

DETAILED PROJECT REPORT

Flood Hazard Mapping & Drainage Analysis of

## **Maravanthuruthu**

Grama Panchayat, Vaikom Block Panchayat,  
Kottayam, Kerala

# FLOOD VULNERABILITY & MITIGATION



**K-DISC**  
Kerala Development and Innovation  
Strategic Council



Ashank Desai  
**Centre for Policy Studies**  
Indian Institute of Technology Bombay  
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**TAGS**

**DETAILED PROJECT REPORT:**

**FLOOD VULNERABILITY & MITIGATION**

**Flood Hazard Mapping & Drainage Analysis of  
Maravanthuruthu Grama Panchayat, Vaikom Block  
Panchayat, Kottayam, Kerala**

**Submitted by**

**Technology and Governance Support Forum**

**Submitted to**

**Kerala Development and Innovation Strategic Council**



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## List of Abbreviation

Sl. No	Abbreviation	Expansion
1	OLOI	One Local Body One Idea
2	K-DISC	Kerala Development and Innovation Strategic Council
3	LSGI	Local Self Governing Institution
4	DPR	Detailed Project Report
5	KII	Key Informant Interview
6	MSL	Mean Sea Level
7	GIS	Geographic Information System
8	GP	Grama Panchayat

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## Chapter 1: General Background

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### 1.1 Problem Statement

The problem statement as submitted by the Panchayat:

“നാടു തോടുകൾ വൃത്തിയാക്കി ആഴം കൂട്ടി മാലിന്യ നിർമാർജ്ജനം നടത്തി സഞ്ചാരയോഗ്യമാക്കുക ടൂറിസവുമായി ബന്ധപ്പെട്ട വള്ളം കയാക്കിംഗ് എന്നിവ സഞ്ചരിക്കാൻ പറ്റുന്ന വിധത്തിൽ തോടുകൾ വൃത്തിയാക്കുക.”

*“Clear and dredge the nearby streams/canals, ensuring they are passable by removing garbage. Cleanse the canals to facilitate tourism activities like boating and kayaking.”*

Following is the problem description

Maravanthuruthu Panchayat is surrounded by water on all four sides. In the past, there has been a situation where the water from the river comes down through the streams to help agriculture. But the canals became unusable due to pollution, shallowing and careless felling of trees. Encroachment is also seen in the canals. If the canals are deepened and kept clean by removing waste, the water from the river flows and helps in agriculture. By carrying out these activities in Ariwal Thodu, the tourism activity can be improved and the water street project can be improved. By raising slabs and bridges, boats and kayaks can move smoothly. Through this water conservation, paddy cultivation, vegetable cultivation, banana cultivation can be improved and water availability in wells and ponds can be ensured.

This project is undertaken as part of the One Local Government One Idea (OLOI) program by the Kerala Development and Innovation Strategic Council (K-DISC). The OLOI program aims to support Local Self-Government Institutions (LSGIs) in Kerala in addressing complex, second-generation developmental challenges through innovative, practical solutions. It fosters collaboration between LSGIs, academic institutions, experts, and startups to resolve real-life issues and enhance governance, service delivery, and local development.

## 1.2 Scope of the project

The project focuses on developing sustainable, community-driven solutions to address critical local

challenges. Key areas include:

- **Knowledge Integration:** Utilizing expertise from academia, government, and industry to address developmental issues.
- **Problem Analysis and Solution Development:** Analyzing problems identified by LSGIs and developing innovative, feasible solutions.
- **Community-Centric Approach:** Ensuring solutions are practical, accepted by the community, and aligned with local needs.
- **Sustainability and Scalability:** Prioritizing long-term sustainability and the potential to scale successful solutions.

## 1.3 Project Objectives

Our aim was to conduct a comprehensive study and develop a preliminary project report with a focus on understanding the context and mapping the existing situation. Our objectives were

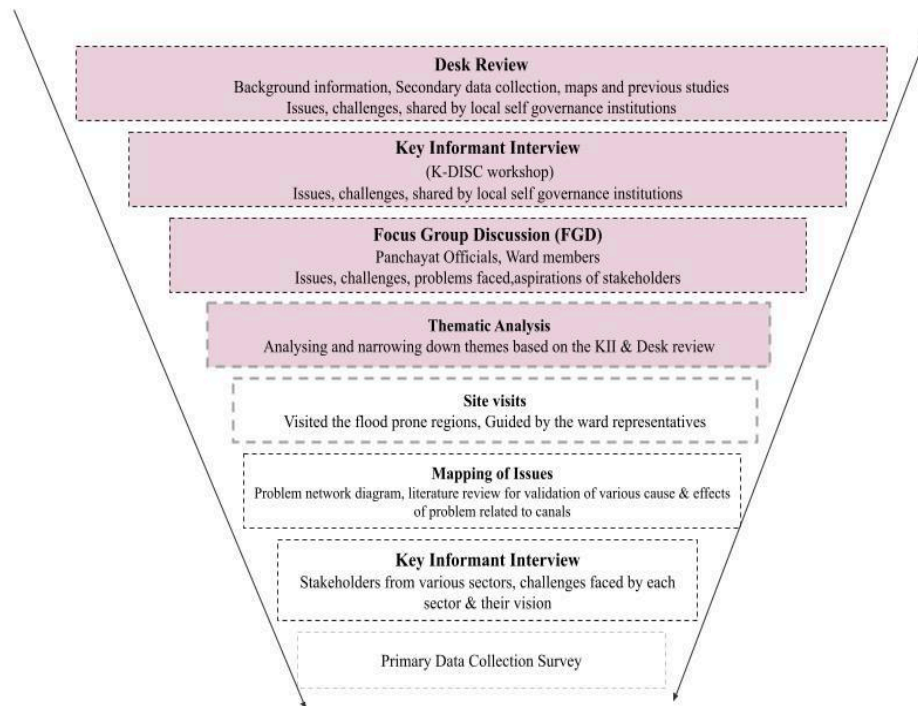
- To identify the key stakeholders with influence on the canal network, as well as those directly affected by the canals.
- To capture the aspirations and expectations of the identified stakeholders.
- To understand the challenges of the canal network, in order to evaluate its role in the tourism sector, and assess its potential for boating and kayaking through primary and secondary data analysis.
- To curate the issue to cultivate innovations for the innovator ecosystem.

This Situation Assessment Report has been prepared in alignment with the objectives outlined in Section 1.3 of the project. To achieve these objectives, extensive field studies were conducted in collaboration with technical experts, local residents, stakeholders, and practitioners. Through detailed analysis, the issues and their root causes were thoroughly examined to gain a deeper understanding of the ground realities.

## 1.4 Methodology

### 1.4.1 Problem Screening and Scoping

This section details our strategy and methods used to further dissect the problem. We applied a funnel approach that moves from an abstract, broader, general understanding to a specific, detailed and fine-grained understanding of the research subject. The approach is iterative in nature where each stage of data collection and analysis helps to determine subsequent steps. The approach also helps in data triangulation. Various steps vis-à-vis methods adopted as part of the funnel approach are discussed below (figure 1).



*Fig 1 : Methodology*

**Desk Review:** The steps involved are (a) review of state or local government reports, documents such as disaster management plans and (b) review of studies on Vembanad lake. The review helped in developing contextual understanding of the study area and identifying broader issues and challenges. The step also involved collection of base maps and secondary data on population, number of households, and socio-economic data (ration cards, caste, religion).

**Key Informant Interview:** This involves direct observations, where researchers (our team) held a neutral position and passively observed the phenomenon or subject matter. For this, the team observed and took notes of problems, aspirations, issues and challenges faced by the local

government institutions in their area. These were shared in the K-DISC OLOI workshop held on 18th May 2023.

**Focus Group Discussion:** This involves bringing together small groups of people (6 to 10) at one location, and having them discuss a phenomenon of 1.5 to 2 hours (Bhattacharjee, 2012). The meeting took place in the Maravanthuruthu Panchayat Hall and the meeting was opened by the Panchayat president, Maravanthuruthu Grama Panchayat. with the primary focus being a comprehensive discussion on the flood-related challenges encountered by the Maravanthuruthu Panchayat. The issues, challenges, problems faced and aspirations gathered from 15 ward members. Participants were asked open ended questions on the issues and challenges of canals, and sub canals. Both hand written notes and voice recordings were taken.

**Thematic Analysis:** To systematically analyse the data gathered from the interviews, we conducted a thematic analysis, where we created a comprehensive matrix that mapped themes to their respective participants. This matrix served as a foundation for organising and interpreting our findings. Additionally, we diligently collected secondary data relevant to our research, complementing the primary data obtained from KII. As part of the analysis process, these themes were meticulously refined, allowing us to understand key insights and trends from the combined dataset. This, in turn, aided us in narrowing down the various themes identified under four major issues faced by the canals, namely Siltation, Eutrophication, Encroachment, and Pollution.

**Site Visits:** A site visit refers to the physical inspection of a location or property to gather firsthand information, assess conditions, and evaluate specific aspects for various purposes such as research, planning, or decision-making. The major

**Mapping of issues:** A problem network diagram needs to be generated to connect the diverse effects and causes of the issue, as described during the Focus Group Discussion (FGD) with ward members. A thorough examination for scientific validity through a literature review, leading to subsequent modifications to the diagram.

**Key Informant Interview (KII):** The issues mapped in the problem network were spread across various sectors. Key Informant Interviews (KII) is a qualitative research technique that involves in-depth interviews with individuals who possess expert knowledge or firsthand experience

related to the research topic. This method allows for a comprehensive exploration of the subject matter and to delve deeper into the complexities of the identified challenges.

## Chapter 2 : Study Area Profile

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Maravanthuruthu, a gram panchayat in Vaikom Taluk of Kottayam District, Kerala, exemplifies a unique rural-urban interface with a strong focus on sustainable development. Spanning an area of 15.69 sq. km, the panchayat is situated between **9.774°–9.807° North latitude** and **76.365°–76.452° East longitude**, tracing the shores of **Vembanad Lake**, a Ramsar site, on its western edge.

The panchayat is bordered by **Chempu and Vellur gram panchayats to the north**, **Thalayolaparambu gram panchayat to the east**, and **Udayanapuram gram panchayat to the south**, with Vembanad Lake forming the western boundary. The **Muvattupuzha River**, originating from the northeastern boundary, bifurcates into two branches:

1. **Ithipuzhayar**, which flows through the eastern and southern parts of Maravanthuruthu before merging into Vembanad Lake.
2. The second branch, flowing northward, converges with the Murinjapuzha River.

Renowned for its intricate hydrological network, agricultural significance, and pioneering sustainable tourism initiatives, Maravanthuruthu's location amidst rivers and a Ramsar site underscores its ecological importance. However, it also poses challenges in water resource management, flood mitigation, and land use planning.

### 2.1 Geographical and Hydrological Characteristics

#### 2.1.1 Geographical Profile

- **Coordinates:** Latitude: 9.774°–9.807° N, Longitude: 76.365°–76.452° E
- **Topography:** Predominantly low-lying floodplains with elevations ranging between **1 and 5 meters above mean sea level (MSL)**, making the region vulnerable to flooding during monsoons and tidal surges.
- **Land Use:** Approximately **65% agricultural land**, with the remaining area occupied by water bodies, settlements, and tourism zones.

### 2.1.2 Boundary Details

- **North:** Chempu and Vellur Gram Panchayats
- **East:** Thalayolaparambu Gram Panchayat
- **South:** Udayanapuram Gram Panchayat
- **West:** Vembanad Lake

Table 1: *Profile of Maravanthuruthu Panchayat*

<b>Attribute</b>	<b>Details</b>
<b>District</b>	Kottayam
<b>Area</b>	15.69 sq. km
<b>No. of Wards</b>	15
<b>Population</b>	22,983
<b>Age Group (0-6)</b>	1,285
<b>Families</b>	6,026 (SC: 536; ST: 8)
<b>Boundary</b>	North: Muvattupuzha River

	South: Muvattupuzha River
	West: Vembanad Lake
	East: Muvattupuzha River
<b>Main Source of Income</b>	Agriculture, Fishing, and Tourism

