

**Reviving the Vaigai: Urban Riverfront
Redevelopment for Cultural and Social Integration
in Temple City Madurai**

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Reviving the Vaigai: Urban Riverfront Redevelopment for Cultural and Social Integration in Temple City Madurai

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Abstract

Day by day cities around the world are working on the natural- based, local-cultural approaches for the riverfront development rather than the concretise solution . This study is carried out in a 4-kilometer stretch of the Vaigai River in Madurai, Tamil Nadu to revive the river from the present condition. Historically significant Vaigai river has been now plagued by pollution, urban encroachments, and socio-ecological disconnect. Urban River Management Plan (URMP), Water-Sensitive Urban Design (WSUD), and Cultural Landscape Theory, explores about the ecological restoration and cultural traditions and there significant important in the riverfront development. Inspired by lessons from Sabarmati, Patna, and Yamuna riverfronts, it proposes restored Ghats, shaded walkways, flood-resilient green spaces, and gathering and celebration spaces. The proposal integrates seasonal adaptability and cultural integration while promoting public engagement. Findings suggest that urban rivers can be restored as vibrant socio-ecological corridors when cultural narratives, local hydrology, and inclusive planning converge.

Keywords: Urban Riverfront, Vaigai River, Nature-Based Solutions, Socio- Culture riverfront,

1. Introduction

Many cities in the world have been established along the river banks (FrancisR, 2012). For instance, many civilizations settled along the Euphrates- the Tigris Rivers in Mesopotamia, the Nile in Egypt, the Ganges in India, the Indus in Pakistan and the Huang-Ho in China throughout the history (NovaresioP, 2006). In case of Madurai, one of India's oldest cities and southern city in the state of Tamil Nadu the civilization happens along the banks of Vaigai river. Vaigai historically served as a source of water, a cultural spine, and a space for spiritual rituals is now in a degrade condition due to pollution, encroachment, disconnection from people, and seasonal stagnancy. For instance, studies have revealed alarming transformations in cities like Bengaluru, where urban areas have expanded by over 900 percent in just four decades, leading to depletion of green spaces and waterbodies (Ramachandra, 2017). Similarly, Mumbai has witnessed a decline of 60-65 percent in biodiversity and waterbodies due to urbanization (Fermades & Chatterjee, 2017). Like the way there has been significant changes in the water level and vegetative index is seen in vaigai. This research aims to propose a holistic riverfront revival strategy that not only addresses environmental challenges but also rejuvenates the city's cultural fabric.

2. Objectives

- To restore the Vaigai River as a vibrant and sustainable cultural, and recreational corridor in Madurai, the temple city.
- To activate the river edges through multifunctional zones by enhancing accessibility and connectivity
- To create a cultural corridor that facilitate the temple precision and festivals
- To Mitigate Urbanization Impacts through instilling a sense of belonging in citizens.

3. Methodology

The research adopts a multi-layered methodology combining Data collection, site analysis, Issues Identification, stakeholder mapping, comparative case studies and Strategy Development. Key components include:

3.1 Data Collection

The existing environmental, social, and infrastructural conditions of the Vaigai River and its adjacent urban fabric are recorded. The study focused on parameters including land use and land cover (LULC), surface temperature variations, seasonal floods, festivals and gathering carried out in riverfront, sewage outfalls, and contamination levels.

- **Primary Data:** Conducted, stakeholder interviews, photographic documentation, and on-site spatial measurements along the 4 km project stretch.
- **Secondary Data:** Government records (WRD Basin Report), high-resolution satellite imagery from USGS, and research publications in India and abroad.

3.2 Analysis

Interlinked analysis of ecological and socio-cultural dynamics of the riverfront, combining both quantitative and qualitative evaluations:

- **Seasonal flow and water availability patterns** were analysed to design interventions adaptable to dry and monsoon periods.
- **Flood Plain map:** to analyse the flood line for the past years
- **Land use and land cover** mapped land use transformations over time and correlated them.
- Evaluating the impacts of urbanization and impervious surfaces on flooding and storm water management.
- **Water quality mapping** identified major sewage outfalls, levels of contamination, and siltation patterns in check dams.

