HISTORICAL BACKDROP OF FLOODS IN KERALA WITH SPECIAL REFERENCE TO THE 2018 DELUGE IN PARAVUR TALUK OF ERNAKULAM

Dissertation submitted to the Department of History,

St. Teresa's College (Autonomous), Ernakulam

in partial fulfilment of the requirements for the degree of

MASTER OF ARTS IN HISTORY

By

NIVEDYA RAJEEV

M.A HISTORY (2022-2024)

REG. NO. SM22HIS003

DEPARTMENT OF HISTORY

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This is to certify that the dissertation entitled **"HISTORICAL BACKDROP OF FLOOD IN KERALA WITH SPECIAL REFERENCE TO THE 2018 DELUGE IN PARAVUR TALUK OF ERNAKULAM"** submitted in the partial fulfilment of the requirements for M A Degree in History, Mahatma Gandhi University, Kottayam is a bonafide work done by **NIVEDYA RAJEEV** under my supervision and guidance. In addition, it is certified that this project or any part of this has not been previously submitted elsewhere to adjudge any degree, diploma, or other title or acknowledgement.

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Head
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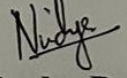
Submitted to viva- voce Examination held on ..21-03-2024..... at the Department of History, St. Teresa's College (Autonomous), Ernakulam.

Name and signature of Examiners

1. Dr. Santha. K.S 21/3/24
2. Ms. MINTU JUDSON 21/3/24

DECLARATION

I hereby declare that this dissertation work entitled "**HISTORICAL BACKDROP OF FLOODS IN KERALA WITH SPECIAL REFERENCE TO THE 2018 DELUGE IN PARAVUR TALUK OF ERNAKULAM**" is an original work done by me under the supervision and guidance of Smt. Jacquiline Deepika, Lecturer of the Department of History, St. Teresa's College (Autonomous), Ernakulam, and I have not submitted this project to any other universities for the award of any degree or diploma.



Place: Ernakulam

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Nivedya Rajeev

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INTRODUCTION

The word ‘flood’ has been derived from the Old English term ‘flod’, which is common in Germanic languages. Flod literally means a flowing of water, or an overflowing of land by water, or a deluge. The term flod comes from Proto-West Germanic ‘flodu’, from Proto-Germanic ‘floduz’ from ‘plew’ which means to flow. The earliest known use of the term flood is in the Old English period around pre–1150.

The history of floods in India is considered to be as old and diverse as the civilisation itself, which is deeply linked with the country’s geography, climate, and socio-economic conditions. The floods that occurred in India are marked by both reverence and destruction, which has paved the way in the shaping and development of the region in the fields of economy, society, culture, and politics as well. In the annals of Indian history, floods have played a significant role in influencing trade routes, and agricultural practices, and also in the rise and fall of several empires.

Since the ancient period, the rivers of the Indian subcontinent, especially the Ganges, Yamuna, Brahmaputra, and their tributaries have been considered as sacred entities responsible for sustaining life and livelihoods near the banks of these rivers. However, their changeable nature has also led to recurrent floods, which have caused widespread destruction and loss of life. Similarly, during the medieval period, there were recurrent floods that took place, but the construction of elaborate hydraulic structures such as step wells and reservoirs, aimed at mitigating flood risks. During the colonial era, British administrators recognised the need for flood control measures, which led to the construction and establishment of embankments, canals, and drainage systems throughout the Indian subcontinent. Even though these interventions brought some relief, they also changed the course of natural hydrological patterns, exacerbating flooding in certain areas of the country. During the post-colonial period, there was a gradual growth in urbanisation, deforestation, and climate change which further heightened the flood challenges faced by the country. The increase in population and unplanned growth in development have destroyed the floodplains and natural drainage systems, which amplified the vulnerabilities of millions of seasonal floods. Today, India stands at a juncture in its battle against floods, coping with the dual imperatives of economic development and environmental sustainability.

Similarly, Kerala's relationship with floods is believed to be as old as its civilisation. The state's diverse network of rivers such as the Periyar, Pamba, and Chalakudy has played the role of both a lifeline as well as a source of destruction. Kerala has been affected by floods several times in the years 1341, 1924, 1907, 1961, 1974, 1992, 2003, 2013, 2018 and 2019 respectively. These floods are a clear example of the resilience of the affected people.

However, the flood of 2018 stands out as a remarkable moment in the history of Kerala. The Ernakulam district, which is a commercial hub of Kerala, was the most affected among all the districts and the Paravur taluk, which is one of the seven taluks of the district was severely affected by the deluge of 2018. The magnitude of the disaster was exacerbated by various factors including deforestation, urbanisation, and poor land use patterns, which led to the increasing vulnerabilities of Kerala's socio-economic conditions and highlighted the urgent need for comprehensive flood management strategies.

This dissertation through a multidisciplinary approach and historical analysis tries to unravel the different floods throughout the years that occurred in Kerala giving special focus to the 2018 deluge in Ernakulam as well as the most affected taluk of the district, the Paravur taluk. It also sheds light on the resilience and necessary measures taken by the authorities concerned and the flood-affected people to fight against the flood.

OBJECTIVES

- To analyse historical records and gather primary and secondary sources to understand the causes and impacts of the major and minor floods that occurred in Kerala.
- To evaluate the impact of the 2018 flood on the socio-economic aspects in the Ernakulam district including the destruction of infrastructure, loss of livelihood etc.
- To assess the impact of the 2018 flood in the Paravur Taluk of the Ernakulam district focusing on the Muziris Heritage Project and Chendamangalam Handloom (Kaithari) industry.

REVIEW OF LITERATURE

The literature review for this dissertation includes books, academic works, government reports, etc. that shed light on the causes, impacts, and responses to the floods in the region.

Historical accounts such as "*History of Kerala: Prehistoric to the Present*" by Rajan Gurukkal and Raghava Warrier offers a thorough account of Kerala's history, shedding light on the state's advancements in terms of culture, society, politics, and economy from its ancient beginnings to the present. Similarly, "*A Survey of Kerala History*" by A. Sreedhara Menon highlights the overview of Kerala's historical evolution, encompassing its political, social, cultural, and economic dimensions, while "*Kerala District Gazetteers – Ernakulam*" delves specifically into the detailed geographical, demographic, and historical aspects of Ernakulam district within Kerala. C. Achyutha Menon's "*The Cochin State Manual*" provides a thorough outline of the socioeconomic, administrative, and cultural facets of the Cochin State while also offering insightful information about its history, system of government, and social structure. V. K. R. Menon's "History of Mediaeval Kerala" bids a thorough analysis of Kerala's socio-political and cultural dynamics during this time, emphasising key figures, events, and changes in society. These works have been used to document the history, geography, and etymology, of Kerala as well as the Ernakulam district. These are also used to provide insights into the past floods that occurred in Kerala.

Another work used in this dissertation includes Thakazhi Sivasankara Pillai's "*Vellappokkathil*" which is a moving story that examines the complexities of interpersonal relationships and social conventions against the backdrop of a traditional Kerala home. By examining the ecological effects of land use changes, climate change, and deforestation in the Western Ghats region, Viju B's book "*Flood and Fury: Ecological Devastations in the Western Ghats*" sheds light on the causes and effects of environmental degradation. Rejimon Kuttappan's book "*Rowing Between the Rooftops: The Heroic Fishermen of the Kerala Floods*" recounts the incredible bravery and tenacity of Kerala's fishing community during the disastrous floods, emphasising their altruistic efforts in rescuing and helping those afflicted by the flooding. Manu S. Pillai's "*The Ivory Throne: Chronicles of the House of Travancore*" is a captivating historical account that explores the complex politics, customs, and personalities of the Travancore royal family, giving readers a vivid picture of Kerala's past. These works have contributed necessary pieces of information on the 1924 and 2018 floods as well.

Government reports and documents by agencies such as the Kerala State Disaster Management Authority (KSDMA) and the National Disaster Management Authority provide valuable

insights into flood occurrences, their causes, impacts, and strategies used to recover from them, and policy recommendations.

METHODOLOGY

This dissertation uses the historical method through case study analysis and an interdisciplinary approach, drawing from both primary and secondary resources. Primary sources include interviews with people affected by the flood, and newspaper articles regarding the course of the flood. The secondary sources comprise of books, other research projects, reports, journal articles, online sources, etc.

The findings from primary data sources, such as interviews with individuals impacted by the 2018 floods, are cross-checked with information obtained from secondary sources, such as books, newspaper articles, journals, websites, and government reports.

ORGANISATION OF THE STUDY

The study is proposed to be organised under five chapters as follows:

1. Chapter 1 – Introduction
2. Chapter 2 – Unearthing The Historical Tapestry of Floods in Kerala
3. Chapter 3 – Delving Into the History of Floods in Ernakulam with A Special Focus on The Catastrophic Deluge Of 2018
4. Chapter 4 – The Chronicles of Resilience in the Paravur Taluk amidst the Flood of 2018
5. Chapter 5 – Conclusion

CHAPTER: 1
UNEARTHING THE HISTORICAL TAPESTRY OF FLOODS IN KERALA

Kerala is a state nestled in the southwestern part of India. It has maintained an independent identity within the Indian subcontinent by having worldwide connections with a different topography that has led it to live in a state of political and cultural seclusion.[1] Kerala has gone through various disasters such as tsunamis, floods, earthquakes, and cyclones, each leaving a significant impact on its landscape. These calamities have brought devastating impacts, challenging the resilient powers of the people and infrastructure.

According to the World Health Organisation (WHO), there are two types of disasters which include – natural and man-made disasters.[2] Among these types of disasters, the most commonly seen are floods which can be extremely dangerous, particularly for populations residing at places that are already at risk.

Similarly, in Kerala too, floods are common and have brought devastating impacts upon people, infrastructure, and landscapes. Kerala is well known for its profuse amounts of rainfall and network systems of the rivers.[3] Kerala has two major monsoon seasons, the Northeast monsoon, known as *thulam*[4] in Malayalam, which strikes around mid-October, and the Southwest monsoon, called *edavapathi*[5], which arrives in late May or early June. The monsoon season in Kerala has caused large-scale flooding events that have led to the loss of many lives. The state's geography has made the flood even more difficult for its citizens at some point of time. The complex network of rivers, and other water bodies, combined together with heavy

[1] Menon, A. Sreedharan. *A Survey of Kerala History*. D C Books, 2019. p.13.

[2] "Floods." *World Health Organisation*, https://www.who.int/health-topics/floods. Accessed 27 Dec. 2023.

[3] State Relief Commissioner, Disaster Management, et al. *Kerala Floods - 2018 1st August to 30th August 2018*. 13 Sept. 2018, p. 40.

[4] The month of Thulam in the Malayalam calendar corresponds to October-November, which marks the advent of the post-monsoon season (Northeast monsoon).

[5] The month of Edavapathi in the Malayalam calendar falls during the Midhunam-Karkkidakam (Gemini-Cancer zodiac signs) and comes around late May or early June.

rainfall, have frequently caused floods, which have claimed the lives of people and means of subsistence. The impact of a flood shows how serious a disaster can be. The aftermath has been a tenacious challenge for the state, which requires active approaches to tackle the disaster and provide disaster management and response tactics to decrease the effects of these recurrent disasters. This recurring nature of floods in the state highlights its vulnerability to monsoonal variations and gives importance to the need for a long-term, flexible measure to protect the populations against further flooding events. Despite the calamities, Kerala has demonstrated its unwavering willpower, and resilience in the face of such difficulties. The disaster management strategies, community actions, and efficient response mechanisms of the state have played a pivotal role in mitigating the consequences of these disasters. Through cooperative efforts and the spirit of the community, Kerala has emerged stronger after each disaster and rebuilt its shattered lives and infrastructures. This commitment to learning from the past by the state reflects their enduring spirit.

This chapter sheds light on the historical tapestry of floods in Kerala and provides a thorough examination of the factors that have led to the major and minor floods that occurred in the state and have shaped its terrain from time to time. The chapter also evaluates the patterns and effects of floods that have affected the history of Kerala, tracing the events from the disastrous years of 1341, 1924, and 2018 to the more recent flooding in 2019. There were also minor floods during the years 1907, 1961, 1974, 1992, 2003, 2013, and 2019 that have affected the state, which are discussed in this chapter. Unearthing the historical background of the floods that took place in Kerala, enables us to understand the ongoing battle of the state with this natural disaster since olden times.

KERALA: HISTORY, GEOGRAPHY, CLIMATE, RIVERS AND DAMS

Kerala, regionally referred to as Keralam is popularly known as "God's own country", and is a 38,855-square-kilometer landmass situated on the southwest coast of the Indian peninsula.[6] It is a union of Malayalam-speaking regions created by the States Reorganisation Act and was established as a state on November 1, 1956. Kerala is bordered by Tamil Nadu, Karnataka, and

[6] Menon, A. Sreedharan. Op. Cit.

the Lakshadweep Sea. It has 14 districts and 33,387,677 people inhabiting there according to the 2011 census. Thiruvananthapuram is the capital, and Malayalam is the official language.[7]

Geographically, Kerala is made up of red soil undulations, sandy plains, and loamy areas.[8] The Western Ghats create hilly forests in the east, and the Arabian Sea forms the western border across a distance of 780 km.[9] The highest point in India is Anamudi in the Western Ghats, and the lowest point is Kuttanadu in the Alappuzha district. Passes like Thamarassery Pass and Periya Gap improve Kerala's connectivity. Important places along the shore are Vizhinjam, Kochi, Ponnani, and Kollam.[10]

The climate of Kerala has greatly influenced its history, which features cold High Ranges and the lowlands which are hot and humid. Rainfall is heavy, with 96 inches on average each year carried in by the northeast and southwest monsoons (called Thulam and Edavapathi in Kerala). The most rainfall occurs in the Idukki district, and historical accounts suggest that the Egyptian pilot Hippalus discovered the southwest monsoon about 45 A.D, which became a remarkable discovery that allowed ships to sail directly from the Persian Gulf to Muziris.[11]

Kerala's history and culture have been influenced by its 41 west-flowing and 3 east-flowing rivers. The longest rivers include Bharatapuzha, Chaliyar, Periyar, and Pamba.[12] Rivers have also affected growth and trade; as a result, Cochin has become a significant trading hub. Kerala's development is aided by its hydropower potential and irrigation projects such as Malampuzha and Idukki, which create industrial hubs and turn rivers into modern tourist

[7] Padmanabhan, Dr. N. *Formation of Kerala Society and Culture*.

[8] Gurukkal, Rajan, and Raghava Varier. *History of Kerala: Prehistoric to the Present*. Orient Blackswan Private Limited, 2018. p.1.

[9] A Noble, William. *Kerala | History, Map, Capital, & Facts | Britannica*. 26 Dec. 2023, https://www.britannica.com/place/Kerala.

[10] Menon, A. Sreedharan. Op. Cit. pp. 15-16.

[11] Ibid. p. 19.

[12] Gurukkal, Rajan, and Raghava Varier. Op. Cit. p. 12.

destinations. On the other hand, the region's floods have also been influenced by the rivers. [13] In general, Kerala's historical, cultural, and economic growth has been greatly influenced by its topography, climate, and rivers. Additionally, in 1789, Tipu Sultan was unable to advance south of Aluva and conquer Travancore due to a flood in the same river.[14] These rivers also played a major role in the floods that occurred in Kerala.

Kerala is home to 81 dams. Of the 81 dams, 45 reservoirs are owned by the Kerala State Electricity Board (KSEB), 59 reservoirs are owned by the Kerala Irrigation Department, 20 reservoirs are owned by the Kerala Water Authority, and two reservoirs are controlled by the Kerala Water Authority.[15] These dams are essential to the state's reliance on hydroelectric projects because of the state's copious amounts of rivers and rainfall. These dams assist in the provision of water for cultivation and consumption while also making a substantial contribution to the production of power. They have also emerged as major draws in the expanding hydro tourism sector, providing guests with activities like boating and dam gardens.[16]

Notable dams, including the Banasura Sagar Dam and the Idukki Dam, display amazing architectural achievements amidst stunning scenery. It is imperative to maintain an equilibrium between ecosystem preservation and development, as evidenced by the government's rejection of specific initiatives aimed at safeguarding Kerala's rainforests. Although these dams add to Kerala's tourism appeal, it's important to highlight that they were a major factor in the state's 2018 flood. The floods highlight how crucial it is to operate dams effectively and take the environment into account. Kerala's dams continue to provide visitors with a variety of experiences, fusing technological marvels with the unspoiled beauty of the surroundings, despite these difficulties.[17]

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[13] Krishnachandran, Dr. *The Great Deluge of 1341 CE That Changed the Landscape of Kerala | News & Events*. 29 Aug. 2018, https://news.vidyaacademy.ac.in/2018/08/29/the-great-deluge-of-1341-ce-that-changed-the-landscape-of-kerala/.

[14] Paanchajanya. *Mysore Invasion of Kerala: Part 2 (Tipu Sultan)*. 10 Nov. 2017, https://hindupost.in/history/mysore-invasion-kerala-part-2-tipu-sultan/.

[15] Bureau, Kerala. "*With Dams Brimming, Kerala Sets up Panel to Regulate Discharge*." *The Hindu*, 18 Oct. 2021. *www.thehindu.com*, https://www.thehindu.com/news/national/kerala/with-dams-brimming-kerala-sets-up-panel-to-regulate-discharge/article37059500.ece.

[16] "Kerala Dams." *Kerala Travel Pal*, https://www.keralatravelpal.com/kerala-dams.html. Accessed 2 Jan. 2024.

[17] Ibid.

UNDERSTANDING FLOODS

The World Health Organisation (WHO) defines a disaster as any occurrence that destroys property upends the environment, results in human casualties, deteriorates health, or affects health services to the point when exceptional action from outside the impacted community or area is required.[18] There are mainly two types of disasters and they are natural and man-made disasters. Natural disasters are disasters resulting from natural phenomena. Examples of natural disasters include storms, hurricanes, tsunamis, and floods. Man–made disasters are disasters that arise due to negligence on the part of humans or improper management of hazardous machinery. Transportation accidents, building breakdowns, chemical spills, fires, and contaminated groundwater are a few examples.[19]

The most common natural disaster is flooding, which happens when too much water floods normally dry ground. Floods usually happen over a few hours or days, giving residents time to be ready or leave. Nonetheless, certain floods may appear suddenly, surprising local communities.

Floods may be caused due to heavy rainfall, quick snowmelt, or a storm surge or cyclone that develops along coastal areas due to a tropical storm or tsunami. Floods may have far-reaching consequences, including the loss of life, and the destruction of private properties, and essential public health infrastructure. Most in danger are those who live in floodplains, in buildings that are not resistant to flooding, or who do not have or get warnings or knowledge of flood threats.[20]

There are three main types of floods and they are flash, river, and coastal floods. Flash floods are caused by intense rain that quickly raises the water level to the point where it overflows into roadways, rivers, streams, and channels. River flood takes place when a nearby floodplain may be impacted by river inundation caused by heavy rain, dam or levee breaches, quick

[18] *"Floods." World Health Organisation. Op. Cit.*

[19] Zibulewsky, Joseph. "*Defining Disaster: The Emergency Department Perspective*." Proceedings (Baylor University. Medical Center), vol. 14, no. 2, Apr. 2001, pp. 144–49. *PubMed Central*, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1291330/.

[20] "*Floods*." World Health Organisation. Op. Cit.

melting of mountain ice, or well-placed beaver dams.[21] The coastal floods occur due to storm surges associated with tsunamis and tropical storms.

Eighty to ninety percent of natural disasters that took place in the last ten years have been linked to heat waves, floods, droughts, tropical cyclones, and strong storms. Remarkably, among them, floods are becoming more frequent and intense.[22] This indicates the urgent need for adaptive disaster management techniques to address these challenges effectively.

A PRELUDE TO THE FLOODS OF KERALA

One of the worst natural disasters that hit India is flooding, which is expected to become more common as a result of climate change along with extreme precipitation occurrences and intense rainfall. Different parts of the country are vulnerable to flooding depending on their geographic location. It is said that Kerala has had significant flooding in different years such as 1341, 1907, 1924, 1961, 1992, 2003, 2013, 2018, 2019, etc. which is sometimes seen as an aftermath of floods that occurred in other regions of the country. Even though the Kerala State Disaster Management Authority introduced a disaster management plan in 2016, it did not prevent the 2018 flood which was mostly caused by dam failure, also said to be a man-made disaster, which turned out to be the worst. This tragic incident affected millions of people, took several lives, and resulted in financial losses leading citizens to poverty. Some of the contributing causes include poor land use and land cover changes, preexisting hydrologic conditions, reservoir storage, and operations, the expansion of floodplains, and other natural features etc. Despite these difficulties, flood management, which includes tactics such as planning, mitigation, rescue, and recovery was essential in reducing the effect of the floods. This study promotes novel approaches to learning about the historical background, causes and consequences, and risk reduction, which are especially important to know about vulnerable regions of Kerala.[23]

It is believed at some point that the ancient floods have shaped the history and landscape of Kerala. These floods, which deeply impacted Kerala culture, are more than just natural

[21] *Flood*. https://education.nationalgeographic.org/resource/flood. Accessed 10 Jan. 2024.

[22] "*Floods*." World Health Organisation. Op. Cit.

[23] Srija, P., et al. "A Case Study on Kerala Floods." *International Journal of Current Engineering and Technology*, Aug. 2021, p. 6, https://inpressco.com/wp-content/uploads/2021/08/Paper626-31.pdf.

disasters; they are stories of resiliency, adaptability, and the complex relationship between the natural world and human society. Each event played a major role in Kerala's story, beginning from the historic floods of 1341 to the floods of 1924 that coincided with changes in society and politics and culminated in the deluge of 2018.

FLOOD OF 1341

Periyar River once was crossed by busy oarsmen and crowded with sailors wearing brightly coloured robes and laden with wealth. A Roman expedition made its way across the Mediterranean to the coast of the Chera dynasty, drawn by the alluring scent of pepper, also known as the "Black Gold." This was the beginning of many centuries of trade relations. Muzuri Pattanam, popularly known as Muziris, is a famous port that has been visited by explorers from all over the world, such as the Greeks, Portuguese, and Dutch, who left their stamp on the port's marine heritage. Muziris rose to prominence as an important seaport, known for both its spice trade and its rich forest resources.[24] There have been several debates on the causes of the decline of the Muziris port. Some argue that it was due to the deluge of 1341 whereas others do not.

The devastating impact of the 1341 flood in Muziris Port

The flood of 1341, is also known as the great flood of 677 (according to the Malayalam calendar).[25] Historians believe that the ascendancy of Kochi as a significant port city can be attributed to the major flood in the river Periyar in the year 1341.[26] Before that period, the main trading center was Mahodayapuram and its port of Muziris (present-day Kodungallur). Nonetheless, the catastrophic flood and the persistent invasions by the Zamorins, the Malabari dynasty, marked the end of this port city and commercial hub. As a result, traders began to move towards the natural harbour that the floods in Kochi created.[27]

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[24] Paul, Jiji. "How Periyar's Dance of Death Changed Kerala's Landscape." *OnManorama*, 22 July 2018, https://www.onmanorama.com/travel/travel-news/2018/07/22/periyar-floods-muziris-port.html.

[25] Ibid.

[26] *Floods in Kerala: A History - Indpaedia*. http://indpaedia.com/ind/index.php/Floods_in_Kerala:_a_history. Accessed 20 June 2023.

[27] "Emergence as an Important Port City, Kochi, Cochin, Ernakulam, Kerala, India." *Kerala Tourism - Kochi*, https://www.keralatourism.org/kochi/emergence-port-city-kochi.php. Accessed 28 Dec. 2023.

Several historical narratives emphasise the major Periyar flood of 1341. Among the first to make a detailed connection between this flood and the start of the Puthu Vaippu era is *Sir William Wilson Hunter*,[28][29] a statistician, compiler, imperial historian, a man of literature with a broad interest in philology, journalism, diplomacy, race, and religion, as well as a member of the Indian Civil Service. The author observes that the date 1341 (A.D.) on which the island was formed by the action of the sea and river is occasionally referred to in legal documents as the start of an era known as Puttuveppu or Puthu Vaippu (new deposit). Based on some accounts the floods in the Periyar River in 1341 clogged the mouth of the Cranganore harbour, making it unusable for commerce. According to K P Padmanabha Menon, in his work 'Kochi Rajya Charithram', the 1341 flood was an exceptional deluge that turned the region into an estuary.[30]

According to Bartholomaeo's 'A Voyage to the East Indies', the historic port town of Muziris on the Malabar Coast, vanished abruptly due to the catastrophic flood of 1341. It was most likely caused by a natural disaster that occurred in the river Periyar in 1341 and changed the region's topography. On the western shore, a new land mass abruptly accreted from Kodungallur to Alleppey. The present-day Cochin Estuary, or "Kochazy," and its port were made accessible by the floodwaters, which also assisted in the construction of the Vembanad Backwater. The breach occurred between the present-day Fort Kochi and Vypin. The islands that make up the northern portion of the Cochin Estuary are commonly referred to as the Vypeen/Vypin Islands since they have altered access to the Periyar River. The island of Vaypi, which is located on the northern coast of Cochin, emerged from the sea in the year 1341. Its arrival is dated by the fact that it ushered in a new period of Hindu history known as Puduvepa, also known as Puthu Vaippu, or the new introduction or new deposit. At the same time as Vaypi appeared, the waters that were released during the rainy season burst through the channel's

[28] *Hunter, Sir William Wilson - Banglapedia*. https://en.banglapedia.org/index.php/Hunter,_Sir_William_Wilson. Accessed 28 Dec. 2023.

[29] Skrine, Francis Henry. *Life of Sir William Wilson Hunter*. 1901.

[30] Maddy. *1258 and Calicut*. https://historicalleys.blogspot.com/2013/08/1258-and-calicut.html. Accessed 20 June 2023.

banks, overtaking a village and creating a lake and harbour large enough for light ships to anchor.[31]

Joseph J Thayamkeril, as detailed in his memoir, corroborates these facts and concurs with this assessment. In the ancient history of the area, this event marks one of the most notable geological shifts and landforms. According to geophysical measurements, the shoreline was around three km east of the present coast 200–300 years ago.[32]

The coastline of Malabar underwent a significant change as a result of the extraordinary cyclonic floods that occurred in 1341. The ancient harbour was filled with silt when Muziris, or its successor known then as Cranganore, was overwhelmed by the flood. The new Periyar exit into the Arabian Sea is indicated by a coastline shift estimated to be several kilometres in length. The backwater that resulted from the newly constructed Vypin Island's increased length was also established by this event.[33]

According to Dr. P J Cherian, director of the Pattanam research project, history does not support the idea that the Muziris port was devastated by floods. As no other explanation has been documented, current information is considered historical. Information that is now available mentions the severe floods of 1341, which raises the possibility that floodwaters from the eastern plains and hills may have changed the Periyar's path. Dr. P J Cherian contends, however, that it is improbable to attribute the port's demise to floods as there is no proof to back up the theory that it vanished during the flood.[34] [35]

The only historical source is the Moroccan traveller Ibn Battuta, who purposefully avoided Kochi and Kodungallur during his travels in the fourteenth century. It is possible that this

[31] Bartolomeo, Paolino da San. *A Voyage to the East Indies: Containing an Account of the Manners, Customs, Etc of the Natives, with a Geographical Description of the Country*. Cambridge University Press; Illustrated edition, 2014.

[32] Thayamkeril, Joseph J. "MEMOIRS: THE GREAT DELUGES OF 1341 AND 1924 AND SIGNIFICANCE OF FLOOD PLANNING." *MEMOIRS*, 17 Sept. 2017, http://josephjthayamkeril.blogspot.com/2017/09/the-great-deluges-of-1341-and-1924-and.html.

[33] Black, Harper McAlpine. *Out of Phase: The Lost City of Muziris*. 27 Feb. 2016, https://harpermcalpineblack.blogspot.com/2016/02/the-lost-city-of-muziris.html.

[34] Paul, Jiji. Op. Cit.

[35] Paul, Jiji. Interview. Conducted by. Nivedya Rajeev. 6th February 2024.

avoidance was caused by a natural calamity that affected these areas. There are rumours which say that a tsunami may have destroyed the port. After a thorough investigation spanning almost three thousand years, the town's soil strata surprisingly revealed no evidence of a flood. Since human remains are typically found preserved in soil layers for millennia, the lack of things piled vertically in the soil layers implies that no concrete evidence of a flood has been found to corroborate this theory.

