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KERALA FLOODS
2018

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

Kerala Floods, 2018

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Kerala Floods 2018

ISBN No.: 978-93-82571-56-8

Edition: 2020

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Published by :
National Institute of Disaster Management (NIDM),
Ministry of Home Affairs, New Delhi-110042.

Citation :
Walia, A. and Nusrat, N. (2020). *Kerala Floods 2018*. National Institute of Disaster Management, New Delhi, Pages 106.

Cover Picture Source :
Anu Sharma (Chandigarh City News)
https://www.chandigarhcitynews.com/choosing-the-best-kerala-tour-packages/1551629577_kerala_tour_feature-png/

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Resilient India - Disaster Free India

Maj. Gen. Manoj Kumar Bindal
VSM
Executive Director

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FOREWORD

Kerala with a geographical terrain of both hills and plains, was battered by torrential rain which triggered ravaging floods and landslides in 2018. This was one of the worst disaster faced by the state in its history. The disaster highlighted the weakening of the bond which connected the inhabitants to its nature. As per the Kerala State Disaster Management Authority, the disaster resulted in 433 fatalities (268 men, 98 women and 67 children).

The response of the community in the state was overwhelming. Organizations such as Kudumshree highlighted how women can be effective responders to disasters. The search and rescue activities carried out by fishermen community helped to save the lives of many. The people who belonged to Kerala, but were not in the country during the time of disaster, used technology to send coordinates of the trapped survivors to search and rescue personnel through crowd sourcing. The community demonstrated their tenacity, grit and, unity in spirit to tide over a common tragedy that engulfed them.

While we cannot prevent natural phenomena, we can definitely limit their repercussions on the society. The challenge in facing these natural hazards is to find a way to live with these phenomena rather than die from them and enhance resilience of the community in facing such recurrent disasters in the future. It is hoped that the publication of this document will stimulate improved data collection and research which can enable the gaps identified in the management of the disasters to be addressed in future. The document draws on lessons learnt from the flood disaster of 2018 in Kerala, reflecting a common concern in building disaster resilient communities and reducing human, social, economic and environmental losses due to such disasters.

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ACKNOWLEDGEMENT

Disasters wipe away what was written on the slate earlier. They give us the opportunity to write back on a clean slate in such a way that it facilitates building of more resilient communities. This can be done by documentation of disasters and analysing the best practices as well as our failures in the process. The documentation of Kerala Floods, 2018 was also undertaken by NIDM as a step in that direction. The aim of the documentation was to learn from the disaster and contribute towards forward looking policies pertaining to social development, economic growth, environmental quality and justice, in addition to other essential values that contribute to sustainability.

This document was developed as a part of internship project carried out by the authors in 2019. It is based on secondary sources of information and aims to document the floods which ravaged Kerala in 2018 along with the lessons learnt from the disaster. The authors would like to thank the Executive Director of NIDM, Major General Manoj Kumar Bindal, VSM who took a keen interest in the outcome and guided us with his comments and directions. Professor Santosh Kumar, HOD, Governance and Inclusive Disaster Risk Reduction Division, helped us with his expertise and valuable inputs.

We also thank our reviewers, Shri G.P. Padmanabhan, Former Emergency Specialist, UNDP, India and Dr. Swapnamita Choudhary, Scientist D, Wadia Institute of Himalayan Geology for their valuable and extensive comments and suggestions which helped in giving final shape to the document.

We hope the documentation of Kerala Floods, 2018 shall be useful to those who are working relentlessly in building a disaster resilient society.

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Assistant Professor

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Intern, NIDM

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LIST OF ABBREVIATIONS

ASHA	Accredited Social Health Activists
AHD	Animal Husbandry Department
ARISE	Acquiring Resilience and Identity through Sustainable Employment
ADB	Asian Development Bank
BBB	Building Back Better
CMDRF	Chief Minister's Disaster Relief Fund
CECs	Continuing Education Centers
CWC,	Central Water Commission
DDD	Dairy Development Department
PDNA	Post Disaster Needs Assessment
ESZs	Ecologically- Sensitive Zones
ETF	Engineer Task Forces
FRL	Full Reservoir Level
GIS	Geographic Information System
GFA	Gospel for Asia
GDP	Gross Domestic Product
HLC	High-Level Committee
HDI	Human Development Index
HADR	Humanitarian Assistance Disaster Relief
IMD	Indian Meteorological Department
IAF	Indian Air force
IWRM	Integrated water resources management
IMCT	Inter-Ministerial Central Team
JRDNA	Joint Rapid Damage and Needs Assessment
RKLS	Resurgent Kerala Loan Scheme
KSDMA	Kerala State Disaster Management Authority
KSIDC	Kerala State Industrial Development Corporation
KWA	Kerala Water Authority

LSG	Local Self Government
MGNREGA	Mahatma Gandhi National Rural and Employment Guarantee Scheme
MDR	Major District Roads
MSL	Mean sea level
MW	Megawatt
MCM	Million Cubic Meters
MIDH	Mission for Integrated Development of Horticulture Scheme
NASA	National Aeronautics and Space Administration
NCMC	National Crisis Management Committee
NDRF	National Disaster Response Fund
NIDM	National Institute of Disaster Management
NIFAM	National Institute of Fisheries Administration and Management
NGO's	Nongovernment Organizations
PWDs	People with Disabilities
RKI	Rebuild Kerala Initiative
RAHI	Rise Against Hunger India
SANDRP	South Asia Network on Dams, Rivers and People
SLR	Sea Level Rise
SMF	Small and Marginal Farmers
MSMEs	Small and Medium-Sized Enterprises
SWM	Solid Waste Management
SDRF	State Disaster Response Fund
SGDP	State Gross Domestic Product
SH	State Highways
SC-NEC	Sub-Committee of National Executive Committee
TINA	There Is No Alternative
TFCI	Total Fixed Capital Investment
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe

Chapter 1 : Background

Kerala is located on the southwestern Malabar Coast of India. It came into existence on 1st November, 1956 after the States Reorganization Act was passed by the Government of India. Kerala was formed by uniting the Malayalam-speaking regions under its sovereignty. It is stretched over 38,863 km^2 (15,005 square miles) of area and shares its boundaries with Karnataka, Tamil Nadu and the Lakshadweep Sea & Lakshadweep group of Islands (UT). Kerala has 14 districts with Thiruvananthapuram officiated as its capital. The official language of the state is Malayalam.

Kerala performs excellently well on the Human Development Index (HDI). Despite having a population of over 33 million its place is fixed on the top among all the states of India. The state was ranked among the top five states for its per capita state domestic product in 2015-16. It was also ranked amongst the first four states for its growth in per capita income in the same year. The state is at par with other developed countries of the world in other indicators and parameters of the human development index. For example; as compared to the national average of 73%, the state has a literacy rate of 94%. The life expectancy at birth was 68.8 years for the country but Kerala reported 75.2 years of life expectancy at birth in 2011-15. This was the highest life expectancy at birth amongst all the states. The infant mortality rate of 10 per thousand live births in the state is lowest amongst all the Indian states. Kerala boasts of having 7% population below the poverty line while the national average of population living below the poverty line stands at 22%. As per the data of 2015-16, electricity is available for 99% of the households, 98% of the households have access to improved sanitation facilities while 94% of them had access to improved drinking water facilities. (UNDP, 2018). As compared to the other states, the state of Kerala has more equitable human development. The HDI was reported to be 0.712 in 2015. The positive population growth is 3.44% and is the lowest in the country. The sex ratio is 1,084 women per thousand men and is the highest in the country. The high literacy rate of Kerala makes their local government and village population highly participatory, communicative, responsible and alert.

The state has the twelfth largest economy in the country. The gross domestic product (GDP) is ₹ 6.86 lakh crores while the per capita GDP is ₹ 1, 79,000 crores. A significant part of its population has immigrated to the Arab states. The immigration started during 1970s and 1980s during the Gulf Boom. The emigrated community contributes significantly in the economy of the state through remittances. Majority of the population practices Hinduism as their religion followed by Islam and Christianity. The culture of the state is significantly influenced by different regions within and outside the country.

Figure 1.1 : State map of Kerala (Source: http://www.indmaps.com/state-map/kerela/)

There has been an increase in old age population, especially single old women or men living alone as their children have settled abroad. A report was published by the Ministry of Statistics, Government of Kerala in 2016 on the elderly in the state putting their population to 12.6%, which is the highest in the country. Almost every village and town in the districts have a retirement home or more appropriately old age home. The districts have mostly shown a negative population growth notwithstanding a marginal increase in the density.

Table 1.1 shows Kerala's District wise Headquarters Population (Census 2011), Sex ratio and Average Literacy details.

Table 1.1 : District wise Population (Census 2011), Sex ratio and Average Literacy of Kerala

S No.	District	Headquarters	Population (Census 2011)	Sex Ratio (per 1000)	Average Literacy
1	Alappuzha	Alappuzha	2,127,789	1100	95.72%
2	Ernakulam	Kakkanad	3,282,388	1027	95.89%
3	Idukki	Painavu	1,108,974	1006	91.99%
4	Kannur	Kannur	2,523,003	1136	95.1%
5	Kasaragod	Kasaragod	1,307,375	1080	90.09%
6	Kollam	Kollam	2,635,375	1113	94.09%
7	Kottayam	Kottayam	1,974,551	1039	97.21%
8	Kozhikode	Kozhikode	3,086,293	1098	95.08%
9	Malappuram	Malappuram	4,112,920	1098	93.57%
10	Palakkad	Palakkad	2,809,934	1067	89.31%
11	Pathanamthitta	Pathanamthitta	1,197,412	1132	96.55%
12	Thiruvananthapuram	Thiruvananthapuram	3,301,427	1087	93.02%
13	Thrissur	Thrissur	3,121,200	1108	95.08%
14	Wayanad	Kalpetta	817,420	1035	89.03%

Source: Census, 2011

The state has achieved good progress in various health indicators like infant mortality rate, birth rate, death rate, and expectancy of life at birth. However, sustaining the gains and achievements in the health sector is a challenge. Moreover, the State needs to tackle the problems of lifestyle diseases like, coronary heart or artery disease, renal disease, diabetes and geriatric problems. Communicable diseases like chikungunya, dengue, leptospirosis, and swine flu are also huge concerns. In addition to this, there are new health threats which has become a matter of concern for the State, like mental health disease, rising trend of suicide, substance abuse, and increasing occurrences of road traffic accidents. To address these issues, inter-sectoral coordination with collaborative and committed efforts is imperative **(Economic Review, 2016).** Table 1.2 highlights the major health indicators in the state:

Table 1.2 : Health Indicators of Kerala

Health Indicators	Kerala	India
Birth rate (per 1,000 population)	14.60	22.80
Couple Protection rate (%)	62.30	52
Death rate (per 1,000 population)	6.60	7.40
Infant mortality rate (per 1,000 population)	12.0	44.00
Life expectancy at birth (Average)	74.00	63.50
Life expectancy at birth (Female)	76.30	64.20
Life expectancy at birth (Male)	71.40	62.60
Maternal mortality ratio (per lakh live births) * 2009	40	301
Total Fertility rate (per woman)	1.70	2.90

Source: State Planning Board, Kerala Available at : http://spb.kerala.gov.in/EconomicReview2016/web/index.php

A very significant social feature of Kerala is that in recent years, the rampant movement of people from Kerala to different parts of India and to different nations abroad has affected all facets of their life. This new development has been occurring since 1960s. Kerala was not essentially an out-migrating state before 1940s. With the beginning of great depression of 1930s, followed by the Second World War, many people who migrated for employment came back to their homes. When many colonial nations in Africa, South and South East Asia got freedom during 1940s, Keralites migrated again for livelihood and it became a trend. After the Indian independence, out-migration increasingly became a way of life for the educated youth. The volume of both out-migration and external migration has been increasing greatly since the 1970s **(S Rajan & K C, 2018).** However, from 2008 to 2017, there has been a decrease in the emigration of populace. Inspite of the decrease, a significant population has emigrated from the state. Table 1.3 shows the details of Kerala's International Migration from 2008–2017 .

Table 1.3 : International Migration in Kerala from 2008-2017

Year	ECR (Emigration Check Required) Granted	% Decrease
2008	1,63,737	0
2009	1,19,188	27.2
2010	1,03,889	12.8
2011	88,040	15.3
2012	98,132	-11.5
2013	86,134	12.2
2014	66,055	23.3
2015	43,157	34.7
2016	25,166	41.7
2017	16,643	33.9

Source: www.emigrate.gov.in

It is estimated that nearly 36% of Kerala's state gross domestic product (SGDP) comes from remittances (Zachariah and Rajan 2014; Rajan and Zachariah, 2017), which is almost 13 times higher than the share of remittances received by our country in its GDP (World Bank 2017). Even though remittances have been an intrinsic feature of Kerala's economy, there has been a considerable decrease after the financial crisis of 2008. Kerala had the highest number of migrants among Indian states in 2008 migrating to ECR countries, which included countries in West Asia and Malaysia. A total of 1,63,737 workers left in 2008. These numbers showed a considerable decrease and reached 16,643 in 10 years. When households face adverse shocks, migrants act as insurers. At the time of disasters, remittances from migrated persons enable the family to cope with the shock.

The high development indicators of Kerala show the robust standing of the state in non disaster times. It is expected that a state should be able to withstand any calamity or emergency with resilience, and determination. In such testing times, the strength of a society lies in how fast it recovers from a crisis, the ability to restart lives, and undertake holistic disaster recovery. States have to mobilize resources to take immediate steps to overcome losses and ensure an effective transition to normalcy. The floods of 2018 in Kerala were unexpected and came as a surprise. It highlighted some major gaps in a state which was high on all this indicators.

Chapter 2 : Hazard and Vulnerability Profile of Kerala

The geographic location of Kerala along the coast of the sea and the slopes of the Western Ghats makes it highly vulnerable to hazards with a natural origin and impacts of climate change. As per Kerala State Disaster Management Plan, the state is vulnerable to 39 hazards of natural origin along with other human induced hazards. The high density of Kerala which is 860 persons per square kilometers makes it more susceptible to disaster losses and damages. Floods and landslides are a recurring phenomenon along the Western Ghats. Landslides occur mostly in Wayanad, Kozhikode, Idukki, and Kottayam districts. Drought like conditions are common during the summer months. The years between 1881 and 2000 have witnessed 66 drought years. The issue of water scarcity is aggravated during summers due to dry rivers and low water tables. Other natural hazards which beset the state include lightning, forest fires, and high wind speed. Soil piping and coastal erosion make the area more vulnerable to hazards and disasters. The state also lies in seismic zone III which is an indicator of earthquake vulnerability.

Kerala's climate is humid and tropical. The predominant climatic phenomena include the South-West monsoons from June to September and the North-East monsoons which last from October to December. The South-West monsoon is more significant as it produces 80% of the total annual rainfall. Kerala has an average annual precipitation of 3000 mm. About 90% of the rainfall takes place during the monsoon months. The monsoon storms of high intensity causes heavy discharges in rivers and leads to floods. Kerala is highly prone to floods. It is a major and the most frequent hazard in the state. With about 14.8% of the area prone to flooding. Floods also lead to secondary disasters like landslides as was witnessed in the floods of 2018. About 50% of the land area of Kerala is moderately to severely drought prone. It is expected that impact of global climate change will increase the extreme rainfall and lead to urban flooding probability during the north-east monsoon period, shortage of water during peak summer months, an increase in urban temperature, as well as eroding of coasts along the populated coastline due to increasing sea-levels. Climate change is expected to increase the frequency and intensity of floods, droughts, and mudflows. Another impact being witnessed is, progressive coastal erosion which affects nearly 63% of the State's 580 km of coastline.

Table 2.1 below depicts specific details of Kerala's exposure to climate and geographical hazards.

Table 2.1 : Kerala's exposure to climate and geophysical hazards

Hazard	Time Frame	Description of hazards
Extreme Precipitation and Flooding	Current	Observed decreasing trend based on rainfall data for the last 100 years; extreme events expected to increase in frequency.
	Future	Rainfall trends in Kerala over the past decade exhibit sporadic long spells of heavy rains, leading to an increasing likelihood of extreme rainfalls and flooding.
Drought	Current	Seasonal drought conditions are experienced every year during the summer months. Rainfall data over the last 100 years shows that there is a significant (99%) decreasing trend of rainfall in most of the regions of Kerala especially in the month of January, July and November.
	Future	State's Disaster Risk Management shows that more than 50% of the land area in the state shall be moderately to severely drought susceptible, majorly on the drinking water side.
Sea Level Rise	Current	The historic sea level rise (SLR) from Mean sea level (MSL)for Cochin is estimated to have been 2 cm in the last one century.
	Future	Sea level rise in increasing due to global warming and the projected SLR from Mean sea level (MSL) along the coast of the state on an estimation of 10 cm to 20 cm over the next hundred years. Vulnerability to Sea Level Rise would be alarming for the majority of the coastal communities living on sandy coasts, which include barrier beaches or spits. Backwater banks, islands , filtration ponds and paddy fields are other areas of the coastal zone, which shall be highly susceptible to Sea Level Rise.
Strong Winds	Current	Kerala has identified strong winds as a state specific disaster calamity that has been experienced often in the last decade.
	Future	The maximum wind speed from tropical cyclones is expected to increase, but estimates are highly uncertain

Tsunami	Current	The 590 km coast of Kerala is one of the most densely populated land areas in the country. This coastline is exposed to high waves, storm surges and Tsunami. Indian Ocean Tsunami on 26th December, 2004 affected approximately 250 km coastline of Kerala with sea water entering up-to 1.5 km inland.
Landslide	Current	Apart from floods the mountain regions of the State experience several landslides during the monsoon season. It is known that a total of 65 fatal landslides occurred between 1961 and 2009 causing the death of 257 individuals. In the recent floods in 2018, the State has suffered more than 5,000 small and big landslides and landslips that emerged as a major cause of economic and life loss in the floods.

Table 2.2 below shows the vulnerability of Kerala to various natural hazards in Kerala.

Table 2.2 : Vulnerability of Kerala to Natural Hazards

Landslides

Susceptible area km^2	5607.4
Susceptible are as % of State's total area	14.4
Major landslide in the last 20 years	Debris flow at Amboori, Thiruvananthapuram on 10th November, 2001
Human fatality	38

Floods

Susceptible are km^2	5624
Susceptible are as % of State's total area	14.5
Major flood incident in the last 20 years	2013
Estimated damage in the floods of 2013	899 crores*
Human fatality	145*

Drought

Susceptible are as % area of the state's total area	• Severe drought : 2.5% • Moderate drought : 63.8% • Slight drought : 23% • No drought : 10.7%
Major drought in the last 20 years	Drought 2012-13: The State Government had to officially declare drought in all 14 districts. An amount of ₹ 132.3 crs was expended by the state during the period from 2012 to 2014 for tackling the consequences of this drought directly from the National/State Disaster Response Fund. Indirect costs of the drought spell still remain unaccounted.