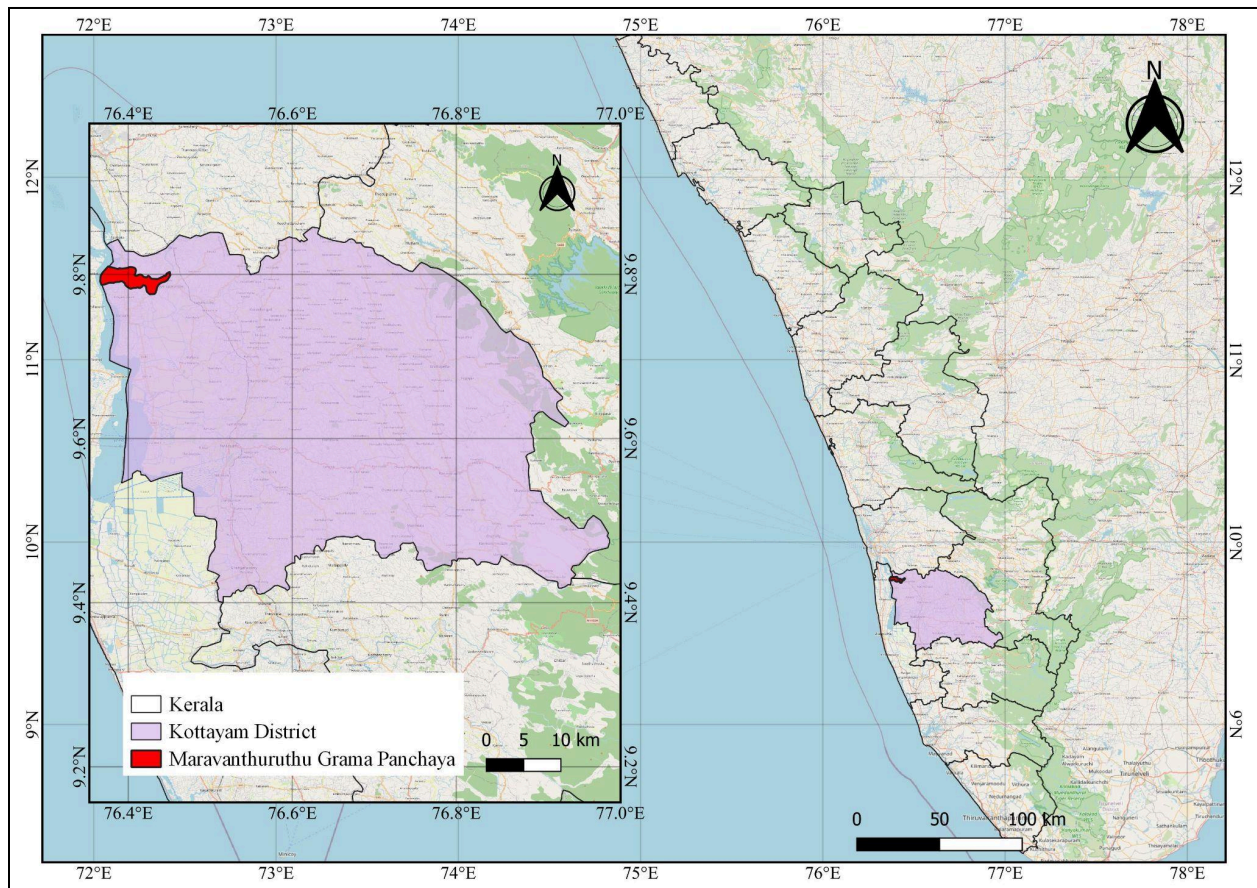


Fig 2 : Location of Maravanthuruthu GP

## 2.2 Profile of the Grama Panchayat

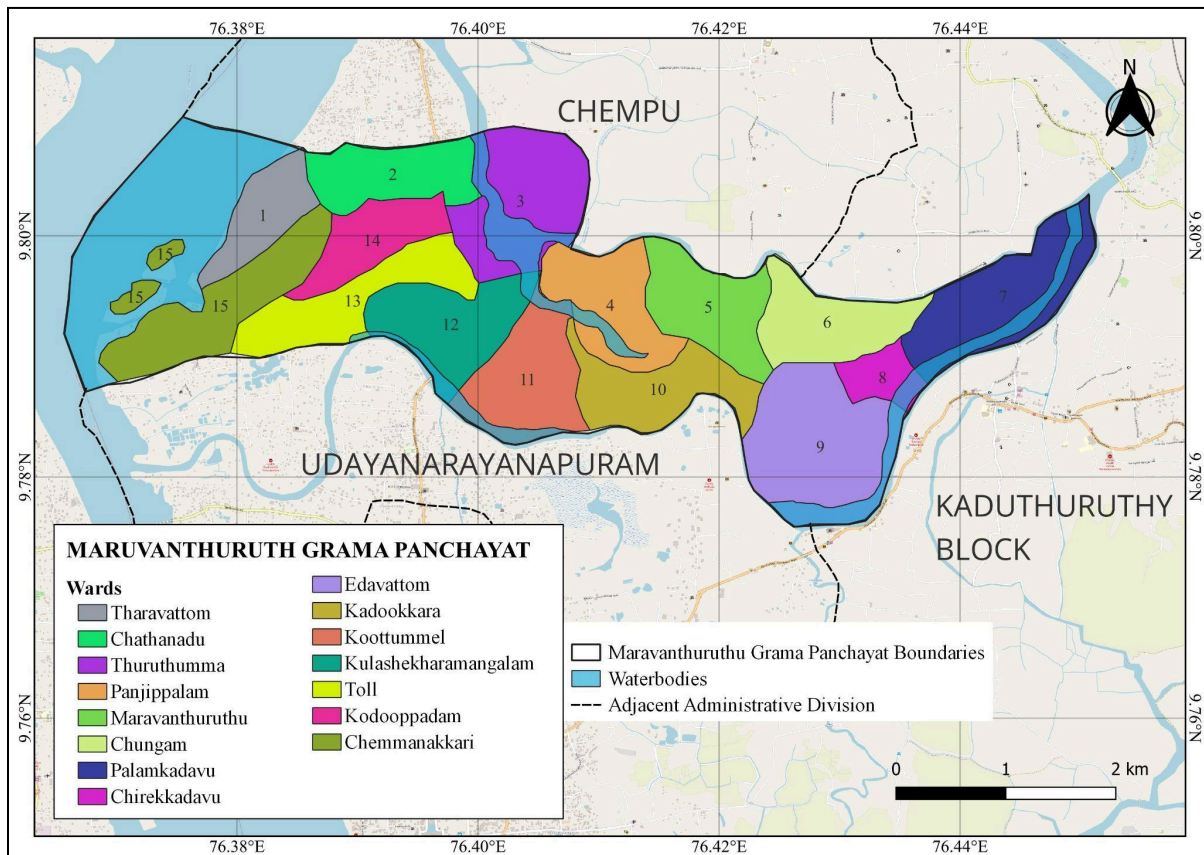


Fig 3 : Ward map of Maravanthuruthu GP

The Maravanthuruthu Grama Panchayat was established in the year 1953 has a total of 15 wards. The corresponding revenue jurisdiction is Kulasekharapuram Village. The corresponding Block Panchayat is Vaikom and Jilla Panchayat is Kottayam. The total area of the Panchayat is 15.69 sq, Km. The panchayat has a total of 15 wards, and has a total population of 22983 which consist of 11413 males and 11570 females. The number of families within the Panchayat is 6100. The literacy rate is 95%. The Panchayat is surrounded by water bodies (Muvattupuzha River and Vembanad Lake) and hence the word “Thuruthu”, meaning island, is present in the name. In addition to these there are other minor streams and canals present within the Panchayat boundary. The main source of income for the people of Maravanthuruthu is Agriculture, Animal Husbandry, Fishery, Coir industry etc. In recent times there has been a rise in the number of people working in other fields, including daily wages workers. The SC/ST population of the panchayat make up 10% of the population. There are a total of 536 SC households with 922

male and 1032 female individuals. When it comes to ST, there are 8 households with 22 male and 19 female residents<sup>1,2</sup>

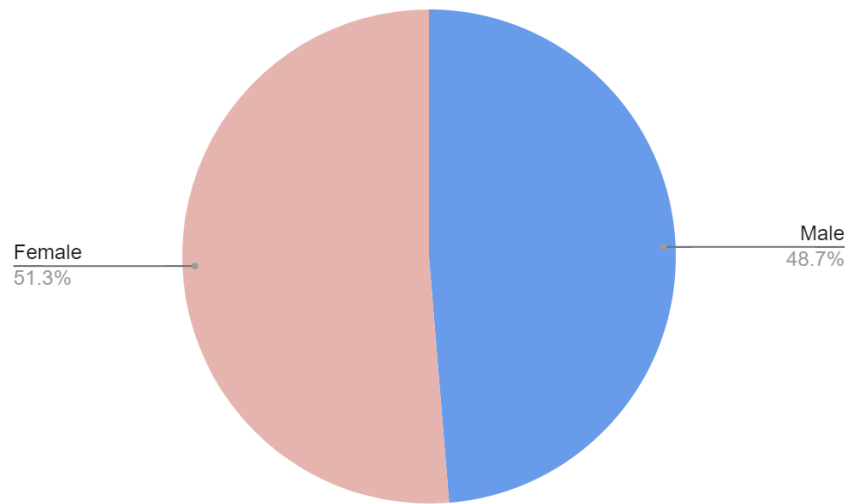


Fig 4 : Distribution sexes of Maravanthuruthu

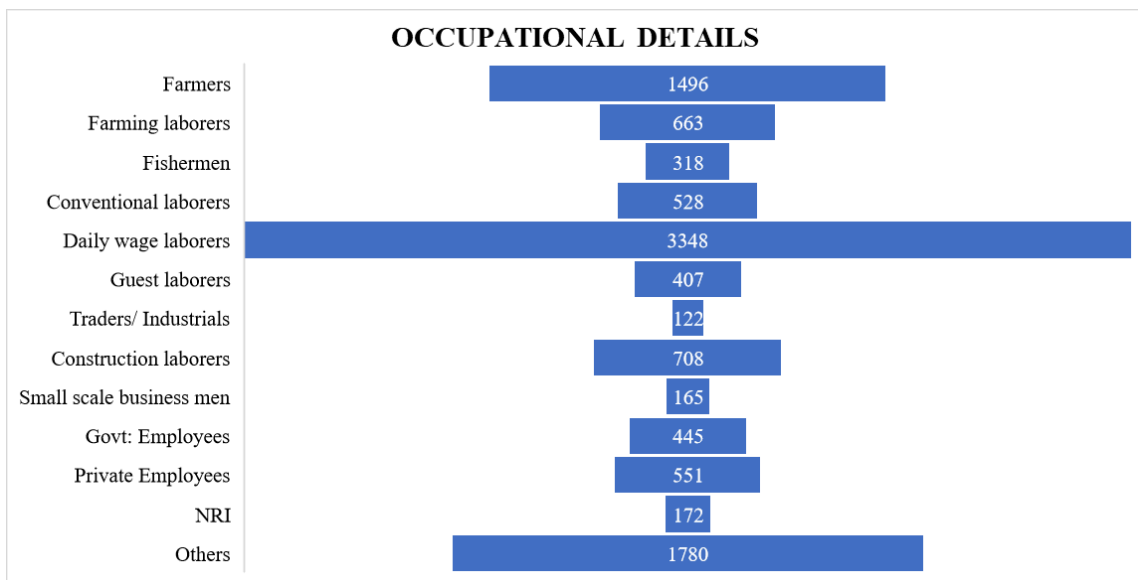


Fig 5 : Panchayat level occupational details (Source : DM Plan 2019)

The occupation details of Maravanthuruthu Panchayat are illustrated in Figure 5. It indicates a higher number of daily wage laborers compared to other occupations. Following this, there are

<sup>1</sup> Directorate of Census Operations Kerala (2011) *DCH Kottayam 2011*, 10

<sup>2</sup> Maravanthuruthu Grama Panchayat (2022), *Developmental Plan Maravanthuruthu*, 2022 -27

Farmers, Farming laborers, Fishermen, Conventional laborers, Guest laborers, Traders/Industrials, Construction laborers, Small scale business men, Govt: Employees, Private Employees, Others, as well as those in NRIs, among others.

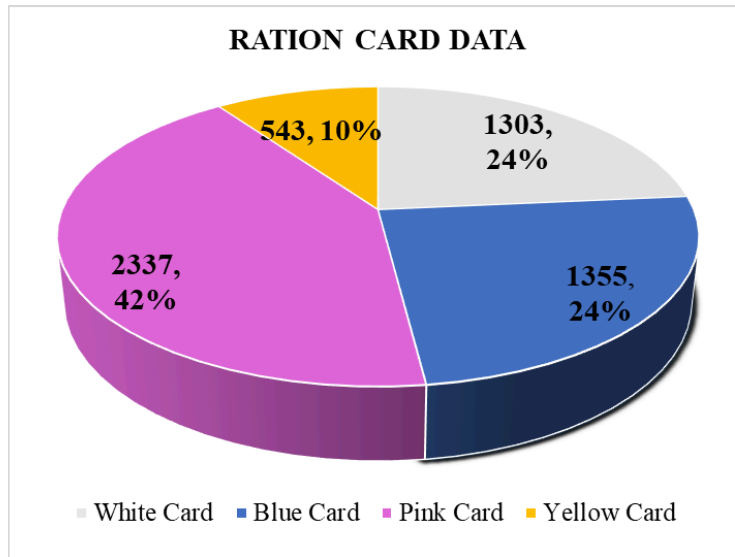


Fig 6 : Ration Card Details<sup>3</sup>

As per Vaikom Civil Supply Office (December 2022) estimate there are a total 6026 families in Maravanthuruthu Panchayat. Out of which 551 households have their own yellow card, 2940 families have priority – pink cards, 939 families are getting subsidies with blue cards and the remaining 1596 families have white cards.

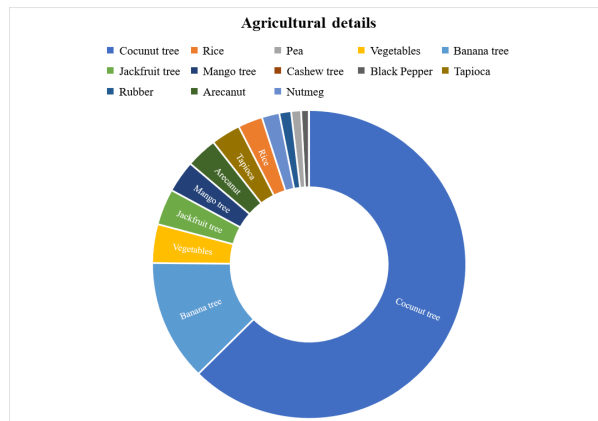


Figure 7 : Panchayat level agricultural details<sup>4</sup>

<sup>3</sup> Civil supplies office 2022

<sup>4</sup> Development Document 2022 - 2027

The agricultural details of Maravanthuruthu Panchayat are illustrated in Figure 7. It indicates a higher number of coconut production compared to other agricultural crops. The production of coconuts, the primary crop, is close to the state average. Coconut cultivation covers an area of 550 hectares. This includes 450 hectares of fruiting area and 100 hectares of non-fruiting area, with a total of 25000 impacted coconut trees. Coconuts in coastal areas along rivers usually yield fruit. Rice, Pea, Vegetables, Banana tree, Jackfruit tree, Mango tree, Cashew tree, Black Pepper, Tapioca, Rubber, Arecanut and Nutmeg are also there.

