

The River Pamba in Kerala and Thottappally: Strategies for Preventing Floods

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ABSTRACT:

In Kerala's Pathanamthitta and Alleppey districts, the Pamba River has considerable cultural and historical value. Kuttanad, Kerala's rice bowl, gets its water from this river. Thottappally and other settlements were destroyed by the 2018 floods on the Pamba River. Thoothappally spillway connects Vembanad Lake to the Arabian Sea through the waterway. Historically, Thottappally and the surrounding Kuttanad region have experienced seasonal as well as unseasonal floods. Proper procedures and processes must be put in place in order to offset this. Last but not least, having the ability to accommodate an influx of new clients is critical. As a consequence of the recent flooding in Thottappally, there are a number of concerns that need to be addressed.

These include Kuttanad Lake and paddy cultivation, as well as rain and monsoons.

INTRODUCTION

Flooding is common in Kuttanad and the surrounding region. These conditions warrant the use of the word "waterlogging," not floods. Kuttanad is vulnerable to flooding because of its low height. As a result of heavy rainfall in the Kuttanad area of Kerala, a water spillway was built in 1955. Just 600 cubic metres per second of discharge capacity was discovered upon its commissioning, a far cry from the projected 19,500 cubic metres per second that was expected. The Thanneermukkom bund was built to keep seawater out of Kuttanad during the rice harvest season. Only in Kumarakom can you find rice being grown below sea level.

Due to the devastation caused by the monsoons, Kerala's rice bowl, Kuttanad, is often in the news. These rivers both bless and harm Kuttanad. Keeping their enterprises afloat requires a careful balancing act between drowning in the floodwaters and keeping afloat on land. Thottappally and Thanneermukkom are home to four rivers that empty into the Arabian Sea: the Pamba, the Manimala, the Achankovil, and the Meenachil. The Thottappally spillway allows the Muvattupuzha River to enter Vaikkom Lake at the same time. More rain than the Vembanad Lake can hold during the monsoons, as shown by a study conducted lately in the area between Thottappally and Thanneermukkom. Flooding in Kuttanad was spurred by a recent flood in Kerala and an examination of Thottappally, a community in the area. Long-term planning necessitates the implementation of flood control systems.

Kuttanad Kumarakom, a region in Kerala, is the state's primary rice-growing area. Only a handful of areas on the planet are home to a sizable population that cultivates rice below sea level. You may be 12 feet below sea level, depending on where you are. Vembanad Lake's paddy fields are a popular tourist destination in India. Kuttanad is divided into three distinct regions: Lower, Upper, and North Kuttanad.

According to the Food and Agriculture Organization (FAO), South India's polder farming system in Vembanad Ramsar has been designated as a "important agricultural heritage system" (GIAHS). Kuttanad's rivers and rice fields have been polluted by the usage of diesel boats by tourists. Despite the loss of Kuttanad's water biodiversity, farming remains very unprofitable. When given the chance to regain its natural equilibrium, the Kuttanad area has been declared a "GIAHS" (Jacob et al., 2018).

Paddy fields that have been restored from the Vembanad backwaters are used to grow the crop. This is mostly because of the recent floods in Kuttanad, which severely disrupted the lives of those who live there. Construction of the Thanneermukkom bund and the Thottappally spillway made landscaping simpler. many times each year (Chandran and Purkayastha, 2018).

The Pamba River in Kuttanad

Pamba River: The 176-mile-long River Pamba is inseparable with Kerala's history and culture. It runs through Pathanamthitta and Cochin in Kerala, as well as the state's rice bowl, the Pamba River. Eastern and Western Ghats,

and the Pampa basin and Arabian Sea to the west, surround it. The Pampa basin, which comprises the Manimala River to the north and the Achankovil River to the south, provides more than 80% of Kerala's water and electrical needs. It flows Vembanad Lake in Mullappally, Alleppey district, Kerala, and the Thottappally spillway Near Kuttanad, the Pampa River is fed by a number of other rivers. The Pulachimalai hills near Peerumedu provide water for the Pampa dam and several smaller dams in the Sabarigiri hydropower complex.