Earthquake

Major earthquake in the last 20 years	Erattupetta Earthquake, 5M, 12th Dec. 2000
No major fatality or dame has been reported due to earthquake in Kerala in the recent past	

Wind

Major single event in the last 20 years	Gustnado at Poruvazhi, Kollam on 10-06-2016
5 houses totally damaged, 44 houses partially damaged, 10 ha vegetation damage and 150 trees uprooted	

Source: Kerala State Disaster Management Plan, 2016

Kerala has experienced disasters in the past, resulting in loss of human lives and livestock along with damage to infrastructure including public and private properties. The details of some major disasters experienced by the State are as follows:

Great flood of 99, (1924) : The great flood of '99 occurred as the result of the flooding of the Periyar River in Kerala in July, 1924. That was the year 1099 ME in the Malayalam Calendar (Kollam Era). The flood is generally called as Thonnootti Onbathile Vellapokkam which translates to "flood of '99". Kerala saw unprecedented rainfall in this incident of 'flood of 99' with nearly 3,368 mm of rain was recorded that month. It was 64 per cent higher than the normal rainfall and is the highest recorded rainfall till date. It has been established that offshore vortices along the west coast was the reason that could have caused the flood. There is a widespread consensus among the older generation of Kerala that a breach of the Mullaperiyar Dam caused the floods. This breach in the Mullaperiyar Dam occurred 29 years after the dam was built. Around 1000 people died in the great flood of '99 **(Wikimapia, 2013).**

Sabarimala stampede (1999) : Sabarimala stampede was a human stampede that happened at Sabarimala temple in Kerala in 1999. On 14th January, 1999, (the Makara Jyothi Day), 53 people, majority of them from outside Kerala, died in the stampede at the Pamba base camp caused by, among other things, the collapse of the sides of a hillock. A Judicial Commission headed by Justice Chandrasekhara Menon was constituted to investigate the tragedy. The report pointed out the need to provide basic amenities on the Pullumedu route through which a large number of pilgrims travel from Tamil Nadu. Over 60% of devotees coming to Sabarimala during the pilgrimage season were from other states and this route provided them easy access to temple towns like Madurai on their return journey **(The Hindu, 1999).**

Kadalundi train derailment (2001) : Kadalundi train disaster was among the biggest accidents on the Indian railway network in 2001. The Mangalore-Chennai Mail passenger train was heading towards Chennai on 22nd June. It was crossing Bridge 924 built over the Kadalundi River and connecting Malappuram and Kozhikode district. Four carriages were derailed and fell into the river. The bridge is situated near Kadalundi railway station in

KadalundiGramapanchayat of Kozhikode district in Kerala. The death toll for the accident rose steadily as bodies were retrieved from the wreckage over the course of a week, but a figure of 57 people was eventually reported as killed or missing, including at least eight women and two children **(BBC, 2001).**

Thekkady boat disaster (2009): The Thekkady boat disaster happened on 30th September, 2009, when the double-decker passenger boat Jalakanyaka sank in Lake Thekkady, Periyar National Park in Kerala. Out of a total of 82 people who were on the boat, 45 died. Among the victims were 19 women, 17 men and 9 children **(Press Trust of India, 2009).**

Sabarimala Stampede (2011): A human stampede at the Sabarimala shrine was again witnessed on 14th January, 2011 on the Makara Jyothi Day. It broke out during an annual pilgrimage, killing 106 pilgrims and injuring about 100 people. The pilgrims were returning from the Hindu shrine on the last day of a yearly festival which attracts millions of devotees. It began after a Jeep toppled over. It was the worst recorded accident to have occurred in Sabarimala.

Figure 2.1 : People gathered in Sabarimala where the incident took place

To conclude, Kerala has had a history of disasters and is categorized as a multi-hazard prone state. The state experiences various kinds of disasters of recurrent nature causing immense misery and hardship to the affected population.

The state experiences heavy rainfall and flood during the southwest monsoon. Drought conditions have become more frequent during the pre-monsoon period and at times with the failure of southwest monsoon and /or northeast monsoon. Coastal erosion along the coastal areas is very severe causing frequent evacuation and rehabilitation of the coastal people. Incidences of biological disasters such as epidemics, pest attack are also on the rise. Fatalities in road and rail accidents, human induced accidents, lightning and boat capsizing are high in the state. Landslide or landslip is another hazard of the hilly regions of the state. The tsunami that struck Kerala Coast in 2004 has added a new dimension to the disaster scenario of the state as most of the low lying and mid land areas in Kerala are having an altitude of 4 – 6 meters only.

The State is also vulnerable to cyclone and experiences high winds due to the westward movement of cyclonic storms crossing Tamil Nadu coast. The fact that Kerala falls under earthquake Zone III makes the state vulnerable to earthquakes of magnitude of 6.5 or more. Possibilities of chemical and industrial disasters and disasters like dam burst also cannot be ruled out. The threat of global warming and its resultant climatic variations such as inter seasonal variations in rainfall, environmental issues and rise in sea level increase the vulnerability of the state. Issues related to rapid urbanization and waste disposal are assuming a gigantic proportion. Urban floods (UF) are among the most recurring hazards. Unplanned construction was one of the reasons due to which most of the towns were flooded in 2018 in Kerala. As an example, the flooding of Cochin airport can be discussed. An elevation study proves that the Cochin airport and the Periyar river were almost on the same altitude and areas to the north were at a higher elevation. Hence, in the event of heavy rainfall, storm water from the north drained towards the airport. It is in this context, the Government of Kerala recognizes the need to have a proactive, comprehensive, and sustained approach to disaster management to reduce the detrimental effects of disasters on overall socio-economic development of the state.

The subsequent chapters give a detailed description of the Kerala Flood Disaster in 2018 and the steps taken by the government for Response, Relief, Rehabilitation and subsequent Recovery.

Chapter 3 : Overview of Kerala Floods, 2018

The onset of monsoon in the country is signalled when it hits the state of Kerala. It brings relief from the sweltering heat experienced in the state further beautifying the lush green cover of 'God's own country', as the state is sometimes called. Kerala, in every sense is the land of 'rains and rivers'. It has two rainy seasons, one is the Southwest monsoon or Edavapathi, arriving towards the end of May or early June, and the other one is Northeast monsoon or Thulam that hits the land of Kerala during mid- October. These monsoon rains are indispensable parts of the State's season every year. The Southwest monsoon of 2018 brought calamity with it resulting into a disastrous flood. The floods in Kerala were one of the worst floods experienced by the state in a century. It resulted in the loss of over 400 lives. All the districts in the state were affected. People had to be evacuated from various districts of Chengannur, Pandanad, Edanad, Aranmula, Kozhencherry, Ayiroor, Ranni, Pandalam, Kuttanad, Malappuram, Aluva, Chalakudy, Thrissur, Thiruvalla, Eraviperoor, Vallamkulam, North Paravur, Vypin Island and Palakkad Chellanam. The state government reported that one sixth of the population was directly affected by floods and ensuing secondary disasters. The central government declared the floods as "calamity of a severe nature". 35 out of 54 dams in the state were opened for the first time in the history. In the Idukki dam, all the five overflow gates were opened simultaneously and in Malampuzha dam of Palakkad, 5 gates were opened for the first time in 26 years. There were heavy rains in the districts of Wayanad and Idukki which triggered severe landslides. This resulted in the isolation of the hilly districts (The Indian Express, 23rd August 2019).

Kerala experienced the worst floods in its history between 1st June and 19th August, 2018, since the Great flood of '99. The state that year received 42 % of excess rainfall compared to average rainfall. That year, there were two consecutive active spells of rain with above normal rainfall peaking around 14th & 20th June. Another above normal rainfall was experienced around 20th July. Later on, Kerala received a fresh spell of active rainfall from 8th August to 17th August. Thereafter, there was a gradual decrease in rainfall over the State. Due to the rainfall scenario that prevailed till the end of July, 2018, all major 35 reservoirs storage were closed to the full reservoir level (FRL). They had no buffer storage to accommodate the heavy inflows from 8th August onward. The continued exceptional heavy rainfall in August (with 170% above normal) in the catchment areas compelled the authorities to resort to heavy releases downstream into the rivers. This led to overflowing of all river banks leading to widespread flooding almost all over the state (IMD, 2018).

The state government reported that 1,259 villages out of a total of 1,664 villages in 14 districts were affected. The seven districts which were severely affected included were

Alappuzha, Ernakulam, Idukki, Kottayam, Pathanamthitha, Thrissur, and Wayanad. The entire 7 districts were notified as flood affected. This calamity affected 5.4 million people, displaced 1.4 million people, and took the life of 449 people (UNDP, 2018).

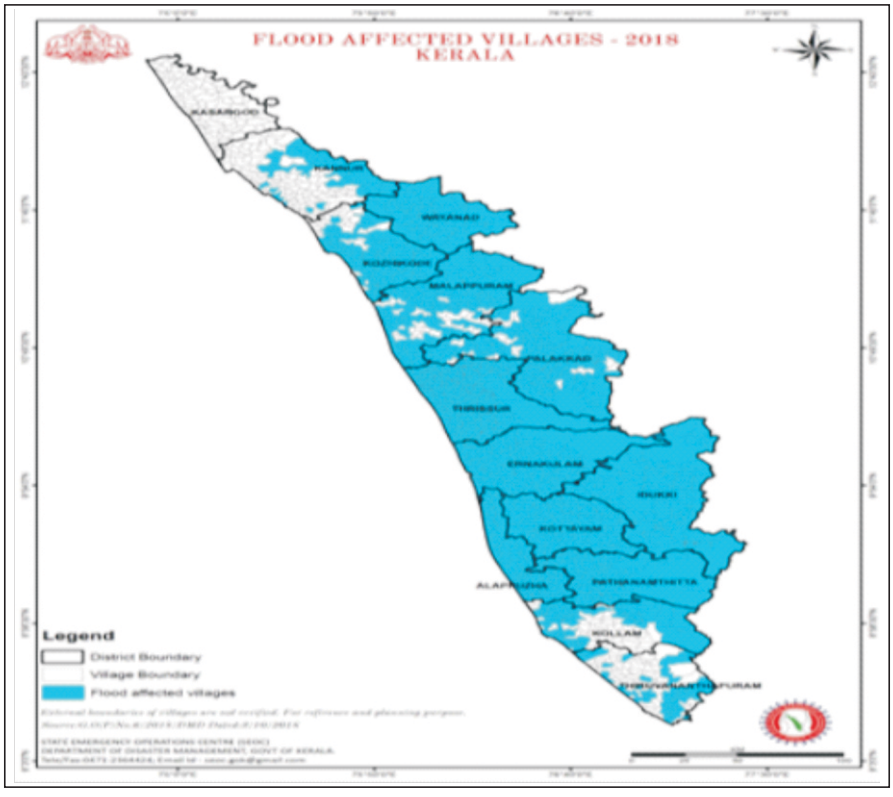


Figure 3.1 : Map of flood affected villages in Kerala

Source: UNDP, 2018

According to IMD data, Kerala received 2346.6 mm of rainfall starting from June, 2018 to 19th August, 2018. This was in contrast to an expected 1649.5 mm of rainfall. Further, the rainfall received by Kerala in June, July and starting of August to 19th of August was 15%, 18% and 164% respectively, which was above normal.

The rains resulted in landslides in hilly areas after torrents of water loosened soils from hill slopes. These slurries of water, soil, rock, and vegetation overwhelmed villages, downed power lines, and cut some communities off from receiving immediate aid. About **341 landslides were reported from 10 districts.** The worst hit district was Idukki which was ravaged by 143 landslides. The natural cause of the landslides was the simple reality of steep terrain being bombarded with too much water. During the torrential rains, water

percolated under the surface of the soil and tried to flow downhill. In certain areas, subsurface "pipes" formed, carving water channels under the soil. These pipes either quickly drained subsurface water, destabilizing hillslopes, or became clogged, creating a backlog of water that grew larger and larger until the entire slope gave way. The human made cause of landslides was rapid urbanisation. When people built new structures, the terrain got altered by the cutting of slopes and removal of soil. This transformed the runoff pattern and opened up new ways for water to seep underground leading to increased infiltration. This resulted in destabilization of the slope thus leading to landslides **(Duncombe, 2018).**

Figure 3.2 : Devastation caused by Floods (Photo courtesy: Google images)

Table 3.1 : District wise rainfall released during 1st June, 2018 to 22nd August, 2018

Districts	Normal Rainfall (mm)	Actual Rainfall (mm)	Departure from normal (%)	
Kerala State	1701.4	2394.1	41	Excess
Alappuzha	1380.6	1784	29	Excess
Kannur	2333.2	2573.3	10	Normal
Ernakulum	1680.4	2477.8	47	Excess
Idukki	1851.7	3555.5	92	Large Excess
Kasaragode	2609.8	2287.1	-12	Normal
Kollam	1038.9	1579.3	52	Excess
Kottayam	1531.1	2307	51	Excess
Kozhikode	2250.4	2898	29	Excess
Malappuram	1761.9	2637.2	50	Excess

Palakkad	1321.7	2285.6	73	Large Excess
Pathanamthitta	1357.5	1968	45	Excess
Thiruvananthapuram	672.1	966.7	44	Excess
Thrissur	1824.2	2077.6	14	Normal
Wayanad	2281.3	2884.5	26	Excess

Source : Hydrological Studies Organization, CWC (September, 2018).

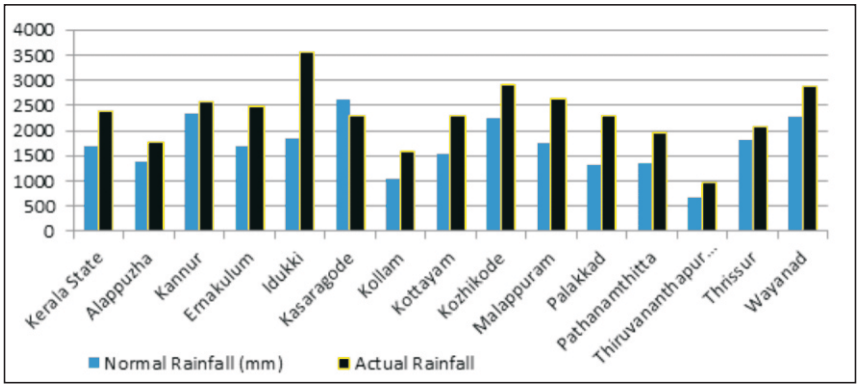


Figure 3.3 : Bar Diagram of District wise Normal and Actual rainfall in the monsoon period, 2018

Source: Government of Kerala, 2018

Month-wise rainfall data for the period of deluge, as reported by IMD, is given in Table 3.2 below:

Table 3.2 : Rainfall in Kerala during the monsoon season

Period	Normal Rainfall (mm)	Actual Rainfall (mm)	Departure from normal (%)
June, 2018	649.8	749.6	15
July, 2018	726.1	857.4	18
1-19, August, 2018	287.6	758.6	164
Total	1649.5	2346.6	42

Source: IMD, 19 August, 2018.

The floods highlighted a number of structural constraints that left Kerala unprepared for major disasters caused by natural hazard or climate change shocks. This included inadequate policies and institutional frameworks to manage and monitor critical natural resources such as water and land, absence of risk-informed spatial and sectored planning policies and frameworks that led to extensive urban sprawl, unmanaged construction in hazard prone areas, exclusion of disaster risk preparedness in key socioeconomic sectors, weak capacity of institutions to anticipate and respond to extreme events, and limited fiscal resources as well as absence of ex ante financing modalities for risk pooling and sharing. Due to these systemic weaknesses, Kerala was at the mercy of the 2018 floods and landslides and suffered major socio economic losses.

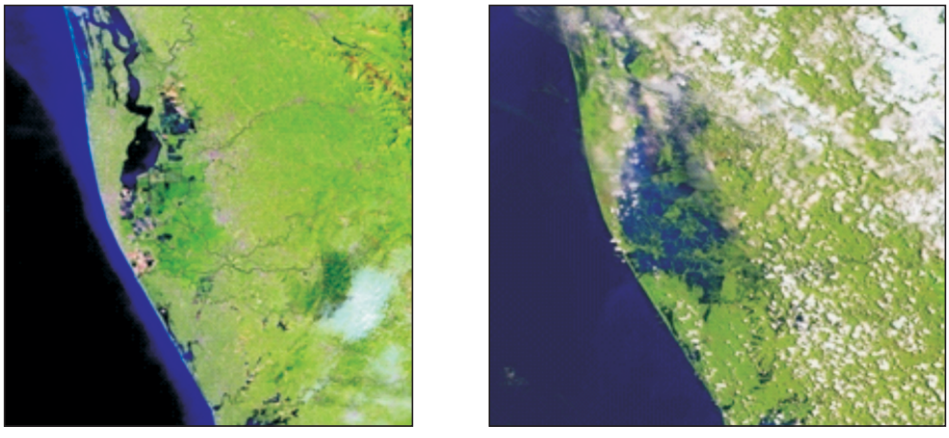


Figure 3.4 : The before and after images released by the NASA, 2018

Source: NASA,2018

NASA had released the satellite images of the Kerala flood that showed how the 'calamity of severe nature' had taken over the state.

The tragedy in Kerala gained public responses at three levels. At the first and basic level, it attained a spontaneous humanitarian response from several segments of society, which transcended regional and national boundaries. Responses at this level seemed to have been unmediated by any prior calculations or instrumental factors. The humanitarian aid that continued to flow into Kerala both from within the country and abroad, particularly from the non-governmental organizations, was quite phenomenal. These acts transcended all the defined boundaries, and demonstrated how our common humanity mattered more, leading to the mobilization of resources from various corners of the country and the world, evoked by human emotions. The response which occurred at the second level initiated with relentless criticism of the handling of the situation, this time focusing the Kerala government that was caught in the vortex of the disaster. The environmentalists sought to criticize the successive governments for failing to acknowledge the warnings that were

given from time to time. The second level response, unlike the first, was not emotionally spontaneous and involved the force of scientific truth, and hence morally empowered the experts to fix the responsibility not on nature, but on human self-interests and the public institutions that protected those interests. At the third level, the response understandably was a bit delayed, but was articulated neither on scientific nor instrumental grounds, but through causes mediated by a supernatural force. In the event of the devastating tragedy that gripped most parts of rural and urban Kerala, the people of Kerala rose over superficial boundaries, and demonstrated their tenacity, grit and, unity in spirit to tide over a common tragedy that had inundated them **(EPW, 2018).**

Chapter 4 : Damage and Loss Assessment

The unprecedented floods of 2018 resulted in loss of lives causing disability and injury along with extensive damage to infrastructure. It caused disruption in the lives of people in both densely populated cities and villages. The direct loss included quantifiable losses such as the number of people killed and damage to buildings, infrastructure and natural resources. Indirect losses included decline in output or revenue, impact on wellbeing of people including psychological stress, impact on the environment, which included contamination of drinking water, saltwater intrusion, destruction of aquifers and disruptions in the flow of goods and services after the floods.

Recovery from the devastating floods demanded significant amounts of resources including funds as well as time. Damage and loss assessment was done by the State Government, which was captured in the form of a memorandum submitted to the Central Government. The memorandum captured the damage to government assets only with a focus on productive sectors. Subsequently, damage and loss assessments capturing direct and indirect losses by the floods were also carried out extensively by international agencies along with the State Government under the ambit of post disaster needs assessment (PDNA) which focussed on inclusion of social sectors. The following section details out the losses incurred by the State as per the memorandum submitted by the State Government.

State Government Memorandum:

In any disaster, central government allocates the needed finances as per the guidelines of State Disaster Response Fund (SDRF) and National Disaster Response Fund (NDRF) to meet the rescue and relief expense (notified by central government). State Disaster Response Fund has been constituted in each State in which Centre contributes 75% for General Category States and 90% for Special Category States of hilly regions every year as per the award of the successive Finance Commissions.

As per the guidelines, Central Government provides its allocation to SDRF of each State in advance in two installments. In case of any natural calamity, the State meets the expenditure of relief and rescue from SDRF already available at its disposal. In case of any natural calamity beyond the coping capacity of a State, the concerned State Government submits a detailed memorandum indicating the sector-wise details of damages and requirement of funds for relief operations of immediate nature. On receipt of a memorandum, an Inter-Ministerial Central Team (IMCT) is deputed by the Central Government for on-the-spot assessment of damages and additional requirement of funds. The report of IMCT is considered by the Sub-Committee of National Executive Committee (SC-NEC) headed by the Union Home Secretary in conformity with the norms and then by a

High Level Committee (HLC), chaired by the Union Home Minister for approving the quantum of additional assistance from the NDRF.

