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Recommendations on Fluvial Flood Management in Kerala Context

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ABSTRACT: One of the most hazardous problems on the planet today is Flooding, which has been happening more regularly recently.Comparing Kerala to the other Indian states, Flooding is a problem that Kerala is far less prone to. With its recent devastation, the 2018 flood demonstrated its intensity and impact on the socioeconomic, psychological, infrastructural, etc. Future-focused flood management should address where river floods are most severe and effectively controlled. The study covers mitigation, management, and suggestions for creating fluvial flood management to better prepare for Flooding worldwide.

KEYWORDS: Flash flooding, Inundation, Fluvial Flooding.

I. INTRODUCTION

Kerala experiences floods because of the heavy monsoon rains, and the severity of the Flooding worsens as the climate changes. As more people live in flood plains and water bodies and wetlands are reclaimed, flood damages rise. The general area of the State is susceptible to Flooding at 14.8%. Kerala had 2346.6 mm of rain between June 1 and August 19, 2018, compared to an estimated 1649.5 mm, or 42% higher than typical, according to IMD statistics. In 2019, the monsoon rains returned and caused considerable Flooding.As a precaution owing to the recent intense rains, the India Meteorological Department issued red alerts in 9 districts in Northern and Central Kerala, orange alerts in 3 districts in Central Kerala, and yellow notices in 2 districts in Southern Kerala.

In 2020, Kerala faced significant monsoon floods for the third consecutive year. Thousands of individuals have been transferred to refugee camps or other safer locations. In 2020, 104 people were murdered, and 40 were wounded in Kerala's 14 districts. On August 7, 2020, five sections experienced Flooding (Idukki, Wayanad, Malappuram, Thrissur, and Kottayam). The rain got harder starting late on October 15, 2021. According to the authorities, the areas most severely impactedare Kottayam and Idukki, which got 164.5 and 305.5 millimetres of rain, respectively. This research looks at risk reduction strategies and the impacts of river flooding in Kerala, both before and after it has been controlled.

NEED FOR STUDY

One of the most catastrophic natural catastrophes in the world, Flooding, has been on the rise recently. Floods interrupt transportation and communication networks, harm the environment, infrastructure, social well-being, and economic stability, and result in fatalities.

Kerala has seen increasing Flooding in recent years, underscoring the significance of fluvial flood management. Damages from Flooding are getting worse and are increasingly challenging to control. Create plans for risk management, public awareness campaigns, and mitigation techniques to ensure the issue is under control.

RESEARCH QUESTION

- What factors are impacted by Flooding?
- What flood management capabilities result in an effective planning measure to enhance vulnerable communities?
- In the event of Fluvial Flooding, how can the deluge situation be managed and mitigated?

AIM

To develop planning recommendations for the effective management of the impact of fluvial Flooding in Kerala

OBJECTIVES

- To understand Floods, Flood management, Fluvial Flooding, its types, causes, impacts and effects.
- To study Fluvial Flooding in Kerala, causes, impacts, issues, Managemental involvements, Mitigation measures, Methods adopted, etc.

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- Observe and analyse different planning measures, risk reduction strategies, protection of the riverbanks, and planning interventions.
- To develop planning recommendations for the management of Fluvial Flooding in Kerala.

SCOPE

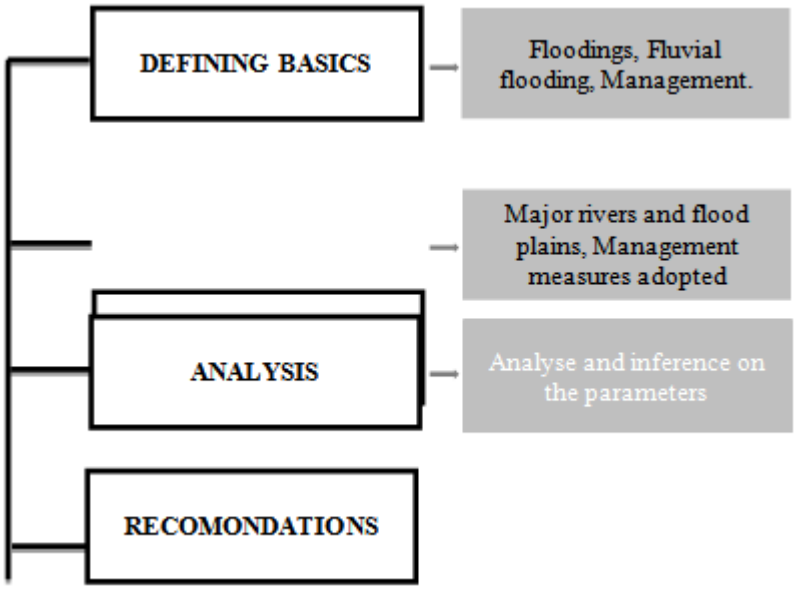
Most of the 2018 floods in Kerala, where one-sixth of the population was directly impacted by flooding and related occurrences, necessitated flood management due to an intense monsoon period's several flood scenarios surges. In the upcoming years, there will be more rain, which will be problematic in every way.