The Manimala River receives its water from the Western Ghats' Muthuvara Hills. The Pampa River and the Manimala River have long been considered separate entities. Several location-based mapping systems, such as Google Maps, have shown this to be untrue throughout the years of their use. In Kuthiathode, only near Kallunkal do the Pampa and Manimala rivers really split. Water from the Nedumpuram tributary of the Pampa River, which splits from the Manimala at Nedumpuram, flows into many districts of Kerala. The Kuttanad area is home to Vembanad Lake.

Several Western Ghats streams flow into the Meenachil River, which is fed by the water. The Meenachil River flows through Poonjar, Teekoy, Erattupetta, and Pala in the Kottayam district. Kumarakom, a prominent tourist destination situated near the Thaneermukkom Bund, receives its water from the Meenachil River.

Rishimala, Pasukidamettu and Ramakaltheri rivers all feed into the Achankovil River. The 128-kilometer course of the Pampa River culminates at its mouth. Veeyapuram near Thottapally in Pathanamthittan district is where one of the world's most renowned rivers meets with another. The Achankovil Forest in the Kollam area is said to be the river's source.

Kerala's Muvattupuzha River runs through Ernakulam, making it a vital waterway. Thodupuzha River tributaries combine into a single stream. Upstream of an important bridge connecting the two rivers, this bridge crosses across a confluence. Muvattupuzha, the confluence of these two rivers, was the birthplace of the name. After the confluence, the river was given the new name Muvattupuzha River. Before joining Vaikkom Lake, it continues its own route.

There are four rivers that flow into Vembanad Lake: Pampa, Meenachil, and Achankovil. The Muvattupuzha River also provides water for Vaikkom Lake. From Vembanad Lake, there are only two options for getting to the Arabian Sea: either by boat or by aircraft. Two examples are the Thanneermukkom Bund and the Thottappally Spillway. These structures keep Kuttanad dry at high tides. Because of this, they were able to grow rice in this mineral-rich river basin.

Thottappally has a spillway.

Construction of the Thottappally Spillway, completed in 1955, enabled water from the Pampa river basin to be diverted to this location. Canals near Kuttanad on the Arabian Sea are often blocked by increasing water levels during the monsoon season. The spillway's shutters must open and close in response to changes in water levels in order to function properly. It is essential that no salty water enters the system. Saltwater will reach Kuttanad before the completion of the Thottappally dam.

There was only one crop that could be cultivated at a time because of this. This has to be done during low tide. Nature has wreaked havoc on the lives of Kuttanad farmers many times during the monsoons and when sea levels rise. This led to the construction of the Thottappally Spillway. During the dedication ceremonies for all three buildings, official keepsakes were given out. Kuttanad's monsoon floods take a long time to recede, according to this historical record. In December, the saline water in Kuttanad renders the land unusable as an agricultural location for any reason. It was found during working on the land that it had formerly been home to trees. Fresh evidence that this site had previously been submerged in the water was discovered by piling. The spillway was built with the help of 40 four-ton shutters.

Water levels in Kuttanad rose beyond permissible levels during the southwest monsoon due to flooding from river systems. After the north-east monsoon ended, low-lying areas of the region were flooded in order to cultivate a second crop in October. To avoid flooding, water might be channelled to the river. In the early 1930s, a thorough hydraulic research revealed that the flood boundary's southernmost extremity was in the Arabian Sea. Kerala's Alappuzha district is home to a spillway built in 1951, around 20 kilometres south of Alappuzha.

During the monsoon season, up to 90% of the floodwaters that reach the Kuttanad area are forced out to sea. Due to increasing sea levels, a new spillway was required. designed with this in mind.