3.3 Issues Identification

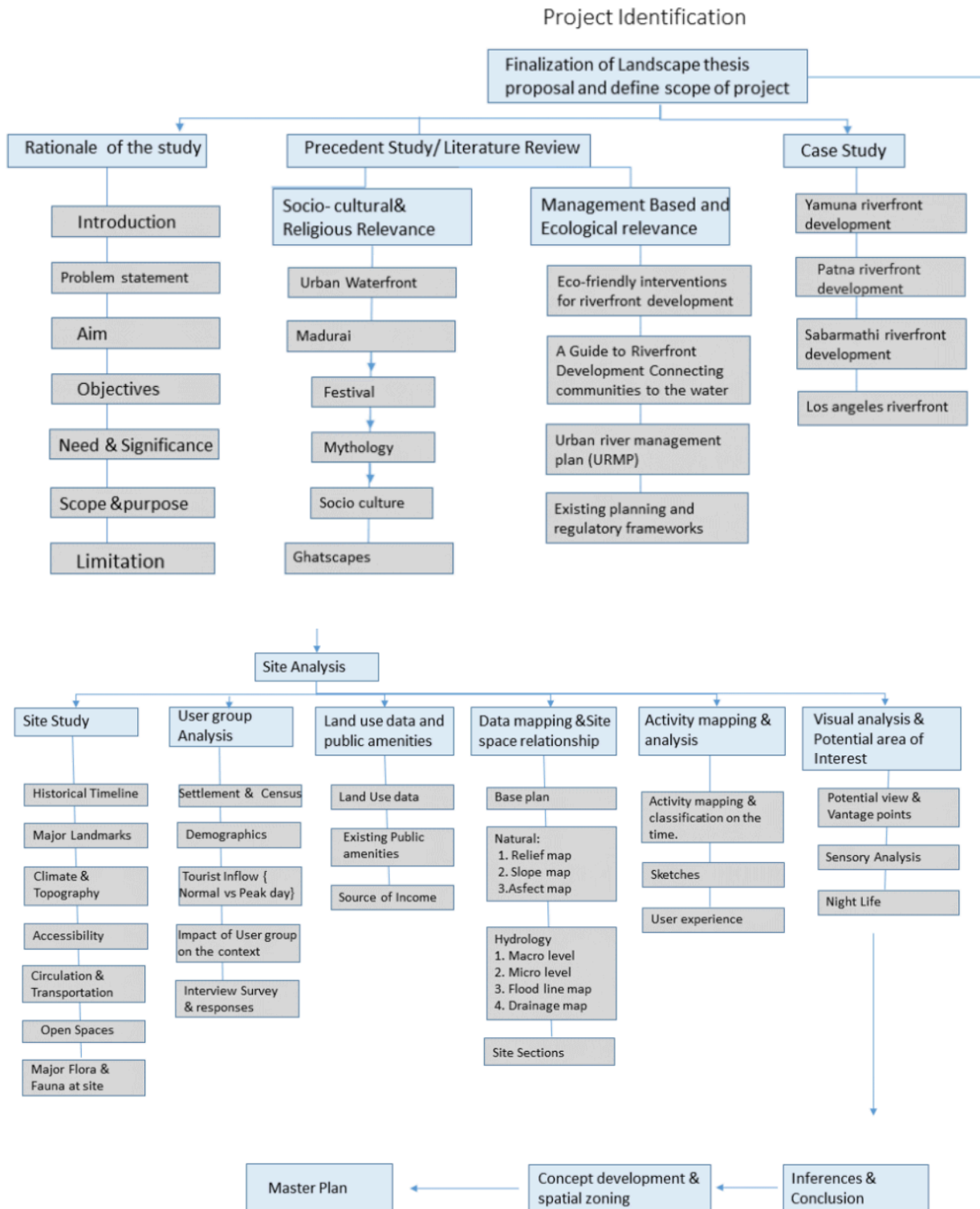
The integrated findings highlighted key environmental and infrastructural challenges:

- Encroachment of natural riparian zones and shrinking river width
- Urban heat island formation due to reduced vegetation
- Inefficient drainage and untreated sewage discharge
- Pollution hotspots and declining aquatic biodiversity
- Siltation in check dams affecting river flow and storage capacity

3.4 Strategy Development and Validation

Based on identified issues, strategic interventions were formulated, including:

- Riparian habitat restoration and wetland development
- Bioswales and rain gardens for stormwater management
- Reviving padithurais and mandapams for cultural continuity
- Non-motorised path with Pedestrian and cycle track is to be create
- Community-led pollution mitigation programs
- Climate-resilient flood management infrastructure