## 2.6 Land Use

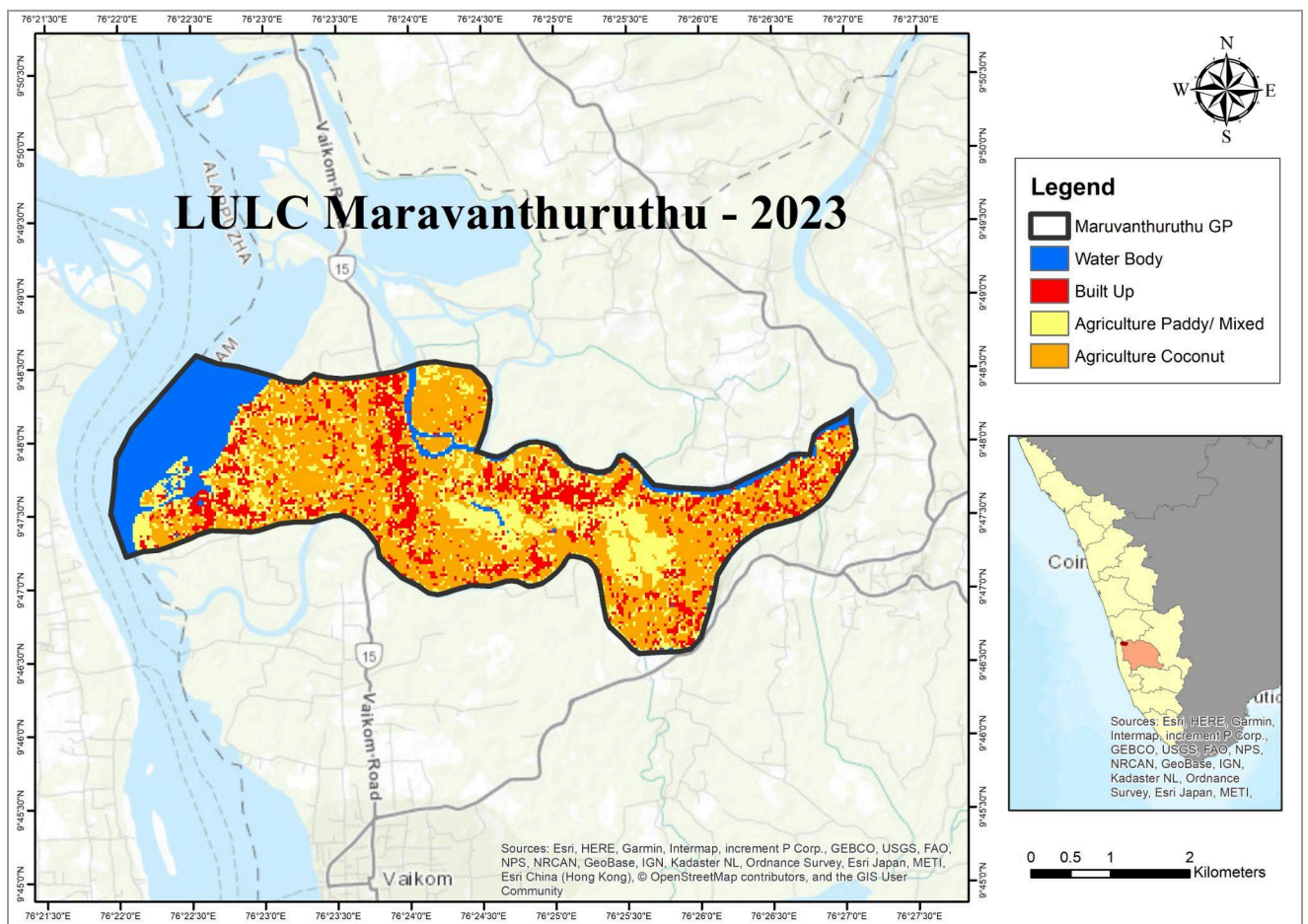
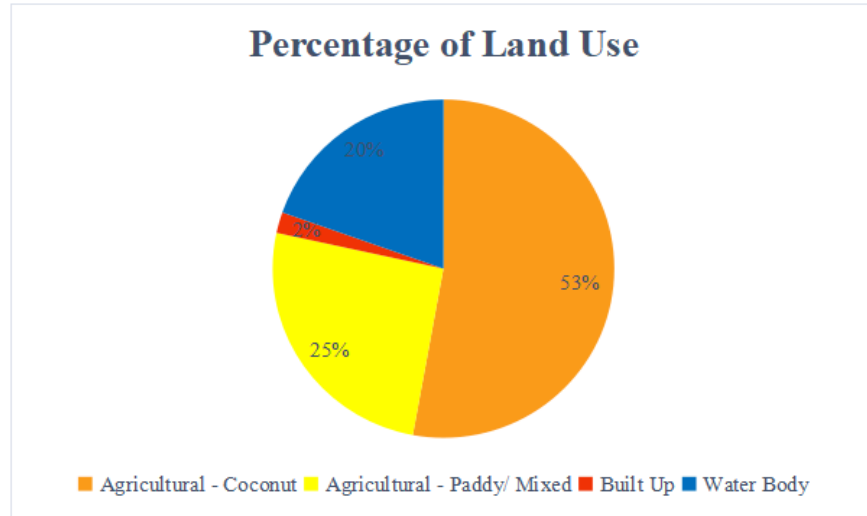


Fig 8 : Land use pattern of Maravanthuruthu Grama Panchayat



*Fig 9 : Land Use Distribution of Maravanthuruthu Grama Panchayat*

From the land use patterns of the panchayat from the year 2023, it's clear that most of the area under the panchayat lies under agriculture use. Within agriculture the majority of the area is under coconut plantation which makes up to 53% of the total area. This can be due to the presence of sandy terrain. Paddy/ Mixed crops also constitute a major part of the area and make up 25 %. Next comes water bodies which make up 20% of the area. The least area belongs to the built up which constitutes about 2% of the total area. Upon examining the scenario within the Vaikom block panchayat, a similar trend can be seen where agricultural land use dominates the rest. Most of the agricultural crops are grown in laterite and sandy areas. Coconut is the only major crop in the sandy area. Paddy and other crops are found in muddy sandy areas. Only paddy is cultivated in the muddy areas.<sup>5</sup>

<sup>5</sup> Maravanthuruthu Grama Panchayat (2022), *Developmental Plan Maravanthuruthu, 2022 -27*

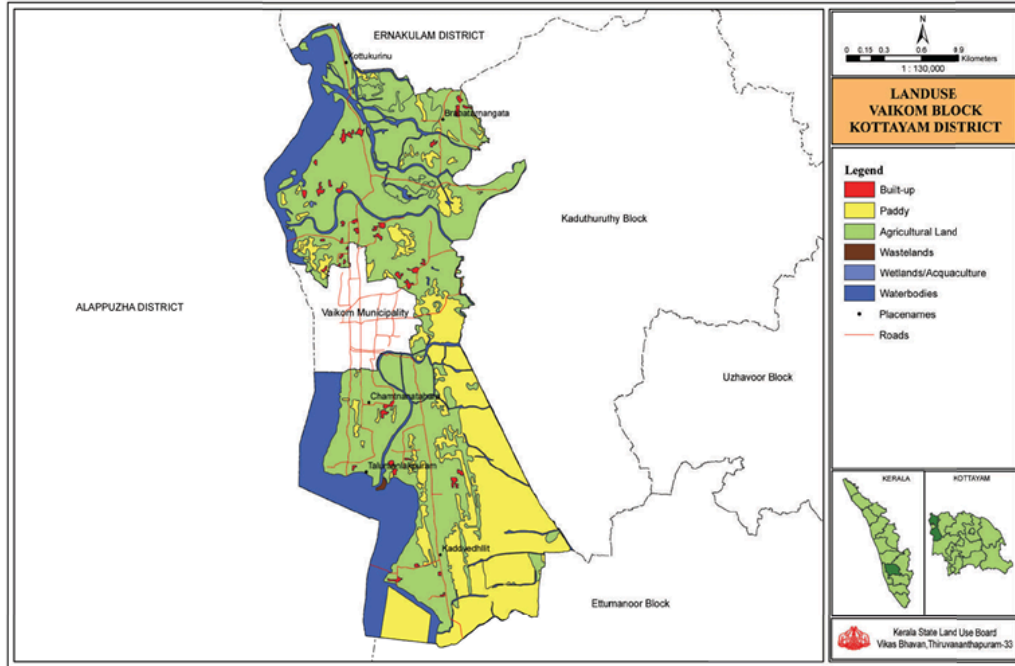


Fig 10 : Landuse pattern of Vaikom Block Panchayat<sup>6</sup>

## 2.5 Soil Type and Elevation

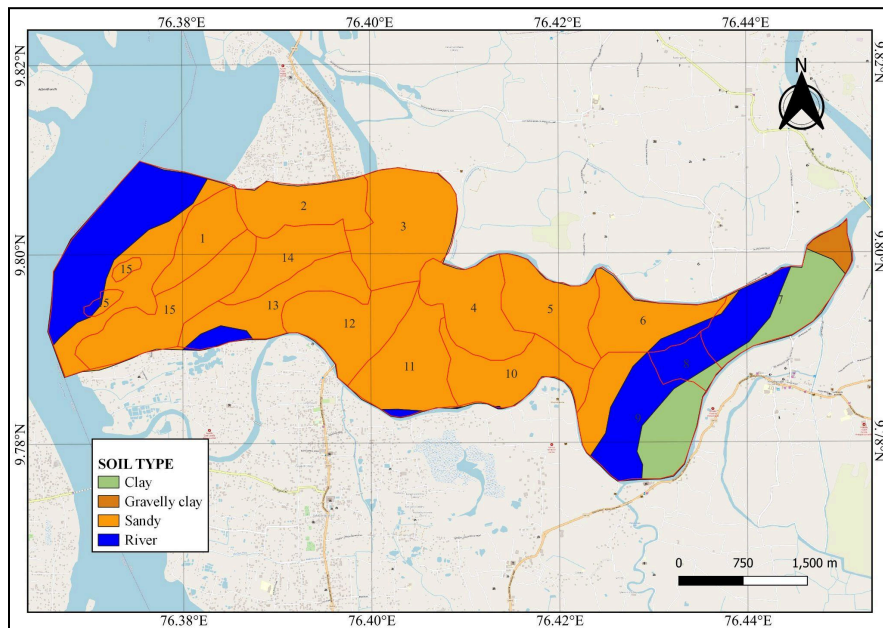


Fig 11 : Soil Map of Maravanthuruthu Grama Panchayat<sup>7</sup>

<sup>6</sup> Kerala Landuse Board

<sup>7</sup> Kerala Soils:NBSS

The clay variants of the soil are seen towards the eastern borders of the Panchayat. The rest of the panchayat is covered by sandy soil. Due to the presence of soil deposited by the rivers, the basic nature is more prominent. There has also been a decline in the presence of organic carbon over the years. Nitrogen and Potassium are present in adequate amounts. Magnesium, sulfur and Boron are also present in lesser quantities.<sup>8</sup>

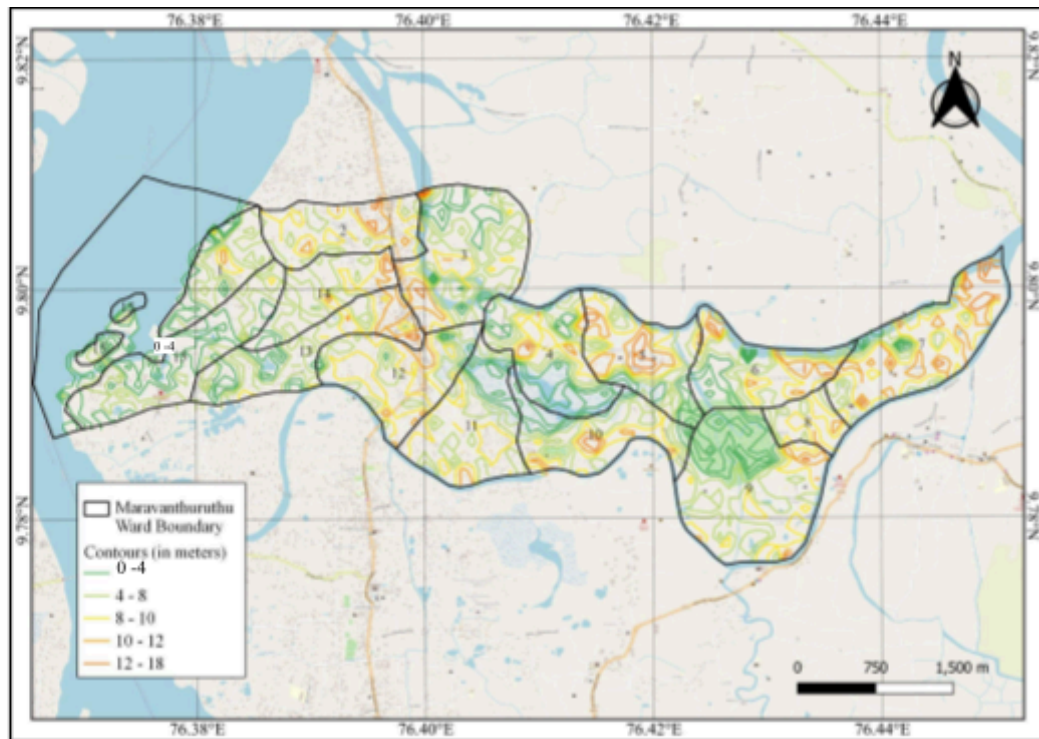


Fig 12 : Contour Map of Maravanthuruthu Grama Panchayat<sup>9</sup>

The lower lying areas of the panchayat lie towards the western ends near to the Vembanad lake. The eastern edges are the areas where relatively higher elevated areas occur. Majority of the area could be termed as midland. For our case area, being situated near the Vembanad lake, which is part of the Kerala backwaters, the elevation is close to the sea level. The low lying terrain and the presence of sandy soil which does not allow percolation of water results in further flood risk. In addition special care must be taken in the design of infrastructure such as roads, bridges, drainage systems etc. to minimize the flood risk. Further development also should be carefully planned to avoid areas that may possess additional risk.

<sup>8</sup> Maravanthuruthu Grama Panchayat (2019), *Disaster Management Plan Maravanthuruthu 2019*

<sup>9</sup> United States Geological Survey (USGS). (n.d.). Earth Explorer.

## 2.3 Climate

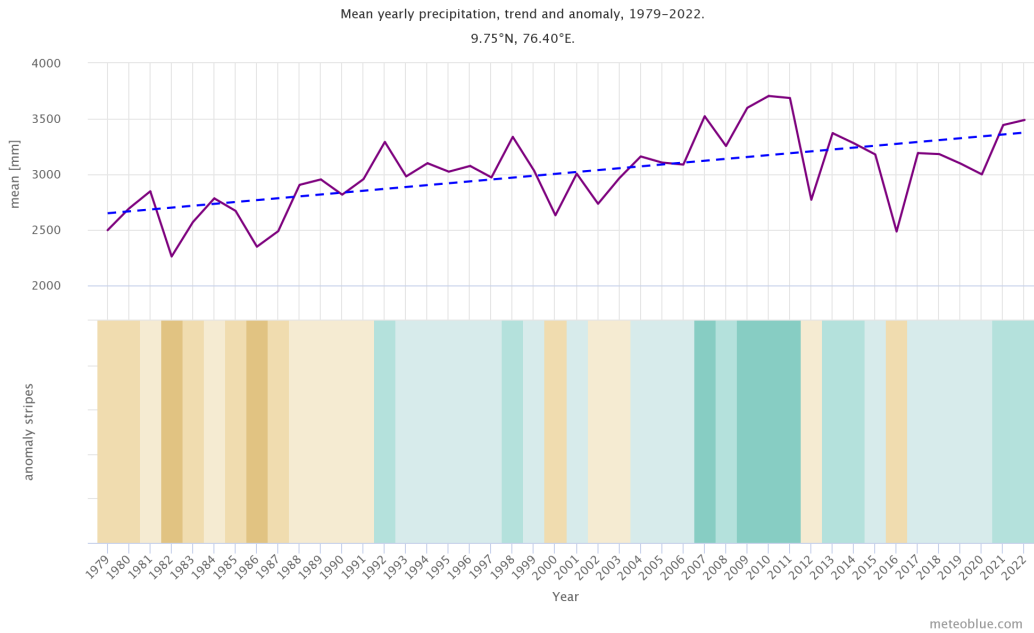


Fig 13 : Yearly Precipitation Change - Vaikom

The graph shows an estimate of mean total precipitation for the larger region of Vaikom for the past 43 years. The dashed blue line is the linear climate change trend. Since, the trend line is going up from left to right, the precipitation trend is positive and it is getting wetter in Vaikom due to climate change. In the lower part the graph shows the so-called precipitation stripes. Each coloured stripe represents the total precipitation of a year - green for wetter and brown for drier years. Over the past 43 years, Vaikom has experienced an annual precipitation ranging from 2260 to 3704.7 mm. The highest recorded precipitation occurred in 2010, while the lowest was observed in 1982. From 2001 onward, the trend line consistently depicts annual rainfall surpassing the state's yearly precipitation levels each year.