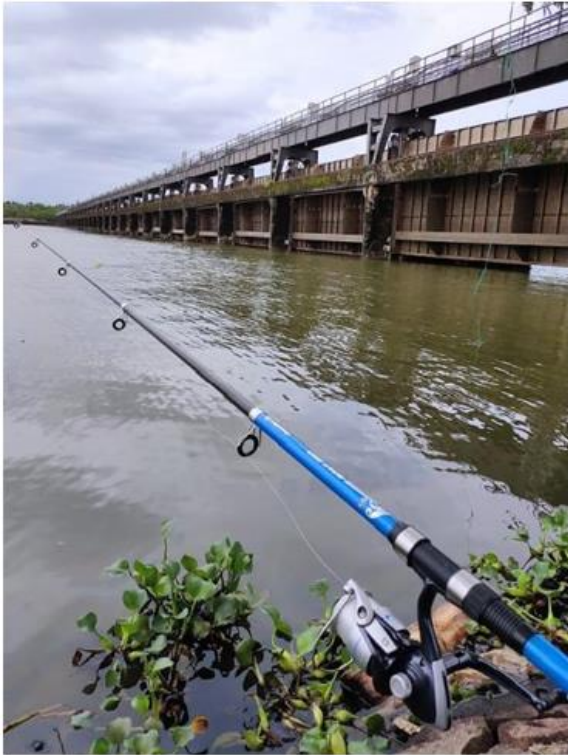


Fig. 1. Thottappally Spillway, Kerala

The sand bar on the seaward side of the spillway was not taken into consideration during the monsoon months. Hence, when the spillway was built in 1955, the actual capacity of it was less than one-third of the predicted capacity, and thus it was unable to fulfil its intended function (Thomas, 2002).

To alleviate flood conditions in the Kuttanad region, the Thottappally spillway was built in 1955 as part of Kuttanad's development plan to redirect the flood waters of Pamba, Manimala, Achenkovil and Meenachil straight to the sea. According to reports, the spillway's design capacity was 1812 cumec, but the current average maximum flow is only 630 cumec, which is less than a third of the spillway's design capacity (SRF Report, 2007).

In the Interest of Full Disclosure,

Paddy farming in Kuttanad has been marked by the erection of permanent outer bunds surrounding the R Block kayal lands in 1961 under the R Block-Holland Project. There was no way the mud embankments erected as part of the reclamation project could survive the constant wave action. During the monsoon season, several of them were submerged in floods. As part of Holland's R Block-Holland Scheme, bunds that stood six feet above the MSL with 10 feet of top width and a total length of 10.4 kilometres were built around R Block Kayal Lands in the R Block area of Holland (Thomas, 2002).

The Bund of Thanneermukkom

The Thottappally spillway in Alappuzha district would add a new bund to Thanneermukkom. A salt water barrier has to be built for this undertaking.

As part of the Kuttanad Development Scheme, it works to keep saline water out of the Thanneermukkom and Vechur regions to the west and east, respectively. The Thanneermukkom Bund was first used in 1976, a year after it was initially constructed. In the immediate area, fisherman have raised a wide range of concerns about the

development's effect on the environment. Invasive water plant water hyacinth and an ecological imbalance in this area are key concerns.. There are 62 shutters on the Thanneermukkom bund. During the early stages of reclamation in Kuttanad's kayal fields, puncha crop damage has been a regular problem. It was hoped that reducing saltwater intrusion into the Kayal plain to the south of Thanneermukkom during the summer months would be beneficial.

In order to safeguard the summer crop from water salinity, the project was designed to allow for a second harvest after Puncha season. The Vembanad kayal is bridged between Vechoor and Thanneermukkom, where the Barrier is situated. Regulations are only lifted in May when the pre-monsoon rainy season begins to enhance flow from feeder rivers. This is done to keep salty water out of the lake. Most Puncha farms have been able to grow a second crop because to the deployment of this barrier (Thomas, 2002).

What led to the Kuttanad floods in India?