To minimise riverine flood casualties as a forward-looking approach, the study focuses on an efficient planning method for flood control.

LIMITATION

- The study is limited to the Flood events that happened after 2018

II. METHODOLOGY



III. LITERATURE REVIEW

When water overflows its banks, whether they be natural or artificial, and lands on ordinarily dry terrain, as happens when a river floods its floodplain, a flood occurs. Floods may have various negative consequences on human health, ranging from specific blessings to catastrophes. (Britanica, 2022)

Fluvial Flooding - A fluvial or river flood happens when the water level in a river, lake, or stream rises and overflows onto the banks, beaches, and nearby land. A river flood may be highly destructive since the overflow affects smaller rivers downstream, causing dams and dikes to break and drowning nearby areas. The water level may have increased due to excessive rain or snowmelt.

Overbank Flooding - Flooding, defined as "overbanking", occurs when water levels rise and spill over riverbanks or streams.

Flash flooding - An intense, swift stream of water that occurs abruptly in an established river channel is known as flash flooding.

Flood management –

Flood control - all techniques employed to lessen or stop the negative consequences of flood waters.

Flood relief - There are techniques to lessen the consequences of floodwaters.

An emergency management strategy consists of four steps: mitigation, readiness, response, and recovery.

Floating and Amphibious housing – These homes are made to float in water and may change shape to accommodate shifting water levels. Unlike floating houses permanently submerged in water, amphibious dwellings usually rest on concrete foundations and are attached to flexible mooring poles. The fasteners confine the motion of the water to the mooring posts. If the water level rises, they could float and move higher. These buildings

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adapt to changing water levels and effectively manage Flooding.

Room for the river –

A Dutch flood control scheme includes a variety of measures, including deepening rivers, storing water, altering dikes, creating high water channels, reducing floodplains, lowering groynes (structures put into rivers that restrict water flow), or eliminating polders (tracts of land surrounded by dikes). In the 1990s, excessively high-water levels in the Netherlands caused various problems, which prompted the creation of "Room for the River" as a novel approach to dealing with high water levels in and around rivers. By creating "room for the river," landscapes next to waterways can be improved so that they will serve as "natural water sponges" in the event of a flood.

IV. STUDY AREA

INTRODUCTION

One of the most populated states in India is Kerala. Sized at 38,863 sq. km., it has a population density of 819 people per sq. km. The area, located southwest of the Indian peninsula, is bordered to the east by the Western Ghats and to the west by the Arabian Sea. According to the physiography, the Resource Atlas of Kerala from 1984 shows five zones from west to east: highlands and peaks (>1800m), highlands, midlands, lowlands, and coastal plains andlagoons.

Kerala flood map

Kerala has a history of Flooding that dates back to 1907; the most destructive flood occurred in 1924, and then there is the instance of the present flood scenario in 2018.

Kerala's demographic profile -A population of 3.34 crores (2011) and 3.18 crores, respectively (2001). In 2011 and 2001, the population density was 860 square kilometres and 819, respectively. In 2011 and 2001, the literacy rate was 94% and 90.86%.

RAINFALL AND FLOOD

90% of the rain that falls in Kerala annually—an average of 3000 mm—occurs during the six monsoon months. The monsoons govern rainfall in the State in the southwest and northeast. High-intensity storms during the monsoon season cause significant Flooding in all rivers. The steep and undulating terrain receives a lot of precipitation, which finds its way into the main rivers via several streams and waterways.

The State of Kerala saw the worst floods in decades in 2018, thanks to hefty rains between June 1 and August 19. Kerala received 2346.6 mm of rain from June 1 to August 19, 2018, against the anticipated 1649.5 mm, according to IMD figures (CWC, 2018). 13 districts saw devastating Flooding as a result.

RESERVOIRS IN KERALA

Four of Kerala's 57 large dams are managed by the Tamil Nadu government. Kerala's total capacity for live storage is 5.806 BCM or 7.4% of the average annual flow of 44 rivers (78 BCM). 74% of Kerala's whole live storage is housed in seven reservoirs with live capacities of more than 0.20 BCM. As a result of the catchments' significant rainfall since June 1, there has been consistent rain, and several reservoirs have nearly reached total capacity (FRL). Devastating Flooding occurred in 13 of the 14 districts due to yet another bout of heavy rain that started on August 14 and continued until August 19.(CWC,2018).

