP-2015



Source: The World Bank. Retrieved from https://projects.worldbank.org/en/ projects-operations/project-detail/P154990

4.2.2.1 Technical Advancement-Planning of a Multi-Hazard Risk Assessment (MHRA)

One of the key components of the JTFRP project was the multi-hazard risk assessment of the entire UT of Jammu and Kashmir assigned to RMSI. This initiative was taken to gain an in-depth understanding of the risks and vulnerabilities of the region to make the overall project more effective.

The key components of the study as mentioned by RMSI are as follows:

- An in-depth analysis of major hazards such as flood, earthquake, landslide, avalanche, Glacial Lake Outburst Flood, drought, forest fire, urban fire, and industrial hazards that affect the state/UT.
- A detailed understanding of the extent of historical impacts of these hazards.
- Development of specific vulnerability of the community and infrastructure ;and ,
- Determination of the degree of potential exposure to future events.

Technical assistance such as the development of a GIS-based Digital Disaster Risk Database (DRDB) will help in providing real-time warning for hydro-meteorological hazards and enhance the response. Other advancements are:

1. Web-enabled Management Information System (MIS)
2. GIS based EMDSS (Emergency Management Decision Support System) which will eventually connect UT Emergency Operation Centres (EOCs) at Jammu and Srinagar, District EOCs, and several field department control rooms (Police, Forest, etc.)

The MHRA assesses all major disasters that J&K is vulnerable to and quantifies risk at UT level, District level and Tehsil level through hazard modelling, exposure data development, and vulnerability assessment.

The Digital Disaster Risk Database incorporates all the data developed under MHRA in three modules namely hazard, exposure, and risk. These modules interact with IOFS for effective forecasting of hydro-meteorological hazards like floods, drought & avalanche, etc. In addition to the data from DRDB, IOFS will utilize hydro-meteorological data directly from IMD forecast as well as the HMAP network that J&K is planning to implement.

Hydro-Meteorological Action Plan (HMAP)

HMAP is an important component of Multi-Hazard Risk Assessment (MHRA) which encompasses collection of real-time meteorological and hydrological data. The equipment used for the regulation of this plan has the primary function of recording the precipitation, the water levels/sediment load of major rivers and their tributaries. They include Automatic Water Level Recorders (AWLR), Automatic Rain Gauges (ARG), Automatic Snow Gauges (ASG), Acoustic Doppler Current Profiler (ADCP), Water Velocity Radar Sensor (WVRS) and Sediment Analysis equipment.

For this purpose, a Hydro-Meteorological Action Plan for Jhelum and Chenab Basins which includes the upgradation of hydro-meteorological equipment and allied infrastructure of the Irrigation and Flood Control Department has been prepared under the Jhelum and Tawi Flood Recovery Project. This component is expected to bring about huge positive changes into the forecasting system, and with its help, sufficient time for evacuation can be achieved.

Consultancy Studies by JTFRP under MHRA

The scope of work of the consultancy studies under MHRA of JTFRP is to develop, calibrate, validate, and operationalize hydrology, hydraulic, hydrodynamic and morphological model, review flood management options and choose the potential ones, prepare hydrological and morphological reports, conduct data collection campaigns, and preparation of disaster risk reduction for flood and river management works, etc. The status of consultancy studies under JTFRP for Multi-Hazard Risk Assessment of Jammu, Kashmir, and Ladakh can be found in the table 4.12. It consists of a total of eight tasks, all of these reports have been submitted and 3 of them accepted as well. However, 2 tasks are still under review.

Table 4.12: Status of consultancy studies under JTFRP for Multi-Hazard Risk Assessment of Jammu, Kashmir, and Ladakh Divisions of earlier State of J&K

Deliverables	Description	Status	Remarks
Task 1	Inception Report	Submitted	Accepted
Task 2	Component 1: Data inventory and Data Review	Submitted	Accepted
Task 3	Component 2: Hazard Analysis &outputs in DRDB	Submitted	Accepted

Deliverables	Description	Status	Remarks
Task 4	Component 3: Exposure/Vulnerability assessment	Submitted	
Task 6	Component 4: Risk Assessment/ State Risk Atlas	Submitted	Under Review
Task 7	Component 5: DRDB ready for Demo	Submitted	Under Review
Task 8	Component 6: IOFS ready for Demo		Basic model ready on IOFS cloud server.

Source: Data provided by the JTFRP

4.2.2.2 Development of a Decision Support System (DSS) for J&K State Disaster Management Authority

A Decision Support System, in general, is a computerized system or program designed to support the concerned authority or department to make judgements, develop decision making ability in crucial situations, and help in the accomplishment of required sequence of actions. A DSS usually consists of a data bank, a data analysis capability, normative models, and technology for the interactive use of data and models, etc.[72] In the context of disaster management, the system incorporates useful disaster data or data related to the disasters such as weather statistics, etc. and coupling it with the hardware, it provides information which is useful for arriving at appropriate decisions during a calamity.

Looking at the benefits of the DSS, it was felt essential to incorporate it into the State/UT disaster mitigation planning for effective management of floods. For this cause, RMSI company, was entrusted to carry out the development and commissioning of a DSS for JKSDMA (Jammu & Kashmir State Disaster Management Authority) to strengthen the Government's capacity for preparedness and emergency response as a part of disaster risk reduction strategy[73] . This project has the following main initiatives:

- Connecting EOC at Jammu and Srinagar, and District EOCs
- Connecting emergency service departments like Police, Fire, Forest, etc. for response coordination
- Provide tools for the emergency service departments to act as a team and share real-time situational information
- Enable two-way information exchange across all the line departments and emergency response special groups
- Provide mechanisms for real-time monitoring and informed decision making

The DSS platform is expected to act as a common platform to respond to disasters as it integrates real-time information from national and global resources with information

[72]Wallace, W.A. & Balogh, F.D. "Decision Support Systems for Disaster Management", accessed from https://www.jstor.org/stable/3135008 on April 24, 2021
[73]Government of Jammu & Kashmir

regarding historical hazards, socio-economic vulnerabilities and infrastructural data, etc. Such studies will help the government to enable better disaster risk management along with minimizing future losses. It will have the capability to be used for managing disasters induced by natural hazards, human-induced disasters, special events like mass gatherings, and day-to-day emergency management operations of JKSDMA and District Disaster Management Authorities. It also aims at addressing all phases of disaster management such as preparedness, response, rehabilitation and recovery and is looking forward to have the functional capabilities to address the coordination needs of all disaster management activities. The status of the development of DSS platform as of March 2021 can be observed from the table 4.13:

Table 4.13: Status of DSS for J&K State Disaster Management Authority as of March 2021

Deliverables	Description	Status	Remarks
Task 1 (D_1)	Inception report	Submitted	Under Review
Task 2 (D2)	EDSS basic functions installed for SEOC	Submitted	Uploaded
	Data, operations, and current business process flow of all ESF departments mapped	Submitted	Under Review

Source: Data provided by the JTFRP

4.2.2.3 Sub-Projects under JTFRP

There are several sub-projects going on under these five decided components for the JTFRP project. Table 4.14 contains the consolidated costs of the sub-projects under each component.

Table 4.14 : Sub-projects and their consolidated costs under each component of JTFRP project

Components	Sub-projects	Cost (US$)
Reconstruction and strengthening of critical infrastructure	1. Construction of buildings at various college campuses. 2. Two hospital blocks 3. Construction of administrative building and store block for Fire and Emergency Department 4. Construction of 56 number classroom building	43.48 million
Reconstruction of roads and bridges	1. 15 road sub-projects comprising of 18 roads 2. 16 bridge sub-projects	60.48 million

Components	Sub-projects	Cost (US$)
Restoration of urban flood management infrastructure	1. Upgradation of 49 storm water pumping stations. 2. Construction of 4 storm water drainage schemes 3. Installation of SCADA system for 80 storm water pumping stations 4. 7 sub-projects for procurement of equipment	37.70 million
Restoration and strengthening livelihoods	1. 12 sub-projects under civil works and equipment 2. 17 sub-projects under consultancy works	7.49 million
Strengthening disaster risk management capacity	1. 21 sub-projects under civil works/goods/machinery 2. 6 sub-projects under consultancy items	33.35 million

Source: Data provided by the JTFRP

The JTFRP since 2015, has been executing numerous reconstruction projects as part of "Build Back Better" strategy. The restoration initiatives taken under this project includes development and widening of access roads, construction and amenities improvement for hospitals and schools, building new institutions, industrial expansions, and flood mitigation measures, etc. About 170 projects in the UT had been or are being implemented with the help of different agencies and consultants.

4.2.2.4 Recent works under JTFRP

Renovation of woollen sector of Jammu and Kashmir under JTFRP, September 30, 2020

Jammu and Kashmir Economic Reconstruction Agency (JKERA) under the component of Restoration and Strengthening of Livelihoods, of the World Bank funded JTFRP, is taking concrete steps for the restoration/strengthening of livelihoods under the traditional cottage-based industry. In this regard, the restoration of Govt. Woollen Mills at Bemina are going through a major revamp[74]. The main aim of the sub-project is to strengthen the infrastructure of the heritage mills and provide the machinery with the latest equipment's so that the production of wool products is maximized to full potential.

Webinar on "Promoting Safe Habitat & Structural Safety", October 8, 2020

The webinar was organized by JTFRP as part of the sensitization campaign on one of its sub-projects namely "Upgrading Design Guidelines, building codes/ material specifications with

[74]Economic Reconstruction Agency, Government of Jammu and Kashmir. Retrieved from http://jkera.org/erafpweb/news.asp

respect to multiple disasters in J&K" under the component of "Strengthening the Disaster Management Capacity". The Webinar was attended by more than 150 participants from the across the country which included urban planners, architects, structural engineers, policy makers, researchers and various experts in the field of disaster mitigation and many officers of JTFRP.