One thing is for sure, is that the Periyar has changed throughout the years, because of various reasons including earthquakes, tsunamis, and floods. Without the aid of dredging machinery, natural ports are doomed to natural decay after five centuries due to mud accumulation near river mouths. According to Dr. Cherian, this may be Muziris' story.[36]

Vypeen/Vaippu: The Birth of an Island and a New Era

The origins of Vypeen Island, the development of Cochin Harbour, and the start of the Puthu Vaippu era are all linked together. Vypeen is the Portuguese translation of Vaippu, which is sixteen miles long and three miles wide, thus the name Puthu Vaippu. It is located between Cochin and Kodungallur (Cranganore). The major changes in the geography of Cochin, Vypeen, and Cranganore were commemorated during the Puthu Vaippu Era. Puthu Vaippu, another name for Vypeen, is a deposit that represents a formation; where the local people date it to a time before it was formed in 1341 A.D. This important moment resulted in the creation of a brand-new harbour that is now known as Kochi (Cochin) Harbour, also known as Kochazhi or small harbour. The course of events that would finally surpass the significance of Calicut in this harbour would involve strategic partnerships with other powers, particularly the Portuguese, Dutch, and English, and would take over 500 years to complete. The region's future was significantly shaped by the clever manipulation of internal tensions between the Zamorin and the Cochin king by these outside powers.[37]

V K R Menon explores the Putu Vaippu Era in his work ‘History of Medieval Kerala’, opines that the islands formed suddenly in 1341. Menon suggests that this period began with the

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[36] Ibid.

[37] *Floods in Kerala: A History - Indpaedia*. http://indpaedia.com/ind/index.php/Floods_in_Kerala:_a_history. Accessed 20 June 2023.

foundation of the Vijayanagara monarchy, not with the abrupt appearance of an island. His research indicates that the Cochin Raja and Harihara of Vijayanagar signed a strategic alliance in 1341 intending to fend off the Tughlaqs. In 1341, taxes were first imposed on the subjects to satisfy the mandated tribute. Following Menon's thesis, "Pudu Vaippu" translates to "New Foundation."[38]

The Aftermath of Muziris

Before Christ, Kerala was visited by Phoenicians, Persians, Egyptians, Greeks, and Arabs due to its thriving port at the meeting point of the Periyar and the sea. With the disappearance of Muziris, Kollam became an important port city. Kochi may have been used to divert spices to Kollam, but the port city started to develop at the same time as trade did. Notably, Italian traveller Nicolo Conti also visited Kochi in 1400, and Ma Huan, a team member of Chinese diplomat Cheng Ho, made this statement. However, it was not until the arrival of the Portuguese that Kochi became a major trading hub.[39]

Dr. Rajan Chembadath, a historian, suggests that ships that were initially headed for Muziris may have looked for a different port because of declining commerce or weather-related uncertainty, which helped adjacent Kochi become a major harbour. In the second phase of Muziris study with Pennsylvania University, Dr. Rajan, a member of the research team under the leadership of Dr. Vimala Bleggi, indicates that one possible contributing aspect might have been the protection provided by multiple islands near the port. He noted that there was no evidence of a flood in his investigation of the soil layers, highlighting the fact that intact soil strata are proof of ongoing human existence. Dr. Rajan said that if there had been a significant flood, it should have left a visible gap in the soil strata.[40]

The two massive floods that opened the port of Kochi in 1341 and the one that occurred in the fourth century are both credited with building the Bhoothathankettu Dam. It is thought that

[38] Menon, V. K. R. *History of Medieval Kerala*. Pragati Publications, 2006.

[39] Paul, Jiji. Op. Cit.

[40] Ibid.

enormous boulders tumbled down from the mountain and became embedded in the Old Bhoothathankettu as a result of the enormous landslides that occurred during the flood.[41] [42]

To sum up, the Periyar River flood of 1341 had a significant and varied effect on the Malabar coast. Whether it was viewed as a progressive change or a cataclysmic disaster, it was crucial in changing the region's topography. Our knowledge is aided by a variety of historical viewpoints, ranging from the nuanced opinions of V K R Menon to the scholastic observations of Sir William Wilson Hunter and Dr. Thomson on geology. Changes in the shoreline, the rise of Vypeen Island, and the start of the Puthu Vaippu era were major turning points that changed the history of Muziris and Cochin. These accounts of the flood's aftermath not only depict physical changes but also socioeconomic and political factors, making it a keystone in the growth of Kerala's coastline.

FLOOD OF 1924

In July 1924, the rising waters of the Periyar River in Kerala caused the disastrous Great Flood of '99. It corresponded to the year 1099, sometimes referred to as the Kollam Era, in the Malayalam calendar. A turning point in Kerala's meteorological history was this flood, also known as “Thonnootti Onbathile Vellapokkam” or the "flood of '99."[43] During this occurrence, the region received around 3,368 mm of rain, which is an exceptional amount of rain for that particular month. As the most precipitation ever recorded in Kerala's history, this amount is 64% more than the average rainfall. Another element that may be responsible for the deluge is the development of offshore vortices along the west coast.[44]

Causes of the flood

There was a noticeable increase in wind speed and rainfall during the final week of July in 1924. The prevailing opinion in Kerala, according to the elder generation, holds that a break in

[41] *The Hindu: The Magic of Bhoothathankettu*. 23 May 2003, https://web.archive.org/web/20030523024720/http://www.hinduonnet.com/2001/12/29/stories/2001122903250300.htm.

[42] Pillai, C. V. Raman. *Rama Raja Bahadur*.

[43] *Karinthiri*. https://wikimapia.org/17306917/Karinthiri. Accessed 28 Dec. 2023.

[44] Walia, Ajinder, and Naima Nusrat. *Kerala Floods 2018*. National Institute of Disaster Management (NIDM), Ministry of Home Affairs, New Delhi-110042., 2020, https://nidm.gov.in/PDF/pubs/KeralaFlood_18.pdf.

the Mullaperiyar Dam, which was constructed in 1895 by a British engineer named John Pennycuick, caused the floods.[45] Only 29 years had passed since the dam's completion when this rupture happened. Since there were no other dams in the area at the time, it is believed that this breach was probably the main reason behind the disastrous floods. Nevertheless, there is little evidence to support this claim, especially in light of the floods Kerala experienced before to the dam's completion.[46]

The proprietor of a tea plantation, P. John John, said in a letter that his two tea plantations, Karimkulam and Karimtaruvi, suffered large losses during the flood of 1924. An official declaration outlining the magnitude of these losses was sent with the letter. According to the owner, the primary cause was the unintentional opening of gate valves of the Mullaperiyar dam. The letter said that the Mullaperiyar Dam construction happened without notice and that the situation was made worse by the unusually heavy rain, especially in the Peeramedu district. Authorities realised the river was already flooded because of the combination of intense rain and the opening of several gate valves. When the lake level rose over the maximum, the sluice gates opened to the fullest height, allowing the river to flow out.[47]

Aftermath

At least a thousand people lost their lives in Kerala as a result of the devastating flood, which also severely damaged buildings and crops and killed a great number of animals and birds. The floodwaters swept away a great deal of the former states of Travancore and Cochin, as well as sections of the Malabar area.[48]

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[45] Abraham, Bobins. *The Kerala Deluge Brings Back Memories Of "The Great Flood Of 99" Which Almost Wiped Out Munnar*. https://www.indiatimes.com/news/india/the-kerala-deluge-brings-back-memories-of-the-great-flood-of-99-which-almost-wiped-out-munnar-351058.html. Accessed 28 Dec. 2023.

[46] Sivaraman, Sanchita. *Do You Know about the Great Flood of 99? - The New Indian Express*. 17 Aug. 2018, https://www.newindianexpress.com/states/kerala/2018/aug/17/do-you-know-about-the-kerala-flood-of-1924-1859072.html.

[47] "Great Flood Of 99: Most Up-to-Date Encyclopaedia, News & Reviews." *Academic Accelerator*, https://academic-accelerator.com/encyclopedia/great-flood-of-99. Accessed 28 Dec. 2023.

[48] Katakam, TA Ameerudheen &. Anand. "Monsoon Trends: For Many in Kerala, This Year's Rain Recalls the Great Flood of '99." *Scroll.In*, https://scroll.in, 15 Aug. 2018, https://scroll.in/article/890593/monsoon-trends-for-many-in-kerala-this-years-rains-recalls-the-great-flood-of-99.

Munnar had an incredible 4850 mm of rainfall during the flood, which caused extensive damage. Landslides rendered the historic Aluva-Munnar route via Kothamangalam-Kuttampuzha-Mankulam inaccessible, and even though the road was rebuilt all the way to Pooyamkutty, it was finally abandoned. As a result of this desertion, the tribal community of Edamalakkudy became isolated and the region was reclaimed by deep trees. Furthermore, the Kundala Valley Railway, a Munnar narrow-gauge railway line, was completely destroyed by flooding and landslides.[49] The Aluva-Perumbavoor Road was completely engulfed in ten feet of water, according to Travancore government data.[50]

Early in August, many relief centres were providing aid to displaced families and refugees. A government worker attached to the Madras presidency, Devan T. Raghavaiah, observed that accommodations were provided for 4,000 persons in Ambalapuzha, 3,000 in Alleppey, 5,000 in Kottayam, 3,000 in Changanassery, 8,000 in Parur, and so forth.[51]

The recollections of this flood evoke an eerie atmosphere for the elder generation in Kerala, many of whom were still in their early childhood years. Meenu Jacob, a historian, points out, "The significance of the flood was such that many old people in Travancore used to anchor their memories in relation to the flood." A number of religious buildings collapsed as a result of the significant impact.[52]

The districts of Thrissur, Ernakulam, Idukki, Kottayam, Alappuzha, and Chittanad were the most badly impacted by this disaster. This flood had far-reaching effects, including the loss of the Kundala Railway and significant erosion of the enormous Karinthiri Mala (mountain).[53]

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[49] Raman, Giji K. "Munnar's History Caught in Frames." *The Hindu*, 5 Aug. 2020. *www.thehindu.com*, https://www.thehindu.com/news/national/kerala/munnars-history-caught-in-frames/article32277545.ece.

[50] Roychowdhury, Adrija. "Kerala Floods: The Deluge of 1924 Was Smaller, but Impact Was Similar." *The Indian Express*, 21 Aug. 2018, https://indianexpress.com/article/research/year-1099-keralas-great-flood-of-1924-too-affected-same-areas-5317677/.

[51] Ibid.

[52] *Kerala Floods Was Worse Than The "Great Flood Of 99" Says 100-Year-Old Bishop Who Has Seen Both*. 28 Aug. 2018, https://www.indiatimes.com/news/india/kerala-floods-was-worse-than-the-great-flood-of-99-says-100-year-old-bishop-who-has-seen-both-351984.html.

[53] Srija, P., et al. Op. Cit.

Currently, Idukki and Wayanad are the only two districts in Kerala without railway access because of their inhospitable landscapes. However, Munnar is where Kerala's railway lines were first established, which is a little-known historical fact. Called the Kundala Valley Railway, it began as a monorail in 1902 and was converted to a restricted gauge in 1908. The major objective was to convey tea, which was the British people's primary crop from the highlands. Munnar's railway network was severely damaged by the devastating flood of 1924, which destroyed stations and rails that would never be rebuilt. The relics of abandoned bridges and railroads are all that are left today. The road from Kothamangalam was replaced with the current one after the crumbling Munnar road was too damaged to be repaired. Tea estates were gradually replanted, and the historic Munnar was rebuilt as the modern town. While Munnar and Idukki took the impact, several other districts also experienced significant damage. It is estimated that for days, parts of central Kerala were up to 20 feet flooded. Since there is no reliable account of the number of people who perished in the flood of '99, the subject of how many people were affected by it is still open.[54]

Historian Manu S Pillai vividly describes the 'great flood of 99' in his book, 'The Ivory Throne,' portraying a scene where the skies seemed to have torn apart, unleashing endless waters and transforming the once-bountiful landscape into a catastrophic spectacle.[55]

As the floodwaters subsided, it became evident how urgently an alternate route from Ernakulam to Munnar was needed. Mr. Valentine, the British surveyor, was in charge of overseeing the building of this new route. The road was finished by 1931, and on March 31 of that year, Regent Queen Sethu Lakshmi Bayi opened it.[56]

The inaugural event took place at Ranikkallu, which is close to Neriyamangalam. The impacted areas saw a dramatic change in the years that followed. Large-scale encroachment on the

[54] Abraham, Bobins. *The Kerala Deluge Brings Back Memories Of "The Great Flood Of 99" Which Almost Wiped Out Munnar*. https://www.indiatimes.com/news/india/the-kerala-deluge-brings-back-memories-of-the-great-flood-of-99-which-almost-wiped-out-munnar-351058.html. Accessed 28 Dec. 2023.

[55] Pillai, Manu S. *The Ivory Throne: Chronicles of the House of Travancore*. First, HarperCollins Publishers, India, 2015.

[56] Sivaraman, Sanchita. *Do You Know about the Great Flood of 99? - The New Indian Express*. 17 Aug. 2018, https://www.newindianexpress.com/states/kerala/2018/aug/17/do-you-know-about-the-kerala-flood-of-1924-1859072.html.

riverbanks was addressed, especially in Idukki. Idukki's seismic susceptibility led to the issuance of alerts about possible dangers. In 2017, the district's assembly committee backed the quick demolition of over a hundred unauthorised buildings. Most of these unpermitted buildings were located in Munnar's and its surrounding areas' hills and valleys.[57]

The Great Flood of '99 in Kerala was a historic event that resulted in above-average rainfall, leaving a wake of destruction and over a thousand dead. Districts were reshaped and significant harm was caused as a result of discussions on the Mullaperiyar Dam's involvement in the aftermath. Churches were irreparably damaged by the catastrophe, which also required the hurried building of detours. Massive relief operations that housed thousands of people were followed by initiatives to alleviate seismic concerns and encroachment. The narrative of the area is still being shaped by the '99 flood's lasting effects on Kerala's history, geography, and society.

FLOOD OF 2018

The unusually heavy rainfall on August 16, 2018, caused major flooding in Kerala, a state in southern India.[58] [59] This was Kerala's most destructive flood in almost a century.[60] Over 483 people tragically lost their lives in the disaster, and 15 people were reported missing.[61] A million or so people were evacuated, mostly from different places that were badly hit. Among the areas that were heavily evacuated were the districts of Chengannur, Pandanad, Edanad, Aranmula, Kozhencherry, Ayiroor, Ranni, Pandalam, Kuttanadu, Malappuram, Aluva, Chalakudy, Thrissur, Thiruvalla, Eraviperoor, Vallamkulam, North Paravur, Chellanam, Vypin

[57] Ibid.

[58] *Kerala Floods Latest News: Over 100 Killed in Kerala in Just One Day as Flood Crisis Worsens*. https://timesofindia.indiatimes.com/city/kochi/kerala-floods-live-updates-more-ndrf-teams-rushed-to-kerala-as-flood-situation-worsens/liveblog/65403405.cms. Accessed 1 Jan. 2024.

[59] Hunt, Kieran M. R., and Arathy Menon. "The 2018 Kerala Floods: A Climate Change Perspective." *Climate Dynamics*, vol. 54, no. 3, Feb. 2020, pp. 2433–46. *Springer Link*, https://doi.org/10.1007/s00382-020-05123-7.

[60] Baynes, Chris. *Worst Floods in Nearly a Century Kill 44 in India's Kerala State amid Torrential Monsoon Rains | The Independent | The Independent*. 15 Aug. 2018, https://www.independent.co.uk/news/world/asia/india-worst-floods-flooding-death-monsoon-rain-dead-kerala-kochi-a8493011.html.

[61] *483 Dead in Kerala Floods and Landslides, Losses More than Annual Plan Outlay: Pinarayi Vijayan | India News - The Indian Express*. 30 Aug. 2018, https://indianexpress.com/article/india/483-dead-in-kerala-floods-and-landslides-losses-more-than-annual-plan-outlay-pinarayi-vijayan-5332306/.

Island, and Palakkad.[62] All 14 districts and the state as a whole were put on red alert.[63] According to the Kerala government, the floods and other occurrences had a direct impact on one-sixth of the state's total population. It was designated as a Level 3 Calamity by the Indian government, which denotes a serious calamity.[64] [65]

A historic event occurred in Kerala during the 2018 floods when 35 of the 54 dams in the state were opened for the first time.[66] All five gates of the Idukki Dam opened simultaneously, and the five gates of the Malampuzha Dam in Palakkad opened for the first time in 26 years.[67] The state's hilly regions were cut off from the rest of the state by major landslides caused by heavy rains in Wayanad and Idukki.[68] [69] The National Crisis Management Committee was prompted to watch the situation closely and coordinate rescue and relief efforts in addition to assessing

[62] Varghese, Anuja Susan. *Kerala Floods: Horror and Heartache at Chengannur- The New Indian Express*. 18 Aug. 2018, https://www.newindianexpress.com/thesundaystandard/2018/aug/18/kerala-floods-horror-and-heartache-at-chengannur-1859525.html.

[63] "Kerala Floods: Monsoon Waters Kill Hundreds in Indian State." *BBC News*, 16 Aug. 2018. *www.bbc.com*, https://www.bbc.com/news/world-asia-india-45216671.

[64] Raghavan, T. C. A. Sharad. "The Hindu Explains: 'Calamity of a Severe Nature.'" *The Hindu*, 20 Aug. 2018. *www.thehindu.com*, https://www.thehindu.com/news/national/the-hindu-explains-calamity-of-a-severe-nature/article61501741.ece.

[65] Prasad, Srinivasa. "Centre Declares Kerala Floods 'Level-3' Calamity; Demand to Call It 'National Disaster' Either Ignorance or Mischief-India News, Firstpost." *Firstpost*, 21 Aug. 2018, https://www.firstpost.com/india/centre-declares-kerala-floods-level-3-calamity-demand-to-call-it-national-disaster-amounts-to-ignorance-or-mischief-5011141.html.

[66] Staff, T. N. M. "Kerala Floods Live Updates: 35 Dams Opened, Death Toll Rises to 67." *The News Minute*, 15 Aug. 2018, https://www.thenewsminute.com/kerala/live-updates-33-dams-opened-kerala-floods-wreak-havoc-86598.

[67] "All 5 Idukki Dam Gates Opened for 1st Time in History as Kerala Battles Unending Rains." *India Today*, https://www.indiatoday.in/india/story/kerala-rains-all-5-gates-idukki-dam-open-1310804-2018-08-10. Accessed 1 Jan. 2024.

[68] *Landslides Hit Several Places in Malabar; Munnar, Wayanad Isolated, Landslides*. 14 Aug. 2018, https://english.mathrubhumi.com/news/kerala/landslides-hit-several-places-in-malabar-munnar-wayanad-isolated-1.3060948.

[69] *Mullaperiyar Dam: Sudden Water Release by Tamil Nadu from Mullaperiyar a Reason for Deluge: Kerala to SC | India News - Times of India*. 24 Aug. 2018, https://timesofindia.indiatimes.com/india/sudden-water-release-by-tamil-nadu-from-mullaperiyar-a-reason-for-deluge-kerala-to-sc/articleshow/65519730.cms.

the situation. Even though it was a necessary precaution, the opening of the dams severely disturbed the lives of individuals who lived nearby.[70]

Causes of the flood

Kerala saw a very strong southwest monsoon in 2018, with 23% more rain than usual for the season and 96% more rain than usual in August alone.[71] In the middle of the evening on August 8, the state received 116% more rainfall than typical, which caused the dams to overflow. Kerala had a considerable 310 mm (12 in) of rain during the next 48 hours. Nearly all of the dams had to be opened, submerging the nearby low-lying areas, to prevent overflow caused by the growing water levels.[72] Remarkably, this was the first time in Kerala's history that 35 of the 54 dams were opened at the same time. Wetland degradation is mentioned as a contributing issue, and global warming is blamed for the disastrous flood.

Independent hydrological studies conducted by specialists from IIT Madras, Purdue University, and IIT Gandhinagar concluded that high rainfall, not poor dam management, was the primary cause of the 2018 Kerala floods.[73] [74] Researchers from Purdue University and IIT Madras showed through computer simulations that the flood's intensity was not exclusively caused by dam water discharge; the chance of such catastrophic floods is only 0.06%.[75] Four main causes were found by Professor Vimal Mishra of IIT Gandhinagar: an unusually high precipitation, widespread extreme rainfall events, reservoirs that were already over 90% full

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[70] *Kerala Floods: Centre to Give More Funds to State, Says Rs 600 Crore Was Only Advance Assistance | India News - The Indian Express*. 23 Aug. 2018, https://indianexpress.com/article/india/kerala-floods-centre-to-give-more-funds-to-state-says-rs-600-crore-was-only-advance-assistance-5321879/.

[71] Regional Meteorological Centre, Chennai. *REGIONAL REPORT ON SOUTHWEST MONSOON – 2018 OVER THE SOUTHERN PENINSULAR INDIA*. 2018, p. 54.

[72] Gupta, Swati. *Kerala Floods: Red Alert Issued as Death Toll Rises in Indian State | CNN*. 16 Aug. 2018, https://edition.cnn.com/2018/08/16/asia/india-kerala-floods-intl/index.html.

[73] *Kerala Floods: Flood Caused by Excessive Rainfall: IIT-Madras | Kochi News - Times of India*. https://timesofindia.indiatimes.com/city/kochi/flood-caused-by-excessive-rainfall-iit-madras/articleshow/66808949.cms. Accessed 1 Jan. 2024.

[74] Prasad, R. "Kerala Floods: IIT Professor Identifies Four Major Factors." *The Hindu*, 23 Sept. 2018. *www.thehindu.com*, https://www.thehindu.com/news/national/kerala/kerala-floods-iit-professor-four-major-factors-for-disaster/article61530617.ece.

[75] Koshy, Jacob. "Water Release from Dams Didn't Lead to Kerala Floods: IIT-M-Purdue University Study." *The Hindu*, 22 Nov. 2018. *www.thehindu.com*, https://www.thehindu.com/news/national/kerala/water-release-from-dams-didnt-lead-to-kerala-floods-iit-m-purdue-university-study/article25570143.ece.

before the intense rains, and an unprecedentedly high downpour in significant reservoir catchment areas.[76] *High-frequency mixed Rossby-gravity waves*[77] caused by tropical Pacific disturbances were implicated in the unusual 2018 rainfall. These waves resulted in cyclonic and anticyclonic circulations as well as concentrated convection zones throughout the Indian Ocean basin. MetBeat Weather LLP,[78] [79] a private weather forecasting company, predicted floods well in advance and attributed the scenario to several weather systems affected by climate change and global warming, which led to intense rainfall in a short amount of time.[80] The Central Water Commission is among the expert agencies that have endorsed the findings of scientists from IIT Madras, Purdue University, and IIT Gandhinagar concerning the reason behind the 2018 Kerala floods.

According to a report written by Adv. Jacob P. Alex, an amicus curiae, appointed by the High Court of Kerala, said that the state government's inefficient dam management was the cause of the 2018 flood. According to Alex's study, the main goals of the dams were irrigation and hydroelectricity production rather than flood protection. The research criticised the simultaneous release of water from many dams during periods of high rainfall and recommended a revision of the flood cushion in reservoirs. It brought to light problems with warning issuing as well as inadequate precautions and follow-up steps following a red alert. On August 20, 2019, the Kerala High Court, however, dismissed the amicus curiae report, claiming that it was inappropriate to utilise for political disputes and contests.[81]

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[76] Prasad, R. Op. Cit.

[77] High-frequency mixed Rossby-gravity waves are atmospheric disturbances combining features of Rossby and gravity waves, with shorter wavelengths and higher frequencies, playing a crucial role in energy transfer and atmospheric dynamics, often generated by topography or tropical convection. Understanding these waves is essential for predicting weather patterns and comprehending global climate variability.

[78] A private climate forecasting group in Kerala

[79] *MetBeat Weather | About*. https://metbeat.com/about/. Accessed 1 Jan. 2024.

[80] Kiran, S. R. "High-Frequency Mixed Rossby-Gravity Waves in the Mid-Troposphere Triggered Kerala Floods of 2018." *Journal of Extreme Events*, vol. 08, no. 01, Mar. 2021, p. 2150014. *worldscientific.com (Atypon)*, https://doi.org/10.1142/S2345737621500147.

[81] Haneef, Mahir. *Amicus Report Not Accepted: Kerala Floods 2018: Amicus Report Not Accepted yet, Says HC | Kochi News - Times of India*. 20 Aug. 2019, https://timesofindia.indiatimes.com/city/kochi/kerala-floods-2018-amicus-report-not-accepted-yet-says-hc/articleshow/70759167.cms.

The government of Kerala argued in the Supreme Court that the Tamil Nadu government's sudden release of water from the Mullaperiyar Dam contributed to the devastating flood in Kerala.[82] The Tamil Nadu government, refuted this claim, and said that the flood was caused by the overflow of water from the state reservoirs as a result of intense rainfall. It stressed that while the outflow from the Mullaperiyar dam was significantly lower, the flood surplus from the Idukki dam was principally caused by flows from its separate catchment as a result of very high rainfall.[83]

Aftermath

Over 489 people lost their life in Kerala's severe flooding, while 140 people were hospitalised and 15 people remain missing.[84] [85] 33,000 people were rescued when the Kerala State Disaster Management Authority declared a red alert, but many villages were left in danger due to damaged 10,000 km of highways and disrupted water treatment plants.[86] 12,47,496 individuals were housed in over 3,274 relief camps, forcing the cancellation of Onam festivities to provide funding for relief efforts.[87] [88] [89] Due to runway flooding, Cochin International Airport, the

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[82] *Mullaperiyar Dam: Sudden Water Release by Tamil Nadu from Mullaperiyar a Reason for Deluge: Kerala to SC | India News - Times of India*. Op. Cit.

[83] Roxy, M. K., et al. "A Threefold Rise in Widespread Extreme Rain Events Over Central India." *Nature Communications*, vol. 8, Oct. 2017, p. 708. *PubMed Central*, https://doi.org/10.1038/s41467-017-00744-9.

[84] *483 Dead in Kerala Floods and Landslides, Losses More than Annual Plan Outlay: Pinarayi Vijayan | India News - The Indian Express*. Op. Cit.

[85] *Kerala Floods: Govt Puts off Onam Celebrations in Kerala | Thiruvananthapuram News - Times of India*. https://timesofindia.indiatimes.com/city/thiruvananthapuram/kerala-floods-govt-puts-off-onam-celebrations/articleshow/65402195.cms. Accessed 21 Jan. 2024.

[86] *India: Death Toll in Devastating Kerala Floods Rises to 77 | Floods News | Al Jazeera*. https://www.aljazeera.com/news/2018/8/16/india-death-toll-in-devastating-kerala-floods-rises-to-77. Accessed 21 Jan. 2024.

[87] NDMA India, राष्ट्रीय आपदा प्रबंधन प्राधिकरण ɪɴ [@ndmaindia]. "#KeralaFloods2018 Report as on 10 AM 21 Aug 2018 No. of Villages Affected:776 | Population Affected:5411712 | Lives Lost: 373 | Missing: 32 | Evacuated:280679 (7500 in Last 24Hrs) | Relief Camps:5645 | Inmates in Relief Camps: 12,47,496 Https://T.Co/Et0cRYULxT." *Twitter*, 21 Aug. 2018, https://twitter.com/ndmaindia/status/1031796290219257857.

[88] *Kerala Floods: Over 8 Lakh People In Nearly 4,000 Relief Camps Across Flood-Hit Kerala*. https://www.ndtv.com/india-news/kerala-floods-over-8-lakh-people-in-nearly-4-000-relief-camps-across-flood-hit-kerala-1903031. Accessed 21 Jan. 2024.

[89] France-Presse, Agence. "Kerala Floods Kill Dozens with 36,000 Evacuated." *The Guardian*, 12 Aug. 2018. *The Guardian*, https://www.theguardian.com/world/2018/aug/12/kerala-floods-kill-dozens-with-36000-evacuated.

busiest airport in the state and fourth busiest in India, suspended all operations on August 12 and remained closed till August 29.[90] For safety concerns, there were limits on tourism in some districts and state-wide school closures.[91] On August 16, the Kochi Metro momentarily closed, however, it later offered free services to help individuals impacted by the flooding.[92] Due to heavy rain and rising water levels, the Southern Railway suspended train services on the Thiruvananthapuram-Kottayam-Ernakulam and Ernakulam-Shoranur-Palakkad sectors.[93]

OTHER FLOODS IN KERALA'S HISTORY

Kerala, a state blessed with beautiful scenery and a great deal of rainfall, has seen several floods throughout its history, each of which has left an indelible mark on the local inhabitants and environment. Kerala has seen smaller-scale floods with less severe effects in addition to the larger floods that occurred in 1924 and 2018, which add to the region's complex flood history. Among the most notable were the floods that occurred in 1907, 1961, 1974, 1992, 2003, and 2013. Each of these floods had a different amount of rainfall and an impact.

1) Flood of 1907

Kerala had around 1780 mm of rainfall in July and August 1907, which is 175% more than the typical amount. With 1380 mm of rain, the Idukki district had the most rainfall.[94] It is believed to be the highest rainfall in Kerala and has led to floods in various regions.[95] In the '*Kannipayyur Notebook – I*',[96] the following excerpt is taken:

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[90] *Kerala Floods Latest News: Over 100 Killed in Kerala in Just One Day as Flood Crisis Worsens*. https://timesofindia.indiatimes.com/city/kochi/kerala-floods-live-updates-more-ndrf-teams-rushed-to-kerala-as-flood-situation-worsens/liveblog/65403405.cms. Accessed 1 Jan. 2024.