Map showing dam locations in Kerala

MAJOR RIVER BASINS

The elevation of Kerala spans from 48 m below sea level to +2692 m, with 35 percent of the region between 0-50 m, 39.82 % between 50-500 m, and % of the territory over 500 m receiving a substantial quantity of rainfall every year.

Major River basins affected by Flooding are Periyar, Pamba, Chalakudi, Bharathapuzha andKabini sub-basins

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Major River basins in Kerala

The Periyar is Kerala's longest river, measuring 244 kilometres in length. The basin's overall drainage area is 5389 sq.km., Distribution of the drainage area of Kerala and Tamil Nadu over the share is 5284 sqm and 114 sq km, respectively, which is about 98% for Kerala and 2% for Tamil Nadu.

Map - Periyar sub-basin

The Periyar river drains an area of 4,033 km2 up to the CWC gauging station at Neeleshwaram. The Mulla Periyar, Idukki, and Idamalayar dams provide a large storage area for the Periyar sub-basin. The river catchment area of the Mulla Periyar dam is approximately 637 square kilometres. About 605 square kilometres of the free catchment area are between Mulla Periyar and the Idukki dam. Idamalayar Dam's catchment area is roughly 472 square kilometres.

The third longest river in Kerala is the Pamba, which is 176 kilometres long. The Pamba, Kaki, Arudhai, Kakkad, and Kall rivers converge to form it.On the Peermedu Plateau, where the Pamba Aar rises at 1670 meters, there are hydrological observation stations at Kalloppara (Manimala) and Malakkara (Pamba). The river divides to the west around Pandanad, and Manimala meets Pamba at the Neeretupuram branch before flowing north through several components into the Vembanad lake (Pallathuruthy Aar and the Nedumudy Aar). The Pamba basin's biggest reservoir project is the Kakki dam.

The environment is characterised by plentiful rainfall, mild temperatures, and a humid atmosphere. A total of 487 MCM, or 10.5% of the average annual runoff of 4.64 BCM, is available for active storage. Nearly 92% of all live storage in the Pamba sub-basin is in Kakki storage. Next to Kakki storage is Pamba storage (live storage only 31 MCM). The Pamba sub-basin contains eight dams and one barrage. The total live storage capacity of all other reservoirs and barrages is just 9 MCM.

Map - Pamba sub-basin

The Chalakudy River, the fifth-longest in Kerala, is created when five streams—Parambikulam, Kuriarkutty, Sholayar, Karappara, and Anakkayam—all have their origins in the Anamalai Hills of the Western Ghats. The Periyar subbasin in the south and the Karuvannur subbasin in the north serve as the boundaries of the Chalakudi river basin. The wetland covers over 30,000 hectares of the basin. The average annual rainfall in the region is about 3000 mm. 1704 square kilometres make up the whole drainage area of the river, 1404 square kilometres of which are in Kerala, and 300 square kilometres are in Tamil

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Nadu. About 130 kilometres make up the river's length.

Map –Chalakkudy river basin

CAUSES OF FLOOD

- Dam authorities want the essential information to assess the relationship between rainfall totals in various catchment regions and the pace of increase in reservoir water levels.
- Storage capacity was decreased because of inadequate maintenance and desilting.
- The cross-section of the river was hindered by the growth of artificial islands in the riverbed.
- With less forest area, land use patterns have changed.
- Simultaneously, all dams were opened.

IMPACT ON SECTORS

Dam management and Power generation–

In Kerala, during June, July, and August, the water level in the reservoirs frequently exceeds 40–50% of their capacity. Near the conclusion of the northeast monsoon is often when the Kakki, Pamba, and Idukki reservoirs have their maximum water levels. The separate power stations' poorly managed electricity generation resulted to extremely high-water storage levels. Suppose electricity output could be managed and surplus water from the different dams could be discharged at the right times by opening the corresponding spillways. In that case, the water levels in the reservoirs could be reduced to a much more manageable level.

Agriculture –

Agriculture suffered major crop and output losses because of the flood. Floods were a major blow for farmers who were already under pressure from unsustainable crop prices. Crops that were being raised suffered greatly at the hands of diseases. The wetland in Kuttanad needs special care since it has a distinctive ecology that is frequently impacted by floods and other natural calamities.

Housing–

The 2018 flood extensively destroyed homes. Many individuals had to be moved, and those who lost their houses were particularly hard impacted because many of the investments they had made in their lives were destroyed. Extreme psychological tension is produced by it. Thus, it requires the most urgent assistance.

The number of dwellings destroyed exceeds 15,000.