Medical Equipment procured under JTFRP to Revolutionize Critical Health Care System in J&K, January 16, 2021

About forty-two different types of latest state of art critical care equipment are being procured under the CERC (Contingency Emergency Response Component under the Jhelum Tawi Flood Recovery Project[75]. The total allocation for the equipment stands at USD 50 million. This critical care equipment can be used to treat critically ill patients at the peripheral hospitals. This will help in reducing the burden of the referrals on the District and Tertiary Hospitals besides providing the people with quality health care facilities in their native places.

Training Programme on "Flood Forecasting Methods", March 18, 2021

A four-day training programme on "Latest Flood Forecasting Methods and its Application in Integrated Forecast System" has recently been organized by JTFRP for the engineers of the Irrigation and Flood Control Department[76]. About 30 engineers of the department attended this programme, wherein they were provided with hands-on training on the use of various latest software used in many advanced countries across the globe for timely forecasting of floods. JTFRP also aims at organizing a similar training programme for the engineers of the Irrigation and Flood Control Department shortly.

4.2.3 Role of Directorate of Education, Srinagar

As a result of the 2014 deluge in Kashmir, about 48 schools/educational institutions got fully and 312 partially damaged. This led to the disruption of education because some of the schools in the Kashmir Division remained affected ranging from one to three months[77].

Keeping in mind the damages by floods of 2014 to the educational infrastructure, the loss of education afterward, the Directorate of Education (DOE) of Kashmir has taken up a lot of initiatives regarding the prevention of damages and destructions owing to any flood/disaster event in the future. One of the first and foremost works to be considered was the reconstruction and repair of the damaged educational institutions. Many of the schools were reconstructed and many were repaired as per the need. Fig 4.5 shows the status of some schools immediately after the floods and post flood renovation and repair works undertaken by the government.

[75]Economic Reconstruction Agency, Government of Jammu and Kashmir
[76]Economic Reconstruction Agency, Government of Jammu and Kashmir. Retrieved from http://jkera.org/erafpweb/news.asp
[77]Directorate of Education, Srinagar

Apart from taking the structural reconstruction and renovation measures immediately after the floods or later, the Directorate of Education had taken up some special measures like preparation of disaster management plans for schools, training of Head of Institutions, teachers and authorities, establishment of school safety clubs, and many other such activities. Some of them can be summed up as below[78]:

1. Detailed Disaster Management Plan

A comprehensive disaster management plan named as Child Centered Emergency Preparedness Plan had been finalized for the education department by the Directorate of School Education Kashmir. This plan has been submitted for further processing to the administrative departments and the State Disaster Management Authority.

Figure 4.5: Situation of schools immediately after the floods and after post flood renovation/repair works

Source: Photo credit to Mr. Shakir Nabi Lone, Officer on Special Duty, Directorate of Education, Kashmir Division

2. School Disaster Management Plans (SDMP)

School Disaster Management Plans have been finalized in 3731 schools across the Kashmir division; a comprehensive format of which has also been finalized. The format of school disaster management plan constitutes every major to minor details of the schools. From

[78]Directorate of Education, Kashmir. Retrieved on March 16, 2021.

general information about the number of students and staff in the schools to infrastructural details have been incorporated in the format to have a detailed understanding.

3. Training Programmes

Regarding the effective preparation of the School Disaster Management Plans and the Child Centered Emergency Preparedness Plan, several sessions of trainings of Head of Institutions (HOIs) were conducted by the Cultural Education Unit of DSEK. The trainings were held in 6 districts namely Srinagar, Budgam Ganderbal, Kulgam, Shopian, and Pulwama. The Directorate of Education assures to conduct similar trainings in the remaining four districts as well shortly.

4. Mock Drills

About 4,341 schools in the state had participated in annual mock drills conducted under the school safety programme. The mock drills were all related to disaster management at the times of disaster emergencies.

5. Fire Safety

As per the data given by the DOE Kashmir, fire extinguishers have been installed in 7814 schools under the pretext of fire safety at the times of emergencies.

6. School Safety Clubs

Various school safety clubs had constituted in every Model Higher Senior Secondary School with the Principal as the Chairperson and one teacher and student representative as members of the club.

7. Disaster Management as a part of the curriculum

Disaster Management has been regarded as an integral part of the curriculum and is being taught at secondary level.

8. Chief Education Officers as Nodal Officers

Chief Education Officers have been nominated as Nodal Officers in all the districts; one of which has further been nominated at the Divisional Level. The Divisional Level Nodal Officer has been a part of all the training programmes conducted by NIDM, SDMA, and IMPARD. Such training programmes provide useful insight to the disaster situations in the region and help in managing the disaster to some extent as well.

9. Quarterly reports

One of the most appreciative efforts taken up by the DOE Kashmir is the submission of quarterly reports to the administrative department regarding various components of disaster management in schools. QPR (quarterly progress report) has already been submitted to the administrative department dated December 2020.

4.2.3.1 Future Course of Action

Apart from the above-mentioned points, there are several other works related to disaster management in schools or in the education department that DOE plans to go ahead with. Some of them are mentioned below:

1. Training of Trainers Programme

The education department of Kashmir aims at conducting a three-day training of trainers' programme wherein two resource persons from each of the 10 districts will be given training regarding school safety and safety auditing. For the regulation of this programme, following attempts have been/will be made:

i) For the provision of training, experts from institutions like NIDM and SDMA will be requested.

ii) Proposals in this regard have been submitted to the State Disaster Management Authority and Office of Divisional Commissioner, Kashmir.

iii) Authorities have been requested to provide funds to conduct of training/capacity building programme.

2. Promoting Mock Drills

The department also aims at conducting several mock drills in the future in collaboration with the Department of Civil Defense.

3. School Safety Clubs

It was targeted to have the extension of school safety clubs to all the higher secondary schools by the academic year 2021-22.

4. Safety Audit

Structural and Non-Structural inspection of safety in all the schools with the support of Fire and Emergency Department, Red Cross, District Disaster Management Authorities and other line departments to be conducted in future.

4.2.4 Srinagar Municipal Corporation (Drainage Sector Scenario)

A major portion of Srinagar city is prone to flooding and waterlogging owing to a high-water table, low-lying areas, and a large expanse of wet and marshy lands surrounding it. The combined effect of these factors and heavy rainfall made the floods of 2014 historic. With large scale waterlogging and drainage sector issues, extreme inadequateness of the existing infrastructural facilities and the drainage system in the region was exposed. This led the Srinagar Municipal Corporation to undertake some critical steps in this regard. Some of them are discussed below[79]:

[79]Srinagar Municipal Corporation

4.2.4.1 Restoration of damaged drainage facilities

The deluge of 2014 submerged and damaged almost all the de-watering stations which led to the forced opening of river embankments for draining out the floodwaters. This problem needed to be repaired and safeguarded from any such event in the future. Hence, the erstwhile State/UT Government Government, upgraded the 28 de-watering stations in the most vulnerable parts of the city.

Involvement of Jammu and Kashmir Economic Reconstruction Agency (JKERA)

Moreover, installations of submersible pumps, DG power backup and other electromechanical equipment, new pump house buildings through the Economic Reconstruction Agency under Asian Development Bank funding, were some of the works undertaken in this regard. The ERA has executed some post flood major drainage schemes in vulnerable areas of Srinagar City.

As much as Rs 27.28 crores for the upgradation and upliftment of 23 drainage pumping stations on right and left sides of river Jhelum in Srinagar City have been spent by the Jammu and Kashmir Economic Reconstruction Agency (JKERA)[80].

The sub-project by the ERA involves revamping of these pumping stations as well by installation of new electro-mechanical equipment along with the necessary civil works that were necessitated due to the raised HFL in Srinagar city due to the floods of 2014 during which the said pumping stations were badly damaged.

ERA has been executing some drainage schemes currently under World Bank funding within Srinagar city. One of which is the 'construction of a mega de-watering pump station'. The project includes upgradation of 49 high-tech de-watering pump stations across the city which is managed by Jhelum and Tawi Flood Recovery Project (JTFRP). As per a statement by the Chief Executive Officer of ERA, it has been estimated that around 4 to 5 lakh population will be benefited from this project[81]. Moreover, it has been said that these pumping stations are being equipped with the latest technology so that they can work automatically when a flood-like situation occurs. About Rs. 103 crores have been funded by the World Bank for this project.

4.2.4.2 Project AMRUT

Srinagar Municipal Corporation under centrally sponsored scheme AMRUT (Atal Mission for Rejuvenation and Urban Transformation) had also executed five drainage schemes including de-watering stations in different areas of Srinagar city after the floods. The total cost decided for this project came around Rs. 55 crores.

Moreover, SMC planned to take up two new drainage schemes named D/S Hamdania Colony Bermina Phase-1, and D/S Iqbal Colony HMT Shalteng. The total cost decided for the execution of these schemes came around Rs. 24 crores. All of the drainage facilities and de-watering projects were taken up by SMC, are summed up in the Table 4.15.