The prolonged downpours that flooded Vembanad Lake to its maximum extent were to blame for this year's devastating floods. A smaller-scale version of this occurred in 2019. Kuttanad is almost guaranteed to be inundated because of its low elevation. Both Vembanad Lake and Arabian Sea emissions demand immediate action. In the event of significant rains, there is no long-term solution, even with the greatest efforts of the administration. Sea levels are rising as a result of global climate change, notably the warming of the planet. Due to the aforementioned conditions, flooding is becoming increasingly common in Kuttanad. There can be little optimism for the future of Kuttanad in light of the existing situation in the area.

Towards the conclusion of the essay, several measures to decrease the impact of future natural calamities are highlighted. Storms, earthquakes, and tsunamis, to name a few, have shown that man has no power over nature. Floods are unpredictable and occur often, making it potential for a civilization to be wiped out. It is thus essential to prepare and execute an efficient disaster management strategy well before a crisis occurs. Due to the Lake's dwindling floodplain area, there will be a greater risk of flooding and destruction. The TSW and its main canal decreased flooding in Kerala's Lower Kuttanad area.

The area's flood control capacities have degraded over the preceding many decades owing to neglect and a lack of collaboration. A degradation in flood flow capacity and inadequate spillway management have devastated 3,500 hectares of rice crops in Kuttanad's Purakkad Kari. Modernization of the TSW, channel deepening and bund protection, and enhanced spillway operation management are among the recommendations to improve spillway operations (SRF report, 2007).

The Kochi outflow of Vembanad Lake, which has a southern Periyar branch north of Muvattupuzha, discharges the lake's four main west-flowing rivers into the Arabian Sea. An inland lake that runs from Munambam in the north to Alleppey in the southernmost district of Kerala, Kerala's Vembanad Lake borders the Alappuzha (Alleppey) region. There are about 200 square miles of surface area on the lake. The lake's depth ranges from 1 to 12 metres throughout its 500- to 4-kilometer width (CWC Report, 2018). This year's four rivers received a significant amount of rain and runoff between August 15 and August 17. When it comes to water sources, there are far more rivers that drain into Lake Cochin than there are rivers that flow into it from north of the Thanneermukkom barrier. Kuttanadu is a marshy delta formed by the confluence of four rivers: the Pamba, Manimala, Achankovil, and Meenachil. Throughout the monsoon season, estuaries may be submerged to a depth of 2.5 metres below sea level, and saltwater intrusion can occur at any time during the summer months when the weather is more conducive. In November 2002, the Vembanad Lake was recognised as a Ramsar Site. The CWC Report for 2018 may be downloaded by clicking [here](#). Because to new land development, the system's capacity has been lowered from 2.4 BCM to an incredible 0.6 BCM (Planning Commission Report, 2008). In the low-lying regions of Thrissur and Kuttanad, satellite pictures and DEM show an exceptionally huge increase in water levels during the 2018 floods (Vishnu et al., 2018).

There is a lot we can learn from the Dutch in terms of North Sea defences.

To become famous, this prosperous country waged a long-running war with the North Sea. This country's construction of the North Marine seawall is a technical triumph. As a result of the North Sea's devastation, persons and property alike were killed or damaged. Flood prevention has been a primary priority for the federal government in the United States since the deadly floods of 1953.

Low-lying land was protected from water intruders by man-made barriers like as dyes. Due to Holland's low altitude, the country has several difficulties. At least 75% of its surface area is underwater. The whole design was built using dams with detachable, hollow, and floating gates. If necessary, they may be taken out. Fish may have been able to readily pass between these gates, preserving a rather steady ecosystem. If the gates are overwhelmed by a storm surge, the sea will be unable to enter. Millions of lives have been spared because to this man-made barrier. The building is held in place by massive pillars, each 30 to 40 metres tall and weighing 18,000 tonnes. This impressive structure spans a distance of almost three km.