[91] *India Monsoon Floods Kill 73 in Kerala - BBC News*. https://www.bbc.com/news/world-asia-india-45205516. Accessed 21 Jan. 2024.

[92] *Kerala Floods: MLAs Call out for Help as PM Modi Reaches State to Take Stock of Situation | India News - The Indian Express*. https://indianexpress.com/article/india/kerala-rains-live-updates-tamil-nadu-weather-kochi-airport-idukki-dam-mullaperiyar-5307286/. Accessed 21 Jan. 2024.

[93] *Kerala Floods Latest News: Over 100 Killed in Kerala in Just One Day as Flood Crisis Worsens*. https://timesofindia.indiatimes.com/city/kochi/kerala-floods-live-updates-more-ndrf-teams-rushed-to-kerala-as-flood-situation-worsens/liveblog/65403405.cms. Accessed 1 Jan. 2024.

[94] Srija, P., et al. Op. Cit.

[95] *Kerala Flood 2018 - Sevakiran Response*. p. 33, https://sevakiran.org/uploads/reports/sevakiran_Flood_report.pdf.

[96] The "Kanippayyur Notebook I" is a single copy of a collection of notes on many topics, primarily mathematics and astronomy, that was found in the Kanippayyur Sankaran Namboodirippad Memorial Research

> *"In 1082 in the month of Karkadakam, rains were in excess (lit. excess rainfall began) and on 22nd, a Tuesday, in the evening, the water of Perar, [also known as] Bharathapuzha, became excess (i.e., the river swelled), destroying several homes. The kali for that day: dharābandhuprahṛṣṭa. At that time, an earthquake occurred and a comet rose in the sky as well."*[97]

It mentions the flooding of the river Bharathapuzha which destroyed several homes. According to the Malayalam calendar, the date mentioned in the document is Tuesday, 1082 Karkadakam 22. This date lines up with August 6, 1907.[98]

2) Flood of 1961

It took place between June 4 and August 21. Kerala had 2387 mm of rain, which is 50% more than the typical amount. Significant damage was done to the villages of Cherannalloor, Varapuzha, and Kodungallur, which are located on around 3,500 acres, 3,803 acres, and 3,862 acres of land, respectively.[99] In 1961, a year marked by abundant rainfall in Kerala, the town of Nilambur, although not as developed and renowned as it is today, reportedly experienced days of submersion due to the floodwaters from the formidable Chaliyar river.[100]

3) Flood of 1974

In 1974, there were floods in July and August when 2266 mm of rain fell. With 854 mm of rain, Idukki District had the most rainfall. Over 300 lives were tragically lost as a result of the disaster, leaving many homeless.[101]

Library (Thrissur, Kerala, India). It was given the title "Kanippayyur Notebook – I" since it was discovered in the Kanippayyur Library and had content similar to a notebook. The current author transcribed it, and Pavanapuri Research Centre (Guruvayur, Kerala) released it in November 2019.

[97] Iyer, Vinay. *The Comet of 1907 Mentioned in a Kerala Manuscript*. Pavanapuri Research Centre, 2019. p.1.

[98] Ibid. p. 2.

[99] Srija, P., et al. Op. Cit.

[100] Varma, Vishnu. "Kerala: Overwhelmed by First Flood in Half a Century, Nilambur Now Tries to Pick up Pieces." *The Indian Express*, 11 Aug. 2019, https://indianexpress.com/article/india/kerala-overwhelmed-by-first-flood-in-half-a-century-nilambur-now-tries-to-pick-up-pieces-5895535/.

[101] Srija, P., et al. Op. Cit.

4) Flood of 1992

On October 10 and 11 in the year 1992, the rain continued, resulting in significant flooding in the districts of Alappuzha, Kollam, and Trivandrum. The effect of a well-defined low-pressure system over Madhya Pradesh was blamed for this incident.[102] [103]

5) Flood of 2003

There was a monsoon that was below average in 2003. The monsoon came, although a week later than expected, in Kerala and certain areas of Tamil Nadu on June 8.[104] Kerala was hit by a flood on June 24th, 2003, and the area received 1722.6 mm of rain. This catastrophe, which affected 11 out of 14 districts (116 villages), was brought on by strong rainfall and landslides. In addition to damaging 488 homes, the flood tragically took the lives of 8 people.[105]

6) Flood of 2013

From June 1st to August 8th, landslides, flash floods, and waterlogging in several locations caused a flood. Kerala had a total of 2561.2 mm of rain.[106] The Aluva region was affected.[107] Over 20,000 homes were destroyed, 10,000 km of roads were damaged, and 30,000 people were forced to relocate to government relief camps as a result of the tragedy.[108]

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[102] Ibid.

[103] *India Floods Nov 1992 UNDRO Information Reports 1 - 2 - India | ReliefWeb*. 16 Nov. 1992, https://reliefweb.int/report/india/india-floods-nov-1992-undro-information-reports-1-2.

[104] *India: South West Monsoon 2003 - Flood Situation Report No. 19 - India | ReliefWeb*. 14 July 2003, https://reliefweb.int/report/india/india-south-west-monsoon-2003-flood-situation-report-no-19.

[105] Srija, P., et al. Op. Cit.

[106] Ibid.

[107] *Kerala Floods: Residents of Aluva Fear Repeat of 2013 Flood | Kochi News - Times of India*. https://timesofindia.indiatimes.com/city/kochi/residents-of-aluva-fear-repeat-of-2013-flood/articleshow/65359740.cms. Accessed 21 Jan. 2024.

[108] Srija, P., et al. Op. Cit.

7) Flood of 2019

On August 8, 2019, Kerala experienced a major flood as a result of monsoon-season heavy rainfall.[109] The India Meteorological Department issued a red alert in the nine districts in Northern and Central Kerala, an orange alert in three districts in Central Kerala, and a yellow alert in two districts in Southern Kerala as a precautionary measure due to the current severe rainfall.[110] Thousands of people have been taken to relief camps and safer locations.[111] [112] As of August 19, 2019, 121 persons had perished as a result of rain-related accidents.[113]

The floods of 1907, 1961, 1974, 1992, 2003, 2013 and 2019 are prominent chapters in the complex tapestry of Kerala's history, each with its tale of downpour, destruction, and resiliency. These incidents, which were marked by differing levels of precipitation and its aftereffects, have influenced the region's common memory. Kerala has seen smaller-scale floods in addition to the larger ones, which adds to the complexity of the state's flood history. The repercussions of these historic floods serve as a reminder of the resilience of the people and the necessity of continuous efforts in disaster management and preparedness, even as the state continues to struggle with the difficulties presented by its geographic location and regional climate patterns.

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[109] *Kerala Flood: Heavy Rains, Landslides Wreak Havoc in State; Red Alert Issued in 4 Districts - BusinessToday*. https://www.businesstoday.in/latest/trends/story/kerala-rains-heavy-rains-landslides-wreak-havoc-state-red-alert-issued-4-districts-219450-2019-08-08. Accessed 21 Jan. 2024.

[110] *Pinarayi Vijayan on X: "Heavy Rain Has Increased across Most Parts of the State. Red Alert Has Been Issued for 9 Districts in North and Central Kerala, 3 Districts in Central Kerala Are under Orange Alert and Remaining 2 Southern Districts Are Issued Yellow Alert. #KeralaFloods Https://T.Co/Ir2g7Hwwlu" / X*. https://twitter.com/pinarayivijayan/status/1159719778082181120. Accessed 21 Jan. 2024.

[111] "Death Toll in Flood-Hit Kerala Rises to 121, 40 Injured." *India Today*, https://www.indiatoday.in/india/story/death-toll-in-flood-hit-kerala-rises-to-121-40-injured-1582258-2019-08-19. Accessed 21 Jan. 2024.

[112] *Kerala Sees Heavy Rains: Many Areas Flooded, Hundreds Shifted to Relief Camps*. https://www.thenewsminute.com/kerala/kerala-sees-heavy-rains-many-areas-flooded-hundreds-shifted-relief-camps-106847. Accessed 21 Jan. 2024.

[113] Death Toll in Flood-Hit Kerala Rises to 121, 40 Injured." Op. Cit.

In summary, the first chapter of this dissertation explores the historical background of floods in Kerala as a whole, highlighting the complex interrelationships between natural and man-made disasters. The chapter goes through important incidents including the 1341 flood that shaped trade routes, the construction of the Mullaperiyar Dam that changed the landscape and how it led to the deluge of 1924, and also the 2018 flood which led to several loss of lives. Floods are classified as both man-made and natural disasters, and they are made worse by things like climate change and deforestation. The devastating floods highlight the need for comprehensive measures, taking into account dam failures, land use changes, and poor warnings, even with a disaster management strategy in place. The chapter highlights the dynamic link that exists between Kerala and its floods, telling the story of adaptation, transformation, and a continuous search for resilience that is sustainable. Kerala wants to improve its readiness for future floods by learning from previous ones.

In the upcoming chapter, the dissertation aims to shed light on the impacts of floods that occurred in Kochi, focusing on the flood of 2018. The inquiry will examine the underlying causes of the 2018 flood in Kochi, examine its complex effects, evaluate the fallout, and closely examine the preventive measures put in place to lessen similar incidents.

CHAPTER: 2

DELVING INTO THE HISTORY OF FLOODS IN ERNAKULAM WITH A SPECIAL FOCUS ON THE CATASTROPHIC DELUGE OF 2018

The destructive floods that ravaged Kerala in 2018, particularly impacting the thriving commercial hub of Ernakulam, stand as a poignant testament to the devastating power of nature. This introduction delves into the historical narrative of these catastrophic events, shedding light on the extensive damage and enduring disruptions experienced by the city's social and economic fabric. By unravelling the intricate web of circumstances leading up to and following the floods, this exploration aims to elucidate the myriad factors contributing to this calamity. From socioeconomic vulnerabilities exacerbating the flood's impact to climatic conditions precipitating its onset, each aspect of the narrative offers valuable insights into understanding its underlying causes. Additionally, the introduction underscores the areas within Ernakulam and its environs that bore the brunt of the flooding as it unfolded, painting a vivid picture of communities overwhelmed by the relentless force of rising waters. Moreover, it delves into the enduring repercussions that lingered long after the floodwaters receded, examining how they reshaped livelihoods, strained resources, and tested the resilience of the affected populace.

Following the floods that occurred in Ernakulam in 2018, the area saw a wave of support and unity from people all around the country. Communities banded together to help those in need by offering food, housing, and support, demonstrating the strength of compassion and solidarity during trying times. Governmental and non-governmental organisations, as well as volunteers, quickly mobilised relief operations, putting in endless hours to deliver vital services and aid in recovery. Nevertheless, despite the admirable fortitude shown by the locals, underlying problems including poor infrastructure, unplanned urbanisation, and environmental degradation were apparent, emphasising the necessity of sustainable development and catastrophe preparedness. Lessons from the 2018 floods acted as a spur for continued efforts to create a more resilient and fair future for Ernakulam and its people as the area started the long road to recovery.

ERNAKULAM: HISTORY, GEOGRAPHY, RIVERS, AND DAMS

Ernakulam is one of the 14 districts of Kerala with Kakkanad as its headquarters, is situated in the centre of the state, encompassing around 2,924 square kilometres and housing more than 9% of Kerala's population. Ernakulam is the commercial hub of Kerala, as well as a home to historic synagogues, mosques, and Hindu temples. Ernakulam, known for producing large amounts of income and being home to many different industries, is an important part of Kerala's economy.

Ernakulam is located on the northern edge of Thrissur, the eastern edge of Idukki, surrounded to the south by Alappuzha and Kottayam, and to the west by the Lakshadweep Sea, Ernakulam reflects a rich legacy that complements global advancements in industry and commerce. Ernakulam is frequently identified as a crucial part of Kochi, known as the Queen of the Arabian Sea, in historical accounts of Kerala.

The district of Ernakulam came into being on April 1, 1958, combining the taluks of Kanayannur, Kochi, Kunnathunadu, Aluva, and Paravur. After lengthy discussions in 1957 which took place in the Kerala Fine Arts Hall, which was populated by media, social, and political activists, led to the creation of the district.

According to Komattil Achutha Menon, the etymology of 'Ernakulam' links to a kind of mud known as 'Erangiyal,'. While others associate it with the name 'Erayanar' for Lord Shiva which was commonly seen in the Madras presidency during the early years. This later led to the origin of the word ‘Ernakulam”. It is also said that the term Ernakulam has been derived from the words "Ernakulathappan" (Lord Shiva) and "Kalam" (land), which reflects its cultural significance as a land dedicated to divine worship. The name ‘Kochi’ is an amalgamation of two terms, Koch and Azhi, which means small river mouth.[114]

The kingdom achieved unparalleled splendour when the regional king of Perumpadappu shifted the capital to Kochi from Mahodayapuram in 1405 AD. Then, he came to be known as the King of Kochi. The Portuguese traders, who took advantage of the regional disputes between the King of Kochi and Zamorin of Calicut, began to trade in Kochi. The King permitted the

[114] Menon, A. Sreedharan. *Kerala District Gazetteers - Ernakulam*.

Portuguese to open a warehouse and provided all the facilities. However, in 1663, the monarch, backed by the Dutch, drove them out. Gradually, the relationship between The Kochi king and the Portuguese traders deteriorated, and in 1663, with the help of the Dutch, the king was able to expel the Portuguese from Kochi. [115]

Today, Ernakulam is a vibrant metropolis full of life and action. Its skyline is dotted with modern skyscrapers, juxtaposed against the timeless charm of historic landmarks such as the Mattancherry Palace and the Paradesi Synagogue. The city's marketplaces and thoroughfares are crowded with vendors, shoppers, and visitors, adding to the bustle of everyday life on the streets.

In terms of the economy, Ernakulam is essential to the development of Kerala since it is the centre of several sectors, including manufacturing, IT services, tourism, and hospitality. One of India's busiest ports, Cochin Port, is a thriving hub for both domestic and international trade and commerce. The city has attracted investment and business activity due to its advantageous position and well-developed infrastructure.

Culturally speaking, Ernakulam is a kaleidoscope of customs and traditions, with a rich social fabric interwoven with literature, music, and art. Festivities such as Onam and Vishu are widely observed, drawing individuals from many backgrounds to savour the essence of harmony and companionship.

Ernakulam is not without its difficulties or challenges. It's infrastructure and natural resources are under stress due to the country's rapid urbanisation and population increase, which has resulted in problems including traffic congestion and environmental degradation. Furthermore, as demonstrated by the destructive floods of 2018, which severely damaged the city's infrastructure and population, the area is no stranger to natural disasters.

[115] *History | Ernakulam District Website | India*. https://ernakulam.nic.in/history/. Accessed 1 Jan. 2024.

Rivers

The two major rivers of Ernakulam are Muvattupuzhayar and Periyar, the latter of which passes through the taluks of Muvattupuzha, Aluva, Kunnathunad, and Paravur. These rivers are full during the rainy season, and significant floods impact the low-lying communities along their banks; but, throughout the summer, they usually dry out and become narrow.

1) Muvattupuzha river

The Muvattupuzha River, flows through Muvattupuzha in the Ernakulam district, giving the area a serene beauty. This river is the source of the town's name. Three words make up the term "Muvattupuzha": "Moonu," which means three; "Aaru," which means tiny river; and "Puzha," which means river. The Muvattupuzha River, as its name suggests, was created when the Kothamangalam, Kaliyar, and Thodupuzha rivers joined together. The combined waters of these tributaries form a single river that finally flows to the Arabian Sea via Vaikom Lake. The beginning of the river is located in the town of Muvattupuzha, and its approximate length is 121 km. Currently, this river is contaminated, and numerous campaigns have been launched to stop the pollution. The Muvattupuzha River is crossed by a very old bridge known as the Muvattupuzha Bridge. It is regarded as India's first concrete bridge. This river was used in the past for the transportation of products in wooden boats. This river is home to the well-known tourist attraction known as the Thommankuthu Waterfalls. In addition, a dam that spans the river was constructed for irrigation.[116]

2) Periyar River

The Periyar River is the longest river in Kerala, stretching 244 km, a status it proudly bears. This perennial river, known as the "Lifeline of Kerala," is an essential supply of drinking water. It starts in the Western Ghats' Sivagiri hills and winds its way through Periyar National Park before arriving at Periyar Lake. Its waters go further from this point on into the Vembanad Lake and, finally, the Arabian Sea. One significant diversion is when part of the lake's water is directed into the Vaigai River in Tamil Nadu via a tunnel. This river provides vital drinking water to the state's drought-affected

[116] *Muvattupuzha River | Rivers in Ernakulam | Kerala | Kerala*. https://kerala.me/environment/lakes-and-rivers/muvattupuzha. Accessed 1 Jan. 2024.

districts. An important part of water management is the Periyar Lake dam, which is maintained by the Tamil Nadu government under a bilateral agreement.

The Periyar is the main river in Ernakulam that has shaped the district's topography and has aided in its growth. Its flow is enhanced by notable tributaries such as the Edamala River, Muthirapuzha, Mullayar, Cheruthoni, and Perinjankutti. The Idukki Dam is built in this river. The Idukki Hydro Electric facility, the largest hydroelectric facility in Asia, is housed at the base of the Periyar River and is the cornerstone of hydroelectric power generation. The river's usefulness is increased by further dams, such as those at Neriyamangalam, Mullaperiyar, and Pallivasal. Regrettably, the discharge of industrial waste has led to pollution issues in the Periyar River. The trip of the Thattekad Bird Sanctuary, pilgrimage centres at Malayattoor and Aluva, and the birthplace of Sankaracharya at Kaladi are among the culturally and biologically significant locations along its banks that contribute to the rich tapestry of biodiversity and tradition.[117]

Dams

There are mainly three dams situated in Ernakulam. These dams can be seen in detail as follows:

1) Bhoothathankettu Dam

One of Kerala's most gorgeous dams is Bhoothathankettu. It is believed that bhoothams, or ghosts and spirits, constructed the area's natural defences, which are hills and woods. It is situated in the Ernakulam district and has some of the state's greatest trekking routes. This is an exciting place to go through the woodlands. Here, taking a boat trip is a lovely way to take in all of the breathtaking scenery. The fabled Salim Ali Bird Sanctuary at Thattekkad is not far away.

Nearby are the Periyar Valley Irrigation Project and the Idamalayar, the district of Ernakulam's two principal irrigation projects. In these regions, pedal boats and cruises are also accessible. About ten kilometres from Kothamangalam, it's a beautiful picnic area.

[117] *Periyar River | Rivers in Kerala | Kerala*. https://kerala.me/environment/lakes-and-rivers/periyar. Accessed 1 Jan. 2024.

Two major floods, one in the 4th century and the other in 1341, which broke open the port of Kochi, have been credited with building the Bhoothathankettu Dam. huge rocks are thought to have tumbled down from the mountain and become embedded in the Old Bhoothathankettu as a result of the flood's huge landslides.[118] [119]

2) Idamalayar Dam

The Idamalayar Dam is a multipurpose concrete gravity dam located on the Idamalayar, a tributary of the Periyar River in South India. It is prominently positioned at Ennakkal, between Ayyampuzha and Bhoothathankettu in Kerala's Ernakulam district.[120] After construction was finished in 1985, a multipurpose reservoir spanning 28.3 km² in the scenic Anamalais highlands was created by the dam, which measured 373 metres in length and 102.8 metres in height. In addition to being a beautiful landmark, the dam has a hydroelectric power plant that uses its reservoir storage to generate peak power. The power plant produces 380 GW·h of energy annually with an amazing installed capacity of 75 MW, which is made up of two units, each with a capacity of 37.5 MW.[121]

3) Kallarkutty Dam (Part of Neriyamangalam hydroelectric project)

As a part of the Neriyamangalam hydroelectric project, which spans the Muthirapuzha River, the Kallarkutty Dam was built in 1961. It is a 43-meter-tall gravity masonry dam that is 183 metres long. The reservoir has a 6.88 million cubic metre capacity and is 0.648 square kilometres in size.[122] Situated at Kallarkutty, the Kallarkutty dam is a component of the Neriyamangalam Hydro Electric Project. The construction of a dam at Kallarkutty over the Muthirapuzha river creates the reservoir for the Neriyamangalam Hydro Electric Project. The Sengulam and Panniyar power stations'

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[118] *The Hindu : The Magic of Bhoothathankettu*. 23 May 2003, https://web.archive.org/web/20030523024720/http://www.hinduonnet.com/2001/12/29/stories/2001122903250300.htm.

[119] Pillai, C. V. Raman. *Rama Raja Bahadur*.

[120] *Fact File on Dams Onwed by Kerala State Electricity Board*. https://expert-eyes.org/dams.html. Accessed 1 Jan. 2024.

[121] *Generation - Kerala State Electricity Board*. 6 Dec. 2010, https://web.archive.org/web/20101206145117/http://www.kseb.in/kseb/generation-kseb.html.

[122] *Dams In Idukki – Idukki*. http://idukki-district.com/dams-in-idukki/. Accessed 1 Jan. 2024.

tail race confluences are downstream of where the dam is being built. This reservoir receives the tail water from the Pallivasal, Sengulam, and Panniyar power plants, which are upstream projects. The Muthirapuzha basin's tail end is home to this reservoir. This reservoir is also affected by spills from upstream reservoirs Kundala, Mattupetty, RA Headworks, Anayirankal, Ponmudi, and Sengulam.[123]

Aa an important district in Kerala, Ernakulam is significant both historically and economically. Ernakulam is geographically located between Thrissur and Idukki, with the Lakshadweep Sea to the west and Alappuzha and Kottayam to the south. Important waterways like the Muvattupuzha and Periyar rivers help to create the region's topography, and dams like Bhoothathankettu, Idamalayar, and Kallarkutty support irrigation and energy production. But during the rainy season, low-lying towns along their banks have been severely impacted by floods, which are mostly caused by these same rivers and dams. Notwithstanding their contributions to the district's growth, it is stressed that efficient management and environmental preservation are necessary to lessen the negative impacts on the community.

2018 FLOOD IN ERNAKULAM

When heavy rains caused the Periyar River to overflow, Aluva struggled with flooding. The constant rain combined with the rising Periyar caused extensive flooding in the Aluva area of the Ernakulam district. Most affected residents were those who lived along the riverbanks, with around half of their houses being flooded. As a result, a great deal of people, including kids and senior citizens, were left stuck in their homes.[124]

The district's eastern areas were largely hit by the 2018 flood, which resulted in the flooding of many homes and businesses in Aluva, Paravur, and Perumbavoor. Based on a number of pertinent characteristics, our analysis showed that the taluks of Kothamangalam, Muvattupuzha, Kunnathunad, and Aluva, as well as a tiny portion of Kanayannur taluk, are the most vulnerable. The most severely affected regions encompass Perumbavoor, Karukutty,

[123] *KALLARKUTTY DAM – KSEB Limted Dam Safety Organisation*. https://dams.kseb.in/?p=154. Accessed 1 Jan. 2024.

[124] "Kerala Floods: Aluva Worst Hit in Ernakulam, Power Cut off for over a Day." *India Today*, https://www.indiatoday.in/india/kerala/story/kerala-floods-aluva-worst-hit-in-ernakulam-power-cut-off-for-over-a-day-1316565-2018-08-16. Accessed 2 Jan. 2024.

Eloor, Angamaly, Kalady, Malayattoor, Kothamangalam, Muvattupuzha, Piravam, and Koothattukulam. During times of severe floods, this predictive map is a useful tool for efficient planning and preventative measures in susceptible areas. Flooding in the district is mostly caused by the raised water levels at the Malankara Dam, Bhoothathankettu barrage, and Periyar Valley. The precision and accuracy of flood forecasts in the region are improved by taking these elements into account.[125]

Following heavy rainfall, parts of Ernakulam District (Rural) experienced significant flooding as rainwater inundated the Periyar, Chalakudi, and Muvattupuzha rivers. Overflow from drains and waterways extended over several kilometres, resulting in rising water levels in many areas. According to the Disaster Management Authority, seven villages were completely destroyed, with official reports from the district administration citing 28 deaths and three individuals sustaining serious injuries. In response, fishermen collaborated with the police force to rescue thousands of people and protect their belongings.[126]

The exemplary leadership and bravery of District (Rural) Chief of Police, Sri Rahul R. Nair, inspired the entire police force. Additionally, a 19-member team of diving experts from the Kerala Armed Police Battalion-I remained on standby for rescue operations. The police played a vital role in ensuring that donations from philanthropic organizations and government funds reached those most in need. Post-floods, the police undertook the monumental task of rebuilding, rehabilitation, and extensive cleanup efforts. Approximately 400,000 individuals were relocated to relief camps during the calamity.[127]

Causes of the flood

A 2021 report by the CAG revealed human factors contributed to the devastating Kerala floods of 2018. Lack of planning, infrastructure deficiencies like inadequate flood forecasting and reservoir capacity assessments, and changes in land use, like increased construction and reduced water bodies, were blamed for amplifying the floods' impact. Specifically in Kochi,

[125] Xavier, Rose Mary, et al. *Flood Hazard Vulnerability Mapping of Ernakulam District Using GIS and Remote Sensing*.

[126] *JANAMAITHRI - A JOURNAL OF DEMOCRATIC POLICING*. Vol. 11, Jan. 2019, p. 95.

[127] Ibid. p. 96.

experts pinpoint altered land use patterns, waterlogging, clogged canals, development on wetlands, and tidal influence as key factors contributing to the local floods.[128]

Unregulated Development and Lack of Risk-Informed Planning

As per the 2021 CAG[129] report, from 1985 to 2015, the built-up area in Ernakulam district surged by 212 percent while water bodies dwindled by nearly 17 percent, a trend implicated in exacerbating flood impacts. The report highlighted that such expansion of built-up areas coupled with a decline in water bodies worsens flood runoff, heightening inundation risks during heavy rainfall.[130]

Sekhar Lukose, Member Secretary of the Kerala State Disaster Management Authority, noted that Kochi city evolved without a risk-informed plan, citing the construction of a bypass road connecting Aluva to Edappally by Lulu Mall, which traverses low-lying lands unsuitable for development. Lukose emphasized that these areas were previously wetlands serving as natural flood buffers, cautioning against construction that obstructs natural water flow due to their geomorphological significance.[131]

Reshma Mathew, an independent architect based in Kochi, observed that many public infrastructure projects in the city are contractor-driven, diminishing the role of architects in the design process. Despite repeated drafts of a master plan, urban planners lament its lack of vision and implementation due to the involvement of multiple governing authorities in the city.[132]

Presently, Kochi boasts a corporation limit population of 677,381 within 94.88 km and a total urban population exceeding 2.1 million across 440 km, making it Kerala's largest and most populous metropolitan area. The city serves as the financial, commercial, and industrial hub of the state, boasting an extensive network of roads, railways, and waterways, along with critical

[128] Vohra, Supriya. "Risk-Informed Planning Essential to Prevent Floods in Kochi." *Mongabay-India*, 15 Sept. 2022, https://india.mongabay.com/2022/09/risk-informed-planning-essential-to-prevent-floods-in-kochi/.

[129] CAG: Controller and Auditor General

[130] Vohra, Supriya. Op. Cit.

[131] Ibid.

[132] Ibid.

infrastructures like Cochin Port and industrial parks, facilitating its status as a major economic center.[133]

Waterlogging, silt accumulation in water bodies, and obstruction of canals

Benjamin Pottas, a retired landscape architect and environmental planner with over 40 years of experience working with the state government, says that waterlogging stands out as a major issue in Kochi. Pottas, an expert in mapping wetlands, draws attention to Kochi's intricate system of canals and low-lying wetlands, stressing that constructing infrastructure over wetlands or highways over canals obstructs the natural flow of water from streams to backwaters and the ocean. As a result, Kochi regularly experiences waterlogging, which creates conditions akin to flooding. While Kochi's minor canals, which were originally floodwaters' natural drainage pathways, have severely deteriorated as a result of siltation and trash deposition, the city's principal canals are designed to handle small and medium-sized boats. Consequently, low-lying areas see noticeable floods and waterlogging throughout the rainy season due to their inability to efficiently drain water.[134]

Apart from pollution that clogs canals and backwaters, major waterlogging is caused by building debris from infrastructure projects, which creates conditions similar to flooding. The location near Don Bosco Kadavu, Vaduthala, where the Periyar River joins the Vembanad Lake, serves as an example.[135]

Controversy arose when the Cochin Port Trust built an overhead railway bridge between Edappally and Vallarpadam International Container Terminal between 2007 and 2011. Rail Vikas Nigam Limited (RVNL) was given the project, which involved employing AFCONS Infrastructure Ltd.,[136] a private infrastructure contractor. However, a temporary bund built for

[133] Ibid.

[134] Ibid.

[135] Ibid.