[80]Retrieved from http://jkera.org/erafpweb/news.asp˙offset=40 on April 24, 2021
[81]Retrieved from Https://www.aninews.in/news/national/general-news/govt-constructing-mega-dewatering-pump-stations-under-world-bank-scheme-in-srinagar20200812143434/ on April 24, 2021

Table 4.15: List of 85 permanent dewatering stations of Mechanical City Drainage Division, Srinagar

S.No.	Name of Dewatering Station	S. No.	Name of Dewatering Station	S.No.	Name of Dewatering Station	S.No.	Name of Dewatering Station
1	Abi Guzar	23	Nursing Garh	45	Lal Mandi	67	Sardar Mohalla
2	Alluchi Bagh	24	Sonwar Bagh	46	Lal Trag	68	Shalteng Village
3	Barbar Shah	25	Sonwar Davis	47	Lasjan	69	Shalteng Phase 2
4	Batamaloo	26	Syed Hamida Pora	48	Lower Parimpora	70	Surnai Mohalla
5	Bishember Nagar	27	Teng Pora	49	Magray Mohalla, Old Barzulla	71	Shuhampora
6	DarishKadal	28	S.M.H.S. Hospital	50	Mehjoor Nagar	72	TeergariPora
7	Golf Course	29	Aali Masjid	51	Mughal Masjid	73	ZampKadal
8	IkhrajPora	30	Alamgari Bazar	52	Natipora	74	Channapora (MPS)
9	Iqbal Colony Shalteng	31	AmdaKadal	53	Old Zero Bridge	75	Channapora Bridge (IPS)
10	Kawji Adda	32	Aramwari Zero Bridge	54	Pamposh Colony	76	Tengpora Bridge
11	Khidmat Press	33	Barzulla Flyover	55	Parraypora	77	Bemina-JVC
12	Indra Nagar	34	Bulbul Bagh	56	Peer Bagh	78	Noor Bagh (proposed)
13	Mandir Bagh	35	Chanapora Sluice	57	Radapora	79	Patlipora (proposed)
14	N.R. Colony	36	Co-operative Colony	58	Rathpora	80	Court Road
15	New Gadhanjipora	37	Hassi-Bhat-I	59	Rattan Rani	81	Afandi Bagh
16	Old Gadhanjipora	38	Firdous Abad	60	Rawalpora	82	Alamdar Colony
17	Pandrethan	39	Fruit Mandi	61	Reitang, Khanyar	83	Moominabad
18	Polytechnic	40	Gani Stadium	62	Rose Avenue (HMT)	84	H.S.H.S.
19	Qamarwari	41	Gojwara	63	Roselane Channapora	85	Madina Colony
20	Rajbagh	42	Hassi Bhat-II	64	S.P. College		
21	Shivpora	43	KhacharPora	65	Shaheen Colony		
22	Shora Khan	44	Khan Colony Channapora	66	Shakoor Colony		

Source: Srinagar Municipal Corporation

4.2.4.3 *Mobile dewatering units by SMC*

Srinagar Municipal Corporation had procured around 87 mobile de-watering units to strengthen the emergency response, especially during waterlogging of low-lying city areas. SMC had executed this project under Jhelum and Tawi Flood Recovery Project. The details of those pumping units are mentioned in the table 4.16.

Table 4.16: Number of mobile pumping units by Mechanical City Drainage Division SMC, Srinagar after the floods 2014

Pumping Units	Numbers
Diesel engine driven mobile pumping units	87
Diesel engine driven self-priming type mobile pumping units of low capacity (75000-100000 liters/hr)	20
Diesel engine driven self-priming type mobile pumping units of medium capacity (200000 liters/hr)	40
Auto prime diesel engine driven moderate capacity mobile pumping units (300000-500000 liters/hr)	15
Diesel engine driven high capacity auto prime mobile pumping units of (500000-700000 liters/hr)	12
Quick response/towing vehicle	8

Source: Srinagar Municipal Corporation

In addition, drainage circle of SMC has established 32 temporary dewatering stations in vulnerable areas of the city for storm-water dewatering, all of which are prospective of being upgraded as per the availability of funding.

4.2.4.4 *Other works*

- Augmentation of operational efficiency of city drainage network has been initiated by taking up processes like de-silting, which is being mechanized with the purchase of 20 de-silting machines for a cost of Rs. 2 crores.
- Two super suckers cum jetting machines of 12000-liter capacity each are planned to be procured under the smart city project for the maintenance of drain.
- Twelve medium capacity suckers cum jetting machines have already been deployed by SMC.
- A national level consultant is being appointed to formulate a drainage master plan and detailed project report under the Srinagar Metropolitan Region Master Plan 2035[82].

[82]Srinagar Municipal Corporation

4.2.5 Wullar Lake Project

Wullar Lake is the largest fresh water lake situated about 40 kms north of Srinagar city in Bandipora & Baramulla districts. This lake is very important for the region as it provides about 60% of the total fish consumed in the entire Kashmir valley, provides livelihood to 0.8 million[83] people in the form of plant products, and regulates the hydrological regimes of the valley.

Figure 4.6: Wullar lake during the execution of Wullar Action Plan

Source: Wullar Conservation and Management Authority

To safeguard the lake and prevent disasters from occurring through it, Wullar Lake Action Plan has been initiated; it has been divided into two phases, the key components of which are mentioned in table 4.17.

Table 4.17: Key Components and the Amount (in crores) for Wullar Lake Project

Key components	Amount (in crores)	
	Phase-I	Phase-II
Survey and Demarcation	2.22	4.03
Catchment Conservation	13.52	14.48
Water Management	29.17	175.38
Institutional Development	1.04	2.53
Ecotourism Development	-	1.87
Biodiversity Conservation	-	1.80
Total	45.95	200.00

Source: Wullar Conservation and Management Authority

4.2.5.1 Wullar Action Plan, Phase I (2012-2018)

The Phase-I of Wullar Action Plan was initiated carrying a total of INR 45.95 crores. The works completed under are as follows:

[83]Wullar Conservation and Management Authority

1. Demarcation of lake has been completed.
2. 1159 Boundary pillars fixed and geo-tagged using Remote Sensing Technology.
3. De-silting of an area of about 1.00 sq.km. is done.
4. Removal of silt load of 8.87 lac cub meters finished
5. De-silting of 3.1 km long stretch of choked feeder channel (Naaz Nallah)
6. 1220 Ha degraded catchment area treated with the planting of 12 Lac saplings.

4.2.5.2 Wullar Action Plan, Phase II (2020-2022)

Major works executed or still under execution under Wullar Action Plan Phase-II for each component are discussed as follow:

Water Management

Work	Outcome/Status
Increasing the water holding capacity of Wullar lake & its feeder channel (Naaz Nalla) near village Saderkote Payen & Banyari for conservation & management of the lake	This work has been completed as on March 31, 2021, the outcome of which is enhanced water holding capacity of the lake with improved hydrological regime by desilting of 5.45 lakh cum covering an area of 0.25 sq.km.
Increasing the water holding capacity of the lake with an amount of Rs. 148.59 crore-ongoing (as of march 31, 2021)	Desilting of 63.93 lakh cum covering an area of 3.10 sq.km. About 76.70% of the work in this regard has been completed.
Construction of earthen embankment of Naaz Nallah including construction of approach road to Wullar lake	40% of the work under this component has been completed which has provided better accessibility to lake and future eco-tourism development.

Source: Wullar Conservation and Management Authority

Figure 4.7: Dredging before (left), execution (middle), and after (right) at Wullar Lake

Source: Wullar Conservation and Management Authority

Figure 4.8: Dredging at Feeder Channel Naz Nalla

Source: Wullar Conservation and Management Authority

Catchment Conservation

WORK	OUTCOME/STATUS
Afforestation for an area of 235 ha/ 900 check dams and 775 stream bank protection crates	Work completed, with an increase in area under plantations and reduction in silt loads by reduced erosion due to runoff and stream bank scouring

Source: Wullar Conservation and Management Authority

Figure 4.9: Catchment conservation (Stream bank protection-left, check dams-right) works at Wullar Lake

Source: Wullar Conservation and Management Authority

Survey and Demarcation

WORK	OUTCOME/STATUS
Providing and laying of boundary pillars	Consolidation of lake boundary Effective and holistic working and for availing funds from multiple sources including international organizations Tendering and evaluation completed awaiting approval from administrative department

Source: Wullar Conservation and Management Authority

Figure 4.10: Demarcation works under Wullar Action Plan

Source: Wullar Conservation and Management Authority

Biodiversity Conservation and Eco-tourism development

WORK	OUTCOME/STATUS
Development of delta/bird watch tower/bird surveys/outreach programmes	Better socio-economic conditions of the area and improved habitat management

Source: Wullar Conservation and Management Authority

Institutional Development

WORK	OUTCOME/STATUS
Construction of field office at SK Payeen Bandipora	Strengthening of institutional support at field level and infrastructure development. This work is still under process.

Source: Wullar Conservation and Management Authority

Willow Extraction

WORK	OUTCOME/STATUS
Extraction of willows from Wullar lake	Decreased area under unwanted plantations 19.47 crore revenue has been generated as of March 31, 2021

Source: Wullar Conservation and Management Authority

4.2.5.3 Financial Achievements under Wullar Action Plan

Table 4.18 shows the financial expenses for the work undertaken for each key component under Wullar Action Plan

Table 4.18: Financial Achievements under Wullar Action Plan

Key Components	Amount utilized (in crores)	Works undertaken
Survey and Demarcation	0.06	Boundary Consolidation/Internal Monitoring
Catchment Conservation	3.32	Afforestation Works (235 ha) Soil & Moisture Conservation Activities (900 crate-wire check-dams/775 Streambank crates)
Water Management	91.93	Dredging Works/Road development, etc.
Institutional Development	0.027	Interpretation Material
Ecotourism Development	0.00	-
Biodiversity Conservation	0.517	Construction of Field office of Authority
Total	95.85	

Source: Wullar Conservation and Management Authority

4.2.5.4 Wullar Action Plan-Achievements till February 2021

Summarising the achievements of Wullar Action Plan till Feb 2021 as shown in table 4.19 are:

Table 4.19: Wullar Action Plan-Achievements till February 2021

Name of the project	Wullar Action Plan (Wullar Dredging)
Total quantity/area to be dredged	63.93 lac cum/3.10 sq. Km
Total quantity already dredged	49.04 lac cum (76.70% of the work completed)
Balance to be achieved	14.89 lac cum

Source: Wullar Conservation and Management Authority

4.2.2.5 Other Achievements

Submission of the project report: A detailed project report and comprehensive conservation and management plan for Wullar lake have been submitted to the administrative department for approval on February 25, 2021.

Capacity building green skill development programme

Wullar Conservation and Management Authority (WUCMA) has successfully conducted two training sessions under Green Skill Development Programme by the Ministry of Environment, Forestry and Climate Change. The themes were:

i) Bird Identification and basic course on Ornithology, in which 17 participants were trained for 160 hrs.

ii) Solid Waste Management, in which 20 participants went under training for 260 hrs.