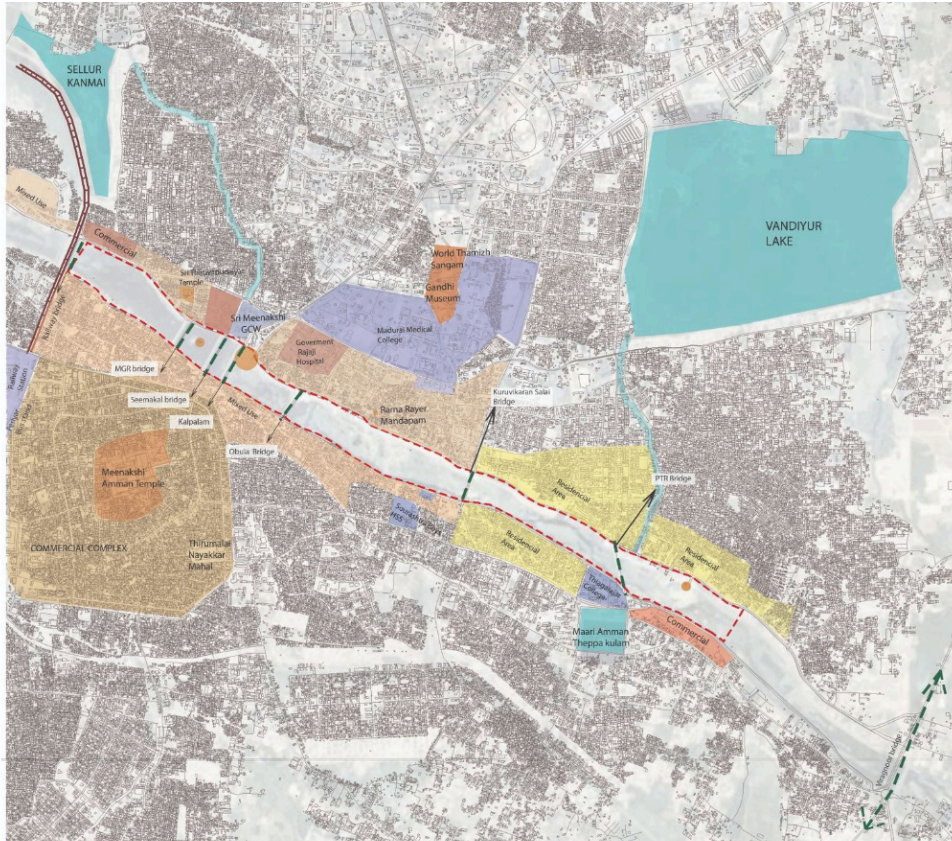
4.Introduction to site



Madurai, located in southern India, is a historic city in the state of Tamil Nadu. Positioned along the banks of the Vaigai River, it is the third largest city in the state. Geographically, Madurai lies at 9.9252° N latitude and 78.1198° E longitude. Recognized as the cultural capital of Tamil Nadu, it also serves as the administrative center of

4.1 Site Context:

-
- The map illustrates the Madurai Corporation area and its surrounding planning areas. Key locations include Vadipatti, Sholakandan, Alanganallur, A. Vailalappatti, Perumalpet R.F., Melur, Kodimangalam R.F., Perurai, Madurai Corporation, Thirunelgalam, and Tirunelveli. The map shows various transportation routes, including National Highways (red lines), State Highways (purple lines), and Railways (black lines with cross-ticks). It also indicates different land use types such as Municipalities (yellow), Town Panchayats (orange), Planning Areas (pink), and Municipal Corporation (light blue). Water bodies are shown in light blue, and forests in green. A legend on the left side provides a key for these symbols and colors. A scale bar at the bottom right indicates distances from 0 to 15 km, and a north arrow is located in the top right corner.



4.2 Padithurai:

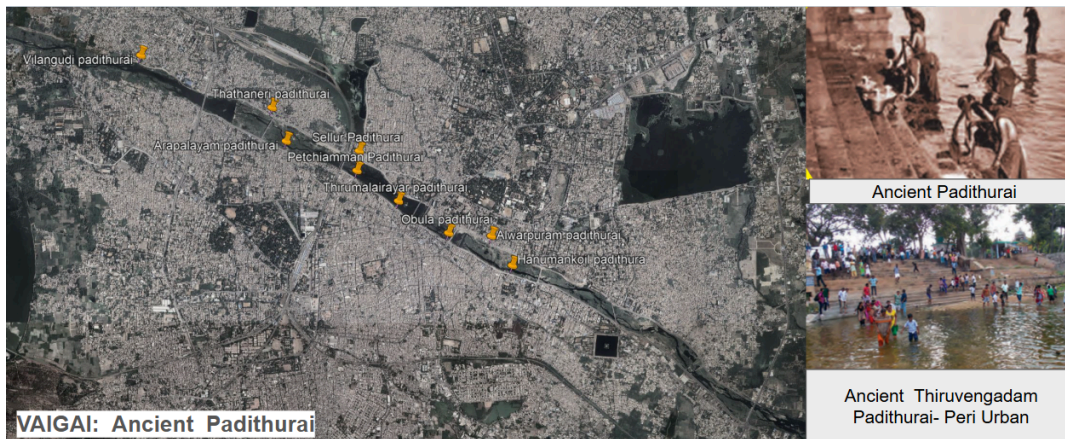


Figure 5 Padithurai : The ancient padithurais enabling access to the river along the site