In the case of floods and landslides in Kerala, an interim memorandum was submitted by the State for damages caused by the disaster from 29th May-31st July 2018 of ₹ Eight hundred and twenty crore forty-two lakh eighty-two thousand only **(₹ 82042.82 lakhs only).** Since there was a second spell of floods in the State, the State Government submitted an additional memorandum on the fresh damages caused by the floods and landslides from 1st to 30th August 2018 of ₹ Four thousand seven hundred and ninety six crore thirty five lakhs **(₹ 4,796,35 lakhs only)** So, the total damage amount claimed by the state from the Central Government was ₹ Five thousand six hundred and sixteen crores, seventy-seven lakhs and eighty-two thousand **(₹ 561,677.82 lakhs only). (Government of Kerala, 2018).**

The disaster resulted in loss of lives, livestock and agriculture, damaged houses and crops, destroyed roads bridges, school etc. The Cochin International Airport got flooded and had to hold back its operations from 15th to 29th August, 2018. It is to be noted that Cochin International Airport is one of the busiest international airport in India. Continuous intense rain battered down most areas of the state from 8th to 18th of August, 2018 leading to widespread destruction to all the major sectors of the state. The section below focuses on the detailed damage and loss in Kerala floods.

The cumulative loss and damage from the preliminary and additional memorandum is discussed below:

a. **Human Fatalities:** The disaster of floods and landslides resulted in **433 fatalities; 268 men, 98 women** and **67 children up to 22nd May–29th August, 2018** (UNDP PDNA report on Kerala floods, 2018). All 14 districts and **1260 out of 1664 villages** were affected. 687 km square of land was flooded. The floods were accompanied by **341 landslides.** Landslides occurred inland from the rivers and occurred independently of the high flood levels in the river. It happened mainly due to soaking of soils, soil piping, and human activities such as road construction and housing. A large number of houses were completely or severely damaged. The cyclonic storms, wind and rainfall caused severe damage to the fisheries sector of the state.

b. **Agriculture:** The devastating floods damaged the state's agriculture production mainly the plantation and spice crops which are the backbone of the state's agriculture. Kerala cultivates around 1,62,660 ha of spice crops across the state with a production of 140,000 tonnes per annum. Idukki and Wayanad together are contributors of nearly 62 per cent of the total area under spices in the state. Incidentally, in 2018, these districts witnessed a high quantum of south west monsoon. A survey was undertaken with the support of officials of Agriculture Department and other agencies in 60 village panchayats across 27 community development blocks of the state. The major crops

considered in the study were black pepper, cardamom, nutmeg, ginger, turmeric and clove which contribute more than 90 per cent of the total spice crops cultivated in the state. Table 4.1 and 4.2 below represent the losses in spices and agriculture due to Kerala floods in 2018.

Table 4.1 : Damage to Spices

Crop	Area affected (ha)	Production loss in 2018-19 (tonnes)	Value (Million INR)
Black pepper	26613	10700	4027
Cardamom	15655	6600	6795
Nutmeg	4400	2749	1018
Clove	160	13	9.3
Ginger	1030	4100	605
Turmeric	395	976	86.8
Total	48,253	25138	12541.1

Source: ICAR- Indian Institute of Spices Research, Report on impact of rain induced natural calamity on spice crops in Kerala, 2018

Attention to be paid to the reality that small and medium farmers account for the major population of farmers. Generally, these are small and marginal farmers (SMF) who claim for damages via NDRF/ SDRF (Government of Kerala, 2018). Hence, the loss estimation and claim has been made taking into account the SMF section.

Table 4.2 : Agricultural damages in the districts of Kerala

District	>33% crop loss extent (ha)	Relief as per norms(in Lakhs)
Thiruvanthapuram	1356.96	168.595
Kollam	869.73	108.431
Pathanamthitta	12085.05	984.986
Alappuzha	12095.55	1606.928
Kottayam	7170.71	939.179
Idukki	5745.97	966.176
Ernakulam	1296.66	142.496
Thrissur	3569.25	468.672
Palakkad	6250.43	840.264
Malappuram	5275.4	666.561

Kozhikode	627.04	59.503
Wayanad	1876.80	248.463
Kannur	926.53	126.882
Kasargode	199.29	29.968
Total	**59345.37**	**7357.104**

Source : State Government of Kerala, Additional Memorandum, 2018

Figure 4.1 : Farmer walks through his destroyed plantain farm in Wayanad.

Source: Google images

c. **Fisheries:** The floods resulted in the aggregate loss of ₹ 10,304 lakh in aquaculture and inland capture fisheries. The flood wrecked important fishing assets e.g. boats and fishing nets. Houses of fishermen were damaged beyond repairs. Government owned fishery farms, hatcheries and other assets of the state government like department of fisheries such as National Fish Seed Farm and Centre for Fresh water Aquaculture at Neyyar Dam and National Institute of Fisheries Administration and Management (NIFAM) at Aluva were badly affected. **(Government of Kerala, 2018)** Furthermore, flagship activities aimed at the fishermen community's alternative livelihoods (Theeramythri programme for fishermen women) were badly hit too. As many as 235 boats were fully damaged out of which 96 boats were from Ernakulam district. Out of the 1002 boats that were partially damaged, 818 boats were solely from the Kottayam district. A total of 1748 nets were fully damaged while 1620 nets were partially damaged during this disaster in Kerala **(Government of Kerala, 2018).**

d. **Animal Husbandry:** The unprecedented rainfall which triggered flooding in the state resulted in the death of scores of cattle, buffaloes, goats and poultry.

Figure 4.2 : Carcass floating in flood waters

Source: Google images.

Further, destruction of cattle sheds, shortage of fodder, veterinary medicines and vaccines worsened the situation. Alappuzha was the worst affected district with regard to this sector. A total of 7146 cattle died, including 650 cows and buffalo, 2994 sheep and 3502 calves. Almost 500792 poultry died in these flash floods **(Government of Kerala, 2018).** Table 4.3 and 4.4 below shows the loss and damage incurred by the State as per the preliminary and additional memorandum submitted to the Central Government.

Table 4.3 : Total loss and Damage as per the Preliminary Memorandum

Loss / Damage category	Total figure
Human fatalities	110
Partially damaged houses (Damage cost estimated)	10040 (₹ 5115.38 lakh)
Fully damaged houses (Damage cost estimated)	389 (₹ 396.391 lakh)
Fully damaged boats	50
Partially damaged boats	47
Fully damaged nets	83
Partially damaged nets	18
Restoration of fish farm area (cost)	2600 Ha (₹ 2132 lakh)
Corp loss in area (cost)	21704.78 Ha (₹ 22073.67 lakh)
Cost of debris clearance from agricultural land	₹ 36.7358 lakh
Animal husbandry and dairy development sector	₹ 222.07 lakh
Irrigation Sector	₹ 4487.30 lakh
Water supply sector	₹ 347.69 lakh
PWD roads	196.689 (km) ₹ 19668.90 lakh
Panchayat owned Schools affected	54

Panchayat owned Anganwadis	40
Panchayat owned Primary health centre	27
Panchayat owned building	69
Panchayat owned Local Self Government (LSG) Roads	4017
Municipality owned Schools affected	65
Municipality owned Anganawadis	66
Municipality owned Primary health centre	64
Municipality owned building	50
Municipality owned LSG Roads	312
Corporation owned Schools affected	26
Corporation owned Anganawadis	22
Corporation owned Primary health centre	26
Corporation owned building	29
Corporation owned LSG Roads	141

Source: Kerala Government, Preliminary Memorandum, 2018

Table 4.4 : Summarizes the total loss and damage caused by the floods in the state.

Table 4.4 : Total loss and damage as per the Additional Memorandum

Loss / Damage category	Total figure
Human fatalities	339
Agriculture crops loss extent (Relief as per norms)	59345.37 (₹ 7357.104 lakh)
Agriculture land & other losses area (Relief as per norms)	59345.37Ha (₹ 13122.22 lakh)
Fully damaged houses (Damage cost estimated)	10319 (₹ 10520.22 lakh)
Several damaged houses (Damage cost estimated)	85336.1 (₹ 95856.3 lakh)
Partially damaged houses in Urban (Damage cost estimated)	1,11,356 (₹ 27839 lakh)
Partially damaged houses in Rural (Damage cost estimated)	5,81,492 (₹ 145373 lakh)
Fully damaged boats	235
Partially damaged boats	1002
Fully damaged nets	1748
Partially damaged nets	1620
Restoration of fish farm area (cost)	12452.2Ha (₹ 1021.1lakh)
Animal husbandry and dairy development sector	₹ 4653.824 lakh
Large animal carcasses disposed	7765
Small animal carcasses disposed	7,51,303
Power sector	₹ 8503.11 lakh

Restoration of road (Damage cost incurred)	9538.45 Km (₹ 9538.45 lakh)
Restoration of road (Damage cost incurred)	
Restoration of bridges (Damage cost incurred)	510 (₹ 510 lakh)
Irrigation Sector	₹ 51259.79 lakh
Water supply sector	₹ 2343 lakh
Total number of Relief camps	12253
Total number of inmates in Govt. run camps	3415937
Total cost in relief camps	₹ 7434.0697 lakh
Supply of drinking water	
Immediate assistance for loss of utensils and clothes (Cost)	₹ 6,05,675 (23015.65 lakh)
Cost of search and rescue	₹ 27100 lakh
Number of boats search and rescue (cost incurred)	₹ 669 (334.5 lakh)
Law and order Damaged station (Amount claimed)	₹ 87 (174 lakh)
Gram Panchayat, Block Panchayat & District Panchayat owned Schools affected	416
Gram Panchayat, Block Panchayat & District Panchayat owned Anganawadis	927
Gram Panchayat, Block Panchayat & District Panchayat owned Primary health centre	188
Gram Panchayat, Block Panchayat & District Panchayat owned building	330
Gram Panchayat, Block Panchayat & District Panchayat owned LSG Roads	12235.6 km
Municipality owned Schools affected	63
Municipality owned Anganawadis	180
Municipality owned Primary health centre	25
Municipality owned building	88
Municipality owned LSG Roads	2524.105 km
Corporation owned Schools affected	16
Corporation owned Anganawadis	44
Corporation owned Primary health centre	4
Corporation owned building	6
Corporation owned LSG Roads	626.919 km

Source: Kerala Government, Additional memorandum, 2018

Post-disaster needs assessments (PDNA)

The Government of Kerala commissioned a committee for the post disaster needs assessment. It was initiated on 18th September, 2018. The PDNA, jointly developed by international development partners –European Union, World Bank and UN system represented a tool and methodology for assessing damage and loss and estimation of recovery needs. The Kerala PDNA was undertaken by line ministries and 78 international, national and state level experts. The process was participatory and included several rounds of consultations with all stakeholders and communities of affected areas. The PDNA of Kerala floods built upon the Joint Rapid Damage and Needs Assessment (JRDNA) which was undertaken by the World Bank and the Asian Development Bank. The JRDNA focussed on the damage and recovery needs from infrastructure sectors of transport, power, water resources and irrigation. The PDNA, on the other hand covered a total of 15 sectors and cross cutting issues, an analysis of macroeconomic and human development impact and recovery strategy.

Loss and Damage Estimated in PDNA

Around 14 lakh people were shifted to relief camps during the floods as their houses were inundated with flood water. Many people took left their homes to take shelter with their relatives and friends. The access to piped water was disrupted for about 20% of the state's population. About 3, 17,000 shallow wells were either damaged or contaminated in six affected districts, directly affecting 14 lakh people. An estimate of 95,000 household latrines were significantly damaged affecting nearly 4 lakh people. More than 1.75 lakh buildings were fully or partially damaged, affecting 7.5 lakh people. Apart from loss of lives and destruction of homes, the affected populace people grieved over the loss of jewellery, family photographs, and religious objects.

Figure 4.3 : Damaged Houses

Source: https://www.onmanorama.com/news/kerala/2018/08/19/tips-for-flood-victims-kerala-home-management.html

Figure 4.4 : Devastation caused due to floods

Source: https://www.indiatoday.in/india/story/kerala-floods-damage-20000-crore-assocham-1318996-2018-08-20

Figure 4.5 : Inundated Kochi Airport

Source: https://www.deccanchronicle.com/nation/current-affairs/170818/kerala-floods-kochi-airport-closed-till-august-26.html

On top of all that, the loss of essential documents including certificates, ration cards, and land records piled up as added stress for the affected population. Interviews at relief camps revealed that the community in Kerala was undergoing emotional trauma in the aftermath of the floods as they were experiencing psychosocial shocks and stress and trauma of losing homes and loved ones, their livings, assets, possessions. The floods and landslides caused massive damage to houses, infrastructure like roads, railways, bridges, power supplies and communications networks. The floods washed away crops and livestock thereby impacting the lives and livelihoods of people.

Women and children bore the brunt of lack of civic amenities and poor access to educational institutions. The damage was categorized as follows: (i) land and the building was destroyed; (ii) only the building was destroyed; and, (iii) buildings were partially damaged. . Each category was further subdivided based on extent of damage: (i) up to 15%; (ii) 16%–29%; (iii) 30%–59%; (iv) 60%–74%; and (v) greater than 75%. It was decided that all houses with over 75% damage would be rebuilt from scratch. Additionally, 1.20 lakh households (whose houses may have remained intact) lost their possessions **(UNDP, 2018).**

The floods caused significant damage to the housing sector. The damage was caused due to foundation scouring, by soil settlement, and due to inundation for many days. It occurred near rivers, canals etc. A total of 17,316 houses were completely destroyed or damaged as per the data compiled on 4th October, 2018. A number of houses were destroyed due to landslides, mostly in Idukki, and Wayanad. Apart from causing damage to the housing sector, the floods and landslides also wreaked devastation to the agriculture sector. There already was preexisting distress in farming sector because of the fragmentation of agricultural land holdings, decrease proportion of land use for paddy cultivation, increasing agricultural wages etc.

The total damage (in monetary terms) to education and child protection sector was estimated at ₹ 179.48 crore, A total of ₹ 214 crore were estimated to be the recovery and reconstruction needs for the education sector for the next 3–5 years **(UNDP, 2018)** The major costs for recovery were related to the reconstruction of partially or fully damaged schools and continuing education centers (CECs).

Near about 52% of Kerala's population inhabit rural areas, and 17.15% of the population of the state is dependent on the agriculture (including crops, livestock and fisheries) for its livelihood. All the three subsectors including crops, livestock, and aquaculture/fisheries suffered losses and damages due to floods and landslides of 2018. Crops were most heavily affected, contributing to 88% of the total loss and damage to the sector, followed by livestock (10%) and fishery/aquaculture (2%). A total of ₹ 890 crores was estimated to be the damage caused to water, sanitation and hygiene (WASH) sector. Losses in the WASH sector were estimated at a total of ₹ 471 crores (water-supply loss: ₹ 349 crore; sanitation loss: ₹ 48 crore; and solid waste management (SWM) loss: ₹ 74 corers).

The flood had damaged Kochi International Airport also. The total damage caused to the Kochi International Airport during Kerala floods was estimated to be between ₹ 200 to ₹ 250 crore. Kochi was the busiest airport in Kerala and receives bulk of its international passengers from the Gulf countries. All the operations in Kochi airport were cancelled from 15th August, 2018 after floodwater crossed the periphery walls and flooded the runway, making it unfit for use. Nearly 800 runway lights needed to be repaired, besides reconstructing 2,600 meters of periphery wall. Officials worked around the clock to ensure

that the perimeter walls were replaced with temporary structures so that the airport's security was not breached. Kochi airport is the world's first airport which runs on solar power. The massive flooding inside the airport damaged the solar panels. About 20 per cent of the panels were damaged. The damage was not limited to solar panels, the floodwater also destroyed the airport's power storage facility and circuits. Only four out of the eight power storage plants were functional. The cost of repairing and replacing solar panels was estimated to be around ₹ 10 crore **(India Today, 2018).**

Figure 4.6 : Kochi airport was shut down on 15th August, 2018 after floodwater beached the boundary wall.

Source: India today, 2018

Roads are the principal mode of transport in Kerala that share about 75 percent of freight and 85 percent of passenger load. Kerala has a dense road network which is about three times the national average. Based on the primary and secondary data collected by the Roads & Building Department about 2,004 km of State Highways (SH) and 13,246 km of Major District Roads (MDR) across 14 districts suffered varying degree of damages during the floods. 1,090 km of State highways and 6,527 km of Major District Roads sustained light damages and would mostly needed pavement rehabilitation through patching, shoulder repairs and clearance of debris (Government of Kerala, 2018). About 734 km of State highways and 6,463 km of Major District Roads sustained medium to heavy pavement damages and needed re-laying of surfacing and limited repair of drainage, cross drainage and other kinds of protection works. 179 km of State highways and 256 Km of Major District Roads were fully damaged and would need complete depth pavement reconstruction, considerable repair/reconstruction of drainage, cross drainage and slope protection works and limited road raising, and new cross drainage works **(Government of Kerala, 2018) .**

Figure 4.7 : Destruction of Roads

Source: https://www.onmanorama.com/news/kerala/2018/08/18/kerala-rain-floods-live-updates.html

The four sources of power generation in Kerala include hydro power, thermal power, wind power and solar power. The distribution of power in 300 odd electrical sections in seven districts was shattered. More than 1700 Distribution Transformers were either inundated or damaged. More than 10,000 Distribution Substations were pulled off power to avoid further disasters. Feeding from 16,158 Distribution Transformers was also affected. Service to 25.60 Lakh consumers was disrupted in the calamity.

The total damages in the employment and livelihoods were estimated at Rupees 881 crores. It included Rupees 509 crores damage in tourism, ₹ 359 crores in micro, small and medium-sized enterprises (MSMEs) and ₹ 13 crores in Kudumbashree and coir. The total loss was estimated at ₹ 9,477 crore including wage loss of ₹ 7,301 crore and inventory loss of ₹ 2,176 crore concluding at gross loss for this sector of about ₹ 10,358 crore under Post Disaster Needs Assessment. Total human days of employment loss came to ₹ 1,097 lakh along with a wage loss of ₹ 7,301 crores to the workers. About two-thirds of the migrant workers (22.7 lakhs) lost their workdays. This amounted to an estimated wage loss of ₹ 2,033 crores. Table 4.6 shows the sector-wise Summary of Disaster Effects (Damage and Loss) and Recovery Needs.

Table 4.6 : Summary of Disaster Effects sector wise (Damage and Loss) and Recovery Needs after the Kerala Floods, 2018.

Sector	Damage (Crores) (INR)	Loss (Crore) (INR)	Total Effect (D+L)		Total Recovery Needs	
			Crores	USD Million	Crores (INR) Million	USD
Housing, Land and Settlements	5,027	1,383	6,410	916	5,443	778
Health and Nutrition	499	28	527	75	600	86
Education and Child Protection	175	4	179	26	214	31
Cultural heritage	38	37	75	11	80	11
Agriculture, Fisheries and Livestock	2,975	4,180	7,155	1,022	4,498	643
Water, Sanitation and Hygiene	890	471	1,361	195	1,331	190
Transportation	0	0	0	0	10,046	1,435
Power	0	0	0	0	353	50
Irrigation	0	0	0	0	1,483	212
Other Infrastructure	0	0	0	0	2,446	349
Environment	26	0.04	26	4	148	21
Employment and livelihoods	881	9,477	10,358	1,480	3,896	557
Disaster Risk Reduction	17	583	599	86	110	16
Gender and Social Inclusion	0.9	0	0.9	0.13	35	5
Local Governance	28	0	28	4	32	5

Integrated Water Resources Management	0	0	0	0	24	3
Grand total					30,739	4,392
Grand total (Rounded off)					31,000	4,400

Source: UNDP, 2018

The total damages estimated by PDNA was around ₹ 10,557 crores and total losses were estimated to be around ₹ 16,163 crores totaling to disaster effects of around ₹ 26,720 crores (USD 3.8 billion). This did not include the damage estimates as per the Joint Rapid Damage and Needs Assessment (JRDNA) carried out by the World Bank and the Asian Development Bank (ADB). The total estimated damage excludes damages done to private buildings and properties, losses incurred by private traders and business units, damage, and loss suffered by Kochi airport and road transport and waterways. The damage and loss which was calculated at ₹ 26,720 crores in this report would be much higher if the review is done.