Anti-encroachment measures

After the identification of all encroachments in Wullar Lake, an area of about 0.36 sq.km. which is 0.27% of the lake area has been encroached. In addition, community leaders and local people were motivated to remove encroachments on their own.

Public Outreach Programmes

Apart from the structural measures, several non-structural measures including various public outreach programmes were conducted, several schools were renovated, distribution of food and other essential items such as vegetable seeds and fruit plants were also provided to the public, etc.

4.2.6 Works done under TAMEIR Plan

The Aggregative Multi-sector Economic & Infrastructural Rebuilding (TAMEIR), 2015-2020 Plan was initiated to assist the erstwhile state/UT of Jammu & Kashmir in rebuilding infrastructure which got devastated in the floods of 2014. TAMIER plan covered projects of worth Rs. 200 crores, completed in March 2017[84] and included the upgradation of industrial estates in Anantnag, Anchidoora, Bijbehara, Pulwama, Poonch, Udhampur, Kathua. Several agencies were involved in executing the TAMEIR and PMDP. Some of them are mentioned in the table 4.20 including the works completed and cost incurred.

[84] https://www.crosstownnews.in/post/5301/projects-worth-rs-11641-cr-to-be-undertaken-with-world-bank-assistance-rs-200-crore-under-tameir-ganga.html

Table 4.20: Abstract TAMEIR and PMDP Plan

Executing Agency	Total No. of works	No. of works completed	Estimated Cost (Rs. Lakhs)	Authorized Cost
TAMEIR				
Engineering Wing of School Education Department	3	2	320.11	140.50
J&K Housing Board	10	3	1404.39	1366.69
J&K Police Housing Corporation	15	13	975.50	944.50
PW, (R&B Department	1	0	120.00	120.00
District Development Commissioner, Baramulla	5	4	217.40	217.40
Total TAMEIR	**34**	**22**	**3034.40**	**2789.09**
PMDP				
PW, (R&B) Department	33	31	370.00	370.00
Engineering Wing of School Education Department	1	0	10.16	10.16
Chief Education Officer, Kulgam, Anantnag	13	9	135.00	135.00
Total PMDP	**47**	**40**	**515.16**	**515.16**
Grand Total	**81**	**62**	**3549.56**	**3304.25**

Source: Government of Jammu and Kashmir

The Prime Minister Development Programme (PMDP), 2015-2020 of worth Rs. 80 crore package constituted various components of development after the floods 2014. Humanitarian Relief, Crisis Management, Social Infrastructure, Development Projects for tourism, agriculture, horticulture, and urban development sectors, and Economic Infrastructure including major projects related to power, road, transport and highways, etc. are some of the main components in this programme. A summary of assistance by the centre for each of the components can be observed from table 4.21.

Table 4.21: A summary of central assistance for each component under PMDP/TAMEIR

Sector	Central Assistance (in crores)
Humanitarian Relief	6313.00
Crisis Management	5858.00
Social Infrastructure	8057.00
Development Projects	5521.00
Economic Infrastructure	54319.00
Total	80068.00

Source: https://vifdatabase.com/wp-content/uploads/2018/05/pmdp.pdf

4.2.6.1 Projects under Prime Minister's Development Package

The PMDP plan was announced on November 17, 2015, consisting of 63 projects with an outlay of Rs. 80,068 crores, out of which 20 projects have been completed so far, and about 34 of them are ongoing[85]. Table 4.22 provides details about the completed projects under PMDP.

Table 4.22 : Completed Projects under PMDP

S. No.	Name of the Project	Concerned Ministry	PMDP Cost (INR Crores)	Share Released (INR Crores)	Share Utilized (INR Crores)
1	Construction of double lane road Batote - Kishtwar – Sinthan pass - Anantnag (NH-244)	M/o Road, Transport and Highways	130.00	130.00	130.00
2	4-laning of Jammu-Udhampur section of NH -1A (km 15 to 67)	M/o Road, Transport and Highways	83.00	2651.59	2651.59
3	Four laning of Chenani - Nashri section of NH -1A (km 89 to 130) (Tunnel project – 9km long tunnel – 2 lane)	M/o Road, Transport and Highways	781.00	4709.47	4709.47
5	Interest Subvention on assistance for restoration of livelihood for traders/ self - employed/business establishment	M/o Finance/ NITI Aayog	800.00	824.90	824.90
6	EAP project of J&K urban sector development Investment programme	M/o Finance/ NITI Aayog	712.00	622.28	622.28
7	Counterpart Funding- ADB-II	M/o Finance/ NITI Aayog	566.00	313.96	313.96

[85]http://www.jkplanning.gov.in/pdf/PMDP.pdf

S. No.	Name of the Project	Concerned Ministry	PMDP Cost (INR Crores)	Share Released (INR Crores)	Share Utilized (INR Crores)
8	Assistance for completely damaged/severely damaged/ partially damaged houses- Approx. 73000 Kucha house and 1,58,300 for Pucca Houses	M/o Finance/ NITI Aayog	1200.00	1194.85	1177.05
9	Rehabilitation Package for Jammu Migrants	MHA	13.00	13.00	13.00
10	Rehabilitation package for one-time settlement of 36384 families from POK and Chhamb DPs	MHA	2000.00	1411.76	1411.76
11	Enhanced rate of remuneration to SPOs from Rs. 3,000 p.m. to Rs. 6,000 p.m.	MHA	450.00	450.00	450.00
12	Balance Central Share Liability of ongoing JnNURM projects	Ministry of Urban Development	163.00	30.25	25.53
	Total		**6898.00**	**12352.06**	**12329.54**

Source: Prime Minister's Development Package. Retrieved from http://www.jkplanning.gov.in/pdf/PMDP.pdf

4.2.7 Indian Meteorological Department

The Indian Meteorological Department (IMD), being the nodal agency for national meteorological services, undertakes meteorological observations and forecasts for the optimum operation of weather-sensitive activities, and provides accurate warnings against potentially damaging hazards[86]. Weather forecasts and early warnings are the two major features of the department.

The early warning system generally comprises of four basic components, viz., knowledge or analysis of the risk involved, monitoring and warning service, dissemination and communication of the warning, and response capability. Taking these into consideration, the role of IMD in providing early warnings and weather forecasts for disasters like cyclones, thunderstorms, floods, heatwaves, and cold waves, etc. is astounding. For flood disasters, IMD provides real-time hydro-meteorological observations which incorporate Decision Support System -(DSS) for issuing Quantitative Precipitation Forecast (QPF) and heavy rainfall warnings. This is done with the help of technologies like Doppler Weather Radar (DWR) network. The DWRs used by IMD has been increased to 27 in number across the country being

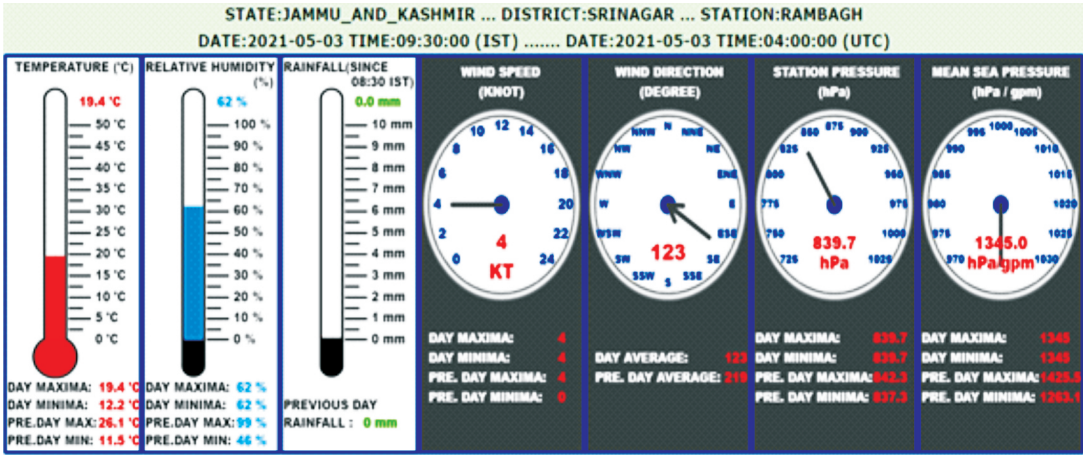
[86]Indian Meteorological Department. Retrieved from https://mausam.imd.gov.in/imd_latest/contents/pdf/pubbrochures/Weather%20Forecasting%20Services.pdf

used for forecasting and dissemination of early warning of heatwaves, heavy rainfall, thunder, lightning, and thunderstorms, etc.

After the Kashmir floods 2014, IMD has worked towards the improvement of weather forecasts and early warning systems in the region by initiating developments such as adding up new and latest instruments and weather models for better forecast and to provide a better warning system for future meteorological disaster and strengthening the existing early warning system. A summary of the works done by IMD after the floods are discussed as follows[87]:

The Department has worked towards strengthening the observational network at the district level with a minimum establishment of one Automatic Weather Station (AWS) and 14 Automatic Rain Gauges (ARGs) in each district[88]. These instruments set up by the Department in each district of Kashmir give real-time (15 min to 1 hourly) rainfall information. Moreover, this information has been regulated in the form of an online website[89] which is accessible to everyone. A snapshot of the website representing weather data of Rambagh, Srinagar, dated May 3 2021, can be seen with the help of figure 4.11.