Source: Author

The Vaigai Riverfront beautification initiative, under the Vaigai River Front Development programme, has led to the disappearance of over 14 ancient ghats that once reflected the city's deep-rooted historical and cultural heritage. Traditionally built with stone masonry, these Padithurais have now been replaced by concrete structures, often limited to side access. This shift has resulted in the loss of the riverfront's socio-architectural identity. The erosion of cultural significance has turned these once-sacred spaces into neglected areas, now misused for open urination,

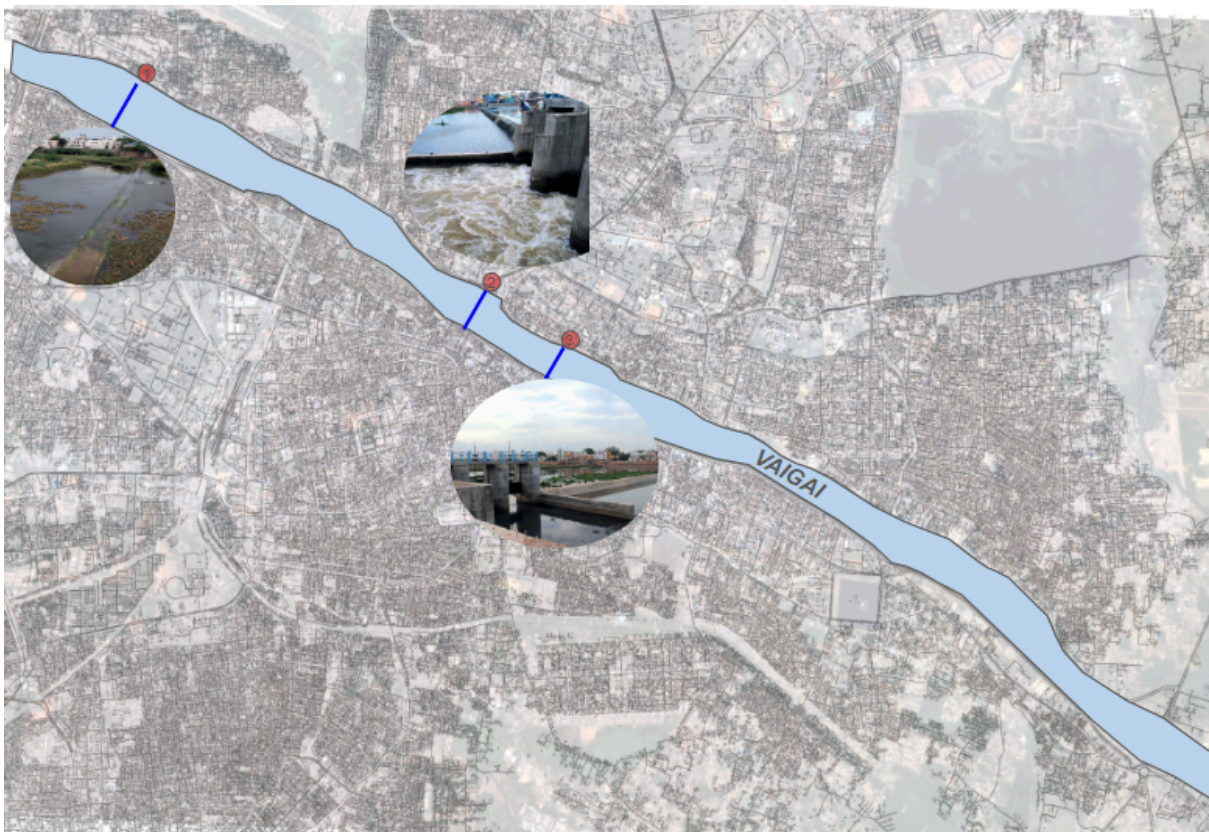
defecation and solid waste dumping .