## 2.4 Drainage and Watershed

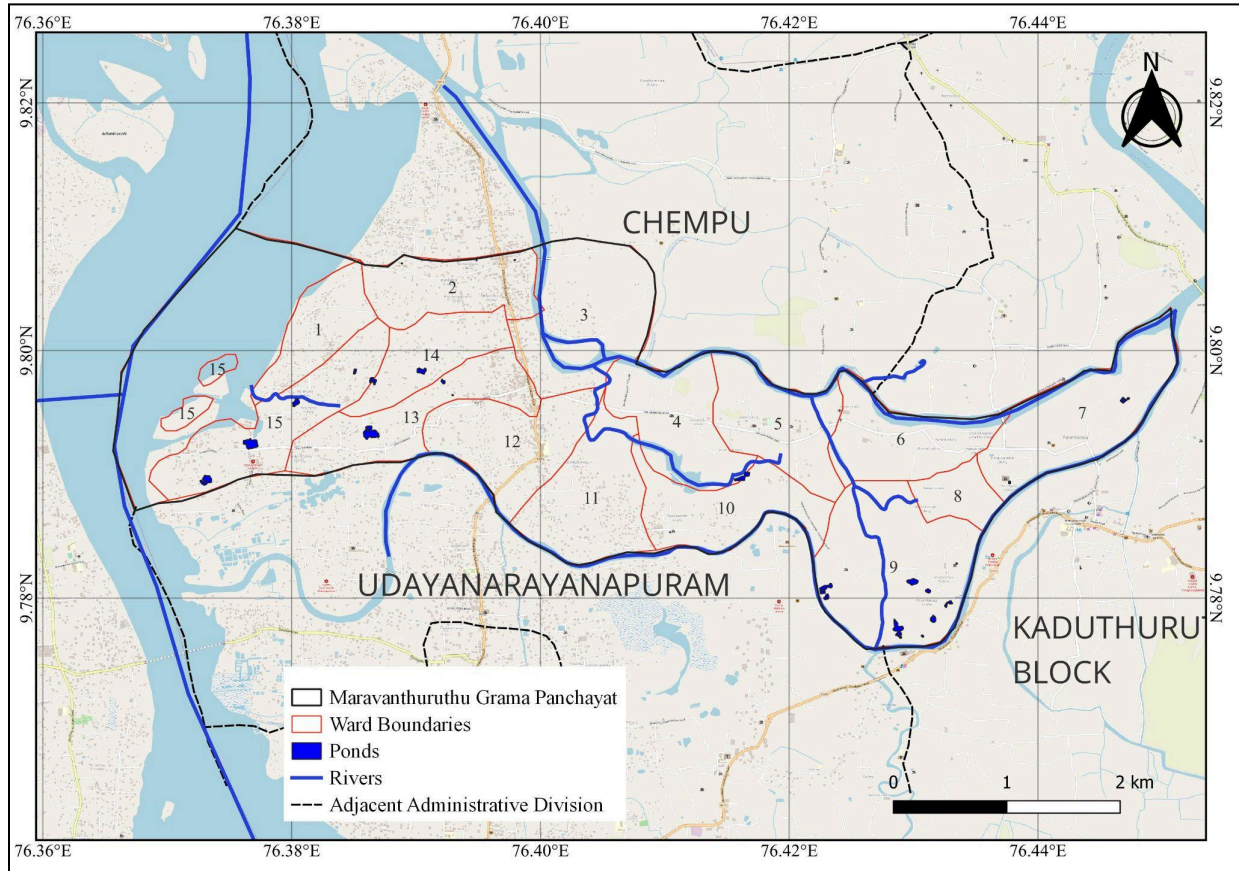


Fig 14 : Drainage map of Maravanthuruthu Grama Panchayat<sup>10</sup>

### Hydrological Features

- **Primary Canal and streams:**
  - *Ariwal Thodu:* Supports irrigation and navigation; recently prioritized for rejuvenation under tourism initiatives. Currently has about 1.7 to 2 km of navigable stretch.
  - *Smaller canals and streams:* The entire Maravanthuruthu area is crisscrossed by smaller streams that are interconnected with the Muvattupuzha River or Vemaband Lake.
- **Drainage Pattern:** A dendritic system fed by secondary streams that discharge into the Muvattupuzha River and Vembanad Lake.

<sup>10</sup> **MeteoBlue.** (n.d.). MeteoBlue Weather Services.

- **Tidal Influence:** Tidal ingress from the lake frequently impacts agricultural fields, particularly during high tide and monsoon-driven river discharge.

It is to be noted that the location of Maravanthuruthu Grama Panchayat is at the downstream end of the Muvattupuzha River Basin, which stretches through the four districts of Idukki, Kottayam, Ernakulam and Alappuzha. The river originates in the western Ghats and finally joins the Vembanad lake near our concerned area.

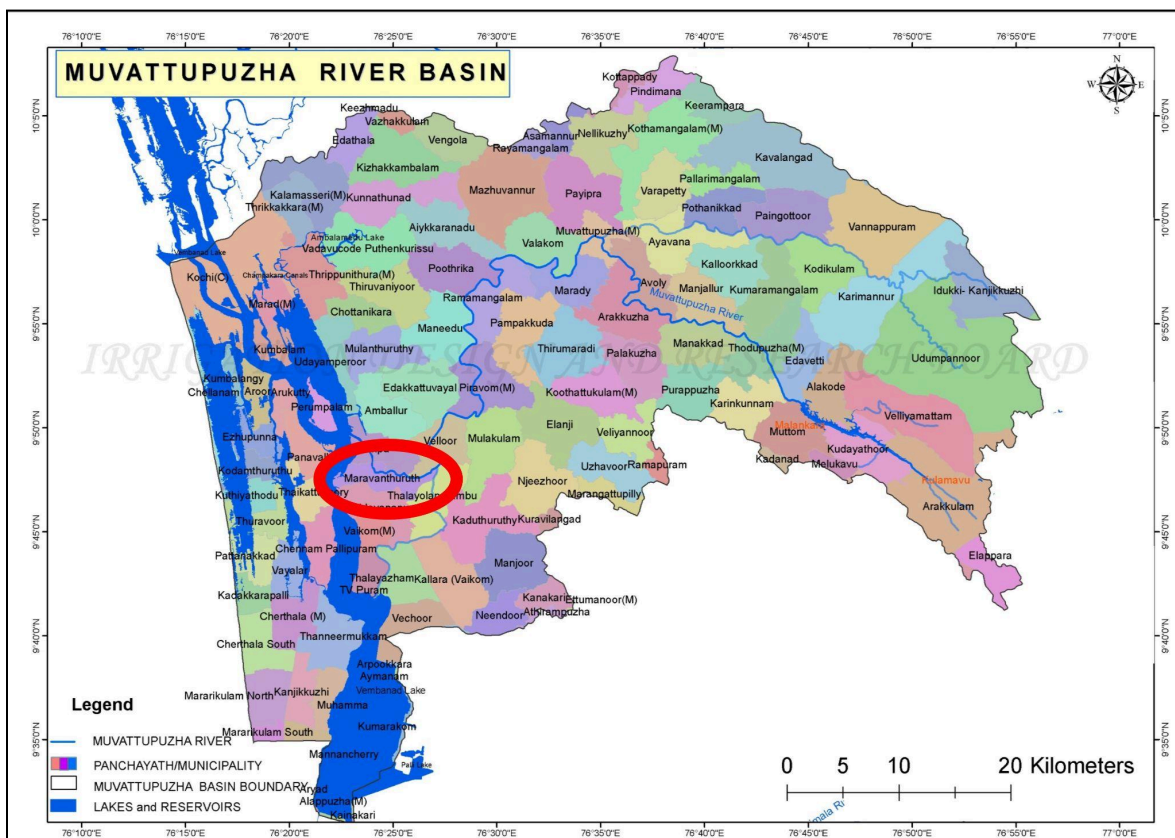


Fig 15 : Location of Maravanthuruthu Grama Panchayat within Muvattupuzha River Basin<sup>11</sup>

Upon comparison with the sediment transport process for a large fluvial system, the Mravanthuruthu grama panchayat lies in the deposition zone. This could lead to over accumulation of sediments in the streams. This could be applicable for our case as it falls under

<sup>11</sup> Kerala Irrigation Department

the deposition zone. And further from the KIIs, reduction of channel depth due to accumulation of silt is a major issue in Maravanthuruthu.<sup>12</sup>

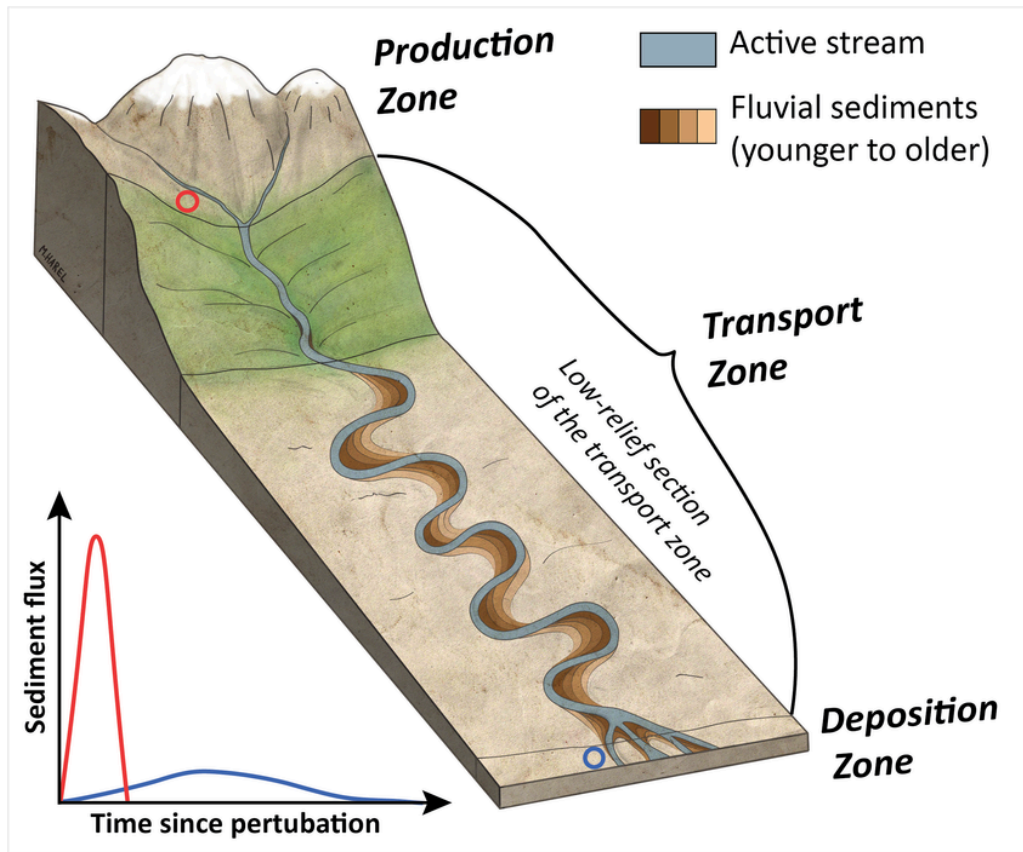


Fig 16 : Schematic diagram of sediment transport in large-scale fluvial systems

## 2.7 Flooding in Maravanthuruthu Grama Panchayat

Flooding poses a significant challenge in Maravanthuruthu Grama Panchayat. According to the Key Informant Interview (KII), Ward Members highlighting the severity of flood issues in specific wards, namely 1, 15, 9, 8, 14, 10, 11, and 12. It was noted that wards 9, 8, 11, and 12 have experienced prolonged flooding. The major canal named "Arival Canal" (thodu) passes through wards 12, 13, 10, 11, 3, 4, 14, and 15.

<sup>12</sup> Ben-Israel, M., Armon, M., ASTER Team, & Matmon, A. (2022). *Sediment residence times in large rivers quantified using a cosmogenic nuclides based transport model and implications for buffering of continental erosion signals*. *Journal of Geophysical Research: EarthSurface*, 127, e2021JF006417. <https://doi.org/10.1029/2021JF006417>, 18