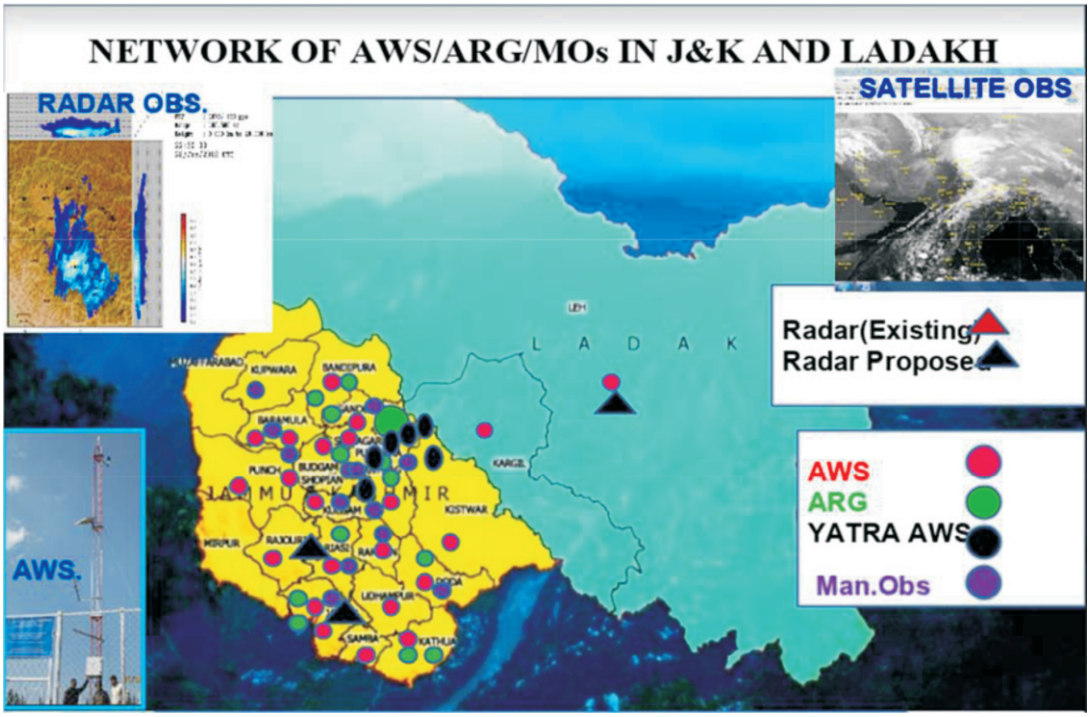
Figure 4.11: Weather data by AWSs and ARGs of Rambagh, Srinagar dated May 3, 2021



Source: AWS, IMD website. http://aws.imd.gov.in:8091/

[87]Source: Indian Meteorological Department
[88]A total of 17 Automatic Weather Stations and Automatic Rain Gauges were set up by IMD as per information gathered from a presentation by Sonam Lotus at a webinar organized by NIDM on September 18, 2020.
[89]It can be accessed from http://aws.imd.gov.in:8091/

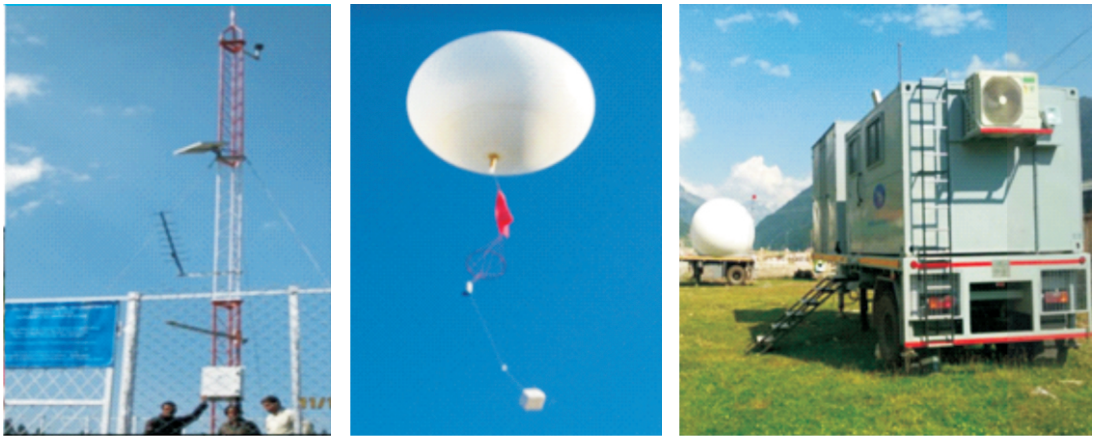
Figure 4.12: Location of Automatic Weather Stations and Automatic Rain Gauges in J&K and Ladakh



Source: Adopted from the presentation by Sonam Lotus from IMD during a webinar on "2014 Kashmir Flood Recovery: Experiences and Initiatives" organized by NIDM on September 18, 2020.

1. The Department has upgraded and strengthened the network of observatories, space and land based upper air RADARDS, etc.
2. Installation of two sophisticated X-Band Doppler Weather Radars (DWRs) at Srinagar and at Banihal Top in the month of February 2015 was completed; one of these is operational as per information received as of March 31, 2021.
3. The Department has also worked towards installing a CCTV-enabled control room which is placed under the Divisional Commissioner of Kashmir.
4. Drone system has also been enabled in many parts of Kashmir.
5. IMD also took the help of several research institutes such as the Indian Institute of Tropical Meteorology (IITM) and The National Centre for Medium Range Weather Forecasting (NCMRWF) for generating various district level weather models.

Figure 4.13: Monitoring System Installed by IMD in Jammu & Kashmir



Source: Mr. Sonam Lotus, Regional Director, IMD Srinagar Office (adopted from the presentation given at a webinar organized by NIDM on September 18, 2020

1. The department has set up a Meteorological Centre in Rambagh village of Srinagar which aims at flood forecast within the region.

2. For the year 2020-2021, an additional Doppler Weather Radar for Jammu Kashmir and Ladakh has been set up by the department[90].

3. Apart from structural measures, another notable thing is that all stakeholders have pledged to work in complete cooperation with one another to achieve a common set up goal of "Zero Casualty and Minimum Loss to Property".

4. More recent developments by IMD includes the issuance of 'impact-based forecasts', daily rainfall data being shared on mails and WhatsApp groups under the supervision of senior officers, regular interactions among stakeholders. These improvements were made in 2019-2020[91].

5. Apart from these measures, IMD has also enabled flash messages/alerts service through the radio, TV, SMS, android app, Twitter, and Facebook pages, etc. to disseminate early warning effectively and timely.

6. Further, the department thinks that even though the forecasting and early warning system has been strengthened, it needs more reinforcement, which will be undertaken soon.

[90] Adopted from presentation by Sonam Lotus at a webinar organized by NIDM on "2014 Kashmir Flood Recovery: Experiences and Initiatives", September 18, 2020
[91] Presentation on "Improvement of early warning systems post 2014 flood in J&K by IMD" by Sonam Lotus

4.2.8 Establishment of State Emergency Operation Centre (SEOC)

In the aftermath of the floods, the State/UT of Jammu and Kashmir has established two Emergency Operation Centres for better coordination of activities related to disaster management among various stakeholder at State/UT level. The two EOCs are located at Hari Niwas, Gupkar Road, Srinagar and Humhama, Srinagar, respectively. The EOC is being watched by staff 24×7 during peak seasons like winter months and flood season and regular watch is maintained for developing and issuing of the EWS under the administrative control of Divisional Commissioner Srinagar. The EOC was established with the following objectives:

- Monitoring of situations arising due to hazards/disasters at the state/UT level and coordination of management at these situations with all stakeholders including all concerned departments at national, state/UT as well as district levels.
- Preparation of daily situational reports related to disaster management at the state/UT level.
- Pooling of resources as per the requirement for effective management of situations.
- Sharing of water levels of Jhelum and Tawi River with the concerned departments for the effective response.
- Coordination with all the departments at National, State/UT as well as District level
- Widespread dissemination of weather updates across the Jammu & Kashmir.
- Share details of any mishap like fire incidents, road accidents, etc. to concerned departments for immediate response.
- Disseminate alerts like cold wave warning, avalanche warnings, heavy snowfall/rainfall, etc. via print and electronic media, email and other social media platforms like WhatsApp etc.
- Share all the alerts/warnings that are received from national and local departments like IMD, INCOIS, GSI, NWFC, etc. with all concerned stakeholders
- Share Traffic Plan and advisory of National Highway, Mughal Road, Zojila, etc. on daily basis.
- Organizing public awareness activities through workshops/training programs on multiple themes.
- Assisting in the upgradation of Disaster Management Plans at all levels.
- Pooling of resources as per the requirement.
- Other responsibilities as assigned by the concerned authorities time to time, such as due to the advent of Covid-19, its management has also been assigned to this Centre.

The details of equipments at the EOC established at Hari Niwas, Gupkar Road, Srinagar, can be observed from the table 4.23. The SEOC is the main command and control centre responsible for disaster management in the UT including emergency service integration and has been designed for 24×7 functioning.

Table 4.23: Details of equipment at EOC located at Hari Niwas, Gupkar Road, Srinagar is equipped (as on May 01, 2020)

Available Equipments		
S. No.	**Particulars**	**Quantity**
1	HP Computer System	02 No
2	HP Laser Jet 1020 plus Printer	01 No
3	HP Laser MFP 136w Printer	01 No
4	BSNL Landline with broadband connections	02 No
5	LED TVs / Monitors 54 inch	02 No
6	Luminous Inverter 1050w	02 No
7	Battery 150 Volt	02 No
8	Any tone AT-588	01 No
9	H/Band S.no 0145	01 No
10	Any tone AT-588	01 No
11	L/Band S.NO 0342	01 No
12	DMR Motorola 8668	01 No
13	Battery Charger	01 No
14	Battery (12v)	02 No
15	Reducer	01 No
16	GP Antenna	03 No
17	Feeder Roll	04 No
18	Mast	03 No
19	Cameras installed at 4 locations: a) Shankaracharya b) Nehru Park c) Ram Munshi Bagh d) Hari Niwas	04 No
20.	Other items	

Source: State Emergency Operation Centre, Hari Niwas, Gupkar Road, Srinagar

Figure 4.14: Clips of the State Emergency Operation Centre, Hari Niwas, Gupkar Road, Srinagar

Source: Visit of Dr. Amir Ali Khan to Srinagar (March 2021)

In addition, various maps indicating the following have been placed for on-the-spot information, dissemination, and management purposes:

- Map showing flood control rooms of Irrigation and Flood Control Department.
- Map showing boat station locations.
- Map showing water gauges in Kashmir Division.
- Map showing the location of rain and water gauges in Kashmir Division.
- Map showing rain gauges in Kashmir Division.
- Map showing critical infrastructure (health facilities) in high flood scenario.
- Map showing critical infrastructure mobile towers (Reliance Jio) in the high flood scenario.
- Map showing critical infrastructure (Government Departments) in the high flood scenario.
- Map showing critical infrastructure (educational institutions) in the high flood scenario.
- Map showing critical infrastructure (police stations) in the high flood scenario.
- Map showing extent of flooding for 20 ft rise in water level at Ram Munshi Bagh.
- Map showing extent of flooding for 30 ft rise in water level at Ram Munshi Bagh.