4.3 Checkdams:

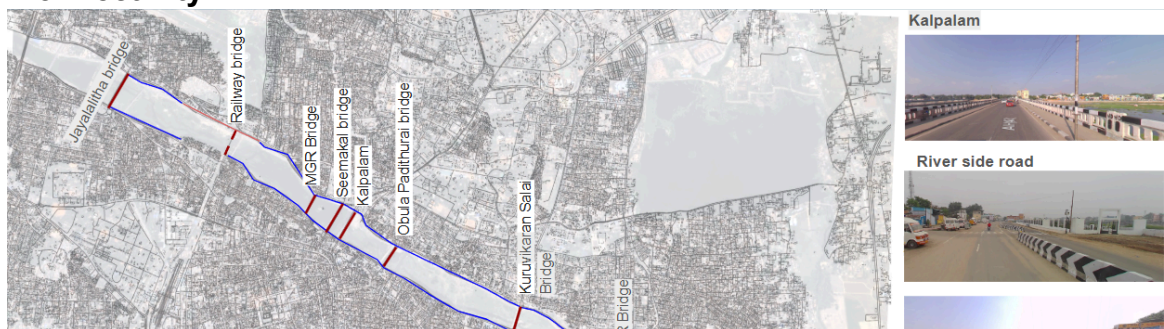
1. Kochadai check dam - Permanent RCC structure without sluices(height of 5 feet with 1-meter top crust). This stagnation positively impacts by increase in groundwater level.

2. Kalpalam Check dam- Permanent RCC structure with four sluices, two at each corner where the level is maintained at 5 feet by 1-meter. The increase in the surface water level facilitates the water flow in the Paniyur channel which supplies water to the Mariamman Kovil.

3. Ismaiypuram Check dam- Permanent RCC structure with four sluices (two at each corner) where the level of the check dam is maintained at 5 feet.



4.4 Connectivity:



4.5 Construction Ghat:

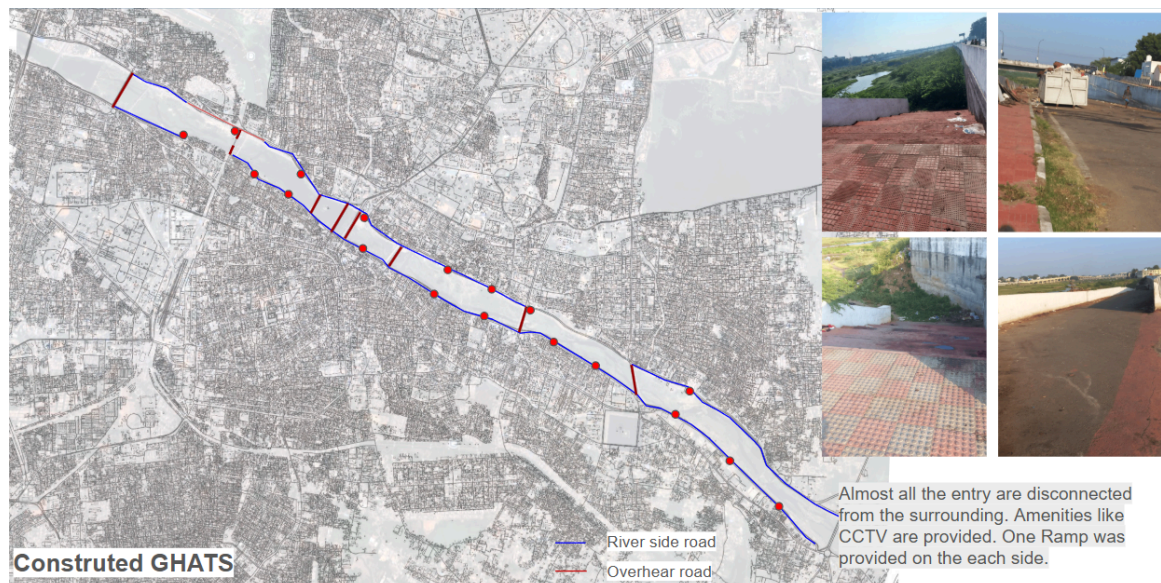


Figure 8 Ghats : The ghats constructed along the site stretch enabling access to the river

Source: Author

4.5 Issues:



Table 1 Issues
Source: Author

1. Water Pollution Issues	2. Ecological Issues	3. Social & Infrastructure Issues
Stormwater drain carrying sewage	Intensive extraction of groundwater	Traditional washerman community losing access due to retaining walls
Sewage water inlet polluting the river water channel	Reduction in fish population	No gathering space
Padithurai acting as a urinal and open defecation spot	Prosopis juliflora invasion	No shaded open space
Disposing of waste into the river	Nitrification	Lack of seating and recreational areas
Industrial effluents from Sidco	Loss of native vegetation	Access to the river for livestock is difficult due to concrete solutions
Cremation activity	The check dam is almost silted	Lack of Effective Waste Management
Oil and grease	Sudden shrinking of river width from 350 meters to 200 meters	Ineffective Sewage Treatment Plants (STPs)
Eutrophication	Sand mining spots visible in the region	Flooding During Monsoons
	Construction and demolition waste	
	Starching of clothes in the river	
	Water hyacinth invasion	