The assessment across social, productive, infrastructure and cross-cutting sectors (public and private) tells that complete recovery requires the sum of ₹ 31,000 crores (USD 4.4 billion). The share of estimated total disaster effects among the sectors of social and economic activity showed that the most affected sectors was the infrastructure sector which accounted for 38% of the total disaster effects. This was followed by cross-cutting sectors (27%) followed by social sectors (18%), and finally the productivity sector (17%). The share of estimated recovery needs among the sectors of social and economic activity showed that the infrastructure sector had the highest recovery needs which accounted for 51% of the total recovery need. This was followed by the social sectors (20%), productive sectors (15%) and finally cross-cutting sectors (14%) (UNDP, 2018).

The memorandum which was submitted by the State Government to the Central Government estimated the damages to be ₹ 5616 crores. The Joint Rapid Disaster Needs Assessment carried out by the World Bank estimated damages and losses to be ₹ 25,050 crores. The Post Disaster Needs Assessment carried out by UN led team estimated the damages and losses to be around ₹ 26,780 crores. However, after including the recovery needs the cost put forward was ₹ 31,000 crores. A need was felt for convergence in the process of Damage and Loss Assessment to facilitate a holistic framework from responding to recovering from any disaster.

Chapter 5 : Causes of Floods

The combination of hazards, vulnerability and inability to reduce the potential negative consequences of risk results in a disaster. Disasters test the strength of our protection against them: the quality of infrastructure, the resilience of our power, sanitation, telecommunications, medical and transportation systems. They gauge our competence and resilience in the face of an emergency. There were several causative factors which contributed to the immense rainfall in Kerala getting converted into a disaster. The natural factor of torrential rains was augmented with several human factors, which resulted in loss of lives, infrastructure and livelihoods. The causative factors are discussed in detail below:

1. High Rainfall

Kerala received abnormally high rainfall from 1st June 2018 to 19th August, 2018 causing severe flooding in 13 out of 14 districts of the state. As per the data generated by IMD, Kerala received a total of 2346.6 mm of rainfall from 1st June, 2018 to 19th August, 2018 in contrast to an expected 1649.5 mm of rainfall. This rainfall was about 42% above the normal. The rainfall across the state in June, July and between 1st to 19th of August was 15%, 18% and 164% respectively, above normal. Although heavy rainfall had already started earlier, the first onset of flooding started towards the end of July.

The rainfall in a single day was recorded 398 mm, 305 mm, 255 mm, 254 mm, 211 mm and 214 mm as at Nilambur, Mananthavadi, Peermade, Munnar KSEB and Myladumparain and Pallakad respectively on 9th August, 2018. This cumulatively brought flooding at many places in Mananthavadi and Vythiri in Wayanad district from 8 to10th August, 2018. There was another severe spell of rainfall which started from the 14th of August and persisted till the 19th of August. This resulted in flooding in 13 out of 14 districts. As per IMD, the rainfall depths recorded during the 15-17, August, 2018 was comparable to the severe storm that occurred in the year 1924 (CWC,2018). This heavy downpour was one of the natural causes for disastrous flooding in the state.

The flood situation was aggravated by the Perigean spring tide which is a high tide occurring three / four times in a year, from 11th to 15th August, 2018. This lead to abnormally high sea levels, further, hampering river outflow to the sea.

2. Dam Management

The role of dams in causing floods was marked with controversies. Many independent researchers claimed that dams played a crucial role in compounding the disastrous effects of Kerala flood disaster. Majority of Kerala's dams (57%) were hydroelectric projects operated by the Kerala State Electricity Board; the remaining dams were operated by the

irrigation department. For both entities, the amount of water to be stored is motivated by necessity for electricity and irrigation, rather than flood control measures. There are 33 dams in the state, out of which the major dams are as under:

Table 5.1 : Major Dams in Kerala

S. No.	Name of Dam/ Reservoir	Rivers on which Dam/Reservoir	Riparian Districts (Districts lying in interface between land and a river or steam.	Full Reservoir Level
1	Idukki Reservoir	Periyar	Idukki	732.42 M
2	Malampuzha Dam	Bharathapuzha	Palakkad	114.6 M
3	Mullappriyar Dam	Periyar	Idukki	41.48 M
4	Vazhanni Dam	Wadakkancherry	Thrissur	62.48 M
5	Banasura Sagar Dam	Kaanapuzha	Wayanad	775.60 M
6	Idamalayar Dam	Idamalayar	Ernakulum	169 M
7	Meenkara Dam	Meenkara	Palakkad	156.63 M
8	Chulliyar Dam	Meenkara	Palakkad	154.08 M
9	Kanjirapuzha Dam	Kanjirapuzha	Palakkad	97.53 M
10	Pothundi Dam	Meenichiladipuzha and Padipuzha	Palakkad	108.20 M

Source: NDRF, 2018

Figure 5.1 : Water flowing from the dams during floods
Source: SANDRP, 2018

Theoretically, dams help to moderate the force of floods in the downstream areas, unless dams have the capacity to store water. In fact, every action that helps to store, hold, recharge (to groundwater aquifer), delay the flow of rainwater from the catchment to the river would help to moderate flow and flooding the river. And as a matter of fact, Kerala's catchments were already losing that capacity rapidly. This loss of capacity was combined with continuous devastation of wetlands, local water bodies, natural forests.

Figure 5.2 : Water released from the Dams
Source: Google images

Generally speaking, the potential capacity of the dam to help in moderating flood can be realized only when dams are operated with that objective in mind. Otherwise and instead dams are filled up as soon there is water available, then they have no space left to store more water. Then they are left with only TINA (there is no alternative) and to release all the inflows to the downstream river. When this release happens while downstream areas are already facing floods due to local rainfall or some other reasons, the dams end up increasing the proportions of downstream flood disaster.

Every dam is supposed to have, a dam specific rule curve that tells, among other things, how the dam is supposed to be filled during the monsoon, to optimize flood moderation for the downstream area, while ensuring that the dam is filled up only closer to the end of the monsoon. Almost all the dams in Kerala were almost full by the end of July.

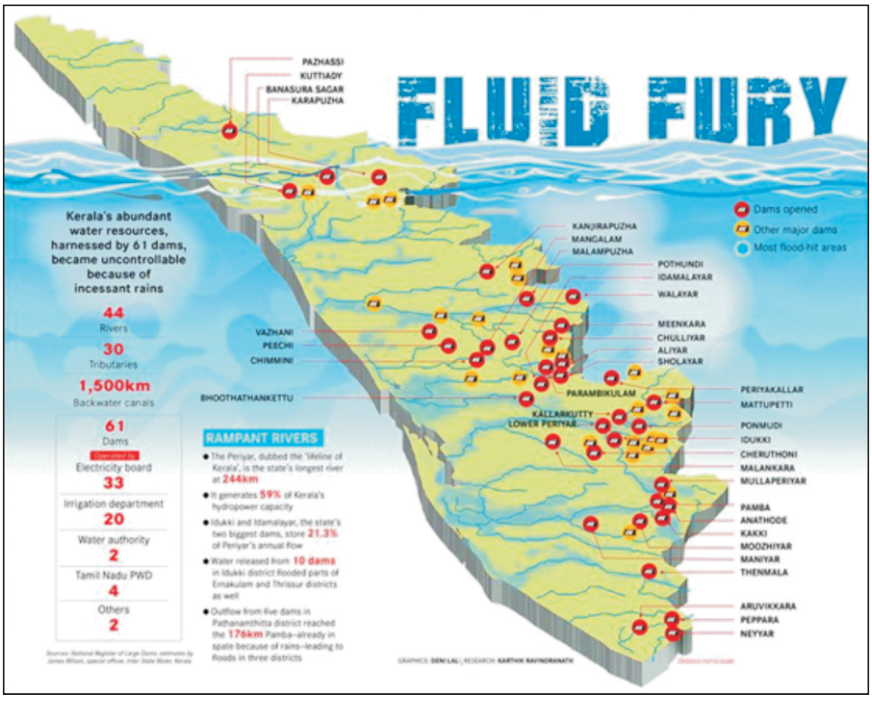


Figure 5.3 : Location of Dams in Kerala

Source: https://www.theweek.in/theweek/cover/2018/08/24/burnt-by-water.html

There was deviation from the rule curve, as end of July was just half through the South West Monsoon and large parts of Kerala gets benefitted from the North East Monsoon that follows Southwest Monsoon. So filling up the dams by end of July was a sign of forthcoming disaster. Idukki and Idamalayar were the only Kerala dams having live storage capacity over 1000 Million Cubic Meters (MCM). Idukki Dam live storage was already 25% full even before the monsoon started on May 31, 2018, reducing available storage capacity to that extent. Idukki is a hydropower dam and it can use water only for hydropower generation. It has six units of 130 Megawatt (MW) each. One of its unit was out of operation since August, 2017. Another went out of operation on June 26, 2018, for annual maintenance. Hence one third of its water usage facility was unavailable during peak flood season. Prior to 2018, the Idukki dam had never been full anytime in the southwest monsoon since it was commissioned in 1975. The only two times its gates were opened (1981 & 1992) was in NE monsoon. In 2018, this dam not only got filled up for the first time ever in Southwest Monsoon, but filled up by over 90% by end of July, just halfway through the Southwest Monsoon. That should have been a clear warning for the authorities **(SANDRP, 2018).**

This viewpoint of dams playing a role in aggravating the floods was refuted by Central Water Commission (CWC). According to CWC, the drainage capacity to the sea of the Kuttanad water body was much below the original capacity of the structures and the drainage of canals and rivers draining towards them. The heavy deposits of silt in the canal augmented by the overall poor state of maintenance, drastically reduced their capacities. The smaller floods also lead to water logging of built-up areas. The communities did not bother about small floods as they were often useful for flushing out polluted canals. Many reservoirs were almost brimmed to their capacity by the end of July due to heavy rainfall from 1st June. Heavy rainfall in a few places from 8th to 9th August was followed by another severe spell of rainfall which started from 14th August and continued till 19th August.

The high rainfall caused an absence of storage in reservoirs upstream. On the other hand, there was pre-existing depleting 'carrying capacities' of water bodies (lakes etc.) porous land and rivers. Limited capacity of Vembanad Lake and Thottappally Spillways of Kuttanad region helped in worsening the disastrous impacts of the flood. Numbers of area were already inundated with water for over fifteen days **(UNDP, 2018).**

As per CWC, the operations of major dams like Idukki, Mullaperiyar, Parambikulam and Kakkin in the upper catchments regions of the Periyar, Chalakudy and Pamba rivers would have had only a minimal effect on increasing the flood levels in their lower reaches and backwaters along with increasing the duration of waterlogging. They insisted that protocols should be adhered to (along with operational rules) for optimizing power generation, irrigation supply, protection of the dam and downstream flood protection during the occurrence of heavy rains and drought. If the water released from the dam is optimized for downstream flood protection, it would, anyway allow for increase in extreme peak flows downstream of the dam and thus cause a reduction in the damage caused. If the releases from dams which are located more than 100 km upstream from the wetlands are controlled, it would have a minimal effect on the flood levels in the lower parts, particularly when the sea outflow was already obstructed.

The small reservoirs tend to have some flood shaving effect. Efficiency of reservoirs for controlling flood for downstream areas lies in the fact that the capacity, from their upper catchment area, should be greater than the volume of flood.

3. Overflow of Rivers and Blockage of Water Bodies

India is blessed with two rich biodiversity hotspots, the Western Ghats and North Eastern Himalayan regions. Kerala is located on the South-West coast of India, embraced by 44 rivers, most of them originating from Western Ghats. The Periyar, Bharathapuzha, Pamba, Manimala, Meenachil, Achenkovil, Chalakudy and Kabini overflowed in flood time and played important role in causing the Kerala floods.

Figure 5.4 : Over flow of Water Bodies

Photo courtesy: https://timesofindia.indiatimes.com/city/thiruvananthapuram/ half-of-kerala-reels-under-floods-as-29-die-54000-are-homeless/articleshow/65362118.cms

Periyar is the longest river with the largest discharge potential in the State. Its sub-basin consists of about 50% of the cumulative live storage of Kerala. During the flood most affected cities by Periyar overflow were Kochi, Aluva, Ernakulum, Idduki, Neriamangalam, Kalady, Malayattor, Thrissur etc. Bharathapuzha, the interstate river of Kerala and Tamil Nadu flows into the Arabian Sea. This sub-basin has neighboring Cauvery basin in the east and Arabian Sea in the west. The route of the river to the district was affected. Four biggest west flowing rivers namely Achenkovil (128 km), Pamba (176 km), Manimala (90 km) and Meenachil (78 km) join into the southern part of the Vembanad Lake while a southern branch of Periyar drains into Cochin Kayal. It finally drains to the Arabian sea through Kochi outlet. Pathnamthitta, Kottayam and Alapuzha were the most affected districts during the flood by these rivers. Chalakudy River (130 km) is the fifth longest and the steepest river of Kerala. Thrissur was the most affected area by this river's overflow in this Monsoon season. River Kabini (240 km) is one of the major tributaries of Cauvery River in south India. The catchment area of Kabini is 1934.5 km. The outflow from the Kabini reservoir in H.D. Kote reached a record level of 80,000 cusecs, inundating low-lying areas in H.D. Kote, Nanjangud, Suttur, and other towns. This was caused by heavy rains in Wayanad, which is the upper catchment area of the Kabini **(NDRF, 2018)**

4. Poor Resource Management-

Most of the area which got affected by the monsoons was classified as an ecologically-sensitive zones (ESZs) by the expert panel on Western Ghats Ecology. It was also referred to as the Gadgil Committee. The report was delivered by a team which was headed by Madhav Gadgil, who was a renowned ecologist and also the founder member of the Centre for

Ecological Sciences at the Indian Institute of Science, Bengaluru. According to environmentalists, the committee's recommendations were strong enough to protect the sensitive Western Ghat region. The recommendation of the committee was to categorize 140,000 Km stretch of the Western Ghats in three zones. The committee recommended strong restrictions on mining and quarrying activities, using land for non-forest purposes and disallowing high rises in the concerned areas. The report was first submitted to the government in 2011. However, the recommendations of the committee were not adopted. Shri Gadgil maintained that quarrying was a major reason for the mudslides and landslides. Further, he added that Kerala floods was a man-made calamity where intense rainfall and human intervention had made it a serious disaster. **(First Post, 2018).**

5. Lack of Awareness

Lack of awareness with respect to disaster risks from urban floods are living testimonies of the conflict between urban development and weather-related vulnerabilities. An example of this was the closure of Cochin International Airport for two weeks when flood waters from the swollen river breached the periphery walls and flooded the runway. Additionally, the world's first solar-powered airport lost approximately 20 percent of its solar panels owing to damage. In total, a loss of USD 35 million was incurred owing to damage to the airport and the ensuing closure. The airport is a mere 420 metres away from the Periyar River, located within the floodplains of the river. The Chengalthodu creek, which connects to the Periyar River, was completely realigned. Kochi's airport wasn't unique in this aspect. Airports in Mumbai and Chennai, which are also located close to rivers and have expanded their runways over river channels and floodplains and have also experienced extreme flooding and closure in 2005 and 2015 respectively. **(WRI INDIA, 2018).**

6. Poor Discharge Capacities of Water Bodies

The embankments of rivers in Kerala are steep, stable to a degree. It seems the rivers are stable within their bed. Flooding occurs whenever the river discharges. People were used to limited flooding in the area but were not prepared for the extreme floods that occurred in 1924 and 2018. Regular flooding was a phenomena which mostly occurred in the low areas around the backwaters and reaches of the lower part of river. The flood discharge inflow from rivers did cause flooding but it was aggravated by poor discharge capacities of the canals and blockage of discharge at the sea outlets (azhis and pozhis). Rising frequency of heavy rainfall and precipitation during monsoon led to an increase in the magnitude and frequency of river floods. It is projected that the sea level rise (SLR) along the coast will be somewhere around 100 mm–200 mm in the next 100 years. Needless to say, this would bring drastic uncomfortable changes in the large part of coastal communities living on sandy coasts. Backwater banks, paddy fields, filtration ponds are other sections of the coastal zone are susceptible to SLR. Although it is of not much significance for the next

planning cycle, but it is particularly vital for the long-term scenario spanning over 50 years **(UNDP, 2018).**

7. Unplanned Urbanization

Unplanned and unchecked urbanization is undoubtedly the common denominator that adds to the intensity of any disaster, particularly in densely populated, developing nations. Development of human societies lead to inevitable conflicts with nature and the impacts would depend on the setting of the landscape, and the utilization of land and water resources. The rugged eastern highlands that transform as the midlands and as coastal regions make Kerala's landscape spectacular, but it is also vulnerable to natural processes that can lead to disasters. While urbanization (poorly planned drainage, underpasses, lack of waste recycling, etc.) is an important factor in causing floods in large cities (Chennai, Mumbai), the story of Kerala is different. It is not just urbanization; it is the unscientific use of its land and water resources that added to the severity of damage. Unchecked tourism and illegal constructions, mostly related to tourism (again arising from lack of regulations) was another triggering factor that was accentuated by incessant rains. The other issue was with our river management, including construction of dams. Unlike other large rivers (like Godavari, Narmada), the rivers in Kerala are smaller and narrower. The numerous dams across these rivers have reduced the flow into the rivers and over time, their floodplains have shrunk, and people have occupied these floodplains for cultivation and construction **(The Hindu, 2018).**

The constant removal of natural infrastructure and ecological defenses such as forests and wetlands makes land less able to absorb flood water. Reckless urban expansion results in destruction of flood-buffering forests. The infrastructure was built over floodplains, and destroyed the water bodies. In summary, the accumulation of natural and primarily human made factors caused the devastating floods. These include high rainfall, high spring tides, issues in flood storage capacity in the reservoirs, overflow of rivers, poor drainage capacity of canals and sea outlets, poor resource management and unplanned urbanization.

Chapter 6 : Landslides

Kerala, due to its geographical terrain such as coastal line and steep gradient in Western Ghats is vulnerable to the hazard of landslides. The Kerala State Disaster Management Authority identifies 14.4 percent of the area in the state as vulnerable to landslides. The high density of population (860 persons per square kilometres) also makes it more vulnerable to the damages inflicted by landslides. Moreover, whenever floods occur in hilly areas, they are bound to trigger landslides in the region. Hence, landslides would be the secondary disaster caused by the primary disaster of floods. The following figure shows the location of landslides in the state due to 2018 rains:

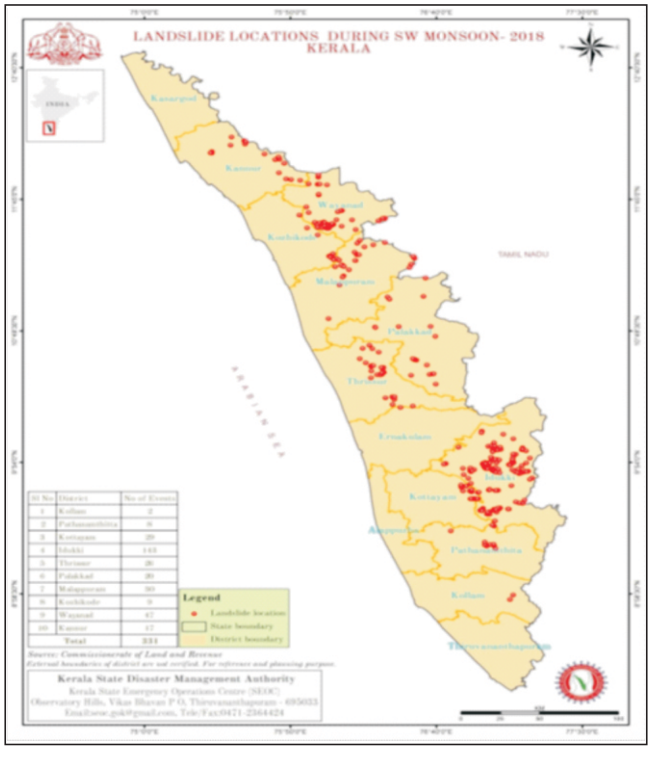


Figure 6.1 : Landslide zonation map of Kerala

Source: SDMA Kerala

(Source: Additional memorandum submitted by State Government: 1st-31st August, 2018)

According to the Post Disaster Needs Assessment report, 2018, there were nearly 341 landslides in 10 districts. Idukki was worst hit as it was ravaged by 143 landslides. These instances of landslides made local authorities release the excess water from 37 dams all

across the state, thus compounding on the flood's impacts. The preliminary memorandum submitted by the state government reported 47 landslides during the floods from 29th May - 31st July alone. However, the additional memorandum submitted by the state government from 1st August to 30th August stated that the land revenue department had reported a total of 331 landslides in the state. The memorandum further reported that 104 people lost their lives in the month of August due to landslides. The difference in the number of landslides may be due to the fact that UNDP had captured satellite data for major landslides during the flood period (June-August, 2018). However, the memorandum submitted by the state government relied on the data given by District and Taluk level Revenue and Disaster Management Department. This data was captured just before the rehabilitation work started in the state.