Some of the images of the maps on display can be observed from fig 4.15.

4.2.9 Directorate of Health Services, Kashmir

The Directorate of Health Services, Kashmir (DHSK) is one of the prominent departments playing a crucial role during a disaster in the region. Through its efforts, the Directorate has recorded a radical improvement in terms of major health indicators at the State/Division level. In view of the disaster situation in the state, after the deluge of 2014, several notable attempts by the department were observed, such as the establishment of a Disaster Preparedness and Mitigation Unit at Divisional level, a comprehensive disaster management plan, structural measures, and infrastructure developments in the health sector, etc.

Apart from the aforementioned points, there are some new initiatives that the DHSK has accomplished. They are discussed as follows[92]:

- **A Disaster Management Manual:** To effectively mitigate an upcoming disaster in terms of health and services, a disaster management manual on September 12, 2017, has been issued by the Directorate of Health and Services which carries out the details of the mechanism to be followed at times of an emergency or disaster.

  The Disaster Management Manual emphasizes the necessary guidelines, need for a command system, response teams and alternative measures for the quick response and immediate relief during disasters, and suggests various actions that can help to bring early stabilization in such situations.
- **Emergency codes:** The establishment of emergency codes at the district hospital in Pulwama was another fruitful achievement. Two codes, Viz., Code Yellow and Code Blue, were set up to use at times of a disaster. These codes are generally used to alert staff and provide the essential information quickly; they are designed for creating little to no confusion at all, and for alerting the staff while remaining discrete to keep both patients and visitors calm.
- **Computerized Radiography:** A system of computerized radiography has been started on PPP mode to reduce investment by the hospital and generating more revenue along with providing of a wide spectrum of services.
- **Bed-side oxygen delivery:** Bed-side oxygen delivery has been initiated in peripheral hospitals of Kashmir which is to be followed by many other hospitals, viz., DH Anantnag, DH Bandipora, DH Budgam, DH Kulgam and JLNM hospital, etc.
- **Automatic Central Lab:** The DHSK has marked a successful establishment of a fully automatic central lab having parameters of immunology, biochemistry, hematology, serology and pathology at district level; echocardiography and TMT at JLNM hospital in Rainwari including two more; an IT wing for the regulation of effective data management at directorate level; a DHSK media cell for direct and effective communication with the media, which also handles various social media accounts for the dissemination of information and effective outreach.

[92]Source of information here is the official website of "Directorate of Health Services, Kashmir", http://www.dhskashmir.org/health17.php

- **3D CT scan:** Three-dimensional CT scan service has been started at the district hospitals.
- Minimal Access Surgeries: Minimal access surgeries are something most needed at times of disasters in hospitals when there is very limited access to the resources; DHSK has established a Minimal Access Surgical Unit at JLNM hospital which has provided numerous advanced surgeries till now.
- **SOPs:** Standard Operating Protocols have been constituted to follow an effective mechanism enforced at chaotic times.
- **Better Management of Records:** For the management of records of patients and networking, a Medical Records Department has been established which contains computerized records of everything in the hospitals.
- **Establishment of New Type Primary Health Centres (NTPHCs):** Foundation of two (NTPHC) were laid in November 2017 at Chewdora and Ratsun villages at Beerwah Block in district Budgam and at Khiram, Anantnag.
- **Observing November 1st as Disaster Preparedness Day:** The Directorate of Health Services, Kashmir has marked November 1st as the 'Disaster Preparedness Day' for Kashmir wherein various exercises will be attempted and actions will be carried to minimize the effect of disaster.

The exercises performed on this day each year will be done for preparing health personnel and making them aware of their roles and responsibilities that they have to perform during a disaster. It was commenced with a view that health personnel are one of the first responders when a disaster strikes. The activities conducted by the health department include workshops about disaster preparedness like Fire Mock Drills, Basic Life Support Training, Handling of Medical Emergency (Pre & Post Hospital Care), handling of Critical Care Ambulances and Code Yellow & Code Blue drills in various districts of the valley.

Moreover, some structural upgradations still needed to be taken into account, as the health department is considered one of the first responders on disastrous events; thus, making the hospital buildings more resilient to disasters, setting up the equipment in less vulnerable portions of the building, construction of buildings keeping in mind the building codes, and away from the land having the potentiality of damage in a disaster like floods, etc. are some of the initiatives necessary for the cause.

5. Lessons Learned and Way Forward

LESSONS LEARNED AND WAY FORWARD

The September 2014 floods in Jammu and Kashmir was one of the worst urban flood disasters in the living memory. The unprecedented flood situation, particularly in the Kashmir Valley, has raised numerous questions related to preparedness at the national, state and community levels. The case study of Jammu and Kashmir reveals that less preparedness, mitigation and response planning had caused irreparable physical and economic losses to the community. Although, disaster management systems may have been developed at various administrative levels, their functionality and effectiveness to respond to the disaster are still uncertain. Some of the gaps and issues in the management of Jammu and Kashmir Floods are identified through this study.

Despite several events of floods in Jammu and Kashmir, the region has not been identified as flood prone. Installation of flood forecasting and early warning systems at appropriate locations and their regular monitoring has been a big challenge. Jammu and Kashmir have three hydrological stations viz. Sangam, Ram Munshi Bagh, and Safpora installed by Irrigation & Flood Control Department on Jhelum River which runs through the valley. These had detected the rise of water levels from 5.3 meters on 3rd September 2014 to 10.13 meters on 4th September 2014. However, the local authorities could not read the alarming signals of the rise in the water level as these stations were used to only monitor the flow of water from India to Pakistan and are not tagged as flood forecasting stations. Had the information by these stations provided flood forecast to the state authorities, they would have prepared for flood recovery by providing an early window to evacuate people from low-lying areas, deployment of special teams and arrangement of relief supplies.

Failures in the flood forecasting systems and inadequacy of the existing early warning system probably contributed to the severity of the floods. The situation could have been controlled by proper communication networks and last-mile connectivity. This was one of the several issues raised in the seminar[93] held right after the floods in Srinagar. As a result, an early operation of the Flood Early Warning System for Jhelum and Chenab under short-term/urgent measures was suggested[94]. The task is being taken up by several departments such as IMD and the Irrigation and Flood Control Department; their efforts have improved the early warning system in the region; however, as mentioned by Mr. Sonam Lotus from IMD, it is still a long way process and the flood early warning system needs more improvement if looked from the perspective of a deluge like 2014. The Seminar held in November 2014 raised some issues and suggested several short-term and long-term measures that are essential for building resilience in the region. Correspondingly, the issues persisting in the erstwhile State/UT and their respective measures are mentioned in this section.

[93] A 2-day national seminar on ""Retrospective and prospective of 2014 Kashmir Floods for building flood resilient Kashmir" was held at Srinagar in the month of November, 2014.
[94] Personal discussion with Dr. Dar, Faculty at IMPRD in light of Seminar outcome

Inadequate coordination of technical capacity of the State and Central Governments in flood forecasting, assessment of vulnerability and scenario mapping, etc. led to the mismanagement of the persevering flood situation. Discussions with Dr. GM Dar, underlined long-term urgent measures pointing towards the need for urgent institutionalization of a disaster management authority in the State/UT, which will solely focus on building the capacity of the region against all types of hazards.

The erstwhile state government though has approved disaster management policy in 2012, the institutional system and allocation of responsibilities to the departments during natural disasters are still underway. The DDMA was not set up in most of the districts of the UT. There were gaps and deficiencies found in institutional arrangements, policies and plan formulation as well as in the implementation of pre-disaster measures. Although, a considerable scope for improvement in SDRF funds to augment available resources as well as to ensure its utilization for the intended disaster preparedness and relief was there, deficiencies and delays in damage and need assessment, diversion in relief fund and delay in reaching relief and assistance to the affected persons was also observed. This marks the urgency of institutionalization of disaster management in the region to properly organize the persisting issues and overcome them thoroughly.

As per the erstwhile State/UT DM Policy, the existing Centre for Disaster Management at Jammu and Kashmir Institute of Public Administration and Rural Development (J&K IMPARD) was to be upgraded to State Institute of Disaster Management (SIDM), which has not been done till date. SIDM aims at fulfilling the need of capacity-building in the domain of DRR, and function as a technical, training, planning, and analysis, wing of the State Disaster Management Authority as well as incorporating the roles of various stakeholders working in the field of DRR in Jammu and Kashmir; all of them are essential for building resilience in any region.