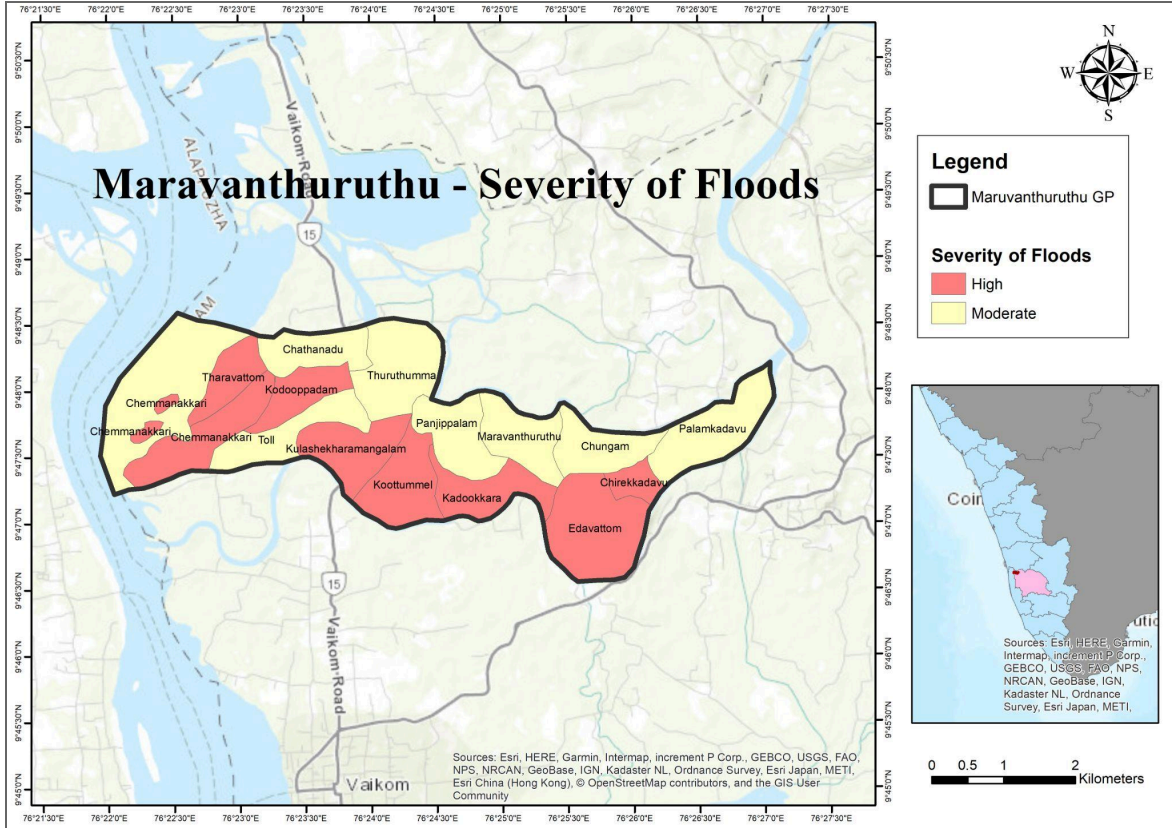


Fig 17 : Flood Affected Areas of Maravanthuruthu Grama Panchayat

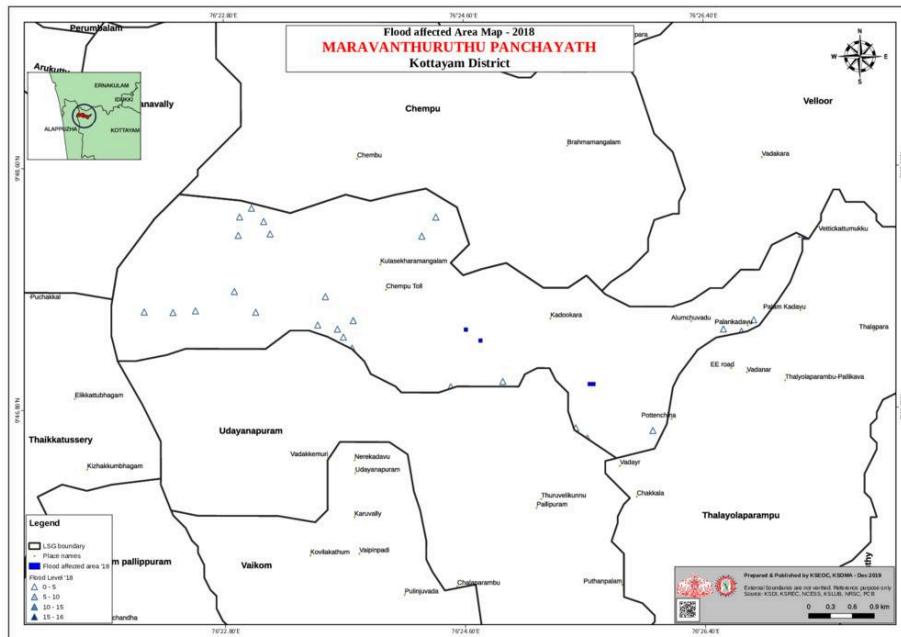


Fig 18 : Flood Affected Areas of Maravanthuruthu Grama Panchayat - 2018



## Chapter 3: Stakeholder Aspiration and Key Findings

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Based on insights gathered during stakeholder interactions, the following key aspirations were identified:

- ***Minimizing excessive silt deposition, preventing the accumulation of waste and eutrophication, and reducing encroachment and obstructions from the stream's path in order to maintain the stream's natural flow and improve its capacity to reduce flooding.***

Currently the capacity of the canals are reduced due to various reasons including the over accumulation of the silt within the streams. There needs to be a proper system which ensures periodic dredging to ensure maintenance of canal dimensions. In addition eutrophication also causes obstruction to proper stream flow. There have also been instances where the branches of the tree are cut and disposed of into the stream. In addition the encroachments of the stream is to be restricted and existing ones are to be removed

- ***Construction and maintenance of Bunds/ side walls/ shutters along the streams to reduce the impact of floods.***

The banks of the stream are not maintained properly resulting in collapse of the river banks, exacerbating the flooding. Also there have been cases of breach. In addition, there have been cases of lack of maintenance & repair of shutters and lack of regular infrastructure upkeep resulting in inefficiency in managing water flow during flooding.

- ***Enhancing the revenue being generated from the canal for the residents and thereby creating a need for its preservation***

Earlier the water bodies were the source of income for the residents of the area via Fishing, agriculture, tourism. These are to be further reinforced with updated technology resulting in enhanced income, resulting in generating a need among the people to conserve the canals

- ***Reduce the salt water intrusion from the Vembanad lake to the Panchayat and enhance its water holding capacity through silt removal***

Currently during the period of November to April there have been cases of intrusion of salt water into several areas of the Panchayat. There needs to be proper interventions to

reduce the drinking water shortage caused due to this. In addition there has been degrading of the water quality of the canals/ water bodies.

### **3.1 Findings from KII**

Flooding in the Panchayat is a recurring issue, particularly in Wards 1, 15, 9, 8, 14, 10, 11, and 12. Among these, Wards 9, 8, 11, and 12 experience prolonged inundation due to a combination of natural and anthropogenic factors. A key contributor is the Arival Canal (Thodu), which flows through Wards 12, 13, 10, 11, 3, 4, 14, and 15. The canal's reduced depth, caused by extensive siltation, leads to overflows even during minor rainfall events. While partial desilting has improved conditions in certain stretches, much of the canal remains vulnerable to flooding.

Encroachments and canal flattening for pathway construction have disrupted natural water flow in multiple locations. These modifications have resulted in stagnant water accumulation and delayed drying of inundated areas. Weak and unfortified bunds further exacerbate the situation, as they often collapse under pressure during floods. Bund strengthening using stones was identified as a practical solution, along with the construction of additional bund shutters and the repair of existing ones, many of which are rusted and non-functional.

The absence of sidewalls along riverbanks poses another critical challenge, as frequent collapses contribute to increased flood risks. This issue is further aggravated by a shift in local livelihoods. With fewer residents engaged in agriculture, traditional practices of canal maintenance have declined, leading to increased siltation, encroachment, and eutrophication. The resulting degradation of canals and rivers amplifies flood risks, with even three hours of continuous rain causing significant waterlogging in vulnerable areas.

Specific locations, such as Vettikkad Mukk and Vellor, face dual challenges. From November to May, these areas suffer from saltwater intrusion, while during the remaining months, they are prone to freshwater flooding. Meanwhile, Vembanad Lake, a critical hydrological feature, has seen its depth reduced from 6–7 meters to approximately 2 meters due to alluvial deposits. This reduced capacity has diminished its ability to manage floodwaters effectively. Constructing a larger outer bund was suggested as a potential intervention to address these challenges.

Eutrophication is another pressing concern, exacerbated by the unchecked growth of water weeds. While biannual weed removal is practiced, stakeholders emphasized the need to compost these weeds for agricultural use, turning a challenge into an opportunity for sustainable practices.

The post-2018 flood scenario has further strained the Panchayat's resources, with high tides compounding flooding issues. Critical sectors such as fishing, agriculture, and tourism have been severely affected. Reduced water depths impede boat movement, while eutrophication disrupts fishing activities, rendering traditional techniques like net fishing and "oonnikutti" ineffective. Moreover, initiatives like the "Water Street" project remain stalled due to inadequate water body depths.

Solid waste, particularly plastic, has further degraded the Vembanad Kayal ecosystem, reducing fish diversity and water quality. In narrower canals or *thodus*, where machine-based desilting is impractical, manual desilting has been identified as an essential intervention to restore depth and improve water flow.

These findings underscore the critical need for holistic flood management strategies, including comprehensive desilting programs, reinforced bund construction, regular maintenance of water channels, and ecosystem restoration. Addressing these challenges requires a combination of structural and non-structural interventions to enhance resilience and ensure sustainable development in the Panchayat.

Table 2 : *Finding From KI*

Issue	Cause	Effect
<p><b>Silt Deposition</b></p>	<p><b>Continuous sedimentation</b> due to river flow.</p> <p>Accumulation of alluvial soil, causing shallowing of canals.</p>	<p><b>Significant depth reduction</b> impeding boat movement.</p> <p>Delayed implementation of the "<i>Water Street</i>" project.</p> <p><b>Frequent overflow</b> during even minor rainfall.</p>

		<p>Vembanad Lake's depth reduced from <b>6–7 meters to ~2 meters</b>.</p> <p>Narrow canals require manual desilting as machines are impractical.</p>
<b>Encroachments</b>	<p><b>Unauthorized constructions</b> (flattening canals to build pathways).</p> <p>Lack of regular canal maintenance.</p>	<p><b>Disruption of natural drainage</b>, leading to stagnant water.</p> <p><b>Increased flooding risks</b> with waterlogging and uneven drying.</p>
<b>Eutrophication</b>	<p>Inadequate maintenance fosters weed overgrowth.</p> <p>Limited strategies to mitigate eutrophication.</p>	<p><b>Fishing activities restricted</b>, including net fishing and “oonnikutti.”</p> <p>Biannual weed removal is performed, but <b>composting removed weeds</b> could provide agricultural benefits.</p>
<b>Waterlogging &amp; Saltwater Intrusion</b>	<p><b>Prolonged rainfall</b> overwhelms drainage systems.</p> <p>Proximity to the sea/Lake causes <b>seasonal saltwater intrusion</b>.</p>	<p>Persistent <b>waterlogging during monsoons</b>.</p> <p>Saltwater intrusion affects <b>groundwater quality</b> (November–May), followed by six months of freshwater flooding.</p>
<b>Absence of Sidewalls</b>	<p><b>Insufficient planning and funding</b> for constructing sidewalls.</p>	<p><b>Riverbank collapses</b>, worsening flooding and erosion.</p> <p>Weak containment of water flow exacerbates the issue.</p>
<b>Inadequate Bunds and Shutters</b>	<p>Poor maintenance and <b>resource constraints</b> hinder repairs.</p>	<p><b>Non-operational shutters</b> fail to regulate water levels.</p> <p>Weak bunds are prone to breaches, increasing <b>flood vulnerabilities</b>.</p>

<p><b>Solid Waste (Plastic) Pollution</b></p>	<p>Inefficient <b>solid waste management</b>, especially for plastics.</p>	<p><b>Severe ecosystem damage</b> in Vembanad Lake.</p> <p><b>Decline in fish species</b> diversity and abundance.</p> <p>- Degraded water quality.</p>
<p><b>Neglect of Canal Systems</b></p>	<p>Shift in livelihoods as people move from agriculture to urban jobs.</p> <p>Decline in traditional canal maintenance practices.</p>	<p>Increased <b>silt deposition, encroachments, and eutrophication</b>.</p> <p>Reduced efficiency of water management infrastructure.</p>
<p><b>Post-2018 Flood Challenges</b></p>	<p><b>Insufficient recovery measures</b> post-2018 floods.</p> <p>Persistent high tides continue to pose challenges.</p>	<p><b>Adverse impact on key revenue sectors:</b> fishing, agriculture, and tourism.</p> <p>Ecosystem degradation disrupts livelihoods and reduces water depth.</p>

## Chapter 4: Ward Level Situation Assessment

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The comprehensive assessment of the Panchayat's canal networks and flood management challenges reveals systemic issues requiring urgent attention. The following analysis provides a deeper understanding of the identified problems, supported by technical conclusions.

### 4.1 Flood-Prone Areas and Vulnerability

Flooding remains a persistent issue across the Panchayat, with varying degrees of severity observed. Wards 3, 4, 6, 7, 8, 9, 10, and 11 experience high flood risks due to a combination of factors, including the proximity to inadequately maintained canal systems, encroachments, and inadequate flood control infrastructure. Moderate flood vulnerability was noted in Wards 5, 12, and 13, while Wards 1 and 15 are comparatively less affected.

In areas such as Kadukkara (Ward 10), where water levels during floods can rise up to 3 meters, the lack of drainage capacity highlights critical hydraulic bottlenecks. Similarly, Ward 13 experiences prolonged inundation lasting up to a week, underscoring the inefficiency of existing drainage systems in managing floodwaters. These observations indicate a strong need for hydrological modeling and capacity assessment to design long-term solutions.

### 4.2 Canal Pollution and Eutrophication

Pollution and eutrophication have emerged as significant challenges in the Panchayat's canal network, severely impacting water quality and exacerbating flood risks. Nutrient overloading, resulting from domestic and industrial effluents, has led to widespread algal blooms in key canals, including Vallampally Canal (Ward 10) and Chalumkadav Canal (Ward 13). This not only clogs waterways but also disrupts aquatic ecosystems and intensifies the stagnation of water during floods.

The problem is further compounded by improper waste disposal practices. Canals have become repositories for solid waste, with deep pits from illegal sand mining acting as reservoirs for debris. These pits exacerbate flooding by releasing waste during high water events, leading to

unhygienic conditions in affected areas. Additionally, there are reports of nearby factories discharging untreated waste directly into canals, creating hotspots of contamination.

### **4.3 Encroachments and Structural Constraints**

Encroachments along canal banks present another significant challenge, particularly in areas such as Nadathara Thood (Ward 3) and Vallampally Canal (Ward 10). Unauthorized structures have reduced the effective cross-sectional area of canals, impeding natural water flow and increasing the severity of floods.

The use of undersized culverts, often replaced by narrow pipes, has further restricted the natural flow of water. This substitution has created localized obstructions, which exacerbate flooding during periods of heavy rainfall. The reliance on temporary flood control measures such as sandbags and manually operated shutters, observed in Wards 5, 7, 8, 9, and 10, underscores the inadequacy of existing structural interventions.

### **4.4 Socio-Economic and Operational Challenges**

The decline of traditional livelihoods tied to the canal system, such as fishing and waterway-based transport, has led to a lack of community engagement in maintaining the waterways. The newer generations, shifting away from canal-dependent professions, contribute less to canal upkeep, leaving them neglected and vulnerable to degradation.

Operational challenges were also highlighted, particularly the limited availability of manpower for canal cleaning and the lack of resources to deploy mechanized cleaning in smaller canals. Financial constraints were repeatedly emphasized, with ward representatives and Panchayat officials pointing to insufficient funding for regular maintenance and rejuvenation activities.

### **4.5 Health and Environmental Impacts**

The deteriorating state of the canals has had significant health implications. Reports of skin diseases linked to polluted water emphasize the urgent need for improving water quality. Additionally, encroachments, sand mining, and eutrophication have disrupted the ecological

balance, reducing the canals' ability to act as natural drainage systems and increasing their susceptibility to stagnation.

In conclusion, the technical analysis underscores the interconnected nature of the challenges facing the Panchayat. Flooding, pollution, encroachments, and operational shortcomings collectively highlight the need for a comprehensive and sustainable approach to canal network management. These findings provide a foundation for identifying targeted solutions to enhance flood resilience and environmental sustainability within the Panchayat.