4.6 Activity Analysis:

- **Morning:** Dhobi activity, ritual bathing, temple chants
- **Afternoon:** Low activity, high solar exposure, children playing
- **Evening:** Livestock bathing, informal gathering, open defecation observed in certain areas

Access points are poorly maintained, and there are no organized public spaces or safe pedestrian trails along the riverbanks.



Group	Role/Interaction	Issues Faced
Dhobi (Washermen)	Use ghats and open areas for washing	Lack of clean water, no storage, no shelter
Livestock Rearers	Use shallow zones for bathing animals	Access blocked due to retaining walls
Religious Groups	Conduct rituals and processions	Unsafe access, missing Padithurais
Informal Vendors	Operate near high-traffic ghats	Lack of facilities, encroachment threats
Students	Use open areas for gathering	Underutilized due to unsafe/unhygienic edges

4.7 Festival:

4.8 Flood Vulnerability:

Table 2 Flood mitigation measures

Source: Atkins

Slum Area	Core characteristics	Key Environmental Risks/Hazards	Risk mitigation measures
SMP COLONY (Ward 33)	Located along the river Vaigai and within the flood plains Primarily housing construction workers	Repeated floods every 3-4 years. Last major flood 2003-04. Unsafe drinking water Open drains and sewers Solid waste dumping Health and sanitation issues: water borne diseases, jaundice typhoid and dengue	Artificial bund (about 3-4m high) provides some barrier to prevent flooding. Houses have been allocated for slum relocation under JNNURM: families are unwilling to relocate due to increased travel distance for employment.
Vandiyur Devar Nagar (Ward 32)	Located along the river Vaigai and within the flood plains Primarily housing skilled labourers – masons, carpeters, hotel workers	Repeated floods every 3-4 years. Last major flood 2003-04. Poor quality of drinking water Poor sanitation Poor waste management	Some construction of houses on raised platforms allowing water to penetrate ground floor areas.
Nethaji Nagar (Ward 32)	Located along the river Vaigai and within the flood plains Primarily housing skilled and semi-skilled labourers in construction sites	Subject to frequent flooding during rains. Contaminated drinking water Absence of land tenure Improper sewerage & drainage systems leading to health issues	No flood barriers Residents have constructed stone houses over the time to protect them from floods Unanimous consent for relocation is lacking.
Nagamal Madam, Therkuvaasal (Ward 62)	Located along the Kridhumal river channel Primarily housing marginal workers - waste picking, old newspaper collection	High flood risk Water contamination Land contamination Air pollution	No flood barriers Families are unwilling to relocate due to increased travel distance for employment.
Avaniapuram – emerging growth area on edge of city	Low lying area on urban fringe with close proximity to water tanks	Water contamination due to encroachment and sewage dumping in tanks - high levels of BOD, COD and NOx content Lack of integration of storm water drainage plans and sewage network plans Dengue and malaria	None

சு

JUNE

JULY

AUGUST

SEPTEMBER

DECEMBER

AAVANI-ஆவணி

Ala
Sund
Mee,
moon
proc,
Thok
Siva

Navarathri
The Deities stay within the temple along with beautifully dressed decorated Gopas celebrating the ceremony of (nine-night) festival celestial Navarathri



KARTHIGAI-கார்த்திகை

Karthigai Deepam Festival
Marghazhi monti
shi amman assumes the form of
girl and Unjal festival is celebrated
t 10 days.