An organization named Mathrubhumi in the collaboration with Centre for Migration and Inclusive Development brought out a report titled "Leaving No One Behind: Lessons from the Kerala Disasters" stated that more than 5,000 landslides of varying type and intensity took place in the city as a result habitats of hilly areas wander around due to panic looking for safe places to hide **(Thummarukudy & Peter, 2019).**

Figure 6.2 : Roads blocked due to Landslides in Kerala, 2018

Source: https://india.timesofnews.com/city/ahmedabad/kerala-floods-death-toll-

It has been the trend that the landslides in Kerala are usually of 'debris flow type' with having limited affected areas surrounding few catchment areas. However, during the devastating floods of 2018, due to unpredicted and unprecedented rainfall, there were many deep-seated landslides, rock slides and landslips. The landslides were caused due to natural as well as human made factors. The steep terrain of water was subjected to excess water due to floods. The water on the slopes of Western Ghats seeped through the surface of soil while flowing downhill. There were subsurface 'pipes' formed which created water channels under the soil. These pipes either quickly drained subsurface water, destabilizing hill slopes, or became clogged, creating a backlog of water that grew larger and larger until the entire slope gave way. On the other hand, human made causes like building new structures by cutting slopes and removing soil changes the runoff pattern of water and created new paths for the water to seep into soil. This increased infiltration destabilized the slopes and led to landslides in 2018. The hill slope modifications (cut slopes) carried out for developmental activities and plantations in disaster prone areas failed during the Kerala Floods in 2018.

Various organizations working in the area of landslide mitigation and management have emphasised land use planning and zoning regulations to reduce damages from landslides and strengthen disaster preparedness.The organizations have advocated the use of susceptibility maps to understand what type of landslide size is expected in a specific area and how it might behave in the specific area. The maps can then be interpreted logically in terms of settlement and infrastructure. This can help to prioritise resource management, prioritise awareness programmes in villages and prioritise resources at the regional level. Moreover, environmental friendly ways of lives can also help to avoid such disasters in future.

Chapter 7 : Response and Relief

Response includes actions aimed at limiting injuries, loss of life, and damage to property and the environment that get impacted during the disaster. It is the most visible function during disasters and hence has to be carried out effectively as it is always under scrutiny. Although response functions includes saving lives and giving assistance in the early phase of a post disaster scenario, it has to be done keeping in view the geographic location of the disaster.

Response consists of evacuation of humans, livestock and other animals. Immediately after the floods, the basic amenities of providing food, clothing, shelter and medicines to disaster survivors is of utmost importance. If these needs are fulfilled timely and immediately, the disastrous effects of the disaster to living beings can be reduced. In the wake of Kerala floods, various stakeholders like NDRF, Indian Army, State-led, community volunteers, fishermen, women volunteers, Non-state actors and technological interventions responded to the massive deluge in a very effectively manner.

National Disaster Response Force (NDRF)

As a part of proactive measures, NDRF had pre-positioned its 3 teams in Kerala for emergency response since 29th July, 2018 in Ernakulam, Thrissur and Idukki. On requisition of State Emergency Operation Centre (SEOC), Kerala, 3 additional teams were sent by road from NDRF base Arakkonam and 4 teams were airlifted from Indian Navy Ship INS Rajalion 09th August, 2018. To supplement the efforts of State Government, four more teams were airlifted from NDRF base Arakkonam on 10th August, 2018 making 14 teams functional on ground. Chief Minister of Kerala, on further assessment, decided to approach the Centre for assistance in the form of additional NDRF Teams.

Figure 7.1 : NDRF teams getting ready for responding to Kerala Floods, 2018
Source : NDRF, 2018

On 15th August, 2018, a meeting of the National Crisis Management Committee (NCMC), the country's apex body for handling emergency situation was held in New Delhi to ensure continued support and scaled up the assistance to the state of Kerala in view of the prevailing flood situation. As per direction of Government of India, 44 additional NDRF fresh teams were airlifted on 16th & 17th August, 2018 to Kerala from NDRF base Pune, Ghaziabad, Kolkata, Odisha, Gujarat, Mundali, Bhatinda, Arakkonam and Patna in order to scale up the operations.

Figure 7.2 : NDRF Teams rescuing elderly women during the floods
Source: NDRF, 2018

Lack of access to the affected areas due to road blocks along with landslides and flooding hampered the rescue operations. The devastating floods had swept all fourteen districts of the state, stuck thousands of people in various regions due to damaged roads and landslides. Pathanamthitta, Idukki, Alappuzha, Wayanad, Kotayam, Ernakulum, Thrissur, Kozhikode, Trivandrum and Mallapuram districts were the worst affected. Bridges and roads were completely destroyed and no communication system was functional. This was the situation when NDRF was called for rescue. The NDRF responders performed war front like services in the hamlets of rain hit Kerala. Continuous heavy rainfall, endangering weather conditions and terrain rose the fear of another landslide every minute and made the rescue operation very difficult. The flood situation deteriorated with each passing day, as people were separated and needed essential commodities. In several places that were inaccessible through boats, NDRF teams used rope rescue techniques to made access to the stranded people and provide essential commodities. Maximum numbers of boats were employed to evacuate people with specific areas being allocated to each team/ unit for rescue and evacuation operations. For swift response, the rescue and relief operations were commenced throughout day and night on rotation basis. NDRF made its highest ever deployment in a single state since its raising and deputed 58 teams for fighting flood fury in the worst affected areas.

Figure 7.3 : NDRF personnel clearing debris after landslides and floods
Source: NDRF,2018

Maximum teams were deployed in worst affected districts viz. Pathanamthitta, Idukki, Alappuzha, Wayanad, Kotayam, Ernakulum, Thrissur, Kozhikode, Trivandrum and Malapuram. Besides, NDRF also assisted the state administration in several other situations like landslides, house collapses and restoring communication facilities, essential services and civil supplies.

In total, National Disaster Response Force (NDRF) sent 57 teams along with 435 boats for search and rescue in addition to five companies of paramilitary forces, armed forces and coast guards with 40 helicopters, 20 aircraft, 2 ships, 10 columns and 10 teams of Engineering Task Force. In Kerala, the younger population is generally employed outside the state or the country. It is the elderly population who stays at home with their family members. During the rescue and evacuation operations, elderly and females were reluctant to leave their homes. NDRF teams assisted such elderly people by providing food/medical assistance as well as psychological support by visiting them at least once in a day **(NDRF, 2018).**

Indian Army

The Indian Army was deeply involved in the rescue and relief operations in Kerala. Request for provision of Army assistance was received on 09th August, 2018. Accordingly, Indian Army carried out execution of Disaster Relief tasks on a war footing which has been greatly appreciated by civilian populace and the State administration. The Army rescued over 23,000 people as part of its 'Operation Madad'. As part of the operation, the Army provided medical aid to over 2,000 people. It also restored the connectivity at 42 locations, cleared 22 landslides and constructed 15 temporary bridges. It also pressed into service two Advanced Light Helicopters and two Cheetah Helicopters to rescue marooned people and provide essential supplies to various parts of the state. Choppers played a crucial role in

evacuating people stuck on the rooftops of their flooded homes. Hundreds of people were ensured safety (Times of India, 2018).

Figure 7.4 : Indian Army rescuing people in flood ravaged Kerala
Source: https://www.bbc.com/news/world-asia-india-45239398

In total 5 medical teams and 10 groups or columns of soldiers each consisting of 50-60 personnel were sent for performing relief activities in Kerala.

Table 7.1 : Details of Flood Relief Columns deployed by the Indian Army

Serial	Group or Column Number	Place of Deployment	Date of Deployment
(a)	Column 1 & 2	Ayyankunnu (Kannur)	09 Aug 2018 16 Aug 2018
(b)	Column 3	Mananthwady (Wayanad)	09 Aug 2018
(c)	Column 4	Kozikode	09 Aug 2018
(d)	Column 5	Karuvarukundu & Nilambur (Malappuram)	09 Aug 2018
(e)	Column 6	Adimali, Idukki	10 Aug 2018
(f)	Column 7	Aluwa, Ernakulam	11 Aug 2018
(g)	Column 8	Ernakulam	13 Aug 2018
(h)	Column 9	Pathnamathitta	13 Aug 2018
(i)	Column 10	Thiruvananthapuram	15 Aug 2018

Source: Ministry of Defence, 2018 Available at : pib.nic.in

Engineering Task forces are time-bound and outcome-focused groups that were convened to support Kerala relief and rescue mission. So, in addition to the 10 flood relief columns, 10 Engineer Task Forces (ETF) each having an approximate strength of 40 personnel from Jodhpur, Bhopal, Pune, Bangalore and Secunderabad were pressed into action. Army also utilized 53 military boats to evacuate civilians from flood affected areas.

Table 7.2 : Details of Engineering Task Force (ETF)

Serial	Group or Column Number	Place of Deployment	Date of Deployment
(a)	ETF 1	Munnar, Idukki	09 Aug 2018
(b)	ETF 2	Ernakulam	09 Aug 2018
(c)	ETF 3	Pathnamathitta	11 Aug 2018
(d)	ETF 4, 5, 6	Thrissur	16 Aug 2018
(e)	ETF 7, 8, 9	Trivandrum	16 Aug 2018 17 Aug 2018
(f)	ETF 10	Kozhikode	17 Aug 2018

Source: Ministry of Defence, 2018

Figure 7.5 : Indian Army engaged is Search and Rescue
Source:https://www.dnaindia.com/india/report-kerala-floods-navy-deploys-18-more-teams-readying-25-more-2651216

In spite of continuous and heavy rains, Indian Army columns worked round the clock to restore connectivity to remote villages by constructing temporary foot bridges, bunds and preparing alternate routes. 13 temporary bridges were constructed to reconnect 38 remote areas and total of 3627 personnel were rescued, which included 22 foreign nationals. Relief materials were sent to 19 villages with medical aid. In addition 3000 pre-cooked meals and 300 life jackets were handed over to civil administration on 17th Aug 2018 by the Indian Army (Ministry of Defence, 2018).

Indian Air force (IAF)

Due to heavy rainfall and resultant extreme floods and landslides, many parts of Northern Kerala was left completely isolated. For this, the Government of Kerala called IAF for help, and they provided immediate assistance by carrying out **'Operation Karuna'** and through Humanitarian Assistance Disaster Relief (HADR) mission. The IAF delivered aid by deploying transport aircraft's on 9th August, 2018.

Figure 7.6 : 'Operation Karuna' launched by Indian Air Force
Source:Indian Air Force: Government of India. (2018)

With the help of IAF's aircrafts, tonnes of supplies including food, clothing and water etc. were provided everyday to the affected population including medicinal help with doctors on board. On 9th of August alone, 300 KGs of relief material was dropped followed by 900 kg on 16th August.

State-Led Response:

The fatigue and resource constraints hampered the ability of affected communities to respond to the disaster in the initial days of incessant rains and flooding. The primary role of rescue and relief was conducted by state and non-state service providers. Among these, the government disaster management teams, state government machineries and the local governments played an important role. The formal response received key information from the local administration and the State Disaster Management teams. However, realizing that the formal emergency services would not be adequate to provide such large-scale support, the state government had asked openly to the citizens for participation **(RKDP, 2019).**

Prompt and efficient rescue and relief operations were conducted by the Government of Kerala with the help of local communities who mobilized around the cause at ground level as well on virtual mode vis-à-vis social media. The role of local volunteers and voluntary groups were immense which were majorly consisted of Keralite youth. The process of rehabilitation in this flood was also marked with inspiring acts of the people of Kerala who, by the sheer force of resilience or desperation for some stability or may be the combination of both, in a week returned to their homes to rebuilding them from the scratch. The administrative machinery of the government was working in full during the relief operations even though their loved ones or relatives were struggling with the impacts of the flood. The Kerala State Disaster Management Authority (KSDMA) as per its responsibility coordinated emergency responses, rescue and relief operations when the flood was ravaging and after the flood. Relief assistance in the form of providing cereals and pulse, drinking water, kerosene and other lie-essential items was given in the relief camps. Food packets and monetary assistance of ₹ 10,000 per family (for rebuilding inundated houses) were also disbursed. The State's renowned Poverty Eradication and Women's Empowerment Programme, **'Kudumbashree',** was highly effective in these efforts. Kudumbashree members cleaned houses and public offices, provided counseling to families, managed community kitchens in affected areas, collected relief material and distributed it in camps, provided assistance for packing of take-home kits, supplied volunteers for various activities, rehabilitated flood victims in their homes, and conducted mass cleaning activities in some districts. They also raised funds and contributed nearly ₹ 11.2 crores to the Chief Minister's Disaster Relief Fund. The contribution made by Kudumbashree has been detailed out under the section of Women and Response, later in this chapter.

Thousands of families in panchayats like Edathiruthy, Kaipamangalam, Perinjanam and Mathilakam on the banks of Canolly canal took shelter in relief camps.In many places relief and rescue operations were organized which clearly shows the effectiveness of local level planning and leadership. It is reported that local people had sponsored one year rent for all those who have lost their houses completely in Puthupadygrama panchayat. The state

administration asked self-governing village panchayats and gram sabhas to contribute in relief panchayat operations and distributing food and drinking water in flood affected areas. Panchayat staffs were deployed for disaster management operations. The panchayat director issued a directive to all the secretaries to issue a circular entrusting panchayat staff with disaster management activities. Only the essential staff stayed back for office duties. The government had earlier given sanction to local bodies to spend amount for disaster relief from own funds as per requirement. Staff of panchayats including engineering wing were deployed for disaster management as directed by state disaster management authority **(Times of India, 16th August, 2018).**

The Central Government along with many other states provided support to the state government's response and relief efforts. The Prime Minister, under the Pradhan Mantri AwasYojana (PMAY), had declared financial assistance package of ₹600 crore for providing houses in villages which lost many houses to flood. The Ministry of Rural Development sanctioned ₹1,800 corers under Mahatma Gandhi National Rural and Employment Guarantee Scheme (MGNREGA) for 2018-19. Clear directions were issued for insurance companies for the timely release of compensation to the affected families/beneficiaries under social security schemes. In addition to contributions in kind (medical and relief supplies) the Chief Minister's Disaster Relief Fund (CMDRF) had credited approximately ₹1,400 crores from millions of individuals and organizations across India and overseas.

Community Volunteers

The other equally important component of Kerala's response was the manner in which people from across the state, and especially in the affected areas, rose up to help. In this, there was an over-arching sense of collective solidarity and desire to support that cutting across religious, political or class lines. This feeling was either channelized by diverse political, social, cultural and religious groups or it expressed itself spontaneously in simple acts of bravery and selfless service. Several mass organizations gave calls for participating in the rescue efforts at the local level. Trade unions – including the now famous fisher folk's unions – worked night and day to organize rescue and relief operations. As rains had eased and waters were receded, these organizations were worked to clean the villages from mud and debris that flood waters had left behind. Thousands of volunteers worked in relief camps including doctors and paramedical staff. They undertook a range of duties such as, cooking food, unloading supplies of relief material, looking after those who were elderly or sick, or taking care of children. Students, daily farm workers, carpenters, electricians and plumbers from across Kerala went from house to house, removing mud, restoring power and water connections, and repairing doors and windows.

Nongovernment Organizations (NGO's)

As Kerala fought with the worst floods in its recent history, many NGOs have lent their support to ensure supply of packaged meals and other relief items to the worst affected areas of the state. Red Cross used their vast network and immediately began to perform rescue missions. Vans, boats, and even helicopters were utilized to rescue individuals trapped by the floodwaters. Red Cross partnered with Airbus Foundation to cover greater distances. Red Cross also worked on assisting people in relief camps with healthcare and other basic needs.

Gospel for Asia (GFA),another NGO responded by mobilizing on-the-ground networks of workers who helped rescuing hundreds of people, provided immediate critical relief to stranded families and in relief camps, equipped victims with tools to help them rebuild long term, set up medical camps, and partnered with local churches and communities to bring aid where it counted the most **(Missions Box, 2018)**

A renowned International NGO,- Rise Against Hunger India (RAHI) associated with many NGOs including Arshabharath, Hope Foundation and the Times Foundation to help the families living in the make-shift relief camps.Not only food, RAHI mobilized other important and essential items like hygiene kits, toiletry, soaps, water containers, utensils, bedsheets, blankets, clothing, water purifier and similar products, which could be utilized by survivors in relief camps. Save the Children India unit too helped the victims, especially children, in the flood-affected areas. It had set up child-friendly spaces, which provided children with important psycho-social well-being through learning and recreation facilities. **(Business Standard, 2018)**

Fishermen

Fishermen from across the state came together to the rescue those who were in need. The fishing community put together boats that they take to sea. Fishermen came to Aluvafrom Vypin, Cherai and Allappuzha to help those who were stranded and needed to get out of their homes. Hundreds of fishermen reached out to the worst-affected areas from far-flung places, spending their own money to transport their mechanized boats A total of 4537 fishermen went out with 669 boats and managed to save at least 65,000 lives and the every element of cost for this rescue activity was born by the Government **(Additional memorandum, 2018).**

Figure 7.7 : Fishermen rescuing survivors during the Kerala floods.

Source: https://www.newindianexpress.com/states/kerala/2018/aug/22/

It is worth mentioning that months before the flood these fishermen struggled with Ochki cyclone and were on the way of rehabilitation and recovery. Many of them were living in poor conditions, working hard for their living, but still took the responsibility of helping in the relief and rescues operations. With memories of December, 2004 tsunami tragedy still fresh, these fishermen had a better understanding of the helplessness of those trapped in coastal areas **(India Today, 2018).**

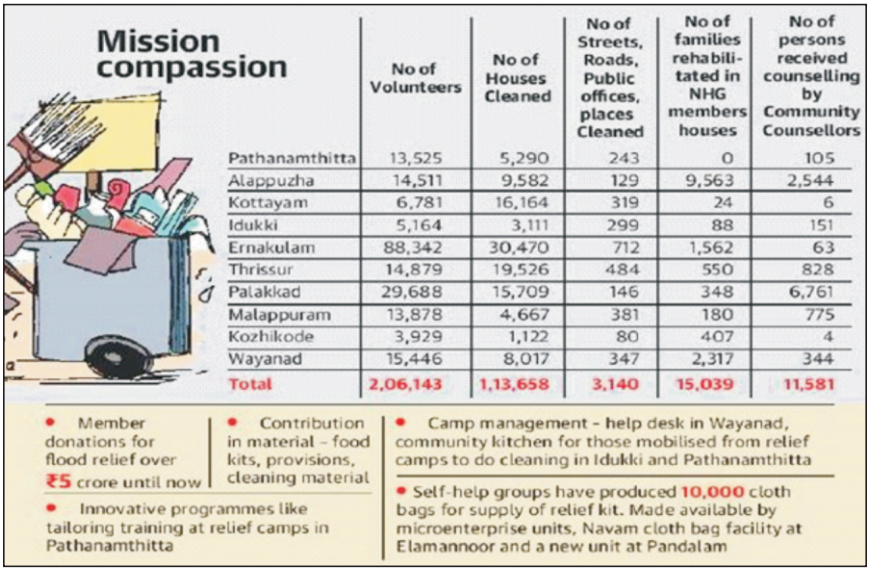
Women and Response:

'Kudumbashree'- a Kerala government's poverty eradication and women empowerment programme played a crucial role in women empowerment. The name Kudumbashree in Malayalam language means 'prosperity of the family'. Kudumbashree is essentially a community network that covers the entire State of Kerala. Nearly 5 million women are a part of Kudumbashree, making it the world's largest women empowerment project.