Table 3: *Ward Wise Details of the Issues*

<b>Ward No.</b>	<b>Areas Affected by Flood</b>	<b>Covered Areas</b>	<b>Flood Duration</b>	<b>Cause of Flood</b>
1	Tharavattom area	Less	2-3 days	Close to lakes
2	Iyamkulam Michabhoomi, Nambatt	Less	1 week	Close to Muvattupuzha River
3	Thuruthumel, Panjipalam	High	1 week	Close to Muvattupuzha River, non-availability of shutters, bunds, side walls
4	Panjipalam road-South, Appamkoot-Laksham Veedu colony, IHDP college area, Mangalasheeri	High	1 week	Close to Muvattupuzha River
5	Odichkutti Palam, Valavarmangalam Palam	Less	1 week	Close to Muvattupuzha River, eutrophication
6	Chugam to Vallampally	Less	1 week	Close to Muvattupuzha River

7	Vakkayil Palam, Kulangara Colony, Palamkadav Chittezhath Bhagam, Thuruthumel Bhagam, Velakunath Malayil Bhagam	High	1 week	Close to Muvattupuzha River, water discharge from Pozhavediyil Thood
8	Chirayil Kadav, Puzhavil Kaling, Manathumparamb Kaling, Kulangara Laksham veedu colony	High	1 week	Close to Muvattupuzha River, eutrophication, encroachments, pollution, high dumping of waste
9	Manalel colony, Kulangara colony, Perumkarauva Parayana colony	High	1-2 weeks	Close to Muvattupuzha River, eutrophication, encroachments
10	Kadukara, Thereparamb, Alinjiveed Bhagam, Kudichukuttipalam	High	1 week	Close to Muvattupuzha River, encroachments, eutrophication
11	Kuttumel Muttapally Bhagam, Kolluruth Bhagam, Kulikatharamb Bhagam	High	1 week	Close to Muvattupuzha River, encroachments
12	Parepadam, Talathi Paramb Colony, Chirayil Mandopali Thagam, Thaiparamb, Ottemasheri, Channiyil Kandoth Thagam	High	1.5 weeks	Close to Muvattupuzha River, encroachments
13	Chemanavari Kayal Road, Kallukadav	Medium	1 week	Close to Muvattupuzha River, encroachments, eutrophication

14	Kudu Padam, Manthadhara, Elakiri, Saradamadam	High	1-2 weeks	Eutrophication, high pollution
15	Bundel, Devasam Thuruth, Parayanki Thuruth, Chiminagiri	High	1-2 weeks	Close to Muvattupuzha River

## 4.6 Key Issues Impacting Maravanthuruthu

The issues identified through surveys, consultations with stakeholders, and field observations reflect the complex interplay of natural and human-induced factors that exacerbate flooding and pollution. Key problems include the inadequacy of flood control infrastructure such as shutters and bunds, canal pollution caused by eutrophication, encroachments, and the lack of resources for proper maintenance and cleaning of water bodies. These challenges significantly impact the community's resilience to flooding, water quality, and local livelihoods. The following subsections provide a comprehensive overview of the primary issues, their causes, and the technical implications for addressing these problems.

### 4.6.1. Eutrophication and Canal Pollution

Eutrophication has emerged as a significant environmental challenge in Maravanthuruthu Grama Panchayat, primarily due to the proliferation of aquatic plants like water hyacinth. These plants obstruct the natural flow of water, leading to a decline in water quality by increasing nutrient loads and fostering conditions conducive to organic pollution. This deterioration in water quality has had direct adverse effects on local fisheries, disrupting aquatic ecosystems and reducing the availability of resources for fishers. In addition to the visible effects on the aquatic environment, the dense plant growth contributes to oxygen depletion in water bodies, exacerbating the overall pollution problem.

**Conclusion:** The eutrophication of canals is a critical issue that affects water quality, disrupts aquatic life, and hampers local fisheries. Immediate action is required to control plant growth and

restore the natural flow of water to mitigate its impact on the ecosystem and community livelihoods.

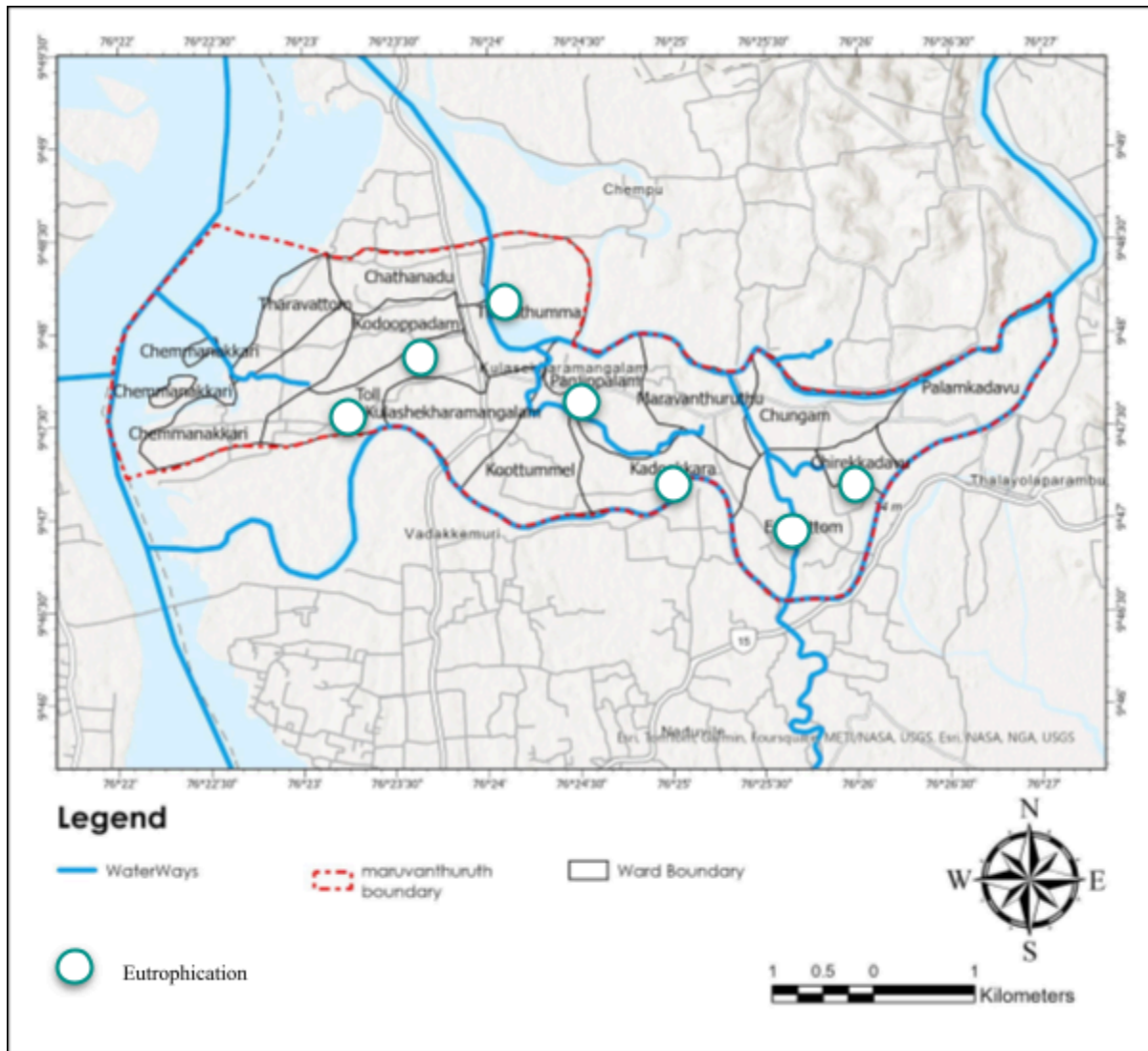


Fig 20 : Location of Presence of Eutrophication

#### 4.6.2. Absence of Functional Shutters and Bunds

The lack of operational flood control infrastructure, such as shutters and bunds, significantly increases the vulnerability of Maravanthuruthu Grama Panchayat to flooding. While shutters are available in certain wards (5, 7, 8, 9, and 10), they are largely inactive and unable to perform

their intended function of controlling floodwaters. Moreover, the existing bunds, notably in Ward 6, are in poor condition, with structural degradation leading to a reduced capacity to prevent water overflow during peak flood events. The absence of adequately constructed bunds and shutters across other vulnerable areas of the Panchayat exacerbates the flood risks, particularly during monsoon seasons.

**Conclusion:** The inadequate and non-functional flood control infrastructure is a fundamental issue contributing to recurrent flooding. Immediate rehabilitation and upgrading of shutters and bunds are essential for effective flood risk management in the Panchayat.

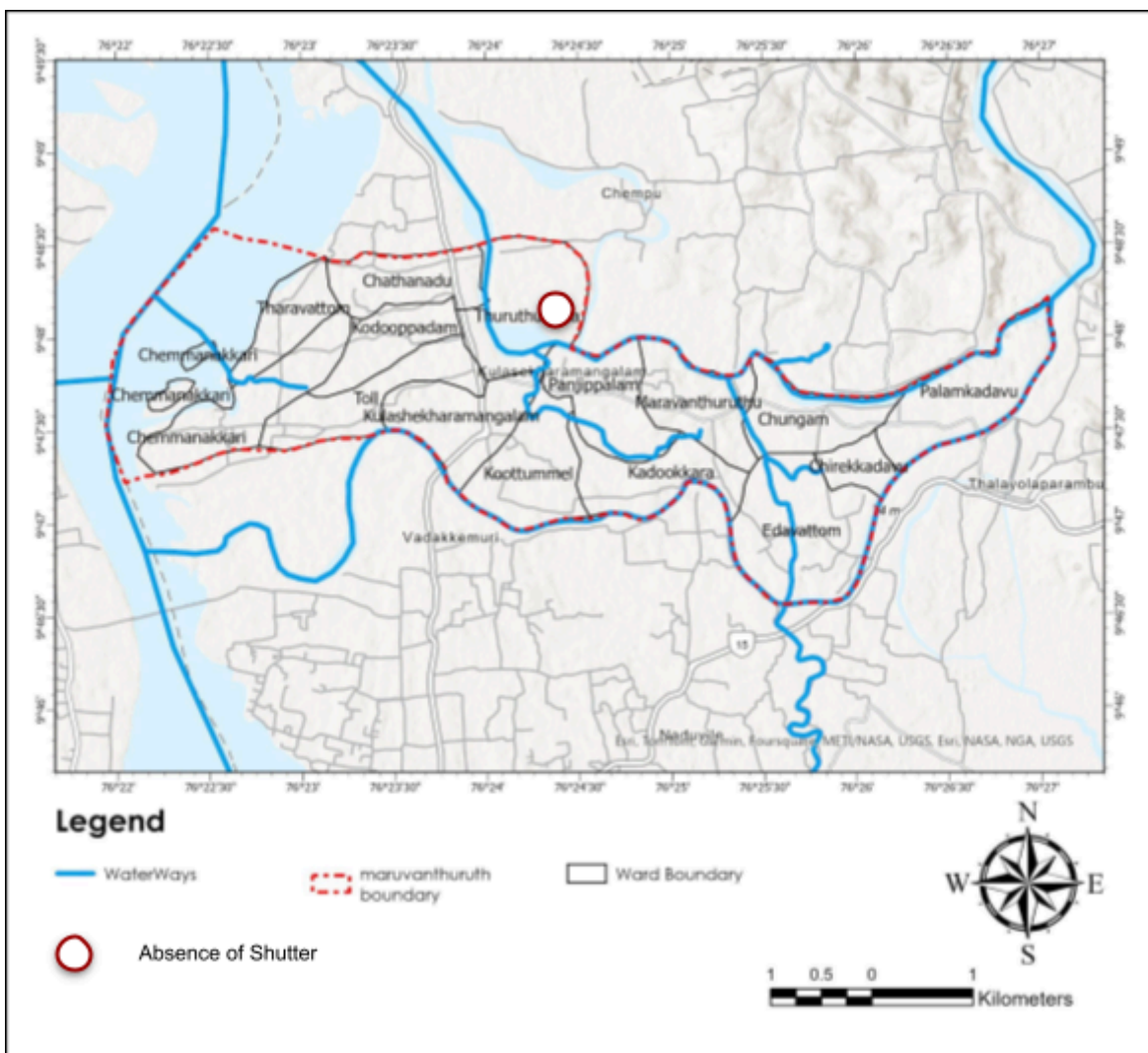


Fig 21 : Location of Absence of Shutter

### **4.6.3. Encroachments and Blocked Drainage**

Encroachments along the canals and other water bodies have led to a significant disruption in the natural flow of water. These unauthorized structures obstruct the intended path of drainage systems, causing water to accumulate and stagnate in certain areas, leading to localized flooding. The encroachments have also exacerbated pollution levels in water bodies by introducing waste materials and contributing to habitat destruction. Additionally, the presence of encroachments complicates efforts to maintain and rehabilitate flood control infrastructure, as these structures often obstruct access to key water management systems.

**Conclusion:** Encroachments are a key obstacle to effective flood management, water flow, and environmental conservation. A systematic removal of encroachments, coupled with stricter enforcement of regulations, is essential to restore natural water flow and reduce flooding risks.



Fig 22 : Location of Encroachments

#### 4.6.4. Inaccessibility of Manpower and Equipment for Canal Cleaning

The inadequate availability of skilled manpower and cleaning equipment for canal maintenance has been identified as a critical challenge in Maravanthuruthu Grama Panchayat. Despite the presence of cleaning machinery, several smaller canals are inaccessible, preventing the removal of waste and organic material that accumulates in these waterways. Additionally, the lack of government approval for the employment of laborers for canal cleaning exacerbates the situation, resulting in neglected canals that contribute to water quality deterioration and increased flood risk.

**Conclusion:** The lack of manpower and equipment for regular canal cleaning is hindering the effective maintenance of water bodies. Establishing a dedicated workforce and improving access to cleaning equipment are necessary to restore canal functionality and reduce pollution levels.