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Madurai city went through many floods during North east Monsoon. The flood year of Madurai are 1677, 1709, 1814, 1843, 1884, 1922, 1977, 1979 and 1993. The 1993 was worst in recent time, Vaigai dam opened 1lakh cusec, Sathaiyar dam was overflowing breaching many tanks

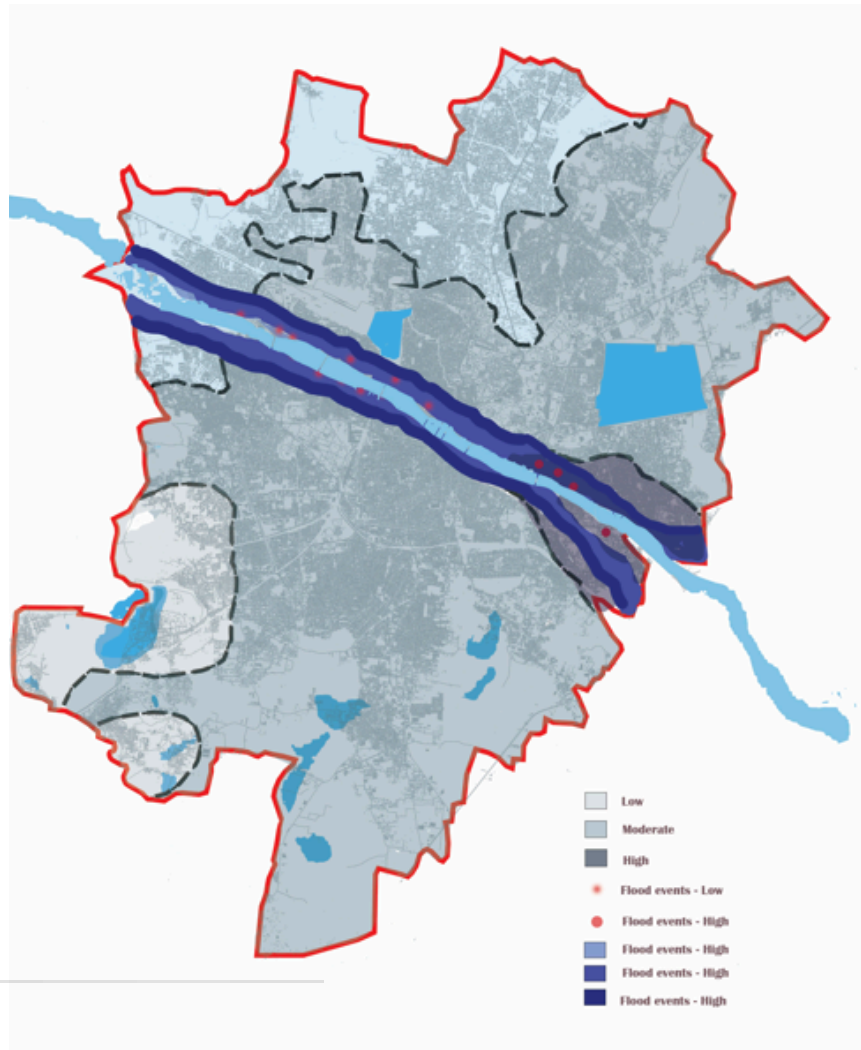


Figure 13 Flood Image : Water logging issues during the floods

Source: TNgeography

5. Strategies and framework

5.1 Spatial Framework

The spatial design is organized as a series of three interconnected zones, each responding to distinct physical, social, and ecological characteristics of the site. These zones form the structure for phased implementation and differentiated interventions.

Zone 1: Cultural and Heritage Corridor

- Located near prominent temples and padithurais
- Includes mandapams, religious routes, ritual ghats
- Focus on restoring historic architecture and integrating modern us



Zone 2: Ecological and Community Interface

- Densely populated with informal settlements and stormwater outlets
- Focus on constructed wetlands, floating wetlands, and community parks
- Spaces for dhobi ghats, livestock access, ragpicker stations

Zone 3: Urban Recreation and Resilience Zone

- Open lands and institutional interfaces
- Bioswales, urban forests, sports zones, and resilience landscapes
- Smart infrastructure like solar lights, CCTV, and emergency points

5.2 Landscape Strategies

1. Riparian Edge Typologies

- Hard Edge Revival: For rituals and high-footfall zones using stone masonry and stepped ghats
- Soft Edge Restoration: Natural banks with native vegetation for infiltration and wildlife
- Floating Edge Modules: Removable decks for variable water levels during dry/monsoon seasons

2. Green-Blue Infrastructure

- **Constructed Wetlands** near sewage outlets to treat greywater
- **Miyawaki Forest Patches** in low-density banks to create urban biodiversity hubs
- **Permeable Trails and Swales** to allow groundwater recharge and prevent runoff

3. Public Realm Features

- **Plazas and Gathering Spaces** with shaded pergolas
- **Informal Market Pockets** for vendors and local craft exhibitions
- **Interpretation Panels** on river rituals, biodiversity, and architecture