[136] Afcons Infrastructure Limited, headquartered in Mumbai, is a multinational construction and engineering firm operating in India.

piling construction close to the backwaters of Vaduthala impeded water flow, causing local fishermen to protest about the impact on their means of subsistence.[137]

Even after the project was finished in January 2009, the bund continued to exist, which led to complaints from nearby fishermen about its disruption of water flow and impact on their means of subsistence. Ten years later, in August 2018, the area saw its greatest floods ever recorded due to high tides and strong rains, leaving behind extensive destruction. Under the Social Welfare Action Alliance Society (SWAAS), Santhosh and other locals banded together to demand an investigation into the source of the flooding and subsequent action.[138]

The Periyar River blockage near the Vallarpadam bridge in Vaduthala was evaluated by an inspection carried out by the Kerala Engineering Research Institution (KERI). They found traces of drainpipes and concrete piers close to the railway bridge piers during their investigation. Furthermore, sediment deposition with a predominant composition of clay and silt—unsuitable for building or beach nourishment—was seen up to 1 km upstream and about 2 km downstream of the railway bridge. Of the 19 gaps that were inspected, only two were found to be suitable for country boats to navigate. KERI concluded in August 2021 that desilting the 780m overall width will improve the Periyar River's natural flow in their initial investigation report.[139]

The High Court gave the water resources department instructions on June 9, 2022, to form a "high-level committee" to look into the construction of the bund in Vaduthala and provide a report. There was then a conversation about who was in charge of clearing the debris. A committee appointed by the High Court on August 12 of that year examined the bund's formation and determined that it was caused exclusively by the railway bridge being built across the Vallarpadam Container Transhipment Terminal.[140]

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[137] Vohra, Supriya. “Risk-Informed Planning Essential to Prevent Floods in Kochi.” *Mongabay-India*, 15 Sept. 2022, https://india.mongabay.com/2022/09/risk-informed-planning-essential-to-prevent-floods-in-kochi/.

[138] Ibid.

[139] Ibid.

[140] Ibid.

Santhosh said to Mongabay-India, "Since 2020, we have been actively working on this issue. The irrigation minister is now the chair of a high-level committee that the High Court has established, and other members include AFCONS and Railway Vikas Nigam Ltd."[141]

Role of rivers

The Periyar River, originating in the Western Ghats and flowing entirely through Kerala for 244 kilometres, culminates in the Arabian Sea near Ernakulam. During heavy rainfall, the river surpassed its historically highest flood levels, inundating areas downstream of the Mullaperiyar Dam and the Periyar Barrage, notably impacting the city of Aluva situated along its banks.[142]

Luxury hotels like Hotel Periyar, Hotel Shirly's Homestay, and Ayurveda Resort in Aluva suffered significant losses due to flooding. Their basements, utilized for essential services such as storage, laundry, and security, incurred damage from sediment deposition, necessitating extensive cleaning and restoration efforts. These hotels remained closed for 10 to 15 days, resulting in an average loss of ₹40 to 50 lakhs per establishment.[143]

Cochin International Airport Limited (CIAL), located near Aluva, faced severe inundation, with water levels reaching 1.5 to 2 meters. The airport, renowned as one of India's busiest, experienced damage to its infrastructure, including the solar power system, boundary wall, electrical equipment, and duty-free shops. The closure of operations from August 14 to 26, 2018, led to an estimated income loss of ₹250 crore for CIAL and Kochi flight operators.[144]

Educational institutions like SCMS Cochin School of Business in North Kalamassery also suffered extensive damage, with floodwaters reaching depths of around 3 meters. Equipment and facilities, including computers, laboratories, and electrical systems, incurred losses totalling approximately ₹4–5 crores, with content damage alone accounting for ₹2 crores.[145]

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[141] Ibid.

[142] AIR Worldwide Corporation. *2018 Kerala Floods Learnings from the Post-Disaster Damage Survey*. July 2020. p. 6.

[143] Ibid.

[144] Ibid.

[145] Ibid. pp. 6-7.

Commercial establishments along the North Kalamassery area and Salem Kochi highway faced inundation, with water depths ranging from 0.5 to 1 meter. These businesses incurred losses of ₹2 to 5 lakhs each for debris removal, cleaning, and restoration efforts.[146]

Residential areas near the Periyar River, including Desam, Kalady, Perumbavoor, Kothamangalam, Chendamangalam, and Puthanvelikkara, experienced flooding with depths of 1.5 to 2 meters. Buildings in these areas suffered significant damage to contents, primarily furniture and major appliances, exacerbating the plight of residents affected by the deluge.[147]

FLOOD-AFFECTED AREAS OF ERNAKULAM

There are mainly 24 areas that was hit by the flood of 2018 and they are as follows:

1. Chengamanad
2. North Paravur
3. Vadakkekkara
4. Puthanvelikkara
5. Binanipuram
6. Angamaly
7. Aluva East
8. Aluva West
9. Nedumbassery
10. Njarackal
11. Perumbavoor
12. Kalady
13. Kuruppampady
14. Muvattupuzha
15. Ramamangalam
16. Kuttampuzha
17. Pothanikad
18. Piravom

[146] Ibid. p. 7.

[147] Ibid.

19. Eloor
20. Kalamassery
21. Thrikkakkara
22. Palarivattom
23. Cheranalloor
24. Varapuzha

1. Chengamanad

The highest number of fatalities within the Aluva sub-division occurred within the jurisdiction of the Chengamand police station. Collaborating with members of the Kunnukara panchayat, the police-initiated rescue efforts in the Ayiroorpadam Kuthiyathodu area. Road transportation was severely impacted by the overflow from the Periyar and Chalakudi rivers, beginning with heavy rainfall on the 6th. Despite temporary receding of waters, relief camps were reinstated on the morning of the 14th when water levels rose again, reaching their peak on the 15th due to overflow from the rivers and rising tides.[148]

Reports emerged of an individual stranded clinging to a tree in the Puthenthodu region. Police team courageously navigated the strong currents to rescue the young man using a boat. Though he faced near-drowning, his determination to persevere enabled his rescue.[149]

Telecommunications suffered complete disruption, leaving only a 15 km radius around the police station unaffected by rising waters. Relief operations were coordinated from this relatively secure zone.[150]

Twelve camps were established, and by August 17th, the water level had surged to a height of 12 feet. The collapse of St. Francis Church in Kuthiyathodu resulted in the tragic loss of six lives. Both entry and exit were impeded by strong undercurrents and flooding in the area on the 17th and 18th. On the morning of the 19th, a collaborative

[148] Ibid. p. 102.

[149] Ibid.

[150] Ibid.

effort involving personnel from the army, Puthanvelikkara police, and Chengamanad police reached the site of the collapsed church at 2:30 am, successfully recovering two deceased individuals. The following evening, two more bodies were retrieved, with the army's dinghy boats proving invaluable in these operations.[151]

2. North Paravur

The area was severely flooded, rendering road transport impossible and causing isolation. In response, 31 camps were established, but six of them were affected by the floods, necessitating the relocation of the inmates to other camps. Additionally, the floods washed away the pillars of the Chemmayam bridge.[152]

Remarkably, during this crisis, a single individual took on the role of coordinating with multiple people and departments, displaying exceptional leadership qualities. The distress experienced in the affected area was likened to the catastrophic deluge of 1924, resulting in two casualties. Coordination efforts were paramount, and the police assumed full responsibility for rehabilitation and the distribution of relief materials.[153]

Rescue operations extended beyond the immediate vicinity, reaching into the Kongorpilly region within the Binanipuram station limits. Boats and lorries were utilized to conduct these operations, with coastal police assistance in boat patrols and food distribution. The police also undertook the task of burying deceased animals and providing drinking water to affected areas. Additionally, 100 Onam kits were distributed for the state festival.[154]

On August 16th, when several camps were affected by the floods, approximately 8,000 people were transported to three camps located in Ernakulam, Kalamassery, and the Infopark.[155]

[151] Ibid. p. 103.

[152] Ibid. p. 101.

[153] Ibid.

[154] Ibid.

[155] Ibid.

Relief workers successfully evacuated approximately 6,500 individuals from Alangad, Binanipuram, and Karingamthuruthu. The navy played a crucial role in rescue efforts in the Pizhala region.[156]

On August 17th, over 1,200 individuals, including pregnant women, children, youth, and elderly individuals, who had been stranded for more than 72 hours without sufficient food at the Kovoor Kongorpilly HSS, were rescued. This operation utilized available boats and vehicles, coordinating the efforts of local residents and other volunteers. Unfortunately, some food supplies were stolen during this chaotic period. Additionally, utensils stored in a Christian church for a festival were pilfered, but with police assistance, these items were recovered and returned.[157]

Boat-based rescue operations were conducted in various locations including Puthenpally, Valanad, SNDP Junction, Varapuzha, Koonammavu, Chanthapadi, and Kocharal. Most fishermen, who constituted the majority of the population in these areas, had already evacuated using small boats. The police were provided with a jankar to aid in their operations.[158]

3. Vadakkekkara

The water level inside the police station rose to four and a half feet. Before the situation became critical in Veliyaperumballithuruthu and Cheriyaperumballithuruthu on the morning of August 15th, individuals were relocated to relief camps. Dealing with a continuous influx of false alarms and messages proved to be a persistent challenge for the police. Unfortunately, four fatalities occurred in the relief camps. Despite being rescued by an army helicopter, an individual later succumbed to the currents at Chendamangalam bridge. Collaborating with the army, fire department, NDRF, and local volunteers, the police conducted relief efforts in Chendamangalam, Thattukadavu, and Chittethukara areas. Due to the overwhelming number of people seeking assistance,

[156] Ibid.

[157] Ibid.

[158] Ibid.

the police focused on coordinating relief and rescue operations rather than directly engaging in rescue efforts. Additionally, amidst the floods, the police were tasked with investigating cases of theft, including incidents involving goats.[159]

4. Puthanvelikkara

Puthanvelikkara village is believed to have been shaped by the receding force of powerful tides, primarily affecting the flood-prone areas of Paravur taluk. Situated at the convergence of the Chalakudy river with the Periyar in Elenthikara, Puthanvelikkara finds itself nestled along the banks of the Chalakudy, Periyar, and Kottappuram backwaters. The inundation caused by surging tides and relentless heavy rainfall submerged not only the police station but also the surrounding areas. Water levels within the police station surged to a staggering five feet above ground level when the flooding commenced on August 15th.[160]

Despite facing personal challenges, such as attending to his own child at the hospital, S.H.O.[161] E.V. Shibu promptly returned to the station upon the directive of the district (Rural) Police Chief. He ensured the immediate relocation of equipment and files to the station's top floor, along with the telephone and related instruments, allowing the station to continue functioning from that elevated position. Shibu's directive to document all flood-rescue-related calls in writing was meticulously followed. Additionally, a WhatsApp group named 'Ready to Move' was established, comprising leaders of people's organizations and panchayat members.[162]

Nine relief camps were established initially, but due to flooding, six of these camps were affected, necessitating the relocation of inmates to other camps. The flooding within the station limits commenced on the 15th, with water receding only around the 20th.[163]

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[159] Ibid. p. 100.

[160] Ibid. p. 98.

[161] SHO: Station House Officer

[162] *JANAMAITHRI - A JOURNAL OF DEMOCRATIC POLICING*. Op. Cit. p. 98.

[163] Ibid. pp. 98-99.

Rescue operations were conducted utilizing a boat procured by the Munambam S.I. Residents of the Fatima Mata church at Cherukada were rescued using smaller boats. Tragically, six individuals lost their lives when the hillocks surrounding the St. Francis church in Kuthiyathodu, within the Chengamanadu station limits, collapsed. Responding to a request from the Chengamanad S.I., a collaborative effort involving local police, navy personnel, coastal police, and the army was initiated to conduct combing and rescue operations in the area.[164]

Inmates of the Karunyalayam Home for Nuns and the Aged were safely relocated to shelters. H.S.A. Murali demonstrated exceptional resolve by transporting a snake-bite victim via boat and police vehicle to the Little Flower Hospital in Angamaly, overcoming numerous obstacles. The commendable efforts of Rino from K.AP. 1 and Umesh, CPO of Puthanvelikkara station, during the rescue operations were noteworthy.[165]

Regrettably, three fatalities occurred within the police station limits during the floods, and police officers involved in rescue operations faced challenges such as skin infections and other minor hazards.[166]

A WhatsApp group named 'Kochuveedu' (Small Cottage), consisting of both police officers and local residents, was established with the aim of reconstructing thirty homes that were devastated by the floods. To date, ten of these residences have been successfully rebuilt. Furthermore, after a thorough police investigation, a sum of two hundred thousand rupees, which had gone missing from a relief camp, was recovered.[167]

[164] Ibid. p. 99.

[165] Ibid.

[166] Ibid.

[167] Ibid.

The police made concerted efforts to facilitate the return of lost boats and cattle to their rightful owners. Additionally, they provided assistance in organizing the final rites for those who perished in the floods.[168]

Sister Federick expresses her heartfelt appreciation for the assistance provided by A.S.I. Shibu, H.S.A. Balakrishnan, C.P.O. Umesh, and others. They courageously rescued and transported elderly women and nuns, including Sister Federick herself, who weighs over a hundred kilograms, from the Karunyalayam Old Age Home in the jurisdiction of the Puthanvelikkara police station. Despite being in neck-deep water, they carried them on their shoulders and backs to safety in relief shelters.[169]

While the army and navy officers involved in the rescue operations were dedicated teams equipped and trained for emergencies, the Kerala Police, lacking such specialized training and equipment, admirably rose to the occasion. They relied on the assistance of ordinary citizens and whatever resources were available to rescue those stranded, earning praise from the entire populace of the state.[170]

5. Binanipuram

In the Binanipuram police station jurisdiction, severe flooding affected areas such as Kadungallur East, Kadungallur, Panaikulam, Kongorpilly, and Muppathedam, resulting in extensive damage to thousands of residences. While most places were inundated, the police station remained unaffected by the floodwaters. Various types of boats, including dinghies, Taurus boats, and small country boats, were utilized for rescue efforts. Approximately 10,000 individuals sought shelter in relief camps, where tragically, two women lost their lives, and one youth tragically took his own life due to the distress caused by rising water levels. Communication networks became non-operational, contributing to challenges in coordinating relief efforts.[171]

[168] Ibid.

[169] Ibid. p. 100.

[170] Ibid.

[171] Ibid. p. 103.

Despite facing minor law and order issues stemming from disputes, the police diligently conducted relief operations, with some officers opting to work without their uniforms. This led to misunderstandings regarding the police's involvement in relief efforts. Upon receiving complaints, the police investigated and arrested nine individuals involved in illicit activities, including the misappropriation of relief materials from the Consumer fed go down and price gouging by merchants.[172]

Following the floods, the community organized ceremonial events to express gratitude and honour the efforts of the police force. Collaborating with the armed police and voluntary organizations, the police actively participated in cleaning affected households and facilitating the transportation of essential supplies to relief camps, thus playing a significant role in post-flood rehabilitation efforts.[173]

6. Angamaly

In the Angamaly police station jurisdiction, elevated water levels were observed in the Mambra, Elavoor, and Paalupuzha areas within the Parakadavu panchayat, as well as in the Angamaly municipality, Peechanikad, and Thuruthu. Despite warnings, four households in the Ezhatumukham locality refused to evacuate, necessitating their forceful removal to safer areas. Regrettably, their homes were subsequently engulfed by the rising waters. Additionally, a shop in Angamaly provided relief by distributing food and essential supplies worth approximately two lakhs.[174]

Moreover, concerns arose regarding the obstructive nature of the pavements constructed along both sides of the Manjali canal within the Angamaly station limits, impeding the natural flow of water.[175]

[172] Ibid. pp. 103-104.

[173] Ibid. p. 104.

[174] Ibid. p. 104.

[175] Ibid.

7. Aluva East

The floods completely isolated the Thuruthu, Iliyanoor, and Kunjunnikara areas within the jurisdiction of the Aluva East police station. Additionally, Companypady, Thottumukham, and Keezhmadu regions were inundated.[176]

On August 17, 2018, C.P.O. Rajeev, stationed at the Aluva East police station, undertook a daring rescue mission. He saved an entire household comprising two septuagenarian women, two elderly men, two children under the age of ten, and a housewife who were stranded on the upper floor of a house in Manuppuram, Thottukattukara. While transporting them to safety, their boat capsized near the camp office, trapping them in eight-foot-deep water. Displaying remarkable courage, C.P.O Rajeev dove into the water, rescued an old man and a child, and secured them on the ledge of a wall. He then managed to tie the capsized boat to a post and used the rope to assist two elderly individuals and the housewife to reach safety. Subsequently, he swam with one of the elderly men on his shoulders to a nearby flat. Despite the perilous conditions, he selflessly provided his life-jacket to the family for their safety. Rajeev and Faisal, the head of the household, found shelter only after two and a half hours of relentless effort.[177]

Furthermore, CPOs Rajeev and Sudheer, along with several others, rescued an eight-month pregnant woman who had been stranded for three days in a flat on Thailoth Road. They carefully transported her, seated in a tire-tube, through neck-deep water to the hospital.[178]

8. Aluva West

The water levels surged significantly in various areas under the jurisdiction of the police station, including Mambra, Naalucentu colony, Veliyathuruthu, Karumallur, Purapillykavu, Manjali, Mattupuram, Kottappuram, Alangad, Tiruvallur, Malikampeedika, Cherthanad, and Neethikodu, leading to complete isolation.

[176] Ibid.

[177] Ibid. pp. 104-105.

[178] Ibid. p. 105.

Approximately 95% of the region within the police station limits was submerged, with only the roads from Cherai remaining accessible.[179]

To mitigate the risk of spreading contagious diseases, measures such as distributing preventive medications and conducting awareness sessions were implemented with the assistance of the medical team based in Parur. Cleanup operations for flood-damaged homes belonging to both civilians and police personnel were coordinated from the police station. Unfortunately, one residence within the station limits was completely washed away by the floodwaters. Recognizing the urgent need for housing, the police took the initiative to construct three houses for those in need.[180]

Despite the disruption caused by the floods, the spirit of community remained strong. Festival celebrations at the Marad church, which were postponed due to the floods, were carried out in relief camps, where the police played a crucial role in distributing food and ensuring the continuation of traditions.[181]

9. Nedumbassery

On August 16th, heavy rainfall commenced within the police station limits, affecting most areas including Avanamkodu, Thuruthisseri, Nayathodu, Thuravumkara, Chovvara, Kondotty, Pattoorkunnu, Colonybhagom, Athani, Moozhiyar, Akaparambu, Aarucentucolony, and Kuzhupallom colony, leading to widespread flooding. When the Chengal canal overflowed near the Coast Guard Quarters in Thuravumkara, the police promptly responded by deploying boats to rescue stranded individuals. In the vicinity of Chengalthodu, the water levels surged to approximately eight feet, causing the eastern walls of the International Airport to collapse under the force of the currents, resulting in water inundating the airport premises. Amidst the rescue operations, the police successfully rescued a group of eight individuals whose boat had capsized in the

[179] Ibid.

[180] Ibid. pp. 105-106.

[181] Ibid. p. 106.

strong currents. A total of 9406 people from the affected region were rescued and relocated to safer areas.[182]

10. Njarackal

Njarackal is characterized by its diverse geographical features, encompassing coastline, backwaters, and rivers, making it a haven for fisherfolk. Collaborating with the police, they played a crucial role in rescuing numerous individuals. Within the station limits, areas such as Kuzhipilly, Vachakkal, Aniyal, Nedungad, Puthenkadappuram, Kudungassery, Valiyavattam, Manjanakad, Arattuvazhi, Perumpilly, Elamkunnapuzha, Pallampilly, Pookad, Karuthedam, Ochenthuruthu, and Valappu experienced particularly high-water levels.[183]

Tragically, Midhun Kumar, a youth involved in rescue efforts, went missing after his boat capsized. In response, Station Inspector M.K. Murali mobilized fisherfolk in 35 boats to assist in rescue operations across other station limits, in collaboration with coastal authorities.[184]

An unidentified boat, previously safeguarded in the station following the Ockhi storm, proved instrumental in rescue efforts. A total of 250 individuals, including 34 police personnel, participated in these operations. With 56944 people from 17303 households seeking shelter, 43 camps were established, where around 2000 persons were rescued. Given the area's vulnerability to sea-related threats, permanent relief camps were established at village offices in Nayarambalam and Elakunnapuzha within the station limits.[185]

11. Perumbavoor

In the Perumbavoor station limits, the floods severed access to areas like Ockalthuruthu, Parappuram, Vallam, Rayonpuram, South Vallom, and Kochangadi. Additionally,

[182] Ibid.

[183] Ibid.

[184] Ibid. pp. 106-107.

[185] Ibid. p. 107.

water levels surged in Chelamatton, Thannipuzha, Mudickal, Paathipalam, Thandekad, Palakkatuthazham, Kandenthara, and Saddam Road, submerging all roads except the Perumbavoor-Kothamangalam MM Road. The inundation persisted from the 14th to the 18th of August.[186]

Despite warnings, residents of double-storey houses in Chelamattam, Perumattam, South Vallam, Onampilly, Mudickal, and Madampilly refused to evacuate, necessitating rescue efforts on the 16th and 17th. Approximately twenty vehicles, including navy boats, tippers, and Taurus lorries, were deployed for assistance. Due to water ingress, six out of eighteen relief camps had to be relocated.[187]

Parts of the station limits bounded by the Periyar River experienced overflow, causing some damage. Reports emerged of individuals stranded near the Chelamattam temple. Subsequently, SI Faisal led a daring rescue mission, utilizing a fishing boat to reach the location despite strong currents, successfully evacuating all stranded persons, including two pregnant women who were promptly transferred to a hospital.[188]

The media highlighted the courageous actions of Perumbavoor Crime Branch Sub-Inspector Soofy, who participated in rescue efforts in the Vaarapetty Inchiyoor region along the Periyar, wearing nothing but a towel as a makeshift loin-cloth.[189]

Witnessing slow progress in rescue operations in Kalady, Inspector Baiju Paulose took the initiative to mobilize fishing boats from Alappuzha. On the 17th, Sub-Inspector Soofy, along with two fishermen, distributed food supplies in the hardest-hit areas of Kalady, reaching houses isolated by the floods. A total of 28 relief camps operated within the Perumbavoor station limits, with police maintaining a continuous presence to oversee activities such as cleaning and food distribution.[190]

[186] Ibid.

[187] Ibid. pp. 107-108.

[188] Ibid. p. 108.

[189] Ibid.

[190] Ibid.

12.Kalady

In the Kalady station limits, flooding isolated several areas including Malayattoor, Nileeshwaram, Kottamam, Mekaladi, Kalady station, Kaipattoor, Manikyamangalam, Kalady town, Chengal, Kanjoor, and Thettali. Extensive property damage occurred in Madurima junction, Naduvattam, and Companypadi areas. Consequently, 39 relief camps were set up, with three of them relocating inmates due to rising water levels. Floodwaters began to rise in the Kalady region on the evening of the 14th, prompting the relocation of files, weapons, and equipment from the police station to a safer location by the night of the 15th. A navy boat arrived for rescue operations on the evening of the 16th, followed by boats from Alappuzha on the 17th. By the evening of the 18th, the water began to recede, leaving houses surrounded by dirt approximately two and a half feet high.[191]

With rivers altering their courses, nearly all roads were submerged, halting transportation. Additionally, the bridge near the Federal Bank on the road to Kanjoor was completely destroyed. The Kalady police station was submerged under nearly six feet of water for a period. Some incidents related to alcohol consumption occurred in a few camps. CPO Robin, involved in rescue operations, suffered a snake bite and received treatment. CPO Joshi underwent surgery for an eye injury, while CPO Anil sustained a grievous leg injury.[192]

On the 15th, when floodwaters rose significantly in the station limits, road transport against the current became impossible. The number of people stranded in houses increased, leading to a surge in requests for help and relief. Both the police and the public collaborated to rescue the stranded individuals using available resources, including oversized cooking utensils.[193]

[191] Ibid.

[192] Ibid. pp. 108-109.

[193] Ibid.

13.Kuruppampady

In the Kuruppampady station limits, the floods isolated several areas including Panamkuzhy, Krariyeli, Kochupurackal Kadavu, Society Paalam, Paaniyeli, Mekkepaala, and Asamanoor. Additionally, landslides occurred at two locations in the Ponginchuvadu Adivasi colony, resulting in the destruction of the bridge within the colony due to flooding.[194]

14.Muvattupuzha

Located approximately 300 meters from the banks of the Muvattupuzha river and standing at an elevation of about 10 meters above the water level, Muvattupuzha experienced severe flooding during the recent calamity. Triggered by overflowing rivers—Thodupuzha, Kaliyar, and Kothayar—along with heavy rainfall and rising tides, the waters surged beyond the municipal bridge.[195]

In the affected areas within Muvattupuzha municipality, including Thottunkalpeedika, Pallikavu, Petta, Latha Stand, Kizhakkekara, Maniamkulam Kavala, Randar, 130 Junction, Murickallu, Kavumpady Road, Kaacherithazam, Kitcheripadi, Vellooorkunnam, and Vazhapilly, devastation was widespread. Similar damage was reported in Arakuzhi panchayat areas such as Thottakara, Arakuzhi Panchayat office region, Vallikada, Peringazha, and Perumballoor, as well as in Avoli Panchayat area covering Rackad, Mekadambu, Cheriya Oorayam, Valakam, Peruvamoozhi, and Avunda. Additionally, Perumattambhagom in Kunnakkal Panchayat was affected.[196]

The water level reached up to 5.8 feet, inundating Muvattupuzha town following the onset of heavy rains on the 15th. Sadly, six fatalities were recorded during this period. Amidst perilous conditions, Sub-Inspector Yakub displayed remarkable courage,

[194] Ibid.

[195] Ibid. pp. 109-110.

[196] Ibid. p. 110.

rescuing twelve individuals after being thrown overboard by an air-boat collision, using only a sturdy rope.[197]

15. Ramamangalam

In the Ramamangalam area, including, Kizhumuri, Ooramana, Vettithara, and Nettipalam, the floods completely isolated the communities. The suspension bridge connecting Ramamangalam to Thammanimattam was destroyed. Ramamangalam police undertook the rescue of approximately 45 individuals. On August 15th, the Muvattupuzha River began overflowing, leading to the isolation of 14 houses in Kayanadu, Maradi Panchayat. The river split into two, affecting around twelve houses in Ooramana. By the night of the 16th, water had entered the police premises, prompting the relocation of documents and equipment. In Attukuzhi, police rescued a family, including a husband, wife, their son, and a two-year-old child, using a fibre boat.[198]

16. Kuttampuzha

In the Kuttampuzha region of Kothamangalam taluk, a forested area, resides 18 Adivasi tribes along with various other communities. Among the severely affected areas by the floods are Inchathotty, Pooyamkutty, and Chappath. Despite the availability of boats previously, they had deteriorated due to lack of regular maintenance and use. The prompt and effective action by the police played a crucial role in mitigating the flood's impact. However, due to the dispersed nature of Adivasi families across a 40-kilometre stretch, rescue operations posed challenges for the police. As police jeeps couldn't access these remote regions, private jeeps and other means of transportation were relied upon. Areas like Manikandanchaal, Kallelimedu tribal colony, and Wariyam were completely isolated, making it impossible for police intervention. Inchathotty, Manikandanchaal, and Vellaramkunnu suffered flood damage, with Chappath submerged entirely. The floods also led to extensive crop damage, and sadly, two fatalities occurred as a result.[199]

[197] Ibid.

[198] Ibid. pp. 110-111.

[199] Ibid. p. 111.

17. Pothanikad

Floodwaters inundated the areas of Valloor, South Punnammatom, Pothanikad, Pulinthanam, Kadumpidi, West Punnammatom, and Vallakadavu. Back in 2013, seven individuals lost their lives due to a landslide. The three-story building erected near the police station to serve as a refuge for disaster-affected individuals following that incident proved highly beneficial during the recent floods.[200]

18. Piravom

Thottabhagom, Mulakkulam, Kakkad, Kalmboor, and Palachuvaddu areas within the jurisdiction were completely submerged. Surrounding the Piravom police station, water created a barrier. All major roads were underwater, halting transportation. The river overflowed, reaching the backwaters three kilometers away. Evacuating residents became even more challenging when the dam shutters were opened on the night of the 16th. Twelve canoes and two boats were deployed for rescue operations. Severe damage occurred in two or three wards. Thanks to the successful implementation of the Janamaithri program, relief efforts proceeded smoothly. Responding to a call for help from Dr. Sunil, who worked at Piravom Government Hospital, police found water levels had risen above the first floor of his home. The doctor's family was safely evacuated, and in the following days, Dr. Sunil joined police in providing medical assistance to the sick and injured in camps. Kalady police took charge of cleaning four roads, twelve anganavadis, and approximately 150 houses. Piravom station police led efforts to construct two houses for displaced individuals.[201]

19. Eloor

Anticipating potential flooding, eight camps were established in the area by the 10th. By the 13th, except for two camps, all others were closed as the water started to recede after two days. Despite this, the Janmaithri police held public meetings to discuss preparations in case the Idukki and Edamalayar dams' shutters were opened. Citizens

[200] Ibid. p. 112.