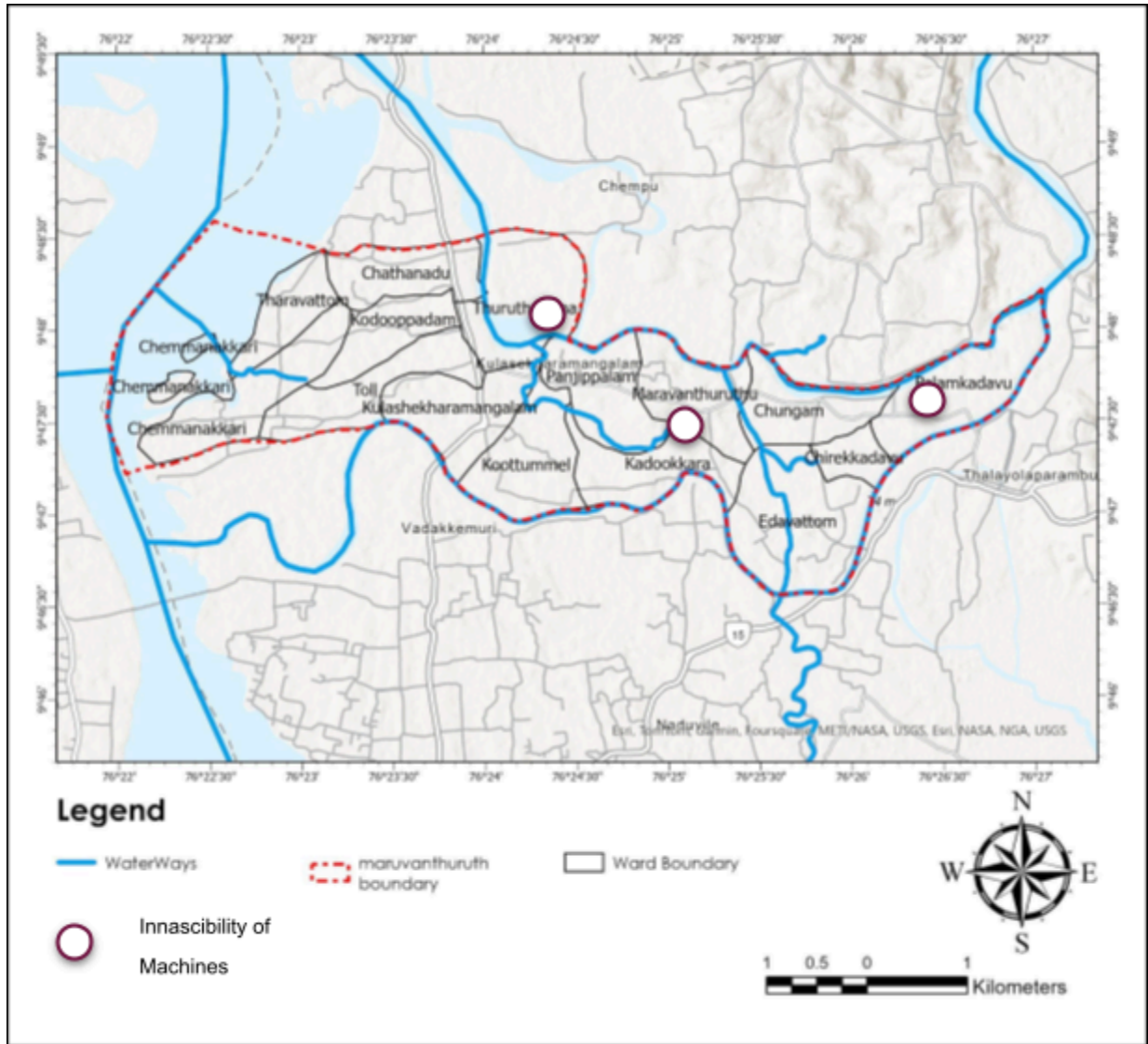


Fig 23 : Smaller streams which are inaccessible for machines for desilting

#### 4.6.5. Inadequate Funds for Flood Management and Water Quality Improvement

Financial constraints have been consistently highlighted as a major barrier to addressing the flood management and water quality challenges in Maravanthuruthu Grama Panchayat.

Insufficient funding for the construction and maintenance of critical flood control infrastructure, such as bunds, shutters, and drainage systems, has led to the degradation of existing infrastructure and hindered the development of new solutions. Furthermore, the absence of funds for the removal of waste and pollutants from canals and water bodies has allowed pollution to build up, worsening environmental and flood risks.

**Conclusion:** The inadequate financial resources allocated for flood management and water quality improvement are limiting the effectiveness of mitigation efforts. Securing dedicated funding for infrastructure rehabilitation, waste management, and flood control is crucial for addressing the ongoing challenges in the Panchayat.

#### **4.6.6. Riverbank Erosion and Overflow Risks**

The absence of protective side walls along the riverbanks has led to significant erosion and increased vulnerability to river overflow. Without adequate protection, riverbanks have eroded, creating pathways for floodwaters to breach their natural boundaries. This has resulted in frequent flooding in surrounding areas, particularly during periods of high rainfall. The lack of erosion control measures further exacerbates the risk of flooding and damage to surrounding infrastructure.

**Conclusion:** Riverbank erosion and the absence of protective measures are critical factors contributing to flood risks. Implementing structural interventions, such as riverbank reinforcement and erosion control, is essential to reduce overflow risks and protect local communities.

#### **4.6.7. Dumping of Waste in Canals**

One of the most significant contributors to the deterioration of canal functionality is the widespread dumping of solid waste, construction debris, and other pollutants into the canals. This practice obstructs the natural flow of water, leading to blockages that exacerbate flooding risks and contribute to the degradation of water quality. The accumulation of waste materials not only hinders the proper functioning of drainage systems but also introduces harmful chemicals and pollutants that further impair aquatic ecosystems and pose health risks to local communities.

**Conclusion:** Waste dumping in canals is a severe environmental and flood management issue. Efforts to prevent unauthorized dumping, coupled with regular cleaning and waste management campaigns, are essential to restore the functionality of canal systems and improve overall water quality.

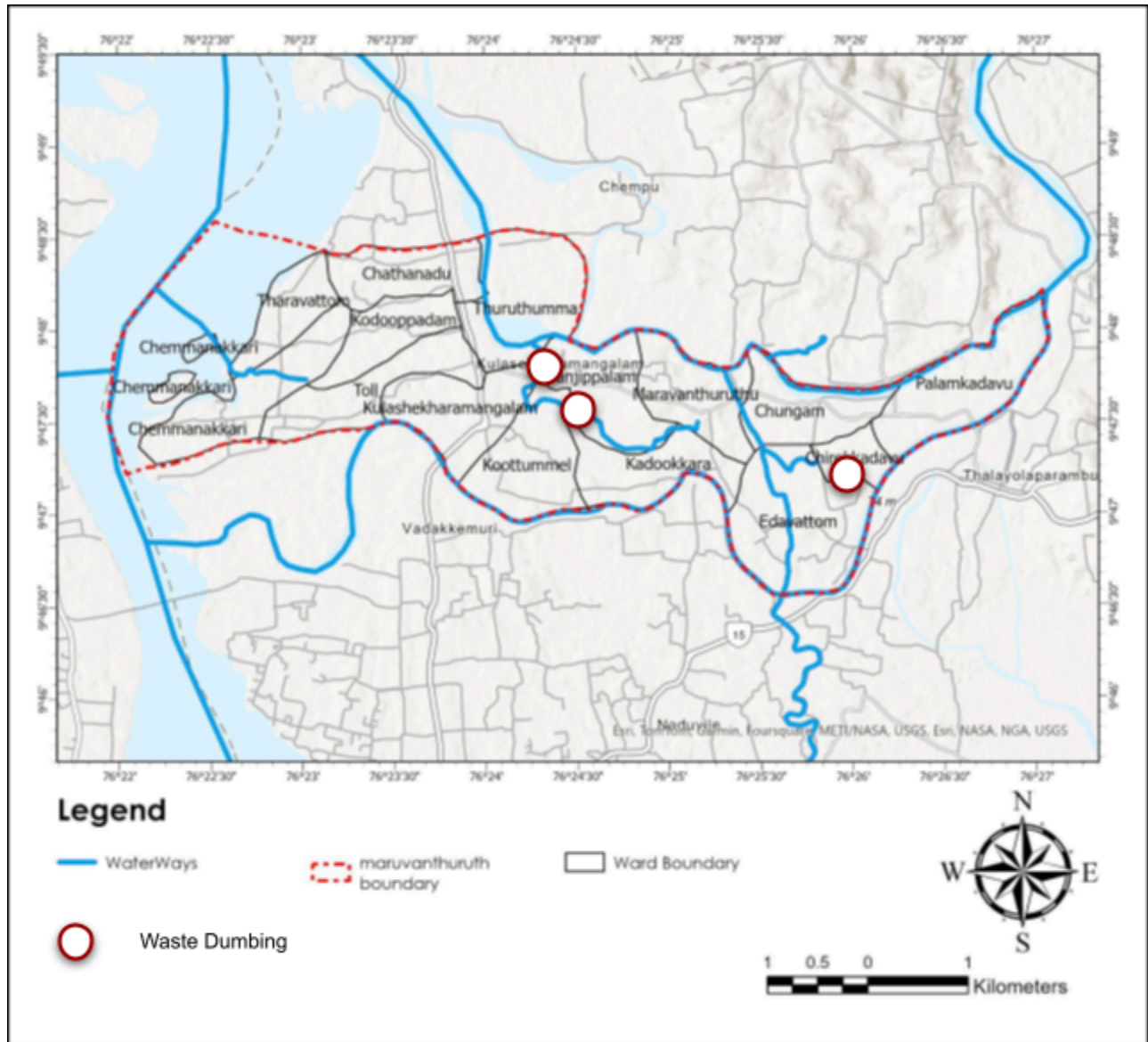


Fig 24 : Location of Waste Dumps

The challenges identified in Maravanthuruthu Grama Panchayat are interlinked and arise from a combination of environmental, infrastructural, and resource-based deficiencies. The absence of effective flood control infrastructure, widespread canal pollution, encroachments, and insufficient manpower and funding are all significant barriers to improving flood resilience and water quality in the area. Addressing these issues requires a multi-faceted approach that includes the rehabilitation of flood control infrastructure, removal of encroachments, enhanced canal cleaning efforts, and securing adequate funding for infrastructure maintenance and pollution control. Moreover, structural interventions such as riverbank protection and the restoration of natural water flow should be prioritized to mitigate the impacts of flooding and environmental degradation. By addressing these critical issues, Maravanthuruthu Grama Panchayat can significantly improve its flood resilience, environmental health, and the livelihoods of its residents.

## Chapter 5: Problem Framework

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Given the problem statement and context for Maravanthuruthu Panchayat, the following technical breakdown explains the key issues in the problem framework. The challenges are mainly driven by the degradation of the canal system due to factors such as pollution, sediment accumulation, encroachments, and lack of maintenance. These issues hinder the canals' original function, which supported agriculture, water supply, and local tourism activities. The framework aims to address the underlying causes of these challenges to provide a clearer understanding of the situation.

### 5.1. Terrain & Location

Maravanthuruthu's geographical features significantly influence the canal network's functionality.

- **Downstream Deposition Zone:** The terrain of the downstream sections of the canals leads to a natural deposition of sediments, particularly silt and organic matter. This deposition is exacerbated by the canal's reduced ability to transport water, resulting in a build-up of materials that narrow the canal cross-section. This further impedes water flow and worsens the condition of the canal.
  - **Silt & Sludge Accumulation:** The accumulation of fine sediments (silt) and organic sludge over time significantly reduces the water-holding capacity of the canal. These materials, originating from agricultural runoff, vegetation, and organic decay, settle at the canal bottom, gradually increasing its shallowness. One of the major factors exacerbating this issue is the restriction on silt extraction. In the past, local communities actively engaged in sediment extraction from rivers, which was then sold. However, the introduction of legal measures gradually restricted and ultimately banned sand mining from Kerala's rivers. The **Kerala Protection of River Banks and Regulation of Removal of Sand Act, 2001**, was the first significant legislation aimed at protecting riverbanks from erosion and regulating the removal of sand. This act established a framework for sustainable sand mining, introducing local committees to oversee and manage

extraction activities. Further restrictions followed in 2013 when a ban was imposed on sand mining in the **Muvattupuzha River**, which flows through Maravanthuruthu, due to concerns over excessive and unregulated extraction. In 2016, the **Kerala government implemented a statewide ban on riverbed sand mining**, citing the depletion of sand deposits and the associated environmental impacts. This ban was intended to remain in place until detailed sand audit reports were completed and reviewed. While these legal measures were crucial in protecting river ecosystems, they also restricted the traditional practice of silt extraction by local communities. As a result, sediment accumulation in canals and rivers has increased, leading to reduced water-holding capacity and exacerbating flooding and waterlogging issues. Additionally, regular desiltation efforts, which should be carried out periodically, face significant delays due to issues related to fund allocation and interdepartmental coordination. Desiltation projects by the irrigation department are typically executed on a first-come, first-served basis, leading to inefficiencies in addressing silt accumulation. In summary, while the legal frameworks were designed to protect water bodies, they have also contributed to the increasing accumulation of silt and sludge in Maravanthuruthu's waterways, intensifying flood risks and waterlogging challenges..

- **Blocked Canals: Reduced Size:** As the canal fills with silt and sludge, its cross-sectional area decreases, reducing its flow capacity. This physical narrowing of the canal restricts the movement of water, limiting its function as a flood mitigation system and water transport route.
- **Canal Network Deterioration:** As sedimentation continues unchecked, canal walls may erode, and infrastructure such as embankments and culverts may degrade. This deterioration affects the long-term sustainability of the canal system, making it increasingly difficult to maintain or restore its original functionality.
- **Flooding:** The inability to clear blockages and the reduced size of the canals result in poor water management,

especially during heavy rains or high tides. As the canals fail to accommodate the water volume, flooding occurs, adversely affecting agriculture, local transportation, and overall community safety.

## 5.2. Canal Encroachments

Encroachments are a significant factor in reducing the canal's capacity and impeding the natural flow of water.

- **Road Widening Reducing Canal Dimensions:** Encroachment through road development, particularly along the canal's edges, results in the narrowing of the canal's cross-section. The construction of roads and infrastructure near canal banks reduces the space available for water flow, further obstructing the canal's capacity to handle water volume.
  - **Blocked Canals: Reduced Size:** The encroachment of land for roadways or other infrastructure constricts the canal's flow, leading to blockages. The blockage, compounded by sedimentation, limits water passage and increases the risk of overflows and flooding.
    - **Canal Network Deterioration:** Encroachment and reduced canal size lead to both physical deterioration (e.g., erosion of the banks, cracking, and weakening of culverts) and functional degradation. The canal is no longer able to serve its intended purposes effectively, contributing to long-term infrastructural decay.
      - **Flooding:** The combined effects of reduced canal dimensions from encroachments and the resulting deterioration lead to flooding, especially during peak water flow events like heavy rains or high tides. These localized floods have cascading impacts on agriculture, local communities, and even tourism.
- **Streams Encroached for Agriculture:** When streams or smaller waterways are encroached upon for agricultural activities, the natural water flow patterns are disrupted.

- **Silt & Sludge Accumulation:** Encroachment results in changes to the flow dynamics, leading to increased sedimentation. Without proper channels for water to flow through, water is forced to stagnate or slow down, allowing for more sediment and sludge deposition.
  - **Blocked Canals: Reduced Size:** The stream or canal that once served as a vital waterway is gradually filled with silt and agricultural waste, resulting in the narrowing of the canal's width. This reduces its ability to transport water effectively.
  - **Canal Network Deterioration:** The encroachment and sedimentation further strain the canal network, contributing to structural deterioration over time. The narrowing of the canal worsens water stagnation and accelerates the degradation of the entire system.
  - **Flooding:** The combination of blocked canals, narrowed dimensions, and deteriorating infrastructure leads to poor water flow control, resulting in frequent flooding. The flooding exacerbates agricultural losses, disrupts local communities, and damages infrastructure.

### 5.3. Change in Utility

Shifts in how the canals are used have significantly altered their original functions, leading to their degradation.