In Jammu and Kashmir, there has been a rapid pace of developmental activities, including economic and infrastructure without adequate care for environmental safety and sustainability; such as mining activities on the flood plains of Jhelum and its river bed, unauthorized construction practices including construction of railway lines and poorly planned urbanization, etc. Most of these developmental activities are usually undertaken with utter disregard to environmental, geological, geomorphological and ecological conditions of the region. The ongoing construction boom is being fed by indiscriminate mining of sand, gravel, and boulders from riverbeds, which intends to weaken the existing flood control infrastructure which, in turn, makes the rivers more vulnerable to flash floods. The course of streams, rivers and canals has shifted or vanished for expansion of farmlands resulting in the water overflowing on the banks through fields and villages. The rapid urbanization in the valley, encroachment of water bodies in land adjoining river banks, the disappearance of wetlands, etc. have blocked the natural drainage patterns.

This depletion and degradation of water bodies and wetlands has crippled the efficiency to retain the floodwaters during peak discharge of water and flash floods, which has increased the variability of floods in the region. There is a need for relevant laws against illegal construction especially in the low-lying areas, and a need for revising the construction policies. Regulation of mining activities by keeping in mind the morphology and other hydrologic and geologic factors, restoration of wetlands, water bodies, and the removal of encroachment afterwards in the flood spill channels should be given high priority. Also, revision of the existing land use policy and building codes is required to minimize the human and economic loss owing to a natural disaster[95].

Keeping in mind the issues related to the river Jhelum and its basin, GM Dar in his list of suggestions, addressed the Irrigation and Flood Control Department (I&FC) to initiate the structural and non-structural measures for erosion control in the central and north Kashmir part of the Jhelum basin. The I &FC department has taken a lot of appreciative efforts in this regard as mentioned in chapter 4.

The existing flood control infrastructure in Kashmir was overwhelmed during the floods of 2014 leading to a hazardous situation in the region. Strengthening of flood control infrastructure using the available techniques in 4 high-gradient streams in south Kashmir, viz., Rambiara, Veshu, Romshi, and Lidder, enormously contributed to the discharge at Sangam, which will ascertain the flood peak and concentration time to be appreciably delayed by staggering the streams in the watershed itself before their discharge into the Jhelum at Sangam.

Disasters cannot be managed unless the stakeholders from the governmental departments, non-government organizations, international agencies and private sectors are working together in a well-coordinated manner. One of the reasons why the flood disaster could not be managed during initial hours was the lack of coordination between the state administration and its several departments. During the floods, a total collapse of communication facilities was observed which led to poor coordination of different activities. The Irrigation and Flood Control Department of Jammu and Kashmir due to power cut faced the difficulties in coordination during floods. The teams for disaster response could not be identified and sent to the affected places, and effective advisory about shifting from low-lying areas could not reach to the communities. All of this together hampered the identification of affected villages, numbers of beneficiaries, assessment of damages, and relief distribution process efficiently and effectively. The community volunteers, NGOs and humanitarian agencies were working independently without much involvement or assistance of the government agencies.

The flood 2014 taught a very important lesson of strengthening the flood disaster preparedness at governmental and community levels with effective coordination between responsible authorities so that there is a well-rehearsed mechanism in place for quick response. This will lead to integrated and proper management of the disaster, despite all the

[95]Discussion with Dr. GM Dar, IMPARD in light of seminar held in November 2014

adversities and limitations; as a result of which the impacts on the people and property could be minimized to considerable extent.

Some other long-term measures taken in this regard would be; the construction of an alternate flood channel from Dogripora to Wullar, improvement of the drainage system in urban areas in the Jhelum basin, restoration of the natural drainage, conservation and restoration of the degraded wetlands in the Jhelum basin, sewage treatment, city and town planning being conscious to flood and earthquake vulnerability, and other structural and non-structural measures as mentioned by Dr. GM Dar.

Flood prevention and mitigation measures are generally used by the regions where floods are a recurrent phenomenon. People living in such areas are habitual of taking certain precautions such as shifting from low-lying areas, crops grown in the undulated parts, creation of embankments/banks, construction of dams and reservoirs, channel improvement, desilting of rivers, land use planning and diversion of floodwaters to reduce the damage, etc. However, in the case of Jammu and Kashmir, such measures were not much implemented by the communities and officials, resulting in acute destruction.

There is still a large number of populations that remain unaware of the casualties and destructions that can incur to a large-scale disaster like Kashmir floods 2014. Hence, it has been emphasized that a massive capacity building program on a large scale must be initiated for public awareness and soliciting public involvement in flood risk reduction. Moreover, community-based disaster risk reduction plans must be prepared on priority basis, as the community is regarded as one of the first responders during a disaster. Such initiatives could lead to long-term vigorous changes and even loss of lives and property can be minimized.

To observe the anniversary of Kashmir floods 2014, the National Institute of Disaster Management organized a webinar entitled "2014 Kashmir Flood Recovery: Experiences and Initiatives", in which several prominent and influential speakers of interest, such as Dr. G. N. Qasba (Former Municipal Commissioner, Srinagar), Prof. Shakeel Romshoo (Dean Research, University of Kashmir), Mr. Sonam Lotus from IMD, and Iftikhar Kakroo, Chief Engineer, I&FC Department took part and shared their experiences and initiatives taken on behalf of their department, etc. Many appreciable resilient strategies and suggestions were carried out from the webinar. Some of the recommendations by these speakers have been discussed as following.

Identification of vulnerable areas by mapping of hotspots keeping in mind the population and infrastructure factor, debris management after the floods, rescue operations, prioritization of critical areas and marginalized populations for providing them with immediate recovery and rehabilitation, identification of financial and non-financial resources, capacity building with augmentation of skilled manpower for the response, relief, and recovery measures, community engagement, flood proofing of structures in vulnerable sites, and use of remote sensing technology for carrying out preparedness, response and mitigation of floods, etc.

Formulation of a robust action plan for flood control in the Jhelum basin, which must consist of flood early warning system, massive dredging of the main Jhelum, Wullar, and the Flood Spill Channel, siltation management from the catchment, conservation and restoration of the wetlands, flood vulnerability assessment and DRR, strengthening of the flood control infrastructure, and outstanding flood peaks and storages, etc. He also emphasized upon the need of incorporating a massive public awareness component into the flood mitigation process.

The response operation of Jammu and Kashmir exposed several shortcomings related to immediate response, distribution of relief supplies, rescue, damage assessment, restoration and rehabilitation, which had affected the entire recovery and rehabilitation process badly. A lot of time was lost in developing repair and reconstruction mechanism within government and resource management. During the period of recovery, rehabilitation, and reconstruction, Jammu and Kashmir equipped themselves with Build Back Better (BBB) approach to post-disaster recovery that reduces vulnerability to future disasters and build community resilience to address physical, social, environmental, and economic vulnerabilities and shocks. Recovery within a BBB framework gives impacted communities the chance to reduce risk not only from the immediate hazard but from potentially hazardous conditions as well.

The UT of Jammu and Kashmir, has already worked to build resilience under the post flood recovery projects. However, there is stills a long way to go in this direction. The UT government is working to create necessary structural and non-structural infrastructure to meet the challenge of disasters. It is expected that with continuous efforts of the UT government in this direction, entire region can achieve sufficient levels of resilience and start performing prolifically at times of disasters.

6. Bibliography

BIBLIOGRAPHY

1. A sprit of partnership, Annual report 2014-15, SEED India, https://www.seedsindia.org/wp-content/uploads/2018/07/Annual_Report_2014-2015_final_MC_230216.pdf, Retrieved on 21st October 2019
2. ANI News report "Govt constructing mega dewatering pump stations under World Bank scheme in Srinagar" retrieved from on April 24, 2021
3. Assessing the Seismic Behavior of Rammed Earth Walls with an L-Form Cross-Section, 4 November 2018, file:///C:/Users/thoma/Downloads/sustainability-11-01296-v3.pdf, Retrieved on 27th September 2019.
4. Assessing the seismic performance of rammed earth walls by using discrete elements, 14 June 2014, https://www.tandfonline.com/doi/pdf/10.1080/23311916.2016.1200835, Retrieved on 27th September 2019
5. Climate of Jammu and Kashmir, IMD, Govt. of India. Retrieved on 18th September 2019.
6. Cross Tpwn News, July 2016 "Projects worth Rs. 116.41 cr to be undertaken with World Bank assistance, Rs. 200 crore under TAMEIR: Ganga - Cross Town News, a Leading Newspaper of J&K" https://www.crosstownnews.in/post/5301/projects-worth-rs-11641-cr-to-be-undertaken-with-world-bank-assistance-rs-200-crore-under-tameir-ganga.html
7. Das, S.K. et al. 2007. "Flood and Drought Management through Water Resources Development in India", World Meteorological Organization. Retrieved from https://public.wmo.int/en/bulletin/flood-and-drought-management-through-water-resources-development-india on April 30, 2021
8. Department of Disaster Management, Relief, Rehabilitation and Reconstruction, Jammu and Kashmir State Disaster Management Authority, http://www.jksdma.org/wp-content/uploads/2017/08/SDM-Policy-2017-Final.pdf. Retrieved on 18th September 2019.
9. Directorate of Health Services, Kashmir", http://www.dhskashmir.org/health17.php
10. Directory of Lakes and Water bodies of Jammu and Kashmir State Using Remote Sensing and GIS Technology, Department of Environment and Remote Sensing, Forest Complex, Jammu, http://www.jkdears.com/eers/eers/orders/Directory%20Wetlands.pdf, Retrieved on 19th September 2019.
11. Dr. Ruheela Hassan, Disasters in Kashmir: Impact and Response, IOSR Journal of Humanities and Social Science (IOSR-JHSS) Volume 19, Issue 7, Ver. VI (July. 2014), PP 32-42 e-ISSN: 2279-0837, p-ISSN: 2279-0845. http://www.iosrjournals.org/iosr-jhss/papers/Vol19-issue7/Version-6/F019763242.pdf, Retrieved on 1st October 2019.

12. Economic Survey of Jammu and Kashmir, 2016, State Budget 2018-19 Department of Horticulture, Govt. of Jammu and Kashmir. http://ecostatjk.nic.in/ecosurvey/Economic%20Survey%202016%20PDF.pdf. Retrieved on 24th September 2019.