[201] Ibid.

were advised to be ready for evacuation if necessary. On the 14th, the Municipality organized a meeting involving all departments to implement precautionary measures.[202]

In the jurisdiction, 30 out of 31 wards were impacted by rising water, affecting 80% of the area. Five houses were completely destroyed, and 845 residences suffered partial damage. Police led efforts to clean 127 houses and chlorinate public roads. Collaborating with volunteers, they arranged for electricians to repair 110 homes, and approximately 30 houses were reconstructed.[203]

20. Kalamassery

The Kalamassery area in Ernakulam district bore the brunt of the floods. The most severely affected areas included NAD, Vidaakuzha, and Edapally. Upon receiving a warning from the City Police Commissioner on the 6th regarding the likelihood of heavy rainfall and floods, the Municipal Chairperson convened a meeting on the 7th to address the situation. This led to the initiation of rescue operations and coordinated efforts. The collective involvement of the public proved crucial in saving many lives from peril.[204]

To streamline operations, a temporary control room was established at the Pathadipalam Guest House, manned by a three-member team. Nine rescue teams were put on standby at the police station. Responsibilities related to relief and rescue were divided into two groups: one focused solely on rescue operations, while the other handled evacuation, camp security, food provision, and patrolling. Approximately 18 camps were established in the area, accommodating around 3,000 individuals. Unfortunately, two fatalities occurred.[205]

Despite their efforts, the police faced challenges, including encounters with rudeness from the public and difficult situations when rescuing individuals trapped in

[202] Ibid. p. 113.

[203] Ibid.

[204] Ibid.

[205] Ibid. pp. 113-114.

apartments. When flooding affected relief camps in Cheranalloor, North Parur, Aluva, and Eloor, the occupants were relocated to the 18 camps in the Kalamasseri area, with the assistance of police vehicles and school buses.[206]

21. Thrikkakara

In the Thrikkakara area, flooding affected several neighborhoods including Balan Menon Nagar, Cherumattapuzhakara, Thuthiyoor, Kariyil colony, and Keerelimala. The flow of water inundated 19 houses in Kariyil colony, while concerns arose for the safety of residences in Keerelimala due to the absence of concrete walls, increasing the risk of landslips. To address the situation, police collaborated with revenue authorities to identify suitable locations like schools and other buildings for use as relief camps, a proactive measure that helped minimize the impact of the floods.[207]

Landslides occurred in the Keerelimala region, prompting the mobilization of necessary resources including rescue and relief equipment, medical teams, fire services, revenue officials, volunteers, and municipal councilors. When flooding submerged camps in Cheranalloor, Eloor, and North Parur, occupants were evacuated to 28 camps within the Thrikkakara area. Additionally, police took the lead in coordinating cleaning efforts in various colonies, public spaces, relief camps, and dwellings across Kariyila colony, Koikkarapaadam, Parur, and the Pathalam region, with support from community members and voluntary organizations.[208]

22. Palarivattom

In the Paralivattom area, the hardest-hit regions included Chalikavattam, Vennala, Koothapaadi, and Ponnurunni. Thanks to the prompt and effective efforts of both law enforcement and community members, relief operations were conducted smoothly and safely, preventing any loss of life. A total of 3147 individuals sought refuge in relief camps, many of whom had been evacuated from areas falling under the jurisdiction of

[206] Ibid. p. 114.

[207] Ibid.

[208] Ibid. pp. 114-115.

other police stations. The Palarivattam police station served as a central hub for collecting food supplies.[209]

23. Cheranalloor

Similar to neighboring regions, the continuous heavy rainfall and escalating water levels brought severe distress to the Cheranallooor area. Within this vicinity, there were nine relief camps established, facilitating the evacuation of approximately 7000 individuals. Due to the challenging conditions, rescue and relief efforts via roadways were rendered impractical. Abdul Jaleel, residing near the Indraji Nagar bridge, courageously plunged into the water to rescue two migrant laborers. Tragically, while attempting to extricate himself from the water after their rescue, he succumbed to drowning, with his body recovered two days later.[210]

24. Varapuzha

Varapuzha was among the many areas of the Ernakulam district that experienced devastation and displacement as a result of the 2018 flood. Varapuzha, which is located along the banks of the Periyar River, was severely flooded as the river overflowed its banks and buried residential neighbourhoods and low-lying areas. Floodwaters swept into residences, places of business, and agricultural land, severely damaging livelihoods and infrastructure. Varapuzha, a town renowned for its thriving markets and lively population, came to a complete halt as its citizens struggled with the disaster's repercussions.

The flood had a wide-ranging effect on Varapuzha's citizens, impacting many facets of their everyday lives. Numerous families were left homeless and in danger after their homes were destroyed or severely damaged. Significant damages were incurred by businesses, causing shops and markets to flood and interrupting livelihoods and economic activity. A major industry in Varapuzha, agriculture suffered greatly as a result of soil erosion and waterlogging, which damaged crops and rendered farmlands worthless.

[209] Ibid. p. 115.

[210] Ibid.

In Varapuzha, the flood also presented issues with public safety and health. Emergency response activities were impeded by the disruption of key utilities including transport and electricity, and there was a risk of waterborne infections from contaminated floodwaters. In addition, the tragedy had a profound psychological impact on the neighbourhood as its members struggled with shock, bereavement, and future uncertainty.

Varapuzha's citizens banded together following the flood to repair and recover from the destruction. Relief, shelter, and rehabilitation for those impacted were made possible in large part by community-led projects supported by governmental and nonprofit institutions. There was an attempt to rebuild damaged infrastructure, bring back critical services, and put policies in place to lessen the likelihood of floods in the future. The inhabitants of Varapuzha persevered and showed unity in the face of adversity as they attempted to reconstruct their lives and bring their cherished village back to life. The aftermaths of flood in Varapuzha can be seen in the upcoming chapter as well.

The devastating flood of 2018 left a profound impact on the Ernakulam district, affecting numerous areas including Chengamanad, North Paravur, Vadakkekara, and many others listed above. From submerged homes to damaged infrastructure, the flood wreaked havoc on the lives and livelihoods of residents across these 24 areas. In the aftermath of the disaster, communities came together to support one another, demonstrating resilience and solidarity in the face of adversity. While the road to recovery has been challenging, efforts to rebuild and restore these flood-affected areas continue, driven by a collective determination to overcome the aftermath of the calamity. As these communities work towards recovery, the lessons learned from the 2018 flood serve as a reminder of the importance of disaster preparedness, infrastructure resilience, and community cooperation in mitigating the impact of future disasters.

OTHER IMPACTS

According to the residents of the Ernakulam district, two bridges damaged in the 2018 floods, which cut off the hamlets of Kunjipara, Thalavechupara, Variyam, Vellaramkuthu, and Meenkulam from the mainland, need to be rebuilt. The District Legal Services Authority (DLSA) conducted a survey recently, and the results showed that these tribal villages' quality

of life has been significantly damaged by inadequate road connectivity. In addition, they are pushing for an adjustment to the LIFE Mission project's[211] allotment for building houses, pointing to the rising expenses associated with delivering building supplies to their isolated hamlets. Residents are asking an increase to ₹8 lakh per unit because they believe the existing allotment of ₹6 lakh per unit is insufficient. In addition, a number of homeowners are still waiting on reimbursement for damage to their homes caused by the floods, and money meant for upkeep of homes built as part of the LIFE Mission project has not yet reached a number of households.[212]

DLSA Secretary N. Renjith Krishnan presented the survey results to Minister K. Radhakrishnan, who oversees the welfare of Scheduled Castes, Scheduled Tribes, and Backward Classes. The survey was carried out by a group of thirty volunteers from the National Service Scheme Unit 5 of the Cochin University of Science and Technology, under the direction of S. Aparna Lakshmanan, the programme officer. Because store owners, who were formerly rewarded by the State government for such deliveries, have stopped offering doorstep delivery services, tribespeople are having difficulty obtaining foodgrains from ration shops. The tribespeople now have to travel great distances to obtain ration supplies, which has increased costs and caused difficulty. The survey brought to light additional urgent concerns, such as the need to repair the deteriorating Uriyampetti anganwadi building, the state of the roads, the need for reliable power and water supplies, the need for fully functional hospitals, and incidents of conflicts between people and wildlife.[213]

The flood had a major impact on education because it made kids anxious about their safety, which caused emotional tension in them. While many youngsters in rescue camps battled to discover means of reducing their vulnerability, many others were obliged to stay at home, fearing for their safety. Furthermore, schools that served as relief hubs sustained significant

[211] The Government of Kerala's LIFE Mission (Livelihood Inclusion Financial Empowerment) aims to give all homeless individuals in the state jobs for a living and to participate responsibly in social activities within the next five years. The objective is to provide all social welfare benefits, including financial services, and to provide the recipients with safe and reasonably priced housing.

[212] Bureau, The Hindu. "Residents of Tribal Hamlets in Ernakulam Demand Repair of Bridges Damaged in 2018 Floods." *The Hindu*, 23 Apr. 2023. *www.thehindu.com*, https://www.thehindu.com/news/cities/Kochi/residents-of-tribal-hamlets-in-ernakulam-demand-repair-of-bridges-damaged-in-2018-floods/article66769994.ece.

[213] Ibid.

harm during the refugee crisis, with facilities and furniture destroyed. Because of the instability caused by this disturbance, schools were unable to complete their academic curricula, which resulted in concessions in the quality of education.

Schools' mitigation efforts during the floods played a critical role in helping the impacted communities. Schools became relief camps, offering supplies and a place to stay to those affected by flooding. In addition, a few schools were converted into emergency phone centres, which helped organise the public to organise rescue teams and assist with evacuations. People who were impacted were evacuated to safer areas using vehicles, especially buses. Schools provided free counselling services to help pupils deal with the trauma and stress brought on by the disaster since they understood the emotional toll that the incident had on them. In addition, despite the difficult circumstances, faculty members implemented waste management practices on school grounds to preserve hygienic conditions. These preemptive actions by educational institutions were crucial in aiding the impacted populace and streamlining relief efforts in areas devastated by flooding.

Kerala had the worst flooding it has ever seen in August 2018, which has a significant negative influence on the lives of its citizens. All areas of society were affected, but education was especially hard hit since it dealt with children's mental, emotional, and psychological health. Schools actively participated in putting plans into place to lessen the consequences of the flood, offering some respite to those impacted, with assistance from the government. It would be ideal to do frequent mock exercises for students and community members and integrate disaster preparedness measures into the curriculum as steps towards improving preparedness for future disasters.

The chapter provides a comprehensive overview of the historical sketch and administrative divisions of Cochin State, along with an exploration of significant rivers and dams in Ernakulam district. It underscores the importance of efficient management and environmental preservation to mitigate the impact of floods on the community. The 2018 flood in Ernakulam, triggered by heavy rainfall, resulted in significant devastation, including loss of lives and displacement of thousands. Human factors such as lack of planning and infrastructure deficiencies exacerbated the situation. The aftermath saw collaborative efforts from stakeholders in rescue, rehabilitation, and cleanup operations. Ongoing initiatives aim to address infrastructure challenges and mitigate future flood risks. Additionally, the chapter

highlights the urgent needs of flood-affected areas, including housing assistance, infrastructure repair, and access to essential supplies, underscoring the necessity for government intervention to alleviate the villages' hardships and ensure community resilience.

In the forthcoming chapter, the dissertation delves into the specific impact of the 2018 flood on North Paravur, offering a detailed analysis of the damages, challenges faced by the residents, and the subsequent recovery efforts. The narrative unfolds by examining the unique geographic and demographic characteristics of North Paravur, providing context for understanding the vulnerability of the area to natural disasters like floods.

CHAPTER: 3

THE CHRONICLES OF RESILIENCE IN THE PARAVUR TALUK AMIDST THE FLOOD OF 2018

Describing in detail the historical background of the Paravur taluk, located in the verdant landscapes of Ernakulam district of Kerala. This taluk covers an expanse of 195.2 sq. km and is home to two municipalities and eleven panchayats, each contributing to the vibrant socio-economic fabric of the area. It is surrounded by the major river of Periyar in the east, and Varapuzha backwaters in the south. The taluk is characterised by its coastal plains, where prawn cultivation and pokkali rice cultivations thrive. However, amidst the picturesque scenery lies a story of resilience etched by the devastating flood of 2018. Amidst the devastation, communities within Paravur Taluk displayed remarkable resilience, coming together to confront the challenges brought by the flood.

Describing in detail the partially flood-affected (Eloor, Ezhikkara, Kottuvally, Paravur, Varapuzha) and most flood-affected areas (Vadakkekkara, Chittattukkara, Chendamangalam, Puthanvelikkara, Kunnukara, Karumallur, Alangad, and Kadungallur) of the taluk. The residents of the affected areas exhibited solidarity in the face of adversity, supporting each other through relief efforts and post-flood reconstruction endeavours.

The flood's impact extended beyond residential areas to encompass heritage conservation efforts, notably affecting projects like the Muziris Heritage Project and the handloom (Kaithari) industry. Despite setbacks caused by flood and damage to historical sites and artifacts, restoration efforts persevered, underscoring the commitment to preserving Kerala's rich cultural legacy. Moreover, the emergence of initiatives like the Chekkutty dolls, borne out of the flood's aftermath, symbolized the resourcefulness of the community in finding sustainable solutions to post-disaster challenges.

In response to the vulnerabilities exposed by the flood, a comprehensive mitigation plan was proposed, encompassing a spectrum of strategies aimed at enhancing resilience and promoting sustainable development. From desilting canals and widening rivers to implementing multi-purpose infrastructure projects and floodplain management measures, the plan comprises a proactive approach to mitigating future flood risks while fostering community resilience.

Through the lens of Paravur Taluk's experience, delving into the complex interplay between natural disasters, community resilience, and sustainable development. It unveils narratives of strength, solidarity, and adaptation, painting a portrait of a region that, despite facing adversity, remains steadfast in its resolve to forge a brighter, more resilient future.

ADMINISTRATIVE STRUCTURE OF PARAVUR TALUK

Paravur Taluk is one of the *seven taluks of the Ernakulam district*[214] in the Indian state of Kerala.[215] It lies in the northwestern part of Ernakulam. Paravur taluk has a total area of 195.2 square km and includes 13 LSGs (Local Self Governments) having 2 municipalities and they are North Paravur and Eloor. It also comprises of eleven gram panchayats with a total population of 4,10,571 (200,612 males and 209,959 females).[216] [217] [218] The surrounding taluks are Kochi to the west comprising Vypin islands; Aluva to the east including Angamaly and Nedumbassery; and Kanayannur to the south consisting of Kochi city.[219] [220] The Periyar river encircles the taluk in the east and its considerable network of canals and streams make up the Varapuzha backwaters in the southern part. The western part of the taluk are coastal regions that consist of prawns and *pokkali*[221] rice cultivation.[222]

[214] Seven taluks of the Ernakulam district include Aluva, Kunnathunadu, Kochi, Kanayannur, Kothamangalam, Muvattupuzha and Paravur.

[215] Ministry of Micro, Small and Medium Enterprises, Government of India. *Brief Industrial Profile of Ernakulam District*. p. 4.

[216] *Censusindia2011*. https://www.censusindia2011.com/kerala/ernakulam/paravur-population.html. Accessed 22 Feb. 2024.

[217] T D, Sreejith. *MITIGATION PLAN FOR FLUVIAL FLOOD MANAGEMENT IN PARAVUR TALUK*. 2022. APJ Abdul Kalam Technological University. p. 43.

[218] Shivam Soni, Dev. "CDP." *Habitat For Humanity India*, 23 Dec. 2020, https://habitatindia.org/cdp/.

[219] *Paravur Taluk*. https://wikimapia.org/13580710/Paravur-Taluk. Accessed 22 Feb. 2024.

[220] T D, Sreejith. Op. Cit.

[221] Pokkali: Pokkali is a unique saline tolerant rice variety that is cultivated in coastal regions using an organic method. It is seen in regions such as Alappuzha, Thrissur and Ernakulam districts of Kerala.

[222] T D, Sreejith. Op. Cit.

Municipalities in Paravur Taluk

As mentioned earlier, Paravur taluk consists of two municipalities and they are:[223] [224]

1. North Paravur
2. Eloor

Panchayats in Paravur Taluk

There are eleven panchayats in Paravur taluk and they are as follows:[225] [226]

1. Vadakkekkara
2. Chittattukara
3. Chendamangalam
4. Puthanvelikkara
5. Kunnukara
6. Karumallur
7. Kottuvally
8. Ezhikkara
9. Varapuzha
10. Alangad
11. Kadungallur

2018 FLOOD IN PARAVUR TALUK

The flood of 2018 was mostly affected in the Paravur taluk compared to all the other taluks of Ernakulam district. As Paravur lies in the delta region of the Periyar River and when the shutters of the Cheruthoni dam were opened, the area was submerged under water due to the unabated rainfall of August 2018. The taluk is located between the Periyar River in the east and Varapuzha backwaters in the south along with several canals and streams. The taluk comes under the category of coastal plains.[227] The major types of soil found in this taluk include

[223] Ibid. p. 45.

[224] "Villages and Towns in Paravur Taluka of Ernakulam, Kerala - Census India." *www.Censusindia.Co.In*, https://www.censusindia.co.in/villagestowns/paravur-taluka-ernakulam-kerala-5659. Accessed 22 Feb. 2024.

[225] T D, Sreejith. Op. Cit. p. 45.

[226] "Villages and Towns in Paravur Taluka of Ernakulam, Kerala - Census India." Op. Cit

[227] Shivam Soni, Dev. "CDP." *Habitat For Humanity India*, 23 Dec. 2020, https://habitatindia.org/cdp/.

a) Silty clay
b) Silty sand
c) Laterite [228]

Based on some reports, over 6000 cases of damage to mini, micro, and small businesses and the complete destruction of around 56 structures are seen. 60,000 households were affected due to the flood out of 75,000.[229] According to the flood reports of the Disaster Management Authority, flood-affected houses located in the Paravur taluk stand the highest with 84,608 houses. While the second position goes to the Aluva taluk with 35,725 houses being affected by the flood and the array includes the other taluks such as Kanayannur, Kochi, Kunnathunadu, Muvattupuzha and Kothamangalam with 22920, 13421, 10350, 8613 and 2075 respectively.[230]

Affected areas mostly include the low-lying areas and regions situated near the river banks, especially the river Periyar and Chalakkudy river. Also, the connecting canals and inner drainage canals have led to a massive impact on flooding as well. The highest flood level which was demarcated concludes at about 9m to 11m in altitude.[231] The flood of 2018 has highlighted major gaps in infrastructure that have enormously contributed to the vulnerability of the Paravur taluk.[232]

FLOOD-AFFECTED REGIONS OF PARAVUR TALUK

It is said that the failure of local bodies as well as district administration to clear blockages to streams and canals that drain straight to the backwaters situated in the taluk ahead of the monsoon has paved the way and heightened the flood risk of the area. The Department of Minor Irrigation has identified about 24 canals and streams in the area which require immediate intervention if the damages caused by the flood need to be minimised. The survey conducted by the departments reveals that 24 out of 34 streams have no more openings towards the backwaters of the taluk. Also, most of the streams that run through private properties have

[228] Ibid.

[229] Ibid.

[230] T D, Sreejith. Op. Cit. p. 54.

[231] T D, Sreejith. Op. Cit. pp. 54-55.

[232] Shivam Soni, Dev. Op. Cit.

closed the mouth of these streams by its owners thereby increasing the risk of submergence.[233] [234]

The flood-affected regions of Paravur can be classified into two categories[235] such as

a) Partially flood-affected areas
b) Most flood-affected areas

a) PARTIALLY FLOOD-AFFECTED AREAS

Partially flood-affected areas include five areas and they are as follows:

1) Eloor
2) Ezhikkara
3) Kottuvally
4) Paravur
5) Varapuzha

1) Eloor

The total area comprises of 11.28 sq. km with a population of 36,637 (18293 men and 18344 women).[236] There are 8872 houses within 31 wards. 75% of thirteen wards were affected whereas three communities remained unaffected.[237]

The municipality consists of both loamy and some other gravelly type of soil. There was no shortage of water as there was a high inflow. There are paddy fields adjacent to this area. Around 33 notified drain canals were silted which led to flooding.[238]

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[233] Karunakaran, Binu. "Kerala: Operation Breakthrough Need of the Hour in Paravur." *The Times of India*, 28 May 2020. *The Economic Times - The Times of India*, https://timesofindia.indiatimes.com/spotlight/drive-operational-excellence-iim-kozhikodes-coo-programme-with-a-global-edge-by-kellogg-executive-education/articleshow/108043076.cms.

[234] John Thooval, Santhosh. "Kerala Floods: Mark the Level on Walls, Not Just in Minds." *OnManorama*, https://www.onmanorama.com/news/kerala/2018/09/06/kerala-floods-waterlevel-mark-buildings.html. Accessed 29 Feb. 2024.

[235] T D, Sreejith. Op. Cit. pp. 55-66.

[236] Census of India, 2011.

[237] T D, Sreejith. Op. Cit. p. 55.

[238] Ibid.

The Don Bosco colony in Eloor was flooded on 13th August 2018. As there were only two weeks left for the Onam festivals, the residents feared whether they would have to spend it in relief camps.[239]

As the Idamalayar dam was opened, on the 12th of August evening itself, the water level started to rise. According to Lakshmi Murukan of Erikkeril house, Ward 13, Eloor, they came back home from the relief camps to clean their house and to keep the household goods in safe positions. Around 8 pm, they witnessed the rise in the water level in this area. By the next morning, their houses were flooded with water. The residents were completely tired of cleaning their houses again and again. Meanwhile, they found it difficult to dump the waste and the things that were no longer useful to them.[240]

The flooding events were distressing for the daily wage labourers. According to Radhakrishnan, a toddy tapper of the Eloor area, toddy tapping in this region was the main source of income for him. But, due to the flooding, he was not able to work for five days which has immensely affected his day-to-day life. He opines that it may take around one month to get back to his normal job.[241]

P S Sanal of Palakkandathil house said that water flooded his house three times within five days. His children were affected by fever and leg pain. He feared the spread of epidemics that might strike after the flood.[242]

According to the then-13th ward councillor of Eloor municipality, Chandramathi, there were approximately ten camps in the Eloor region. As the water receded from the houses of the residents, the district authorities closed six out of ten camps on 12th August and the people who stayed at the relief camps were sent back home. But, the heavy rainfall on 13th August led to the rise in the water level again which caused

[239] Correspondent, D. C. *Eloor Colony Flooded Again.* 14 Aug. 2018, https://www.deccanchronicle.com/nation/current-affairs/140818/eloor-colony-flooded-again.html.

[240] Ibid.

[241] Ibid.

[242] Ibid.

flooding in the houses of the residents and they were made to come back to the camps.[243]

As a result of the formation of cyclonic circulation in the Southwest Arabian Sea and adjoining Lakshadweep, on 5th October 2018, the Eloor municipality organised an emergency meeting of the Municipal Disaster Relief Committee. During this time, the districts of Idukki and Ernakulam are on alert.[244]

The meeting was participated by the personalities of different fields such as the Municipal Chairperson, vice chairman, standing committee councillors, corporation secretary, fire and rescue services, Kerala State Electricity Board (KSEB), Kerala Water Authority (KWA), Kerala Police, Integrated Child Development Services (ICDS) and the corporation Primary Health Care (PHC). The information given by the Indian Meteorological Department (IMD) was taken into account in association with the cyclonic circulation which made the district ensure safety in the regions which were affected by floods in the past months.[245]

The corporation decided to clear the drains and channels to prevent water logging. Along with this, the other matters discussed during the meeting include the selection of relief camps, cutting down trees that may cause trouble, arranging the facilities for country boats, and also arranging transportation facilities for the needy. Several departments were also instructed to take the needful steps to tackle the situation. Migrant immigrants residing in this area were evacuated and notices were given to industries that were prone to flood threats.[246]

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[243] Ibid.

[244] "Emergency Meet Held in Flood-Prone Eloor." *The New Indian Express*, 6 Oct. 2018, https://www.newindianexpress.com/cities/kochi/2018/Oct/06/emergency-meet-held-in-flood-prone-eloor-1881635.html.

[245] Ibid.

[246] Ibid.

2) Ezhikkara

Ezhikkara has a total area of 15.27 sq. km with a population of 18,019 (8,784 men and 9,235 women).[247] Within 14 wards, it includes 6,156 houses. Among these, most of the wards were affected but, not so severely. Topographically, the panchayat was divided into three sectors:

i. Light admixture of sludge
ii. Low-lying farmlands
iii. Wetlands.

Around 39 houses were damaged due to the flood and 995 were partially damaged.[248]

In recent efforts, volunteers in the flood-prone panchayat of Ezhikkara have initiated tidal mapping[249] with the support of various agencies such as Equinoct[250] [251] and M S Swaminathan Research Foundation (MSSRF),[252] the Ernakulam district panchayat and the District Disaster Management Authority. Also, the Tata Institute of Social Sciences (TISS) is involved in these activities.[253] [254] Ezhikkara has witnessed an increase in the rise of tidal flooding[255] in recent years. The duration of flooding has increased, as well

[247] Census of India, 2011.

[248] T D, Sreejith. Op. Cit. p. 56.

[249] Tidal mapping: It includes the systematic measurement and analysis of tidal patterns and variations seen in the coastal areas in order to understand the dynamics of tidal currents, water level, and also their effects on the surrounding environment.

[250] Equinoct: It provides science-based solutions for addressing the impacts of climate change, working with communities, and governments. They work towards a climate-resilient future.

[251] *Home - Equinoct*. https://www.equinoct.com/. Accessed 28 Feb. 2024.

[252] MSSRF is a non–profit trust.

[253] Bureau, The Hindu. "People's Action to Tackle Climate Change: 1,400 Tidal Flood Maps Being Readied in Ezhikkara Panchayat." *The Hindu*, 5 June 2023. *www.thehindu.com*, https://www.thehindu.com/news/cities/Kochi/peoples-action-to-tackle-climate-change-1400-tidal-flood-maps-being-readied-in-ezhikkara-panchayat/article66933906.ece.

[254] *Tidal Flooding: Co-Creating Resilience - Equinoct*. 6 Oct. 2022, https://www.equinoct.com/project/tidal-flooding-co-creating-resilience/.

[255] Tidal flooding: It refers inundation of coastal areas due to rise in tide, which may lead to temporary or permanent submersion of land, infrastructure, and communities.

as the intensity and its spread. Studies suggest that the sea level rise might be the cause of tidal flooding.[256]

Within the 14 wards in Ezhikkara panchayat, 12 are prone to tidal flooding. The involvement of local communities such as the Kudambashree workers, has helped in the empowering of people to face the threats of climate change. The then Ezhikkara panchayat President, K D Vincent, opines the need for the old method of planting mangroves to fight against the flooding and high tide waves.[257] Due to flooding, schools were closed.[258]

3) Kottuvally

Kottuvally encountered extensive damage during the flood of 2018.[259] Kottuvally has an area of around 20.82 sq. km with a population of 42,922 (21,034 men and 21,888 women).[260] Within 22 wards, it consists of 11,733 houses. Among these, ten wards were flooded around 75% and four neighbourhoods were affected by about 50%.

A tributary of the Periyar River, namely, the Cheriyappally River flows through this area. Panchayat includes swamps and high plains with open fields.[261] The central and northern parts are mostly high and have sloping plains too. The western side of the area includes swampy areas and coastal plains and the remaining sections are of typical

[256] Bureau, The Hindu. "People's Action to Tackle Climate Change: 1,400 Tidal Flood Maps Being Readied in Ezhikkara Panchayat." *The Hindu*, 5 June 2023. *www.thehindu.com*, https://www.thehindu.com/news/cities/Kochi/peoples-action-to-tackle-climate-change-1400-tidal-flood-maps-being-readied-in-ezhikkara-panchayat/article66933906.ece.

[257] Bureau, The Hindu. "Call for Combining Scientific and Traditional Methods to Check High Tide Flooding in Ernakulam Panchayats." *The Hindu*, 10 June 2023. *www.thehindu.com*, https://www.thehindu.com/news/cities/Kochi/call-for-combining-scientific-and-traditional-methods-to-check-high-tide-flooding-in-ernakulam-panchayats/article66953873.ece.

[258] "Some Schools in Alappuzha, Ernakulam Not to Open Wednesday." *OnManorama*, https://www.onmanorama.com/news/kerala/2018/08/28/select-schools-alappuzha-ernakulam-not-open-wednesday.html. Accessed 28 Feb. 2024.

[259] Centre for Migration and Inclusive Department. *LEAVING NO ONE BEHIND: Lessons from the Kerala Disaster*. First, Mathrubhumi Books, 2019. p. 56.

[260] Census of India, 2011.

[261] Mohandas, Reshma. Interview. Conducted by. Swetha Anil. 26th February 2024.

sandy areas.[262] The soil quality index mean of Kottuvally is 0.53.[263] The results of the present study on the soil quality assessment of pokkali lands in the post-colonial flood scenario of Kerala reveal that the Kottuvally panchayat is poor in relative soil quality index.[264] [265]

According to Sulaiman, a shopkeeper residing in Kottuvally, said that due to high moisture that resulted from the flood had made the grains in his store sprout.[266] The cases of leptospirosis[267] were reported in this area.[268] The disposal of damaged food items was increasing and the focus of authorities were shifted to the disposal of damaged food items accumulated at various civil supplies distribution centres in panchayats like Kottuvally.[269]

During the post-flood scenario, the Kottappuram Integrated Development Society (KIDS), built new houses in the Kottuvally panchayat.[270] A medical camp was also conducted for the well-being of the residents.