- **Shift from Waterways to Road Transit:** As the local transportation system shifts from boats and waterways to roads, the canals lose their primary function.
  - **Pipes Replacing Culverts at Canal-Road Crossings:** In places where roads cross the canals, pipes are often installed instead of traditional culverts, further disrupting the natural water flow. These pipes have a limited capacity and can get easily clogged, exacerbating water flow issues.
    - **Blocked Canals: Reduced Size:** The installation of pipes reduces the cross-sectional area for water flow, causing blockages and narrowing of

the canal over time. This obstruction exacerbates sedimentation, further reducing the canal's size.

- **Canal Network Deterioration:** The shift away from water transport, combined with inadequate infrastructure for managing water flow, leads to the deterioration of the canal network. The system no longer meets its intended functions, becoming increasingly difficult to maintain.
  - **Flooding:** With canals unable to handle the water volume due to pipe installations and reduced dimensions, flooding occurs, affecting agriculture, local transportation, and community safety.
- **Waste Dumping in Canals:** With reduced use of the canals, they become dumping grounds for solid waste, organic debris, and plastics.
  - **Silt & Sludge Accumulation:** Waste dumping adds to the accumulation of organic materials and debris in the canal, increasing the load of silt and sludge. This further reduces the canal's capacity to handle water flow.
    - **Blocked Canals: Reduced Size:** Waste buildup, coupled with the deposition of sediment, gradually narrows the canal's cross-section. This reduces the space available for water to flow through.
    - **Canal Network Deterioration:** Continued waste dumping and sedimentation cause long-term deterioration of the canal system, including structural damage, erosion, and eventual collapse of certain sections.
      - **Flooding:** Waste and sediment buildup, coupled with the reduced capacity of the canal, lead to poor water flow management and flooding during heavy rains or high tides.

#### 5.4. Lack of Planning/Maintenance

Without adequate planning, maintenance, and governance, the canal system has fallen into disrepair, contributing to its current condition.

- **Commercial Desilting: Govt. Restrictions:** Government restrictions on commercial desilting prevent local bodies from hiring contractors for large-scale cleaning and maintenance of the canals.
  - **Absence of Periodic Desilting:** Without regular desilting, the canals accumulate silt and organic debris, further narrowing their cross-sectional area and compromising their function.
    - **Silt & Sludge Accumulation:** As desilting efforts are limited, the canals become increasingly filled with sediments and sludge, reducing their capacity to manage water effectively.
    - **Blocked Canals: Reduced Size:** The lack of desilting leads to blockages in the canal, which further reduce the canal's size and impede water flow.
    - **Canal Network Deterioration:** With insufficient maintenance, the canal infrastructure deteriorates over time, leading to erosion, damage to embankments, and weakened structural integrity.
      - **Flooding:** The deteriorating canals, clogged with sediments and waste, fail to handle water effectively, leading to localized flooding in the surrounding areas.
- **Narrow Channels: Unsuitable for Machinery & Manual Desilting:** The narrow channels in Maravanthuruthu prevent the use of modern desilting machinery, while manual cleaning is not feasible due to unhygienic conditions and restricted space.
  - **Absence of Periodic Desilting:** Without desilting capabilities, sediment continues to accumulate, narrowing the canal further.
    - **Silt & Sludge Accumulation:** Sediment build-up increases, causing the canals to become shallower and less effective in carrying water.
    - **Blocked Canals: Reduced Size:** Narrow channels, combined with sediment accumulation, lead to the obstruction and further reduction of canal size.

- **Canal Network Deterioration:** The canals, now filled with silt and sludge, begin to deteriorate structurally.
  - **Flooding:** Reduced canal dimensions and poor maintenance lead to flooding during periods of heavy rain or water influx.
- **Non-functional Shutters:** Some of the canal gates and shutters designed to control water flow may be non-functional or damaged.
  - **Blocked Canals: Reduced Size:** These non-functional shutters prevent proper regulation of water, contributing to blocked canals and narrowed dimensions.
    - **Canal Network Deterioration:** The lack of functioning gates results in improper water management, contributing to the deterioration of canal infrastructure.
      - **Flooding:** Poor regulation of water flow leads to frequent flooding, especially during high tide or rainy periods.
- **Unregulated Dam Openings:** The uncontrolled release of water from dams can flood the surrounding areas and the canal system.
  - **Flooding:** Unregulated dam openings contribute to sudden water surges that overwhelm the canal system, leading to localized flooding in Maravanthuruthu.

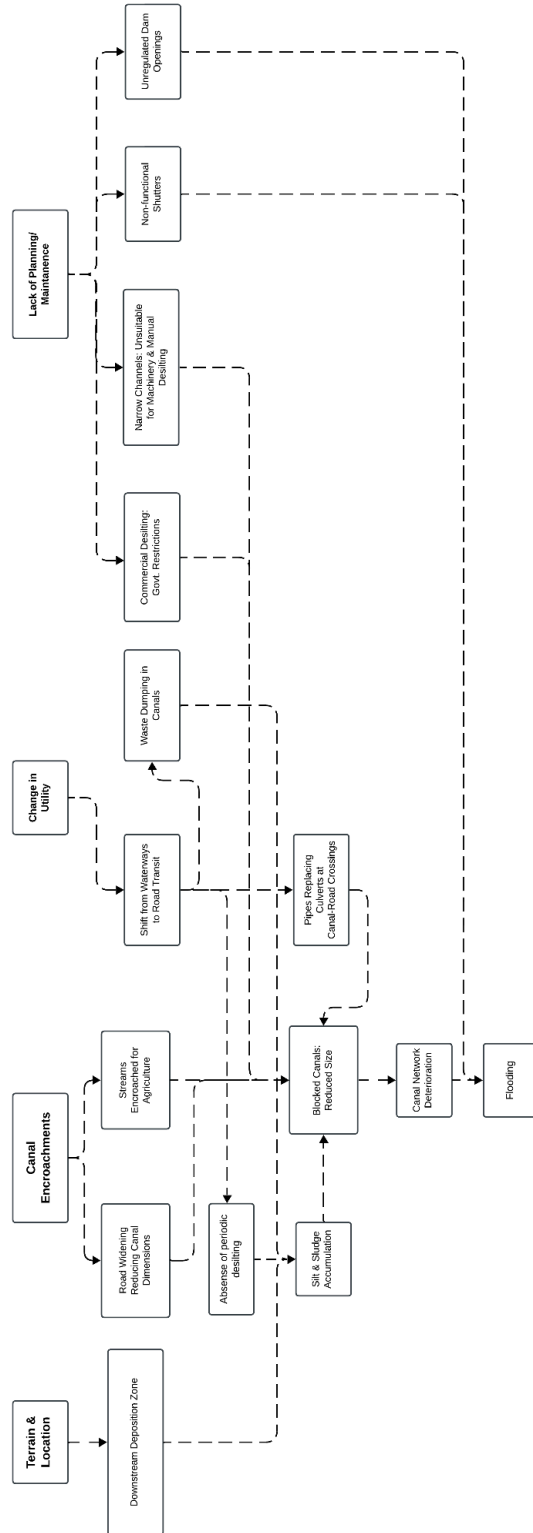


Fig 25: Problem Framework

## Chapter 6: Challenges to Opportunities

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The current situation in Maravanthuruthu Panchayat reflects a series of technical, infrastructural, and environmental challenges that have significantly contributed to the deterioration of the canal network. Historically, the canals in this region played a vital role in supporting agricultural irrigation, improving water availability for domestic use, and have the potential to contribute to the development of eco-tourism. However, with the degradation of the canal system, these crucial functions have been disrupted, leading to increased flooding, reduced agricultural productivity, and hindered tourism growth.

A detailed analysis of the existing challenges highlights the urgent need for intervention to restore the functionality of the canal network and improve the resilience of the area to flooding. Key technical issues identified include the accumulation of silt and sludge due to inadequate desilting, narrowing of canal dimensions from encroachments, unregulated sluice gates, blocked canals, and poor waste disposal practices. These challenges, intertwined with social and infrastructural factors, require a comprehensive approach to restore the hydraulic capacity of the canals, ensure sustainable water management, and address encroachments.

Key Issues Contributing to the Degradation of the Canal System in Maravanthuruthu:

### **6.1 Lack of Suitable Machinery for Desilting Small Water Bodies**

Small canals and water bodies, typically around 1 meter wide, play a crucial role in the drainage system of Maravanthuruthu Grama Panchayat, particularly in mitigating waterlogging and flooding. However, the existing machinery, such as large desilting machines and mechanical dredgers, is unsuitable for these narrow watercourses. These machines are designed for larger channels, making them inefficient and impractical for maintaining the smaller canals that are vital to the Panchayat's drainage system.

#### **Problem Details:**

- **Size Mismatch:** The current machinery cannot effectively navigate or operate within these small canals due to their size, resulting in inefficiency and neglect of these critical waterways. Small-scale desilting tools capable of working in these narrow spaces are either unavailable or not accessible for regular use.
- **MGNREGS Limitations:** Volunteers under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), who typically undertake canal maintenance and cleaning, are unable to work in these small water bodies due to the hazardous, unhygienic, and resource-intensive nature of the task. These conditions make it unsafe and impractical for manual cleaning efforts.
- **Accumulation of Sediment:** The lack of suitable desilting mechanisms leads to the accumulation of sediment, debris, and aquatic vegetation such as algae and water hyacinth. This obstructs water flow, reduces the drainage system's efficiency, and worsens flooding during heavy rains. Moreover, the buildup of organic material contributes to deteriorating water quality, posing health risks to the local population.
- **Impact on Flooding:** Blocked small canals disrupt the efficiency of the overall drainage network, resulting in widespread waterlogging in low-lying areas. This increases the frequency and severity of flooding during the monsoon season. Additionally, these blockages hinder the natural recharge of groundwater, affecting water availability during dry periods and contributing to long-term water scarcity.

## 6.2 Canal Narrowing and Encroachments

Encroachments in canal corridors, resulting from infrastructure development and agricultural land conversion, have significantly reduced the capacity of Maravanthuruthu's canals to convey water. These issues exacerbate flooding risks and hinder the functionality of the drainage system. Addressing these challenges requires a combination of detailed mapping and innovative solutions, making it a resource-intensive and complex task.

### Problem Details:

- **Infrastructure Development:** Construction activities encroach into canal corridors, narrowing waterways and obstructing natural flow paths. These blockages complicate regular maintenance and exacerbate flooding.

- **Agricultural Conversion:** Agricultural land along canal corridors has been converted for other uses, permanently reducing the space available for drainage and increasing local flood vulnerability.
- **Reduced Water Flow Capacity:** Encroachments create bottlenecks that limit water flow, particularly during monsoons, leading to stagnation, overflows, and widespread flooding.

Engaging students in mapping canal encroachments offers a community-driven approach to addressing these challenges. With proper training and technology, students can create a detailed spatial database using GIS tools, mobile apps, and drones, ensuring efficient and large-scale data collection. Their involvement fosters community awareness, builds local capacity, and provides real-world environmental management experience. Combining student-led mapping with technological innovation—such as automated encroachment detection, digital monitoring platforms, and restoration strategies—can enhance decision-making and long-term canal management. This integrated approach ensures field data informs scalable solutions, creating a continuous cycle of improvement in encroachment monitoring and prevention.

### **6.3 Unregulated Sluice Gates and Dam Openings**

Another critical issue contributing to the flooding in Maravanthuruthu is the non-functionality of sluice gates and unregulated dam openings. These infrastructure components are essential for controlling water flow in and out of the canal system, but their improper operation leads to unpredictable water flow patterns, exacerbating flood risks.

### **6.4 Waste Disposal and Water Quality Degradation**

Improper waste disposal, particularly the dumping of solid waste into the canals, has contributed to the degradation of water quality. The accumulation of waste, combined with organic matter like algae, obstructs the canals and further reduces their water-carrying capacity.

### **6.5 Presence of Pipes Instead of Culverts in Smaller Streams**

In many areas of Maravanthuruthu, pipes have been used instead of traditional culverts where roads cross small streams. While pipes offer a cost-effective and quick solution in the short term, they significantly reduce water flow capacity, leading to severe flooding and waterlogging issues, particularly during heavy rainfall.

### **Core Problem: Pipes as a Drainage Bottleneck**

The reliance on pipes instead of culverts has become a major contributor to drainage inefficiencies. The reduced capacity of these pipes leads to water stagnation and overflow during peak stormwater events, directly impacting road conditions, residential areas, and agricultural fields.

### **Problem Details**

1. **High Initial Costs:** Replacing existing pipes with culverts requires significant investment in materials, labor, and planning. Municipalities operating on tight budgets often prioritize short-term, lower-cost solutions like pipes, even though they are less efficient in the long run.
2. **Water Flow Restriction:** The small diameter of pipes drastically reduces the ability of streams to manage stormwater, especially during monsoons. Additionally, these pipes frequently become clogged with debris, further obstructing water movement.
3. **Insufficient Drainage Capacity:** Pipes often cannot accommodate peak flow rates, leading to localized flooding. This issue is exacerbated when multiple pipes are installed without proper hydraulic design.
4. **Increased Flooding Risk:** Poor drainage caused by inadequate pipe capacity worsens flooding and waterlogging, damaging infrastructure, disrupting livelihoods, and increasing maintenance costs for local authorities.

Replacing pipes with culverts in Maravanthuruthu is a crucial step toward sustainable flood management. While cost constraints pose a challenge, exploring alternative culvert designs, prefabricated units, and hybrid drainage solutions can provide practical and scalable interventions. Collaboration between engineers, urban planners, and policymakers will be

essential in ensuring that future drainage infrastructure supports long-term resilience against flooding.

### **Innovation as a Means to Drive Solutions**

To address these challenges, a **hackathon** will be conducted as a means of bringing forward innovation. This event will bring together engineers, planners, students, and technology experts to develop cost-effective, scalable solutions for desilting small canals, mapping encroachments, improving sluice gate functionality, culvert alternatives and enhancing waste management. The key deliverables from this hackathon will include prototype designs for compact desilting equipment, digital tools for encroachment mapping and monitoring, automated water regulation mechanisms, and community-driven waste management initiatives. These innovations will be evaluated for feasibility and potential implementation within the canal restoration framework of Maravanthuruthu Grama Panchayat.

### **Conclusion**

The challenges facing Maravanthuruthu Panchayat's canal network are numerous and interconnected. The issues of inadequate desilting, encroachments, unregulated sluice gates, waste disposal, and the decline in water transport and usage of canals have collectively contributed to the degradation of the canals, increasing flood risks, reducing agricultural productivity, and limiting the region's tourism potential. Addressing these challenges will require a multi-faceted approach, integrating technical, infrastructural, and social interventions. A hackathon focused on developing innovative solutions for canal restoration, desilting technologies, waste management, and water regulation could play a pivotal role in finding cost-effective, scalable solutions. By restoring the functionality of the canals, Maravanthuruthu can regain its agricultural, ecological, and socio-economic balance, improving water availability for domestic use and unlocking the full potential for eco-tourism development.

Ultimately, these interventions will not only improve flood resilience and water quality but also enhance the broader socio-economic fabric of Maravanthuruthu Panchayat, ensuring long-term sustainability and growth.

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