5.3 Policies and Guidelines:

Table 3 Policies and guidelines

Source: Author

Policy	Existing condition and drawbacks	Policies and guidelines		
		Short term	medium term	Long term
WATER QUALITY				
Water Quality - Industrial water pollution	The vandiyur channel is carrying effluents from the industrial sector and releasing it into vaigai without any treatment. as a result eutrophication is noted along the river	Channel Tapping: Direct releasing of effluents into channels should be closed Leaching: hazardous solid waste is disposed on the riverbed . During rainy days leaching is happening thereby affecting the riverbed	Pipeline Networking: seperate pipe network for sewage water drain to STP has to be laid Reuse of Wastewater: Increasing the reuse of waste water by the industries itself	Exclusive STP: Separate Stp for Industries PPP Model: Adopted by the industrial . In which the operation of Cetp is done by industries itself. Phyto remediation: helps in reducing the heavy metals and dissolved particles.
Water Quality - Agricultural water pollution	The upstream and the downstream of the vaigai is having large area of agricultural land and that are	Organic Farming : Reducing the use of fertilizer in agriculture Creating Buffer zone: Helps in absorbing the	Agro forestry: Converting the available open space of land into agro forestry. Soil Fertility: As the fertility of the sand are	Irrigation Method: water has to be used effectively for agriculture. Excess extraction of water should be monitored Recharge Pits: Construction of recharge pits or retention ponds that

	mainly using fertilizer and this increases the nutrient content of the water	excess nutrients in the water.	increased the use of fertilizers are also reduced	will helps in recharging the ground water level.
Water Quality - Domestic water pollution	The sewage from the residential and the mixed group zone were released directly on the river without any treatment. the channels are also opened into storm water inlets.	<p>Tapping: Nallah tapping should be done and a strict prohibition of sewage discharge into the river should be done.</p> <p>Integrated Approach: Depending solely on mechanical means of treating waste water i.e. installing STP's should be looked upon. Coupling Nature Based Solutions with Mechanical methods would reduce the load on STP and will help in creating more green spaces.</p> <p>Constructed wetlands, Cleansing Biotpes, Riparian Buffers are some of the many methods of Nature Based Water Treatment.</p>	<p>Reuse treated water: Reuse of treated water in different areas like irrigation of public green areas, for flushing and cleaning etc. should be promoted.</p> <p>Local level treatment :Local level treatment of waste water on smaller levels should be implemented by installing STP's at apartment complexes, inside gated communities and then the treated water should be conveyed by the municiple pipelines.</p>	Community Involvement-Community-driven initiatives of conserving water, treating water at a local level and decentralising the watse water treatment chain will help in building long lasting impact.
GROUND WATER				

Reduction of Ground water level	There is a sudden depletion of 7 m of ground water level which is documented on the north side of the site.	Increase the pervious layer by introducing riparian zone and permeable material will help in increasing the infiltration	Constructing Infiltration tank and retention ponds that will help in recharging the ground water	Creating awareness among the citizen for the over exploitation of ground water.
FLOODPLAIN				
Regulating Activities in flood plain	At present there is no regulation of activities happening in the floodplain. The shultering of cows in the floodplains causes nitrification, contamination of riverbed and water	Creating a buffer zone after the floodplain that helps in regulating the movement and activities	Time based activities and restriction of activities in the riverbed has to be done	Monitoring: Monitoring of activities happening in the floodplain and proper investigation of has to be done to prevent encroachment of floodplain
River health Monitoring	Despite many issue. the river still hold the self revival character. and it is still used for agriculture and drinking in downstream	Creating Riparian Zones: to facilitate infiltration and increase percolation Removal of seemai karuvai (prosopis juliflora) that completely alters the bed characters of the river.	Plantation drive - to revive the native plant species growth	Proper Monitoring of river bed from sand Mining.
WASTE MANAGEMENT				
Solid Waste Management	More residential areas on the northern side disposes solid wastes and raw sewage into to the river on a regular basis.	Segregation of wastes. blocking the hazardous waste from being disposed into river	Value generated system can be incorporated in the solid waste management	Monitoring of river bed from dumping of waste. and by laws has to be enforced

Awareness			
Awareness program by NGO 'S	The public connection with the vaigai river is missing. The awareness program has to given to address this issue	Awareness program , Instalation describing the importance of the riverine system for the city	

6. Conclusion

The Vaigai Riverfront revitalization offers a blueprint for transforming neglected urban rivers into resilient public landscapes that honor tradition while embracing innovation. The fusion of cultural heritage and ecological planning ensures that the riverfront becomes not just a space of transit, but of gathering, ritual, and regeneration. Replication of such an approach in similar Indian cities can significantly advance sustainable urbanism and water-sensitive design.

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