[262] T D, Sreejith. Op. Cit. p. 57.

[263] Unni, Neha, and A. K. Sreelatha. *Soil Quality Assessment of Pokkali Lands (AEU 5) in the Post (2018) Flood Scenario of Kerala*. 2018. p. 110.

[264] Ibid. p. 111.

[265] Mathew, Dr. Reena, and Dr. P. Indira Devi. *Research Report 2019*. Kerala Agriculture University, 2019.

[266] M K, Sunilkumar. "Paravur Still Cut off from Mainland." *The Times of India*, 21 Aug. 2018. *The Economic Times - The Times of India*, https://timesofindia.indiatimes.com/city/kochi/i-asked-my-crew-and-they-said-yes/articleshow/65485501.cms.

[267] Leptospirosis is a bacterial infection that is mostly spread through water or soil contaminated with the urine of infected animals, which may lead to flu-like symptoms and severe complications if not treated.

[268]"Kerala on High Alert." *The New Indian Express*, 5 Sept. 2018, https://www.newindianexpress.com/cities/kochi/2018/Sep/05/kerala-on-high-alert-1867528.html.

[269] "Kerala Floods: Carcasses Disposed of by Burning." *The Times of India*, 4 Sept. 2018. *The Economic Times - The Times of India*, https://timesofindia.indiatimes.com/city/kochi/kerala-floods-carcasses-disposed-of-by-burning/articleshow/65665883.cms.

[270] "Disaster Management Programs." *Kids Kottappuram*, https://kidskottapuram.org/disaster-management-programs/. Accessed 29 Feb. 2024.

4) North Paravur

North Paravur, also known simply as Paravoor, Paravur, or Parur, is a municipality and main administrative centre of this taluk.[271] It is an area located on the outskirts of Ernakulam district.[272] It is situated in the northern suburb of Kochi city around 20 km from the main city centre. Historically, North Paravur is considered as the first place in India to use electronic voting machine during the by-elections of 1982 for a limited number of polling stations.[273] [274]

The term Paravur has been derived from the word Parayur, which means the place of Paravar.[275] [276] Paravars used to reside in the coastal areas of Kerala, especially during the reign of the Chera dynasty, and were also seen near their ancient capital of Mahodayapuram. It is also said that there are mentions of Paravur in the Sangam literature.

North Paravur is home to numerous numbers of small, medium, and large enterprises. The livelihood of the residents majorly depends upon agriculture, tailoring units, handloom and khadi units, fishing as well as livestock rearing. The flood and its impact on these establishments have affected the income generation of the residents.[277] North Paravur has an area of 9.02 sq. km with a population of 31,503 (15,060 men and 16,443 women).[278] It consists of 8,997 houses within 29 wards. Around 23 wards of this region

[271] T D, Sreejith. Op. Cit. p. 43.

[272] Census Commission of India. *Census of India 2001*. https://web.archive.org/web/20040616075334/http://www.censusindia.net/results/town.php?stad=A&state5=999 . Accessed 21 Feb. 2024.

[273] "History of EVM." *Election Commission of India*, https://old.eci.gov.in/voter/history-of-evm/. Accessed 21 Feb. 2024.

[274] *General Election 2009*. 7 Mar. 2009, https://web.archive.org/web/20090307223038/http://pib.nic.in/elections2009/.

[275] Paravar is an ancient maritime tribal community, mostly residing in Kerala, Tamil Nadu and Sri Lanka.

[276] Thevar, Sharmalan. *The Paravars*. 26 June 2013, https://sharmalanthevar.blogspot.com/2013/06/the-paravars-ancient-tamil-tribe.html.

[277] Shivam Soni, Dev. "CDP." *Habitat For Humanity India*, 23 Dec. 2020, https://habitatindia.org/cdp/.

[278] Census of India, 2011.

were flood-affected, out of which nine neighbourhoods were affected above 90%.[279] About 250 houses of the families residing in the North Paravur block were declared uninhabitable due to the aftermath of the 2018 flood.[280] [281]

The rainwater storage capacity of this area is about 7 to 9 meters. Clay and rocks are intermingled at larger depths. The water which rises from the deep is considered to be salty and sour. The area is surrounded by crops such as coconut and other intercrops.[282]

5) Varapuzha

Varapuzha comprises of a total area of 7.74 sq. km with a population of 29,397 (14,529 men and 14,868 women).[283] The region includes 9,333 houses in 16 wards. Most of the wards were affected by the flood, but severe damages were not found. The mainstream within this area is the Periyar River. The municipality is situated over the fringe which resulted in the high population density, which leads to a change in land use. Geographically, the land is around 10m high, and the flood of 2018 marked 8' flood levels. About 20 houses were entirely submerged under water while 3,200 houses were partially damaged.[284]

On 14th August 2018, the church located on the outskirts of Varapuzha tolled to warn the residents of the rising water level. According to Francis, a carpenter residing at Nediyanthara along with his wife Mary came back to their home one week post the flood only to find out that all their belongings and furniture were underwater. It took three weeks of hard work to remove the mud and to make the house liveable again. Mary would wake up mid-sleep imagining the church bells reverberating again to warn the residents. Similarly, Francis had nightmares too. Likewise, three sisters residing in the area Meenu, Geethu and Neenu had become silent as they came back to their home

[279] T D, Sreejith. Op. Cit. p. 57.

[280] Mohandas, Reshma. Interview. Conducted by. Swetha Anil. 26th February 2024.

[281] M S, Nandita. Interview. Conducted by. Nivedya Rajeev. 6th January 2024.

[282] T D, Sreejith. Op. Cit. pp. 57-58.

[283] Census of India, 2011.

[284] T D, Sreejith. Op. Cit. pp. 58-59.

living in the relief camp for six days, saw their books buried under the sludge of the flood. This had affected their mental health and has turned gloomy. Whenever they tried to concentrate on their studies, the images of the events of the flood would come to their mind.[285]

Most of the residents shifted their household goods to the upper floors of their houses or other safe places. Also, some of the people found asylum in their relatives' houses temporarily.[286]

The students of Government Model Engineering College, Thrikkakkara, conducted a survey in the Varapuzha panchayat on behalf of the government. The students visited several houses that were affected by the flood and calculated the extent of damage and recorded pictures of it. According to them, the damage was very much evident in these houses.[287]

Therefore, these are the partially affected areas of the Paravur taluk (Eloor, Ezhikkara, Kottuvally, Paravur, and Varapuzha) and their narrative of resilience amidst the flooding events of 2018. It reveals the intricate relationship between nature's force and human endeavour when the flood surges and brings with them both disruption as well as adaptation. Majorly through communal support, these partially affected areas not only weather the storms of flooding events but also, emerge stronger, which made their resilience etched into the very fabric of their existence in the society.

b) MOST FLOOD-AFFECTED AREAS

Most flood-affected areas comprise of eight areas such as:

1) Vadakkekkara

[285] Ameerudheen, T. A. "As Kerala Adjusts to Life after Floods, Health Officials Race to Tackle Mental Health Problems." *Scroll.In*, Sept. 2018, https://scroll.in/article/895023/as-kerala-adjusts-to-life-after-floods-health-officials-race-to-tackle-mental-health-problems.

[286] "Flood Fury: Areas Ravaged by Last Year's Flood See Exodus." *The New Indian Express*, 10 Aug. 2019, https://www.newindianexpress.com/cities/kochi/2019/Aug/10/flood-fury-areas-ravaged-by-last-years-flood-see-exodus-2016714.html.

[287] Arun, Ema. "Student Volunteers Assess Damage to Flood-Hit Houses." *OnManorama*, https://www.onmanorama.com/news/kerala/2018/09/22/student-volunteers-assess-damage-flood-hit-houses.html. Accessed 29 Feb. 2024.

2) Chittattukkara
3) Chendamangalam
4) Puthanvelikkara
5) Kunnukara
6) Karumallur
7) Alangad
8) Kadungallur

1) Vadakkekkara

Vadakkekkara has a total area of 9.5 sq. km including a population of 32,745 (16,484 men and 15,897 women).[288] It constitutes 10,330 houses in 20 wards. About 90% of these wards were flood-affected as the Periya River had a direct connection with this panchayat. This area of land is known for the historic Muziris heritage centre. There was a gradual change in the soil structure after the flood of 2018. Houses numbering 588 were entirely flooded and 6,250 houses were partially destroyed during this flood. The flood did not affect much in the wards such as ward number 3, 8, and 10.[289]

According to Valluvally Muslim Jamaat President, Azad V M, a stream of Valluvally River diverted and about a 700-metre stretch of the panchayat of Vadakkekkara was flooded, which made the region to be cut off from the remaining parts of the Ernakulam district. So, people residing in Vadakkekkara had to live without food and water for days. There was an increase in snake bites too in this region, and many people were admitted to hospitals due to this. Snakes of both dead and alive were found in several houses in Vadakkekkara panchayat.[290]

[288] Census of India, 2011.

[289] T D, Sreejith. Op. Cit. p. 59.

[290] M K, Sunilkumar. "Paravur Still Cut off from Mainland." *The Times of India*, 21 Aug. 2018. *The Economic Times - The Times of India*, https://timesofindia.indiatimes.com/city/kochi/i-asked-my-crew-and-they-said-yes/articleshow/65485501.cms.

Vadakkekkara is known for its rich plant diversity and the panchayat is a natural breeding site for several fishes.[291] The mangrove areas in the panchayat helped in controlling the water flow and prevented soil erosion to a certain extent.[292] The cage culture of oysters seen in Kottuvallikkadu near Vadakkekkara was affected by the flood.[293] Several cages of fish such as Kalanji, Karimeen, Moda, Chembally, Kalava, Valodi, Vatta, etc. were lost due to the flood.[294]

The traditional implements used in agriculture such as the thoomba (shovel), mazhu (axe), and types of equipments used for fishing like Chinese fishing nets (Cheena vala), Meen kettu, Vanchi (boat), Choondavala (fishing hook), Oonni vala (stake nets), Neettu vala, Ottal (trap), etc. were completely destroyed in this panchayat.[295]

2) Chittattukara

Chittattukara constitutes 9.46 sq. km of area with a population of 31,3.3 (15,264 men and 16,031 women).[296] The panchayat has around 10,330 houses along with its 18 wards. All the wards were flood-affected by about 90%. Similar to Vadakkekkara, Chittattukara too had a direct connection with the Periya River and has a sandy loam range black coloured soil. The soil structure changed during the post-flood scenario. The entire region has low-lying topographic features. 192 houses and 3,420 houses were completely and partially destroyed. There was also a livelihood loss of about 1,133.[297]

[291] S C, Dr. Joshi, et al. *IMPACT OF FLOOD/LANDSLIDES ON BIODIVERSITY - Community Perspective*. Kerala State Biodiversity Board, Thiruvananthapuram, Aug. 2018. p. 124.

[292] Ibid. p. 116.

[293] Ibid. p. 124.

[294] Ibid. p. 195.

[295] Ibid. p. 197.

[296] Census of India, 2011.

[297] T D, Sreejith. Op. Cit. p. 60.

3) Chendamangalam

Chendamangalam is a historical place located near the ancient port of Muziris. There are synagogues and the place is also known for its significance in the Kochi Biennale.[298] Chendamangalam comprises an area of 10.72 sq. km along with a population of 29,326 (14,153 men and 10,223 women).[299] The panchayat has some 10,223 houses within 18 wards. All the wards were affected by the flood of 2018 as it has a direct connection with the Periyar River. The panchayat includes rivers, streams as well as creeks. Here, both the Periyar and Chalakkudy rivers join together and flow around the region. 295 houses were completely destroyed by the flood and 5,989 houses were partially destroyed. According to reports, 29,326 houses were prone to flooding.[300] The handloom industry of this area was severely affected due to the flood.[301]

4) Puthanvelikkara

Puthanvelikkara consists of 19.87 sq. km of area and has a population of 33,372 (16,251 men and 17,121 women).[302] The panchayat includes 17 wards with around 8,302 houses. All the wards except the wards of 1 to 6 were flood affected of about 90%. The panchayat was surrounded by water on all sides. In the southern portion of the region, the Periyar River covers 8 km of its area. 89 houses were completely and 2,355 houses were partially destroyed during the flood of 2018.[303]

Cages of fish such as Kalanji, Karimeen, Moda, Chembally, Kalava, Valodi, Vatta, etc. were lost due to the flood.[304]

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[298] Advit Foundation. *REVIVING HANDLOOMS FOR LIVELIHOOD ENHANCEMENT OF WEAVER COMMUNITY - Project Report*. Nov. 2018.

[299] Census of India, 2011.

[300] T D, Sreejith. Op. Cit. p. 61.

[301] C S, Sharon. Interview. Conducted by. Nivedya Rajeev. 22nd December 2023.

[302] Census of India, 2011.

[303] T D, Sreejith. Op. Cit. p. 62.

[304] S C, Dr. Joshi, et al. Op. Cit. p. 195.

5) Kunnukara

Kunnukara has an area of 21.25 sq. km and a population of 21,765 (10,610 men and 11,155 women).[305] It includes 8,302 houses within 15 wards and all the wards were completely affected by the flood. The area has low terrain with flood plains of both rivers of Chalakkudy in the north, Periyar in the south, and Manjali canal in the center and west which caused the flooding. The region of Kunnukara is considered as the rice grain of the Paravur taluk. The major industry seen in this region is brick construction.[306]

6) Karumallur

Karumallur, a panchayat in the Paravur taluk comprises an area of 21.05 sq. km and a population of 29,805 (14,452 men and 15,353 women).[307] It has a total of 19 wards. Periyar River flows through this region which resulted in the flood of 2018 affecting above 90% of the area except in the highland wards. As the low-lying areas of the region are below the riverbed level, it was prone to f; flooding. Development was mostly concentrated on the highlands. During the 2018 flood, 11m was the flood level in this panchayat.[308]

7) Alangad

Alangad, one of the panchayats of the Paravur taluk has an area of 18.35 sq. km and a population of 47,329 (23,204 men and 24,125 women).[309] It has 18 wards which includes 10,330 houses. All wards were flood-affected in 2018 above 90%. The rivers that flow through this region are the Periyar and Neerikod rivers. Similar to Karumallur, the panchayat has low-lying areas which are below the riverbed level, thus being vulnerable to flooding. 188 houses were completely destroyed and 2,833 houses were

[305] Census of India, 2011.

[306] T D, Sreejith. Op. Cit. p. 63.

[307] Census of India, 2011.

[308] T D, Sreejith. Op. Cit. p. 64.

[309] Census of India, 2011.

partially destroyed during this flood and 1,808 houses were said to be prone to flooding.[310]

8) Kadungallur

Kadungallur has an area of 18.05 sq. km and a population go 45,117 (22,505 men and 12,612 women).[311] It has 21 wards with 15,456 houses and except for one ward, all the others were affected by floods of above 90%. Both Periyar and Onjithod river flows through this region. The panchayat is situated 11m above the sea level. The region had an inundation level of 8' – 12' during the flood of 2018. Ward numbers 16, 17, and 18 comprise industrial sectors. 36 houses were completely damaged, 3,201 were partially destroyed, and 634 were prone to flooding.[312]

Hence, these are the most flood-affected areas of the Paravur taluk where resilience was not a virtue but, a necessity that was deeply engraved in the minds of people. From the streets of Vadakkekkara to the serene landscapes of Chittattukkara, from the historically rich area of Chendamangalam to the bustling neighbourhoods of Puthanvelikkara and Kunnukara, each area tells a story of endurance in the face of calamity. In the areas of Karumallur, Alangad, and Kadungallur, where the flood affected severely, the spirit of resilience was the brightest. Despite the challenges put forth by the flood, these communities were strong enough to fight back which drew strength from their shared experiences and collective efforts to rebuild and renew.

ASSESSING THE IMPACT OF THE 2018 FLOOD ON THE MUZIRIS HERITAGE PROJECT AND THE HANDLOOM INDUSTRY IN PARAVUR TALUK

The flood of 2018 has left an indelible mark on Paravur Taluk shaping its landscape and livelihoods in several ways. From the historical sites under the Muziris Heritage Project to the traditional handloom industry of Chendamangalam, the flood's impact can be seen across the

[310] T D, Sreejith. Op. Cit. p. 65.

[311] Census of India, 2011.

[312] T D, Sreejith. Op. Cit. p. 66.

taluk, testing the resilience of its communities. Amidst the devastation, stories of restoration efforts and innovative solutions like the Chekkutty dolls emerged, symbolizing the spirit of adaptation and renewal.

MUZIRIS HERITAGE PROJECT: A TALE OF SURVIVAL

The Muziris Heritage Project began as a result of several excavations and discoveries made in the town of Pattanam in the Ernakulam district by the *Kerala Council of Historical Research*.[313] This project began in the year 2010 and has completed for a decade. This project mainly aims at reinstating the ancient town which is believed to be a major trading centre during the ancient period, which dealt with the Greeks, Romans, Italians, and other parts of the ancient world. The Project has restored many parts of the historical town, allowing tourists and historians to visit historically significant monuments such as the Kottappuram Fort, Paravur synagogue, Paliam Palace, etc.[314]

The flood of 2018 has left its impact on the Muziris Heritage Project, which is the state's greatest plan to revive the historical and cultural significance of the ancient seaport. According to the authorities, there was no severe damage, but the restored remains of the ancient town were covered with silt and water. No major physical damage was caused to any of the monuments under the Project. According to P M Nowshad, Managing Director of the Muziris Heritage Projects, the Paliam Palace and Kottappuram waterfront were covered with a lot of silt. Another problem faced by the project due to the flood was the condition of the electronic devices such as the display boards and LCD monitors installed in the monuments and museums for tourists. An electrical inspector was appointed to look into this matter.[315]

The Paliam Complex

The Paliam Kovilakam and the Nalukettu are the major two attractions that comes under the Muziris Heritage project. The Kovilakam has Dutch architectural style and was the

[313] Kerala Council of Historical Research is an institute solely dedicated to advancing research and scholarship on the history of Kerala, which facilitates the exploration and preservation of the region's rich history and cultural heritage.

[314] Roychowdhury, Adrija. "Kerala Flood Leaves Remains of Ancient Sea Port Muziris Covered in Silt | India News - The Indian Express." *The Indian Express*, 26 Aug. 2018, https://indianexpress.com/article/india/kerala-flood-rains-leaves-remains-ancient-sea-port-muziris-covered-silt-heritage-monuments-5324603/.

[315] Ibid.

administrative capital of Paliath Achan. The complex includes two-storeyed mansions along with temples, ponds, wells, and a 100-room mansion as well. A four-century old Nalukettu is situated near the Kovilakam which is considered to be the home for women and children.[316]

Historical books were soaked by flood waters. The swords, umbrellas, lamps, and all the golden figurines were submerged in water for several days. Even the control room on the ground floor was affected by the flood. Water reached the staircase on the first floor of the new mansion in the Paliam complex. 29 people were stuck on the first floor of the mansion. The navy boats rescued them after three days. The building structure was unaffected. However, the protection walls of the palace were damaged. The boat jetties built as part of the Muziris project were flooded with mud. The areas that did not get affected much were the Paravur Kottayil Kovilakam, the synagogues, and the Pattanam excavation centre.[317]

The palm-leaf manuscripts found by the Muziris Heritage Project faced the threat of fungus. Around 40 manuscripts were destroyed by the flood. Archaeological experts working under the Muziris Heritage Project have put in their efforts to restore them. The manuscripts which is covered with mud and sludge were not able to dry under the sunlight. It is possible only by taking out each layer using special technologies. The International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) helped the researchers in this regard to restore the affected sources.[318]

Hence, it is said that the Paliam Complex was hit by both the floods of 1924 and 2018. But the impact is more visible the flood of 2018 as there were severe damages compared to the flood of 1924.[319]

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[316] Ibid.

[317] Jose, Cherian. "Muziris Heritage Zone Relives the 1341 Flood." *OnManorama*, https://www.onmanorama.com/news/kerala/2018/10/01/muziris-heritage-zone-1341-floods-memorial.html. Accessed 29 Feb. 2024.

[318] Ibid.

[319] Ibid.

Muziris Resort

The Muziris resort built in the Kottayil Kovilakam suffered severe damaged in the flood. As the resort was built near the river, the ground floor was fully submerged under water. The boat jetty located near the resort was covered with sludge for around two feet. The dried sludge looks more like a parched field. Computers, television set and chairs were all damaged. There were also the presence of cracks on the floor and the wall. Even though, the building is under the district tourism promotion council, an individual is maintaining it under a contract. That person has suffered a loss of approximately Rs. 1.5 lakh.[320]

The boat service which was affected by the flood was closed for 15 days and it was resumed eventually. As a part of the Muziris Heritage Project, there are 11 boats out of which 6 boats are big which can accommodate 24 passengers and 5 small boats that can be used by 6 passengers. The boat ride provides an overall glimpse of the historical monuments under the Muziris Heritage Project.[321]

The authorities working under the Muziris Heritage Project arranged a community kitchen for around 1,500 people and organised relief camps for 285 members.[322]

The post flood scenario of the Muziris Heritage Project is that, there was gradual decline in the number of visitors. Before the flood, except on Mondays, other days were usually filled with domestic as well as foreign tourists in this area, but after the flood visitors were only seen during the holidays. The Paliam Kovilakam and Nalukettu being damaged due to the flood has been a reason for the decline in the number of visitors.[323]

Despite the challenges faced by the Muziris Heritage Project due to the flood of 2018, the project remains steadfast in its mission to preserve and revive the ancient seaport. Through their tireless efforts to restore the destroyed monuments and artifacts, the project continues to offer a glimpse into the past of Kerala by attracting tourists around the world.

[320] Ibid.

[321] Ibid.

[322] Roychowdhury, Adrija. Op. Cit.

[323] Jose, Cherian. “Muziris Heritage Zone Relives the 1341 Flood.” Op. Cit.

THE BATTLE OF CHENDAMANGALAM'S HANDLOOM (KAITHARI) INDUSTRY

In Chendamangalam, one of the panchayats of the Paravur taluk is filled with the rhythmic resonance of slender wooden pieces striking each other with harmonious echoes. Chendamangalam has become famous for its handloom culture which has been passed on through generations and numerous weavers depend upon it for their livelihood.[324] The industry is known for its gift of producing finely woven handloom textiles.[325] The handloom industry traces a long history as it has been linked with the feudal family of Paliam. During the early days, the handloom clothes were only used by the members of the Paliam family.[326] It is believed that Paliath Achan invited handloom weavers from Andhra Pradesh and Tamil Nadu to come and settle in Chendamangalam.[327] This led the royal family and the aristocrats to wear the clothes woven by the Devanga Chettiar's weaving community.[328] This paved the way for the flourishing of the handloom industry. The younger generation of this region started to view this sector as a means of employment which led to the establishment of private handloom weaving units.[329]

The condition of the small weaving units started to deteriorate with the arrival of machine-made fabrics. To tackle this situation, in 1955, the Chendamangalam Handloom Weavers Cooperative Society came into being.[330]

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[324] Sebastian, Shawn. "Weaving Climate Resilience." *CEEW*, 2 Sept. 2022, https://www.ceew.in/how-chendamangalam-is-weaving-climate-resilience-kerala-floods-story.

[325] Jilani, Hasina. "How the Kerala Floods Tragedy Turned the Spotlight on the Lost Art of Handloom | Vogue India." *Vogue India*, 4 Nov. 2019, https://www.vogue.in/fashion/content/how-kerala-floods-brought-the-lost-art-of-handloom-to-the-spotlight.

[326] "Kerala Floods Leave Centuries-Old Handloom Industry under Threat of 'Extinction.'" *The Indian Express*, 2 Sept. 2018, https://indianexpress.com/photos/india-news/kerala-floods-chendamangalam-handloom-industry-photos-5335787/.

[327] *A Journey to Remember: Chendamangalam and Its Weavers - Graamyam*. https://graamyam.com/a-journey-to-remember-chendamangalam-and-its-weavers/. Accessed 29 Feb. 2024.

[328] JAMES, SHALINI. "Read about the Regained Looms of Chendamangalam." *The Hindu*, 20 Dec. 2019. *www.thehindu.com*, https://www.thehindu.com/society/keralas-design-community-got-together-to-bat-for-chendamangalam-handloom-in-2019/article30358790.ece.

[329] *A Journey to Remember: Chendamangalam and Its Weavers - Graamyam*. Op. Cit.

[330] Ibid.

In the present world, the handloom industry is divided into five cooperative societies which are spread across this region.[331] [332]

The five societies are:

i) The Paravur Handloom Weavers Co-operative – No: 3428
ii) Chendamangalam – Karimpadam Handloom Weavers Co-operative Society Ltd. – No: H 191
iii) Chendamangalam Kaithari Naithu Vyvasaya Production Cum Sale Co-operative Society – No: H 47
iv) Paravur Town Handloom Weavers Co-operative Society – No: E 1
v) Kuriappilly Handloom Weavers P & S Co-operative Society Ltd. – No: 3476

The industry was already facing several threats which included the rise of power looms and the depletion of manpower to other sectors of the society.[333] However, the flood of 2018 has added another additional blow to this industry.[334]

The devastating flood of 2018 damaged several weaving units, particularly those at weavers' houses. The weaving community was in despair as their machinery and all the stocks were overflooded with water from the Periyar River.[335] About five societies, under which 600 weavers were employed, have completely lost their finished textile products, traditional instruments used for weaving, and a large stock of thread and dye units in the deluge of 2018.[336] T S Baby, the president of Paravur Handloom Weavers Cooperative Society, says that approximately Rs. 15 crore was lost for these five societies.[337] He opines that if the industry is not revived, then, it would mean the end of this traditional craft, which was awarded the

[331] Jilani, Hasina. Op. Cit.

[332] Advit Foundation. *REVIVING HANDLOOMS FOR LIVELIHOOD ENHANCEMENT OF WEAVER COMMUNITY - Project Report*. Nov. 2018.

[333] Kerala Floods Leave Centuries-Old Handloom Industry under Threat of 'Extinction. Op. Cit.

[334] Sebastian, Shawn. Op. Cit.

[335] Ibid.

[336] Kerala Floods Leave Centuries-Old Handloom Industry under Threat of 'Extinction. Op. Cit.

[337] Jose, Cherian. "Floods Leave Handloom Sector in Tatters." *OnManorama*, https://www.onmanorama.com/news/kerala/2018/08/27/chendamangalam-handloom-flood-damage.html. Accessed 29 Feb. 2024.

Geographical Indication (GI).[338] [339] New products produced for the Onam season that year were submerged under water. The handloom units located in the Karimpadam and Kuriappilly areas have suffered major damage.[340]

The handloom sector was given the task of making uniforms under the government's school uniform project. The project was launched by the government to protect the sector and to provide a new lease of life to the handloom industry. Workers, who earlier left the industry came back to traditional weaving. Under this project, the workers were paid Rs. 600 daily. As the daily wages increased, the weavers took interest in the project and the raw materials and needed things were supported by the government. But the flood of 2018 shattered their new dreams. They, then wanted the government to provide them with necessary help and also to introduce new projects to revive the traditional handloom sector.[341]

According to Ramla Gopalan, a 55-year-old weaver, they could not identify their houses from the roads as it was submerged by water. Ramla has marked the top edge of the main entrance door to show the water level during the calamity. Their work shed was flooded and everything inside of it was damaged. After staying at the relief camp for days, when they returned, all they could see was the muddied yarn and the destroyed looms. Ramla also observes that due to an increase in the construction of roads and houses, several canals that naturally drained water in the locality were filled over. Numerous experts have also pointed out the drastic changes in the land use patterns. According to the Council of Energy, Environment and Water (CEEW), about 64% of Kerala's districts have gone through enormous changes in land use as well as land cover attributes which may have triggered climate extremities.[342]

Another weaver named Rama, says that flooding is common in this locality, because of the southwestern monsoon from June to August, but it was not as grave as the flood of 2018.

[338] Geographical Indication (GI) refers to a sign or symbol used on products that have a particular origin or quality, reputation, or characteristics that are essentially attributed to its origin.

[339] Kerala Floods Leave Centuries-Old Handloom Industry under Threat of 'Extinction. Op. Cit.

[340] Jose, Cherian. Op. Cit.

[341] Ibid.

[342] Sebastian, Shawn. Op. Cit.