13. Economic Reconstruction Agency, Government of Jammu and Kashmir. Retrieved from http://jkera.org/erafpweb/news.asp

14. Economic Survey of Jammu and Kashmir, 2018-19, IBEF, https://www.ibef.org/download/Jammu-and-Kashmir-May-2018.pdf Retrieved on 24th September 2019.

15. Ecology and biodiversity in Pangong Tso (lake) and its inlet stream in Ladakh, 20 July, 2011, International Journal of Biodiversity and Conservation), http://www.academicjournals.org/IJBC, Retrieved on 22nd October 2019.

16. EM-DAT: Natural Disasters 2018 - Centre for Research on the Epidemiology of Disasters – CRED, https://www.emdat.be.Retrieved on 18th September 2019.

17. Epic Tragedy: Jammu & Kashmir Floods: A Clarion Call, Tabish and Nabil, Emerg Med (Los Angel) 2015, https://www.longdom.org/open-access/epic-tragedy-jammu-and-kashmir-floods-a-clarion-call-2165- 7548.1000233.pdf, Retrieved on 3rd October 2019.

18. Geographical Feature and Forest Area, Jammu and Kashmir Forest Department, Govt. of Jammu and Kashmir, http://www.jkforest.gov.in/geo_area.html. Retrieved on 19th September 2019.

19. Government of Jammu and Kashmir, Department of Finance, State Budget 2018-19. Retrieved on 24th September 2019 from India Brand Equity Foundation, http://www.ibef.org.

20. Health Facilities, National Health Mission, State Health Society, Health and Family Welfare Department, Govt. of Jammu and Kashmir. http://www.jknhm.com/healthfacilities.php, Retrieved on 25th September 2019.

21. Indian Meteorological Department. Retrieved from https://mausam.imd.gov.in/imd_latest/contents/pdf/pubbrochures/Weather%20Forecasting%20Services.pdf

22. Indian State of Forest Report, 2011, Forest Survey of India, Ministry of Environment, Forest and Climate Change. http://fsi.nic.in/cover_2011/jammu_kashmir.pdf. Retrieved on 19th September 2019.

23. Jammu and Kashmir development report, Planning commission of India, http://planningcommission.nic.in/plans/stateplan/sdr_JammuandKashmir/sdrjkch1.pdf Retrieved on 18th September 2019.

24. Jammu and Kashmir Floods: Death toll climbs to 277. Indian Express, 19th September 2014, http://indianexpress.com/article/india/india-others/jk-floods-death-toll-climbs- to-277/, Retrieved on 3rd October 2019.

25. Jammu and Kashmir State Disaster Management Policy (Revised: October 2017), Jammu and Kashmir State Disaster Management Authority Department of Disaster Management, Relief, Rehabilitation and Reconstruction, Government of Jammu and Kashmir, http://www.jksdma.org/wp-content/uploads/2017/08/SDM-Policy-2017-Final.pdf, Retrieved on 27th September 2019.

26. Jammu and Kashmir, ENVIS Center on Human Settlement's, Hosted by School of Planning and Architecture, Delhi, Sponsored by Ministry of Environment, Forests and Climate Change, Govt of India, http://spaenvis.nic.in/index3.aspx˙sslid=1378and subsublinkid=104andlangid=1andmid=1, Retrieved on 27th September 2019.

27. Jammu Master Plan 2032, Jammu Development Authority, https://www.jdajammu.in/LUP2032.pdf, Retrieved on 27th September 2019.

28. Jhelum and Tawi Flood Recovery Project, World Bank, http://jtfrp.in/jhelum-river-morphology/, Retrieved on 22nd October 2019.

29. Joint Rapid Needs Assessment Report: Jammu and Kashmir Floods 2014, https://sphereindiablog.wordpress.com/, retrieved on 3rd October 2019.

30. Kashmir Irrigation & Flood Control Department, Rajbagh, Srinagar. Retrieved from http://www.ifckashmir.com/replyjksic.htm

31. Land Use Statistics, India State of Forest Report, Ministry of Agriculture, GOI, 2013-14. http://fsi.nic.in/isfr2017/jammu-and-kashmir-isfr-2017.pdf. Retrieved on 20th September 2019.

32. Live Mint News Article, https://www.livemint.com/news/india/udhampursrinagarbaramulla-rail-link-project-longest-tunnel-t-49-connected-11644981574263.htmlRetrieved on 21 Feb 2022.

33. Master Plan 2035, Srinagar Development Authority, http://www.sdasrinagar.com/wp-content/uploads/2019/03/Master-Plan-2035-ReportFinal.pdf, Retrieved on 27th September 2019.

34. M.Azhar, PRO Kashmir 2019, Complete projects within agreed timelines: CEO ERAhttp://jkera.org/erafpweb/news.asp˙offset=40 Retrieved on April 24, 2021.

35. Ministry of Finance, Press Information Bureau, Government of India, https://pib.gov.in/newsite/PrintRelease.aspx˙relid=122606, Retrieved on 30th October 2019.

36. Mohammad Ashraf Fazili, Kashmir Floods: A Chronology, December 9th 2017, Lost Kashmir History, https://lostkashmirihistory.com/history-of-floods/, Retrieved on 27th September 2019.

37. Mohammad Ashraf Fazili, Kashmir Floods: A Chronology, December 9th 2017, Lost Kashmir History, https://lostkashmirihistory.com/history-of-floods/, Retrieved on 27th September 2019.

38. Monitoring Of Wular Lake And Its Immediate Catchment Area Using Remote Sensing And GIS Under Wular Conservation Project, March 2016, http://wular.org/wp-content/uploads/2019/07/DERS-DRAFT.pdf, Retrieved on 19th September 2019

39. Performance Audit, 31 March 2016, Comptroller and Auditor General of India, https://cag.gov.in/content/report-no4-2016-performance-audit-disaster-management-state-jammu-and-kashmir-government, Retrieved on 16th October 2019

40. Paul Jaquin, A History of Rammed Earth in Asia, International Workshop on Rammed Earth Materials and Sustainable Structures and Hakka Tulou Forum 2011: Structures of Sustainability at International Symposium on Innovation and Sustainability of Structures in Civil Engineering Xiamen University, China, 2011, https://pdfs.semanticscholar.org/be2f/f3ad3d6e7f95bf535e1b9811732aaec2ea21.pdf, Retrieved on 27th September 2019.

41. Press Release, Ministry of Defense Press Information Bureau, Government of India, https://pib.gov.in/newsite/archiveReleases.aspx, Retrieved on 3rd October 2019.

42. Retrospective and Prospective of 2014 Floods for Building Flood Resilient Kashmir, Centre for Dialogue and Reconciliation, April 2015, University of Kashmir, https://www.cdr-india.org/retrospective_and_Prospective_of_2014_Floods_15.pdf . Retrieved on 4th October 2019.

43. River basin atlas of India, Central Water Commission, Government of India Ministry of Water Resources, , Retrieved on 22nd October 2019.

44. Satellite-based assessment of the catastrophic Jhelum floods of September 2014, Jammu and Kashmir, India, Geomatics, Natural Hazards and Risk, 2017, https://www.tandfonline.com/doi/full/10.1080/19475705.2016.1218943, Retrieved on 3rd October 2019.

45. Shakil A. Romshoo, SadaffAltaf, Irfan Rashid and Reyaz Ahmad Dar (2017): Climatic, geomorphic and anthropogenic drivers of the 2014 extreme flooding in the Jhelum basin of Kashmir, India, https://www.researchgate.net/publication/322081697, Retrieved on 3rd October 2019

46. Sir Walter Roper Lawrence, Chapter VIII – Physical History, P 2015, The Valley of Kashmir, https://www.rarebooksocietyofindia.org/book_archive/196174216674_10153460989 311675.pdf , Retrieved on 4th October 2019.

47. Socio Economic Demographic profile of Jammu and Kashmir, Mission Directorate, ICDS, Government of Jammu and Kashmir, https://jkicds.com/socio_jk.php . Retrieved on 18th September 2019.

48. Status of hydro-electric potential development, 31/07/2019, Center Electric Authority, Ministry of Power Govt. of India. Retrieved on 24th September 2019 http://cea.nic.in/reports/monthly/hydro/2019/hydro_potential_region-07.pdf.

49. Transitional shelters Eight designs, International Federation of Red Cross and Red Crescent Societies, Geneva, 2011, , Retrieved on 30th October 2019.

50. UNDRR Terminology, 2017. Retrieved from https://www.undrr.org/terminology/resilience#:~:text=The%20ability%20of%20a%20system,and%20functions%20through%20risk%20management.

51. Wallace, W.A. &Balogh, F.D. "Decision Support Systems for Disaster Management", accessed from https://www.jstor.org/stable/3135008 on April 24, 2021.

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About the Institute

National Institute of Disaster Management (NIDM) was constituted under an Act of Parliament with a vision to play the role of a premier institute for capacity development in India and the region. The efforts in this direction that began with the formation of the National Centre for Disaster Management (NCDM) in 1995 gained impetus with its redesignation as the National Institute of Disaster Management (NIDM) for training and capacity development. Under the Disaster Management Act 2005, NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management.

NIDM is proud to have a multi-disciplinary core team of professionals working in various aspects of disaster management. In its endeavour to facilitate training and capacity development, the Institute has state-of-the-art facilities like class rooms, seminar hall and video-conferencing facilities etc. The Institute has a well-stocked library exclusively on the theme of disaster management and mitigation. The Institute provides training in face-to-face, on-line and self-learning mode as well as satellite based training. In-house and off-campus face-to-face training to the officials of the state governments is provided free of charge including modest boarding and lodging facilities.

NIDM provides Capacity Building support to various National and State level agencies in the field of Disaster Management & Disaster Risk Reduction. The Institute's vision is to create a Disaster Resilient India by building the capacity at all levels for disaster prevention and preparedness.

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Resilient India - Disaster Free India

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