If Kerala's fishermen were in the forefront of saving marooned people from the flood-hit areas, workers of the Kudumbashree which is a poverty eradication and women empowerment programme made efforts to restore normal life in the regions scarred by the disaster. It has been said that, over 1.13 lakh residential premises across 10 districts were cleaned and made habitable by the workers as on August 28th, 2018. They also cleaned over 3,100 public spaces while the Kudumbasree community counsellors, 320 in all, offered psychological support to over 11,000 affected people. Kudumbasree have 42 lakh members and the amount donated was initially 5 crores but by the time the report was published the amount had gone up to 11.2 crores, with some members donating far more than their socioeconomic status could have allowed.

Figure 7.8 : Kudumbashree members working in relief operations
Source: http://www.kudumbashree.org/

Kudumbashree workers were active from the initial days of the flood, making packaged meals available to affected people. In the first three days starting from 15th August, 2018 some 16,000 food packets were distributed at relief camps in Pathanamthitta district alone. The mission also mobilised workers en masse from non-affected or less-affected areas to carry out cleaning drives in hard-hit regions in Pathanamthitta and Wayanad. At a certain point, a total of 6,757 women from the Kudumbasree neighbourhood groups at Kalanjoor, Nedumbram, Enadimangalam, Kadambanad, Ezhamkulam, Peringara, Koduman, Adoor, Pallikkal, Kadapra, Enath, Niranam, Panthalam, Kuttoor and Konni panchayats and Thiruvalla municipality were mobilised to clean living premises at Peringara, Niranam, Nedumbram, Kuttoor and Kadapra panchayats and within the Thiruvalla municipality. These cleaning teams had aprox 20 to 25 women member equipped with bleaching and cleaning lotions.



Mission compassion

	No of Volunteers	No of Houses Cleaned	No of Streets, Roads, Public offices, places Cleaned	No of families rehabilitated in NHG members houses	No of persons received counselling by Community Counsellors
Pathanamthitta	13,525	5,290	243	0	105
Alappuzha	14,511	9,582	129	9,563	2,544
Kottayam	6,781	16,164	319	24	6
Idukki	5,164	3,111	299	88	151
Ernakulam	88,342	30,470	712	1,562	63
Thrissur	14,879	19,526	484	550	828
Palakkad	29,688	15,709	146	348	6,761
Malappuram	13,878	4,667	381	180	775
Kozhikode	3,929	1,122	80	407	4
Wayanad	15,446	8,017	347	2,317	344
Total	2,06,143	1,13,658	3,140	15,039	11,581

- Member donations for flood relief over ₹5 crore until now
- Contribution in material – food kits, provisions, cleaning material
- Camp management - help desk in Wayanad, community kitchen for those mobilised from relief camps to do cleaning in Idukki and Pathanamthitta
- Innovative programmes like tailoring training at relief camps in Pathanamthitta
- Self-help groups have produced 10,000 cloth bags for supply of relief kit. Made available by microenterprise units, Navam cloth bag facility at Elamannoor and a new unit at Pandalam

Figure 7.9 : Response of Kudumbashree in Kerala Floods
Source: The Hindu, 29th August, 2018

Kudumbashree volunteers : They were supported by the respective panchayats, Health Department and Accredited Social Health Activists (ASHA workers). Nearly 1,400 workers from Kollam had carried out a similar drive at Chengannur. In Wayanad, a massive team of 30,000 workers did a day-long cleaning mission **(The Hindu, 2018)**

Non-state actors

Non-state actors also played their role in responding to the Kerala floods, 2018. There was a high dependence on volunteers and civil society organizations to fulfill various on-ground ad hoc tasks. Among the volunteers from different walks of life, members of the fisher communities were involved in the most critical activity which was to evacuate or rescue families that were stranded in the floods. As noted above, Navy boats and helicopters could not be operated due to lack of elbow space for operations in areas with dense populations. More importantly, the large elderly population in Kerala was unable to physically access these big boats or helicopters due to their health conditions. Hence, the country boats brought by the fishermen from across the Kerala coast were used to rescue more people than the motorized large boats brought in by the NDRF and defence teams. Many disaster survivors were rescued and evacuated in country boats which carried them to nearby roads from where they were transferred to the Navy boats which then ferried them to relief camps. In situations where the fishermen did not possess knowledge about the roads and location, they required local volunteers to assist them. Similar services were offered by doctors, nurses, government officials, media persons and college students, who were

crowd sourced and allocated with responsibilities on the ground. Many non-governmental organizations, charity institutions and religious institutions supported the affected communities by providing space to set up relief camps and donating essential relief materials.

Role of Technology

Kerala floods highlighted the vital role played by Information Technology in rescue and relief operations. keralarescue. in , which is a web-based application along with the use of social media like WhatsApp by government officials and voluntary groups helped the rescue personnel to identify the location of victims, location of the camps, things needed in the camps. The registration of the volunteers was also done online which facilitated rescue and relief operations. Traditional information dissemination modes like newspapers, television were also deployed.

Case Study :

These Govt Engg College students' power banks helped people stuck in

#Kerala Floods call family

With Kerala still facing nature's wrath, the scramble for electricity to power up mobile phones is only increasing. To solve this issue, a Government engineering college in Thiruvananthapuram has all hands on deck to make emergency power banks for those stuck without any electricity all over the state. They have shipped out over 350 of their makeshift power banks and are trying roll out as many as possible - to ensure people can connect quickly and let their family know that they're all right.

The Government Engineering College, Barton Hill, has almost all its 2,500 students assembling emergency power banks. The device is a basic prototype made of eight AA batteries (pencil batteries). The idea is to help those whose phones have been drained of charge connect with their friends and family or even call for help. "We were not badly affected by the flood and because most of us are hostelites, we got together and began putting these devices together. We wanted to help people who were stuck without power and needed to make at least one or two phone calls for help," Krishnan Unni, a fourth-year mechanical engineering student of the college who is working actively on this project.

Source: https://www.edexlive.com/people/2018/aug/20/%E2%80%8Bthese-govt-engg-college-students-power-banks-helped-people-stuck-in-keralafloods-call-family-3709.html

Power bank

The students work tirelessly to make the emergency

A. **Social media-** Many people used social media platforms to co-ordinate search, rescue, food distribution and reaching out to people requiring help. The Indian social media was flooded with posts about the Kerala floods informing people about avenues to donate and to help out in any way they can. In many places, locations facilitated by Whatsapp were used as virtual 'control rooms'. Many volunteers were mobilized through social media for one-time cleaning operations. It worked as a device to connect to people in need. The Thanal Palliative and Paraplegic Care Society was one of the organizations which was at the front line of the rescue efforts in the district of Ernakulam. With volunteers trained in paramedical care, This organization rescued 160 People with Disabilities (PWDs) along with the elderly population. Their ability to operate successfully was attributed to two factors. Firstly, they had a network with the community which they were able to harness efficiently and through social media. Moreover, the organization had knowledge about households with PWD and geriatric patients, which acted as a vulnerability map and they were able to target and prioritize those households. Secondly, the organization had also participated in training program on disability-inclusive DRR organized by Kerala State Disaster Management Authority. The training programme had strengthened their capacity to respond in an organized manner (PDNA, 2018).

   Social media viz. Twitter, Facebook, WhatsApp were also widely used by NDRF responders to reach to the distressed people. All the teams' commanders working on the ground were in touch through social media with other officials. A 24x7 helpline was also functional at NDRF headquarter to receive the calls of relatives of the stranded persons. These call details were further forwarded to the NDRF team's Commanders working on the ground at that particular area to facilitate safe and prompt rescue of the stranded people. More than 5000 calls/Whatsapp messages were received by NDRF.

B. **Web-based application-** The web-based applications, especially The Rebuild Kerala app, were used by the authorities to assess damages caused to houses and buildings. The Rebuild Kerala app (application) had efficient feature of payment gateways for compensation packages. Along with this, Chief Minister's Disaster Relief Fund portal

was also used extensively for collecting financial resources. It showed that in the future, information technology could also be used to recover important documents which are lost in disasters, geo-tag beneficiaries, carry out social audits and assist in the redressal of grievances.

C. **Crowd sourcing-** Crowd sourcing is the practice of engaging a 'crowd' or group for a common goal generally for innovation, problem solving, or efficiency. Crowd sourcing played a huge role in collective relief and rescue during Kerala floods, 2018. As illustrated, the first responses to the disaster came from the affected communities. Apart from initiating self-help activities and providing first-level rescue and relief operations, they also reached out to two other actors at this stage. The first is the local-level administration like the Panchayats and local volunteers to demand help and also enquire about the status of the rescue operations. These communications occurred through face-to-face interactions but when physical mobility became difficult, mobile phones were preferred. During this stage, the affected communities also reached out to their non-local friends and families, and updated them with situational information and also sought help, whenever possible, using mobile phones and social media platforms. In many cases, the affected communities sent their location details, information on the number of people trapped due to the floods and also whether any emergency services was required. The next stage was the response of the various stakeholders to the affected communities.

The Non-Resident Indians used mobile phones and social media to demand rescue and relief services on behalf of their family members directly affected by the floods. This became especially relevant when the local mobile network in Kerala collapsed completely. The service providers also responded to these demands using online platforms to show their readiness to help and also shared key information about their operations. Since, these interactions between the service providers and those who were requesting help occurred in an unstructured manner and on multiple online platforms, a need arose for digital volunteers who collated the information on a single platform, verified these messages and also coordinated the crowd sourcing activities, wherever possible, using mobile phones, web-based applications and social media platforms (Ajay, 2019).

Some key findings are made by Ajay (2019) through primary data from some affected places of Kerala, 2018 are reproduce below: The responses of the affected communities to the disaster were as follows.

Table 7.3 : Responses of the affected communities to the disaster

Questions	Types of responses	Proportion
Why did you not evacuate your localities before the floods even when your district was declared as red alert zone?	We did not get any early warning from the local administration	90%
Did you shift to the relief camps when you realized that your house was getting flooded?	We did not expect the rains to continue incessantly for four days; so we thought we would stay in our own houses	72.5%
Did you require any immediate service for evacuation or medical help for any member in your locality?	Yes	27.5%
Who were the first people to provide any kind of help in your locality during the disaster?	Local people	100%
How did you manage food during disaster?	Food was managed locally for the first three days (15–18 August), 2018	100%
When did you start receiving food packets from government and other non-government agencies?	Third day (18th August, 2018)	72.5%
How did you communicate to the service providers to provide information about your situation or demand services?	Phone calls and messages	100%

Source: Ajay, 2019

Immediate Relief measures undertaken:

The main initiative of the flood relief operations were initiated by Animal Husbandry and Dairy Development Department. Below are details of some of the recovery efforts which were taken immediately:

1. Animal Husbandry Department (AHD) plan funds were immediately released to the various flood hit districts for arranging animal rescue camps, on a demand basis, for providing temporary shelter, feed, fodder and medical aid to the rescued animals. In

total, 1172 such camps were set up in the deluge affected areas, fulfilling the need of 80538 animals. From Kerala Feeds and Kerala Co-operative Milk Marketing Federation(Milma)animal feed was distributed by AHD in animal health camps which costed ₹ 2.68 crore.

2. State Government, Veterinary Universities and drug manufactures provided veterinary medicines and vaccines, which were rushed to the affected areas.

3. The Dairy Development Department (DDD) restored the milk stock of the flood affected areas with the help of District Collectors and the Regional Cooperative Milk Producers Unions.

4. The AHD ensured that milk and eggs were available for survivors in relief camps. The National Dairy Development Board and AMUL provided ready to drink milk sachets and milk powder. Approximately, 40813.5 litres of milk were distributed to relief camps by DDD throughout the State.

5. An amount of ₹ 33.75 lakh was provided to flood affected livestock farmers, as insurance claim settlement. An amount of ₹ 21.99 crore was distributed to livestock and poultry farmers in the State as compensation relief through AHD from State Disaster Relief Fund.

6. Along with Dairy Co-operatives, DDD went to 31 relief camps and 582 houses and provided food and essential commodities worth ₹ 2.42 lakh.

7. The UNFAO undertook CERF Project to train farmers and officials regarding post disaster management plans and supplied various inputs like gumboots, milk can, feed supplements, disinfectants, etc.

8. Hand-in of 300 milch animals to dairy farmers who lost their animals in the flood via an initiative called - "The Donate a Cow Programme".

9. During the year 2018-19, DDD implemented special rehabilitation Programmes of ₹ 22 crore for flood affected dairy farmers of the State. Total of 2130 farmers were helped in shed renovation/shed construction and others on demand basis.(https://rebuild.kerala.gov.in/en/relief)

Figure 7.10 : Relief items for the disaster survivors
Source: https://www.bbc.com/news/world-asia-india-45239398

The resolve and coordination shown by the people of Kerala in the rescue and relief operations drew appreciation from all quarters. Common people as well as the government officials worked together in various relief activities. More than 10,000 houses that were covered in mud were cleaned. Thousands of volunteers worked day and night in relief activities. 3 lakh wells were chlorinated and all the water resources were disinfected. Thousands of tonnes of solid waste were removed. The spread of infectious diseases were effectively controlled by the active participation of health activists. Schemes were set up to provide school children their lost study materials. ₹ 687.84 crore was released to 6,87,843 families as immediate relief at the rate of ₹ 10,000 per family. A total of 7,24,352 kits containing 22 essential commodities were given to those who returned home from relief camps and 10,50,838 kits containing food supplies worth ₹ 500 were supplied subsequently. ₹ 51.54 crore was spent on this relief measure. Below are some key points about the response that was provided immediately by the government and other organizations:

1. **Damaged boat repairing:** Initiatives were taken to repair boats that were damaged during rescue operation in flood-hit areas.
2. **Sanitation works in flood-hit regions:** Government provided the go ahead for local self government (LSG) establishments to utilize the required money from their own funds that was needed for operations involving sanitation and cleaning in flood-hit regions.
3. **Local Self-Government monitoring cell:** A control room by the Local Self-Government department in Govt Secretariat was opened to monitor the ward-wise cleaning activities that aimed to cover uninhabitable houses, establishments handed over to LSG dept, other establishments, public places etc.

4. **Immediate restoration of roads:** Chief Engineer, Roads and Bridges of Public Works Department had entrusted to restore damaged roads as per the norms of State Disaster Relief Fund.

Table 7.4 : Money released for restoration of roads

District	Road (Km)	Amount @ 1,00,000/km in Crore
Thiruvananthapuram	530	5.30
Kollam	840	8.40
Pathanamthitta	844	8.44
Alappuzha	427.4	4.27
Kottayam	964.6	9.65
Idukki	733	7.33
Ernakulam	438.86	4.39
Thrissur	600	6.00
Palakkad	550	5.50
Malappuram	398	3.98
Kozhikode	345.77	3.46
Wayanad	327.32	3.27
Kannur	46.4	0.46
Kasaragod	80	0.80
TOTAL	7,125.31	71.25

Source: https://kerala.gov.in/rain-disaster-relief-measures

5. **Agriculture loan moratorium:** Government declared a moratorium on agriculture loans and necessary steps were taken for restarting farming.

6. **Continuation of Courses and Reexamination:** The government took initiatives to enable students who could not attend examinations because of the flood situation. Students of colleges under Collegiate of Education and Technical Education department of all universities in Kerala were allowed to continue their courses, to take their exams again despite losing hall tickets and without giving any special fee.

7. **Duplicate ration card issuing:** For the immediate issue of duplicate rations cards, the state government had issued the following instructions: 1. A self-attested affidavit along with the application for duplication ration card was enough. 2. Damaged ration cards were to be submitted along with the application. 3. Affidavit in stamp paper of ₹ 200/- value along with the application was no longer needed. 4. Person should not give

false or misleading information in the affidavit submitted along with the application. If done, the card holder would be the sole responsible person. 5. On a war-footing, Civil Supplies Director, State Informatics Officer- NIC, and Director CDIT were entrusted to disburse the duplicate ration cards after examination of application and data availability. 6. For the above, Director Civil Supplies was instructed to take immediate steps for making necessary arrangements at supply offices in the district and taluk levels.

8. **Relaxation in wearing of uniform:** Public schools were instructed not to insist flood-hit students to wear uniform till new ones were provided to them.

9. **Reduced rate of Cattle-feed:** Kerala Feeds ,a Public sector undertaking had reduced the price of cattle-feed, in order to help dairy farmers in the wake of flood disaster. The following brands: Rich, Midukki and Elite were priced at ₹ 100/- less from September, 2018 onwards, and the rates were applicable to Pathanamthitta, Kottayam, Alappuzha, Ernakulam and Thrissur districts. **(https://kerala.gov.in/rain-disaster-relief-measures)**

Chapter 8 : Rehabilitation and Recovery

The landslides and floods resulted into widespread damage to crops and livestock, and severely affected houses, roads, bridges, schools, hospitals, power lines and other infrastructure. The disaster crippled lives and livelihoods of people. The task before the Government of Kerala was to ensure that the recovery process was handled efficiently, so that people could get back to their normal lives with ease and dignity.

The Government of Kerala decided to launch an Immediate Recovery Programme, utilizing public finances at its disposal. The administration did face financial challenges reeling under this unprecedented disaster and made key changes in its Annual Plan in order to divert precious resources into the task of recovery. All the major departments of the government swung into action to deliver reconstruction and recovery projects in their sectors. It was estimated that the total rebuilding would cost around ₹ 4,000 crores, a majority portion of which was from the state finances. The efforts of the administration were supplemented with the efforts of affected Keralite communities mobilizing on their own. The people of Kerala displayed remarkable resilience in the face of adversity to the extent that within one week of flood waters receding, most people returned to their homes to rebuild their lives.

It was felt that a traditional approach to recovery and reconstruction would be insufficient to recover from the floods in a resilient and sustainable manner. The State had to address the fundamental drivers of floods as well as prepare better for future disasters. This could have been performed through the development of an inclusive and comprehensive roadmap for a green and resilient Kerala. To realize this process, the Government established the **'Rebuild Kerala Initiative' (RKI) under Local Self Government Department. The Department of Local Self Government on its website page 'Rebuild Kerala Initiative' (lsgkerala.gov.in)**_says that aim of RKI is to ***"bring about a perceptible change in the lives and livelihoods of its citizens by adopting higher standards of infrastructure for recovery and reconstruction, and to build ecological and technical safeguards so that the restructured assets could better withstand floods in the future" (Department of Local Self Government, Government of Kerala, n.d.).*** The major steps taken by different departments of the states for rehabilitation and recovery are detailed below:

Revenue Department

With the operations to rescue stranded people due to the floods nearing to a close, the State Government turned its attention to cleaning of houses and public places so that the people who were lodged in relief camps could return to their homes. This immediate intervention involved massive cleaning drives which saw unprecedented participation of

thousands of volunteers. The great wave of community involvement ensured that families could move back to their homes in the shortest possible time. The next phase was the repair and reconstruction of houses that were damaged or lost in the deluge. An extensive survey of damaged houses was conducted, involving revenue department officials and local self government personnel. The houses that suffered damage were categorized into five categories based on the degree of damage caused. The Government had fixed the compensation to be given to each category and released assistance, a detail of which has been given in the table given below (as on 06.08.2019).