According to her, due to heavy rainfall and climate change, it even floods during the months of December and January.[343]

A few of the designers from Kochi started a campaign to help the weavers and bring back the handloom industry to its old glory. It was then followed by another campaign which certainly helped the weavers to rebuild the looms and bring in much-needed relief. This brought necessary attention to the village of Chendamangalam.[344]

The Indian Chamber of Commerce and Industry in Kochi, which was instrumental in relief activities, reached out to help the Chendamangalam Handloom Society which was completely destroyed by the flood. The Chamber repaired 12 looms and brought them back to action.[345] National Institute of Personnel Management (NIPM) – Kerala Chapter took up the responsibility of rebuilding 20 cottage looms under the Chendamangalam – Karimpadam Weaver's Co-operative Society. These looms were repaired and handed over during the function held at the Society premises on 15th November 2018.[346]

Priyadarshini Gopalan, Secretary of the North Paravur Weavers Cooperative, says that since the devastating flood of 2018, the weavers particularly the ones who live in the low-lying areas are living in constant fear of another flood. After the flood of 2018, the cooperative worked to rebuild the damaged work units of 100 weavers. Presently, the weavers are more alert and prepared in case another flood comes up. As a step of precaution, the weavers do not order another set of yarn, until the rainy season subsides. It is now a common practice for them to hang the leftover stocks at a higher level.[347]

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[343] Ibid.

[344] Jilani, Hasina. Op. Cit.

[345] "Flood-Affected Chendamangalam Weavers Get Aid." *The New Indian Express*, 14 Oct. 2018, https://www.newindianexpress.com/cities/kochi/2018/Oct/14/flood-affected-chendamangalam-weavers-get-aid-1885214.html.

[346] *NIPM Kerala | News*. https://www.nipmkerala.org/flood-rehabilitation.html. Accessed 29 Feb. 2024.

[347] Sebastian, Shawn. Op. Cit.

To avoid an incident same as the flood of 2018 and its consequences, the weavers want the authorities concerned to provide early and accurate warning of any calamities in the future. This will help them get enough time to move their assets to safety.[348]

There is a mixed feeling and lessons from the panchayat of Chendamangalam. As the weaving went through huge economic loss due to the floods, they are now more conscious about the changing climate risks, and the necessity to rebuild and fight back the calamities. The community also realised the importance of conserving natural ecosystems and receiving early warnings which could prevent losses or minimise the increasing climate risks.[349]

The birth of Chekkutty dolls and the resilience of Chendamangalam

The term Chekkutty expands to Chendamangalam Kutty and has been derived from *Cherine Athijeevicha Kutty*, which means the child who outlived the mud. It has a tagline that says, "Keralam onnayi thunnikketti", which literally means Kerala stitched together, which signifies the way that the state has emerged from the floods.[350]

Due to the floods, many clothes were soiled and even dry cleaning them would not allow them to be cleaned. Lakshmi Menon, a designer, who is popular for recycling and upcycling products, was adamant about helping the weavers find a sustainable solution for this. Lakshmi Menon is considered as the fairy godmother of Chekkutty. She considers Chekkutty as her own child.[351]

Statistically, out of a saree, 365 Chekkuttys could be made. The making of the Chekkutty dolls was done by volunteers and the profit made out of it is directly sent to the Weaver's Society. Within six months, there was a gradual increase in the number of volunteers which even comprised of nine countries. The soiled clothes were chlorinated and were sent to the volunteers. Lakshmi has organised several workshops teaching how to make Chekkutty dolls. This initiative was successful and were able to combat the loss of the weavers as well as pay

[348] Ibid.

[349] Ibid.

[350] Benu, Parvathi. "The Chekkutty Story: How a Doll Became a Symbol of Hope for Kerala's Weavers after the Floods." *Edex Live*, https://www.edexlive.com/beinspired/2019/sep/04/the-chekutty-story-how-a-doll-became-a-symbol-of-hope-for-keralas-weavers-after-the-floods-7824.html. Accessed 1 Mar. 2024.

[351] Ibid.

them a few extra lakhs successfully. According to the reports, the Chekkutty dolls are owned by people from around 65 countries. During the United Nations Reconstruction Conference in Geneva, the World Bank gave these Chekkutty dolls as a souvenir to its delegates. A book titled “Chekkutty” was written by the author Sethu.[352]

COMPREHENSIVE STRATEGIES FOR FLOOD MANAGEMENT IN PARAVUR TALUK

Flooding poses a severe threat to the Paravur taluk, as it is interconnected with networks of rivers, canals, and low-lying regions vulnerable to inundation during heavy rainfall. In response to this issue, a comprehensive mitigation plan has been proposed, aiming to enhance the areas’ resilience to floods while giving importance to sustainable development. This plan gives an outline of a series of strategies including desilting and deepening of canals, widening of rivers, provision of dikes, creation of retarding basins, and implementation of multi-purpose infrastructure projects. Additionally, floodplain management measures, installation of sluice gates, and the concept of "Room for River" are proposed to ensure effective flood control and management. Through these concerted efforts, the Paravur taluk aims to mitigate the impacts of fluvial flooding while maximizing opportunities for sustainable development and community resilience.[353]

a) Desilting and Deepening of Canals

The first crucial step involves the desilting and deepening of existing canal systems. These canals, both natural and artificial, play a significant role in managing water flow within the region. With widths ranging from 1 to 6 meters, these canals are essential conduits for water movement. However, encroachments have hindered their effectiveness, necessitating their retrieval to ensure optimal functionality.[354]

[352] Ibid.

[353] T D, Sreejith. Op. Cit. pp. 76-78.

[354] T D, Sreejith. Op. Cit. p. 76.

b) Widening of Rivers

Widening the river courses and deepening them might enhance the water flow capacity. By widening the rivers, more space is created to accommodate increased water volumes during floods. This measure not only manages flood flow effectively but also mitigates the risk of inundation in other areas.[355]

c) Providing Dikes

Dikes serve as critical structures in maintaining riverbank integrity and managing water levels. In Paravur taluk, it is proposed to maintain a continuous riverbank level of approximately 8 meters to facilitate efficient water management. Given the topographic variation of the region, dikes become essential in averting flood-related disasters. The 2018 flood event, with a water level reaching 11 meters, underscores the importance of robust dike systems to withstand such occurrences.[356]

d) Room for River

Clearing obstacles, lowering flood plains, and relocating dikes are essential measures to allow rivers the room they need to flow freely. This approach not only enhances flood resilience but also promotes the ecological health of river systems.[357]

e) Multi-purpose Infrastructure

Leveraging flood plains and low-lying regions for multi-purpose infrastructure development offers a sustainable solution to flood management. By integrating parks, natural beds, and riverfront development areas, new tourism opportunities can emerge, fostering economic growth while enhancing flood resilience.[358]

[355] Ibid.

[356] Ibid.

[357] Ibid.

[358] Ibid. p. 77.

f) Retarding Basins

Integrating retarding basins into the landscape provides temporary storage for stormwater during heavy rain events. These low-lying areas, when dry, can serve as recreational spaces for communities, further enhancing their utility beyond flood management purposes.[359]

g) Flood Plain Management

Designating floodplain areas as no-development zones ensures their preservation for flood mitigation purposes. Moreover, these areas can be utilized for agriculture under government policies, promoting sustainable land use practices and enhancing food security.[360]

h) Installation of Sluice Gates

Strategic placement of sluice gates along rivers and canals enables precise control over water levels and flow rates. This measure is crucial for managing inundation in rivers like Periyar and Chalakkudy, ensuring that floodwaters are channeled effectively into inner canals and tributaries, minimizing the risk of widespread flooding in surrounding areas.[361]

By implementing these comprehensive strategies under the fluvial flood management plan, Paravur taluk can enhance its resilience to flood events while simultaneously fostering sustainable development and preserving its natural heritage.

In this chapter, we focused on the multifaceted impact of the flood of 2018 on Paravur taluk, situated in the northwestern part of the Ernakulam district in Kerala. The chapter explores on how this region, including several municipalities and panchayats, overcame the devastation brought in by the flood, exacerbated by its unique geographical features and proximity to water bodies such as the Periyar River and Varapuzha backwaters. The chapter also focuses on

[359] Ibid.

[360] Ibid. p. 78.

[361] Ibid.

resilience and community response through the stories of its municipalities and panchayats, each facing its challenges and demonstrating remarkable strength in the face of calamity.

The chapter unearths the tapestry of experiences shaped by the flood. Amidst the tales of loss and struggles, the chapter brings to light the initiatives put forward by the Muziris Heritage Project, handloom industries, and also the role played by the Chekkutty dolls, which symbolises Kerala's unwavering spirit.

The communities drew strength from shared experiences and forged pathways toward a more resilient future. The chapter also highlights the mitigation plan proposed to prevent flood risk and promote sustainable development by recognising the importance of proactive measures in safeguarding lives and livelihoods. Therefore, this chapter provides an insight into the profound resilience of the residents of Paravur taluk, united in their resolve to overcome adversity and build a brighter tomorrow.

CONCLUSION

The history of floods in Kerala is a tapestry that has been woven with threads or stories of resilience, destruction, and regeneration. These natural calamities have played an important role in leaving an indelible mark on its landscape and the memory of the people. From the ancient period, recording of floods such as the 1341 deluge to the more recent catastrophe of 2918 and 2019, each event tries to shed light on the story of communities trying to emerge victorious by fighting these disasters with their unwavering determination to overcome them.

Throughout the history of Kerala, it has been borne to various floods, which left a mark on the socio-economic condition of the region. The floods of 1341, 1907, 1924, 1961, 1974, 1993, 2003, and 2013 stand as evidence of the recurring nature of this natural phenomenon, in which each event brings its challenges and lessons.

Among the biggest natural disasters to strike the state in recent years was the 2018 Kerala floods. Heavy rains that started in late May 2018 caused flooding and landslides in several districts of Kerala, leaving a path of destruction in their wake. Weeks of nonstop, deluge-causing rains led rivers to overflow, villages to be submerged, and major damage to houses, farms, and infrastructure. Millions of people were impacted by the floods, which caused hundreds of thousands of people to lose their homes and many fatalities. Roads, bridges, and communication networks throughout the state were severely damaged, which made rescue and relief operations more difficult. The situation was made worse by the floods' disruption of transit and access to necessary services.

But in the middle of the tragedy, there were incredible acts of bravery and resiliency. A large volunteer-led rescue operation took place in Kerala, as fishermen, residents, and government agencies put in endless effort to remove stranded people and help those in need. Social media sites were vital in organising assistance and coordinating rescue operations. The floods' aftermath raised awareness of several topics, such as the effects of climate change, environmental degradation, and urban planning. Following the tragedy, conversations on disaster preparedness and sustainable development gathered steam. To help impacted families reconstruct their lives, the Kerala government began massive relief and rehabilitation activities in collaboration with a number of national and international agencies. The 2018 floods were a

wake-up call, highlighting the necessity of taking preventative action to lessen the effects of natural disasters and increase resilience in areas that are susceptible to them.

However, the catastrophic flood of 2018 left a long shadow over the history of Kerala. Ernakulam, the busiest commercial hub of the state was the most affected district in the state due to flood. The inundation of vast lands, such as the historically significant Paravur taluk, which is one among the seven taluk of Ernakulam district, brought life to a standstill as it affected drastically the vulnerabilities of the region's infrastructure and communities altogether. The affected areas of Paravur taluk have been categorised into mostly affected and partially affected areas. Most flood-affected areas are Vadakkekkara, Chittattukara, Chendamangalam, Puthanvelikkara, Kunnukara, Karumallur, Alangad and Kadungallur. Partially affected areas include Eloor, Ezhikkara, Kottuvally, Paravur and Varapuzha. The Muziris Heritage Project, which is considered as the beacon of Kerala's cultural heritage, bore the effect of the floods, with historical sites and artefacts suffering extensive damage. Likewise, the handloom (Kaithari) industry of Paravur taluk, especially Chendamangalam, faced severe setbacks, which threatened the lives of the weavers.

Apart from the destruction caused by the flood of 2018, it also showcased the resilience and resourcefulness of Kerala's people. Communities residing in Paravur taluk as well as other parts of Ernakulam district rallied together, extending support to one another in relief efforts and post-flood reconstruction activities. The introduction of initiatives including the Chekkutty dolls, which were borne out of the flood's aftermath, symbolises the ingenuity of the people in finding sustainable solutions to post-flood challenges.

In conclusion, the history of floods in Kerala is a testament to the never-ending spirit of the people in the face of calamity. From the ancient period to the present day, floods have shaped the socio-economic conditions of the region, leaving behind tales of resilience, loss, and renewal. According to Sun Tzu, a Chinese general and strategist, amid chaos, there is always an opportunity. Similarly, the lessons learned from the tumultuous history of floods serve as a guiding light for future endeavours in disaster readiness, mitigation, and community resilience.

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APPENDICES

APPENDIX 1: TABLES

DATE OF RELEASE	FORECAST
26/07/2018	During Week 2 (2nd – 8th August 2018), above-normal rainfall activity is very likely to arrive over northern parts of the country and south peninsular India, especially Kerala.
02/08/2018	During Week 2 (2nd – 8th August 2018), above-normal rainfall activity is very likely to arrive over northwestern and eastern parts of the country and south peninsular India, especially Kerala.
03/08/2018	There are no indications of heavy rainfall in Kerala
07/08/2018	There are no indications of heavy rainfall in Kerala
08/08/2018	There are no indications of heavy rainfall in Kerala
09/08/2018	During Week 1 (9th – 15th August 2018), normal to above-normal rainfall activity is very likely to arrive over northwestern and eastern parts of the country and south peninsular India, especially Kerala.

Table 1: Weather forecast for Peninsular South India by the Indian Meteorological Department

DISTRICT	ACTUAL RAINFALL (mm)	NORMAL RAINFALL (mm)	PERCENTAGE DEPARTURE (%)	
Thiruvananthapuram	373.8	142	163	Large Excess
Kollam	644.1	258.7	149	Large Excess
Pathanamthitta	764.9	352.7	117	Large Excess
Alappuzha	608.2	343.1	77	Large Excess
Kottayam	619.2	386	60	Large Excess
Idukki	1478.9	527.3	180	Large Excess
Ernakulam	648.3	401.3	62	Large Excess
Thrissur	734.7	440.1	67	Large Excess
Palakkad	848.8	333.8	154	Large Excess
Malappuram	913.7	395.3	131	Large Excess
Kozhikode	836	500.9	67	Large Excess
Wayanad	1053.5	592.9	78	Large Excess
Kannur	665.3	540.9	23	Excess
Kasargode	636.9	636.3	0	Normal
TOTAL	**821**	**419.3**	**96**	**Large Excess**

Table 2: Monsoon rainfall assessment from 1st to 30th August 2018 by the Indian Meteorological Department

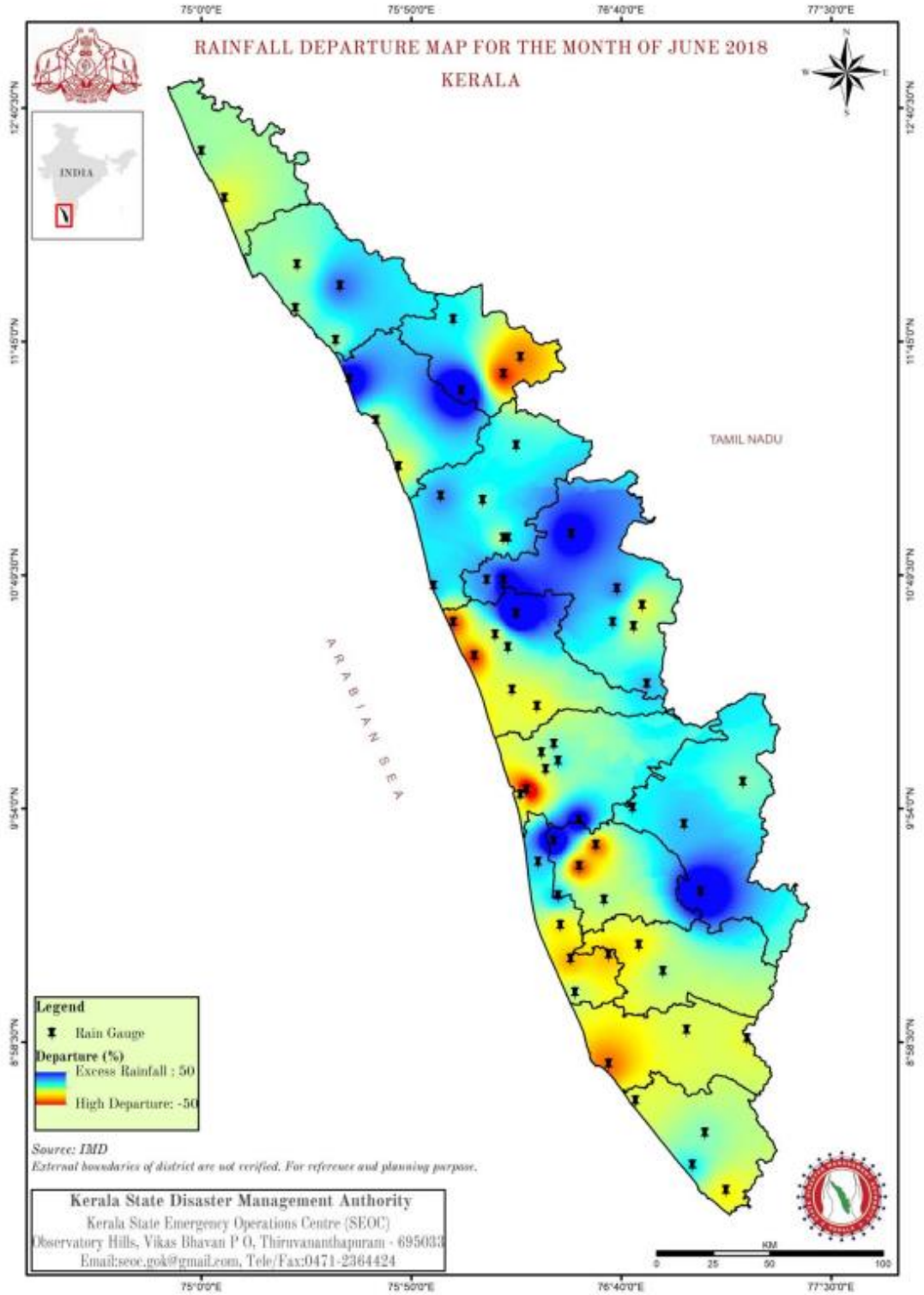
PERIOD	OBSERVED RAINFALL IN 2018 (mm)	NORMAL RAINFALL (mm)	DEPARTURE FROM NORMAL (%)
June	750	650	15
July	857	726	18
1st – 19th August	759	288	164
1st June – 19th August	2366	1664	42

Table 3: Observed rainfall in Kerala in 2018 as compared to normal rainfall

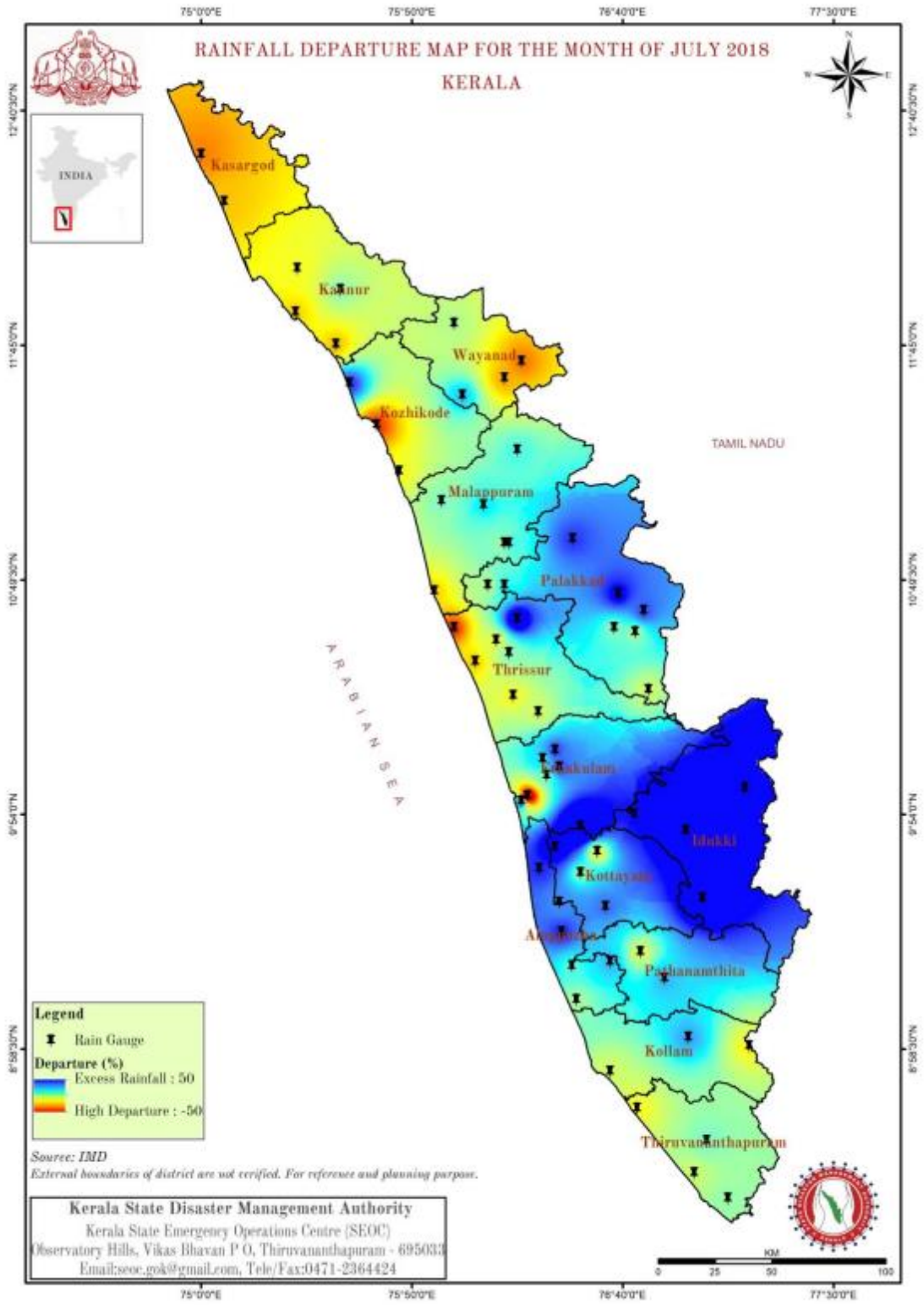
DISTRICT	RAINFALL FORECAST (ACTUAL REALISED)						
	14/8/18	15/8/18	16/8/18	17/8/18	18/8/18	19/8/18	20/8/18
Thiruvananthapuram	Green	Red	Yellow	Green	Green	Green	Green
Kollam	Green	Red	Yellow	Yellow	Yellow	Green	Green
Pathanamthitta	Orange	Red	Red	Red	Orange	Green	Green
Alappuzha	Green	Red	Red	Yellow	Green	Green	Green
Kottayam	Yellow	Red	Red	Red	Red	Green	Green
Idukki	Green	Red	Red	Orange	Green	Green	Green
Ernakulam	Orange	Red	Red	Red	Red	Orange	Green
Thrissur	Green	Red	Red	Red	Green	Green	Green
Palakkad	Orange	Red	Red	Orange	Yellow	Green	Green
Malappuram	Orange	Red	Red	Yellow	Red	Green	Green
Kozhikode	Orange	Red	Red	Yellow	Green	Green	Green
Wayanad	Orange	Red	Orange	Orange	Yellow	Green	Green
Kannur	Yellow	Red	Yellow	Yellow	Green	Green	Green
Kasargode	Orange	Red	Green	Yellow	Green	Green	Green

Table 4: The district-wise realisation of rainfall by the Indian Meteorological Department

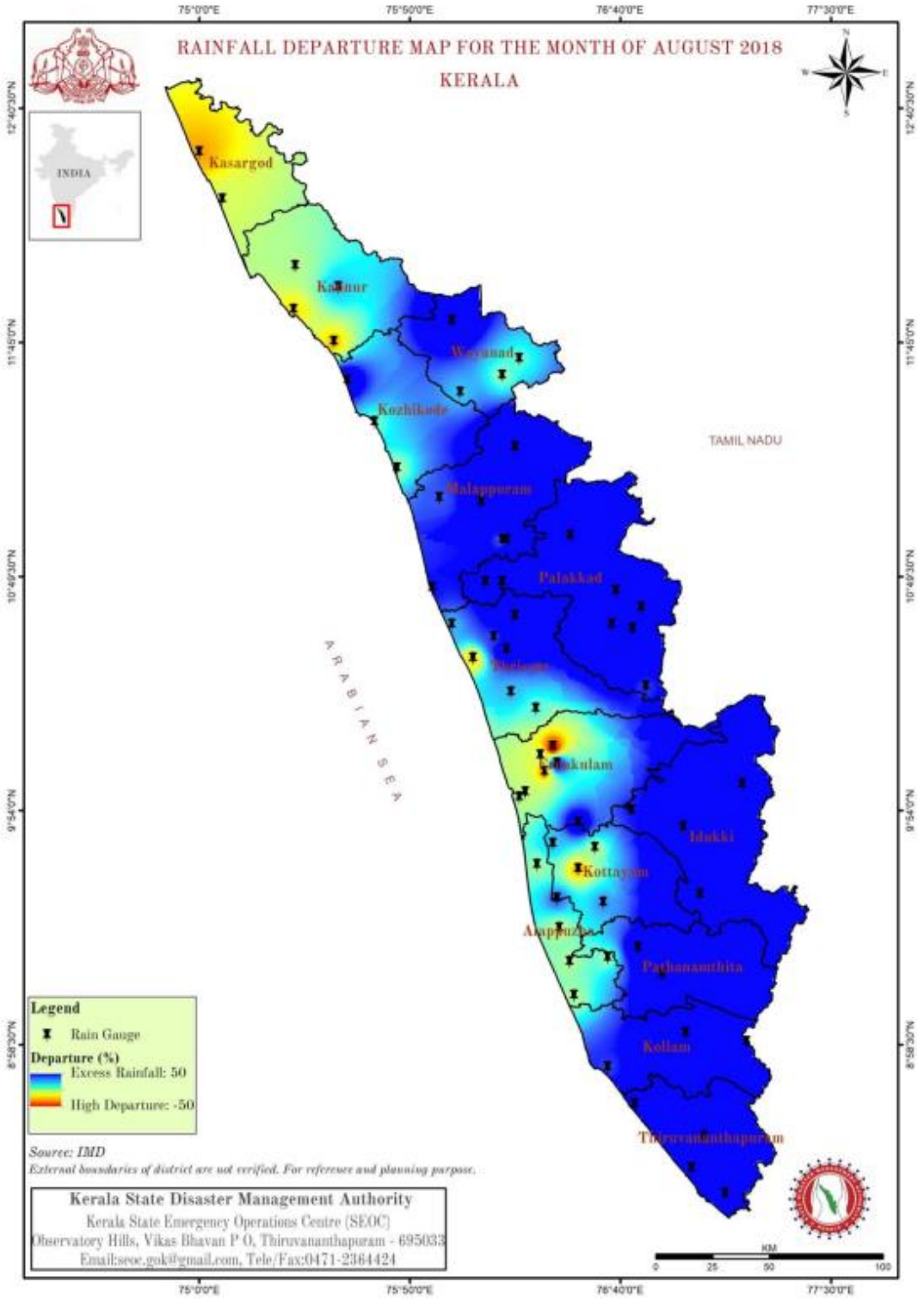
APPENDIX 2: MAPS



Map 1: Rainfall departure for the month of June 2018

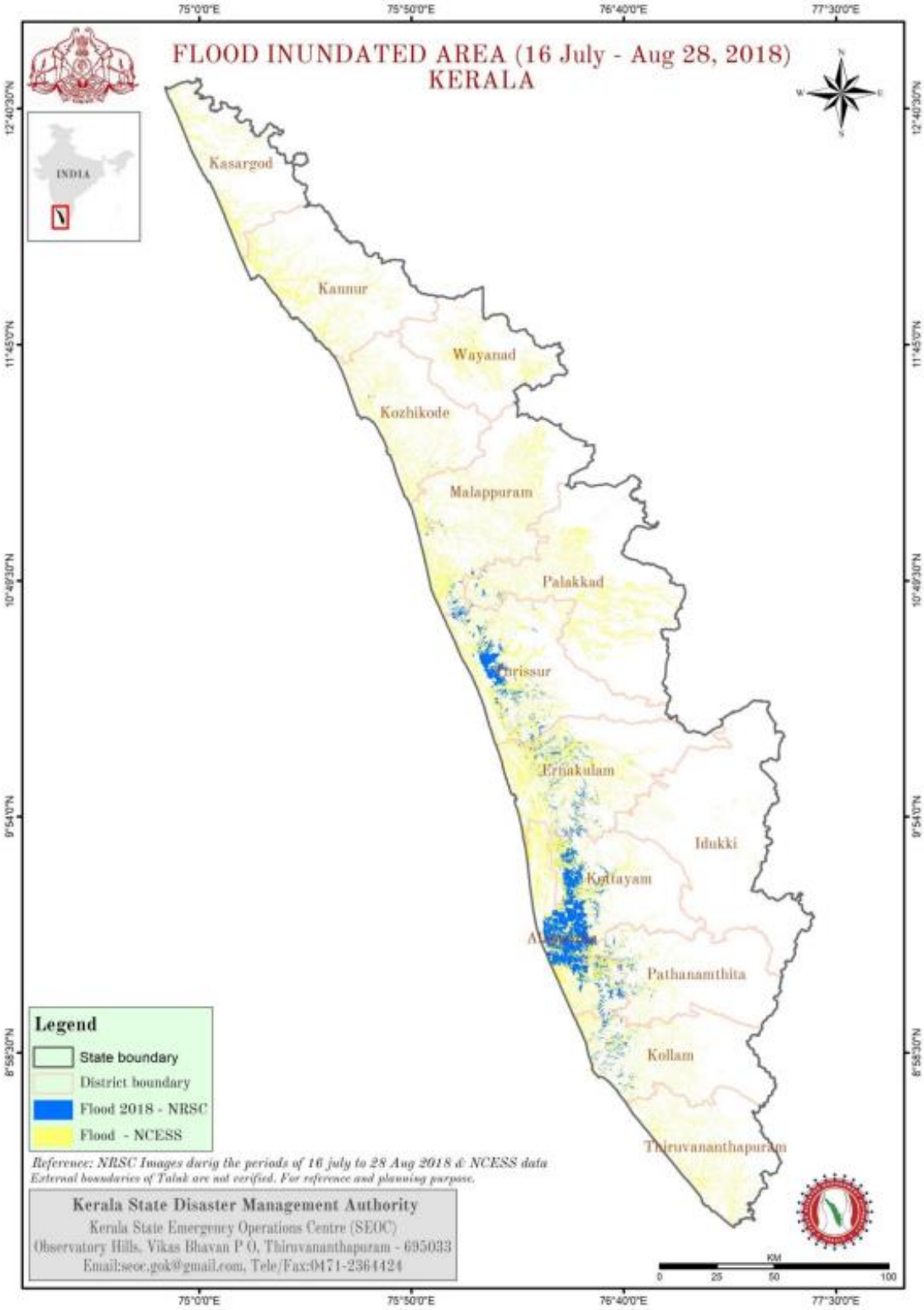


Map 2: Rainfall departure for the month of July 2018



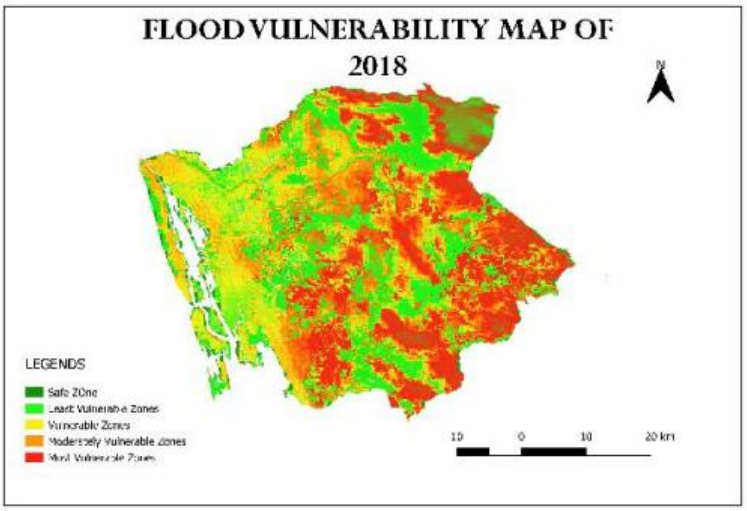
Map 3: Rainfall departure for the month of August 2018