Windmills pumping water from dykes kept the North Sea at bay during this period. Traditional dykes have been replaced with computer-controlled barriers and cutting-edge pumps in this present technology. Making this possible has cost millions of dollars. In order to deal with the ever-increasing ferocity of the North Sea, Deltaplan or Deltaworks was created. The Netherlands has more than 3700 kilometres of dykes and dams. Rotterdam's port, one of the world's busiest seaports, cannot be reached by flooding owing to gigantic man-made movable arms. According to some, this robot has been described as the biggest ever constructed. There are only a handful of times in a million years that Rotterdam is threatened by the Maeslant storm surge barrier that is the world's biggest moving barrier. Part of the Netherlands' considerable investment in sea-level defence against rising seas.

Table 1. Rainfall and runoff in Pamba, Manimala, Achankovil and Manimala river systems up to Vembanad Lake

River	Catchment Area (in Sq.km)	Rainfall depth Aug 2018 (1 day)	Rainfall depth 15 - 16 Aug 2018 (2 days)	Rainfall depth 15 - 17 Aug 2018 (3 days)	Runoff depth 15 Aug 2018 (1 day)	Runoff depth 15 - 16 Aug 2018 (2 days)	Runoff depth 15 -17 Aug 2018 (3 days)
Achankovil	1359	122	231	329	124	235	336
Pamba & Manimala	2656	173	382	517	346	762	1030
Meenachil	820	146	327	437	90	201	268
Total	4835	441	940	1283	560	1198	1634

Kerala and Kuttanad, particularly Thottappally, may benefit from the engineering prowess of Holland. A sand bar protects Kerala's interior waterways from the sea. The Thottappally is one of the rare seawater-only entrances. Cutting-edge engineering technology is essential for flood management in Kuttanad. Thottappally's floodwater problems will undoubtedly be solved if they are continuously monitored and persevered upon.

FINDINGS

Waterlogging is nothing new for the people of Kuttanad. Yet the frequency of flooding continues to rise. Alleppey's low-lying Kuttanad and the neighbouring areas are naturally vulnerable to floods because of their position and height. It is imperative that immediate and regular mitigating steps be taken to prevent a repetition of the previous monsoons. When the monsoon rains come, the four major rivers in and around Thottappally, Kerala, are Pampa, Achenkoil, Manimala and Meenachal. In spite of the locals' environmental worries, however, the Thottappally spillway and the Thaneermukkom bund are critical in reducing floods in Kuttanad and the neighbouring areas.

RECOMMENDATIONS

Throughout the year, use cutting-edge technology to monitor changes in river input and sea level. The sand and silt that builds up in the canal going to the sea must be removed on a regular basis. Keeping an eye on the channel's depth is necessary since sand is accumulating quickly. A team of experts and local residents should conduct frequent site inspections to verify that flood mitigation measures are being installed appropriately and consistently throughout the year. Thottappally's experienced employees should work with marine geologists, sea-and-port specialists, and oceanographers to develop the most effective mitigation solutions. Dams in this area need to be cleaned often to keep them free of sand and silt. As a consequence, the dam's storage capacity will grow. It is possible that Holland's technology may be utilised to pump water from low-lying places when the flood becomes worse. To prevent floods in Thottappally, the best technique is to eliminate sandbars via scientific research. Some of the world's biggest sea

walls have been built by engineers from Holland. The Western Ghats to Thottappally area should be monitored by a computer-controlled flood protection system.

CONCLUSION

Climate change will have a devastating effect on low-lying areas across the world. In the future, Thottappally and the adjacent Kuttanad areas will continue to be submerged in floodwaters.. The study's results and suggestions should be implemented as quickly as practicable in the Pampa basin, according to the findings and recommendations. The use of automated remote control and remote control technologies will be necessary. Keeping an eye on this Ramsar site is the best way to ensure its long-term viability. Ecological imbalances may be corrected if saltwater intrusion is kept at a reasonable level. Flood protection methods must be precise during heavy rains. Investing in the right people and using the right technology might lead to a safer and more ecologically friendly future for this region.

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