Table 8.1 : Compensation given based on damage to houses

Damage to homes	Number of homes damaged	Compensation Amount (₹)	Amount allocated for number of houses	Total Amount Distributed (₹)
15%	1,33,054	10000	1,29,868	129,66,80,000
16-29%	78,778	60,000	75,352	45,21,20,000
30-59%	36,104	1,25,000	31,927	399,08,75,000
60-74%	15593	2,50,000	14353	358,82,50,000
Above 75%	15463	4,00,000	9329	373,16,00,000
Total figure	**63,332**		**61,418**	**1305,95,25,000**

Source: https://www.newsclick.in/rebuild-kerala-initiative-6153-houses reconstructed-so-far

A total of 17067 houses were completely damaged in the floods. The rebuilding of houses is being implemented under six schemes. The beneficiary led construction under the LIFE Mission is the major one. Under this scheme, the amount will be credited to the beneficiary in 3 instalments. 12240 families have opted for beneficiary led construction. First instalment amounting upto 86 crore has been paid to 11678 families. Second instalment has been given to 6793 families. 110 crore have been spent on this account. 91 crore distributed as third instalment which was given to 6793 families. Construction of 5640 houses has been completed so far.

Second scheme is implemented by co-operative service societies. A total of 2098 families opted for this scheme. 17.60 crore has been given to 1957 families as first instalment. Construction of 1808 houses is completed under this scheme.719 families have lost both house and land. Land has been found for 494 beneficiaries. The construction is yet to begun.1091 families living in puramboke land have lost houses. Out of which, land has been procured for 903 families. Land has been procured for 619 families out of 619 families living in disaster prone areas that need to be rehabilitated. Money for the construction will be

distributed soon. In addition to these schemes, there are houses sponsored by NGOs and other organizations. 1084 houses falls under this sponsorship scheme. Construction of 970 houses has started, out of which 862 houses are completed. There has been dispute regarding the ownership of some houses. Adalats are being held to resolve these issues. Construction of 9684 houses have completed under various schemes so far. **(Source: https://rebuild.kerala.gov.in/en/fully_damaged_houses)**

Agriculture Department :

Agricultural sector faced a damage of 2,36,649.5 hectares of crop loss worth ₹ 18,545.25 crore. In addition to this, ₹ 326.25 crore loss was estimated due to destruction of agricultural land and over ₹ 130.34 crore loss on basic infrastructure and assets. Total loss in the agriculture sector was ₹ 19,001.84 crore.

- An amount of ₹ 18.04 crore was given as compensation to 11,718 farmers under the State Crop Insurance Scheme. An amount of ₹ 197.78 crore was allotted for dewatering, bond/block renovation and repair to water pumping service.
- The State Horticulture Mission submitted a proposal to the Central Government for additional assistance of ₹ 102.1855 crore through the Mission for Integrated Development of Horticulture Scheme (MIDH), of which ₹ 93.39 crore was received.
- Punarjani Scheme was implemented for the revival of agricultural sector through social participation by adapting scientific and eco friendly cultivation methods.
- 5650.85 metric tonnes of paddy seed were distributed to farmers free of cost. In addition, one crore vegetable seedlings were provided free of cost and 50 lakh vegetable seed packets and 12 lakh pepper seedlings were also distributed. A total of ₹ 92 crore was given to vegetable farmers as compensation.
- In Alappuzha, Kottayam and Pathanamthitta districts, bund related works were carried out by Padasekhara Samithis at 270 places. 20% of the project cost was given to them in advance.
- Also a moratorium for agricultural loans in flood affected areas was declared for one year from 31st August, 2018. A project proposal of ₹ 745 crore including loan assistance of ₹ 500 crore from the 'International Fund for Agricultural Development' was submitted to the Central Ministry of Agriculture. A 'Post Disaster Need Assessment' group of UNDP worked with the Department of Agriculture, Kerala for the restoration of agricultural sector in the State.
- A proposal for livelihood restoration in the agricultural sector worth ₹ 1603 crore was submitted to the Central Government.

- In addition to ₹ 178 crore provided from Kerala State Budget, an additional compensation of ₹ 21.57 crore was paid to 13,321 farmers under the Crop Insurance Scheme.

Public Works Department (PWD):

In the calamity of 2018 flood twelve districts reported landslides, earth slips, debris flow and rock falls. Roads in the seven districts of Alappuzha, Thrissur, Ernakulam, Kozhikode, Malappuram, Kollam and Kottayam sustained flood induced damages. Loss to 16,954 km of roads under the PWD was reported which required around ₹ 10, 000 crores for repair or reconstruction. The Public Works Department accorded administrative sanction for works worth ₹ 2,764 crore by rearranging its budgetary resources for that year. In addition to this, the department also issued new Administrative Sanction worth ₹ 371 crore for the repair of roads and bridges under NABARD assisted Rural Infrastructure Development Fund (RIDF), in addition to the works sanctioned by the NABARD earlier that financial year. The Department strived hard for completing the works in 2018 itself.

Local Self Government Department:

The local self-government institutions allocated funds from their plan outlay to take up post- flood reconstruction activities. The Urban department allocated 12 crore in 2018-19 and 18 crore in 2019-20 for roads to be repaired or reconstructed. Another ₹ 20.14 crore were allocated for house construction activities.

Kudumbasree:

Government formulated a new Financial Aid Scheme, the Resurgent Kerala Loan Scheme (RKLS), with the aim of giving a helping hand to regain the lives and livelihood and to alleviate the problems caused by impact of the worst natural disaster faced by Kerala. Affected families could avail bank loan of up to ₹ one lakh per family, without collateral, for the purchase of domestic appliances and other purposes. Interest on the loan was to be paid by the State Government. Beneficiaries had been provided loan, totalling to ₹ 1395.16 crore (till 21.06.2020). As part of post flood activity, Kudumbasree initiated another innovative programme to augment the skill of flood affected people to suit the job market available in the flood hit areas. ARISE (Acquiring Resilience and Identity through Sustainable Employment), aimed to provide skill training to 50,000 candidates in 10 selected areas. Skills included housekeeping, plumbing, electronic repair, electrical works, daycare, sales, data entry , laundry and ironing. Kudumbasree had formed 246 construction groups comprising of women trained for various trades in the construction industry for taking up any construction related activities. The Kudumbasree members who were

affected by the disaster were offered more than 300 products from 15 companies at a discounted rate. **(Source: http://www.kudumbashree.org/)**

Mahatma Gandhi National Rural Employment Guarantee Scheme:

Under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), wage employment was provided to 14.72 lakh families. A total of 16.96 lakh individuals were beneficiaries under the scheme. Out of this, employment was been provided to 10.31 lakh families, of which 4.83 lakh families were newly employed. As a result, a total of more than 7.5 Crore (7,63,37,310) person days were generated after 16th August, 2018. 82,605 families were issued New Job Cards after the floods. Unskilled wages paid in the post-flood period, as a result of providing 7.63 crore person days, ₹ 2068.74 crores worth of employment (i.e ₹ 271 wage per day) was generated. Out of this, an amount of ₹ 700.14 crore was disbursed to the beneficiaries as unskilled wages by the Central Government through Direct Benefit Transfer. (As on 12.06.2019)

Kerala Water Authority:

Water supply infrastructure was badly affected because of flooding of electric installations, silting of intake wells, choking of filter beds and washing away of pipelines. The Kerala Water Authority (KWA) had been entrusted with the responsibility of providing potable water in all flood affected areas after the floods. Despite being severely affected by the disaster, KWA provided water through tankers in all affected areas. Water was continued to be supplied in low lying areas in Kuttanad for several weeks, as the wells had been contaminated. 1.1 lakh jerry cans of 15 litre capacities were distributed for storing water in households. Around 1,000 water purifiers were supplied free of cost, by a sponsor. At the time of floods, drinking water was distributed in tanker lorries to the affected areas and relief camps; water authority officials checked the quality of the drinking water as well. The Department supplied almost 9.15 lakh liters of water to 1822 centers in tanker lorries. 200 water kiosks having storage capacity of 1000/2000 liters were distributed in highly affected areas like Kuttanad and Chengannur. Four RO plants given by the Telangana government were installed. Plans were underway to install 8 tube wells as well. Kerala Water Authority installed 176 water kiosks to bring pure drinking water to houses. ₹ 9665. 895 lakhs rupees allotted by the State Plan Fund and State Disaster Management Fund was used to complete 1661 projects. Besides, a five year plan of restoration project with an estimate of Rs 25832 crores was designed by the department.

Directorate of Industries and Commerce

The Directorate of Industries & Commerce had conducted a mobile application survey of flood affected Micro. Small and Medium Enterprises (MSMEs) and Shops. After the survey, it was identified that the flood had caused damages to 5355 MSME units, with losses worth ₹ 1415.69 Crores and damages to 16061 shops with an estimated loss of ₹ 624.90 Crores.

The Disaster Management Department vide GO(MS) No.27/2018/DMD dated 17/12/2018 formulated a new Scheme 'Ujjeevani' aiming to provide bank loans to rejuvenate MSME Units and Shops affected in the floods. This scheme envisaged providing margin money up to ₹ 2 lakh for a loan taken. For instance the Government would pay ₹ 2 lakh margin money for a loan of ₹ 10 Lakhs. The General Manager, District Industries Centers gave necessary handholding service to the flood affected units for the assistance from the Banks. The status of loan sanctioned upto 03/06/2019 is as follows.

Table 8.2 : Details of Loan Sanctioned

Units	Number	Amount sanctioned (In Lakhs)
MSME Units	356	3339.7
Shops	491	2790.00
Total	**847**	**6130.69**

Source: https://kerala.gov.in/documents/10180/668459/KC_August%202019

During the year 2019-20, Directorate of Industries and Commerce formulated two Rebuild Schemes for flood affected.

(a) : Assistance to Rebuild Flood affected Micro, Small and Medium Enterprises MSMEs (Flood Rebuild Scheme) (Outlay: ₹ 1000.00 lakh):

The objective of this scheme was to revitalize flood affected MSME units by offering financial assistance in the form of start-up support and investment support in two phases.

1. The assistance of 15% to 40% of the total fixed capital investment (TFCI) was made as part of rebuilding the enterprises, limited to 20 Lakhs for general category and 30 lakhs for special category enterprises.
2. The total fixed capital investments (TFCI) covered components like (i) Civil works (ii) Plant & Machinery, (iii) Equipments.
3. To extend 50% of the total eligible assistance under the scheme, as up-front assistance (start up support), limited to 5 lakhs and the balance amount was disbursed on rebuilding /restarting the units.
4. The assistance was limited to only MSME manufacturing enterprises as grant was based on clear guidelines of Industries Department.

(b): Interest Subvention to Flood affected MSME Units (Flood Rebuild Scheme) (Outlay: ₹ 600.00 lakh)

Flood affected MSME units in the manufacturing and service category were assisted with up to 8% interest subvention on Term loan/Working Capital loan per year availed from

banks. Maximum amount eligible per unit per year was limited to ₹ 5 Lakhs and the assistance could be extended through banks up to 3 years on assessing the performance/viability of units.

- This assistance was limited to only MSME manufacturing & service enterprises.
- The assistance was in the form of grant tied-up with bankable projects on clear cut guidelines of Industries Department.

Animal Husbandry Department (AHD) and Dairy Development Department (DDD) :

- The plan funds of AHD earmarked for disaster management to the tune of 70 lakh were immediately released to the various flood hit districts for arranging animal rescue camps on a need basis for providing temporary shelter, feed, fodder and medical aid to the rescued animals. A total number of 1172 such camps including satellite camps were set up in the affected areas which catered to the need of 80538 animals.
- The use of digital technology in identifying lost animals and GIS mapping of the farmers were an added advantage of the salvation process.
- Many governmental organizations including the National Dairy Development Board, State Animal Husbandry Department of Tamil Nadu, Karnataka, Telangana, Andhra Pradesh and Gujarat responded immediately to Kerala's request and rushed in animal feed, feed supplements, roughage, medicines etc. Public sector undertaking like Kerala Feeds, Milma, Milk Co-operative Societies and Private feed manufactures also played a vital role in ensuring the supplies needed for the animal camps. AHD distributed feed in animal health camps worth ₹ 2.68 crore from Kerala Feeds and Milma.
- Veterinary medicines and vaccines provided by different state Governments, Veterinary Universities and drug manufactures were collected at the central veterinary stores of the AHD and were rushed to the calamity spots. The Indian Air force played an important role in airlifting the essential veterinary medicines from Trivandrum to remote and inaccessible areas of Idukki.
- In collaboration with District Collectors and Regional Co operative Milk Producers Unions, DDD could have the back-up stock of the milk collection in the flood affected areas very soon.
- When the flood waters started receding, the AHD in co-ordination with Suchitwa mission and Local self Government Institutions took up the task of disposing the carcass of animals that had succumbed to the floods. A detailed protocol for disposal of carcass was prepared and circulated for implementation.
- The AHD also mobilized milk and eggs required for human consumption in the rescue camps. The National Dairy Development Board and AMUL supplied ready to drink milk sachets and milk powder for human consumption.

- Affected people in the relief camps were provided with nearly 40813.5 litres of milk by DDD. The expense was borne by the Dairy Co operatives.
- The Tamil Nadu Poultry Farmers Association donated one lakh eggs and National Egg Co-ordination Committee donated 10 lakh eggs to the flood victims.
- The proposal put forth by AHD in the state level bankers committee for moratorium on bank loan for one year and rescheduling the repayment of loans extending the period for another 5 years was accepted in principle.
- The Insurance Companies were called in for discussions relating to the early settlement of animal insurance claims and simplifying the procedures. An amount of ₹ 33.75 lakh was provided to flood affected livestock farmers, as part of claim settlement.
- An amount of ₹ 21.99 crore was distributed to livestock and poultry farmers in the State as compensation relief through AHD from State Disaster Relief Fund.
- The Animal Disease Control Project office prepared a disease forecast and disease control protocol to be put in force immediately. Surveillance was strengthened for detecting outbreaks of diseased if any. The Central team from Government of India comprising Scientists from New Delhi & Southern Regional Disease Diagnostic Laboratory, Bangalore visited the flood affected areas and animal camps and expressed satisfaction on the action taken by the Department.
- In association with Dairy Co-operatives, DDD visited 31 relief camps and 582 houses and were able to provide food and essential commodities worth ₹ 2.42 lakh.
- The Department officials held interactions with the Experts from FAO, Red Cross society and other animal welfare organizations and the efforts put forth by the AHD were appreciated. UN-FAO undertook CERF Project providing training for farmers and officials regarding post disaster management and supplied various inputs like gumboots, milk can, feed supplements, disinfectants etc.
- Regular advisories were given through visual and print media on the animal health care issues, sanitation and prevention of zoonotic diseases.
- Donate a Cow Programme- An initiative was undertaken by officials of DDD to encourage and motivate the public to contribute financially for donating a milch cow (around 300 milch animals were distributed) for the flood affected dairy farmers.
- Special Rehabilitation Programme for flood affected dairy farmers of the state – Programme worth ₹ 22 crore was implemented by the DDD during the year 2018-19. Three Thousand milch animals were distributed and 2130 farmers were assisted for shed renovation / shed construction and other assistance in need based manner.

Forest Department:

The impact of the flood affected the forest areas in no small way. Five territorial and three wildlife circles reported landslides; earth slips debris flow and rock falls. Death of wildlife, depletion of the farms, destruction to the basic facilities, devastation of agriculture in the Tribal lands and dispossession suffered by them were only some ways the flood had pounded the forest area. The flood strongly affected 296 marked areas in 119 ranges among the various divisions of the forest department. Major roads connecting the forest areas to the mainland sustained flood induced damages. Initial damages were estimated to be 25 crores of which 50% amounted to roads and bridges. Central hit-area of the landslides in 2018 was Western Ghat region. During the heavy rainfall in 2018, landslides were reported from different Forest Divisions. Majority of the landslide sites were in the fringes of forests indicating forest fragmentation disrupting slope continuity as a major factor facilitating landslides in the district.

Compared to the loss suffered by the more populated areas of the state, the destruction which the flood had caused in the forest area was much less. The devastation in the midland, referred to above, happened mainly around the rivers which had dams. Heavy and continual rain caused widespread landslides and mudslides in the forests too with terrible consequences. Apart from the loss thus caused, in some places, the landslides took with it the means of transportation and communication the mainland had with the offices of the forest department and the tribal colonies. Roads, bridges, culverts, camp sheds, office buildings, cantilever bridges, walls to keep off wild elephants, moats, plant nurseries, check dams, furniture, teak plantations, timber depots, government vehicles, drinking water projects, compound walls, camera traps, solar powered electric fences and rail barricades were irreparably affected by the flood.

Infrastructure Restoration:

Disaster result in loss of infrastructure of critical facilities like hospital, communities, schools, power and water supplies, and telecommunication, which gets severely damaged. So restorations of this, was a huge task in Kerala. Some restoration details are given below.

(a) **7,602 Kilometers of roads were rebuilt-** Twelve out of 14 districts in the state reported landslides, earth slips, debris flow and rock falls. A total loss of 16,954 kms of PWD roads was reported which required around ₹ 10,000 crore for repair or reconstruction. The PWD had accorded administrative sanction for works worth ₹ 2764 crore by rearranging that year's budgetary resources. PWD and Local Self Government Departments jointly rebuilt 7,602 kms of roads. 4429 kms of flood ravaged roads were rebuilt by PWD and were made open to transportation. 656 culverts and 127 bridges were reconstructed, most of which were reopened. ₹ 3135 crore was also spent on the renovation and rebuilding of roads through other funds.

(b) 25.6 lakh consumer's power supplies was restored- Electricity connections were restored for 25.6 lakh consumers within 10 days on a war footing basis. 5000 kms transmission lines were replaced. 16,158 transformers were repaired and made functional. 19 power plants and 50 sub-stations were brought back to normalcy. 3 lakh electrical meters were replaced. Technical experts, students of Engineering and officers from neighboring states worked together with Kerala State Electricity Board (KSEB) relentlessly. KSEB faced a loss of ₹ 820 crore worth basic amenities in the deluge .

(c) 67 Lakh of water supplies was reinstated- Water supply infrastructure was badly affected because of flooding of electric installations, silting of intake wells, choking of filter beds and washing away of pipelines. The Kerala Water Authority was entrusted with the responsibility of providing potable water in all flood affected areas after the floods. Water supply was completely restored immediately after the flood receded.

Details of Fully Damaged Houses:

A total of 17067 houses were completely damaged in the floods. The rebuilding of houses was implemented under six schemes. The beneficiary led construction under the LIFE Mission was the major scheme. Under this scheme, the amount was credited to the beneficiary in 3 installments. 12240 families opted for beneficiary led construction. First installment amounting to 86 crore was paid to 10643 families. Second installment was given to 6793 families. ₹ 110 crore was spent on this account. ₹ 91 crore was distributed as third installment, which was given to 6793 families. Construction of 6793 houses was completed and more such projects were going on.

Second scheme was implemented by co-operative service societies. A total of 2098 families opted for this scheme. ₹ 17.60 crore were given to 1957 families as the first installment. Construction of 1808 houses was completed under this scheme.

Figure 8.1 : Completely damaged houses rebuilt after the Kerala Floods, 2018

Source: www.rebuild.kerala.gov.in

In addition to these schemes, there were houses sponsored by NGOs and other organizations. 1084 houses fell under this sponsorship scheme. Construction of 970 houses was started, out of which 862 houses were completed. There was dispute regarding the ownership of some houses. Courts were approached to resolve these issues. Construction of 9684 houses was completed under various schemes so far (Rebuild Kerala, Kerala Government, 2019).

Details of Partially damaged houses :

3,06,766 houses were partially damaged in the flood. The houses that suffered partial damage were categorized into four categories based on the degree of damage caused. The compensation was paid on the basis of this categorization.

There were 1,21,226 appeals filed before revenue authorities regarding the categorization of damage and related matters of which 1,18,010 appeals were settled. District Collectors were directed to dispose the appeals on a war footing basis (Rebuild Kerala, Kerala Government, 2019).