More than lakh homes have sustained partial damage and must be renovated, retrofitted, and repaired.

Environment -

Upstream, silt and sediment deposits may accumulate.

Riverbanks and natural levees are eliminated.

Both terrestrial and marine environments are impacted.

Transportation –

According to the R&BD's primary and secondary data, the recent floods severely damaged about 2,004 km of SH and 13,246 km of MDR in 14 districts. Additionally, the NH wing assessed that around 580 kilometres of NHS have suffered damage (RGIDS, 2018).

Infrastructure –

The State's infrastructure sustained severe damage due to several roadways and bridges being destroyed or damaged. Additionally, thousands of dwellings were injured or killed.

Social - At least 483 people died while thousands of animals perished.

Economic –

Floods have direct and indirect consequences on the economy, with direct effects on those immediately impacted and indirect implications on those affected by the tragedy's physical and social repercussions.

INITIATIVES TAKEN

With community mobilisation, efficient use of information technology, and social media by volunteer youth organisations, Kerala's government carried out timely and effective rescue and relief measures. The people of Kerala also showed tremendous fortitude in the face of adversity, with most citizens returning to their homes to rebuild their lives within a week of the flood waters

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receding. Even though many of their own families and properties were damaged by the floods, government administration continued to function normally during relief efforts. Kerala State Disaster Management Authority (KSDMA) was instrumental in planning an emergency response, rescue operations, and relief activities during and after the floods. The camp residents received relief supplies such as emergency food (rice, wheat, and pulses), drinking water, kerosene, and other life-saving commodities. Food packages and financial aid of Rs. 10,000 per family were distributed for cleaning flooded homes.Kudumbashree, the State's well-known women's empowerment and poverty eradication programme, was heavily involved in these initiatives. Members of Kudumbashree cleaned homes and government buildings, offered family counselling, oversaw community kitchens in affected areas, gathered relief supplies and distributed them in camps, assisted with the assembly of take-home kits, provided volunteers for various tasks, housed flood victims in their homes, and carried out mass cleaning operations in some districts.Additionally, they raised about Rs. 11.2 crores in donations for the Chief Minister's Disaster Relief Fund.

V. ANALYSIS

The best illustration of the magnitude of the harm and fatalities that may result from a significant flood catastrophe is Kerala, one of the states with the most excellent population density.Kerala is notorious for having small floods, even though structural systems for flood management were well-balanced and generally appropriate when they were developed. Due to a dramatic history of Flooding that happened twice or three times in a century, the State was devoid of the concept of flood control for a very long period.

However, due to insufficient maintenance and forecasting of the same in the State on 2018 Floods, the immediate impacts of natural processes like heavy rain, cloudburst, and other quick biological processes cause severe damage. Because shallow and steeply moving rivers have a high threshold for Flooding, the State was unprepared for the significant flood episodes.

VI. RECOMMENDATIONS

- Make and include pre-project preparations for moving and rehabbing residents predicted to be displaced by the flood while considering their sociocultural and livelihood needs.
- Solutions such as building canals and rerouting should be considered to reduce Flooding.
- To protect the riverbanks, biomaterials must be employed for biofencing, and the utilisation of riparian techniques alongside natural forms of embanking with natural solutions must be considered.
- Encroachments on riverbanks must be stopped immediately since they provide risk and expose the region more.
- A geological assessment of the suitable housing location must be done before relocating the homes, and a certificate must be produced.
- Amphibious architecture incorporating bylaws at the beginning with the flood-prone structures is to be prioritised in construction with the introduction of new Flood adaptable designs.
- Significant capacity training of local engineering cadres is required to adopt improved designs as a disaster risk reduction strategy for roads and other rural infrastructure to prevent future risks.
- Knowledge may be accessed in communities by teaching the weak about necessary mitigation strategies and tackling floods from an inclusive perspective.
- By implementing policies and laws and placing development limits over flood-prone areas, control land use planning aims to change planning legislation and regulations.
- Debris removal, de-siltation techniques, asset status monitoring, and upkeep.
- By creating multi-utilitarian places with greenery and open parks above the low-lying/flood plains, interactive landscape zoning can help reclaim the flood lowlands.

VII. CONCLUSION

This study's primary goal was to examine Fluvial Flooding in Kerala, its effects, underlying causes, and analysis while considering the flood events of 2018.The reaction to floods was often associated with methods like tying social media platforms together for data sourcing, post-flood management methods like debris cleaning and resource allocation, evaluating and relaying data to the recovery troops, etc.

For a suitable and sustainable approach to adapting to floods, more studies must be done on micro-scale flood control, considering the spatial structure and surrounding characteristics.

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