Map 4: Accumulated rainfall (in mm) 1st to 19th August

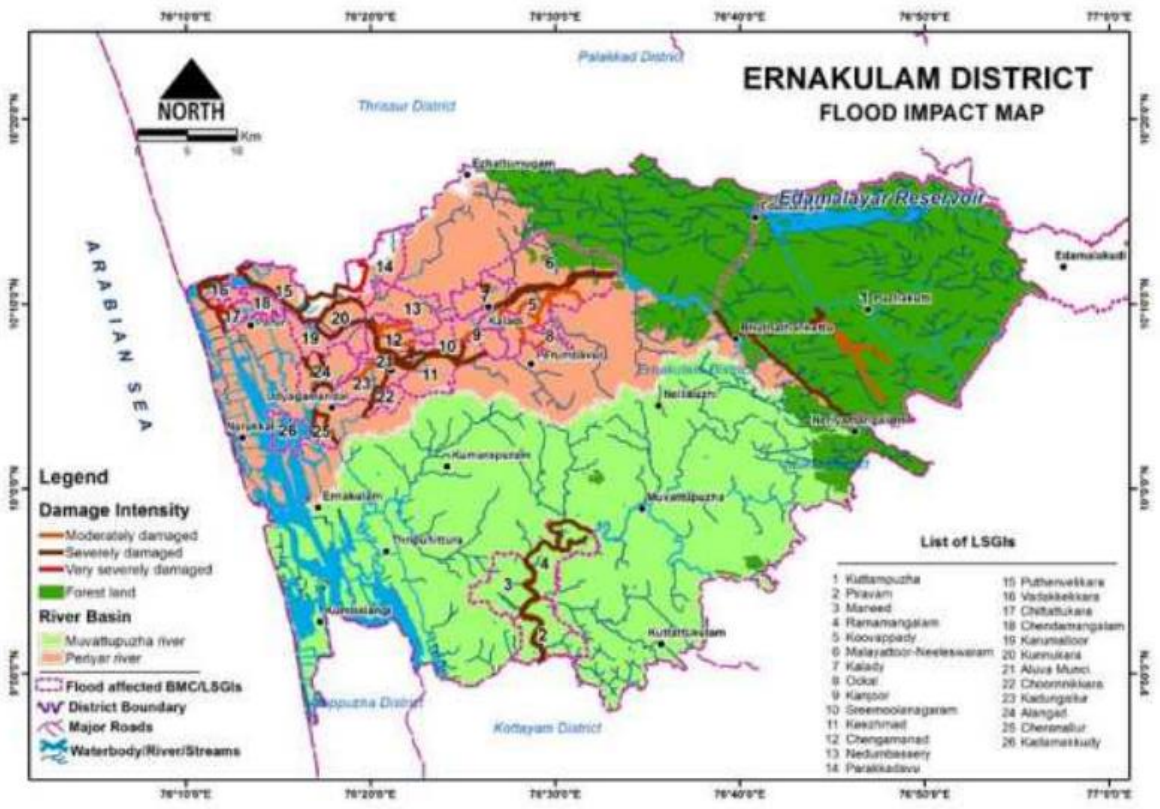


Map 5: Flood-affected areas as derived from Radar Images plotted against the flood-prone regions of Kerala

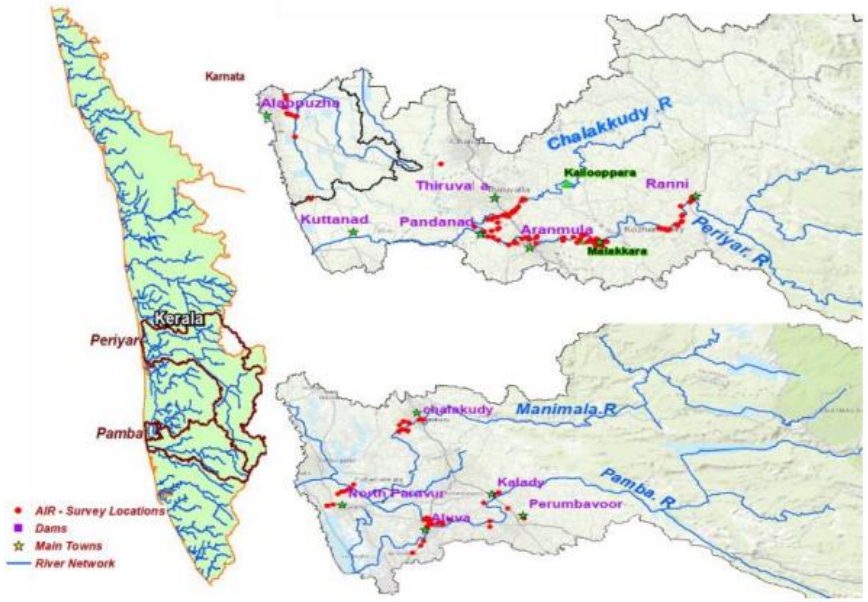
Map 6: Flood-affected areas of Kerala



Map 7: Flood vulnerability map of Ernakulam district in the year 2018

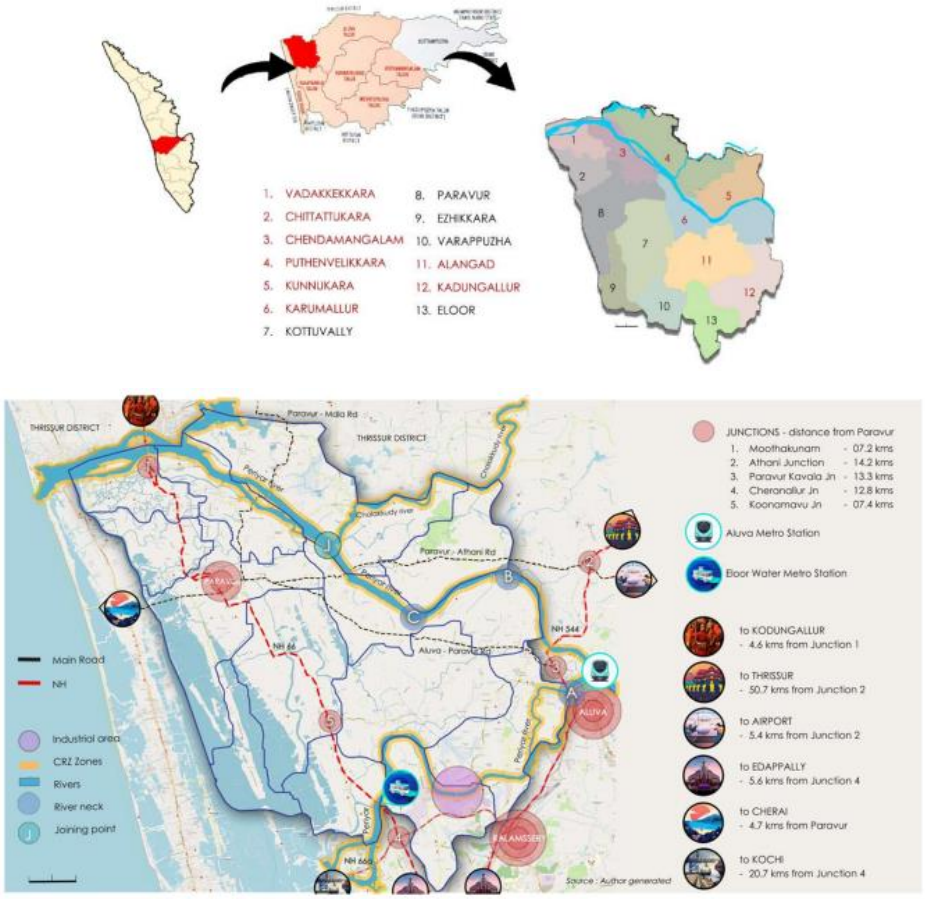


Map 8: Ernakulam district – Flood impact map



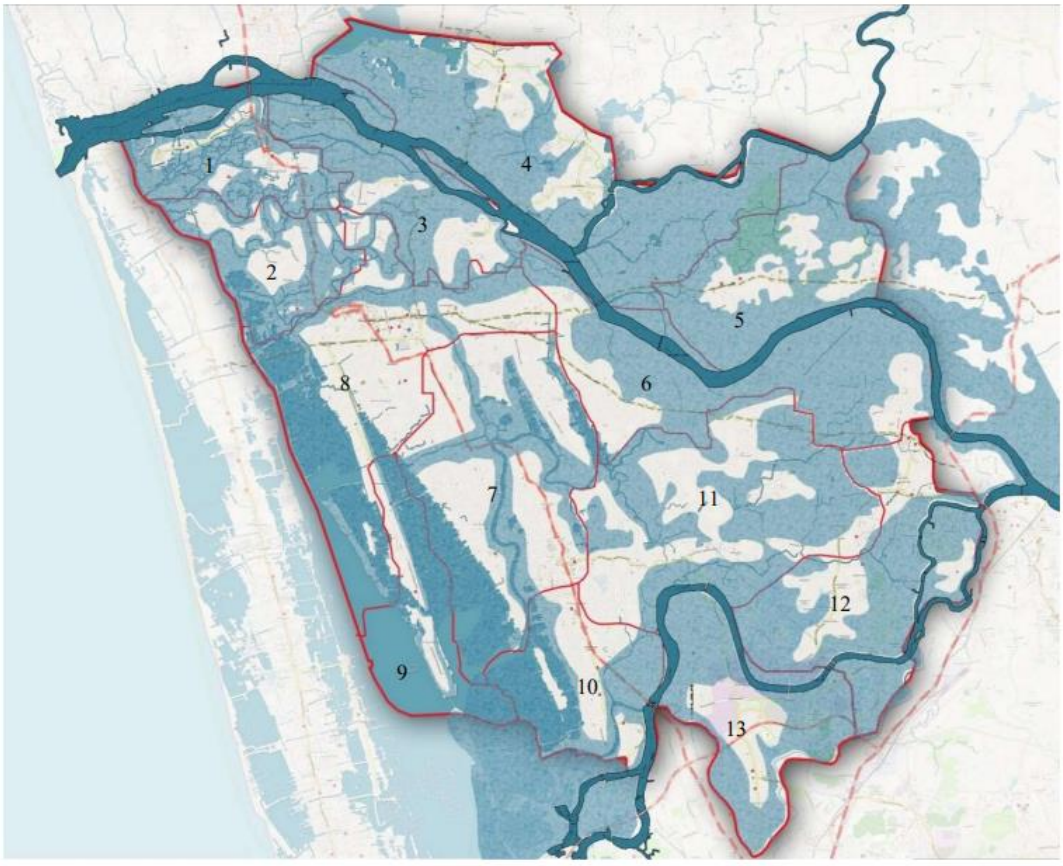
Map 9: Map assessing damage in the Pamba, Chalakkudy, and Manimala River basins

Map 10: Aerial images of Aluva on the banks of Periyar River (left); flood extents on 15th August (center); and AIR 100-year extents in blue on the aerial image (right)



Map 11: Paravur Taluk

Map 12: River map of Paravur Taluk

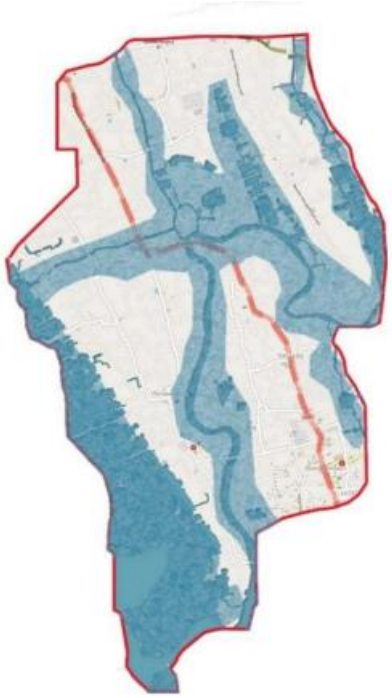


Map 13: Flood map of Paravur Taluk

Map 14: Eloor municipality

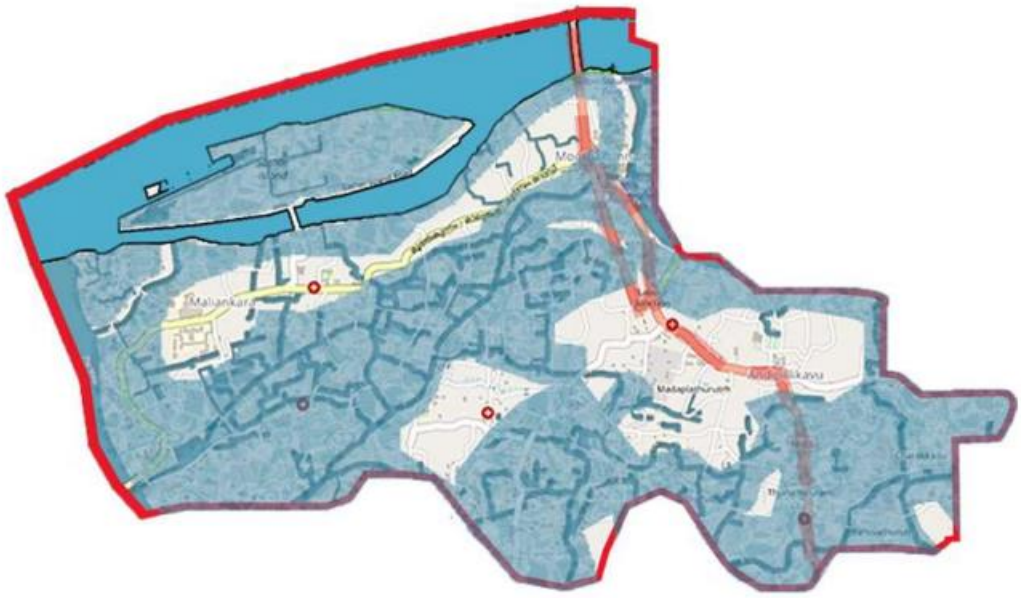
Map 15: Paravur municipality

Map 16: Ezhikkara panchayat

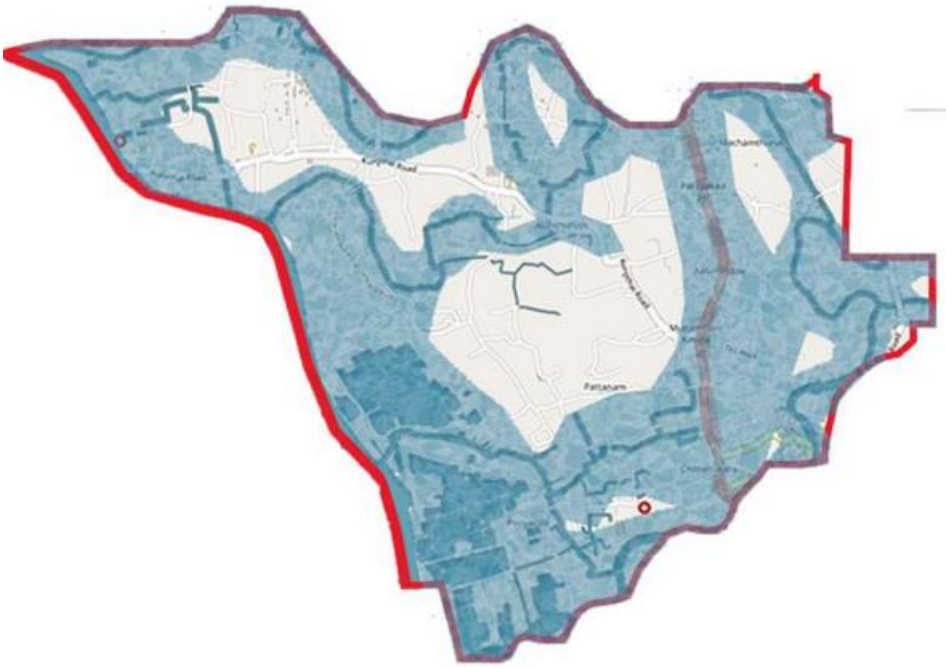


Map 17: Kottuvally panchayat

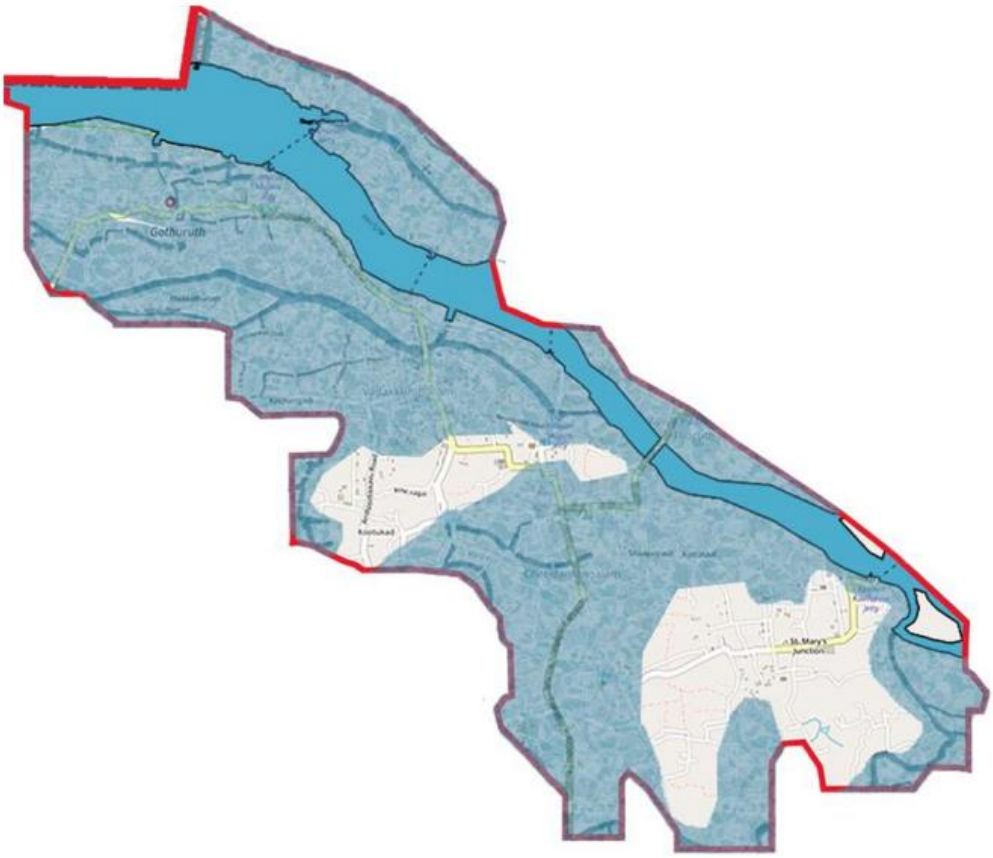
Map 18: Varapuzha panchayat



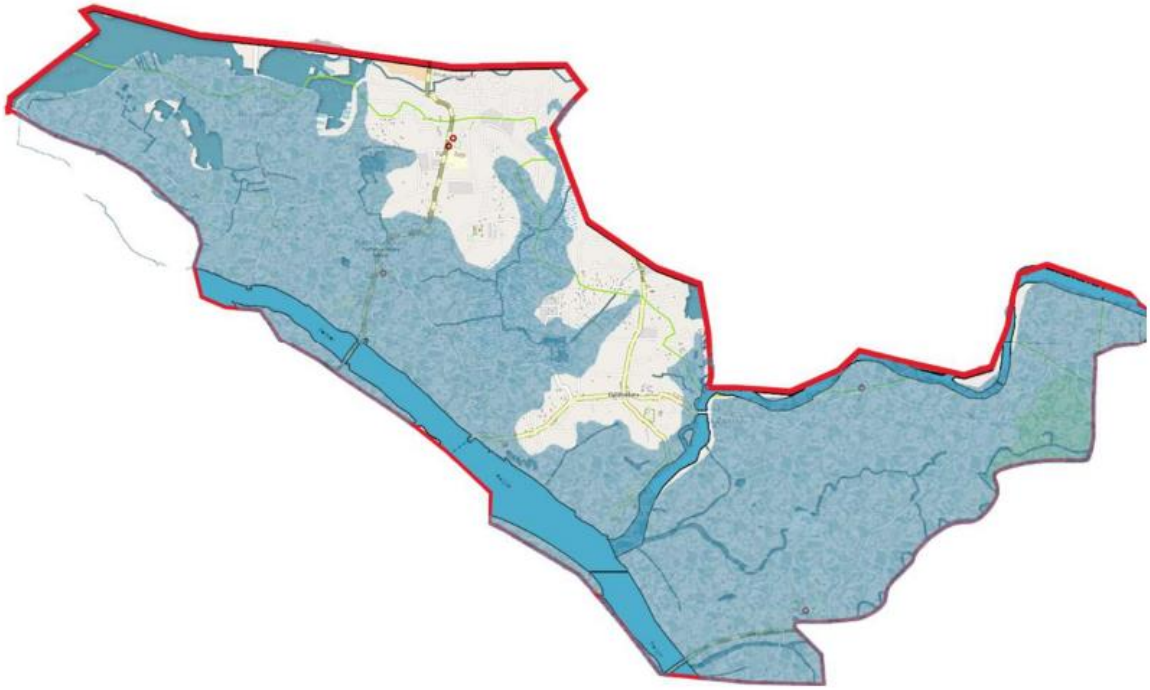
Map 19: Vadakkekkara panchayat



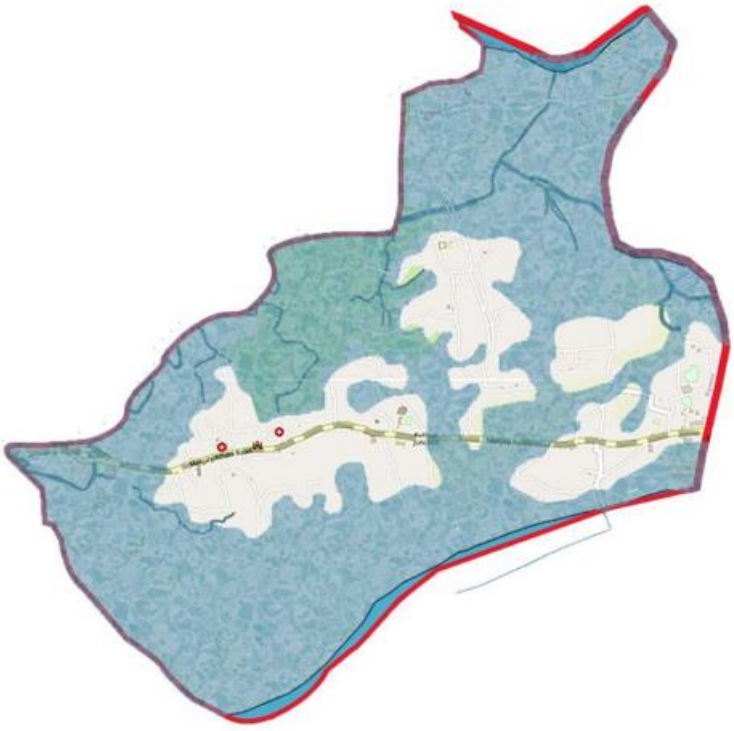
Map 20: Chittattukara panchayat



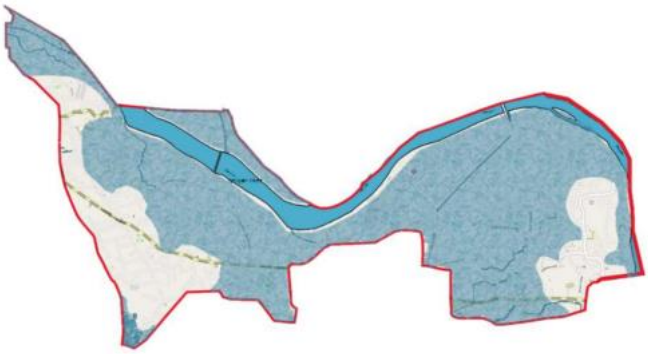
Map 21: Chendamangalam panchayat



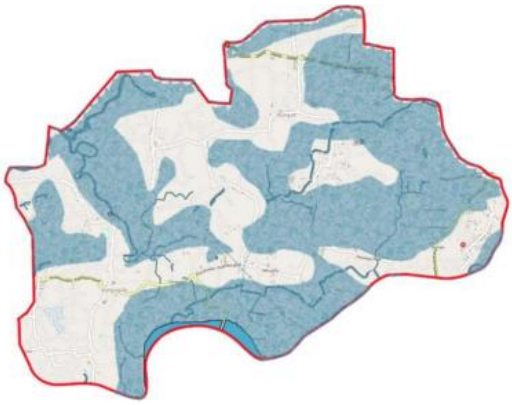
Map 22: Puthanvelikkara panchayat



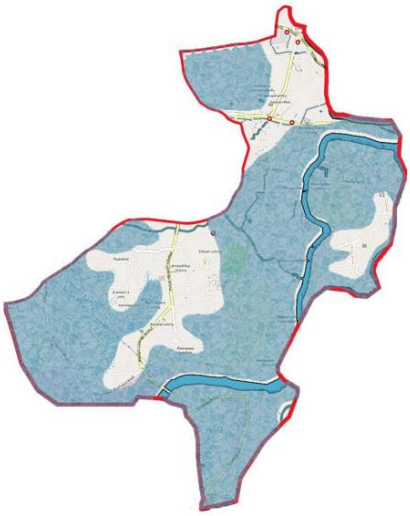
Map 23: Kunnukara panchayat



Map 24: Karumallur panchayat



Map 25: Alangad panchayat



Map 26: Kadungallur panchayat

APPENDIX 3: PICTURES

High water marks on residential buildings flooded by Periyar River waters

Road destruction due to flood

Inundated Cochin International Airport Limited (CIAL)

Kudumbashree workers helping the relief camps

Fishermen rescuing

Elephant’s lifeless body floats in flood water

Chendamangalam during flood

Rescue operations

Flooded Paravur market

Flood affected people of Paravur

Flooded Chendamangalam Panchayat office