Rehabilitation of Fisheries Industry :

Rehabilitation activities of fish farming were initiated in all districts by reallocating plan funds to the tune of ₹40 crore. For the rehabilitation activities of fisheries sector, ₹204.93 crore worth project was prepared. The Fisheries sector suffered a loss of ₹174.78 crore. Of this, the loss to the fish farming sector was estimated at ₹137.76 crore.

A rehabilitation package worth Rs 1086.60 crore was submitted to the Central Government in the fisheries sector. This included rehabilitation of fishermen (₹ 600 crore), fishing input (₹99.91 crore), revival of fish farming sector (₹204.93 crore), livelihood schemes (₹102.80 crore), renovation of fish markets (₹38.98 crore), basic infrastructure development of fish landing centers (₹20.05), artificial ranching (₹4 crore) and ornamental fish (₹15.93 crore).

More than ₹3 crore was also sanctioned for compensating for the damage caused to fishermen involved in the massive rescue operations (Rebuild Kerala, Kerala Govt., 2019).

Rehabilitation of Industries (Ujjeevani Scheme):

The flood had caused damage to 4,992 MSME units, with losses worth ₹1355 crores. Damages to 14,271 shops had been estimated at ₹490 crores.

- The Department of Industry & Commerce formulated a new scheme 'Ujjeevani' aimed to provide bank loans to rejuvenate small, medium enterprises, commercial establishments and shops affected in the floods. This scheme envisaged providing margin money up to ₹2 lakh for the loan taken. For instance, the government would pay ₹2lakh as margin money for a loan of ₹10 lakh.
- 506 applications were received under this scheme till January 2019.
- Kerala State Industrial Development Corporation (KSIDC) introduced a new Loan Scheme called 'Punarjani' to help the flood victims. The scheme intended to assist entrepreneurs with short term loans of ₹3 crore at 9% interest rate.

Source: The above details were extracted from the report of Rebuild Kerala Initiative Secretariat (RKI Secretariat, 2019)

Chapter 9 : Lessons Learnt

Disasters have much in common besides the devastation of lives and property they leave behind. They all teach hard lessons, whether the destruction comes from floods, fires, earthquakes, cyclones or other events. These valuable lessons are imperative to be implemented in the present in order to reduce risk and build resilience of the communities for future extreme events. It is said that a chain is as strong as its weakest link. With every disaster, the weakest point of the management gets exposed. The Flood of 2018 in Kerala also pointed out to the vulnerability and weaknesses of the state to hazards and disasters. The lack of preparedness and fatality of the flood made it highly challenging for the state to cope up. The flood brought attention to a number of structural constraints that left Kerala unprepared for major disasters or climate change shocks. This involved inadequate policies and institutional frameworks to control critical natural resources such as water and land, the lack of risk-proof spatial and sectored planning policies and frameworks that drove to extensive urban turmoil, uncontrolled construction in hazard prone areas, absence of disaster risk preparedness in key socioeconomic sectors, lack of basic infrastructure in urban areas along with aging and poorly maintained infrastructure, poor capacity of institutions to anticipate and respond to extreme events, and limited fiscal resources as well as absence of pre financing modalities for risk pooling and sharing. Due to these weaknesses, Kerala was at the mercy of the 2018 floods and landslides (RKDP, 2019). Some of the lessons which flew unabated for the massive floods of 2018 in Kerala are as follows:

1. Relook into the Land use policy and plan

Kerala is an ecologically sensitive area. We need guided investments to secure community benefits from development .Land use planning plays a critical role to control flood. In Kerala uncontrolled sand mining had constrained river flows, while the rapid spread of high-rise buildings on unstable hill slopes had weakened the soil. This unplanned development had left the area susceptible to flash floods and landslides, caused by a combination of tree felling on steep hills lopes and heavy rainfall. Land use planning is a nonstructural approach that promotes prudent use of land and natural resources by guiding investment to secure community benefits from development (UNECE, 2008). Land use planning is considered as an effective measure to avoid flood risk and reduce the loss of life and property. The strategic land use planning at the local level supported by the increased knowledge of flood hazard is helpful to secure resilience to flooding. The change in the infiltration capacity of soil and soil cover associated with the human alteration and development increases the risk to the future flood events. Thus, the systematic assessment of land and water potential and planning is the best land use option in the area, to reduce the future risk (floodresilience.net).

As discussed earlier in this report, most of the regions which were affected by the devastating floods in the state were classified as ecologically-sensitive zones (ESZs) by an expert panel on Western Ghats Ecology. The report was put into public domain by a team which was headed by Madhav Gadgil, an ecologist and founder member of the Centre for Ecological Sciences located at Indian Institute of Science, Bengaluru. According to environmentalists who were part of the research; the committee's recommendations were strong enough to protect the sensitive Western Ghat region. The recommendation put forward by the committee was- a) to cassifying 140,000 kilometers of area in the Western Ghats into three zones in the view of environmental protection. b) strict restrictions on the activities of mining and quarrying and c) restrictions on putting the use of land for non-forest purposes.

However, the report, which was submitted to the Kerala government in 2011, was subsequently rejected and none of its recommendations were adapted by the government. A recent study conducted by scientists TV Sajeev and CJ Alex of the Kerala Forest Research Institute found that there were 5,924 big, medium and small quarries in Kerala. Earlier, the Kerala High Court has said that quarrying in lands included in reserve forest but assigned for dwelling or cultivation should be banned altogether or strictly regulated. The flood of 2018 had made it clear that land use policy of Kerala was improper and shortsighted. Henceforth, Kerala must improve the state's land use policy to mitigate or avoid such disaster in future. (News18.com, 2019). The first lesson calls for the need to use our land and natural resources prudently.

2. Convergence of Damage and Loss assessment techniques

There were various damage assessments carried out after the deluge in 2018. Firstly, the Joint Rapid Disaster Needs Assessment was carried out by WORLD BANK by 28 experts which calculated an amount of ₹ 25,050 Cr for rebuilding Kerala. Secondly, the Post Disaster Needs Assessment was carried by UN led team of 76 experts for Rs 26,986 Cr. Thirdly, a memorandum was also submitted to Central Government for immediate relief by the State Government for 5616 Cr. The lesson which was thrown by the disaster in Kerala highlighted the need for convergence in the process of Damage and Loss Assessment to facilitate a holistic framework from responding to recovering from any disaster.

3. Vulnerability reduction of single elderly women

Kerala with high rate and proportion of migration of young people to cities and other countries for work already had many older people living alone with extended family. Kerala has one of the highest life expectancy rates in India; the State also has the highest proportion of the elderly in its population. As per the data of the government, the life expectancy of women is higher (77.8 percent) as compared to men (74.9 percent) in the State. According to research by the Centre for the Study of Social Exclusion and Inclusive

Policy at the Cochin University of Science and Technology found that about 6% of the 30 lakh-odd people over 60 years lived alone. Studies on impact of disasters on vulnerable population reveal older people especially women in society are generally slow or unaware of how to appropriately react to dangers surrounding them because of natural calamities. For many reasons, aged women were not able to feel the impending danger and thus safely evacuate their homes. They were generally less aware of warnings against the rising threat of floods and disasters. They were initially suspicious of help coming their way for rescue. They are also reluctant to leave their belongings whatever they might be. The fear of not be able to return to their home and familiar surroundings was traumatic for them. There are also concerns with their mobility, as they were not fully able to travel to camps for resettlement or queue for aid. At the same time, there is a possibility that they may be neglected during distribution of relief provisions. (The Asian Age, 2018).

In the flood of 2018, the distress of elderly women was prominent and they had suffered due to lack of proper evacuation planning for them. Also along with this, the health and social care services which the elderly women required was not available in the state with a long term strategy goal so that the impact of floods and other disasters which are increasingly occurring due to climate change, could have a minimizing effect on the vulnerable group in society. Mainstreaming the more vulnerable group in disaster risk reduction has to be done to ensure that no one is left behind.

4. Women as Disaster Responders

Disasters and their aftermaths mirror the preexisting social inequalities of caste, class, ethnicity, sexualities, disability and age with gender cutting across in all of them. The differential impact of disasters on men/boys and women/girls and transgender community is not taken into account while responding to any disaster. Resource distribution in a post disaster scenario, which is intended for the entire population of a disaster-affected area, rely on the existing structures of distribution that reflect the patriarchal structure of society, and hence women/girls are marginalized in their access to such resources. Meanwhile, the potential contributions that women can offer to disaster risk reduction around the world are often overlooked and their leadership in building community resilience to disasters is hardly highlighted. This is reflected in the lack of a platform for women in formal disaster management organizations for sharing their needs, experiences and priorities. Gender stereotypes also places stress on men to assume greater responsibilities on account of gendered norms and expectations. Hence, the differential needs, vulnerabilities and capacities of men/boys and women/girls need to be taken into account while designing any intervention in the pre as well as post disaster scenario.

Women are generally viewed as a more vulnerable group in disasters but Kerala floods showed that they are effective responders to disastrous events. The example of

Kumdumshree which is a Poverty eradication and women empowerment programme of Government of Kerala can be highlighted. They collected donations over 11 crore , cleaned houses, provided Psychosocial Support, packed meals and distributed them , involved themselves in camp management, made cloth bags for relief kits and imparted tailor training skills at relief camps. The contribution of women in responding to the floods needs to be taken into account. They cleaned oven 1.13 lakh residential premises across 10 districts and made habitable by the workers as on August 28. They had also cleaned over 3,100 public spaces while our community counsellors, 320 in all, offered psychological support to over 11,000 affected people," Women in Kerala joined hands for recovery and sustainable development after the disastrous floods that hit the state last year.

5. Build Back Better

Building Back Better (BBB) is an approach to post-disaster recovery that reduces vulnerability to future disasters and builds 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 threatening hazards and conditions as well. BBB offers the opportunity to rebuild stronger, safer, and more disaster-resilient infrastructure and systems.

The concept of Build Back Better is being advocated globally at various platforms but it was accepted in policy when the PDNA report assessed the recovery needs with the objective of building resilient infrastructure. The Sate adopted the principle of rebuilding as "Nava Keralam" to build a new Kerala to withstand future disasters. The framework for building a Green Kerala which was committed to the vision Nava Keralam (New Kerala), and the concept of 'build back better and faster' rested on four pillars:

- Pillar 1: Integrated water resources management (IWRM)
- Pillar 2: Eco-sensitive and risk-informed approaches to land use and settlements
- Pillar 3: Inclusive and people centred approach
- Pillar 4: Knowledge, innovation, and technology

The advocacy of new and better Kerala with an emphasis on BBB was actually accepted and brought into focus after the Kerala floods.

6. Role of Technology

Technological innovation is bringing digital solutions to sectors that have previously lacked access to technology, including communities. The rapid pace of this change suggests that one of technology's most meaningful benefits for society may lie in the humanitarian sector, which must reach large numbers of people, in remote and dangerous locations, to

provide critical resources fast and efficiently. The boom in technology can be used not only in hazard assessments and modeling but also in responding to disasters. In Kerala, technology was used by the community rather than institutions in responding to the disaster. Social media platforms. Facebook posts, Twitter updates and Whats app groups were used to get information across quickly. There were various Tweets from disaster survivors stuck in homes and other places. Their location and coordinates were shared with the responding agencies. An example is of an Online portal KeralaRescue.in was started to collect donations (to be sent to the CM Disaster Relief Fund), help enlist volunteers, record requests for help etc. Flooded with donations and details of volunteers. the disaster in Kerala highlighted how technology can be used effectively in saving lives as well as garnering support for the disaster survivors.

7. Protection of Wetlands

The usefulness of wetlands for flood abatement can result in storing flood waters and. lowing the speed of flood waters. This action, combined with water storage, can actually lower flood heights and reduce the water's destructive potential. The wetlands located in the lowlands have been the buffers for the state which was endowed with abundant rain, nearing 3,100 mm (as compared with the all India average of 1,200 mm). The rivers of the state had over long periods of time built highly productive floodplains along the backwaters. Till the 18th century, the estuaries were fringed with mangroves which buffered against coastal erosion, supported diverse habitats for numerous plant and animal species. However, inundation and salinity were crucial constraints. Then came an era of rapid conversion of wetlands for agriculture and settlements. Criss-crossing dykes built in Kuttanad were meant to drain water, and enable rice cultivation for as many as three times in a year. The natural shorelines of significant estuaries were converted, encroached upon, and in-flowing rivers recklessly mined for sand. Nearly two-thirds of Kuttanad is presently under agriculture. Ashtamudi estuary has shrunk by one-fourth in last four decades. The wetlands have become shallower which enhanced the flooding in Kerala (Wetlands International, 12th October, 2018).The reduction in wetlands was viewed as a crucial factor in the devastation caused by floods in Kerala. The disaster highlighted the need to stop encroachment of wetlands and conserve them to battle with the fury of floods.

8. Empowerment of the community

Community is the first responder to any disaster. Various communities in Kerala had put immense effort during and post flood restoration. Empowerments of such communities are always a tool to fight against deadly disasters. The biggest rescue work in Kerala was done by Kerala's fisher folks, who arrived with their boats, strong bodies and generosity of spirit and spent tireless hours moving people to safety. Building on the Community skills for Disaster Response They were involved across Kerala were engaged in flood rescue mission.

About 4537 fishermen participated in the rescue operations, with 669 fishing boats and rescued over 65,000 trapped from various districts. According to newspaper reports, the fishermen were offered per diem payment by administration for rescuing people but they refused saying that they helped their brethren in their hour of need. Additionally, the workers of the Kudumbasree poverty eradication and women empowerment programme worked to restore normal life in the regions scarred by the disaster.

The National Disaster Management Authority has developed a scheme for training community volunteers in disaster response in selected 30 most flood prone districts of India (Aapda Mitra). The Apada Mitra scheme aims to provide the community volunteers with the skills that they would need to respond to their community's immediate needs in the aftermath of a disaster thereby enabling them to undertake basic relief and rescue tasks during emergency situations such as floods, flash-floods and urban flooding. This scheme cans be used to empower communities like women and fishermen in Kerala to strengthen their hands in facing any eventuality.

9. Effective Dam Management

Various issues regarding the role of dams in floods was widely discussed in media. According to reports, flood gates of 22 dams were opened and warning was issued in several districts. Kerala has 53 large dams with a combined capacity of nearly 7 trillion liters. During heavy rainfall coupled with the overflow of rivers, these dams should have served as a defensive wall. For dams to effectively control floods, expert's state that the dam reservoirs had to relatively empty before the rainy season. According to Himanshu Thakkar, coordinator of the South Asia Network for Dams, Rivers and People, the Idukki dam was almost full by July-end even as rains were relatively weak (below normal levels) during that period. When the heavy rainfall started in August, the almost full-capacity Idukki had no other option but to release water in the already flooded areas. This school of thought stated that dams were already full when the rains started and water was released suddenly without adequate warning. The floods also raise another recurring, unresolved issue in Indian dam operations: inter-state dam management. The Mullaperiyar is located in one state (Kerala), but operated by Tamil Nadu. Both state governments have been in constant conflict over the dam's water level. If dams were operated in a calculative manner, it could have reduced the affects of the flood (Live Mint, 21st August, 2018).

Another school of thought opined that controlling floods in not the prime objective of construction of dams and they played negligible role in aggravating floods. The floods were aggravated by water release from dams in Tamil Nadu. However , the lesson learnt is that any structure which is constructed and which can have an impact on lives need to be reviewed and Emergency Action Plans s need to be developed to avoid such issues in future.

The lessons which emerge from disasters provide us with valuable information for future preparation and learning from the mistakes. The lessons are i) to be updated regularly about what is working for the smooth functioning system in the sector of concern. ii) what needs to be improved and c) to be aware of what kind of preparedness measures are required for exigencies. Implementation of the lessons learnt can be a path to reduce future disaster damages. It can also assist in mapping out ways to decrease vulnerabilities of the state to disasters. In future, Kerala must prioritize eco-friendly development across the state and also should keep a keen eye to the flood preparedness.

Chapter 10 : Way Forward

The lessons learnt from the deluge of Kerala in 2018 paints the path of way forward to a secure future of the state. It is very much important to implement the lessons that were learnt from Kerala flood 2018, so that in future the casualties are avoided and a well-protected and sustainable society is developed. Some of the ways suggested to handle the calamities in future in more prepared manner are as follows:

1. Land use policy of the state should be made stricter. Illegal construction and mining in restricted areas must be stopped.
2. A policy for protection and prudent use of natural resources need to implemented strictly. These resources act as a buffer to floods.
3. Existing vulnerable lands should be protected so that in future they may years there will not be any damage due to flood.
4. Keeping the vulnerabilities and capacities of the more vulnerable group in mind, an inclusive approach for all phases of disasters preparedness and response need to be adopted.
5. The role played by Kudumbasree has highlighted the effective role played by women in responding to disasters. Hence, interventions must he made to incorporate these capacities of women in all disaster related programmes.
6. Technology has played an important role in the post disaster scenario in Kerala during the flood of 2018. However, social media and technological interventions should be used more frequently in the pre disaster phase as well including dissemination of early warning as well as awareness generation of the citizens. With the help of technology, alerting the people in risk prone and remote areas will be much easier.
7. Protection of wetlands must be an activity that the state has to follow up as early as possible. They must ensure that existing wetlands which were damaged or turned into cultivation field must be taken care of so that it doesn't aggravate any floods in future.
8. Effective dam management must be the priority for the states. If the dams had water more than their capacity, alert should have been given out. Proper planning and immediate alerts can mitigate the damages caused by the flood.
9. Kerala has been one of the most inclusive states in India. Kerala is the first state in India to have transgender policy in 2015. There is a pension plan for transgender persons in Kerala since 2016. In Kochi, there is a school for transgender students to attempt examinations. Government hospitals in Kerala offer free sex reassignment surgeries. A

clinic in Kottayam Medical College opened its first centre on a trial basis in September 2017. They also have a justice board for transgender aimed at ensuring justice and equality for members of the community. It provides free legal aid to check discrimination and violence against them. Kochi Metro became the country's first government agency to hire transgender people; 23 are expected to be on duty for the inaugural run. It is also the first in India to have a workforce that comprises 80% women. If properly trained and guided, transgender people can be very helpful to volunteer in rescue works at the time of deluge in future.

10. Capacity building of the community should be done so that they can effectively respond to any kind of exigencies. Local volunteers must be appointed. Awareness generation regarding safeguarding the environment must be carried out extensively and intensively.

11. Fishermen had played a very effective role in rescuing people during the floods. They form an important segment of the community who can be used in future for responding to disasters. A task force from the fishermen community can be organized with proper training and equipment so that they can serve more efficiently and save more lives.

12. Schemes like Apada Mitra initiated by National Disaster Management Authority should be taken forward. Rescue trainings can be imparted to the volunteers. Necessary equipment's and infrastructure should be provided to these volunteers so that they can save the lives of people in crucial hours.

13. Climate change and human activities have aggravated the onset of hydrometerological disasters. In last decade, in Kerala, many forest areas have been converted into agricultural lands. Many trees have been cut down to extend highways, to build industries. The massive flood occurred due to unsustainable developments and the casualties caused because of lack of preparedness. Kerala must protect its greenery. Environment should be made a priority while doing any new construction.

Disasters are the main challenge that the human civilization is facing from ancient times. They have snatched many lives of humans and cattle; damaged many cities, villages, houses, agricultural fields, roads and various buildings in many countries. In 2018, Kerala has lost almost 449 human lives due to the flood. The infrastructure of the entire state was destroyed. There were huge monetary and humanitarian losses due to the deluge. If all the above mentioned points are incorporated along with rebuilding of Kerala, the state will have a robust disaster management mechanism and it will be well prepared to face any future disasters. There will be minimal humanitarian losses; people will be safer even if the disaster is massive or life threatening.

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Design & Print : skreenographix2@gmail.com

ISBN 978-93-82571-56-8

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